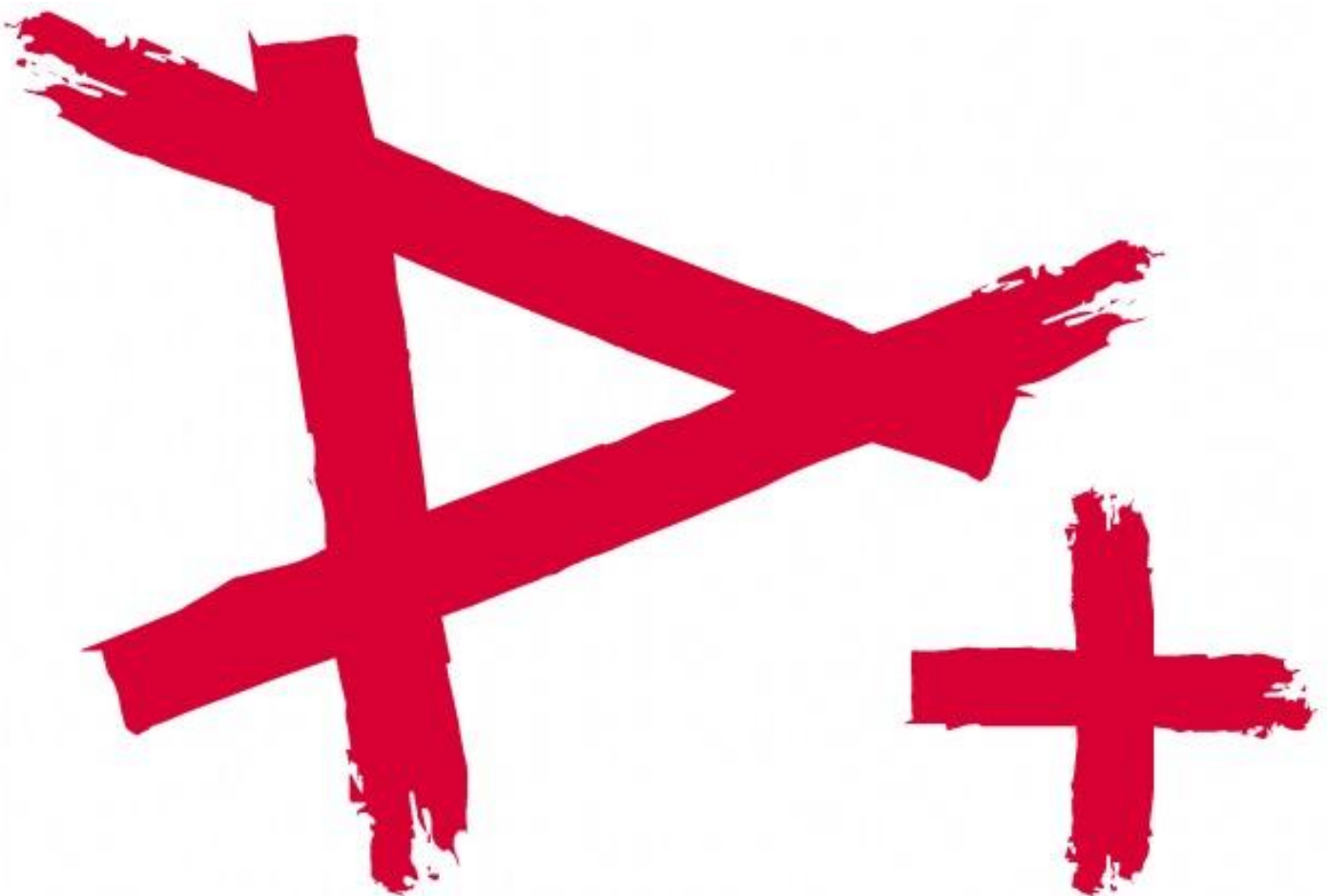




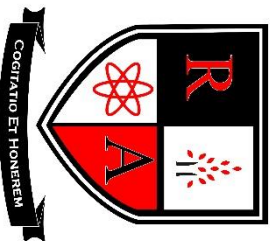
[eduresourceza.com](http://eduresourceza.com)

# GDE PREPARATORY

## PAST PAPERS

2014 TO 2020

REDWOOD ACADEMY



GRADE 12

# MATHEMATICS PAPER 2

BY NAEEM MOHAMED

NAME:

Downloaded from eduresourceza.com

**GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION**

**2014**

**10842**  
**PHYSICAL SCIENCES**  
**SECOND PAPER**

MARKS: 150  
TIME: 3 hours

Pages 19

PHYSICAL SCIENCES: Paper 2  
10842E



10842E

**X10**



3

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

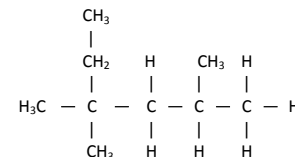
Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 An example of an unsaturated hydrocarbon is:

- A  $C_2HCl_3$
- B  $C_4H_8$
- C  $C_3H_8$
- D  $C_3H_7OH$

(2)

1.2 The semi-condensed structural formula of an organic compound is shown below:

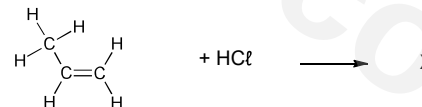


What is the correct IUPAC name for this organic compound?

- A 2,4,4-trimethylhexane
- B 2-ethyl-2,4-dimethylpentane
- C 2,4-dimethyl-4-ethylpentane
- D 3,3,5-trimethylhexane

(2)

1.3 A simple organic reaction is given below:



Which one of the formulae below represents the major organic product X formed in this reaction?

- A  $CH_3CHClCH_2Cl$
- B  $CH_2ClCH_2CH_3$
- C  $CH_3CHClCH_3$
- D  $CH_3CH_2CH_2Cl$

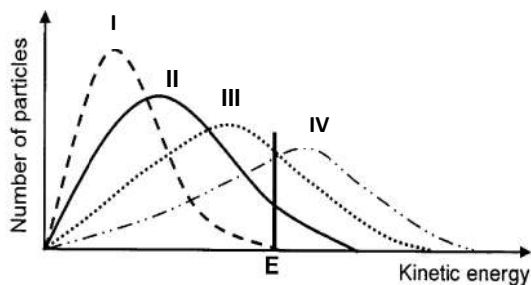
(2)

- 1.4 A chemical reaction is in a state of dynamic equilibrium when the ...
- A reactants and products always have the same masses.  
 B concentration of products is zero.  
 C equilibrium constant is zero.  
 D forward and reverse reactions occur at the same rate.

(2)

- 1.5 The Maxwell-Boltzmann energy distribution curves below show the number of particles as a function of their kinetic energy for a reaction, at four different temperatures. The minimum kinetic energy needed for effective collisions to take place is represented by  $E$ .

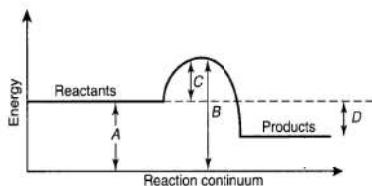
Which one of the curves represents the reaction that takes place at the highest temperature?



- A I  
 B II  
 C III  
 D IV

(2)

- 1.6 Consider the following potential energy diagram for a chemical reaction. Which arrow indicates the activation energy of the forward reaction?



The activation energy of the forward reaction is:

- A A  
 B B  
 C C  
 D D

(2)

P.T.O.

- 1.7 The pH of a solution of NaOH is 10.5. Which one of the following statements is CORRECT?

- A  $[\text{OH}^-] = [\text{H}_3\text{O}^+]$   
 B  $[\text{Na}^+] > [\text{OH}^-]$   
 C  $[\text{H}_3\text{O}^+] < [\text{OH}^-]$   
 D  $[\text{OH}^-] < [\text{H}_3\text{O}^+]$

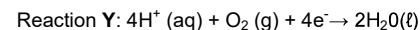
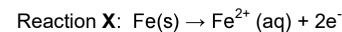
(2)

- 1.8 The oxidation number of sulphur in a sulphate ( $\text{SO}_4^{2-}$ ) ion is ...

- A +8.  
 B +6.  
 C +4.  
 D +2.

(2)

- 1.9 Consider the following chemical reactions:



Which one of the following statements is CORRECT for reaction X and Y?

| Reaction X       | Reaction Y               |
|------------------|--------------------------|
| A Fe is oxidised | $\text{H}^+$ is reduced  |
| B Fe is reduced  | $\text{O}_2$ is oxidised |
| C Fe is oxidised | $\text{O}_2$ is reduced  |
| D Fe is reduced  | $\text{H}^+$ is oxidised |

(2)

- 1.10 In industry, nitrogen gas is prepared by the following process:

- A Fractional distillation  
 B Contact process  
 C Ostwald process  
 D Haber process

(2)

[20]

P.T.O.

**QUESTION 2 (Start on a new page)**

Consider the following compounds and answer the questions below:

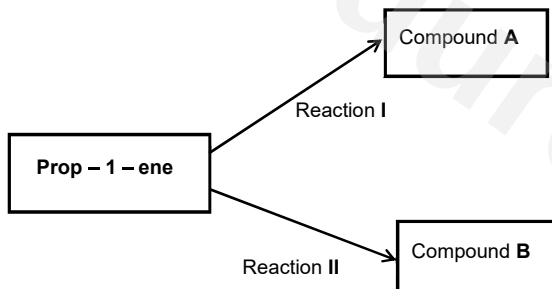
|          |  |          |  |
|----------|--|----------|--|
| <b>A</b> |  | <b>B</b> |  |
| <b>C</b> |  | <b>D</b> |  |
| <b>E</b> |  | <b>F</b> |  |

- 2.1.1 To which homologous series does compound **F** belong? (1)
- 2.1.2 Which compound is an alkyne? (1)
- 2.1.3 Give the IUPAC name for compound **E**. (1)

- 2.1.4 Compound **C** is one of the reactants needed to produce compound **B**.  
Give the IUPAC NAME for the other reactant needed for the production of compound **B**. (1)
- 2.1.5 Write down an equation, using structural formulae to represent the formation of compound **B**. (4)
- 2.1.6 Write down the structural formula of a functional isomer of compound **F**. (2)
- 2.1.7 Compound **A** can burn in excess oxygen. Using molecular formulae, write a balanced equation for the reaction. (3)
- 2.1.8 Name the type of reaction that takes place in QUESTION 2.1.7. (1)
- 2.2 There are two chain isomers for the organic compound with molecular formula  $C_4H_{10}$ .
- 2.2.1 Define the term *chain isomer*. (2)
- 2.2.2 Write down the structural formulae of the two chain isomers and also give their IUPAC names. (4)
- 2.2.3 Which ONE of the isomers mentioned in QUESTION 2.2.2 has the highest boiling point? (1)
- 2.2.4 Explain the difference in the boiling points of the chain isomers. (3)
- [24]**

**QUESTION 3 (Start on a new page)**

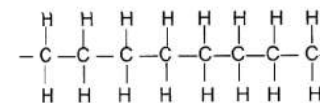
The flow diagram below shows how organic compounds can be prepared from an unsaturated hydrocarbon, prop-1-ene. Reaction I takes place when prop-1-ene reacts with bromine water.



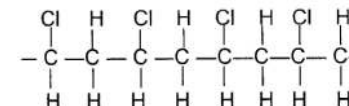
- 3.1 Write down:
- 3.1.1 The name of the type of reaction which takes place in the above Reaction I (1)
  - 3.1.2 The structural formula of compound A (2)
  - 3.1.3 Will Reaction I be spontaneous at room temperature? Answer YES or NO. (1)
- 3.2 Compound B is formed when prop-1-ene reacts with water in the presence of dilute sulphuric acid.
- Write down:
- 3.2.1 the name of the type of reaction which takes place in the above Reaction II (1)
  - 3.2.2 the IUPAC name for compound B (2)
  - 3.2.3 the homologous series to which compound B belongs. (1)
- 3.3 Cracking is a process used to produce petrol with an octane rating of 98. Such petrol is made up of a 98% saturated hydrocarbon called 2,2,4-trimethylpentane.
- 3.3.1 Explain what is meant by the term *cracking*. (2)
  - 3.3.2 Write down the STRUCTURAL FORMULA for 2,2,4-trimethylpentane. (2)

P.T.O.

- 3.4 The diagram below represents two polymers both formed through addition polymerisation.



**Molecule A**



**Molecule B**

- 3.4.1 Give the structural formula for the monomer used to make molecule A. (2)
  - 3.4.2 Which of the polymers (A or B) is PVC? (1)
  - 3.4.3 State ONE industrial use of polymer A. (1)
- [16]**

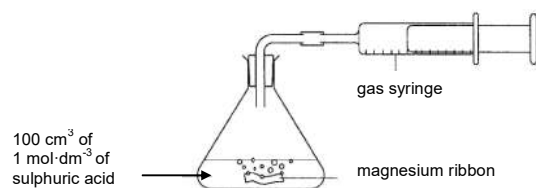
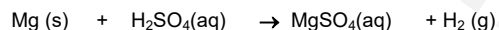
P.T.O.

#### QUESTION 4 (Start on a new page)

The following apparatus was used by a group of learners in an investigation to find out how surface area affects the rate of reaction between solid magnesium metal and 100 cm<sup>3</sup> dilute sulphuric acid with a concentration of 1 mol·dm<sup>-3</sup>.

During the reaction, the gas that forms is collected in the gas syringe which measures the volume of gas produced.

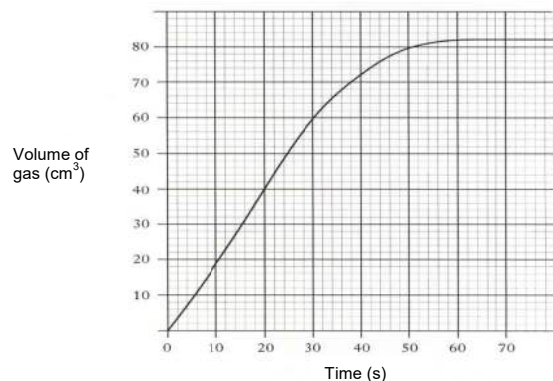
The equation for the reaction is:



In EXPERIMENT I, 20 g of magnesium, in the form of 5 small pieces, was used.

In EXPERIMENT II, 20 g of magnesium, in the form of one big piece was used.

The learners performed the experiments and plotted a graph of their results for experiment one, which is represented below.



- 4.1 Besides the mass and the volume of the reactants, give ONE other variable that must be kept constant in this investigation (1)
- 4.2 Name the dependent variable for EXPERIMENT I. (1)

P.T.O.

- 4.3 Use the graph to calculate the average rate of the reaction (in cm<sup>3</sup>·s<sup>-1</sup>) for the first 30 seconds. (3)
- 4.4 Will the rate of the reaction at 50s be GREATER THAN, LESS THAN or EQUAL TO that rate calculated in QUESTION 4.3? (1)
- 4.5 Give a reason for your answer in QUESTION 4.4. (1)
- 4.6 Predict how the gradient of EXPERIMENT II results would compare to EXPERIMENT I plotted above. Write only INCREASE, DECREASE or NO CHANGE. (1)
- 4.7 Use the collision theory to explain how the increase in surface area of the magnesium metal affects the rate of the reaction. (3)
- 4.8 Calculate the mass of magnesium metal that remains after the reaction has stopped. (5)
- 4.9 Catalytic converters are substances that are coated onto surfaces of car exhausts to act as positive catalysts.

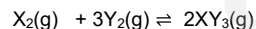
Define a *positive catalyst*.

(2)  
[18]

P.T.O.

### QUESTION 5 (Start on a new page)

When a number of moles of  $X_2(g)$  and  $Y_2(g)$  are placed in an empty, closed  $2\text{ dm}^3$  container at  $800^\circ\text{C}$ , a reaction takes place and eventually reaches equilibrium according to the following equation:



At equilibrium there is  $0,4\text{ mol}\cdot\text{dm}^{-3}$  of  $Y_2$  and  $XY_3$  present.

You are also given the following information for the reaction:

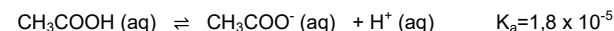
| Temperature $^\circ\text{C}$ | Kc  |
|------------------------------|-----|
| 400                          | 0,8 |
| 600                          | 2,5 |
| 800                          | 4,0 |

1. Calculate the initial number of moles of  $X_2$  and  $Y_2$  placed in the container. (9)
2. Is the forward reaction endothermic or exothermic? (1)
3. Explain your answer to QUESTION 5.2. (2)
4. What effect will adding more  $Y_2(g)$  at  $800^\circ\text{C}$  have on the following?  
Answer only INCREASE, DECREASE OR STAY THE SAME.
  - 5.4.1 The rate of the reverse reaction (1)
  - 5.4.2 Concentration of  $X_2(g)$  (1)
5. Which ONE of the following gases  $XY_3$  or  $X_2$  would be present in a higher concentration in the equilibrium mixture at  $400^\circ\text{C}$ ? (1)
6. Explain your answer to QUESTION 5.5. (2)

[17]

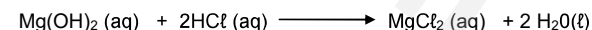
### QUESTION 6 (Start on a new page)

You are given the following ionisation reaction of ethanoic acid in water:



- 6.1 What does the ionisation constant indicate about the strength of the acid? (1)
- 6.2 What is meant by a *concentrated acid*? (2)
- 6.3  $\text{H}_2\text{PO}_4^-$  is an ampholyte.  
Write an equation to indicate its role as a base. (2)
- 6.4 Write down a conjugate acid/base pair from your equation in QUESTION 6.3. (1)
- 6.5 Milk of Magnesia has been used over the ages to relieve stomach ailments caused by excess stomach acid. The active ingredient in Milk of Magnesia is magnesium hydroxide ( $\text{Mg}(\text{OH})_2$ ).  
A group of learners prepare a solution of magnesium hydroxide.
  - 6.5.1 What mass of  $\text{Mg}(\text{OH})_2$  must be dissolved in distilled water to prepare  $500\text{ cm}^3$  of a solution with a concentration of  $0,20\text{ mol}\cdot\text{dm}^{-3}$ ? (5)
  - 6.5.2 What will the concentration of the hydroxide ions in the solution be? Assume 100% dissociation of magnesium hydroxide in water. (2)
  - 6.5.3 The pH of any medicine safe for human consumption must lie between  $\text{pH} = 4$  and  $\text{pH} = 9$ .  
Will this solution that the learners prepare be safe for human consumption? Show all calculations. (5)
- 6.6 The learners now check the concentration of their solution that they made. They run a titration using hydrochloric acid of concentration  $0,1\text{ mol}\cdot\text{dm}^{-3}$ . They transfer  $25\text{ cm}^3$  of the magnesium hydroxide solution into a conical flask.

The balanced chemical equation for this reaction is:

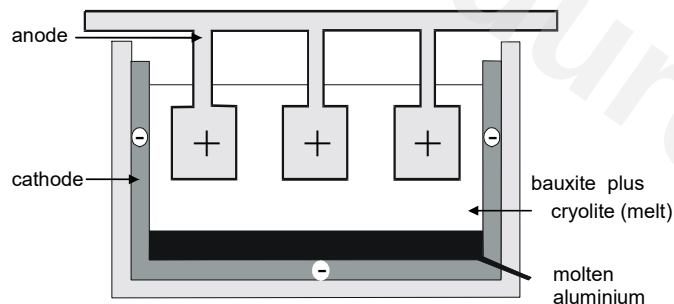


Determine what volume of  $\text{HCl}$  will be needed to fully neutralise the Milk of Magnesia if the concentration is actually  $0,2\text{ mol}\cdot\text{dm}^{-3}$ . (4)

[22]

**QUESTION 7 (Start on a new page)**

Aluminium oxide is an ionic compound. It is found in the earth's crust as an ore called bauxite. In order to obtain aluminium, the aluminium oxide is melted and then electricity is passed through it.

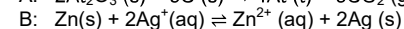
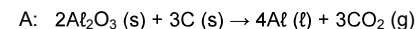


- 1 Define the term *electrolytic cell*. (2)
- 2 Write down the NAMES or FORMULAE of the ions present in the melt. (2)
- 3 Write down the half reaction that occurs at the anode. (2)
- 4 Write down the half reaction that occurs at the cathode. (2)
- 5 Calculate the cell potential for this electrolytic cell if the reaction occurring at the anode has an electrode potential of -0,56 V. (4)
- 6 Explain why the anodes have to be replaced on a regular basis. (1)

[13]

**QUESTION 8 (Start on a new page)**

The equations **A** and **B** below represent two redox reactions.



- 8.1 Define *oxidation* in terms of electron transfer. (2)
- 8.2 Write down the FORMULA of the substance which is:
  - 8.2.1 Reduced in reaction **A**. (1)
  - 8.2.2 The reducing agent in reaction **B**. (1)
- 8.3 A Zn-Ag cell has a cell potential difference of 1,56 V under standard conditions. The cell is allowed to run for 3 hours and the cell potential drops to 1,45 V. Using Le Chatelier's principle, explain the drop in potential difference. (3)
- 8.4 For reaction **A**, write down the half-reaction at cathode. (2)
- 8.5 What type of energy conversion occurs in a galvanic cell? (1)

[10]

**QUESTION 9 (Start on a new page)**

In the CONTACT process for the manufacture of sulphuric acid the second step of the process produces sulphur (VI) oxide as in the following equation:



The rate of the formation of  $\text{SO}_3$  is increased in a number of ways using rate and equilibrium principles.

- 9.1 Name the catalyst used in the Contact Process. (1)
- 9.2 Ammonia compounds are necessary for the production of fertiliser. It is manufactured in the Haber process.
 

Give a balanced equation for the Haber process. (3)
- 9.3 Calculate the **number of moles** of nitrogen in a bag of fertiliser that has a ratio of 7:1:3 (22). The mass of the bag is 5 kg. (5)
- 9.4 The abuse of large amounts of fertiliser can result in the enrichment of inorganic plant nutrients in water sources. Explain how this leads to dead and decaying plant material. (1)

[10]

**TOTAL FOR SECTION B: 130**

**TOTAL: 150**



**GAUTENG PROVINCE**  
EDUCATION  
REPUBLIC OF SOUTH AFRICA

**GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION  
2015**

**10842  
PHYSICAL SCIENCES  
SECOND PAPER**

MARKS: 150  
TIME: 3 hours

Pages 18 and 4 formula sheets

PHYSICAL SCIENCES: Paper 2  
1084E



10842E

X10



3

|                                             |                 |          |
|---------------------------------------------|-----------------|----------|
| <b>PHYSICAL SCIENCES<br/>(Second Paper)</b> | <b>10842/15</b> | <b>3</b> |
|---------------------------------------------|-----------------|----------|

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

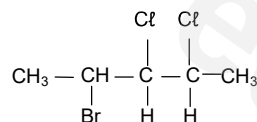
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) of the most correct answer next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 D

- 1.1 Which ONE of the following compounds is a ketone?
- A  $\text{CH}_3\text{COOH}$   
B  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$   
C  $\text{CH}_3\text{COCH}_3$   
D  $\text{CH}_3\text{CH}_2\text{CHO}$  (2)
- 1.2 A chemical reaction reaches equilibrium. Which ONE of the following statements regarding this equilibrium is TRUE?
- A The concentrations of the individual reactants and products are equal.  
B The concentrations of the individual reactants and products are constant.  
C The concentrations of the individual reactants are zero.  
D The concentrations of the individual products increase until the reaction stops. (2)
- 1.3 Which ONE of the following is a primary nutrient needed by plants?
- A Ca  
B C  
C Mg  
D N (2)

P.T.O.

P.T.O.

1.4 The condensed structural formula of an organic compound is shown below:

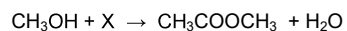


Which ONE of the following is the correct IUPAC name for this compound?

- A 2,3-dichloro-4-bromo-1-methylbutane
- B 4-bromo-2,3-dichloropentane
- C 2-bromo-3,4-dichloropentane
- D 2-bromo-3,4-dichloro-1-methylbutane

(2)

1.5 Consider the following esterification reaction:

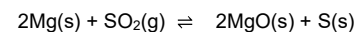


The IUPAC name of the reactant most likely represented by X is:

- A Methanoic acid
- B Ethanoic acid
- C Methanol
- D Ethanol

(2)

1.6 Consider the chemical reaction represented by the following balanced equation:

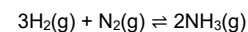


Which ONE of the following statements is CORRECT?

- A  $\text{SO}_2$  is an oxidising agent.
- B  $\text{SO}_2$  is an acid.
- C  $\text{SO}_2$  is a base.
- D  $\text{SO}_2$  is a reducing agent.

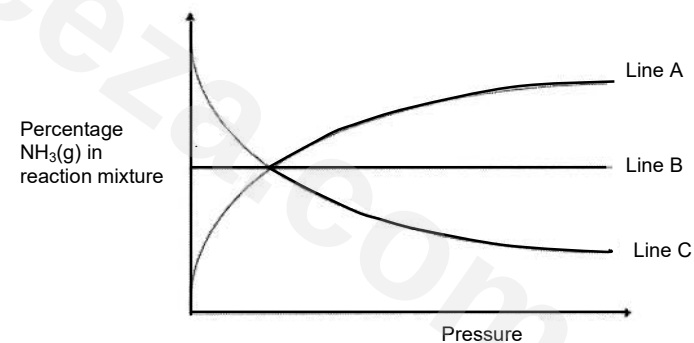
(2)

1.7 The reaction represented by the balanced equation below reaches equilibrium in a closed container at a certain temperature.



The pressure of this system is increased by decreasing the volume while maintaining a constant temperature. The percentage of  $\text{NH}_3\text{(g)}$  in the reaction mixture is recorded and graphed.

The results are indicated below.



The line that shows the correct relationship between the percentage of  $\text{NH}_3\text{(g)}$  in the reaction mixture, and the increasing pressure, is:

- A Line A
- B Line B
- C Line C
- D None of the above

(2)

1.8 Which ONE of the following solutions has the HIGHEST pH value?

- A 0,1 mol·dm<sup>-3</sup> Mg(OH)<sub>2</sub>
- B 0,1 mol·dm<sup>-3</sup> NH<sub>3</sub>
- C 0,1 mol·dm<sup>-3</sup> HCl
- D 0,1 mol·dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub>

(2)

1.9 Which ONE of the following represents the products formed during the hydrolysis of calcium carbonate?

- A H<sub>3</sub>O<sup>+</sup>(aq) and CO<sub>3</sub><sup>2-</sup>(aq)
- B OH<sup>-</sup>(aq) and HCO<sub>3</sub><sup>-</sup>(aq)
- C Ca<sup>2+</sup>(aq) and CO<sub>3</sub><sup>2-</sup>(aq)
- D Ca<sup>2+</sup>(aq) and OH<sup>-</sup>(aq)

(2)

1.10 Which ONE of the following solutions can be stored in an aluminium container?

- A CuSO<sub>4</sub>(aq)
- B ZnSO<sub>4</sub>(aq)
- C NaCl(aq)
- D Pb(NO<sub>3</sub>)<sub>2</sub>(aq)

(2)  
[20]

## QUESTION 2 (Start on a new page.)

Consider the organic compounds represented by the letters **A** to **F** in the table below.

|          |                                                                                                                                                                                                                                                                                                                                                   |          |                                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b> | CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CHO                                                                                                                                                                                                                                                                                               | <b>B</b> | 2 – methylbut-2-ene                                                                                                                                                                                                                                                     |
| <b>C</b> | $\left[ \begin{array}{c} \text{H} \quad \text{Cl} \\   \quad   \\ -\text{C}-\text{C}- \\   \quad   \\ \text{H} \quad \text{H} \end{array} \right]_n$                                                                                                                                                                                              | <b>D</b> | $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{O} & & \text{H} \\ &   & &   & &    & &   \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ &   & &   & & & &   \\ & \text{H} & & \text{H} & & & & \text{H} \end{array}$ |
| <b>E</b> | $\begin{array}{c} & & \text{H} & & & & \\ & &   & & & & \\ & \text{H} & -\text{C} & - & \text{H} & & \\ &   & & & & & \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ &   & &   & &   & &   \\ & \text{H} & & \text{O} & & \text{H} & & \text{H} \\ & & &   & & & & \\ & & & \text{H} & & & & \end{array}$ | <b>F</b> | $\left[ -\text{O}-\text{CH}_2-\text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}- \right]_n$                                                                                                              |

2.1 Write down the LETTER that represents the following:

2.1.1 An addition polymer (1)

2.1.2 A compound that is a functional isomer of compound **D** (1)

2.2 Write down the IUPAC name of the following:

2.2.1 Compound **A** (1)

2.2.2 Compound **E** (2)

- 2.3 Compound **B** is one of the reactants needed to produce compound **E**.  
Write down the ...
- 2.3.1 NAME or FORMULA for the other reactant needed for this reaction. (1)
- 2.3.2 structural formula of compound **B**. (3)
- 2.3.3 type of reaction that takes place. (1)
- 2.4 The table contains a compound that occurs as a result of condensation polymerisation.
- 2.4.1 Define the term **condensation polymerisation**. (2)
- 2.4.2 Write down the **LETTER** that represents the compound that is a condensation polymer. (1)

[13]

**QUESTION 3 (Start on a new page.)**

- 3.1 An organic compound with a molecular formula of  $C_4H_6$  has two positional isomers.
- 3.1.1 Define the term **positional isomer**. (2)
- 3.1.2 Write down the structural formulae of TWO positional isomers of  $C_4H_6$  and also give their IUPAC names. (4)
- 3.2 Heptane can undergo cracking to form an alkene with three carbon atoms and a branched four-carbon alkane.
- 3.2.1 Write down a balanced equation using structural formulae. (3)
- 3.2.2 Write down the IUPAC names of the products formed in this reaction. (2)
- 3.3 An investigation is conducted to determine the boiling points of different types of homologous series. The table below shows the boiling points of compounds from different homologous series.

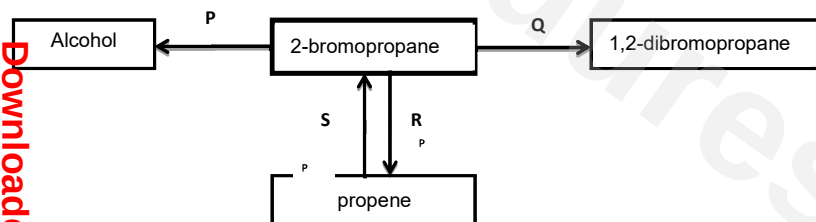
| Organic compound | Boiling point (°C) |
|------------------|--------------------|
| Propane          | -42                |
| Propan-1-ol      | 97                 |
| Propanoic acid   | 141                |

- 3.3.1 Define the term **boiling point**. (2)
- 3.3.2 Explain the difference in boiling points of propan-1-ol and propanoic acid by referring to the TYPE of INTERMOLECULAR FORCES present in the compounds. (3)

[16]

**QUESTION 4 (Start on a new page.)**

The flow diagram below shows various chemical reactions of haloalkanes. P, Q and R represent reaction types.



4.1 Write down the type of reaction represented by:

4.1.1 **Q**

(1)

4.1.2 **R**

(1)

4.2 For reaction **P**, write down the following:

4.2.1 The structural formula of the alcohol formed

(2)

4.2.2 The IUPAC name of the alcohol formed

(1)

4.3 In reaction **S**, propene reacts with compound X to form 2-bromopropane.

Write down the:

4.3.1 **NAME** of compound X

(1)

4.3.2 Balanced equation using structural formulae

(4)

[10]

**QUESTION 5 (Start on a new page.)**

Learners perform **THREE** investigations (**A**, **B** and **C**) to study **THREE** factors which affect the rate of a chemical reaction. They use the reaction between solid calcium carbonate (**CaCO<sub>3</sub>**) and **EXCESS** hydrochloric acid (**HCl**) solution, represented by the balanced equation below, in all three investigations.



The calcium carbonate is **COMPLETELY COVERED** in all the investigations.

**5.1 INVESTIGATION A:**

The learners conduct two experiments using the conditions as shown in the table below.

|                     | Mass of CaCO <sub>3</sub> (g) | State of CaCO <sub>3</sub> | Concentration of HCl (mol·dm <sup>-3</sup> ) | Temperature of HCl (°C) |
|---------------------|-------------------------------|----------------------------|----------------------------------------------|-------------------------|
| <b>Experiment 1</b> | 2                             | powder                     | 0,2                                          | 25                      |
| <b>Experiment 2</b> | 2                             | lumps                      | 0,2                                          | 25                      |

5.1.1 Which factor influencing reaction rate is being investigated? (1)

5.1.2 The learners now repeat **Experiment 1**, but use 4 g of calcium carbonate in excess acid, instead of 2 g. They find that the rate of the reaction **INCREASES**.

Use the collision theory to explain why the rate increases. (3)

5.1.3 If the learners do NOT use excess acid in the reaction of the 4 g of calcium carbonate, they find that 15% of the mass of the original sample of CaCO<sub>3</sub> remains unreacted after completion of the reaction.

Calculate the volume of acid (in dm<sup>3</sup>) of the given concentration needed to react with the remaining calcium carbonate. (5)

## 5.2 INVESTIGATION B:

The learners conduct two experiments using the conditions in the table below.

|              | Mass of $\text{CaCO}_3$ (g) | State of $\text{CaCO}_3$ | Concentration of $\text{HCl}$ ( $\text{mol}\cdot\text{dm}^{-3}$ ) | Temperature of $\text{HCl}$ ( $^{\circ}\text{C}$ ) |
|--------------|-----------------------------|--------------------------|-------------------------------------------------------------------|----------------------------------------------------|
| Experiment 3 | 2                           | lumps                    | 0,2                                                               | 25                                                 |
| Experiment 4 | 2                           | lumps                    | 1,0                                                               | 25                                                 |

5.2.1 Identify the independent variable in this investigation B. (1)

5.2.2 The reactions in both **experiments 3** and **4** run to completion.

How will the yield of  $\text{CO}_2$  produced in **experiment 4** compare that of **experiment 3**?

Write down SMALLER THAN, LARGER THAN or EQUAL TO. (1)

5.2.3 Give a reason for your answer to QUESTION 5.2.2 (1)

## INVESTIGATION C:

The learners conduct two experiments using the conditions as shown below.

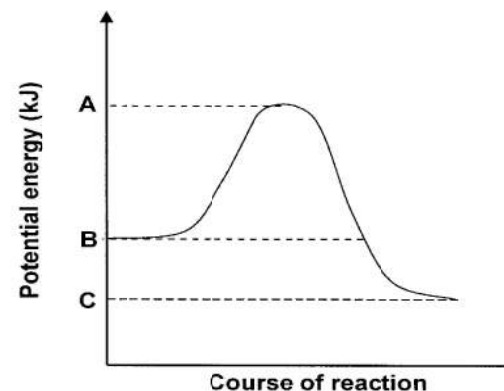
|              | Mass of $\text{CaCO}_3$ (g) | State of $\text{CaCO}_3$ | Concentration of $\text{HCl}$ ( $\text{mol}\cdot\text{dm}^{-3}$ ) | Temperature of $\text{HCl}$ ( $^{\circ}\text{C}$ ) |
|--------------|-----------------------------|--------------------------|-------------------------------------------------------------------|----------------------------------------------------|
| Experiment 5 | 4                           | powder                   | 0,2                                                               | 25                                                 |
| Experiment 6 | 4                           | powder                   | 0,2                                                               | 35                                                 |

5.3.1 In which **experiment, 5** or **6**, will the particles have the highest kinetic energy? (1)

5.3.2 On the same set of axes, draw sketch graphs of the number of molecules versus kinetic energy (also known as a Maxwell-Boltzmann distribution curve) for each of **experiment 5** and **experiment 6**.

- Label both axes
- Clearly label each graph as **experiment 5** and **experiment 6** (3)

5.4 The graph below shows changes in potential energy for the reaction between calcium carbonate and hydrochloric acid.



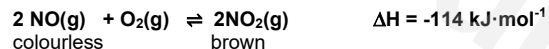
5.4.1 Is this reaction exothermic or endothermic? (1)

5.4.2 Give a reason for your answer to QUESTION 5.4.1. (1)

[18]

**QUESTION 6 (Start on a new page.)**

A certain amount of nitrogen monoxide gas and oxygen gas react in a 50 cm<sup>3</sup> closed container at 230 °C to form nitrogen dioxide gas. The reaction reaches equilibrium according to the following balanced equation:



At 230 °C, the equilibrium constant for this reaction is  $6,44 \times 10^5$ .

Initially, 1 mol of NO(g) and an unknown quantity of O<sub>2</sub>(g) were placed in the container. At equilibrium, the **number of particles** of NO(g) present is  $3,01 \times 10^{21}$ . Calculate the initial number of moles of O<sub>2</sub>(g) placed in the container. (9)

The above reaction is the second step of the Ostwald process. What would be the significance of such a high K<sub>c</sub> for the industrial production of NO<sub>2</sub>(g)? (1)

Will the colour of the mixture of gases become LIGHTER or DARKER as the temperature is decreased to room temperature? (1)

Using Le Chatelier's principle, explain the answer to QUESTION 6.3. (3)

How will a change in the pressure of the gases influence the equilibrium constant at room temperature?

Write down only **INCREASES**, **DECREASES** or **NO EFFECT**. (1)

[15]

**QUESTION 7 (Start on a new page.)**

7.1 Define a **Brønsted-Lowry base**. (2)

7.2 7.2.1 Calculate the pH of a 0,12 mol·dm<sup>-3</sup> HCl solution. (3)

7.2.2 Write down the **FORMULA** for the conjugate base of HCl. (1)

7.3 7.3.1 Why is HSO<sub>4</sub><sup>-</sup> regarded as an ampholyte? (1)

7.3.2 Write down an equation for the reaction of HSO<sub>4</sub><sup>-</sup> with water to form the hydronium ion. (3)

7.4 Bongiwe and Sam plan to do a titration. Prior to the titration each of them prepares a burette using the method given in the table below.

| Bongiwe                                                                       | Sam                                                                       |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| She rinses the burette with the acid before filling it to the mark with acid. | He rinses the burette with water before filling it to the mark with acid. |

Explain why Sam used an **INCORRECT** method. (1)

7.5 A solution of potassium hydroxide is made by dissolving 8,0 g of potassium hydroxide in 250 cm<sup>3</sup> of distilled water.

7.5.1 Calculate the concentration of the potassium hydroxide solution. (3)

7.5.2 25,0 cm<sup>3</sup> of this solution prepared as above is titrated and neutralised against 40,0 cm<sup>3</sup> of a DILUTE sulphuric acid solution.

The reaction is as follows:



Calculate the concentration of the **DILUTE** acid. (4)

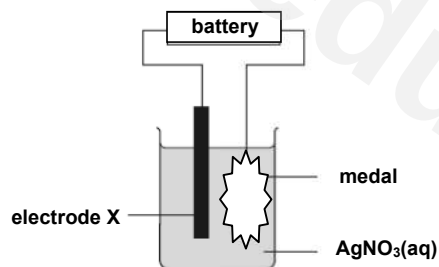
7.5.3 The dilute sulphuric acid solution in QUESTION 7.5.2 was prepared by adding 10,0 cm<sup>3</sup> of concentrated sulphuric acid to 490,0 cm<sup>3</sup> of distilled water.

Calculate the concentration of the **CONCENTRATED** acid. (4)

[22]

### QUESTION 8 (Start on a new page.)

The simplified diagram below represents an electrolytic cell used to electroplate a medal with a thin layer of silver.

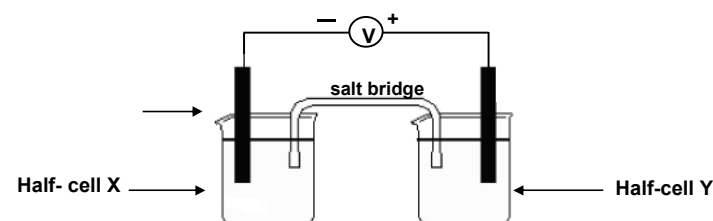


- 8.1 Write down the energy conversion that takes place in this cell. (1)
- 8.2 Which electrode (ANODE or CATHODE) must the medal be? Explain how you arrived at your answer. (3)
- 8.3 Write down the
- 8.3.1 NAME or SYMBOL of the element of which electrode X is made. (1)
- 8.3.2 equation of the half-reaction that takes place at the medal. (2)
- 8.4 Write down the visible changes that will occur at the following:
- 8.4.1 Electrode X (1)
- 8.4.2 The medal (1)
- 8.5 Explain why the concentration of the electrolyte remains constant during electroplating. (2)
- [11]

P.T.O.

### QUESTION 9 (Start on a new page.)

Learners use an electrochemical cell as shown in the diagram below in an investigation to compare the reducing abilities of different metals.



- 9.1 Name the type of electrochemical cell depicted in the above diagram. (1)
- 9.2 What will the voltmeter reading be if the salt bridge is removed? (1)
- 9.3 Name TWO conditions that will need to be kept constant during this investigation. (2)
- 9.4 What will be the independent variable in this investigation? (1)

In their investigation, they use different combinations of the three half-cells in the table below to compare the reducing abilities of Cu, Zn and Al. The cell potential for each combination of half-cells is recorded in the table.

| COMBINATION | HALF-CELL X         | HALF-CELL Y         | VOLTMETER READING (V) |
|-------------|---------------------|---------------------|-----------------------|
| 1           | Cu/Cu <sup>2+</sup> | Al/Al <sup>3+</sup> | -1,8                  |
| 2           | Al/Al <sup>3+</sup> | Zn/Zn <sup>2+</sup> | +0,8                  |
| 3           | Zn/Zn <sup>2+</sup> | Cu/Cu <sup>2+</sup> | +1,0                  |

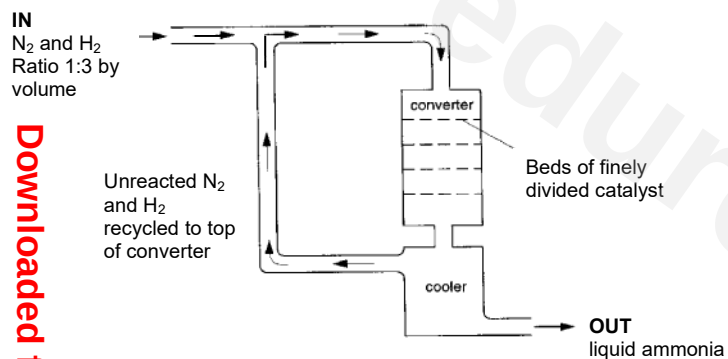
- 9.5 Write down a
- 9.5.1 possible reason why the voltmeter reading for the copper-aluminium cell is negative. (2)
- 9.5.2 suitable conclusion for this investigation. (2)
- 9.6 Write down the NAME or SYMBOL of the
- 9.6.1 metal which is oxidised in cell 2. (1)
- 9.6.2 reducing agent in cell 3. (1)
- 9.7 Omitting spectator ions, write down a balanced equation for the net (overall) cell reaction taking place in cell 2. (3)

[14]

P.T.O.

**QUESTION 10 (Start on a new page.)**

The diagram below illustrates the Haber process for the preparation of ammonia.



From "O level chemistry" SAP.

- 10.1 NAME the catalyst used in this process. (1)
- 10.1.2 Using the COLLISION THEORY, explain why the FINELY DIVIDED catalyst will be more effective than a LARGE SOLID catalyst of the same mass. (2)
- 10.1.3 Give ONE reason, other than cost, why the unreacted nitrogen and hydrogen are recycled. (2)
- 10.2 A farmer adds calcium hydroxide,  $\text{Ca(OH)}_2$ , and ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$  alternately to the soil.
- 10.2.1 Explain the USE of EACH substance. (2)
- 10.2.2 The following reaction can occur when these two substances react:
- $$\text{Ca(OH)}_2(\text{aq}) + (\text{NH}_4)_2\text{SO}_4(\text{aq}) \longrightarrow \text{CaSO}_4(\text{s}) + 2 \text{NH}_3(\text{g}) + 2 \text{H}_2\text{O}(\text{l})$$
- Explain why the farmer should NOT add both substances at the same time. (1)
- 10.3 In one of the steps of the Ostwald process, the following reaction takes place,
- $$4\text{NO}(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 3\text{O}_2(\text{g}) \longrightarrow 4\text{HNO}_3(\text{aq})$$
- Calculate the maximum mass of nitric acid which can be made from  $720 \text{ dm}^3$  of nitrogen(II)oxide (NO) at room temperature. Assume that the molar gas volume at room temperature is  $24 \text{ dm}^3$ . (3)

[11]

**TOTAL: 150**

P.T.O.



**GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION  
2016**

|                              |
|------------------------------|
| 10842                        |
| PHYSICAL SCIENCES: CHEMISTRY |
| SECOND PAPER                 |

**TIME: 3 hours**

**MARKS: 150**

**17 pages + 4 data sheets**

PHYSICAL SCIENCES: Paper 2  
1084E



10842E

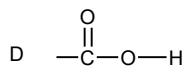
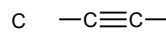
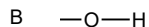
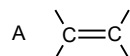
X10



### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

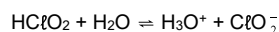
Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 Which ONE of the following is the functional group of the carboxylic acids?

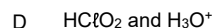
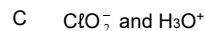
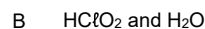
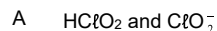


(2)

1.2 Consider the reaction represented below.

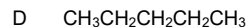
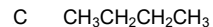
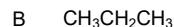
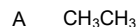


Which ONE of the following is a conjugate acid-base pair in the above reaction?



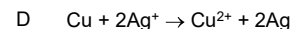
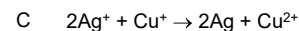
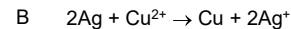
(2)

1.3 Which ONE of the following compounds has the highest boiling point?



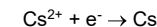
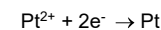
(2)

1.4 A learner leaves a coil of copper wire overnight in a clear solution of silver nitrate. The next morning the learner observes that the solution turned blue. Which ONE of the equations below represents the reaction that takes place?



(2)

1.5 The half-reactions below take place in an electrochemical cell.



Which ONE of the statements below is **TRUE** for this cell when it delivers current?

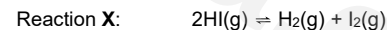
A The mass of the Cs electrode increases.

B  $\text{Pt}^{2+}$  undergoes oxidation more easily than Cs.

C  $\text{Pt}^{2+}$  undergoes reduction more easily than  $\text{Cs}^{2+}$ .

D Electrons will flow from the Pt electrode to the Cs electrode in the external circuit. (2)

1.6 Two reactions, X and Y, represented below, reach equilibrium in two separate, sealed containers.

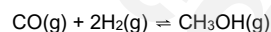


The pressure in both containers is increased by decreasing the volume of the container. How will the number of moles of the products in each container change?

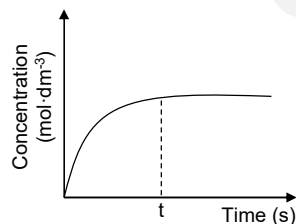
|   | X              | Y              |
|---|----------------|----------------|
| A | Increases      | Decreases      |
| B | Stays the same | Increases      |
| C | Stays the same | Decreases      |
| D | Increases      | Stays the same |

(2)

- 1.7 Carbon monoxide,  $\text{CO(g)}$ , and hydrogen,  $\text{H}_2\text{(g)}$ , react in a closed container to form methanol,  $\text{CH}_3\text{OH(g)}$ , according to the following balanced equation.



The graph below shows the change in concentration of methanol with time.



Which ONE of the following statements, best explains the horizontal section of the graph after time  $t$ ?

- A The forward reaction has stopped.
- B The rates of the forward and reverse reactions are equal.
- C There is no  $\text{CO(g)}$  left to react with the  $\text{H}_2\text{(g)}$ .
- D All the reacting gases have been converted to methanol.

(2)

When base **X** is titrated against acid **Y**, the pH of the solution at the end point is 8. Which ONE of the following represents base **X** and acid **Y**?

|   | X                        | Y                        |
|---|--------------------------|--------------------------|
| A | NaOH                     | $\text{CH}_3\text{COOH}$ |
| B | $\text{Na}_2\text{CO}_3$ | $\text{HCl}$             |
| C | NaOH                     | $\text{H}_2\text{SO}_4$  |
| D | $\text{Na}_2\text{CO}_3$ | $\text{CH}_3\text{COOH}$ |

(2)

- 1.9 Two of the half-reactions below take place in a standard electrochemical cell with an emf of 1,2 V.

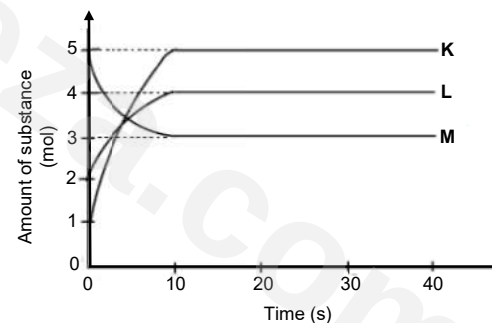


The cell notation of this cell is:

- A  $\text{S(s)}|\text{S}^{2+}(\text{aq})||\text{P}^{2+}(\text{aq})|\text{P(s)}$
- B  $\text{P(s)}|\text{P}^{2+}(\text{aq})||\text{Q}^+(\text{aq})|\text{Q(s)}$
- C  $\text{R(s)}|\text{R}^+(\text{aq})||\text{S}^{2+}(\text{aq})|\text{S(s)}$
- D  $\text{R(s)}|\text{R}^+(\text{aq})||\text{P}^{2+}(\text{aq})|\text{P(s)}$

(2)

- 1.10 The graph below shows the relationship between the amount of substance and time in a chemical reaction, involving substances K, L and M.



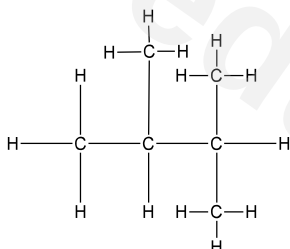
The equation for the reaction can be represented as:

- A  $3\text{M} \rightarrow 4\text{K} + 5\text{L}$
- B  $5\text{M} \rightarrow 2\text{K} + \text{L}$
- C  $\text{M} \rightarrow 2\text{K} + \text{L}$
- D  $\text{M} \rightarrow \text{K} + 2\text{L}$

(2)  
[20]

## QUESTION 2

2.1 Consider the structural formula of an organic compound below.

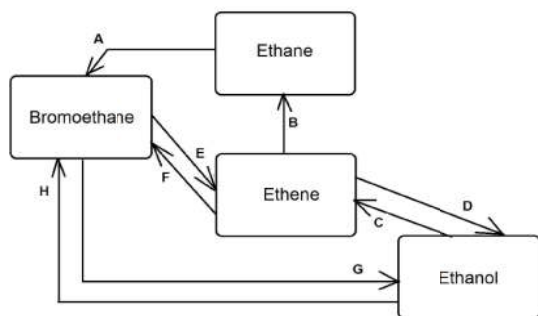


2.1.1 Is the above compound a SATURATED or an UNSATURATED hydrocarbon? Give a reason for the answer. (2)

2.1.2 Write down the IUPAC name of the above compound. (2)

2.2 Draw the structural formula of 4,4-dimethylhexan-2-one. (3)

2.3 In industry, ethene is used to synthesise a variety of organic compounds. The flow diagram below illustrates some of the reactions that ethene can undergo.



Write down:

2.3.1 The general formula of the homologous series to which ethene belongs. (1)

2.3.2 A balanced equation, using *structural formulae*, for reaction B (3)

2.3.3 The type of reaction represented by G (1)

2.3.4 The FORMULA of the inorganic reactant needed for reaction F (1)

2.3.5 The letter that represents a dehydrohalogenation reaction (1)

2.3.6 The difference between the base used in reaction E and the base used in reaction G (1)

2.3.7 The NAME or FORMULA of the catalyst used in reaction C (1)  
[16]

## QUESTION 3

3.1 Write down the name of the homologous series to which each of the following compounds belongs.

3.1.1  $\text{CH}_3\text{CHO}$  (1)

3.1.2  $\text{CH}_3\text{COCH}_3$  (1)

3.2 3.2.1 Define the term *positional isomer*. (2)

3.2.2 Write down the structural formula of an isomer of 1-chloropropane. (2)

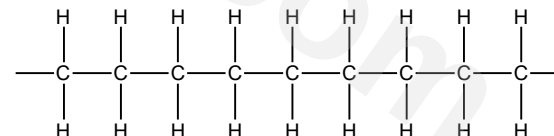
3.3 The compound responsible for a fruity scent, pentyl butanoate, is prepared in the laboratory.

Write down the:

3.3.1 IUPAC names of TWO compounds needed for this preparation (2)

3.3.2 Type of reaction that takes place (1)

3.4 Consider the structural formula of a polymer shown below.



Write down the:

3.4.1 IUPAC name of this polymer (1)

3.4.2 Structural formula of the monomer used to prepare this polymer (1)

3.4.3 Type of polymer of which it is an example (1)  
[12]

#### QUESTION 4

The table below shows data collected for four organic compounds during two practical investigations. The compounds are represented by the letters **A**, **B**, **C** and **D**. The boiling point of compound **B** is unknown and recorded as **X**.

| Investigation | Organic compound                                                                         | Relative molecular mass | Boiling point (°C) |
|---------------|------------------------------------------------------------------------------------------|-------------------------|--------------------|
| I             | <b>A</b> CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> | 72,15                   | 36,1               |
|               | <b>B</b> CH <sub>3</sub> CH(CH <sub>2</sub> )CH <sub>2</sub> CH <sub>3</sub>             | 72,15                   | <b>X</b>           |
| II            | <b>C</b> CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH              | 74,12                   | 117                |
|               | <b>D</b> CH <sub>3</sub> CH <sub>2</sub> COOH                                            | 74,08                   | 141,2              |

4.1 For investigation II, write down the:

4.1.1 Dependent variable (1)

4.1.2 Independent variable (1)

4.1.3 Controlled variable (1)

4.2 Will the boiling point of compound **B**, be HIGHER THAN, LOWER THAN or EQUAL TO the boiling point of compound **A**? (1)

4.3 Fully explain the answer to Question 4.2. (3)

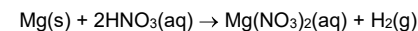
4.4 How will the vapour pressure of compound **C** compare to that of compound **D**? Choose from HIGHER THAN, LOWER THAN or EQUAL TO. (1)

4.5 Fully explain the answer to Question 4.4 (3)

4.6 Write down the STRUCTURAL FORMULA and IUPAC NAME of a FUNCTIONAL isomer of compound **D**. (4)  
[15]

#### QUESTION 5

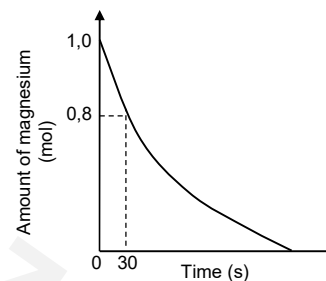
A group of learners use the reaction between magnesium and nitric acid to investigate ONE of the factors that affects reaction rate. The reaction that takes place is represented by the balanced equation below.



They add magnesium ribbon to *dilute* nitric acid and measure the mass of magnesium used per unit time. The experiment is repeated using *concentrated* nitric acid.

5.1 Write down an investigative question for this investigation. (2)

The results obtained for the reaction with dilute nitric acid are represented in the graph below.



5.2 Which substance, **Mg** or **HNO<sub>3</sub>**, is in excess? Use the information from the graph to give a reason for your answer. (2)

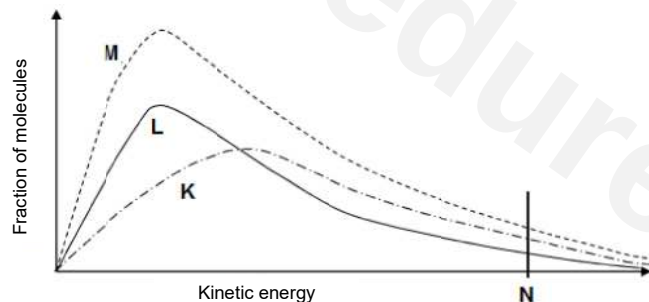
5.3 Define the term *reaction rate*. (2)

5.4 Calculate the average rate of the reaction (in gram per second) during the first 30 s. (5)

5.5 Copy the above graph in your answer book. On the same set of axes use a **DOTTED LINE** to show the curve that will be obtained when concentrated nitric acid is used. No numerical values are required. (2)  
[13]

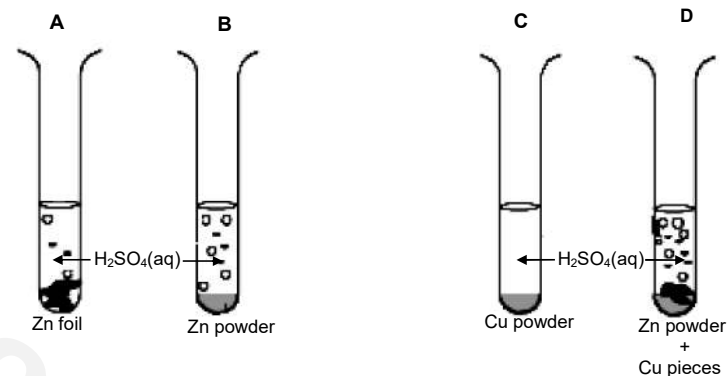
### QUESTION 6

- 6.1 Curve **L** shown below, is the Maxwell-Boltzman distribution curve for a gas in a closed container at 250 °C.



- 6.1.1 Name the energy represented by **N**. (1)
- 6.1.2 Write down the change in reaction conditions that resulted in:
- Curve **M** (1)
  - Curve **K** (1)
- Use the collision theory to explain how this change affects the rate of the reaction. (4)

- 6.2 A series of experiments is conducted to compare the reactions of zinc foil, zinc powder, copper powder and a mixture of zinc powder and copper pieces with dilute sulfuric acid of concentration  $1 \text{ mol} \cdot \text{dm}^{-3}$ . Hydrogen gas is produced in all test tubes where a reaction takes place. The diagram shows the test tubes, some time after the metals have been added to the acid.

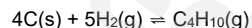


- 6.2.1 Refer to the relative strengths of oxidizing agents or reducing agents to explain why no reaction takes place in test tube **C**. (3)
- 6.2.2 How does the rate of the reaction in test tube **B** compare to that in (Choose from GREATER THAN, SMALLER THAN or EQUAL TO.)
- test tube **A**?  
Give a reason for your answer. (2)
  - test tube **D**?  
Give a reason for your answer. (2)

[13]

### QUESTION 7

7.1 The reaction represented below reaches equilibrium in a closed container.



The equilibrium constants for this reaction at two different temperatures are given in the table below.

| TEMPERATURE (K) | EQUILIBRIUM CONSTANT ( $K_c$ ) |
|-----------------|--------------------------------|
| 400             | $1,58 \times 10^{-3}$          |
| 600             | $1,58 \times 10^{-9}$          |

7.1.1 Is the forward reaction ENDOTHERMIC or EXOTHERMIC? (1)

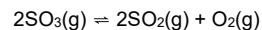
7.1.2 Use Le Chatelier's principle to explain your answer to Question 7.1.1. (3)

7.1.3 The pressure in the container is now decreased by increasing the volume of the container. What effect will this have on the value of the equilibrium constant?

Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

7.1.4 Give a reason for your answer to Question 7.1.3. (1)

7.2 Exactly 24,0 mol  $\text{SO}_3\text{(g)}$  is sealed in an empty 2,0 dm<sup>3</sup> container. The reaction reaches equilibrium at 700 K after 8 minutes, according to the following balanced equation.

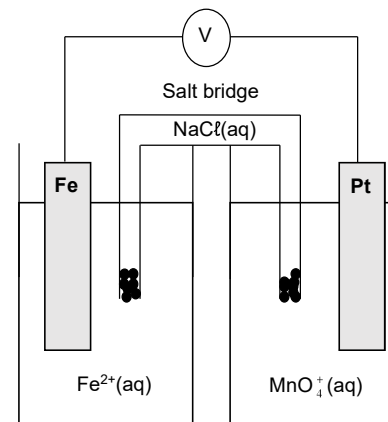


If the reaction mixture contains 10,0 mol  $\text{O}_2\text{(g)}$  at equilibrium, calculate the equilibrium constant ( $K_c$ ) at 700 K.

(7)  
[13]

### QUESTION 8

An electrochemical cell is set up as shown in the diagram below.



8.1 What is the function of the salt bridge? (1)

8.2 Briefly explain the main difference between the cell illustrated above and an electrolytic cell by referring to the energy that is transferred. (2)

8.3 Which electrode, **Fe** or **Pt**, is the cathode? Give a reason for your answer. (2)

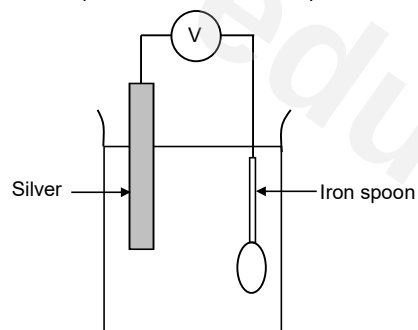
8.4 Write down the FORMULA of the reducing agent in this cell. (1)

8.5 Write down the overall cell reaction that takes place in this cell. (3)

8.6 Calculate the initial reading on the voltmeter when this cell functions under standard conditions. (4)  
[13]

### QUESTION 9

The diagram below shows a simplified cell used to electroplate an iron spoon with silver.



- 9.1 Define the term *electrolyte*. (2)
- 9.2 Write down the: (2)
- 9.2.1 NAME of a substance that can be used as electrolyte in this cell (1)
- 9.2.2 NAME or FORMULA of the substance which is oxidised (1)
- 9.2.3 Half-reaction that takes place at the cathode (2)
- 9.3 Calculate the number of electrons transferred if 2 g of silver is plated on the spoon. (4)
- [10]**

P.T.O.

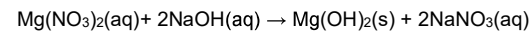
### QUESTION 10

- 10.1 A factory accidentally spills sulphuric acid into a nearby river. The fish species in the river CANNOT survive in water with a pH LOWER THAN 5,8.

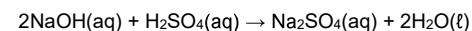
Analysis of water samples from the river shows that the hydrogen ion concentration is  $5,6 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3}$ .

Show with the aid of a calculation that the fish will not survive in the river. (3)

- 10.2 A sample of seawater is treated with  $500 \text{ cm}^3$  of a  $2,5 \text{ mol} \cdot \text{dm}^{-3}$  sodium hydroxide solution to remove the magnesium ions. The reaction that takes place is represented by the following balanced equation:



After removal of the precipitate, the excess  $\text{NaOH}(\text{aq})$  is titrated with  $95 \text{ cm}^3$  of a  $0,2 \text{ mol} \cdot \text{dm}^{-3}$  sulphuric acid solution. The balanced equation for the reaction is:



Calculate:

- 10.2.1 The number of moles sodium hydroxide added to the seawater (3)
- 10.2.2 The original mass of magnesium nitrate in the seawater (6)
- [12]**

P.T.O.

**QUESTION 11**

11.1 A fertilizer bag is labelled 1:4:2(30).

Explain the meaning of the:

11.1.1 Ratio, 1:4:2 (2)

11.1.2 Value in brackets, (30) (1)

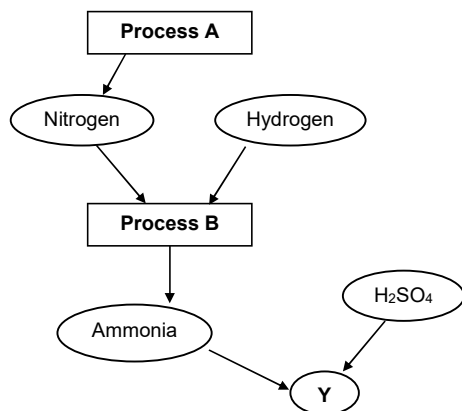
11.2 Consider the two nitrogen containing fertilisers:

Ammonium nitrate:  $\text{NH}_4\text{NO}_3$

Urea:  $(\text{NH}_2)_2\text{CO}$

Which of the above fertilisers will provide the greater amount of nitrogen per kg of fertiliser used? (4)

11.3 The flow diagram below shows two industrial processes, **A** and **B**, used in the production of fertilizers.



Write down the:

11.3.1 NAME of process **A** (1)

11.3.2 balanced equation for the reaction that takes place in the process **B** (3)

11.3.3 FORMULA and the NAME of the fertilizer represented by **Y** (2)  
[13]

**TOTAL: 150**

**GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION  
2017**

|                                                                                           |
|-------------------------------------------------------------------------------------------|
| <p><b>10842</b></p> <p><b>PHYSICAL SCIENCES: CHEMISTRY</b></p> <p><b>SECOND PAPER</b></p> |
|-------------------------------------------------------------------------------------------|

**TIME: 3 hours**

**MARKS: 150**

**15 pages + 4 information sheets + 1 answer sheet**

PHYSICAL SCIENCES: Paper 2  
1084E



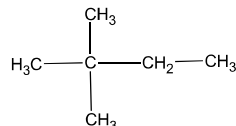
**X10**



### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, e.g. 1.11 D.

- 1.1 Which ONE of the following is the correct IUPAC name for the structure below?



- A 2-ethyl-2-methylpropane  
 B 3,3-dimethylbutane  
 C 2,2-dimethylbutane  
 D 2-methylpentane
- (2)

- 1.2 Which ONE of the following compounds is a possible product after the addition of  $\text{Cl}_2$  to but-1-ene?

- A  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCl}_2$   
 B  $\text{CH}_3\text{CH}_2\text{CHClCH}_2\text{Cl}$   
 C  $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$   
 D  $\text{CH}_3\text{CH}_2\text{CCl}_2\text{CH}_3$
- (2)

- 1.3 The rate of a chemical reaction is increased when the surface area of the reactant is increased. This change in the rate is due to the ...

- A increase in the density of the reactant particles.  
 B increase in the concentration of the reactant.  
 C increase in exposure of more reactant particles to a possible collision.  
 D alteration of the electrical conductivity of the reactant particles.
- (2)

- 1.4 Which of the following is the strongest oxidizing agent?

- A  $\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$   $E^\circ = +0,80 \text{ V}$   
 B  $\text{Pb}^{2+} + 2 \text{e}^- \rightleftharpoons \text{Pb}$   $E^\circ = -0,13 \text{ V}$   
 C  $\text{Ni}^{2+} + 2 \text{e}^- \rightleftharpoons \text{Ni}$   $E^\circ = -0,27 \text{ V}$   
 D  $\text{Sn}^{2+} + 2 \text{e}^- \rightleftharpoons \text{Sn}$   $E^\circ = -0,12 \text{ V}$
- (2)

- 1.5 Consider the following results of experiments.

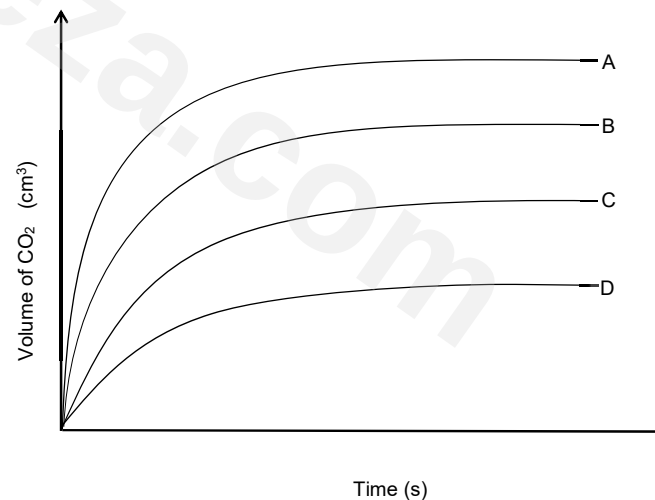
|                       | Experiment 1                                     | Experiment 2                                       |
|-----------------------|--------------------------------------------------|----------------------------------------------------|
| Reactants             | Powdered Cu and HCl                              | Chunk of Cu and $\text{HNO}_3$                     |
| Temperature           | $20^\circ\text{C}$                               | $10^\circ\text{C}$                                 |
| Concentration of Acid | $0,6 \text{ mol}\cdot\text{dm}^{-3} \text{ HCl}$ | $0,4 \text{ mol}\cdot\text{dm}^{-3} \text{ HNO}_3$ |
| Rate                  | Low                                              | High                                               |

Which one of the following factors would account for the lower rate in Experiment 1?

- A Temperature  
 B Concentration of acid  
 C Surface area of Cu  
 D Nature of reactants
- (2)

- 1.6 The four graphs shown below were obtained from experiments involving nickel carbonate and *hydrochloric acid of different concentrations*. The rate of the carbon dioxide produced was measured.

Which ONE of the graphs shows the reaction that had the most concentrated hydrochloric acid?



(2)

1.7 The quantity / quantities that remain constant in all oxidation-reduction reactions is / are ...

- A charge only.
- B mass only.
- C both charge and mass.
- D concentration of reactants.

(2)

1.8 A student wishes to prepare approximately 100 cm<sup>3</sup> of an aqueous solution of 6 mol·dm<sup>-3</sup> HCl using 12 mol·dm<sup>-3</sup> HCl. The correct procedure to follow is to add 50 cm<sup>3</sup> of ...

- A 12 mol·dm<sup>-3</sup> HCl to 100 cm<sup>3</sup> of water.
- B 12 mol·dm<sup>-3</sup> HCl to 50 cm<sup>3</sup> of water.
- C water to 50 cm<sup>3</sup> of 12 mol·dm<sup>-3</sup> HCl.
- D water to 100 cm<sup>3</sup> of 12 mol·dm<sup>-3</sup> HCl.

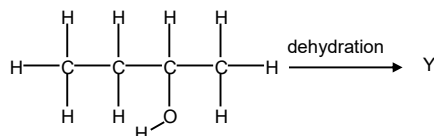
(2)

1.9 In the Haber process, a catalyst is used. The catalyst ...

- A increases the kinetic energy of the reactants.
- B changes the  $\Delta H$  of a reaction.
- C provides a reaction path with a lower activation energy.
- D decreases the potential energy of the products.

(2)

1.10 The dehydration of butan-2-ol is represented below. Compound Y is one of the products.



Which ONE of the following is the correct condensed structural formula for compound Y?

- A  $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3$
- B  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- C  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$
- D  $\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{CH}_3$

(2)  
[20]

P.T.O.

## QUESTION 2

The boiling points of organic compounds A, B, C and D, are shown in the table below.

| Organic compound | Boiling point (°C) | Condensed formula                                                  |
|------------------|--------------------|--------------------------------------------------------------------|
| A                | 119,3              | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ |
| B                | 99                 | $\text{CH}_3\text{CH}_2\text{OOCCH}_2\text{CH}_3$                  |
| C                | 103                | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$           |
| D                | 187                | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$          |

2.1 Define the term *homologous series*.

(2)

2.2 Name the **homologous series** to which each of the following compounds belong.

2.2.1 B

(1)

2.2.2 C

(1)

2.3 Organic compound A is dehydrated during an acid catalysed reaction to form pent-1-ene. Write down the general formula of the homologous series of this product.

(1)

2.4 Write down the IUPAC name for organic compound D.

(2)

2.5 2.5.1 Will the boiling point of the next member in the homologues series of compound D be HIGHER THAN, LOWER THAN or EQUAL TO that of compound D?

(1)

2.5.2 Fully explain the answer to Question 2.5.1.

(3)

2.6 Organic compounds consist of different types of *isomers*.

2.6.1 Define a *positional isomer*.

(2)

2.6.2 Draw ONE positional isomer for organic compound A.

(2)

2.6.3 Write down the IUPAC name for the isomer drawn as the answer to Question 2.6.2.

(2)

[17]

P.T.O.

### QUESTION 3

- 3.1 Learners prepare an organic compound (used as banana flavour in milkshakes and ice creams), by mixing 3-methylbutan-1-ol and ethanoic acid in a test tube.
- 3.1.1 Draw the structural formula of the product of this reaction. (3)
- 3.1.2 After the reaction in Question 3.1.1 is complete, the learners pour the contents of the test tube into some water in a beaker. What is the reason for pouring the mixture into water? (1)
- 3.1.3 Name any TWO safety precautions that should be taken during the preparation of the ester. (2)
- 3.2 3.2.1 Hex-1-ene is mixed with water during a chemical reaction under specific reaction conditions and an alcohol is formed. Write down the IUPAC name of the major product that is formed during this reaction. (2)
- 3.2.2 Name the type of reaction described in Question 3.2.1. (1)
- 3.2.3 Name TWO reaction conditions for the reaction in Question 3.2.1. (2)
- 3.3 The compound  $C(CH_3)_3OH$  and hydrogen chloride react.
- 3.3.1 Draw the structural formula of the organic product formed. (2)
- 3.3.2 Name the products of the reaction. (3)

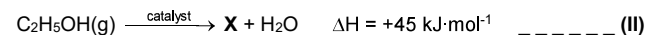
- 3.4 Octane and propane are produced in industry by the thermal cracking of longer chains of alkane molecules, as shown in the equation below.



No catalyst was used in this reaction.

- 3.4.1 Name TWO reaction conditions needed for thermal cracking in REACTION I. (2)

Compound X can also be produced in reaction II as shown below:

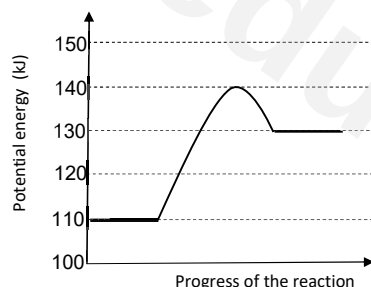


- 3.4.2 Identify X. (1)
- 3.4.3 Name the type of elimination reaction that occurs in REACTION II. (1)
- 3.4.4 Define *addition polymerization*. (2)
- 3.4.5 Compound X reacts to form a polymer. Write down the name of this polymer. (1)

[23]

#### QUESTION 4

4.1 Consider the following potential energy diagram for a reversible reaction.

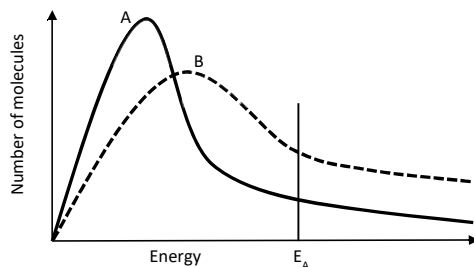


For the **reverse reaction**, write down the value of the ...

4.1.1 *activation energy*. (1)

4.1.2 *heat of reaction*. (1)

4.2 Below is the Maxwell-Boltzman distribution curve of the distribution of the kinetic energy of molecules at two different temperatures.



4.2.1 What does the area under both graphs, **A** and **B**, to the right of the line labelled  $E_A$  represent? (1)

4.2.2 One of the reactions takes place at a high temperature. Which ONE of the graphs, **A** or **B**, represents the high temperature? (1)

4.2.3 Explain the answer to Question 4.2.2 in terms of the collision theory. (4)

4.3 The data in the table below indicates the changes in volume of  $N_2O_5$  recorded at different time intervals.

| Time (s)                   | 0     | 100   | 200   | 300   | 400   | 500   | 600   | 700   | 800   |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Volume $N_2O_5$ ( $cm^3$ ) | 0,100 | 0,081 | 0,066 | 0,054 | 0,044 | 0,035 | 0,029 | 0,023 | 0,019 |

4.3.1 Use the table above to draw a graph of the results. Use the attached graph on the ANSWER SHEET at the end of the question paper. (5)

4.3.2 Define the term *reaction rate*. (2)

4.3.3 Calculate the rate of the reaction at  $t = 240$  s. (3)  
[18]

#### QUESTION 5

An equilibrium reaction for the decomposition of a reddish-brown substance,  $AO_2$ , is given below. Both products are colourless.



Brown      Colourless

Initially 2,0 mol of  $A_2O_3$  and 1,0 mol of  $O_2$  are present in 1,0  $dm^3$  container. Only 10,0 % of the  $AO_2$  decomposes at equilibrium.

5.1 Define the term *dynamic equilibrium*. (2)

5.2 Use the information above to calculate the equilibrium concentration of *each* species. (6)

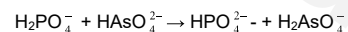
5.3 The volume of the container in Question 5.2 is now reduced to 0,5  $dm^3$ , while the temperature remains constant.

5.3.1 What colour change is observed? Write only BROWN or COLOURLESS. (1)

5.3.2 Use Le Chatelier's Principle to explain the observation made in Question 5.3.1. (3)  
[12]

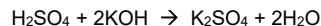
### QUESTION 6

- 6.1 Define *an acid* according to the Brønsted-Lowry theory. (2)
- 6.2 An acid-base reaction is shown below.



Write down the name of the conjugate base of  $\text{H}_2\text{PO}_4^-$ . (1)

- 6.3 In a titration, a 20 cm<sup>3</sup> potassium hydroxide solution was neutralized by 15 cm<sup>3</sup> dilute sulfuric acid with a concentration of 0,1 mol·dm<sup>-3</sup>.



- 6.3.1 Which indicator will be most suitable for this titration?  
Choose from:

*phenolphthalein*  
*methyl orange*  
*bromothymol blue*

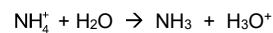
(1)

- 6.3.2 Give a reason for your choice of indicator in Question 6.3.1. (2)

- 6.3.3 Calculate the concentration of the potassium hydroxide solution. (5)

- 6.3.4 Calculate the pH of the potassium hydroxide solution in Question 6.3.3. (5)

- 6.4 The salt ammonium chloride ( $\text{NH}_4\text{Cl}$ ) reacts with water.



- 6.4.1 What do we call this type of reaction? (1)

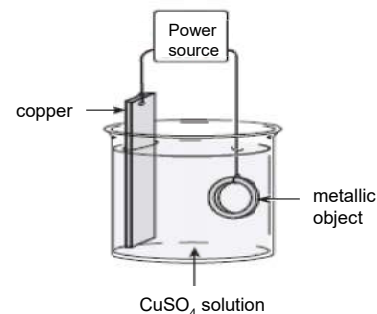
- 6.4.2 What will the approximate pH of the salt solution be? Choose from  
EQUAL TO, SMALLER THAN 7 or GREATER THAN 7. (1)

- 6.4.3 Give a reason for the answer to Question 6.4.2. (1)

[19]

### QUESTION 7

A metallic object, to be plated with copper, is placed in a copper(II)sulphate solution ( $\text{CuSO}_4$ ).



- 7.1 Identify which electrode will be the anode. (1)
- 7.2 Identify the terminal to which the object must be connected. (1)
- 7.3 State whether the copper ions are *oxidized* or *reduced*. (1)
- 7.4 Write down the half-reaction that occurs at the cathode. (1)
- 7.5 Explain why the power supply must be a DC and not an AC power source. (3)

[7]

### QUESTION 8

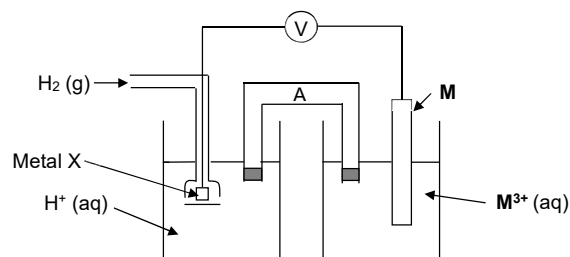
8.1 The standard cell potential produced by a voltaic cell consisting of a platinum electrode in contact with a solution of  $\text{Co}^{3+}$  ions and a silver electrode in contact with a solution of  $\text{Ag}^+$  ions, is 1,01 V.

8.1.1 Write down the cell notation of the reaction. (3)

8.1.2 Identify the oxidising agent. (1)

8.1.3 Write down the reducing half-reaction. (1)

8.2 An unknown metal, **M**, is connected to a hydrogen half-cell as indicated below. The metal, **M**, is placed in a solution of its salt,  $\text{M}^{3+}(\text{aq})$ .



8.2.1 What is the purpose of a standard hydrogen half-cell? (1)

8.2.2 Name the metal labelled **X** in the hydrogen half-cell. (1)

8.2.3 State ONE function of the component labelled **A**. (1)

8.2.4 The reading on the voltmeter is 0,74 V. Identify the unknown metal, **M**. (2)

8.2.5 Use information from the Table of Standard Reduction Potentials to obtain the overall balanced redox reaction for this cell. (3)

8.2.6 How will the reading on the voltmeter change with an increase in the concentration of the  $\text{M}^{3+}$  ions?

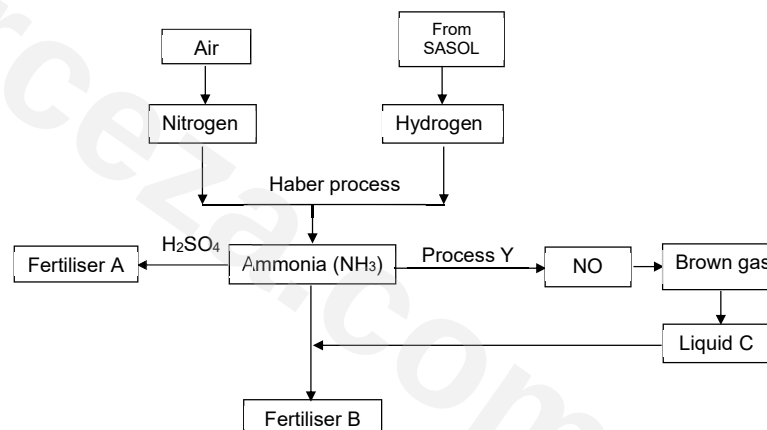
Write only INCREASE, DECREASE or HAVE NO EFFECT.  
Give a reason for your answer. (2)

8.2.7 Write down the reading on the voltmeter when the reaction has reached equilibrium. (1)

8.2.8 Name TWO potential hazards associated with the use of a hydrogen half-cell. (2)  
[18]

### QUESTION 9

The flow diagram below shows the main steps in the industrial preparation of two important solid fertilisers.



9.1 Write down the:

9.1.1 Balanced chemical equation for the formation of the brown gas (3)

9.1.2 NAME of process Y (1)

9.1.3 Chemical FORMULA of liquid C (1)

NAME: \_\_\_\_\_ GRADE 12: \_\_\_\_\_

**Hand in this ANSWER SHEET with your ANSWER BOOK.**

[illegible]

**TOTAL: 150**

**END**



GAUTENG PROVINCE  
EDUCATION  
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION

2018

10842

PHYSICAL SCIENCES

PAPER 2

TIME: 3 hours

MARKS: 150

6 pages + 4 data sheets

PHYSICAL SCIENCES: Paper 2

1084E



10842E

X10



PHYSICAL SCIENCES  
(Paper 2)

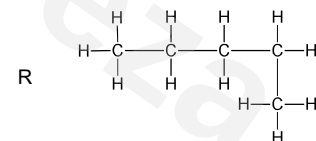
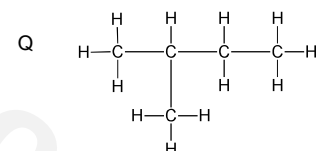
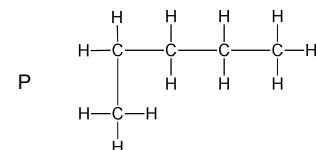
10842/18

3

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the answer book, e.g. 1.11 – D.

1.1 Consider the structural formulae of THREE organic compounds given below:



Which ONE of the following statements about the above compounds is CORRECT?

- A P and R are the same compound.
- B Q and R are the same compound.
- C All three are different compounds.
- D All three compounds are branched alkanes.

(2)

1.2 Consider the four chemical samples below.

P



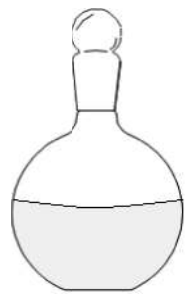
12 g zinc powder

Q



12 g zinc granules

R



1 dm<sup>3</sup> of 1 mol·dm<sup>-3</sup> HCl solution

S



1 dm<sup>3</sup> of 2 mol·dm<sup>-3</sup> HCl solution

A small balloon must be inflated with hydrogen gas. The balloon is attached to the top of one of the flasks into which zinc was added. To inflate the balloon as quickly as possible, which ONE of the combinations will be the most suitable?

- A P and R  
B P and S  
C Q and P  
D Q and S

(2)

1.3 Diluted hydrochloric acid is gradually added to a flask of distilled water. What effect will this have on the value of the dissociation constant  $K_w$  of water at 25° C?

- A Increase, until  $K_w$  reaches a maximum value.  
B Decrease, until  $K_w$  is zero.  
C No effect, no matter how much acid is added.  
D A sharp increase in  $K_w$  and then a sudden decrease in  $K_w$ .

(2)

1.4 Which ONE of the following factors does NOT affect a chemical system in equilibrium?

- A Temperature  
B Time  
C Pressure  
D Concentration

(2)

1.5 Which ONE of the following species CANNOT act as an ampholyte?

- A  $\text{HSO}_4^-$   
B  $\text{H}_2\text{O}$   
C  $\text{CO}_2$   
D  $\text{HSO}_3^-$

(2)

1.6 A standard copper-zinc electrochemical cell delivers a current. How do the concentrations of the two electrolytes change in time?

- A  $[\text{Cu}^{2+}]$  decreases and  $[\text{Zn}^{2+}]$  increases at the same rate.  
B  $[\text{Cu}^{2+}]$  and  $[\text{Zn}^{2+}]$  are unaffected as the reaction proceeds.  
C  $[\text{Cu}^{2+}]$  increases and  $[\text{Zn}^{2+}]$  decreases in time.  
D  $[\text{Cu}^{2+}]$  and  $[\text{Zn}^{2+}]$  both steadily decreases until both are zero.

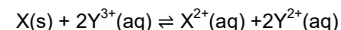
(2)

1.7 A spontaneous reaction occurs when chlorine gas comes into contact with hydrogen gas. The probable reason for this is that ...

- A chlorine is a good oxidising agent.  
B hydrogen is an oxidising agent.  
C chlorine is a good reducing agent.  
D hydrogen and chlorine are both non-metals.

(2)

1.8 Consider the following hypothetical redox equation.



Which ONE of the following statements concerning the above equation is correct?

- A X undergoes reduction by losing 1 electron.  
B X undergoes reduction by losing 2 electrons.  
C  $\text{Y}^{3+}$  undergoes reduction by gaining 1 electron.  
D  $\text{Y}^{3+}$  undergoes reduction by gaining 2 electrons.

(2)

1.9 Which ONE of the following is an industrial use of nitric acid?

- A Refining of petrol and oil
- B Dehydrating agent
- C Recovery of metals from their ores
- D Preparation of fertilisers

(2)

1.10 The reaction  $2\text{SO}_3 + \text{O}_2 \rightarrow 2\text{SO}_3$  in the contact process is ...

- A reversible and does not take place in the presence of a catalyst.
- B not reversible and only takes place in the presence of vanadium pentoxide.
- C reversible and takes place in the heat exchanger of the factory.
- D reversible and takes place in the presence of a catalyst.

(2)

[20]

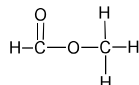
## QUESTION 2

2.1 The molecular formula  $\text{C}_2\text{H}_4\text{O}_2$  has two isomers.

2.1.1 Define an *isomer*.

(2)

2.1.2 The structural formula of one of the isomers of  $\text{C}_2\text{H}_4\text{O}_2$  is



Write down the IUPAC name for this isomer.

(2)

2.1.3 Draw the structural formula of the other isomer of the compound given above.

(2)

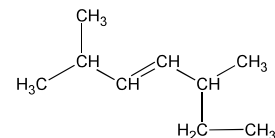
2.1.4 Write down the IUPAC name for this isomer in QUESTION 2.1.3.

(1)

2.1.5 To which **homologous series** does the isomer in QUESTION 2.1.3 belong?

(1)

2.2 Consider the structural formula below.



For this compound, write down the:

2.2.1 **General formula** of the homologous series to which it belongs

(1)

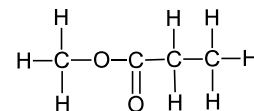
2.2.2 IUPAC name

(2)

2.3 Write down the structural formula of a tertiary alcohol consisting of 4 carbon atoms.

(2)

2.4 Consider the following organic compound below. Write down the structural formula of the functional group of this compound.



(1)

[14]

## QUESTION 3

Grade 12 learners investigate the effect of the molecular mass on the boiling point of the first 8 members of the homologous series of the primary alcohols.

3.1 Give ONE precaution that the learners need to take during this investigation.

(1)

3.2 Structural isomers can influence the outcome of this investigation. Alcohols with more than two carbon atoms have more than one structural isomer.

3.2.1 Write down the TWO structural formulae and the IUPAC names of the isomers of the alcohols containing three carbon atoms.

(4)

3.2.2 The learners used heptan-1-ol as one of the compounds during the investigation. Which ONE of the isomers named in QUESTION 3.2.1 must be used to make the results comparable and fair?

(1)

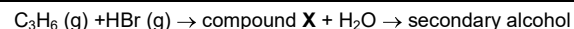
3.2.3 Give the reason for the choice made in QUESTION 3.2.2.

(1)

- 3.3 Butan-1-ol and butan-2-ol have different melting and boiling points. State, with reasons, which ONE of these two alcohols have the highest ...
- 3.3.1 melting point. (3)
- 3.3.2 vapour pressure. (3)
- 3.3.3 Will the boiling point of a primary alcohol INCREASE or DECREASE if the number of carbon atoms in the chain increases to eight? (1)
- 3.3.4 Give a reason for the answer to QUESTION 3.3.3. (2)
- 3.4 Polymers are used widely in our society to form a variety of plastic compounds.
- 3.4.1 Name the process where very large, high-molar mass molecules are formed from small molecules? (1)
- 3.4.2 Name the monomer in the following organic molecule: (1)
- $$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\left[\text{CH}_2-\text{CH}_2\right]_n-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$$
- 3.4.3 Give ONE use of the polymer in QUESTION 3.4.2. (1)
- [19]

#### QUESTION 4

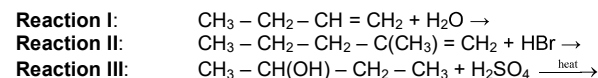
- 4.1 The following equation represents an organic chemical reaction.



- 4.1.1 Write down the molecular formula of compound X. (1)
- 4.1.2 Name the type of reaction that takes place when  $\text{C}_3\text{H}_6$  is converted to compound X. (1)
- 4.1.3 Give the IUPAC name of the secondary alcohol that is formed. (1)
- 4.1.4 Define a *secondary alcohol*. (1)
- 4.1.5 Instead of adding water to compound X, concentrated sodium hydroxide and ethanol is added, and the mixture is heated under reflux. (1)
- Write down the IUPAC name of the organic product that is formed. (1)
- 4.1.6 Name the type of elimination reaction that takes place. (1)

P.T.O.

- 4.2 Most organic compounds can undergo substitution, addition or elimination reactions to produce a variety of compounds. Some incomplete organic reactions are represented below.



- 4.2.1 Name the type of reaction represented by **Reaction III**. (1)
- Both **Reactions I and II** are examples of addition reactions. Name the type of addition reaction that is represented by:
- 4.2.2 **Reaction I** (1)
- 4.2.3 **Reaction II** (1)
- 4.2.4 **Reaction I** takes place in the presence of a catalyst. Write down the FORMULA of the inorganic catalyst used in **Reaction I**. (1)
- 4.2.5 Write down the IUPAC name of the major product formed in **Reaction II**. (2)
- [12]

#### QUESTION 5

- 5.1 The following equation represents a reaction used to prepare  $\text{CO}_2(\text{g})$  in the school laboratory. Pieces of calcium carbonate are added to a 0,1 mol·dm<sup>-3</sup> hydrochloric acid solution in a glass beaker.



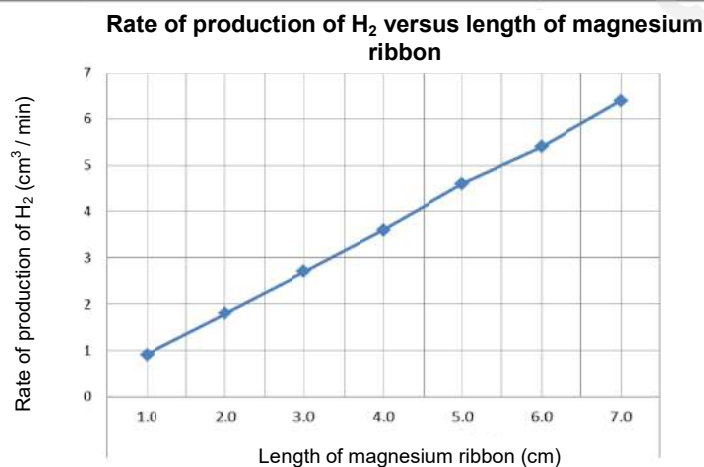
- 5.1.1 Mention THREE ways to increase the rate of  $\text{CO}_2$  production in the above reaction. (3)
- 5.1.2 Discuss TWO methods to measure the rate of this reaction. (4)
- 5.1.3 Give TWO reasons why this reaction will NOT reach equilibrium in the beaker. (2)

P.T.O.

- 5.2 In an investigation, different lengths of magnesium ribbon of the same width react with diluted hydrochloric acid of the same concentration. The rate at which hydrogen gas is produced in each reaction is measured and the data obtained is recorded in the table below.

| Length of magnesium ribbon (cm)                                      | 1,0 | 2,0 | 3,0 | 4,0 | 5,0 | 6,0 | 7,0 |
|----------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| Rate of production of H <sub>2</sub> (cm <sup>3</sup> /min) at 25 °C | 0,9 | 1,8 | 2,7 | 3,6 | 4,6 | 5,4 | 6,4 |

A graph of the results appears below.



- 5.2.1 Use the graph to give the rate at which hydrogen gas is produced from a 5,5 cm length of magnesium ribbon. (1)
- 5.2.2 The experiment is repeated under the same conditions, except that the hydrochloric acid is heated to 60 °C before the magnesium ribbon is added. How will the gradient of the new graph differ from that of the original gradient?  
Write only **STEEPER GRADIENT** or **LOWER GRADIENT**. (1)
- 5.2.3 Explain your answer to QUESTION 5.2.2 in terms of the collision theory. (2)
- 5.2.4 What conclusion can be made from the graph? (2)

[15]

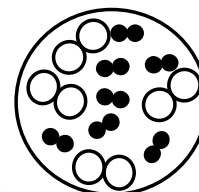
P.T.O.

### QUESTION 6

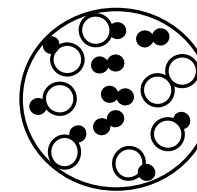
- 6.1 State *Le Chatelier's principle*. (2)
- 6.2 Iodine reacts with excess hydrogen in a sealed container of constant volume. Hydrogen iodide is formed.



Samples of the initial reaction mixture and the equilibrium reaction mixture's molecular compositions are shown below. An iodine atom is represented by (O) and hydrogen atom by (•).



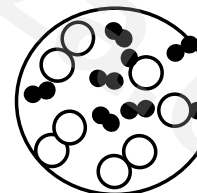
Initial reaction mixture



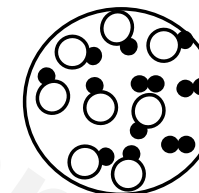
Reaction mixture at equilibrium

- 6.2.1 The temperature of the equilibrium mixture is decreased, and a new equilibrium is established. Choose between **A** and **B** to identify the new molecular composition of the reaction mixture. (1)

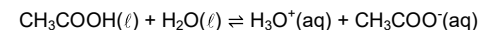
**A**



**B**



- 6.2.2 Explain the answer to QUESTION 6.2.1 (3)
- 6.3 Consider the equilibrium established in an aqueous 0,10 mol·dm<sup>-3</sup> ethanoic acid (acetic acid) solution at 25 °C.



The pH of this solution is 2,87.  
This pH corresponds to a [H<sub>3</sub>O<sup>+</sup>] = 1,34 x 10<sup>-3</sup> mol·dm<sup>-3</sup>

- 6.3.1 Calculate the equilibrium constant of an aqueous solution of ethanoic acid at 25 °C. (3)

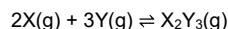
P.T.O.

6.3.2 Concentrated sodium ethanoate ( $\text{CH}_3\text{COONa}$ ), was dissolved in an ethanoic acid solution. How will the pH of the ethanoic acid solution change?

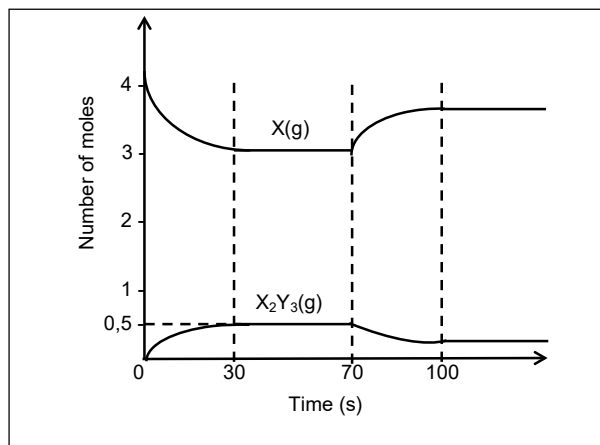
Write only INCREASES, DECREASES, or STAYS THE SAME. (1)

6.3.3 Explain the answer to QUESTION 6.3.2 (3)

6.4 4 mol of gas X and 4 mol of gas Y are added and sealed in a  $2 \text{ dm}^3$  container at a certain temperature. The following equilibrium is established at a certain temperature.



The graph below shows the number of moles of gas X and gas  $\text{X}_2\text{Y}_3$  present from the time the container is sealed.



6.4.1 How many moles of gas  $\text{X}_2\text{Y}_3$  are formed by the time the reaction reaches equilibrium at 30 s? (1)

6.4.2 Calculate the value of the equilibrium constant at  $t = 50 \text{ s}$ . (6)  
[20]

P.T.O.

### QUESTION 7

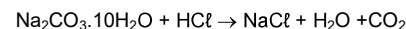
7.1 The dissociation constant of some substances is given below.

| Name of substance     | Formula                 | K <sub>a</sub> (298 K) |
|-----------------------|-------------------------|------------------------|
| Hydrogen sulphate ion | $\text{HSO}_4^-$        | $1,2 \times 10^{-2}$   |
| Ammonium ion          | $\text{NH}_4^+$         | $5,6 \times 10^{-10}$  |
| Phosphoric acid       | $\text{H}_3\text{PO}_4$ | $7,5 \times 10^{-3}$   |
| Hydrocyanic acid      | $\text{HCN}$            | $4,9 \times 10^{-10}$  |

7.1.1 Write down the FORMULA of the substance that has the highest tendency to dissociate. (1)

7.1.2 Write down the FORMULA of the conjugate base of hydrocyanic acid. (1)

7.2 7,6 g of impure commercial washing soda ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ) is dissolved in water. The solution is diluted to  $500 \text{ cm}^3$  in a measuring flask.  $25 \text{ cm}^3$  of this solution is titrated with a standard  $\text{HCl}$  solution of concentration  $0,1 \text{ mol} \cdot \text{dm}^{-3}$ .



7.2.1 Rewrite and balance the chemical equation for the above reaction. (2)

7.2.2 Three indicators are available to indicate the equivalence point of this titration.

- Methyl orange
- Bromothymol blue
- Phenolphthalein

Choose from the list of indicators, the ONE which will be the most suitable for this titration. (1)

7.2.3 Give a reason for the answer to QUESTION 7.2.2 (2)

7.2.4 What colour change will be observed during the titration of the base with the acid. (1)

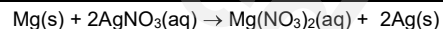
7.2.5 Calculate the mass of pure  $\text{Na}_2\text{CO}_3$  in commercial washing soda, if  $24,8 \text{ cm}^3$  of the  $\text{HCl}$  solution was needed to reach the equivalence point in the titration. (5)

7.2.6 Calculate the percentage purity of the  $\text{Na}_2\text{CO}_3$  in the original mass of commercial washing soda. (3)  
[16]

P.T.O.

### QUESTION 8

- 8.1 A standard electrochemical cell is set up according to the equation below.

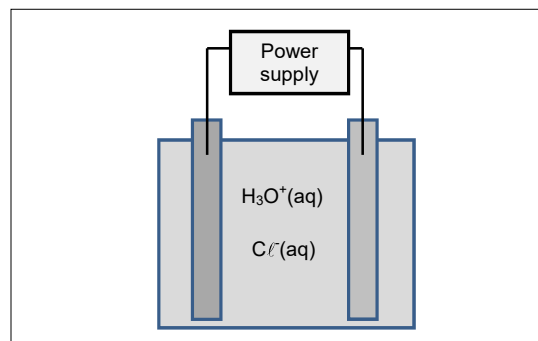


- 8.1.1 Write down the cell notation of this cell. (3)
- 8.1.2 Write down the NAME of the oxidising agent. (1)
- 8.1.3 Calculate the initial emf of this cell. (3)
- 8.1.4 At what temperature is the emf of a standard cell measured? (1)
- 8.1.5 At what half-cell concentration will the cell give the emf obtained in QUESTION 8.1.3? (1)
- 8.1.6 This cell is connected to a light bulb marked 3V;6W. In theory the bulb should light up, but in practice it does not. ( $I = \frac{P}{V}$ ). Give a possible reason for this observation. (3)

[12]

### QUESTION 9

- 9.1 A cell consists of a source of direct current (a battery) connected to two electrodes that are immersed in an aqueous solution of hydrochloric acid as indicated below. The electrical circuit is complete.



- 9.1.1 To which electrode (anode or cathode) do the hydronium ions migrate? (1)
- 9.1.2 Write down the half-reaction taking place at the electrode in QUESTION 9.1.1. (2)

P.T.O.

- 9.1.3 Give the NAME or FORMULA of the product that is formed at the other electrode. (1)
- 9.2 The electroplating of metals is a very important industrial electrochemical application.
- 9.2.1 Define *electroplating*. (2)
- 9.2.2 Name ONE use of electroplating. (1)
- 9.2.3 To which electrode must the object that is to be electroplated be connected? (1)

[8]

### QUESTION 10

- 10.1 The table below shows the ideal soil conditions for growing three types of crops.

| Crop       | Soil pH | Soil nitrogen | Soil phosphorous | Soil potassium |
|------------|---------|---------------|------------------|----------------|
| Wheat      | 6       | Medium        | High             | Low            |
| Potatoes   | 9       | Medium        | Medium           | High           |
| Sugar beet | 7       | Medium        | Medium           | High           |

- 10.1.1 Which crop grows best in acidic soil? (1)

A farmer bought the fertilisers listed in the table below:

| Common name           | Chemical formula                     |
|-----------------------|--------------------------------------|
| Sulphate of potash    | $\text{K}_2\text{SO}_4$              |
| Triple superphosphate | $\text{Ca}(\text{H}_2\text{PO}_4)_2$ |
| Ammonium nitrate      | $\text{NH}_4\text{NO}_3$             |
| Ammonium sulphate     | $(\text{NH}_4)_2\text{SO}_4$         |

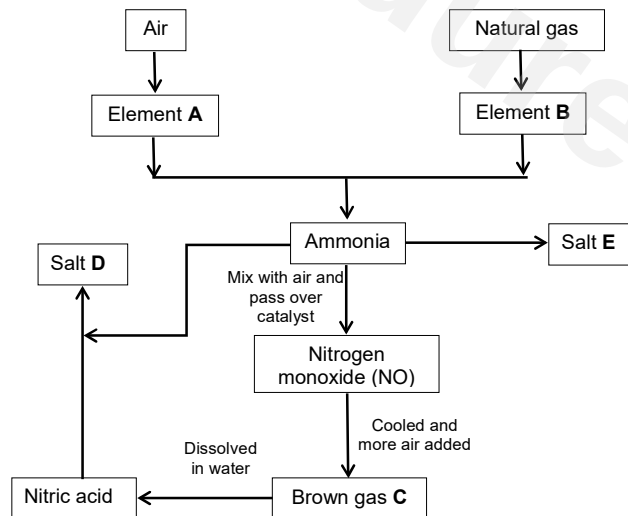
Samples of soil from two fields, A and B were analysed. The results are in the following table:

| Field | Nitrogen | Phosphorous | Potassium |
|-------|----------|-------------|-----------|
| A     | Low      | High        | Low       |
| B     | Medium   | Medium      | Medium    |

- 10.1.2 Which ONE of the fertilisers should the farmer add to the soil in field A to make it more suitable for growing wheat? (1)
- 10.1.3 Give a reason for the answer to QUESTION 10.1.2. (3)
- 10.1.4 Calculate the % nitrogen in the ammonium nitrate. (4)

P.T.O.

- 10.1.5 Some of the processes used in the manufacturing of fertilizers are indicated in the flow diagram below. Complete the flow diagram below by writing down the NAME or FORMULA of substances A to E. Write only the letter and the answer in your ANSWER BOOK.



(5)  
[14]

TOTAL: 150



GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION  
2019

10842  
PHYSICAL SCIENCES: CHEMISTRY  
PAPER 2

TIME: 3 hours

MARKS: 150

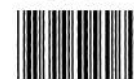
16 pages + 4 data sheets and 1 answer sheet

PHYSICAL SCIENCES: Paper 2



10842E

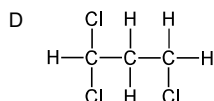
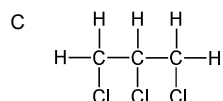
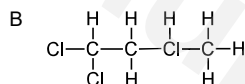
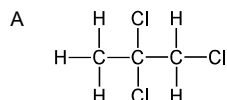
X05



### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 Which ONE of the following is the correct structural formula for 1,2,2-trichloropropane?



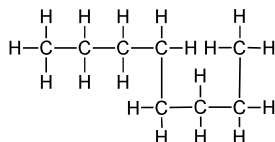
(2)

1.2 Which ONE of the following pairs of compounds contains members of the same homologous series?

- A  $C_2H_4$  and  $C_3H_8$   
 B  $C_3H_6$  and  $C_4H_6$   
 C  $CH_4O$  and  $C_2H_4O_2$   
 D  $C_2H_4O$  and  $C_3H_6O$

(2)

1.3 Consider the following structural formula of an organic compound and the statements referring to it.



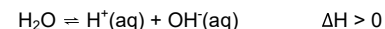
- I. The compound belongs to the same homologous series as methane.  
 II. The compound is a hydrocarbon.  
 III. The compound has a higher boiling point than methane.

Which of the above statements are correct?

- A Only I  
 B I and II  
 C II and III  
 D I, II and III

(2)

1.4 The following equation represents the chemical reaction of the dissociation of pure distilled water:



How will the pH and the acid-base properties of distilled water be affected if the temperature of the water is increased?

|   | pH               | Acid-base properties |
|---|------------------|----------------------|
| A | Decreases        | Becomes acid         |
| B | Decreases        | Remains neutral      |
| C | Remains the same | Remains neutral      |
| D | Increases        | Becomes alkaline     |

(2)

1.5 A standard zinc / copper cell is set up with a salt bridge containing a concentrated potassium nitrate ( $KNO_3$ ) solution. The electrolytes are zinc sulphate ( $ZnSO_4$ ) and copper sulphate ( $CuSO_4$ ). After the reaction has been allowed to continue for an extended period of time, the salt bridge was found to contain ...

- A  $K^+$  and  $NO_3^-$  ions.  
 B  $K^+$ ,  $NO_3^-$  and  $SO_4^{2-}$  ions.  
 C  $K^+$ ,  $NO_3^-$  and  $Zn^{2+}$  ions.  
 D  $K^+$ ,  $NO_3^-$ ,  $SO_4^{2-}$  and  $Zn^{2+}$  ions.

(2)

1.6 The following reaction is given.



The correct conjugate acid-base pair is given as:

- A  $HC_2O_4^-(aq)$  and  $H_2O(l)$   
 B  $HC_2O_4^-(aq)$  and  $H_3O^+(aq)$   
 C  $HC_2O_4^-(aq)$  and  $C_2O_4^{2-}(aq)$   
 D  $H_2O(l)$  and  $C_2O_4^{2-}(aq)$

(2)

1.7 The equilibrium constant for the gas phase reaction given below is 230 at 300°C.

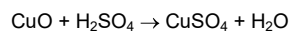


Which one of the following statements is true for this reaction at equilibrium?

- A Only reactants are present.
- B Only products are present.
- C The concentration of reactants is high.
- D The yield of products is high.

(2)

Consider the following chemical reaction:

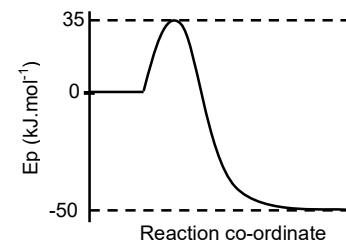
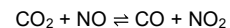


In this reaction copper(II)oxide (CuO) acts as ...

- A a base.
- B an acid.
- C a reducing agent.
- D an oxidising agent.

(2)

1.9 The graph below shows the change in potential energy for the reaction:



The activation energy in  $\text{kJ}\cdot\text{mol}^{-1}$  for the reverse reaction is ...

- A 35.
- B 50.
- C 85.
- D 15.

(2)

1.10 Which ONE of the following statements about the extraction process of aluminium is TRUE?

- A The aluminium ion is oxidised.
- B Aluminium forms at the anode.
- C The aluminium oxide ore is called bauxite.
- D Carbon dioxide gas forms at the cathode.

(2)  
[20]

**QUESTION 2 (Start on a new page.)**

2.1 Consider the condensed structural formulae of the organic compounds below.

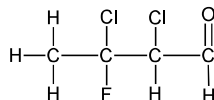
|   |                                                       |   |                                                               |
|---|-------------------------------------------------------|---|---------------------------------------------------------------|
| A | $\text{H}_3\text{C}-\text{CH}=\text{CH}_2$            | B | $\text{H}_3\text{C}-\text{CH}_2-\text{OH}$                    |
| C | $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{OH}$    | D | $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{O}-\text{CH}_3$ |
| E | $\text{H}_3\text{C}-\text{CH}(\text{OH})-\text{CH}_3$ | F | $\text{H}_3\text{C}-\text{C}(\text{OH})(\text{CH}_3)_2$       |

Write down the letter that represents a substance that ...

- 2.1.1 is an unsaturated compound. (1)
- 2.1.2 will react with a halogen by means of an addition reaction. (1)
- 2.1.3 can be used for the preparation of methyl ethanoate. (1)
- 2.1.4 is a primary alcohol. (1)
- 2.1.5 when produced, needs sulphuric acid as a catalyst. (1)

2.2 Draw the structural formula of 2,4-dimethylhexan-3-one. (3)

2.3 Write down the correct IUPAC name of the following compound:



(3)  
[11]

**QUESTION 3 (Start on a new page.)**

3.1 Write down the name of the homologous series to which each of the following compounds belong.

3.1.1  $\text{C}_5\text{H}_{10}\text{O}_2$  (1)

3.1.2  $\text{CH}_3\text{COCH}_3$  (1)

3.2 3.2.1 Define the term *chain isomer*. (2)

3.2.2 Write down the structural formula and IUPAC names of the 3 isomers of  $\text{C}_4\text{H}_8$ . (6)

3.3 The compound responsible for the fruity scent in pineapples, butyl pentanoate, is prepared in a laboratory.

Write down the ...

3.3.1 IUPAC names of TWO compounds needed for this preparation. (2)

3.3.2 type of reaction that takes place. (1)

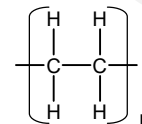
3.4 The boiling points of two compounds are given below.

| Compound         | Boiling point, °C |
|------------------|-------------------|
| butyl pentanoate | 185,8             |
| butyl butanoate  | 166,0             |

Explain why the boiling point of butyl pentanoate is higher than that of butyl butanoate. Refer to relative strengths of intermolecular forces and energy. (3)

3.5 Explain the difference between *addition polymerisation* and *condensation polymerisation*. (4)

3.6 Consider the structural formula of a part of a polymer as shown below.



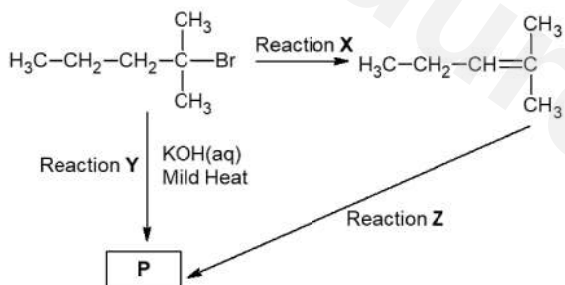
Write down the IUPAC name of ...

3.6.1 this polymer. (1)

3.6.2 the monomer used to prepare this polymer. (1)  
[22]

**QUESTION 4 (Start on a new page.)**

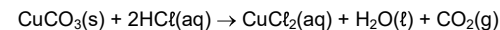
In the flow diagram below, **X**, **Y** and **Z** represent three different types of organic reactions. **P** represents an organic compound.



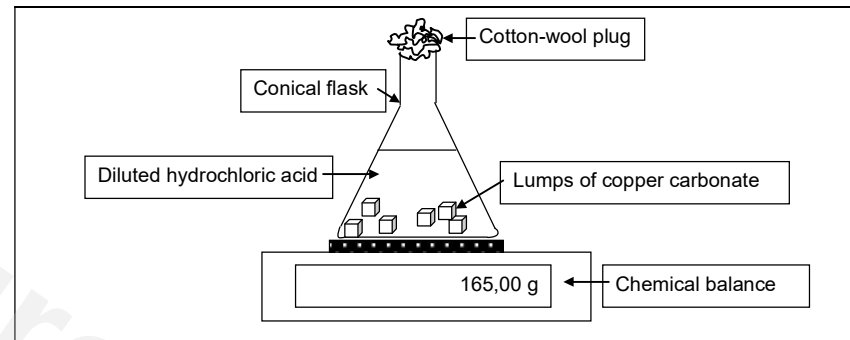
- 1 Name the type of reaction represented by **X**. (1)
  - 2 State TWO reaction conditions needed for reaction **X**. (2)
  - 3 Reaction **Y** represents a substitution reaction. Write down the structural formula of the organic compound **P**, formed in this reaction. (3)
  - 4 Apart from the organic reactant, write down the NAME or FORMULA of the other reactant needed in reaction **Z**. (1)
  - 5 Name the type of reaction represented by **Z**. (1)
- [8]**

**QUESTION 5 (Start on a new page.)**

Copper(II)carbonate reacts with diluted hydrochloric acid as given in the reaction below.

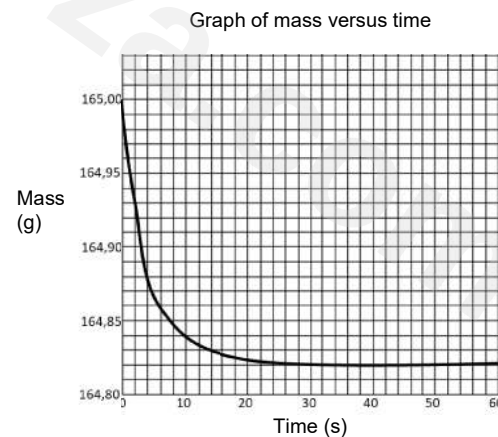


A learner used the apparatus shown below.



- 5.1 Supply a reason why a cotton-wool plug is placed in the mouth of the conical flask. (1)

The experiment was carried out using a 0,50 g sample of pure copper(II)carbonate. The graph below shows the results obtained:



- 5.2 For this sample of pure copper(II)carbonate, calculate the average reaction rate, in  $\text{g}\cdot\text{s}^{-1}$ , for the first 10 seconds. (3)

5.3 The experiment is repeated under the same conditions using a sample of 0,5 g of impure copper(II)carbonate. The data obtained is given below.

|                      |        |        |        |        |        |        |        |        |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Time (s)             | 0      | 4      | 6      | 8      | 12     | 20     | 40     | 60     |
| Decrease in mass (g) | 165,00 | 164,90 | 164,88 | 164,87 | 164,86 | 164,85 | 164,85 | 164,85 |

5.3.1 Draw a line graph showing the change in mass of the impure copper(II)carbonate versus the time.

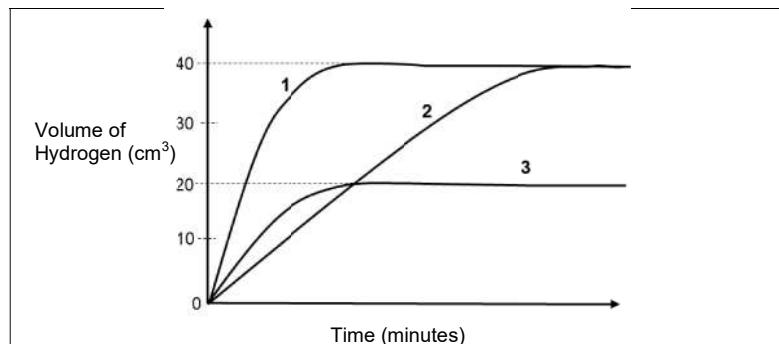
Use the attached ANSWER SHEET to answer this question. (3)

5.3.2 This experiment is repeated with hydrochloric acid that has been heated. Explain in terms of the collision theory how the rate of this reaction will be affected. (4)

5.4 A learner performed three experiments in which zinc reacted with an excess of a 1 mol·dm<sup>-3</sup> hydrochloric acid solution.

In ALL three experiments, the learner kept the initial temperature the same and used the same volume of a 1 mol·dm<sup>-3</sup> hydrochloric acid solution.

The graph below shows the results for each of the experiments 1, 2 and 3.



5.4.1 In which experiment did the reaction take the longest to complete? Choose from 1, 2 or 3. (1)

5.4.2 Suggest ONE factor that could have been changed from experiment 1 to produce the results in experiment 2. (1)

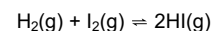
5.4.3 1 g of zinc was used in experiment 1. What mass of zinc was used in experiment 3? (No calculation required.) (1)

[14]

P.T.O.

### QUESTION 6 (Start on a new page.)

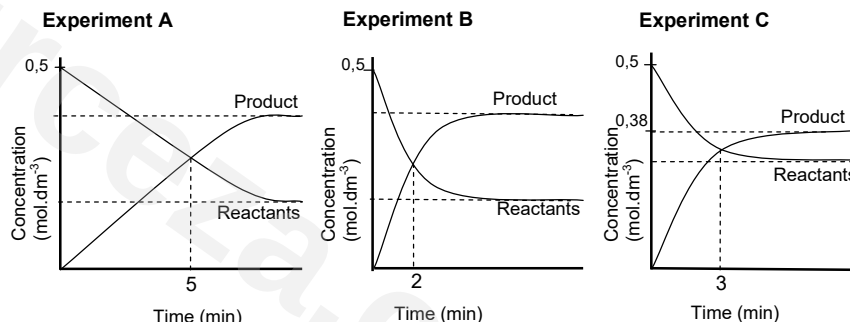
Consider the following reversible reaction represented below in a closed container.



Three experiments were done under different conditions as shown in the table below. In each case 0,5 mol H<sub>2</sub> and 0,5 mol I<sub>2</sub> reacted in a 1 dm<sup>3</sup> container.

| GRAPH | CONDITIONS                        |
|-------|-----------------------------------|
| A     | 500°C                             |
| B     | 500°C; different condition from A |
| C     | 600°C; same conditions as A       |

The sketch graphs of the concentration versus time for the three experiments are shown below.



6.1 What condition changed in experiment B? (1)

6.2 Explain your answer to Question 6.1. (2)

6.3 Refer to the graphs of experiment A and C. Is the forward reaction ENDOTHERMIC or EXOTHERMIC? (1)

6.4 Use Le Chatelier's principle and explain your answer to Question 6.3. (3)

6.5 At equilibrium, 0,3 mol·dm<sup>-3</sup> H<sub>2</sub> is present in the container at a temperature of 500°C. Use the data given to calculate the equilibrium constant at 500°C. (6)

6.6 Will the K<sub>c</sub> value be HIGHER THAN, LOWER THAN or REMAIN THE SAME at a temperature of 600°C? (1)

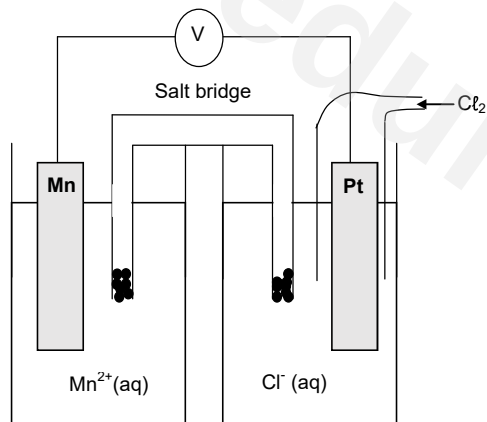
6.7 Explain your answer to Question 6.6. (2)

[16]

P.T.O.

**QUESTION 7 (Start on a new page.)**

An electrochemical cell is set up as shown in the diagram below.

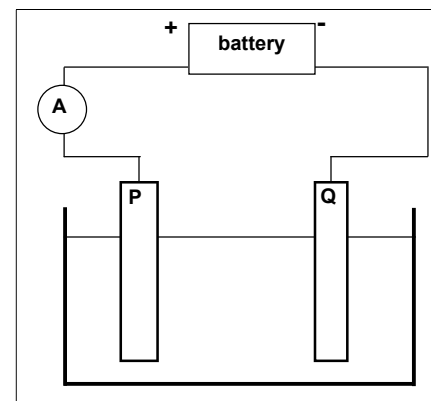


- 7.1 Write down the values of the standard conditions that apply to the  $\text{Cl}_2/\text{Cl}^-$  half-cell. (3)
  - 7.2 For this cell, write down the equation for the ...
    - 7.2.1 oxidation half reaction. (2)
    - 7.2.2 net reaction of the cell. (3)
  - 7.3 Write down the cell notation for this cell. (3)
  - 7.4 Write down the FORMULA of a possible electrolyte that can be used in the  $\text{Mn}/\text{Mn}^{2+}$  half-cell. (1)
  - 7.5 Write down the NAME or FORMULA of the oxidising agent in this cell. (1)
  - 7.6 Calculate the initial reading on the voltmeter when this cell functions under standard conditions. (3)
- [16]**

P.T.O.

**QUESTION 8 (Start on a new page.)**

The diagram below represents an electrochemical cell. The electrodes of the cell are labeled **P** and **Q**.



- 8.1 8.1.1 Which electrode, **P** or **Q**, is the anode in this cell? (1)
  - 8.1.2 Give a reason for your answer to Question 8.1.1. (1)
  - 8.2 This cell is used to plate an iron coin with nickel. The iron coin is connected to a steel electrode while the other electrode is a nickel electrode.
    - 8.2.1 Write down the FORMULA of the ION that can be used as an oxidising agent in this cell. (1)
    - 8.2.2 To which electrode, **P** or **Q**, is the iron coin attached? (1)
    - 8.2.3 At which electrode does reduction occur? Choose from **P** or **Q**. (1)
    - 8.2.4 Write down the half-reaction that will occur at the electrode mentioned in Question 8.2.3. (2)
    - 8.2.5 The anode of this cell is a nickel electrode. How does the concentration of the electrolyte change during the functioning of the cell? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)
    - 8.2.6 Explain your answer to Question 8.2.5. (2)
- [10]**

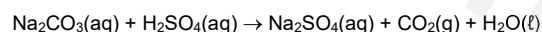
P.T.O.

**QUESTION 9 (Start on a new page.)**

- 9.1 Washing soda contains sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) as its most important constituent.

Learners used 5,13 g of the washing soda crystals to prepare a  $250 \text{ cm}^3$  solution in distilled water. They titrated  $25 \text{ cm}^3$  of the sodium carbonate solution with  $36 \text{ cm}^3$  of a  $0,05 \text{ mol} \cdot \text{dm}^{-3}$   $\text{H}_2\text{SO}_4$  solution to neutralise the solution.

The balanced equation for the reaction is:



- 9.1.1 Define an *ampholyte*. (2)
- 9.1.2 Identify which ONE of the compounds in the equation above CAN act as an ampholyte. (1)
- 9.1.3 Calculate the number of moles of sulphuric acid that reacted with the sodium carbonate. (3)
- 9.1.4 Calculate the mass of the sodium carbonate in the washing soda that was used and neutralised during the titration. (4)
- 9.1.5 Calculate the percentage purity of the washing soda sample. (3)

9.2 When  $\text{CO}_3^{2-}$  ions are added to water, the concentration of the hydroxide ions present in the water increases.

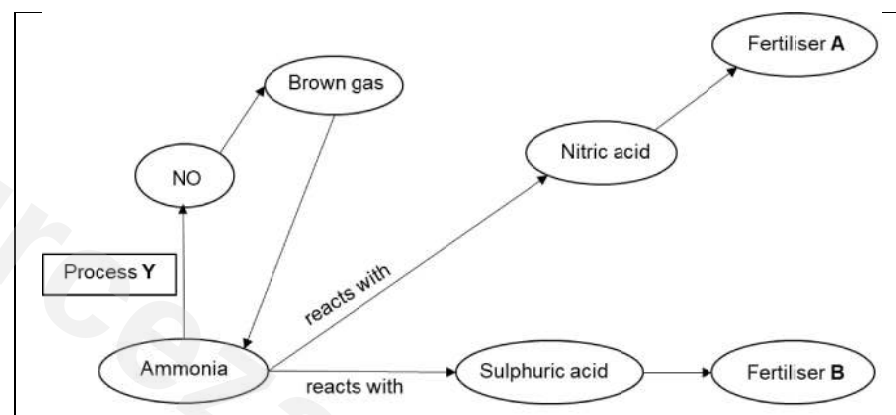
Write down a balanced equation for this reaction between  $\text{CO}_3^{2-}$  and  $\text{H}_2\text{O}$ . (2)  
[15]

**QUESTION 10 (Start on a new page.)**

- 10.1 A fertilizer bag is labelled 2:6:3 (40).

- 10.1.1 Explain the meaning of the value in brackets (40). (1)
- 10.1.2 Name any TWO primary nutrients that are contained in this fertiliser bag. (2)
- 10.1.3 Calculate the percentage mass of nitrogen in this fertiliser bag. (3)

- 10.2 Part of the flow diagram below shows the industrial process used in the production of nitric acid.



- 10.2.1 Write down the NAME or FORMULA of Fertiliser A. (1)
- 10.2.2 Name the process used to make ammonia. (1)
- 10.2.3 Write down the FORMULA of Fertiliser B. (1)
- 10.2.4 Write down the NAME of process Y. (1)
- 10.2.5 Why is it important for fertilisers to be soluble in water? (1)
- 10.2.6 If too much fertiliser is used and it leaches into rivers, what negative effect could this have on rivers and dams? (1)
- 10.2.7 Name TWO reactants needed to produce ammonia. (2)
- 10.2.8 During the manufacturing of  $\text{H}_2\text{SO}_4$  sulphur is burned in air. NAME the product of this combustion reaction. (1)
- 10.2.9 Write down THREE positive impacts of fertilisers on humans. (3)  
[18]

**TOTAL: 150**

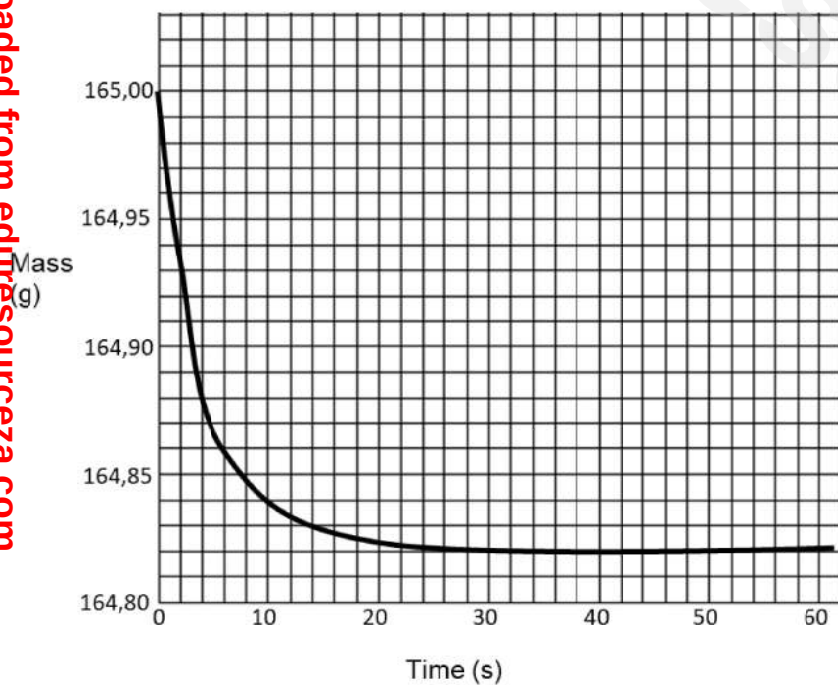
**ANSWER SHEET**

Name: \_\_\_\_\_

Attach this page to your answer book.

**Question 5.3.1**

Graph of mass versus time



**GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATION  
2020**

|                                                  |
|--------------------------------------------------|
| 10842<br>PHYSICAL SCIENCES: CHEMISTRY<br>PAPER 2 |
|--------------------------------------------------|

**TIME:** 3 hours

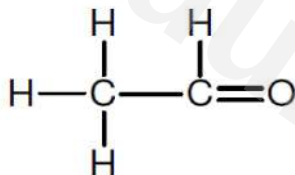
**MARKS:** 150

19 pages + 4 information sheets and an answer sheet

### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK e.g. 1.11 D.

1.1 Consider the structural formula of an organic compound below.



Which of the following is the correct IUPAC name of this compound?

- A Ethanone
- B Ethene
- C Ethanol
- D Ethanal

(2)

Which of the following represents a balanced equation for the combustion of octane?

- A  $2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$
- B  $\text{C}_8\text{H}_{18} + 16\text{O}_2 \rightarrow 8\text{CO}_2 + 9\text{H}_2\text{O}$
- C  $\text{C}_8\text{H}_{18} + 32\text{O}_2 \rightarrow 8\text{CO}_2 + 18\text{H}_2\text{O}$
- D  $2\text{C}_8\text{H}_{18} + 8\text{O}_2 \rightarrow 16\text{CO}_2 + 9\text{H}_2\text{O}$

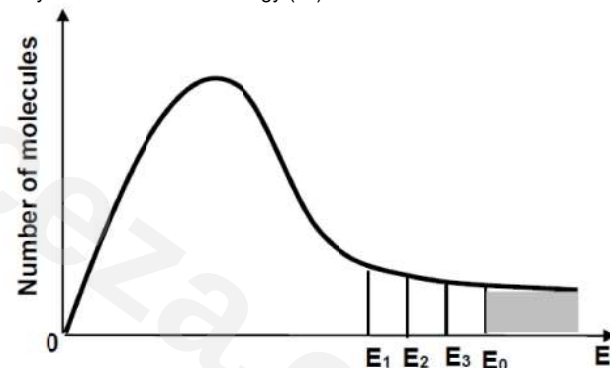
(2)

1.3 Which of the following compounds will decolourise bromine water the fastest under normal conditions?

- A Ethene
- B Ethanal
- C Ethanol
- D Ethane

(2)

1.4 Three catalysts are used separately to increase the rate of a hypothetical reaction. In the diagram below,  $E_1$ ,  $E_2$  and  $E_3$  represent the effect of each catalyst on the activation energy ( $E_0$ ) for the reaction.



Which of the following is the activation energy for the reaction with the HIGHEST rate?

- A  $E_3$
- B  $E_2$
- C  $E_1$
- D  $E_0$

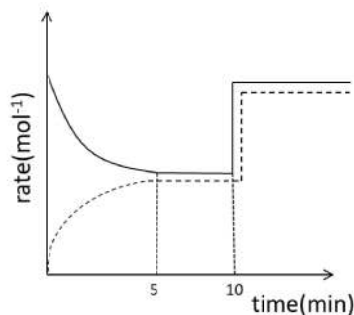
(2)

- 1.5 50 cm<sup>3</sup> of a 0,1 mol·dm<sup>-3</sup> solution of hydrochloric acid is poured on to 5 g granulated zinc which is inside a glass beaker at room temperature. Which of the following factors will **not** increase the initial rate of the reaction?

- A Grinding the granulated zinc into powder
- B Using 30 cm<sup>3</sup> of a 0,2 mol·dm<sup>-3</sup> hydrochloric acid at room temperature
- C Increasing the temperature of the acid solution to 50 °C
- D Using 100 cm<sup>3</sup> of a 0,1 mol·dm<sup>-3</sup> solution of hydrochloric acid at room temperature

(2)

The graph below represents the change in the rate of reaction versus time for the reversible reaction that took place when an amount of hydrogen (H<sub>2</sub>) gas and iodine (I<sub>2</sub>) gas was sealed off in a container. The equation for the reaction is:  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$   $\Delta H < 0$  Equilibrium was first established after 5 minutes.



What change in the conditions was made at 10 minutes to change the rate of the reaction as indicated on the graph?

- A A catalyst was added.
- B The temperature was increased.
- C The temperature was decreased.
- D The external pressure on the reaction mixture was decreased.

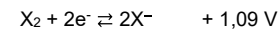
(2)

- 1.7 Consider the four different solutions. Which of these solutions is a dilute weak acid solution?

- A 0,1 mol·dm<sup>-3</sup> HCl solution
- B 5 mol·dm<sup>-3</sup> CH<sub>3</sub>COOH solution
- C 0,5 mol·dm<sup>-3</sup> oxalic acid solution
- D 5 mol·dm<sup>-3</sup> NaOH solution

(2)

- 1.8 The following equations represent two hypothetical half-reactions. The reduction potentials are also provided:



Which one of the following substances from these hypothetical half-reactions will be the strongest oxidising agent?

- A X<sup>-</sup>
- B X<sub>2</sub>
- C Y<sup>+</sup>
- D Y

(2)

- 1.9 Which of the following combinations CORRECTLY shows the products formed during the electrolysis of brine?

|   | ANODE    | CATHODE  |
|---|----------|----------|
| A | Chlorine | Hydrogen |
| B | Hydrogen | Oxygen   |
| C | Oxygen   | Hydrogen |
| D | Hydrogen | Chlorine |

(2)

1.10 Study the diagram below illustrating the industrial production of product C.



Which process is used to produce product C?

- A Fractional distillation of air
- B Oxidation of ammonia
- C Haber process
- D Ostwald process

(2)  
[20]

**QUESTION 2 (Start on a new page.)**

The letters A to F in the table below represent six organic compounds.

|                                                                            |                                          |
|----------------------------------------------------------------------------|------------------------------------------|
| <p><b>A</b></p>                                                            | <p><b>B</b></p>                          |
| <p><b>C</b></p> $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{CH}_3$ | <p><b>D</b></p> <p>Pentyl propanoate</p> |
| <p><b>E</b></p>                                                            | <p><b>F</b></p>                          |

2.1 Write down the letter(s) that represent(s) the following:

- 2.1.1 Alkene (1)
- 2.1.2 A ketone (1)
- 2.1.3 A compound with the general formula  $\text{C}_n\text{H}_{2n-2}$  (1)
- 2.1.4 A structural isomer of octanoic acid (1)

2.2 Write down the IUPAC name of compound:

- 2.2.1 A (2)
- 2.2.2 E (2)
- 2.2.3 F (2)

- 2.3 Compound **D** is prepared by reacting two organic compounds in the presence of an acid as a catalyst.

Write down the:

- 2.3.1 Structural formula of compound **D** (2)
- 2.3.2 IUPAC name of the organic acid used to prepare compound **D**. (1)
- 2.3.3 NAME or FORMULA of the catalyst used (1)
- [14]

**QUESTION 3 (Start on a new page.)**

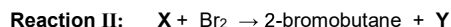
The melting points of four organic compounds, represented by the letters **A**, **B**, **C** and **D**, are given in the table below.

|          | COMPOUND       | MELTING POINT<br>(°C) |
|----------|----------------|-----------------------|
| <b>A</b> | 2-methylhexane | -118                  |
| <b>B</b> | Heptane        | -91                   |
| <b>C</b> | Octan-1-ol     | -16                   |
| <b>D</b> | Octanoic acid  | 16,7                  |

- 3.1 Define the term *melting point*. (2)
- 3.2 Which ONE of **C** or **D** has the higher vapour pressure?  
Give a reason for your answer. (2)
- 3.3 **A** and **B** are structural isomers.
- 3.3.1 Define the term *structural isomer*. (2)
- 3.3.2 Explain why **B** has a higher melting point than **A**. Refer to structure, intermolecular forces, and energy in your explanation (3)
- 3.4 Explain the difference in the boiling points of **C** and **D**. Refer to intermolecular forces and energy in your explanation. (3)
- [12]

**QUESTION 4 (Start on a new page.)**

- 4.1 But-1-ene, an UNSATURATED hydrocarbon, and compound **X**, a SATURATED hydrocarbon, reacts with bromine, as represented by the incomplete equations below.



- 4.1.1 Give a reason why but-1-ene is classified as unsaturated. (1)
- 4.1.2 What type of reaction (ADDITION or SUBSTITUTION) takes place in the following: (1)
- (a) Reaction I (1)
- (b) Reaction II (1)
- 4.1.3 Write down the reaction condition necessary for Reaction II to take place. (1)
- 4.1.4 Write down the IUPAC name of reactant **X**. (1)
- 4.1.5 Write down the name or formula of product **Y**. (1)

2-chlorobutane can either undergo ELIMINATION or SUBSTITUTION in the presence of a strong base such as sodium hydroxide.

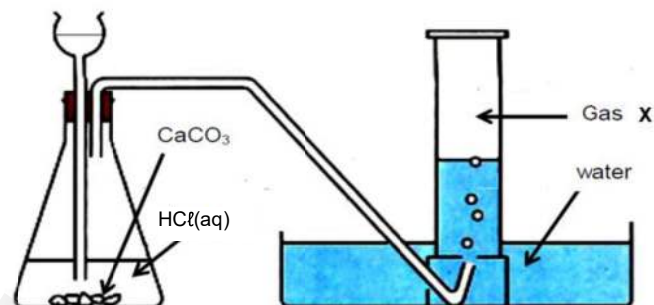
- 4.2.1 Which reaction will preferably take place when 2-chlorobutane is heated in the presence of CONCENTRATED sodium hydroxide in ethanol? Write down only SUBSTITUTION or ELIMINATION (1)
- 4.2.2 Write down the IUPAC name of the major organic compound formed in QUESTION 4.2.1 (2)
- 4.2.3 Use structural formulae to write down a balanced equation for the reaction that takes place when 2-chlorobutane reacts with a DILUTE sodium hydroxide solution. (6)

[15]

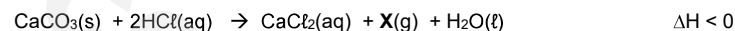
P.T.O.

**QUESTION 5 (Start on a new page.)**

A group of Grade 12 learners uses the reaction between calcium carbonate and hydrochloric acid to investigate one of the factors that influence reaction rate. They use the apparatus shown below.



The reaction that takes place is represented by the following chemical equation:



P.T.O.

5.1 Identify the gas X. (1)

5.2 Two experiments are conducted by using the apparatus shown above. The conditions for each experiment are given in the table below.

| Experiment | Mass of CaCO <sub>3</sub> (s)(g) | State of division of CaCO <sub>3</sub> (s) | Concentration of HCl (mol·dm <sup>-3</sup> ) | Temperature of HCl(aq)(°C) |
|------------|----------------------------------|--------------------------------------------|----------------------------------------------|----------------------------|
| 1          | 4                                | lumps                                      | 0,2                                          | 40                         |
| 2          | 4                                | lumps                                      | 0,4                                          | 40                         |

5.2.1 Define, in words, the term *reaction rate* in terms of THIS investigation. (2)

5.2.2 From the table above, write down the independent variable for this investigation. (1)

5.2.3 Give a reason why the learners must use equal masses and the same state of division of CaCO<sub>3</sub>(s). (1)

5.3 The learners observe that the reaction rate is HIGHER in **experiment 2** than in **experiment 1**.

5.3.1 Use the collision theory to explain this observation (4)

5.3.2 Refer to **experiment 2** and calculate the volume of hydrochloric acid (in cm<sup>3</sup>) that reacts with CaCO<sub>3</sub>(s). Assume that CaCO<sub>3</sub> is the LIMITING REAGENT. (4)

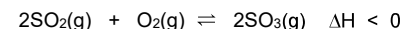
Sketch a POTENTIAL ENERGY versus REACTION COORDINATE graph for this reaction. Label the axes and indicate the following on the graph:

- (a) Heat of reaction
- (b) Activation energy
- (c) Activated complex

(4)  
[17]

#### QUESTION 6 (Start on a new page.)

The following equation represents a key reaction in the preparation of sulphuric acid:



The process of the reaction is controlled in such a way that the temperature inside the container remains between 370°C and 550°C at all times.

6.1 What is represented by the double arrow in the equation? (1)

6.2 Why is this reaction known as the contact process? (1)

6.3 Explain why the temperature is preferably not

6.3.1 lower than 370°C. (2)

6.3.2 higher than 550°C. (3)

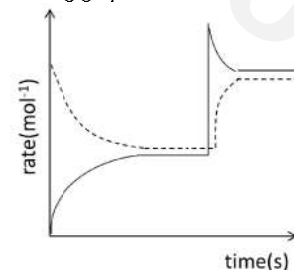
6.4 For the process above, the following information is obtained from the analysis of the equilibrium mixture at 400°C:

Volume of the container = 200 dm<sup>3</sup>  
Initial quantity of SO<sub>2</sub> = 50 mol  
Equilibrium quantity of SO<sub>3</sub> = 22 mol  
K<sub>c</sub> at 400°C = 7,328

Use the above information to calculate the initial mass of oxygen that was used for this reaction. (7)

6.5 The temperature for the process above is increased to 500°C.

Consider the following graph

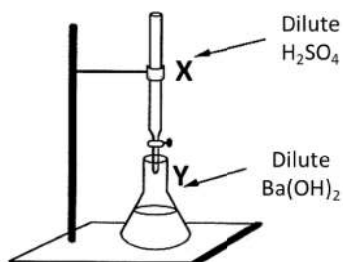
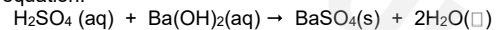


Which reaction, FORWARD or REVERSE, is represented by the dotted line? (2)  
[16]

**QUESTION 7 (Start on a new page.)**

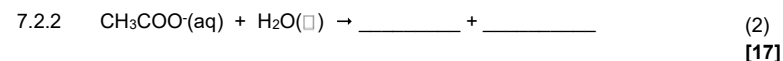
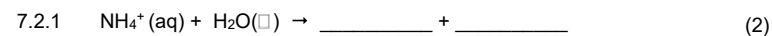
- 7.1 The following apparatus is used for the titration of a dilute alkali ( $\text{Ba(OH)}_2$ ) with a dilute acid ( $\text{H}_2\text{SO}_4$ ).

Balanced equation:



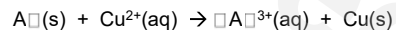
- 7.1.1 What type of reaction takes place when an acid is added to an alkali? (1)
- 7.1.2 Write down the name of the dilute alkali. (1)
- 7.1.3 Name the pieces of apparatus labelled X. (1)
- 7.1.4 Methyl orange is used as an indicator. What will you **observe** in Y, when the acid is added, before the endpoint is reached? (2)
- 7.1.5 State whether each of the following INCREASES, DECREASES or REMAINS CONSTANT, while the acid is being added before the endpoint is reached. (3)
- (a)  $[\text{Ba}^{2+}]$
- (b)  $[\text{OH}^-]$
- (c) pH
- 7.1.6 During the reaction,  $50 \text{ cm}^3$  of the dilute alkali reacts completely with  $30 \text{ cm}^3$  of the dilute acid. Calculate the mass of barium sulphate that will form during the reaction if the concentration of the dilute alkali is  $0,1 \text{ mol} \cdot \text{dm}^{-3}$ . (5)

- 7.2 Two test tubes contain solutions of  $\text{NH}_4\text{Cl}$  and  $\text{CH}_3\text{COONa}$ . Their pH values are less than 7 and greater than 7 respectively. Rewrite the following hydrolysis equations in the ANSWER BOOK and complete them to explain this behaviour.



### QUESTION 8 (Start on a new page.)

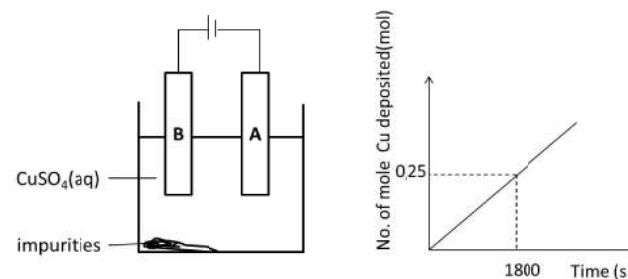
A pupil sets up an electrochemical cell based on the following reaction:



- 8.1 Identify the type of electrochemical cell represented by this reaction. (1)
- 8.2 Represent this cell by writing its cell notation. (3)
- 8.3 Do the electrons in the external circuit flow from the Al- to the Cu- electrode or from the Cu- to the Al- electrode? (1)
- 8.4 For this cell, write down the half reaction that take place at the anode. (2)
- 8.5 Calculate the initial emf of the cell under standard conditions. (4)
- 8.6 5 g of  $\text{Al}(\text{C}_2\text{O}_4)_3$  is dissolved in the aluminium half-cell of the standard cell. (4)
- 8.6.1 What will be the effect on the cell potential? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)
- 8.6.2 Explain your answer to QUESTION 8.6.1. (3)
- 8.7 What energy conversion takes place when the cell is in operation? (1)
- [16]**

### QUESTION 9 (Start on a new page.)

High purity copper is obtained by electrolysis using a thin, pure copper cathode and an ACIDIFIED solution of copper (II) sulphate.



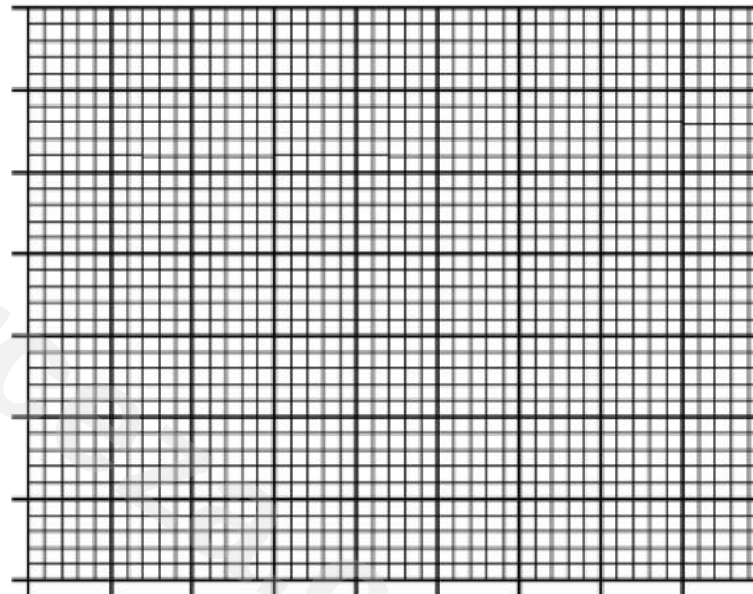
- 9.1 At which electrode would pure copper be deposited? Write only **A** or **B**. (1)
- 9.2 Write down the reduction half-reaction for this cell. (2)
- 9.3 Use the graph to calculate the percentage purity of the impure copper that was used as the anode. The mass of the impurities formed in an hour is 15,8 g when a constant current is used. (4)
- 9.4 The copper (II) sulphate is an electrolyte and the concentration remains constant for the duration of the reaction. (2)
- 9.4.1 Define an electrolyte. (2)
- 9.4.2 Explain why the concentration of the solution remains constant. (1)
- [10]**

**QUESTION 10 (Start on a new page.)**

The use of fertilizer in the agricultural industry is very important. Research has proven that the yield of maize has increased many times by the application of fertilizer to the soil.

- 10.1 Fertilizer contains three primary nutrients.
- 10.1.1 Name the three primary nutrients. (3)
- 10.1.2 Which ONE of the three nutrients is neither produced nor mined in South Africa? (1)
- 10.1.3 One of the primary nutrients is mined in South Africa. State the mineral form in which it is found. (1)
- 10.1.4 Name an industrial process by which the third primary nutrient (not mentioned in 10.1.2 and 10.1.3) is made available as fertilizer. (1)
- 10.2 The use of fertiliser has one important negative effect, called "eutrophication". Define *eutrophication*. (2)
- 10.3 A farmer plans to plant maize. His research shows that he needs 18 kg of N, 3 kg of P and 3,25 kg K in the soil to produce 1 ton of maize per hectare. A fertilizer company advises him to either use 100 kg of **Fertilizer A** that has an NPK ratio of 4:1:1 (36) or 2 packs of 50 kg of **Fertilizer B** that has an NPK ratio of 7:2:2 (15). Do the necessary calculations to advice the farmer on which fertilizer he should buy to avoid over nutrition of the plants. (5)
- [13]**
- TOTAL: 150**

Name: \_\_\_\_\_



END

## PREPARATORY EXAMINATION

### 2014

### MEMORANDUM

|                 |                                    |
|-----------------|------------------------------------|
| <b>SUBJECT:</b> | <b>PHYSICAL SCIENCE P2 (10842)</b> |
|-----------------|------------------------------------|

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 2.15 | $  \begin{array}{c} \text{H} & \text{H} & & \text{H} \\   &   & &   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} & & + & \text{H}-\text{O}-\text{C}-\text{C}-\text{H} \\   &   & &   \\ \text{H} & \text{H} & & \text{H} \end{array} \xrightarrow{\text{Conc. H}_2\text{SO}_4}  $                                                                                                                                                                          | (4) |
| 2.16 | $  \begin{array}{c} \text{H} & \text{H} & & \text{O}^\ominus \\   &   & &    \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   &   & & \\ \text{H} & \text{H} & & \text{H} \end{array}  $                                                                                                                                                                                                                                                                  | (2) |
| 2.17 | $\text{C}_4\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ (products) ✓balancing                                                                                                                                                                                                                                                                                                                                                     | (3) |
| 2.18 | Combustion/oxidation                                                                                                                                                                                                                                                                                                                                                                                                                                          | (1) |
| 2.21 | Chain isomers are compounds with the same molecular formula ✓ but the carbon atoms in the chain change position ✓ to form different arrangements/structural formulae.                                                                                                                                                                                                                                                                                         | (2) |
| 2.22 | $  \begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\   &   &   &   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H}^\ominus \\   &   &   &   \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}  $ <p>butane ✓</p> $  \begin{array}{c} \text{H} & \text{C}=\text{H} \\   &   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H}^\ominus \\   &   &   \\ \text{H} & \text{H} & \text{H} \end{array}  $ <p>methylpropane ✓</p>           | (4) |
| 2.23 | Butane ✓                                                                                                                                                                                                                                                                                                                                                                                                                                                      | (1) |
| 2.24 | Butane is less branched/ has a longer chain/ has a larger surface area. ✓ There are stronger intermolecular forces/ Van der Waals forces between the molecules. ✓ More energy needed to overcome intermolecular forces. ✓<br><b>OR</b><br>2-methyl propane is more branched/ more spherical/ has a shorter chain/ has a smaller surface area. ✓ Weaker intermolecular forces/ Van der Waals forces. ✓ Less energy needed to overcome intermolecular forces. ✓ | (3) |
| [24] |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |

3

10842/14

GAUTENG DEPARTMENT OF EDUCATION  
 PREPARATORY EXAMINATION  
 PHYSICAL SCIENCE  
 (Second Paper)  
 MEMORANDUM

10842/14

|                          |      |     |
|--------------------------|------|-----|
| <b>QUESTION 1/VRAG 1</b> |      |     |
| 1.1                      | B ✓✓ | (2) |
| 1.2                      | A ✓✓ | (2) |
| 1.3                      | C ✓✓ | (2) |
| 1.4                      | D ✓✓ | (2) |
| 1.5                      | D ✓✓ | (2) |
| 1.6                      | C ✓✓ | (2) |
| 1.7                      | C ✓✓ | (2) |
| 1.8                      | B ✓✓ | (2) |
| 1.9                      | C ✓✓ | (2) |
| 1.10                     | A ✓✓ | (2) |
| <b>[20]</b>              |      |     |

|                          |                 |     |
|--------------------------|-----------------|-----|
| <b>QUESTION 2/VRAG 2</b> |                 |     |
| 2.1.1                    | Ketone ✓        | (1) |
| 2.1.2                    | D ✓             | (1) |
| 2.1.3                    | Chloroethane ✓  | (1) |
| 2.1.4                    | Ethanoic acid ✓ | (1) |

|                          |                                                                                                                                                                                        |     |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>QUESTION 3/VRAG 3</b> |                                                                                                                                                                                        |     |
| 3.1.1                    | Addition/ Halogenation/ Bromination ✓                                                                                                                                                  | (1) |
| 3.1.2                    | $  \begin{array}{c} \text{H} & \text{Br} & \text{H}^\ominus \\   &   &   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   &   &   \\ \text{H} & \text{H} & \text{H} \end{array}  $ | (2) |
| 3.1.3                    | Yes ✓                                                                                                                                                                                  | (1) |
| 3.2.1                    | Addition/ Hydration ✓                                                                                                                                                                  | (1) |
| 3.2.2                    | Propan-2-ol ✓✓                                                                                                                                                                         | (2) |
| 3.2.3                    | Alcohol/Alkanol ✓                                                                                                                                                                      | (1) |
| 3.3.1                    | Cracking is the breaking up of large organic molecules into smaller useful molecules. ✓✓                                                                                               | (2) |
| 3.3.2                    |                                                                                                                                                                                        |     |
| 3.4.1                    | $  \begin{array}{c} \text{CH}_3 & & \text{CH}_3 \\   & &   \\ \text{H}_3\text{C}-\text{C}-\text{CH}_3 \\   & &   \\ \text{CH}_3 & & \text{CH}_3 \end{array}  $                         | (2) |
| 3.4.1                    | $  \begin{array}{c} \text{H} & \text{H} \\   &   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   &   \\ \text{H} & \text{H} \end{array}  $                                                 | (2) |
| 3.4.2                    | B ✓                                                                                                                                                                                    | (1) |
| 3.4.3                    | Plastic bags, squeeze bottles, cling wrap, bullet-proof vests. ✓                                                                                                                       | (1) |
| <b>[16]</b>              |                                                                                                                                                                                        |     |

|                          |                                                                                                                                                                                                                                            |     |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>QUESTION 4/VRAG 4</b> |                                                                                                                                                                                                                                            |     |
| 4.1                      | temperature ✓                                                                                                                                                                                                                              | (1) |
| 4.2                      | Rate of reaction ✓                                                                                                                                                                                                                         | (1) |
| 4.3                      | Rate = gradient of graph ✓ = 60-0/30-0 ✓ = 2 cm <sup>3</sup> s <sup>-1</sup> ✓                                                                                                                                                             | (3) |
| 4.4                      | Less than ✓                                                                                                                                                                                                                                | (1) |
| 4.5                      | The rate of change (or gradient) is less ✓                                                                                                                                                                                                 | (1) |
| 4.6                      | decrease ✓                                                                                                                                                                                                                                 | (1) |
| 4.7                      | As the surface area increases, there are more particles available for reacting ✓ Thus there will be more collisions per second, and thus a greater number of effective collisions per second ✓ and thus the reaction rate will increase. ✓ | (3) |

|     |                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                         |     |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 4.8 | $n(\text{Mg}) = m/M$<br>$= 20/24$<br>$= 0.833$ moles<br>$n(\text{H}_2\text{SO}_4) = x \text{ V}$<br>$= 0.1$ moles<br>$0.1$ moles of $\text{Mg}$ will react with $0.1$ moles of sulphuric acid<br>$n_{\text{Mg}} \text{ left} = 0.83 - 0.1 = 0.733$ moles<br>$\text{thus mass of Mg} = n \times M = 0.733 \times 24 = 17.6 \text{ g}$ | <b>Alt. Method</b><br>$24 \text{ g Mg reacts with } 1 \text{ mol H}_2\text{SO}_4$<br>$\therefore x \text{ g} \rightarrow 0.1 \text{ mol}$<br>$x = 2.4 \text{ g}$<br>$\text{mass left} = 20 - 2.4$<br>$= 17.6 \text{ g}$ |     |
|     | <b>Option 1</b><br>$\checkmark$ mass $\rightarrow$ mole<br>$\checkmark$ relationship<br>$\checkmark$ $x \text{ g} - 0.1 \text{ mole}$<br>$\checkmark$ subtraction<br>$\checkmark$ answer                                                                                                                                             | <b>Option 2</b><br>$\checkmark$ mole $\rightarrow$ mole<br>$\checkmark$ relationship<br>$\checkmark$ subtraction<br>$\checkmark$ substitution<br>$\checkmark$ answer                                                    | (5) |

|     |                                                                                                                        |             |
|-----|------------------------------------------------------------------------------------------------------------------------|-------------|
| 4.9 | A substance that increase the rate of a chemical reaction without undergoing permanent change. $\checkmark \checkmark$ | (2)         |
|     |                                                                                                                        | <b>[18]</b> |

## QUESTION 5/VRAG 5

|                                      |                   |                |                            |  |                    |
|--------------------------------------|-------------------|----------------|----------------------------|--|--------------------|
| 5.1                                  |                   |                |                            |  |                    |
| No. of moles                         | $X_2$             | $3Y_2$         | $\rightleftharpoons 2XY_3$ |  |                    |
| Change                               | 1.65 $\checkmark$ | 2 $\checkmark$ | 0                          |  |                    |
| Moles at equm                        | 0.4               | 1.2            | 0.8                        |  | Ratio $\checkmark$ |
| Conc at equm (mol·dm <sup>-3</sup> ) | 1.25              | 0.8            | 0.8 (0.4 x 2)              |  | X 2 $\checkmark$   |
|                                      | 0.625             | 0.4            | 0.4                        |  |                    |

$$K_c = \frac{[\text{XY}_3]^2}{[\text{X}_2][\text{Y}_2]^3}$$

$$= \frac{(0.4)^2}{(0.4)^1 (1.2)^3}$$

$$= \frac{40}{108} = 0.37$$

$$= 0.625 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$\text{No. of mol } X_2 = 1.65 \text{ mol}$$

$$\text{No. of mol } Y_2 = 2 \text{ mol}$$

(9)

MARK ALLOCATION STARTING WITH K<sub>c</sub> calculation and then working back to answer in table.

- Calculation of K<sub>c</sub> (5 marks)
- Moles at equilibrium (1 marks)
- Change (1 marks)
- Initial Moles (2 marks)

5

|       |                                                                                                                                                                                                                                                             |             |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 5.2   | endothermic $\checkmark$                                                                                                                                                                                                                                    | (1)         |
| 5.3   | As temp increases the K <sub>c</sub> increases, [product] increases, indicating the forward reaction is favoured. $\checkmark$ A temperature increase favours the endothermic reaction, thus the forward reaction is the endothermic reaction. $\checkmark$ | (2)         |
| 5.4.1 | increase $\checkmark$                                                                                                                                                                                                                                       | (1)         |
| 5.4.2 | decrease $\checkmark$                                                                                                                                                                                                                                       | (1)         |
| 5.5   | X <sub>2</sub> $\checkmark$                                                                                                                                                                                                                                 | (1)         |
| 5.6   | At a lower temperature the K <sub>c</sub> is smaller indicating fewer products $\checkmark$ and more reactants. $\checkmark$                                                                                                                                | (2)         |
|       |                                                                                                                                                                                                                                                             | <b>[17]</b> |

## QUESTION 6/VRAG 6

|       |                                                                                                                                      |             |
|-------|--------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 6.1   | It is a weak acid $\checkmark$                                                                                                       | (1)         |
| 6.2   | An acid that forms a large no of moles per volume of water $\checkmark \checkmark$                                                   | (2)         |
| 6.3   | $\text{H}_2\text{PO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{PO}_4 + \text{OH}^- \checkmark$                     | (2)         |
| 6.4   | $\text{H}_2\text{O}/\text{OH}^- \checkmark$                                                                                          |             |
|       | or                                                                                                                                   |             |
| 6.5.1 | $\text{H}_2\text{PO}_4^- / \text{HPO}_4^{2-} \checkmark$                                                                             | (1)         |
| 6.5.2 | $m = \text{dm}^3 \times \text{concentration} = 58 \checkmark \times 0.2 \checkmark \times 0.5 \checkmark = 5.8 \text{ g} \checkmark$ | (5)         |
| 6.5.3 | Not safe $\checkmark$                                                                                                                | (2)         |
|       | $[\text{OH}^-] = 0.2 \text{ mol} \cdot \text{dm}^{-3} \checkmark$ positive marking                                                   |             |
|       | $\text{pOH} = -\log[\text{OH}^-] = -\log(0.2) \checkmark = 0.7 \checkmark$                                                           |             |
|       | $\text{pH} + \text{pOH} = 14$                                                                                                        | (5)         |
|       | $\text{pH} = 14 - 0.7 = 13.3 \checkmark$                                                                                             |             |
|       | OR                                                                                                                                   |             |
|       | $[\text{H}^+][\text{OH}^-] = 10^{-14} \checkmark$                                                                                    |             |
|       | $[\text{H}^+](0.2) = 10^{-14} \checkmark$                                                                                            |             |
|       | $[\text{H}^+] = 5 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3} \checkmark$                                                       |             |
|       | $\text{pH} = -\log[\text{H}^+] = -\log(5 \times 10^{-14}) = 13.3 \checkmark$                                                         |             |
| 6.6   | $\rho_{\text{H}_2\text{O}} = \frac{m}{V} \checkmark$                                                                                 |             |
|       | $\rho_{\text{H}_2\text{O}} = \frac{5.8 \text{ g}}{100 \text{ cm}^3} \checkmark$                                                      |             |
|       | $\rho_{\text{H}_2\text{O}} = 0.058 \text{ g} \cdot \text{cm}^{-3} \checkmark$                                                        | (4)         |
|       | $V = 100 \text{ cm}^3 \checkmark$                                                                                                    |             |
|       |                                                                                                                                      | <b>[22]</b> |

## QUESTION 7/VRAG 7

|     |                                                                                                                                                                                                                                    |             |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 7.1 | The cell where a chemical compound is broken down with the aid of an electric current. $\checkmark$ $\text{Al}^{3+}$ and $\text{O}^{2-}$ OR aluminium ion and oxide ion                                                            | (2)         |
| 7.2 | $\text{Al}^{3+} \checkmark$ OR aluminium ion and oxide ion                                                                                                                                                                         | (2)         |
| 7.3 | $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^- \checkmark$                                                                                                                                                                   | (2)         |
| 7.4 | $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al} \checkmark$                                                                                                                                                                    | (2)         |
| 7.5 | $E_{\text{cell}}^{\circ} = E_{\text{cathode/reduction}}^{\circ} - E_{\text{anode/oxidation}}^{\circ}$<br>$= -1.66 \checkmark - (-0.56) \checkmark$<br>$= -1.1 \text{ V} \checkmark$                                                | (4)         |
| 7.6 | $\text{O}^{2-}$ ions in the melt are oxidised to produce $\text{O}_2$ which then reacts with the graphite (carbon) rods to produce $\text{CO}_2$ and so the rods get corroded away and have to be replaced regularly. $\checkmark$ | (1)         |
|     |                                                                                                                                                                                                                                    | <b>[13]</b> |

## QUESTION 8/VRAG 8

|       |                                                                                                                                                                                                                                                                                                                                                                                                                           |             |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 8.1   | The process in which electrons are lost by a substance. $\checkmark \checkmark$                                                                                                                                                                                                                                                                                                                                           | (2)         |
| 8.2   | $\text{Al}^{3+} \checkmark$                                                                                                                                                                                                                                                                                                                                                                                               | (1)         |
| 8.2.2 | $\text{Zn} \checkmark$                                                                                                                                                                                                                                                                                                                                                                                                    | (1)         |
| 8.3   | As reaction proceeds, the $\text{Ag}^+$ ion concentration decreases while the $\text{Zn}^{2+}$ ion concentration increases. According to Le Chatelier's principle, the rate of reverse reaction will increase $\checkmark$ to reduce the increase in product ion concentration, thus favouring the reverse reaction and lowering the forward reaction leading to the decrease in the overall cell potential. $\checkmark$ | (3)         |
| 8.4   | $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al} \checkmark$                                                                                                                                                                                                                                                                                                                                                           | (2)         |
| 8.5   | Chemical to electrical energy $\checkmark$                                                                                                                                                                                                                                                                                                                                                                                | (1)         |
|       |                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>[10]</b> |

## QUESTION 9/VRAG 9

|     |                                                                                                                                       |             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 9.1 | Vanadium pentoxide $\checkmark$                                                                                                       | (1)         |
| 9.2 | $\text{N}_2(\text{g}) + \text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \checkmark$ (reactants) balancing $\checkmark$ | (3)         |
| 9.3 | $22\% \text{ of } 5 \text{ kg} \checkmark = 1.1 \text{ kg}$                                                                           |             |
|     | $7/11 \checkmark \times 1.1 = 0.7 \text{ kg} = 700 \text{ g} \checkmark$                                                              |             |
|     | $n = m/M = 700/14 \checkmark = 50 \text{ moles} \checkmark$                                                                           | (5)         |
| 9.4 | Excess plants block sunlight from aquatic life and organisms die $\checkmark$ / Lack of oxygen. $\checkmark$                          | (1)         |
|     |                                                                                                                                       | <b>[10]</b> |

7



# GAUTENG DEPARTMENT OF EDUCATION PREPARATORY EXAMINATIONS

2015

## MEMORANDUM

|          |                              |
|----------|------------------------------|
| SUBJECT: | PHYSICAL SCIENCES P2 (10842) |
|----------|------------------------------|

GAUTENG DEPARTMENT OF EDUCATION  
PREPARATORY EXAMINATIONS

PHYSICAL SCIENCES  
(Second Paper)  
MEMORANDUM

## QUESTION 1

- 1.1 C✓✓ (2)  
1.2 B✓✓ (2)  
1.3 D✓✓ (2)  
1.4 C✓✓ (2)  
1.5 B✓✓ (2)  
1.6 A✓✓ (2)  
1.7 A✓✓ (2)  
1.8 A✓✓ (2)  
1.9 B✓✓ (2)  
1.10 C✓✓ (2)
- [20]

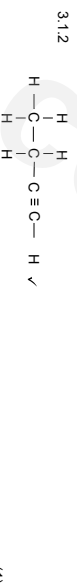
## QUESTION 3

- 2.3.3 Addition / Hydration✓ (1)  
2.4.1 Process by which molecules of two monomers with different functional groups✓ react with the elimination/loss of water molecules. ✓ (2)  
2.4.2 F✓ (1)
- [13]

3.1.1 Organic compounds having the same molecular formula✓ with the same functional group situated at different positions. ✓ or same side chain at different positions

OR

Organic compounds with the same molecular formula ✓ but different positions of the side chain / functional groups. ✓



But -1-yne ✓ /1-butynyl ✓ (1)



But-2-yne ✓ /2-butyne (1)

1

3

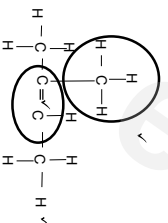
10842/15

10842/15

## QUESTION 2

- 2.1.1 C✓ (1)  
2.1.2 A✓ (1)  
2.2.1 Butanal ✓ (1)  
2.2.2 2-methyl-2-butanol ✓ (2)  
OR 2-methyl-2-butanol  
2.3.1 Water / H<sub>2</sub>O ✓ (1)  
2.3.2 (1)

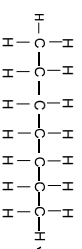
- Correct functional group ✓
- Methyl group on the second carbon ✓
- Whole structure ✓



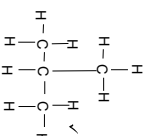
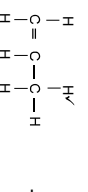
- Notes:**
- Condensed or semi-structural formula:  $\frac{1}{3}$
  - Molecular formula:  $\frac{0}{3}$

(3)

3.2.1



↓



Reactants✓ Products✓✓ (3)

Condensed/semi-structural formulae: Max:  $\frac{2}{3}$

Molecular formula:  $\frac{0}{3}$

Any additional reactant or products: Max:  $\frac{2}{3}$

3.2.2 Propene✓ and methylpropane ✓ (2)

3.3.1 The temperature ✓ at which the vapour pressure of a liquid is equal to the external atmospheric pressure. ✓ OR The temperature ✓ at which a liquid changes phase into the gaseous phase.  $\frac{1}{2}$  (2)

3.3.2

Propan-1-ol has only one hydrogen bond ✓ between its molecules.

Thus, propan-1-ol has weaker intermolecular forces between its molecules. ✓ ∴ Less energy is needed to overcome these intermolecular forces. ✓ thus propan-1-ol has a lower boiling point. **OR**

Propanoic acid has two hydrogen bonds✓ between its molecules.

The intermolecular forces between the propanoic acid molecules are thus stronger ✓ ∴ more energy is needed to overcome these forces. ✓ thus propanoic acid has a higher boiling point. (3)

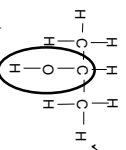
2

4

## QUESTION 4

- 4.1.1 Q: Substitution✓ /halogenation✓/chlorination (1)
- 4.1.2 R: Elimination/ dehydrohalogenation/ dehydrobromination✓ (1)
- 4.2.1 (1)

- Functional group correct
- Whole structure correct



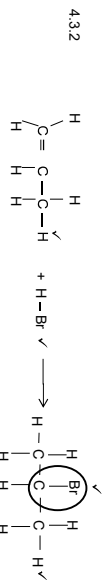
Accept -OH condensed in structural formula

| Condensed/semi-structural formulae | Max: 1/2 |
|------------------------------------|----------|
| Molecular formula                  | 9/2      |

- 4.2.2 Propan-2-ol✓ (1)

2-propanol

- 4.3.1 Hydrogen bromide✓ (1)



|                                      |                                     |
|--------------------------------------|-------------------------------------|
| • Functional group✓                  |                                     |
| • Whole structure correct✓           |                                     |
| Accept HBr                           |                                     |
| Ignore: =                            |                                     |
| • Condensed/semi-structural formulae | Max: 3/4                            |
| • Molecular formula                  | 0/4                                 |
| Any additional reactant or products: | Everything correct, wrong balancing |
| Max: 3/4                             | Max: 3/4                            |

5

(4)  
[10]

10842/15

## QUESTION 5

- 5.1.1 Surface area/state of division/reaction surface✓ (1)
- 5.1.2 There are more particles available for reaction✓ /more collisions. There are a greater number of effective collisions✓ /per unit of time✓ / reaction rate increases (3)

- 5.1.3 Mass of 15% of original 2 g=0.3 g✓  
Number of moles of CaCO<sub>3</sub> 0.3 g✓

$$n = \frac{m}{M}$$

$$= \frac{0.3}{100}$$

$$= 0.003 \text{ mol}$$

$$n_{\text{CaCO}_3} : n_{\text{HCl}}$$

$$1 : 2$$

$$0.003 : 0.006✓$$

$$c_{\text{HCl}} = \frac{n}{V}$$

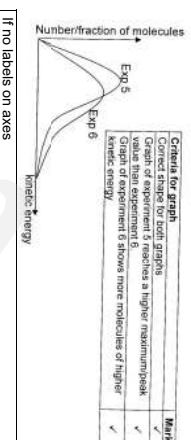
$$0.2 = \frac{0.006}{V}$$

$$V = 0.03 \text{ dm}^3 ✓$$

✓ for both equations

- 5.2.1 Concentration✓ (5)
- 5.2.2 Equal to ✓ (1)
- 5.2.3 The same number of moles/mass/ number of particles of CaCO<sub>3</sub>✓ /produce same number of moles of carbon dioxide/ CaCO<sub>3</sub> is the limiting agent/Acid is in excess. (1)

- 5.3.1 (Experiment 6)✓ (1)
- 5.3.2 (3)



- 5.4.1 exothermic✓ (1)
- 5.4.2 The energy/potential energy of the products is lower than that of the reactants ✓  
OR  
More energy released than absorbed✓ (1)  
OR  
Energy is released [18]

## QUESTION 6

- 6.1 CALCULATIONS USING NUMBER OF MOLES:

Mark allocation:

- USING formula  $n = \frac{3.01 \times 10^{23}}{6.02 \times 10^{23}} ✓$
- Change in  $n(\text{NO})$  = Initial mol – equilibrium mol✓
- Using ratio  $\text{NO(g)} : \text{O}_2(\text{g}) : \text{NO}_2(\text{g}) = 2 : 1 : 2✓$  to determine change in  $n(\text{O}_2)$  and change in  $n(\text{NO}_2)$
- Equilibrium  $[\text{NO}] = \text{equilibrium } n(\text{NO}) / 0.05$
- Equilibrium  $[\text{O}_2] = \text{equilibrium } n(\text{O}_2) / 0.05$
- Equilibrium  $[\text{NO}_2] = \text{equilibrium } n(\text{NO}_2) / 0.05$
- Correct  $K_c$  expression (formulae in [1])✓
- Substitution of concentrations and  $K_c$  value into  $K_c$  expression✓
- $[\text{O}_2]$  at equilibrium✓
- $n(\text{O}_2)$  at equilibrium (x 0.05) ✓
- $n(\text{O}_2)$  initial = n at equilibrium + n change✓

## OPTION 1

$$n(\text{NO}) = 3.01 \times 10^{23} = 5 \times 10^{-3} \text{ mol}$$

$$6.02 \times 10^{23}$$

|                           | NO(g)  | O <sub>2</sub> (g) | NO <sub>2</sub> (g) |
|---------------------------|--------|--------------------|---------------------|
| Initial moles             | 1      | 0.5006✓            | 0                   |
| Change in moles           | 0.995✓ | 0.4975✓            | 0.995               |
| Equilibrium moles         | 0.005  | 0.0031✓            | 0.995               |
| Equilibrium concentration | 0.1    | 0.0615             | 19.9                |

✓ mole ratio  
✓ divide by 0.05

$$K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 [\text{O}_2]}$$

$$6.44 \times 10^5 = \frac{(19.9)^2}{(0.1)^2 [O_2]}$$

$$[O_2] = 0.0615 \text{ mol} \cdot \text{dm}^{-3}$$

[9]

- 6.2 Large  $K_c$  means a high yield of products compared to reactants✓ (1)
- 6.3 Deiter✓ (1)
- 6.4 Temperature is decreased and the reaction will adjust to resist the change. The exothermic reaction is favoured thus the forward reaction✓ is favoured and the contents become diluted✓ (3)
- 6.5 No effect✓ (1)

## QUESTION 7

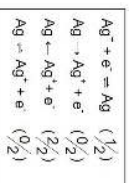
- 7.1 Brønsted-Lowry base accepts a proton✓ (2)
- 7.2.1  $\text{pH} = -\log[\text{H}^+\text{O}^+]$   
 $= -\log(0.12)$   
 $= 0.92$ ✓ (3)
- 7.2.2  $\text{Cl}^-$ ✓ (1)
- 7.3.1 It can act as an acid or a base/ it can accept or donate an  $\text{H}^+$  ion✓ (1)
- 7.3.2  $\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{SO}_4^{2-}$   
 ✓ reactants ✓ products ✓ balancing (3)
- 7.4 Drops of water will change the concentration of the acid/ make it more dilute✓ (1)
- 7.5.1 Option 1:  
 $n = \frac{m}{M}$   
 $= \frac{8.0}{56}$   
 $= 0.14 \text{ mol}$   
 $c = \frac{n}{V}$   
 $= \frac{0.14}{0.25}$   
 $= 0.57 \text{ mol-dm}^{-3}$ ✓ (3)
- Option 2:  
 $c = \frac{m}{MV}$   
 $= \frac{8.0}{56 \times 0.25}$   
 $= 0.57 \text{ mol-dm}^{-3}$ ✓

9

- 7.5.2  $\frac{c_1 V_1}{c_2 V_2} = \frac{n_1}{n_2}$  (dilute acid)  
 $\frac{c_1 (40)}{0.57 (25)} = \frac{1}{2}$   
 OR  
 $c_1 = \frac{1 \times 0.57 \times 25}{2 \times 40}$   
 $= 0.178 \text{ mol-dm}^{-3}$ ✓ (4)
- 7.5.3 **Concentrated acid**  
 $n_1$  (moles concentrated) =  $n_2$  (moles dilute)  
 $c_1 \times V_1 = c_2 \times V_2$   
 $c_1 = \frac{0.178 \times (490 \pm 10)}{10}$   
 $= 8.9 \text{ mol-dm}^{-3}$ ✓ (4)
- OR  
 $c_2 = \frac{1 \times 0.57 \times 0.025}{2 \times 0.04}$   
 $= 0.178 \text{ mol-dm}^{-3}$ ✓

## QUESTION 8

- 8.1 Electrical energy to chemical energy✓ (1)
- 8.2 Cathode✓  
 At cathode,  $\text{Ag}^+$  / silver ions gain electrons✓ and are, reduced to Ag/ silver metal✓ (3)
- 8.3.1 Ag/silver✓ (1)
- 8.3.2  $\text{Ag}^+ + e^- \rightarrow \text{Ag}$ ✓✓ (2)



- 8.4.1 Electrode X becomes eroded/ smaller/ thinner✓ (1)
- 8.4.2 A (silver) layer forms on the metal✓ (1)
- 8.5 The rate at which  $\text{Ag}^+$  / silver ions are reduced at the cathode is equal to rate at which Ag metal/ silver is oxidised at the anode✓✓ (2)

## QUESTION 9

- 9.1 Galvanic✓ cell (1)
- 9.2 There will no reading/ The reading will be zero/ 0V✓ (1)
- 9.3 Temperature ✓ and the initial concentrations of the electrolytes✓  
 But cannot give 25 °C and 1 mol-dm<sup>-3</sup> because the investigation is not carried out under standard conditions because the emf values are not for standard conditions. (2)
- 9.4 The different type of metal/the different half-cells✓ (1)
- 9.5.1 Voltmeter's terminals✓ have been connected incorrectly✓  
 OR  
 Incorrect connection ✓ (+ to anode and – to cathode) ✓ (2)
- 9.5.2 Aluminium is a stronger reducing agent than zinc✓ and zinc is a stronger reducing agent than copper✓ (2)
- 9.6.1 Aluminium/ Al✓ (1)
- 9.6.2 Zinc/ Zn✓ (1)
- 9.7  $2\text{Al}(s) + 3\text{Zn}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Zn}(s)$ ✓ balancing ✓ (1)
- Reactants✓ Products✓ Balancing✓  
 Ignore ⇌  
 Making sure 3e-  
 If only a reactant(s) followed by an arrow, or only a product(s) preceded by an arrow, is/are written, marks may be awarded for the reactant(s) or product(s). If only a reactant(s) or only a product(s) are written, without an arrow, no marks are awarded for the reactant(s) or product(s).  
 Examples:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ ✓ bal. ✓  
 $\text{N}_2 + \text{H}_2 \rightarrow$ ✓  
 $\rightarrow \text{NH}_3$ ✓  
 $\text{N}_2 + \text{H}_2$   
 $\text{NH}_3$  (3)

11

## QUESTION 10

- 10.1.1 Iron oxide/iron/aluminium oxide✓ (1)
- 10.1.2 more collisions per unit time✓  
 greater surface area/greater number of exposed particles✓ (2)
- 10.1.3 Increase the number of moles of  $\text{N}_2$  and  $\text{H}_2$  (reactants)✓ favours the forward reaction✓  
 OR  
 Increase pressure ✓ and thus favours the forward reaction✓ (2)
- 10.2.1 Calcium hydroxide increases the pH/alkalinity of the soil/ reduce the acidity of the soil✓ (2)
- Ammonium sulphate is a fertiliser. ✓ (2)
- 10.2.2 Ammonia gas is formed which will be released and reduce the concentration/number of moles of fertiliser.✓ (1)
- 10.3  $n(\text{XO}) = \frac{m}{M} = \frac{720}{74} = 30 \text{ mol}$ ✓  
 $n(\text{HNO}_3) = n(\text{NO}) = 30 \text{ mol}$ ✓ (3)
- $m(\text{HNO}_3) = nM = (30)(63) = 1890 \text{ g}$ ✓ (1)

TOTAL: 150

# PREPARATORY EXAMINATION 2016 MEMORANDUM

**PHYSICAL SCIENCES: CHEMISTRY (SECOND PAPER) (10842)**  
**FISEIE WETENSKAPPE: CHEMIE (TWEDE VRAESTEL) (10842)**

14 pages

GAUTENG DEPARTMENT OF EDUCATION  
 PREPARATORY EXAMINATION – 2016

**PHYSICAL SCIENCES: CHEMISTRY /**  
**FISEIE WETENSKAPPE: CHEMIE**  
 (Second Paper / Tweede Vraesteel)

10842 / 16

## MEMORANDUM

### QUESTION / VRAAG 1

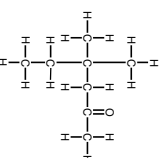
- 1.1 D ✓✓
- 1.2 A ✓✓
- 1.3 D ✓✓
- 1.4 D ✓✓
- 1.5 C ✓✓
- 1.6 C ✓✓
- 1.7 B ✓✓
- 1.8 A ✓✓
- 1.9 A ✓✓
- 1.10 C ✓✓

### QUESTION / VRAAG 2

[20]

- 2.1.1 Saturated / Versadig ✓  
 ANY ONE / ENIGE EEN:  
 • Have ONLY single bonds / Het slegs ENKELE BINDINGE.  
 • Have single bonds between C atoms / Het enkelebindinge tussen koolstofatome.  
 • Have no double OR triple bonds OR multiple bonds / Het geen dubbel OF meervoudige bindinge nie.  
 • Contains the maximum number of H atoms bonded to C atoms / Beskik oor die maksimum aantal H-atome wat aan koolstofatome kan bind. ✓
- 2.1.2 2,3-dimethylbutane ✓  
 2,3-dimethylbutaan (2)

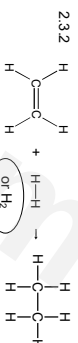
2.2



- Marking criteria / Nasienkriteria:**
- Six C atoms in longest chain with functional group (carbonyl group) on C-2 ✓
  - Two methyl substituents on C-4 ✓
  - Whole structure correct ✓
  - Six C atoms in longest ketting met funksionele groep (karboniel groep) op C-2 ✓
  - Twee metielsubstituentie op C-4 ✓
  - Volledige struktuur korrek ✓

2.3

2.3.1 C<sub>4</sub>H<sub>8</sub> ✓



**Marking criteria / Nasienkriteria:**

- ✓ reactants / reaktante  
 ✓ product / produk  
 ✓ balancing / balansering  
**Rules / Reëls:**  
 Any additional reactant / product / incorrect balancing / arrow omitted  
 Enige addisionele reaktante / produk / verkeerde balansering / pylle uitgeleë
- max 2/3

2.3.3 Hydrolysis / Hidrolise OR / OF Substitution / Vervanging ✓

2.3.4 HBr ✓

2.3.5 E ✓

2.3.6 E – concentrated / gekonsentreerd and / en G – diluted / verdun ✓

OR / OF

Base is more concentrated in reaction E than G. / Basis is meer gekonsentreerd in reaksie E as in G

OR / OF

Base in reaction E is dissolved in ethanol (no water added). / Basis in reaksie E is in etanol opgelos (geen water bygevoeg nie.)

2.3.7 H<sub>2</sub>SO<sub>4</sub>/sulphuric acid / swaetsuur

OR / OF  
 H<sub>3</sub>PO<sub>4</sub> phosphoric acid / fosfoorsuur ✓

(1) [16]

3

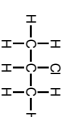
10842 / 16

### QUESTION / VRAAG 3

- 3.1 3.1.1 Aldehyde / Aldehid ✓ (1)
- 3.1.2 Ketone / Kebon ✓ (1)
- 3.2 3.2.1 When molecules have the same molecular formula ✓ but different positions of the side chain, substituents or functional groups on the parent chain. ✓

Molecule met dieselfde molekuleêre formule, maar met verskillende posisies van die sykettings, substituentie of funksionele groepe op die hoofketting. (2)

3.2.2



- Marking criteria / Nasienkriteria:**
- Structure correct / struktuur korrek 2 / 2
  - Any error / enige fout. 0 / 2

3.3 3.3.1 Pentan-1-ol ✓ and butanoic acid ✓

Pentan-1-ol en butanoësuur

3.3.2 Esterification ✓ or acid catalysed condensation. Esterifikasie of suurgekataliseerde kondensasie.

3.4 3.4.1 Polyethene / Polieteen ✓

3.4.2 H – C = C – H



3.4.3 Addition polymer / Addisie polimeer ✓

### QUESTION / VRAAG 4

- 4.1 4.1.1 Type of organic compound / homologous series / functional group ✓
- Type organiese verbinding / homologe reëks / funksionele groep (1)
- 4.1.2 Boiling point / Kookpunt ✓ (1)
- 4.1.3 Relative molecular mass / Relatiewe molekuleêre massa ✓ (1)
- 4.2 LOWER THAN / LAER AS ✓ (1)

 Negative marking from Q.4.2 to Q.4.3  
 Negatiewe nasien vanaf V.4.2 tot 4.3

4.3

**Structure:**  
Compound **A** / Pentane is less branched / no branches / less compact / less spherical / has larger surface area. ✓  
**Intermolecular forces:**  
Stronger / more intermolecular forces / induced dipole forces / London forces / dispersion forces. ✓  
**Energy:**  
More energy needed to overcome / break intermolecular forces. ✓

OR

**Structure:**  
Compound **B** / 2-methylbutane is more branched / more compact / more spherical / has a smaller surface area. ✓  
**Intermolecular forces:**  
Weaker / less intermolecular forces / induced dipole forces / London forces / dispersion forces. ✓  
**Energy:**  
Less energy needed to overcome / break intermolecular forces. ✓

**Struktuur:**

Verbinding **A** / Pentaan het geen sykettings / minder kompak / minder sferies / het groter oppervlakte. ✓

**Intermolekulêre kragte:**

Sterker / meer intermolekulêre kragte / geïnduseerde dipool kragte / London kragte / dispersie kragte. ✓

**Energie:**

Meer energie nodig om intermolekulêre kragte te breek / oorkom ✓

OF

**Struktuur:**

Verbinding **B** / 2-metielbutaan het (meer) sykettings / meer kompak / meer sferiese molekule / het kleiner oppervlakte. ✓

**Intermolekulêre kragte:**

Swakker / minder intermolekulêre kragte / geïnduseerde dipool kragte / London kragte / dispersie kragte. ✓

**Energie:**

Minder energie nodig om intermolekulêre kragte te oorkombreek ✓

4.4



HIGHER THAN / HOËR AS

Negative marking of QUESTION 4.4 to 4.5 / Negatiewe nasien van VRAAG 4.4 na 4.5

(1)

5

10842 / 16

4.5

- (D) propanoic acid has more sites for hydrogen bonding than C / forms dimers / is more polar than C. ✓
- D has stronger / more intermolecular forces / dipole-dipole forces. ✓
- D needs more energy to overcome / break the intermolecular forces. ✓

OR

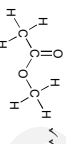
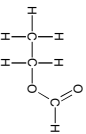
- (C) butanol has less sites for hydrogen bonding than D / forms dimers / is more polar than D. ✓
- C has weaker / less intermolecular forces / dipole-dipole forces. ✓
- C needs less energy to overcome / break the intermolecular forces. ✓

- (D) propaansuur het meer gebiede vir waterstofbindings as C / vorm dimeer / is meer polar as C. ✓
- D het sterker / meer intermolekulêre kragte / dipool-dipool kragte. ✓
- D benodig meer energie om intermolekulêre kragte te oorkom / breek. ✓

OF

- (C) butanol het minder gebiede vir waterstofbinding as D / vorm dimeer / is meer polar as D. ✓
- C het swakker / minder intermolekulêre kragte / dipool-dipool kragte. ✓
- C benodig minder energie om intermolekulêre kragte te oorkom / breek. ✓

4.6

Methyl ethanoate  
Meëtelanoaatethyl methanoate  
eëtelanoaat(4)  
[15]

## QUESTION / VRAAG 5

5.1

**Examples:**

- How will a change in concentration influence the reaction rate?
- What is the relationship between concentration and reaction rate?
- Hoe sal 'n verandering in die konsentrasie die reaksietempo beïnvloed?
- Wat is die verwantskap tussen die konsentrasie en reaksietempo?

**Marking criteria:**

- Identify dependent and independent variables correct / Identifiseer afhanlike en onafhanklike veranderlikes korrek ✓
- Ask a question about the relationship between the variables / Vra vraag oor verwantskap tussen afhanlike en onafhanklike veranderlikes ✓
- If question has a yes/no answer, no marks / Indien die vraag 'n ja/nee antwoord het, geen punte.

(2)

5.2

HNO<sub>3</sub> / Nitric acid / Salpetersuur. ✓

The magnesium is used up / the magnesium is the limiting reagent. ✓

5.3

The magnesium word opgebruik / die magnesium is die beperkende reagens. ✓

5.4

Change in concentration of products / reagents per unit time. ✓

5.5

Verandering in konsentrasie van produkte / reaksie per (eenheids)tyd.

5.6

Rate of change in concentration

5.7

Tempo van verandering in konsentrasie

5.8

Change in amount / number of moles / volume / mass of reactants / products per unit time. ✓

5.9

Verandering in hoeveelheid / aantal / mol / volume / massa van reaktante / produkte per (eenheids)tyd.

5.10

Amount / number of moles / volume / mass of products formed or reactants used per unit time.

5.11

Die hoeveelheid / aantal / mol / volume / massa van produk gevorm of reaktante gebruik per (eenheids)tyd.

5.12

Δn = 1.0 - 0.8 = 0.2 mol

5.13

n =  $\frac{m}{M}$

5.14

0.2 =  $\frac{m}{24}$

5.15

m = 4.8 g

5.16

Average rate / gem. reaksietempo =  $\frac{\Delta m}{\Delta t}$

5.17

=  $\frac{30 - 0g}{4.8s}$

5.18

= 0.16 g s<sup>-1</sup> ✓

5.19

Intercepts x-axis earlier / Snij x-as vroër ✓

5.20

Criteria for marking of graph / nasieningrye:

- Steeper slope below original graph. / Skuinsse/helling onder oorspronklike grafiek ✓
- Intercepts x-axis earlier. / Snij x-as vroër ✓

10842 / 16

(2)

[13]

(3)

(4)

(5)

(6)

(7)

(8)

(9)

(10)

(11)

(12)

(13)

(14)

(15)

(16)

(17)

(18)

(19)

(20)

(21)

(22)

(23)

(24)

(25)

(26)

(27)

(28)

(29)

(30)

(31)

(32)

(33)

(34)

(35)

(36)

(37)

(38)

(39)

(40)

(41)

(42)

(43)

(44)

(45)

(46)

(47)

(48)

(49)

(50)

(51)

(52)

(53)

(54)

(55)

(56)

(57)

(58)

(59)

(60)

(61)

(62)

(63)

(64)

(65)

(66)

(67)

(68)

(69)

(70)

(71)

(72)

(73)

(74)

(75)

(76)

(77)

(78)

(79)

(80)

(81)

(82)

(83)

(84)

(85)

(86)

(87)

(88)

(89)

(90)

(91)

(92)

(93)

(94)

(95)

(96)

(97)

(98)

(99)

(100)

(101)

(102)

(103)

(104)

(105)

(106)

(107)

(108)

(109)

(110)

(111)

(112)

(113)

(114)

(115)

(116)

(117)

(118)

(119)

(120)

(121)

(122)

(123)

(124)

(125)

(126)

(127)

(128)

(129)

(130)

(131)

(132)

(133)

(134)

(135)

(136)

(137)

(138)

(139)

(140)

(141)

(142)

(143)

(144)

(145)

(146)

(147)

(148)

(149)

(150)

(151)

(152)

(153)

(154)

(155)

(156)

(157)

(158)

(159)

(160)

(161)

(162)

(163)

(164)

(165)

(166)

(167)

(168)

(169)

(170)

(171)

(172)

(173)

(174)

(175)

(176)

(177)

(178)

(179)

(180)

(181)

(182)

(183)

(184)

(185)

(186)

(187)

(188)

(189)

(190)

(191)

(192)

(193)

(194)

(195)

(196)

(197)

(198)

(199)

(200)

(201)

(202)

(203)

(204)

(205)

(206)

(207)

(208)

(209)

(210)

(211)

(212)

(213)

(214)

(215)

(216)

(217)

(218)

(219)

(220)

(221)

(222)

(223)

(224)

(225)

(226)

(227)

(228)

(229)

(230)

(231)

(232)

(233)

(234)

(235)

(236)

(237)

(238)

(239)

(240)

- 6.2.2 (a) GREATER THAN / GROTER AS. ✓  
Surface area / state of division is larger in B. / Die oppervlakte area (reaksie oppervlakte / toestand van verdeeldheid) in B is groter. ✓
- (b) Smaller than / Kleiner as. ✓  
The CuCl acts as a catalyst. ✓ for the reaction in test tube D.  
Die CuCl tree as 'n katalisator. ✓ op in proefbuis D.

## QUESTION / VRAAG 7

- 7.1 7.1.1 Exothermic / Eksotermies. ✓

- 7.1.2 Negative marking from QUESTION 7.1.1/ Negatiewe nasien van VRAAG 7.1.1

## Marking criteria / Nasionale riglyne:

- $K_c$  decreases with increase in temperature. /  $K_c$  verminder met verhoging in temperatuur. ✓
- Reverse reaction is favoured. / [reactants] increase and [product] decreases. / Terugwaartse reaksie word bevoordeel / [reaktante] verhoog en [produk] verlaag. ✓
- An increase in temperature favours the endothermic reaction. / 'n Verhoging in temperatuur bevoordeel die endotermiese reaksie. ✓

- 7.1.3 Remains the same / Bly dieselfde. ✓

- 7.1.4 Only a change in temperature has an effect on the equilibrium constant / has an effect on  $K_c$ . / Sleegs 'n verandering in temperatuur beïnvloed waarde van  $K_c$ . ✓

## 7.2

## Marking criteria / Nasionale riglyne:

- $n(\text{O}_2)$  reacted / gereageer =  $n(\text{O}_2)_{\text{eq}} - n(\text{O}_2)_{\text{ini}}$  ✓
- Use ratio / Gebruik verhouding 2 : 2 : 1 ✓
- $n(\text{SO}_2)_{\text{eq}} = n(\text{SO}_2)_{\text{ini}} + n(\text{SO}_2)_{\text{change}} / \text{verandering}$  ✓
- $n(\text{SO}_2)_{\text{eq}} = n(\text{SO}_2)_{\text{ini}} - n(\text{SO}_2)_{\text{change}} / \text{verandering}$  ✓
- $n_{\text{eq}}$  divide by / gedeel deur 2 ✓
- $K_c$  expression / uitdrukking ✓
- Substitute / vervang [ ] into  $K_c$  expression / uitdrukking ✓
- Answer / antwoord: 125 ✓

|                    |                                     |                                  |                                      |
|--------------------|-------------------------------------|----------------------------------|--------------------------------------|
| Initial mol        | 2SO <sub>3</sub>                    | 2SO <sub>2</sub>                 | O <sub>2</sub>                       |
| Amount/mole        | 24                                  | 0                                | 0                                    |
| Change mol         |                                     | 20                               |                                      |
| Verandering in mol |                                     | 20                               |                                      |
| Equilibrium mol    | 24 - 2 (10) = 4 ✓                   | 20                               | 10 ✓                                 |
| Mol by ewig        |                                     |                                  | Use ratio / Gebruik verhouding ✓     |
| Concentration      | $c = \frac{n}{V} = \frac{4}{2} = 2$ | $c = \frac{n}{V} = \frac{20}{2}$ | $c = \frac{n}{V} = \frac{10}{2}$ ✓   |
| Equilibrium        |                                     |                                  |                                      |
| Ewewigskonstantie  |                                     | = 10                             | $c = \frac{n}{V} = \frac{10}{2} = 5$ |

$$K_c = \frac{[\text{SO}_2][\text{O}_2]}{[\text{SO}_3]^2}$$

$$= \frac{(10)^2(5)}{(2)^2}$$

$$= 125 \quad \checkmark$$

(7) [13]

## QUESTION / VRAAG 8

- 8.1 Completes the circuit / allows for the overall charge in the beakers to remain neutral / allows ions to flow between the beakers / electrical neutrality. ✓

- Voltooi die stroombaan / laat toe dat die totale lading in die bekere neutral bly / laat ione vryelik tussen bekere vloei / elektriese neutraliteit. ✓

- 8.2 A galvanic (voltaic cell) converts chemical energy (change) into electrical energy. ✓ whereas in an electrolytic cell, electrical energy is converted into chemical energy (change). ✓

- 'n Galvaniese sel skakel chemiese energie in elektriese energie om, terwyl die elektrolietiese sel elektriese energie in chemiese energie verander.

- 8.3 Pt. ✓

- MnO<sub>4</sub><sup>-</sup> is reduced to Mn<sup>2+</sup> / Reduction takes place. ✓

- MnO<sub>4</sub><sup>-</sup> word na Mn<sup>2+</sup> gereduseer / Reduksie vind plaas. ✓

- 8.4 Fe<sup>2+</sup> (ions/ione) ✓

- 8.5 5Fe<sup>2+</sup>(aq) + MnO<sub>4</sub><sup>-</sup>(aq) + 8H<sup>+</sup>(aq) → 5Fe<sup>3+</sup>(aq) + Mn<sup>2+</sup>(aq) + 4H<sub>2</sub>O(l)

## Notes / Aanmerkings

- Reactants ✓
- Reagents ✓
- Ignore / ignoreer phases / fases
- Marking rule 6.3.10 / Nasionaal 6.3.10
- Products ✓
- Balancing ✓

- 8.6  $E_{\text{cell}} = E_{\text{anode/oxidise}} - E_{\text{cathode}}$  ✓

$$= (+1.51) - (+0.77) \quad \checkmark$$

$$= +0.84 \text{ V} \quad \checkmark$$

(4) [13]

## QUESTION / VRAAG 9

- 9.1 A solution / liquid / dissolved substance that conducts electricity through the movement of ions. / 'n Oplossing / vloeistof / opgeloste stof wat elektrisiteit geleel deur die Beweging van ione. ✓✓

- 9.2 9.2.1 Silver nitrate / silver ethanoate / silver cyanide ✓

- Silwernitraat / silweretanoaat / silwersianied ✓

- 9.2.2 Silver / silwer / Ag ✓

- 9.2.3 Ag<sup>+</sup> + e<sup>-</sup> → Ag ✓✓

- 9.3  $n = \frac{m}{M}$  ✓

$$= \frac{2}{108} \quad \checkmark$$

$$= 1.85 \times 10^{-2} \text{ mol Ag}$$

$$6.02 \times 10^{23} \times 1.85 \times 10^{-2}$$

$$= 1.11 \times 10^{22} \text{ electrons needed / elektrone nodig} \quad \checkmark$$

(4) [10]

## Marking guidelines / Nasionale riglyne:

- Formula / ratio / Formule / verhouding ✓
- Substitute / Vervang M (Ag) = 108 ✓
- Multiply by / Vermenigvuldig met Na. ✓
- Final answer =  $1.11 \times 10^{22}$  electrons (accept  $1.11 \times 10^{22} = 1.12 \times 10^{22}$ ) / Finale antwoord =  $1.11 \times 10^{22}$  elektrone (aanvaar  $1.11 \times 10^{22} = 1.12 \times 10^{22}$ )

**QUESTION / VRAAG 10**

- 10.1  $\text{pH} = -\log[\text{H}^+]$  OR  $\text{pH} = -\log[\text{H}_3\text{O}^+]$  ✓  
 $= -\log(5,6 \times 10^{-9})$  ✓  
 $= 5,25$  ✓ (3)

- 10.2 10.2.1  $c = \frac{n}{V}$  ✓

$$n = cV$$

$$= 1,25 \text{ mol NaOH} \checkmark$$

(3)

**10.2.2 POSTIVE MARKING FROM QUESTION 10.2.1 / POSITIEWE NASIEN VAN VRAAG 10.2.1****Marking guidelines / Nasienriglyne:**

- Substitution into/Vervang in  $c = \frac{n}{V}$  ✓
  - Using ratio/Gebruik verhouding 2.1 ✓
  - $n(\text{NaOH}) = 2n(\text{H}_2\text{SO}_4)$  ✓
  - $n(\text{NaOH})_{\text{used/gebruik}} = n(\text{NaOH})_{\text{initial/aanvang}} - n(\text{NaOH})_{\text{excess/oormaat}}$  ✓
  - $n(\text{Mg}(\text{NO}_3)_2) = \frac{1}{2}n(\text{NaOH})$  ✓
  - Substitute/Vervang  $n(\text{Mg}(\text{NO}_3)_2) = 148 \text{ g mol}^{-1}$  ✓
  - Final answer/Finale antwoord: 64,38 g ✓
- $n(\text{NaOH used/gebruik}) = n(\text{NaOH initial/aanvang}) - n(\text{NaOH excess/oormaat})$ :  
 $1,25 - 0,38 \checkmark = 0,87 \text{ mol}$

$$n(\text{Mg}(\text{NO}_3)_2) = \frac{0,87}{2}$$

$$= 0,435 \text{ mol}$$

$$m(\text{Mg}(\text{NO}_3)_2) = nM$$

$$= 0,435 \times 148 \checkmark$$

$$= 64,38 \text{ g} \checkmark$$

(6)

[12]

## PREPARATORY EXAMINATION VOORBEREIDENDE EKSAMEN

2017

### MARKING GUIDELINES / NASIEN RIGLYNE

PHYSICAL SCIENCES: PHYSICS (FIRST PAPER) (10841)

FISIÊSE WETenskappe: FISIKA (EERSTE VRAESTEL) (10841)

12 pages / bladsye

10841 / 17

GAUTENG DEPARTMENT OF EDUCATION

GAUTENGSE DEPARTMENT VAN ONDERWYS

PREPARATORY EXAMINATION – 2017

VOORBEREIDENDE EKSAMEN – 2017

PHYSICAL SCIENCES: PHYSICS /  
FISIÊSE WETenskappe: FISIKA  
(First Paper)  
(Eerste Vraestel)

**MEMORANDUM****QUESTION / VRAAG 1**

- 1.1 A ✓✓  
 1.2 C ✓✓  
 1.3 C ✓✓  
 1.4 B ✓✓  
 1.5 A ✓✓  
 1.6 C ✓✓  
 1.7 B ✓✓  
 1.8 B ✓✓  
 1.9 B ✓✓  
 1.10 D ✓✓

[20]

**QUESTION / VRAAG 11**

- 11.1 11.1.1 The proportion/Laagte ✓ of nitrogen, phosphorus and potassium (N.P.K.) ✓

Die verhouding ✓ van stikstof, fosfor en kalium (N.P.K.) ✓ (2)

- 11.1.2 Percentage fertiliser / persentasie kunsmisstof ✓ (1)

- 11.2 Ammonium nitrate / Ammoniumnitraat ( $\text{NH}_4\text{NO}_3$ ):

$$\% \text{N} = \frac{28}{80} \times 100 = 35,0 \% \text{N}$$

Urea / Ureum ( $(\text{NH}_2)_2\text{CO}$ ): ✓ (answers)

$$\% \text{N} = \frac{28}{60} \times 100 = 46,7 \% \text{N}$$

Urea – it has the highest percentage N / Ureum het die hoogste persentasie N ✓ (4)

**Marking guidelines:  
Nasienriglyne:**

- Molar masses / Molêre massa ✓
- Multiply with 100 / Vermenigvuldig met 100 ✓
- % N (35,0% and / en 46,7%) ✓
- Identify urea / Identifiseer ureum ✓

- 11.3 11.3.1 Fractional distillation (of liquid air) / Fraksionele distillasie van (vloeibare lug). ✓ (1)

- 11.3.2  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{aq})$

**Marking criteria / Nasienriglyne:**

- reactants / reaktante ✓
- product / produk ✓
- balancing / balanseering ✓

**Rules/Riglyne:**

- Any additional reactant / product / incorrect balancing / arrow omitted: max 2 / 3
  - Enge addisionele reagentse of produkte / verkeerde balanseering / pyl uitgeelaat: maks 2 / 3
- (3)

- 11.3.3  $(\text{NH}_4)_2\text{SO}_4$  ✓  
 ammonium sulphate / ammoniumsulfaat ✓ (2)

[13]

**TOTAL / TOTAAL: 150****QUESTION / VRAAG 2**

Down is positive for the entire question.

Neem af as positief vir die hele vraag.

- 2.1 Velocity with which the tennis ball strikes the balcony:

Snelheid waarmee die tennisbal die balkon tref:  
 Option / Opsie 1 Option / Opsie 2

$$v^2 = v_i^2 + 2ay \checkmark$$

$$v_i = \sqrt{0 + 2 \times 9,8 \times 12} \checkmark$$

$$= 15,34 \text{ m.s}^{-1} \checkmark$$

$$\frac{E_{\text{tennis ball}}}{\frac{1}{2}mv^2 + mgh} = \frac{E_{\text{tennisball / balkon}}}{\frac{1}{2}mv^2 + mgh} \checkmark$$

$$\frac{1}{2}mv^2 + 0 = 0 + mgh \checkmark$$

$$\frac{1}{2}v^2 = 9,8 \times 12 \checkmark$$

$$v = 15,34 \text{ m.s}^{-1} \checkmark$$

(3)

- 2.2.1 Energy that the ball has at bouncing / Energie wat die bal het wanneer dit boos  
 $E_{k1} = \frac{1}{2}mv^2 = 0,5 \times 0,12 \times 15,386^2 \checkmark = 14,112 \text{ J} \checkmark$

(2)

- 2.2.2 Energy left on ball after bouncing / Energie oor op die bal na die boos  
 $E_{k2} = (14,112 - 2) \text{ J} \checkmark = 12,112 \text{ J}$

(tick is for subtraction/ (punt is vir die aftrekking)

## Option 1

Initial velocity after bouncing / Aanvanklike snelheid na die boos

$$\frac{1}{2}mv^2 = 12,112$$

$$v = \sqrt{\frac{2 \times 12,112}{0,12}} \checkmark$$

$$v = 14,208 \text{ m.s}^{-1}$$

$$v = 14,21 \text{ m.s}^{-1}$$

$$v^2 = v_1^2 + 2ay \checkmark$$

$$0 = (-14,21)^2 + 2(9,8) \Delta y \checkmark$$

$$\Delta y = -10,30 \text{ m} \checkmark$$

- 2.3 Height of balcony above the ground / Hoogte van die balkon bokant die grond

$$\Delta y = v_1 \Delta t + \frac{1}{2}a \Delta t^2 \checkmark$$

$$= (-14,208 \times 3,16) + (1/2 \times 9,8 \times 3,16^2) \checkmark$$

$$= 3,999 \text{ m}$$

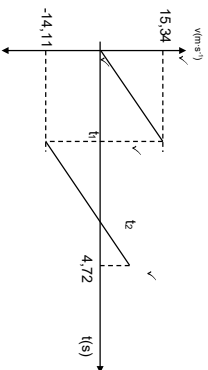
$$= 4,03 \text{ m} \checkmark$$

Balcony is 4,03 m above the ground / Balkon is 4,03 m bokant die grond

(3)

- 2.4 Mark if following is shown / Merk indien die volgende gewys word:

- Velocity ball hits the balcony  $\checkmark$  / Snelheid waarmee bal die balkon tref
- Velocity ball leaves balcony  $\checkmark$  / Snelheid waarmee die bal die balkon verlaat
- Time of flight of ball to reach balcony  $(t_1) \checkmark$  / Tyd wat bal neem om balkon te bereik
- Time ball reaches max height after bounce  $(t_2) \checkmark$  / Tyd wat bal neem om maks hoogte te bereik na die boos



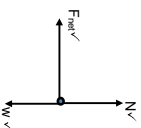
3

(4)

[17]

## QUESTION / VRAAG 3

3.1



$$3.2 \quad 120 \text{ km.h}^{-1} = \frac{120 \times 1000}{3600} = 33,33 \text{ m.s}^{-1} \checkmark$$

(1)

- 3.3 **Work-energy theorem:** The net work done on an object is equal to the change in the objects kinetic energy.  $\checkmark \checkmark$

Arbeid energie beginsel: Die netto arbeid verrig op n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

3.4

$$3.4.1 \quad W_{\text{net}} = E_{\text{af}} - E_{\text{a}} \checkmark$$

$$= 0 - \frac{1}{2}mv^2$$

$$= -555,444,45 \text{ J}$$

$$F_{\text{net}}(\Delta x) \cos 0 = 555,444,45 \checkmark$$

$$F_{\text{net}}(0,8) \cos 180 \checkmark = 555,444,45$$

$$F_{\text{net}} = -694,305,56 \text{ N}$$

Force = - 694,305,56 N to the left / away from the wall/opposiete direction of initial motion

Na links / weg van die muur / teenoorgestelde rigting van die aanvanklike beweging

(5)

$$3.4.2 \quad \text{Time lapse / Tydperk} \quad F_{\text{net}} \Delta t = \Delta p = m(v_f - v_i) \checkmark$$

$$\Delta t = \frac{1,000(0 - -33,33)}{-694,305,56} \checkmark$$

$$= 0,05 \text{ s} \checkmark$$

(4)

3.4.3

- Crumpling increases stopping time  $\checkmark$  / frommeling vergrout stop-tyd

- thus reducing  $F_{\text{net}} \checkmark$  / dus verminder  $F_{\text{net}}$

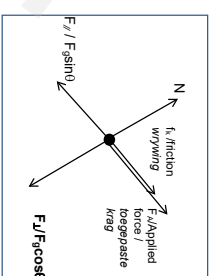
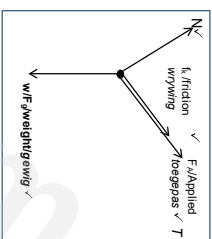
$$F_{\text{net}} = \frac{\Delta p}{\Delta t} \checkmark \quad [18]$$

## QUESTION / VRAAG 4

4.1

Option 1 / Opsie 1

Option 2 / Opsie 2



(4)

| Accepted labels/aanvaarde benoennings |                                             |
|---------------------------------------|---------------------------------------------|
| w                                     | $F_A$ / Applied force / Gravitational force |
| $F_A$                                 | $F_g$ / Gravity / Gravitational force       |
| f                                     | $F_{\text{friction}}$ / Friction            |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight                |
| N                                     | $F_{\text{net}}$ / Net force                |
| N                                     | $F_{\text{normal}}$ / Normal force          |
| N                                     | $F_{\text{applied}}$ / Applied force        |
| N                                     | $F_{\text{weight}}$ / Weight</              |

4.5  $W_A = F_A \times \cos 0^\circ = -816$

$= F \times \underline{8 \cos 180^\circ} = -816$

$F_A = 136 \text{ N}$

Magnitude of force applied by man is  $136 \text{ N}$   
*Grootte van krag toegepas deur man is 136 N*

[18]

### QUESTION / VRAAG 5

5.1 All charge is made up of multiples of a basic charge that has a value of  $1,6 \times 10^{-19} \text{ C}$   
*Alre ladinge word opgemaak uit veelvulde van 'n basiese lading wat die waarde het van  $1,6 \times 10^{-19} \text{ C}$ .*

(1)

5.2.1 New charge / nuwe lading  $= \frac{Q_A + Q_B}{2}$   
 $= \frac{9 \times 10^{-6} - 3 \times 10^{-6}}{2}$

$= +3 \mu\text{C}$

(2)

5.2.2 For sphere A: from  $+9 \mu\text{C}$  to  $-3 \mu\text{C}$  is a loss of  $6 \mu\text{C}$   
 For sphere B: from  $-3 \mu\text{C}$  to  $+3 \mu\text{C}$  is a gain of  $6 \mu\text{C}$   
*Vir sfeer A vanaf  $+9 \mu\text{C}$  tot  $-3 \mu\text{C}$  is 'n verlies van  $6 \mu\text{C}$   
 Vir sfeer B vanaf  $-3 \mu\text{C}$  tot  $+3 \mu\text{C}$  is 'n toename van  $6 \mu\text{C}$*

electrons transferred / elektrone oorgedra

$= \frac{(-) Q_{\text{lost/gained}} / \text{value of } e}{e}$

$= \frac{(-) 6 \times 10^{-6}}{(-) 1,6 \times 10^{-19}}$

$= 3,75 \times 10^{13}$  electrons (Answer must be positive.)

Elektrone (Antwoord moet positief wees)

(3)

5.2.3 B to A / B tot A

(1)

5.3 Coulomb's Law: The force between two charges is directly proportional to the product of the charges, and inversely proportional to the square of the distance between the charges.

*Coulomb se Wet: die krag tussen twee ladinge is direk eweredig aan die produkte van hul ladinge en omgekeerd eweredig aan die kwadraat van die afstand tussen die ladinge.*

(2)

5.4  $F_A = \frac{kQ_1 Q_2}{r_{12}^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6} \times 3 \times 10^{-6}}{0,02^2} = 607,5 \text{ N, attractive}$

(3)

7

9

5.5  $E_{\text{net}} = E_{OA \text{ at } x} + E_{OB \text{ at } x}$

$= \frac{kQ}{r_A^2} + \frac{kQ}{r_B^2}$

$= \frac{9 \times 10^9 \times 9 \times 10^{-9}}{(0,04)^2} + \frac{9 \times 10^9 \times 3 \times 10^{-9}}{0,16^2}$

$= 50\,625\,000 + 1\,054\,687,5 = 5,168 \times 10^7 \text{ NC}^{-1}$

[16]

### QUESTION / VRAAG 6

6.1 6.1.1

It is the apparent change in frequency of a source when there is relative motion between the source and the observer.

*Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.*

(2)

6.1.2

$f_L = \left( \frac{v \pm v_L}{v \pm v_s} \right) f_s$

$v_L = (v + v_A) \frac{f_s}{f_L}$

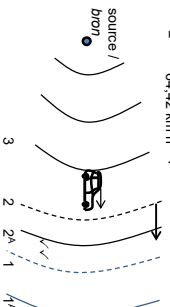
$= (340 + 0) \times \frac{360}{340}$

$= 17,90 \text{ ms}^{-1}$

$= 17,895 \times \frac{3600}{1000}$

$= 64,42 \text{ km} \cdot \text{h}^{-1}$

(5)



Since the driver is moving in the same direction as the waves, the wavefronts will pass him at delayed intervals, thus making the wavelengths longer hence hearing a lower frequency.

*Aangesien die bestuurder beweeg in dieselfde rigting as die golwe, sal die golffronte verby beweeg teen vertraagde intervalle wat dus maak dat die golflengtes langer word en hy dus 'n laer frekwensie hoor.*

(4)

6.3 Speed trap cameras, Doppler flow meter for measuring the speed of blood, ultra sound fetus scan

*Speedvang kameras, Dopplervloei meter vir die meting van die spoed van bloed, ultraklank fetus skandering*

### QUESTION / VRAAG 7

7.1 7.1.1 Potential difference across  $R$  / potensiaalverskil oor  $R$

(1)

7.1.2 Current flowing through  $R$  / stroom vloei deur  $R$

(1)

7.2  $\mathcal{E} = 2,52 + 0,3r$

$- \mathcal{E} = 0,71 + 1,6r$

$0 = 1,81 - 1,3r$  (add – any other method) / (voeg by – enige ander metode)

$r = 1,38 \Omega$

(3)

7.3 7.3.1  $2,9 \text{ V}$

(2)

7.3.2  $2,1 \text{ A}$

(2)

7.3.3 Gradient of graph / gradient van die grafiek

$= \frac{0 - 2,9}{2,1 - 0}$  (Accept any viable calculation of gradient.)  
 (Aanvaar enige sinvolle berekening van gradient.)

(2)

$= -1,38 \Omega$

(2)

7.4

The graph is an average line through the points/learners draw line of best fit. It gives an average value for  $r$  whilst calculation from individual plots does not take into account instrument reading errors, and any other small errors that arise.

*Die grafiek is 'n gemiddelde lyn deur die punte/leerders teken 'n beste paslyn. Dit gee 'n gemiddelde waarde vir  $r$ , terwyl berekeninge vanaf individuele punte nie enige instrumentle aflees foutre in ag neem nie en enige ander klein foutre wat in ag opduik.*

[12]

### QUESTION / VRAAG 8

8.1 For the parallel network  $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{4}$   $R_A = 2,4 \Omega$

(1)

Option 1/ Opsie 1  
 $R_{\text{total}} = R_L + R_{\text{series}}$   
 $= 2,4 + 2 + 1$   
 $= 5,4 \Omega$   
 $I = \frac{R_{\text{total}}}{R_{\text{cell}} + R_{\text{series}}}$   
 $I = \frac{10}{5,4}$   
 $I = 1,85 \text{ A}$

(5)

Option 2/ Opsie 2  
 $\mathcal{E} = I(R_{\text{ext}} + I r)$   
 $= I(R_{\text{ext}} + 1)$   
 $10 = I(2,4 + 2 + 1)$   
 $I = 1,85 \text{ A}$

8.2 For reading of  $V_1$

Option 1/ Opsie 1

$V_1 = \mathcal{E} - V_r$   
 $= \mathcal{E} - I_e r$   
 $= 10 - (1,852 \times 1)$   
 $= 8,15 \text{ V}$

Option 2/ Opsie 2

$R_{\text{ext}} = R_L + R_{\text{series}} / \text{serie}$   
 $= 2,4 + 2$   
 $= 4,4 \Omega$   
 $V_1 = I_{\text{total}} / \text{stroombaan} \times R_{\text{ext}}$   
 $= 1,852 \times 4,4$   
 $= 8,15 \text{ V}$

(2)

8.3 Increases

When switch S is opened, circuit resistance increases leading to a decrease in  $I$ . Fewer volts lost at  $r$  hence  $V_1$  increases.

*Toename*

*Wanneer skakelaar S oopgemaak word, verhoog die weerstand van die stroombaan wat lei tot 'n afname in  $I$ . Minder voltore verloor by  $r$  dus sal  $V_1$  vermeerder.*

(3)

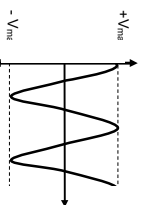
**QUESTION / VRAAG 9**

9.1 AC ✓ / WS

Generator has sliptings ✓ / Generator het sleepinge

9.2

Criteria for marking / Kriteria vir nasien



-Wave starts at +V<sub>max</sub> or -V<sub>max</sub> ✓  
 -two cycles shown ✓  
 -golfie begin by +V<sub>max</sub> of -V<sub>min</sub>  
 - Twee siklusse word getoon

(2)

9.3 a to b ✓ / a tot b

(1)

9.4 9.4.1 It is the DC current which dissipates the same amount of energy as AC. ✓✓

9.4.2 Dit is die GS wat dieselfde hoeveelheid energie lewer as die WS.

Option 1

Option 2

(2)

$$V_{rms} = \frac{V_{max,peak}}{\sqrt{2}} = \frac{6}{\sqrt{2}} \checkmark = 4,243 \text{ V}$$

$$I_{rms} = \frac{V_{rms}}{R} \checkmark$$

$$= \frac{4,243}{10} \checkmark$$

$$= 0,424 \text{ A} \checkmark$$

$$I_{max} = \frac{I_{rms,peak}}{\sqrt{2}} = \frac{6}{10} = 0,6 \text{ A}$$

$$I_{rms} = \frac{I_{max,peak}}{\sqrt{2}}$$

$$= \frac{0,6}{\sqrt{2}}$$

$$= 0,424 \text{ A}$$

(4)

11

10841 / 17

9.4.3

Option 1 / Opsie 1

$$P_{ave} = \frac{I_{rms} V_{rms}}{2} \checkmark$$

$$= \frac{0,6 \times 6}{2} \checkmark$$

$$= 1,8 \text{ W} \checkmark$$

Option 2 / Opsie 2

$$P_{ave} = I_{rms} V_{rms}$$

$$= 0,424 \times 4,243$$

$$= 1,8 \text{ W}$$

10842 / 18

GAUTENGSE DEPARTEMENT VAN ONDERWYS  
 VOORBEREIDENDE EKSAMEN

FIJIESE WETENSKAPPE  
 (Vraestel 2)

NASIENRIGLYNE

VRAAG 1

- 1 A ✓✓
- 2 B ✓✓
- 3 C ✓✓
- 4 B ✓✓
- 5 C ✓✓
- 6 A ✓✓
- 7 A ✓✓
- 8 C ✓✓
- 9 D ✓✓
- 10 D ✓✓

[20]

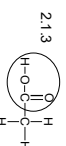
VRAAG 2

2.1 2.1.1 Verbindings wat dieselfde molekulêre formule het, maar verskillende struktuurformules. (twee ✓✓ of nul)

(2)

2.1.2 Metaleenanoaat

(2)



2.1.3

Nasienglyne:

- funksionele groep ✓
- heie struktuur ✓

(2)

2.1.4 Etenoësuur ✓

(1)

2.1.5 Karboksieisuur ✓

(1)

2.2 2.2.1 C<sub>6</sub>H<sub>12</sub> ✓

(1)

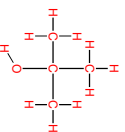
2.2.2 2,5-dimetiesilpropieen

(2)

TOTAL / TOTAAL : 150

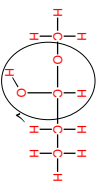
12

2.3



- Nesientydne:
- OH op middel C ✓
  - hele struktuur ✓

2.4



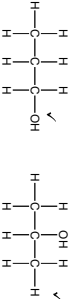
Nesientydne:

✓ funksionele groep

## VRAAG 3

3.1 (Alkohole is vlambaar.) Moenie dit naby oop vlamme bring nie. ✓

3.2 3.2.1



propan-1-ol ✓

propan-2-ol ✓

3.2.2 propan-1-ol ✓

3.2.3 Die posisie van die -OH groep in 'n ketting sal die kookpunt beïnvloed as gevolg van die intermolekulêre kragte en verake strukture.

OF

3.3 3.3.1 Diesnehpunt van butan-1-ol sal hoër wees. ✓

Redes:

- Die waterstofbinding tussen butan-1-ol molekule is sterker as tussen die butan-2-ol molekule, omdat die hidroksielgroep meer blootgestel is in die butan-1-ol as in die butan-2-ol wat dan veroorsaak dat die waterstofbinding 'n sterker effek het. ✓
- Meer energie word benodig om die intermolekulêre kragte te verswak tussen die butan-1-ol molekule wat lei tot 'n hoër smeltpunt. ✓
- Reguit kettings het 'n hoër smeltpunt as vertakte kettings.
- OF
- Butan-1-ol het 'n groter oppervlak area (kettinglengte)
- Daarom sterker intermolekulêre kragte
- Meer energie is nodig om die intermolekulêre kragte te oorkom

(3)

3

3.3.2 Butan-2-ol ✓

10842 / 18

Redes:

- Indien die hidroksielgroep op die terminale koolstofatoom is sal die intermolekulêre krag (waterstofbinding) sterker wees as wanneer die -OH groep op die tweede koolstofatoom is waar dit geskerm word en dit 'n kleiner effek het op die energie benodig om die fase verandering (kook) in die tweede isomeer, die butan-2-ol, te veroorsaak. ✓
- Die kookpunt van butan-2-ol sal laer wees en dus sal die dampdruk van butan-2-ol hoër wees as die van butan-1-ol. Minder energie word benodig om die waterstofbinding te oorkom en die bindings te verswak. ✓

3.3.3 Verhoog ✓

(1)

3.3.4 • Van der Waalskragte (Londonskragte) verhoog met 'n verhoging in molekule massa / kettinglengte / grootte van molekule. ✓

- Hoe langer die ketting, hoe hoër is die kookpunt, hoe sterker is die Londonskragte. ✓

(2)

3.4 3.4.1 Polimerisasie ✓



Eleen ✓

(1)

3.4.3 Enige gebruik (Enige een) ✓

Verpakkingsmateriaal

Drukbotels

Elektriese insulasie

Industriële beskermingsklers

Speelgoed, ens.

[19]

## VRAAG 4

4.1 4.1.1 Verbinding X = C<sub>2</sub>H<sub>5</sub>Br ✓

(1)

4.1.2 Addisie / hidrhalogenasie ✓

(1)

4.1.3 Propan-2-ol ✓

(1)

4.1.4 'n Alkohool waar die hidroksielgroep verbind is aan 'n koolstofatoom wat verbind is aan twee ander koolstofatome. ✓

(1)

4.1.5 Prop-1-een OF propeen ✓

(1)

4.1.6 Dehidrhalogenasie of dehidrhalogenasie ✓

(1)

4.2 4.2.1 Eliminatie ✓

(1)

4.2.2 Hidrasie ✓

(1)

4.2.3 Hidrhalogenasie ✓

(1)

4.2.4 H<sub>2</sub>SO<sub>4</sub> ✓

(1)

4.2.5 2-bromo-2-metielpentaan ✓

(2)

## VRAAG 5

5.1 5.1.1 Gebruik verpoederde CaCO<sub>3</sub> in plaas van stukkies ✓

Gebruik 'n hoër konsentrasie HCl oplossing ✓

Verhul die reaktiemengsel ✓

Voeg 'n geskikte katalisator by

Enige DRIE

(3)

5.1.2 Meet die tempo van SO<sub>2</sub> vorming deur die volume te meet wat vorm by sekere intervale. ✓✓

Meet die tempo waarheen die massa verminder deur die reaksie houet te plaas op 'n sensitielwe massa-meter en noteer die afname in die massa per eenheid tyd. ✓✓

(4)

5.1.3 Dit is nie 'n geskikte sisteem nie. ✓

Die CO<sub>2</sub> gas ontsnap vanaf die reaksie. ✓

(2)

5.2 5.2.1 5 cm<sup>3</sup> / min OR 5 cm<sup>3</sup> / min<sup>-1</sup> ✓

(1)

5.2.2 Steiler gradient ✓

(1)

5.2.3 Die tempo van produksie van waterstofgas sal vinniger wees per eenheid tyd omdat die reaksie verhoop teen 'n hoër tempo by 'n hoër temperatuur. ✓

(2)

5.2.4 Die tempo van waterstofgasproduksie sal toeneem soos die lengte / oppervlakte van die magnesium tikt vermeerder. ✓✓

MOET NIE AANVAAR NIE: Graafek is direk eweredig, dit gaan nie deur die oorsprong nie.

(2)

[15]

5

## VRAAG 6

10842 / 18

6.1 Indien 'n versuuring toegevoeg word op 'n sisteem wat in ewewig is, sal die sisteem op so 'n manier reageer om die versuuring teen te werk en ewewig te herstel onder 'n nuwe stel toestande. ✓✓

(2)

6.2 6.2.1 A ✓

(1)

6.2.2 Die voorwaartse reaksie is endotermies. 'n Afname in die temperatuur van die ewewig sisteem sal die terugwaartse reaksie bevoordeel. ✓ Die terugwaartse reaksie is eksotermies. Daarom sal meer jodium en waterstofmolekules vorm en minder H<sub>2</sub> sal in die reaksie mengsel wees. ✓

(3)

6.3 6.3.1 K<sub>c</sub> = [H<sub>2</sub>O][CH<sub>3</sub>COO] ✓  
= (1,34 x 10<sup>-3</sup>) (1,34 x 10<sup>-3</sup>) ✓  
= 1,80 x 10<sup>-6</sup> ✓

(3)

6.3.2 VERHOOG ✓

(1)

6.3.3 Wanneer natriumetaarsaat, CH<sub>3</sub>COONa, oplos in waterige etanoesuur (asynsuur) CH<sub>3</sub>COOH, dissosieer dit in Na<sup>+</sup> ione en aselaat ione, ✓ CH<sub>3</sub>COO<sup>-</sup>. Die aselaat ione verminder die totale aselaatkon konsentrasie in die oplossing. ✓ Die ewewig word herstel na links en meer etanoesuur (asynsuur) vorm. Dit verminder die [H<sub>3</sub>O<sup>+</sup>] konsentrasie, daarom vermeerder die pH. ✓

(3)

6.4 6.4.1 0,5 mol van gas X<sub>2</sub>Y<sub>5</sub> ✓

(1)

6.4.2

|                     | 2X(g) | 3Y(g) | X <sub>2</sub> Y <sub>5</sub> (g) |
|---------------------|-------|-------|-----------------------------------|
| Aanvanklike mol     | 4     | 4     | 0                                 |
| Aantal mol gevorm   | 0     | 0     | 0,5                               |
| Aantal mol gebruik  | 1     | 1,5   | 0                                 |
| Mol by ewewig       | 3     | 2,5   | (0,5) ✓                           |
| Ewewig konsentrasie | 1,5   | 1,25  | (0,25) ✓ (+2)                     |
| 0,25                |       |       |                                   |

$$K_c = \frac{[X_2][Y_5]}{[X][Y]^3} \quad \checkmark$$

$$= \frac{(0,25)}{(1,5)^3 (1,25)^3} \quad \checkmark$$

$$= 0,057 \quad \checkmark$$

(6)

[20]

## VRAAG 7

- 7.1  $\text{HSO}_3^-$  ✓  
MOET NIE AANWAAR NIE: Waterstofsulfaat ion (1)
- 7.1.2  $\text{CN}^-$  ✓ (1)
- 7.2 7.2.1  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + 2\text{HCl} \rightarrow 2\text{NaCl} + 11\text{H}_2\text{O} + \text{CO}_2$  ✓  
Meliorante ✓ (2)
- 7.2.2 Meliorante ✓ (1)
- 7.2.3 Sterk suur word getitreer met 'n swak basis / die ekwivalente punt is in die pH gebied (3–4,4) / lae pH / suuroplossing na titrasie eindpunt. Enige EEN antwoord sal korrek wees. (2)
- 7.2.4 Rooi tot geel ✓ (1)

## 7.2.5 Opste 1:

$$\alpha_{\text{HCl}} = \frac{n}{V} \quad \checkmark$$

$$\therefore n_{\text{HCl}} = CV \quad \checkmark$$

$$= 0,1 \times \frac{24,8}{1000} \quad \checkmark$$

$$= 2,48 \times 10^{-3} \text{ mol HCl} \quad \checkmark$$

1 mol  $\text{Na}_2\text{CO}_3$  reageer met 2 mol HCl ✓  
n ( $\text{Na}_2\text{CO}_3$ ) in 500  $\text{cm}^3$ :  
 $= \frac{(2,48 \times 10^{-3})}{2} \times \frac{500}{25} \quad \checkmark$   
 $= 2,48 \times 10^{-3} \text{ mol Na}_2\text{CO}_3 \quad \checkmark$

Nasieningspunte:

- Bereken  $n(\text{HCl})$  ✓
- Gebruik formule  $C = \frac{n}{V}$  ✓
- Gebruik verhouding, 1 : 2 ✓
- Bereken  $n(\text{Na}_2\text{CO}_3)$  ✓
- Bereken m van  $\text{Na}_2\text{CO}_3$  ✓

n =  $\frac{m}{M}$  ✓  
m = nM  
 $= 2,48 \times 10^{-3} \times 286 \text{ g mol}^{-1}$   
 $= 7,092 \text{ g} \quad \checkmark$  (5)

7

10842 / 18

## Opste 2:

$n_{\text{Na}} = \frac{C_{\text{Na}}}{C_{\text{Na}} V_{\text{Na}}} \quad \checkmark$   
 $n_{\text{Na}} = \frac{C_{\text{Na}}}{C_{\text{Na}} V_{\text{Na}}} \quad \checkmark$   
 $\checkmark \frac{2}{1} = \frac{(0,1) \left( \frac{24,5}{1000} \right)}{\left( C_{\text{Na}} \right) \left( \frac{25}{1000} \right)}$   
 $C_{\text{Na}} = 0,0496 \text{ mol dm}^{-3} \quad \checkmark$   
 $C = \frac{n}{V}$   
 $n = (0,0496)(0,5)$   
 $= 0,0248 \text{ mol Na}_2\text{CO}_3$   
 $n = \frac{m}{M} \quad \checkmark$   
 $m = nM = (0,0248)(286) = 7,093 \text{ g Na}_2\text{CO}_3 \quad \checkmark$  (5)

7.2.6 Positiewe nasien vanaf VRAAG 7.2.6  
%  $\text{Na}_2\text{CO}_3$  in kommersiele wasoda:  
 $= \frac{\text{werklikemassa}}{\text{beoefenseemassa}} \times 100 \quad \checkmark$   
 $= \frac{7,092}{7,6} \times 100 \quad \checkmark$   
 $= 93,32 \% \quad \checkmark$

Indien 'n antwoord van 7,093 g gebruik is dan sal die antwoord 93,33 % wees. (3)  
[16]

## VRAAG 8

- 8.1 8.1.1  $\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$  ✓ (3)
- 8.1.2 Silver ✓ (1)
- 8.1.3  $E_{\text{cell}} = E^{\circ}_{\text{oksiderende}} - E^{\circ}_{\text{reducerende}}$  ✓  
 $= 0,8 \text{ V} - (-2,36 \text{ V}) \quad \checkmark$   
 $= 3,16 \text{ V} \quad \checkmark$  (3)
- 8.1.4  $25^\circ\text{C}$  of  $298 \text{ K}$  ✓ (1)
- 8.1.5  $1 \text{ mol dm}^{-3}$  ✓ (1)
- 8.1.6 Opste 1 ✓ (1)

Die reaksietempo is te laag om genoeg lading te verskaf om die groot hoeveelheid lading te handhaaf. ✓

## Opste 2

$$I = \frac{P}{V} = \frac{6 \text{ W}}{3 \text{ V}} = 2 \text{ A}$$

Die gloeilamp word vervaardig om effektief te werk indien dit verbind word aan 'n bron van 3 V wat 'n stroom van 2 A lewer. Alhoewel die potensiaalverskil groot genoeg is, is die stroom heel waarskynlik te klein (as gevolg van 'n te groot interne selweerstand.)

[12]

## VRAAG 9

- 9.1 9.1.1 Na die katode. ✓ (1)
- 9.1.2  $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$  ✓✓ (2)
- 9.1.3 Chloorgas ( $\text{Cl}_2$ ) ✓ (1)
- 9.2.1 Die bedekking van 'n oppervlakte of 'n voorwerp met 'n dun laag metaal of deur middel van elektrolyse. ✓✓ (2)
- 9.2.2 Enige EEN gebruik van elektroplating:  
• Beskerming van die oppervlakte van 'n basismetaleel ✓ (1)  
• Dekoratiewe doeleindes (1)
- 9.2.3 Negatiewe elektrode / katode ✓ (1)  
[8]

9

10842 / 18

## VRAAG 10

- 10.1 10.1.1 Graan ✓ (1)
- 10.1.2 Ammoniumnitraat /  $\text{NH}_4\text{NO}_3$  ✓ (1)
- 10.1.3 Graan benodig grond met 'n lae kaliuminhoud. ✓ Medium in stikstof en hoog in fosfor. ✓ Meer stikstof moet by die grond gegee word. ✓ Meer stikstof moet bygevoeg word en ammoniumnitraat het die meeste stikstof. (3)
- 10.1.4  $\% \text{ stikstof in } \text{NH}_4\text{NO}_3 = \frac{\text{massa stikstof}}{\text{mole massa ammonium nitrate}} \times 100 \quad \checkmark$   
 $= \frac{28}{80} \times 100 = 35\% \quad \checkmark$  (4)
- 10.1.5 A Ammoniak /  $\text{N}_2$  ✓  
B Waterstof /  $\text{H}_2$  ✓  
C Stikstofdoksied /  $\text{NO}_2$  ✓  
D Ammoniumnitraat /  $\text{NH}_4\text{NO}_3$  ✓  
E Ammoniumsulfaat /  $(\text{NH}_4)_2\text{SO}_4$  ✓ (5)  
[14]
- TOTAAL: 150

8

10

## PREPARATORY EXAMINATION 2019 MARKING GUIDELINES

PHYSICAL SCIENCES: CHEMISTRY (PAPER 2) (10842)

13 pages

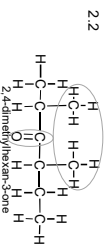
### QUESTION 1

- 1.1 A ✓✓  
 1.2 D ✓✓  
 1.3 D ✓✓  
 1.4 B ✓✓  
 1.5 D ✓✓  
 1.6 C ✓✓  
 1.7 D ✓✓  
 1.8 A ✓✓  
 1.9 C ✓✓  
 1.10 C ✓✓

[20]

### QUESTION 2

- 2.1 2.1.1 A ✓  
 2.1.2 A ✓  
 2.1.3 C ✓  
 2.1.4 B ✓  
 2.1.5 D ✓



- Correct ketone functional group ✓
- Both side chains / branches correct on correct carbon atom ✓
- Whole structure correct ✓

(3)

2.3 2,3-dichloro-3-fluorobutanol ✓

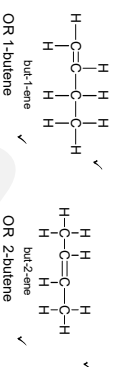
(3)  
[11]

### QUESTION 3

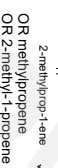
- 3.1 3.1.1 Esters ✓ **OR** carboxylic acids  
 3.1.2 Ketones ✓

3.2 3.2.1 Chain isomers: Same molecular formula, but different types of chains ✓✓ (2)

3.2.2



**Marking guideline:**  
 One mark for whole structure  
 One mark for correct IUPAC name  
 for each of the isomers



3.3 3.3.1 Butan-1-ol ✓ and pentanoic acid ✓

3.3.2 Condensation ✓ **OR** esterification

3.4

If answered as: Butyl pentanoate has a higher boiling point than butyl butanoate.

Both esters have the same type of intermolecular forces (London forces) ✓  
 Butyl pentanoate has a longer chain therefore stronger forces between the molecules. ✓  
 More energy is required to overcome the intermolecular forces between butyl pentanoate ✓ therefore the boiling point is higher.

#### Marking criteria

- same intermolecular forces must be mentioned.
- Their names need not be mentioned. ✓
- comparison chain length / molecular mass ✓
- energy required ✓

(3)

10842 / 19

3.5.1

*Addition polymerisation:* A reaction in which small molecules join to form very large molecules by adding on at double bonds. ✓✓  
*Condensation polymerisation:* Molecules of two monomers with different functional groups undergo condensation reactions with the loss of small molecules, usually water. ✓✓

3.6.1 Polythene or Polyethylene ✓

3.6.2 Ethene ✓

(1)  
[22]

### QUESTION 4

4.1

Elimination / dehydrohalogenation / dehydrobromination ✓

(1)

4.2

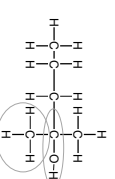
- heat ✓
- Concentrated sodium hydroxide (NaOH) / Concentrated potassium hydroxide (KOH) / Concentrated strong base

**OR**

Hot ethanolic concentrated sodium hydroxide / potassium hydroxide / KOH / NaOH

(2)

4.3



#### Marking guidelines:

- Correct hydroxyl functional group on C-2 ✓
- Side chains / branch correct on correct carbon atom ✓
- Whole structure correct ✓
- If condensed structural formula given -1

(3)

4.4

H<sub>2</sub>O / water ✓

(1)

4.5

Addition / Hydration ✓

(1)  
[8]

10842 / 19

## QUESTION 5

- 5.1 To prevent loss of any solution / acid from the flask ✓  
 OR  
 To allow gas to escape  
 OR  
 To prevent any solids / liquids getting in / out  
 OR  
 To prevent spurring  
**NOTE:** Answer must not be given in terms of preventing evaporation or condensation.

(1)

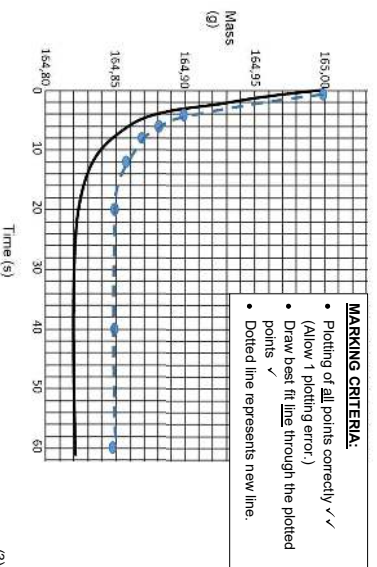
5.2  $\text{Reaction rate} = \text{change in mass} = \frac{164.84 - 165.00}{10.0} = -0.016 \text{ g s}^{-1}$  ✓

Accept positive sign or no sign in the answer.  
 (Negative value indicates loss in mass during reaction.)

(3)

5.3.1

Graph of mass versus time



(3)

5

10842 / 19

- 5.3.3 The reaction will be faster. ✓  
 Increasing the temperature, increases the kinetic energy so that more particles have kinetic energy that is higher than the activation energy. ✓  
 More collisions with correct orientation ✓  
 More successful / or effective collisions per unit time take place. ✓
- 5.4.1 2 ✓ (1)
- 5.4.2 State of division changed – Size of the zinc particles increased / surface area increased – originally lumps were used. ✓ (1)
- Accept: removed catalyst.
- 5.4.3 0.5 g / half of the amount as in experiment 1. ✓ (1)
- [14]

## QUESTION 6

- 6.1 A catalyst was used in the experiment that produced the graph for experiment C. ✓ (1)
- 6.2 The concentration of the products in both graphs at equilibrium are the same and the concentration of the reactants at equilibrium are the same. ✓ But equilibrium was reached faster in Experiment C than in Experiment A. ✓  
 OR  
 Equilibrium concentration is the same, equilibrium was not disturbed.  
 OR  
 Accept:  
 A catalyst was added and the rate of both forward and reverse reactions were increased.

6.3 EXOTHERMIC ✓

(2)

- 6.4 – negative marking from QUESTION 6.3  
 In experiment C the concentration of the reactants is higher than the concentration of the reactants in Experiment A when equilibrium is established. ✓  
 ∴ The reverse reaction is favoured. ✓  
 Endothermic reaction is favoured when the temperature is increased. ✓  
 Therefore reverse reaction is endothermic OR the forward reaction is exothermic. (3)

6.5 Use the data given to calculate the equilibrium constant at 500° C.

|                              | H <sub>2</sub> (g) | I <sub>2</sub> (g) | 2HI(g)           |
|------------------------------|--------------------|--------------------|------------------|
| Initial mol                  | 0.5                | 0.5                | 0                |
| Change in mol                | -0.2               | -0.2               | 0.4 ✓            |
| Mol at equilibrium           | 0.3                | 0.3                | 0.4 ratio used ✓ |
| Concentration at equilibrium | 0.3                | 0.3                | 0.4              |

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} \quad \checkmark$$

$$= \frac{(0.4)^2}{(0.3)(0.3)} \quad \checkmark \text{ (positive marking)}$$

$$= 1.78 \quad \checkmark$$

- MARKING CRITERIA:**
- Change in mol of HI ✓
  - Using ratio 1:1:2 ✓
  - Addition and subtraction to get the correct mol at equilibrium / concentration at equilibrium ✓
  - Correct K<sub>c</sub> expression ✓
  - Correct substitution of concentration at equilibrium values from this table ✓
  - Correct final answer ✓

No K<sub>c</sub> expression, correct substitution Max %Wrong K<sub>c</sub> expression Max 3/6

(6)

7

10842 / 19

- OPTION 2  
 Concentration of I<sub>2</sub> at equilibrium is 0.3 mol·dm<sup>-3</sup>.  
 $c(\text{I}_2) \text{ initial} = \frac{n}{V}$   
 $= \frac{0.5}{1} \quad \text{and} \quad c(\text{H}_2) \text{ initial} = \frac{n}{V}$   
 $= \frac{0.5}{1} = 0.5 \text{ mol} \cdot \text{dm}^{-3} \quad \text{and} \quad = \frac{0.5}{1} = 0.5 \text{ mol} \cdot \text{dm}^{-3}$

|                              | H <sub>2</sub> (g) | I <sub>2</sub> (g) | 2HI(g)           |
|------------------------------|--------------------|--------------------|------------------|
| Initial concentration        | 0.5                | 0.5                | 0                |
| Change in concentration      | -0.2               | -0.2               | 0.4 ✓            |
| concentration at equilibrium | 0.3 ✓              | 0.3                | 0.4 ratio used ✓ |

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} \quad \checkmark$$

$$= \frac{(0.4)^2}{(0.3)(0.3)} \quad \checkmark \text{ (positive marking)}$$

$$= 1.78 \quad \checkmark$$

No K<sub>c</sub> expression, correct substitution Max %Wrong K<sub>c</sub> expression Max 3/6

(6)

- 6.6 Lower than ✓ positive marking from QUESTION 6.3  
 answer would then be: higher than (1)

6.7 +  
 $K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$   
 $= \frac{(0.38)^2}{(0.3)(0.3)} \quad \checkmark \text{ (re-calculate equilibrium concentrations)}$   
 $= 1.6$   
 The [product] is smaller and the [reactant] is higher at the higher temperature. ✓  
 This results in a lower K<sub>c</sub> value at a higher temperature. ✓  
 Or  
 Equilibrium is to the left and reverse reaction is favoured.

**Note:** may use calculation or use explanation.

(2)  
[16]

6

8

## QUESTION 7

- 7.1 Temperature = 25° C / 298 K ✓  
Pressure = 100 kPa (1 atm) ✓  
[Cl] = 1 mol·dm<sup>-3</sup> ✓ (3)

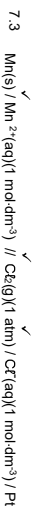
- 7.2 Mn → Mn<sup>2+</sup> + 2e<sup>-</sup> ✓ ✓ (2)

|                                              |                                        |  |
|----------------------------------------------|----------------------------------------|--|
| <u>Marking criteria:</u>                     |                                        |  |
| Mn ← Mn <sup>2+</sup> + 2e <sup>-</sup>      | $\begin{pmatrix} 2 \\ 2 \end{pmatrix}$ |  |
| Mn ← Mn <sup>2+</sup> + 2e <sup>-</sup> ⇌ Mn | $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ |  |
| Mn <sup>2+</sup> + 2e <sup>-</sup> ← Mn      | $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ |  |
| Mn ⇌ Mn <sup>2+</sup> + 2e <sup>-</sup>      | $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ |  |
| Ignore if charge is omitted on electron.     |                                        |  |
| If charge (+) is omitted on Mn <sup>2+</sup> |                                        |  |
|                                              | Max. ½                                 |  |



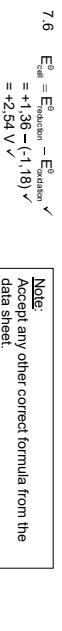
|                          |            |             |
|--------------------------|------------|-------------|
| <u>Marking criteria:</u> |            |             |
| ✓ Reactants              | ✓ Products | ✓ Balancing |

(3)



**NOTE:**  
Do not penalise if phases and conditions are not included.

- (3)



**Note:**  
Accept any other correct formula from the data sheet.  
Any other formula using unconventional abbreviations, e.g.  $E_{\text{red}}^0 = E_{\text{CA}} - E_{\text{OA}}$   
Followed by correct substitutions: Max 2/3

(3)

[16]

9

11

10842 / 19

## QUESTION 8

- 8.1 P ✓ (1)

- 8.1.2 P is connected to the positive terminal of the battery. ✓ (1)

- 8.2 8.2.1 Ni<sup>2+</sup>(aq) ✓ Note: (aq) may be omitted. (1)

- 8.2.2 Q ✓ (1)

- 8.2.3 Q ✓ (1)

- 8.2.4 Ni<sup>2+</sup> + 2e<sup>-</sup> → Ni ✓ ✓ (1)

|                                              |                                        |  |
|----------------------------------------------|----------------------------------------|--|
| <u>Marking criteria:</u>                     |                                        |  |
| Ni ← Ni <sup>2+</sup> + 2e <sup>-</sup>      | $\begin{pmatrix} 2 \\ 2 \end{pmatrix}$ |  |
| Ni <sup>2+</sup> + 2e <sup>-</sup> ⇌ Ni      | $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ |  |
| Ni <sup>2+</sup> + 2e <sup>-</sup> ← Ni      | $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ |  |
| Ni ⇌ Ni <sup>2+</sup> + 2e <sup>-</sup>      | $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ |  |
| Ignore if charge is omitted on electron.     |                                        |  |
| If charge (+) is omitted on Ni <sup>2+</sup> |                                        |  |
|                                              | Max. ½                                 |  |

(2)

- 8.2.5 Remains the same ✓ (1)

- 8.2.6 For each mole of atom of nickel oxidised at the anode, a mole of atom of nickel is reduced at the cathode. ✓ ✓ (2)

OR  
Rate of oxidation equals the rate of reduction.

[10]

## QUESTION 9

- 9.1.1 A substance that can act as either an acid or a base ✓ ✓ (2)

- 9.1.2 H<sub>2</sub>O ✓ (1)

- 9.1.3  $n = cv$  ✓  
= (0.05)(0.036) ✓  
= 1.8 × 10<sup>-3</sup> mol H<sub>2</sub>SO<sub>4</sub> ✓  
1.8 × 10<sup>-3</sup> mol H<sub>2</sub>SO<sub>4</sub> neutralised 1.8 × 10<sup>-3</sup> mol Na<sub>2</sub>CO<sub>3</sub> in 25 cm<sup>3</sup>  
+ positive marking from QUESTION 9.1.3 (3)

- 9.1.4  $m = nM$  ✓  
= 1.8 × 10<sup>-3</sup> × 106 ✓  
= 0.1908 g ✓ ✓

|                          |                |       |
|--------------------------|----------------|-------|
| <u>Marking criteria:</u> |                |       |
| ✓ formula                | ✓ ratio of mol | ✓ 106 |
| ✓ correct answer         |                |       |

Also accept:

$$\frac{M_{\text{Na}_2\text{CO}_3}}{n_{\text{Na}_2\text{CO}_3}} = \frac{c_{\text{H}_2\text{SO}_4}}{c_{\text{H}_2\text{SO}_4}}$$

$$1 = \frac{5}{0.05 \times 36}$$

$$c_{\text{Na}_2\text{CO}_3} = 0.072 \text{ mol} \cdot \text{dm}^{-3}$$

$$c = \frac{m}{MV}$$

$$0.072 = \frac{m}{106 \times 0.025}$$

$$m = 0.1908 \text{ g}$$

(4)

- 9.1.5 Positive marking from Question 9.1.2

$$\% \text{Na}_2\text{CO}_3 = \frac{\text{Actual mass}}{\text{Original mass}} \times 100$$

$$= \frac{1.908}{(10)(0.0018)(106)} \times 100 = 1.908 \text{ g Na}_2\text{CO}_3$$

$$= \frac{1.908}{5.13} \times 100$$

$$= 37.19 \%$$

OR

$$25 \text{ cm}^3 \text{ has } 0.1908 \text{ g}$$

$$250 \text{ cm}^3 \text{ has } 10 \times 0.1908 \text{ g} = 1.908 \text{ g}$$

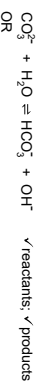
$$\% \text{Na}_2\text{CO}_3 = \frac{1.908}{5.13} \times 100 = 37.19 \%$$

(3)

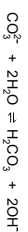
|                               |                        |                  |
|-------------------------------|------------------------|------------------|
| <u>Marking criteria:</u>      |                        |                  |
| ✓ correct calculation of mass | ✓ substitution of 5.13 | ✓ correct answer |

10842 / 19

- 9.2



✓ reactants; ✓ products  
OR



(2)

[15]

## QUESTION 10

|            |                                                                                                                                                                                                                 |                                                |     |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----|
| 10.1       | 10.1.1                                                                                                                                                                                                          | Total percentage mass fertiliser in the bag ✓  | (1) |
| 10.1.2     | Nitrogen, ✓ phosphorous ✓ <b>OR</b> potassium (Any two)                                                                                                                                                         | (2)                                            |     |
| 10.1.3     | % N = $\frac{2}{11} \times 40$ ✓<br>= 2,27 % ✓                                                                                                                                                                  | (3)                                            |     |
| 10.2       | 10.2.1                                                                                                                                                                                                          | Ammonium nitrate or $\text{NH}_4\text{NO}_3$ ✓ | (1) |
| 10.2.2     | Haber process                                                                                                                                                                                                   | (1)                                            |     |
| 10.2.3     | $(\text{NH}_4)_2\text{SO}_4$ ✓                                                                                                                                                                                  | (1)                                            |     |
| 10.2.4     | Ostwald process ✓ <b>OR</b> catalytic oxidation of ammonia                                                                                                                                                      | (1)                                            |     |
| 10.2.5     | So that plants can absorb them from the soil ✓                                                                                                                                                                  | (1)                                            |     |
| 10.2.6     | Eutrophication ✓<br>Any given examples that apply to rivers and dams.<br>Note: do not accept red tide.                                                                                                          | (1)                                            |     |
| 10.2.7     | Nitrogen ✓ and hydrogen ✓                                                                                                                                                                                       | (2)                                            |     |
| 10.2.8     | Sulphur dioxide ✓                                                                                                                                                                                               | (1)                                            |     |
| 10.2.9     | Enhance growth of crops / plants to produce more food for humans ✓<br>Production of fertiliser results in job creation. ✓<br>Selling of fertilisers stimulates the economy. ✓<br>(Any relevant positive impact) | (3)                                            |     |
| TOTAL: 150 |                                                                                                                                                                                                                 |                                                |     |
| [18]       |                                                                                                                                                                                                                 |                                                |     |

## QUESTION/VRAAG 1

|      |       |     |
|------|-------|-----|
| 1.1  | D ✓ ✓ | (2) |
| 1.2  | A ✓ ✓ | (2) |
| 1.3  | A ✓ ✓ | (2) |
| 1.4  | C ✓ ✓ | (2) |
| 1.5  | D ✓ ✓ | (2) |
| 1.6  | A ✓ ✓ | (2) |
| 1.7  | C ✓ ✓ | (2) |
| 1.8  | B ✓ ✓ | (2) |
| 1.9  | A ✓ ✓ | (2) |
| 1.10 | D ✓ ✓ | (2) |

## QUESTION/VRAAG 2

|       |             |     |
|-------|-------------|-----|
| 2.1.1 | A or/of C ✓ | (1) |
| 2.1.2 | B ✓         | (1) |
| 2.1.3 | F ✓         | (1) |
| 2.1.4 | D ✓         | (1) |

2.2.1 4,5-dimethyl ✓ hex-2-ene ✓ / 4,5-dimethielens-2-een

**Marking criteria 2.2.1, 2.2.2 Vasoentdring:**

Only functional group correct/Slegs funksionele groep korrek. Max/Maks:  $\frac{1}{2}$

Whole structure correct/Hele struktuur korrek:

$\frac{2}{2}$

2.2.2

2,3-dibromo-5-methyl ✓ heptane ✓

2,3-dibromo-5-methielheptaan

(2)

2.2.3

4-methyl ✓ pent-2-yne ✓

4-methielpent-2-yn

(2)

2

13

1 0842/20



GAUTENG PROVINCE  
EDUCATION  
REPUBLIC OF SOUTH AFRICA

## GAUTENG DEPARTMENT OF EDUCATION

## GAUTENGSE DEPARTEMENT VAN ONDERWYS

## PREPARATORY EXAMINATION

## VOORBEREIDENDE EKSAMEN

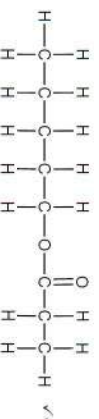
2020

MARKING GUIDELINES  
MASENRIKLYNE

10842

PHYSICAL SCIENCES: CHEMISTRY  
FISIESE WETenskAPPE: CHEMIE  
PAPER/VRAESTEL 2

2.3.1



(2)

**Marking criteria/Masenriklyne**

- Only functional group correct/Slegs funksionele groep korrek:

Max/Maks:  $\frac{1}{2}$

- Whole structure correct/Hele struktuur korrek  $\frac{2}{2}$

2.3.2

Propanoic acid ✓ ✓

Propanoësuur

(1)

2.3.3

Sulphuric acid/ $\text{H}_2\text{SO}_4$  ✓

Swawelsuur/ $\text{H}_2\text{SO}_4$

(1)

## QUESTION/VRAAG 3

|       |                                                                                                                                                                                                |     |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 3.1   | The temperature at which the solid and liquid phase are at equilibrium ✓ ✓<br>Die temperatuur waarty die vaste stof en die vloeistof fase in ewewig is. ✓ ✓                                    | (2) |
| 3.2   | C ✓ It has a lower vapour pressure ✓<br>C ✓ Dit het 'n dampdruk ✓                                                                                                                              | (2) |
| 3.3.1 | Organic compounds with the same molecular formula, but different structural formulae. ✓ ✓<br>Organiese verbindings met dieselfde molekuleêre formule, maar verskillende struktuurformules. ✓ ✓ | (2) |

- 3.32 Compound **B** heptane is less branched/has a longer chain/less compact/less spherical/has a larger surface area. ✓

Stronger intermolecular forces/Van der Waals forces/dispersion forces/London forces/induced dipole-induced dipole forces. ✓  
More energy needed to overcome intermolecular forces ✓

Compound **A**/*n*-methylhexane is more branched/more compact/more spherical/has shorter chain/has a smaller surface area. ✓  
It has weaker intermolecular forces/Van der Waals forces/dispersion forces/London forces/induced dipole-induced dipole forces. ✓  
Less energy needed to overcome intermolecular forces. ✓

Verbinding **B**, heptaan, is minder vertak/has 'n langer ketting/minder kompakt/minder sferies/ het 'n groter oppervlak area. ✓

Sterker intermolekulêre kragte/Van der Waals kragte/dispersiekragte/Londonkragte/geïnduseerde kragte. ✓

Meer energie benodig om intermolekulêre kragte te oorkom. ✓  
OF

Verbinding **A**/*n*-metheksaan is meer vertak/meer kompakt/meer sferies/het 'n korter ketting/gehele 'n kleiner oppervlak area. ✓  
Dit het 'n swakker intermolekulêre kragte/Van der Waals kragte/dispersiekragte/Londonkragte/geïnduseerde dipoolkragte. ✓  
Minder energie word benodig om die intermolekulêre kragte te oorkom. ✓

(3)

- 3.4 Both compounds C and D have hydrogen bonding between molecules. ✓ Compound C has one site for hydrogen bonding whilst compound D has two sites for hydrogen bonding. ✓

Compound C has less sites for hydrogen bonding/weaker hydrogen bonding than compound D.

More energy needed to overcome intermolecular forces in compound D/less energy needed to overcome intermolecular forces in compound E. ✓

Beide verbindings C en D het waterstofbindings tussen die molekule. ✓  
Verbinding C het een plek vir waterstofbinding terwyl verbinding D twee plekke het vir waterstofbinding. ✓

OF  
Verbinding C het minder plekke vir waterstofbinding/swakker waterstofbinding as verbinding D.

Meer energie word benodig om die intermolekulêre kragte te oorkom in verbinding D/minder energie word benodig om die intermolekulêre kragte in verbinding E te oorkom. ✓

(3)

[12]

4

#### QUESTION/VRAAG 4

- 4.1.1 It contains a double bond/C=C between two carbon atoms in its hydrocarbon chain/All carbon atoms not bonded to the maximum number of atoms/four atoms ✓

Daar is dubbeelbindings/C=C tussen twee koolstofatome in die koolwaterstof ketting/Alle koolstofatome is nie gebind aan die maksimum aantal atome vier atome nie. ✓

(1)

- 4.1.2 (a) Addition/Bromination ✓  
(b) Substitution ✓

(1)

Substusie

(1)

- 4.1.3 Heat/sunlight/ultraviolet light ✓  
Hitte/sonlig/ultraviolet lig

(1)

- 4.1.4 Butane/Butaan

(1)

- 4.1.5 Hydrogen bromide/HBr ✓  
Waterstofbromied/ HBr

(1)

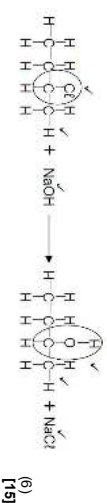
- 4.2.1 Elimination ✓  
Eliminasie

(1)

- 4.2.2 But-2-ene ✓  
But-2-een

(2)

- 4.2.3



(6)

[15]

#### QUESTION/VRAAG 5

- 5.1 Carbon dioxide/CO<sub>2</sub> ✓

Koolstofdioksied/CO<sub>2</sub>

(1)

5.2.1 The decrease in concentration of hydrochloric acid per unit time. ✓  
Die afname in konsentrasie van waterstofchloried per eenheid tyd. ✓

(2)

5.2.2 Concentration (of the acid) ✓

(1)

Konsentrasie (van die suur) ✓

(1)

5.2.3 For a fair test/comparison ✓

(1)

Vir 'n regverdigde toets/of vergelyking ✓

(1)

5.3.1 • Higher acid concentration in experiment 2 means more particles/molecules per unit volume ✓

- More particles have kinetic energy equal to or greater than activation energy/More particles have enough kinetic energy
- More effective collisions per unit time/frequency of effective collisions increases
- Rate of effective collisions increases. ✓

Hoër konsentrasie suur in eksperiment 2 beteken meer deeltjies/molekule per eenheid volume. ✓

Meer deeltjies het kinetiese energie gelyk of groter as die aktiveringsenergie/Meer deeltjies het genoeg kinetiese energie. ✓  
Meer effektiewe botsings per eenheid tyd/frekwensie van effektiewe botsings verhoog

(4)

5.3.2  $n(\text{CaCO}_3) = \text{mM}$

$$= 4/100^\circ = 0,04 \text{ mol}$$

$n(\text{HCl}) : n(\text{CaCO}_3) = 2 : 1$

$n(\text{HCl}) = 2(0,04)^\circ = 0,08 \text{ mol}$

$c(\text{HCl}) = \text{n/V}$

$$0,4 = 0,08 \text{ V}^\circ$$

$$\text{V} = 0,2 \text{ dm}^3 = 200 \text{ cm}^3^\circ$$

(4)

#### Marking Criteria

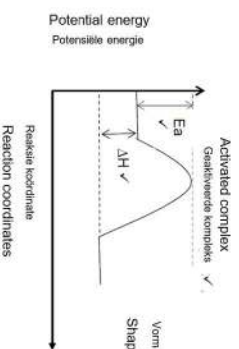
- Substituting 100 into formula mM
- Using ratio 2:1
- Substituting the number of moles into formula  $c = \text{n/V}$
- Final answer
- Verrang 100 in formule mM
- Gebruik verhouding 2:1
- Vervang getal mol in formule  $c = \text{n/V}$
- Finale antwoord

6

5.4

10842/20

10842/20



(4)

[17]

#### QUESTION/VRAAG 6

- 6.1 The reaction is reversible. ✓

(1)

Die reaksie is omkeerbaar. ✓

- 6.2 This reaction is in contact with a catalyst, and therefore is known as the contact process. ✓

(1)

Hierdie reaksie is in kontak met 'n katalisator en daarom staan dit bekend as die Kontakproses. ✓

(1)

- 6.3 If the temperature is too low the reaction rate will be too slow for the yield to be enough. ✓  
Indien die temperatuur te laag is sal die reaksietempo te stadig wees vir die opbrengs om genoeg te wees. ✓

(2)

- 6.3.2 A high temperature favours an endothermic reaction ✓  
If the temperature is high the reverse reaction will be favoured. ✓  
Less product will be formed which is not favourable. ✓

(2)

↳ Hoër temperatuur bevorder die endotermiese reaksie. ✓  
Indien die temperatuur hoog is word die omkeerreaksie reaksie bevoordeel. ✓  
Minder produkte sal vorm en dit is nie voordelig nie. ✓

(3)

5

7

6.4

Marking guideline/Nasienriglyne

- Use the Ratio/Gebruk ratio ✓
- $n(\text{SO}_2)_{\text{before}} = n(\text{SO}_2)_{\text{initial}} - \Delta n(\text{SO}_2)$  ✓
- $n(\text{O}_2)_{\text{before}} = x - \Delta n(\text{O}_2)$  ✓
- Divide equilibrium moles by 200 dm<sup>3</sup> Deel ewewigsmol deur 200 dm<sup>3</sup> ✓
- Correct K<sub>c</sub> expression (formulas in square brackets) ✓
- Korrekt K<sub>c</sub> uitdrukking (formules in blokkies)
- Substitution of values in expression/Vervang van waardes in uitdrukking ✓
- Substitution of/Vervang van 32 g mol<sup>-1</sup> in m = nM ✓
- Final answer/Finale antwoord: 891,17 g ✓
- Range/Gebied: 891,167 – 891,2

|                                                  |                 |                      |                                 |
|--------------------------------------------------|-----------------|----------------------|---------------------------------|
| Initial amount(moles)                            | SO <sub>2</sub> | O <sub>2</sub>       | SO <sub>3</sub>                 |
| Aanvangs hoeveelheid                             | 50              | x                    | 0                               |
| Change in amount(moles)                          | 22              | 11                   | 22                              |
| Vervandering in hoeveelheid                      |                 |                      | Ratio ✓                         |
| Equilibrium amount(moles)                        | 28              | x – 11 ✓             | 22                              |
| Equilibrium concentration(mol·dm <sup>-3</sup> ) | 0,14            | $\frac{x-11}{200}$ ✓ | 0,11                            |
| Ewewigskonentrasie(mol·dm <sup>-3</sup> )        |                 |                      | Divide by 200 dm <sup>3</sup> ✓ |

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 [\text{O}_2]} \quad \checkmark$$

$$7,328 = \frac{(0,14)^2 \left(\frac{x-11}{200}\right)}{(0,11)^2 \cdot 200} \quad \checkmark$$

$$x = 27,849 \text{ mol} \quad \checkmark$$

$$m = n \times M$$

$$= (278,849)(32) \quad \checkmark$$

$$= 891,167 \text{ g} \quad \checkmark$$

(7)

6.5 Forward ✓✓ Voorwaarts

(2) [16]

8

1084/2/20

## QUESTION/VRAAG 7

7.1 Acid-base reaction/neutralisation/problysis ✓

7.1.1

Suur-basis reaksie/neutralisatie/problyse ✓

(1)

7.1.2 Barium hydroxide ✓  
Bariumhidroksied

(1)

7.1.3 X-Burette ✓ Buret

(1)

7.1.4 A white precipitate in a yellow solution that gradually turns orange ✓✓  
n Wit neerslag in n geel oplossing wat geleidelik oranje word. ✓✓

(2)

7.1.5 (a) ✓✓ Remains constant Barium Hydroxide is a strong base that will dissociate/ionise from the start

Bly konstant. Bariumhidroksied is n sterk basis wat sal dissosieer/ioniseer van die begin af. ✓

(b) Decrease ✓ Verminder

(3)

7.1.6

Marking guidelines/Nasienriglyne

- Any formulae/Engse formule. ✓
- Division by Volume ✓ / deel deur volume
- Use mole ratio ✓ gebruik molverhouding
- Use M = 233 g mol<sup>-1</sup> in m = nM ✓
- Answer = 1,165 g ✓

OPTION 1: OPSIE 1

$$\frac{c_a V_a}{c_b V_b} = \frac{n_b}{n_a}$$

$$\frac{c_a (30)}{(0,1)(50)} = 1$$

$$c_a = 0,167 \text{ mol} \cdot \text{dm}^{-3}$$

$$c = \frac{n}{V}$$

$$0,167 = \frac{n}{0,03}$$

$$n = 0,005 \text{ mol}$$

OPTION 2: OPSIE 2

$$c = \frac{n}{V}$$

$$0,1 = \frac{0,05}{V}$$

$$V = 0,005 \text{ mol}$$

$$n(\text{BaSO}_4) = n(\text{Ba}(\text{OH})_2) \quad \checkmark$$

$$m = n \times M$$

$$= (0,005)(233) \quad \checkmark$$

$$= 1,165 \text{ g} \quad \checkmark$$

(5)

9

7.2 NH<sub>4</sub>(aq) + H<sub>2</sub>O(l) → NH<sub>3</sub>✓ + H<sub>3</sub>O<sup>+</sup> ✓ (2)7.2.2 CH<sub>3</sub>COOH(aq) + H<sub>2</sub>O(l) → CH<sub>3</sub>COO<sup>-</sup> + OH<sup>-</sup> ✓ (2) [17]

## QUESTION/VRAAG 8

8.1 A galvanic/voltaic cell ✓ Galvaniese sel/voltiese sel ✓ (1)

8.2 A<sub>2</sub>(s) | A<sup>3+</sup>(aq) (1 mol·dm<sup>-3</sup>) || Cu<sup>2+</sup>(aq) (1 mol·dm<sup>-3</sup>) | Cu(s) ✓

Accept

8.3 At I A<sup>2+</sup> || Cu<sup>2+</sup> | Cu A<sub>2</sub> to Cu<sup>+</sup> (3)8.4 A<sub>2</sub> → A<sup>3+</sup> + 3e<sup>-</sup> ✓✓ A<sub>2</sub> na Cu ✓ (1)

Marking guidelines/Nasienriglyne

- $A_2 \rightleftharpoons A^{3+} + 3e^-$  ✓✓  $A_2$   $A^{3+} + 3e^- \rightleftharpoons A_2$   $\frac{0}{2}$
- $A^{3+} + 3e^- \rightarrow A_2$   $\frac{0}{2}$   $A^{3+} + 3e^- \rightarrow A_2$   $\frac{0}{2}$
- Ignore if charge omitted on electron/Ignoreer indien lading weggelaat op elektron.
- If charge (+) omitted on A<sup>3+</sup> /Indien lading (+) weggelaat op A<sup>3+</sup>:  
Example/Voorbeeld: A<sub>2</sub> → A<sup>3+</sup> + 3e<sup>-</sup>

Max./Maks:  $\frac{1}{2}$ 8.5 E<sup>o</sup><sub>cell</sub> = E<sup>o</sup><sub>reduction</sub> - E<sup>o</sup><sub>oxidation</sub> ✓ (2)

= 0,34V - (-1,66) ✓ = 2V ✓ (4)

Notes

- Accept any other correct formula from the data sheet/aanvaar enige ander korrekte formule vanaf gegeweblad
- Any other formula using unconventional abbreviations, e.g. E<sup>o</sup><sub>red</sub> = E<sup>o</sup><sub>ox</sub> - E<sup>o</sup><sub>ox</sub> followed by correct substitutions/Engse ander formule wat onkonvensionele afkortings gebruik by: E<sup>o</sup><sub>red</sub> = 34
- E<sup>o</sup><sub>ox</sub> = E<sup>o</sup><sub>reduc</sub>ig deur korrekte vervangings  $\frac{3}{4}$

10

1084/2/20

8.6 Decrease ✓ Verminder (1)

8.6.2 NEGATIVE MARKING FROM 8.6.1/NEGATIEWE NASIEN VANAF 8.6.1

The concentration of A<sup>3+</sup> will increase. According to Le Chatelier the system needs to decrease the concentration. ✓  
The reverse reaction will be favoured. ✓  
Therefore the reading will decrease. ✓

Die konsentrasie van A<sup>3+</sup> sal vermeerder. Volgens Le Chatelier sal die sisteem die konsentrasie moet verlaag. ✓  
Die terugwaartse reaksie sal bevoordeel word. ✓  
Dus sal die lesing verminder. ✓

(3)

8.7 Chemical energy to electrical energy ✓

Chemiese potensiele energie na elektriese energie. ✓

(1) [16]

## QUESTION/VRAAG 9

9.1 A ✓ (1)

9.2 Cu<sup>2+</sup> + 2e<sup>-</sup> → Cu ✓✓ (2)

9.3 Marking guidelines/Nasienriglyne

- Multiply n<sub>2</sub> or m<sub>2</sub> ✓ Vermenigvuldig n<sub>2</sub> of m<sub>2</sub>
- Molar mass = 31,75g ✓
- Molar at anode = (31,75 + 15,8)g ✓
- Answer/antwoord 66,77% ✓

$$\frac{n}{m} = \frac{M}{m}$$

$$(0,25 \times 2) = \frac{31,75}{m}$$

$$m = 31,75 \text{ g}$$

$$\frac{\% \text{purity}}{\% \text{molar at anode}} \times 100 = \frac{31,75}{31,75 + 15,8} \times 100$$

$$= 66,67\% \quad \checkmark$$

0,25 mol Cu formed in 1 800 s so in 3 600s (2X0,25) mol formed 0,25 mol Cu vorm in 1 800 s dus in 3 600 s (2X0,25) mol gevorm (4)

9.4.1 Electrolyte is a solution/liquid/dissolved substance that conducts electricity through the movement of ions (2 or 0)

Elektroliete is n oplossing/vloeistof/opgeloste stof wat elektrisiteit geleidelik deur die beweging van ione ✓✓ (2 of 0) (2)

9.4.2 The rate of oxidation is equal to the rate of reduction. ✓

Die tempo waarteen oksidasie plaasvind is gelyk aan die tempo van

(1) [10]

11

## QUESTION/RAAG 10

10.1 Nitrogen ✓ *stikstof*  
 10.1.1 Phosphorus ✓ *fosfor*  
 Potassium ✓ *kallium*

## Acceptaanvaar

N : P : K

10.1.2 Potassium/K ✓

*Kallium/ K*

10.1.3 Phosphates/P ✓

*Fosfate/ P*

10.1.4 Haber or/of Ostwald ✓

10.2 Eutrophication: The process by which an ecosystem eg. A river or dam, becomes enriched with inorganic nutrients, especially phosphorus and nitrogen, resulting in excessive plant growth. ✓

Eutrofikasie: Die proses waarty 'n ekosisteem bv. 'n rivier of dam, verryk word met anorganiese voedingsstowwe, veral fosfor en stikstof, wat 'n oorgroot toename in plantegroei tot gevolg het. ✓

10.3 Marking guidelines/Nasienriglyne

- $m(N) = \frac{1}{2} \times 36$  ✓
- Double up on Fertilizer B ✓ *verduubel kunsmis B*
- Fertilizer A  $m(N) = 24\text{kg}$ ,  $m(P)=m(K) = 6\text{ kg}$  ✓
- Fertilizer B  $m(N) = 19,09\text{kg}$ ,  $m(P)=m(K) = 5,45\text{ kg}$  ✓
- Answer Fertilizer B ✓

## Fertilizer A/kunsmis A

In 100kg 4.1.(36)

$$m(N) = \frac{1}{2} \times 36 \quad \checkmark$$

$$= 24\text{ kg} \quad \checkmark$$

$$m(P)=m(K) = \frac{1}{2} \times 36 \quad \checkmark$$

$$= 6\text{ kg} \quad \checkmark$$

## Fertilizer B/kunsmis B

In 50 kg 7.2.(15)

$$\therefore \text{In } 100\text{kg } 14,4.(30) \quad \checkmark$$

$$m(N) = \frac{1}{2} \times 30 \quad \checkmark$$

$$= 19,09\text{ kg} \quad \checkmark$$

$$m(P)=m(K) = \frac{14}{22} \times 30 \quad \checkmark$$

$$= 5,45\text{ kg} \quad \checkmark$$

Therefore Fertilizer B will be the best ✓

*Kunsmis B sal die beter een wees.*

(5)

[13]

TOTAL/TOTAAL: 150

12