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GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2017

10842

PHYSICAL SCIENCES: CHEMISTRY

SECOND PAPER

TIME: 3 hours

MARKS: 150

15 pages + 4 information sheets + 1 answer sheet

PHYSICAL SCIENCES: Paper 2
1084E

10842E

X10

GAUTENG DEPARTMENT OF EDUCATION

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PHYSICAL SCIENCES
(Second Paper)

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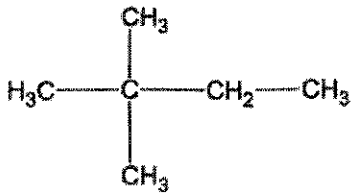
INSTRUCTIONS AND INFORMATION

1. This question paper consists of 9 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start the answer to each question on a NEW page.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line open between sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round-off your final numerical answers to a minimum of TWO decimal places.
10. Give brief discussions, et cetera where required.
11. Write neatly and legibly.
12. Detach the answer sheet for Question 4.3.1 and hand it in with your ANSWER BOOK.

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 Cl_2 to but-1-ene?

A $CH_3CH_2CH_2CHCl_2$
B $CH_3CH_2CHClCH_2Cl$
C $ClCH_2CH_2CH_2CH_2Cl$
D $CH_3CH_2CCl_2CH_3$ (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 $Ag^+ + e^- \rightleftharpoons Ag$ $E^\theta = +0,80$ V
B $Pb^{2+} + 2e^- \rightleftharpoons Pb$ $E^\theta = -0,13$ V
C $Ni^{2+} + 2e^- \rightleftharpoons Ni$ $E^\theta = -0,27$ V
D $Sn^{2+} + 2e^- \rightleftharpoons Sn$ $E^\theta = -0,12$ V (2)

1.5 Consider the following results of experiments.

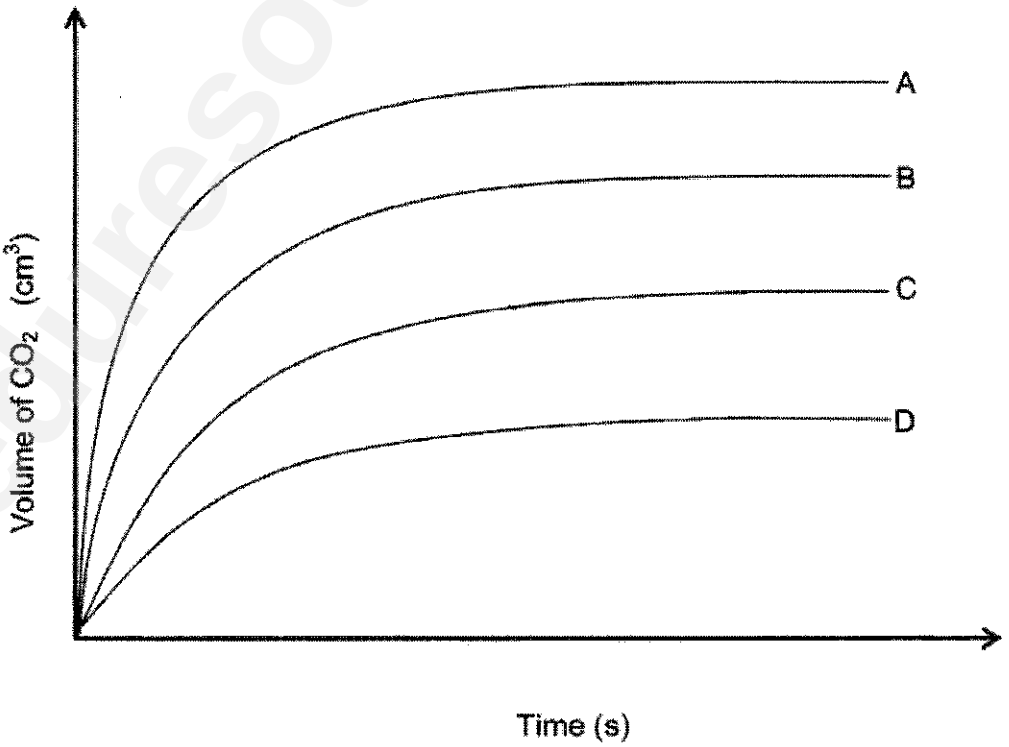
	Experiment 1	Experiment 2
Reactants	Powdered Cu and HCl	Chunk of Cu and HNO_3
Temperature	20°C	10°C
Concentration of Acid	0,6 mol·dm^{-3} HCl	0,4 mol·dm^{-3} HNO_3
Rate	Low	High

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)

P.T.O.

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)

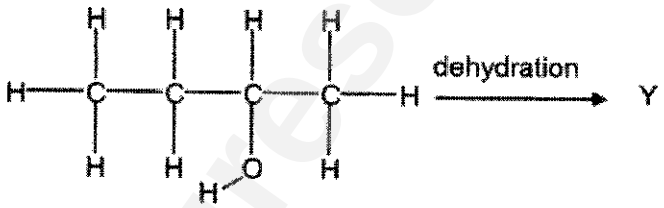
1.8 A student wishes to prepare approximately 100 cm^3 of an aqueous solution of 6 $mol{\cdot}dm^{-3}$ HCℓ using 12 $mol{\cdot}dm^{-3}$ HCℓ. The correct procedure to follow is to add 50 cm^3 of ...

A 12 $mol{\cdot}dm^{-3}$ HCℓ to 100 cm^3 of water.
B 12 $mol{\cdot}dm^{-3}$ HCℓ to 50 cm^3 of water.
C water to 50 cm^3 of 12 $mol{\cdot}dm^{-3}$ HCℓ.
D water to 100 cm^3 of 12 $mol{\cdot}dm^{-3}$ 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 ΔH 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.

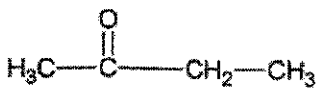


Which ONE of the following is the correct condensed structural formula for compound **Y**?

A $H_3C—CH{=}CH—CH_3$

B $H_3C—CH_2—CH_2—CH_3$

C $H_3C—CH_2—CH_2—CH_2—OH$

D 

(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	$CH_3CH_2CH_2CH(OH)CH_3$
B	99	$CH_3CH_2OOCCH_2CH_3$
C	103	$CH_3CH_2CH_2CH_2CHO$
D	187	$CH_3CH_2CH_2CH_2COOH$

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]

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.

$$C_{15}H_{32} \rightarrow \mathbf{X} + C_3H_6 + C_8H_{16} \quad \text{(I)}$$

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:

$$C_2H_5OH(g) \xrightarrow{\text{catalyst}} \mathbf{X} + H_2O \quad \Delta H = +45\ kJ{\cdot}mol^{-1} \quad \text{(II)}$$

3.4.2 Identify **X.** (1)

3.4.3 Name the type of elimination reaction that occurs in REACTION II. (1)

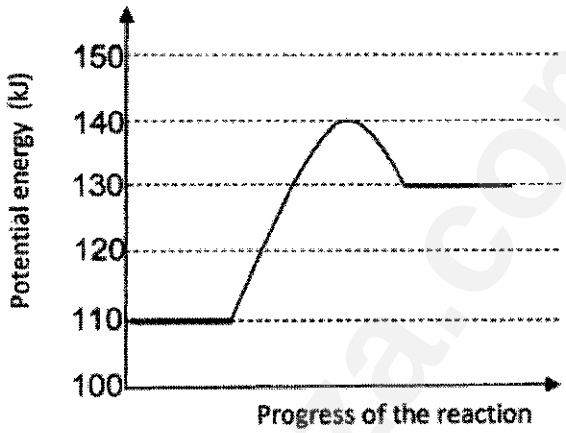
3.4.4 Define *addition polymerization.* (2)

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.

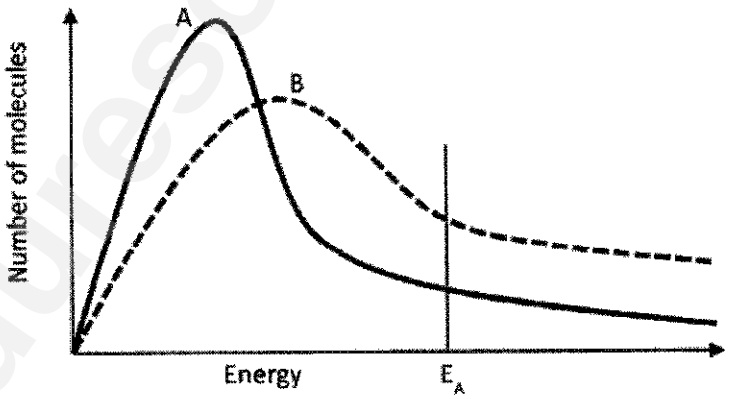


For the **reverse reaction**, write down the value of the ...

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.

$$4AO_{2(g)} \rightleftharpoons 2A_2O_{3(g)} + O_{2(g)}$$

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.

$$H_2PO_4^- + HAsO_4^{2-} \rightarrow HPO_4^{2-} + H_2AsO_4^-$$

Write down the name of the conjugate base of $H_2PO_4^-$. (1)

6.3 In a titration, a 20 cm^3 potassium hydroxide solution was neutralized by 15 cm^3 dilute sulfuric acid with a concentration of 0,1 $mol{\cdot}dm^{-3}$.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

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 (NH_4Cl) reacts with water.

$$NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$$

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

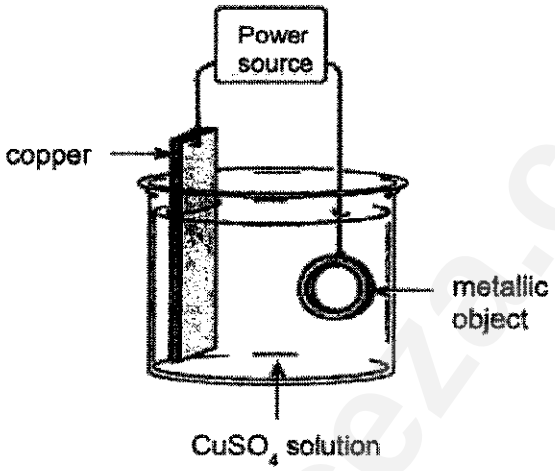
6.4.2 What will the approximate pH of the salt solution be? Choose from EQUAL TO, SMALLER THAN 7 or GREATER THAN 7. (1)

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 ($CuSO_4$).



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

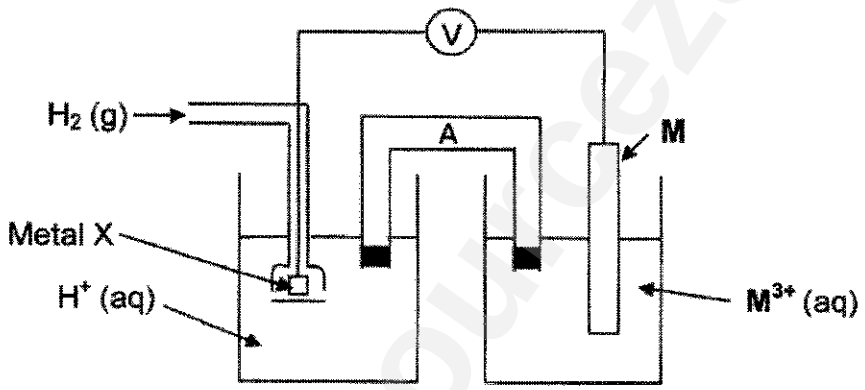
8.1 The standard cell potential produced by a voltaic cell consisting of a platinum electrode in contact with a solution of Co^{3+} ions and a silver electrode in contact with a solution of Ag^{+} ions, is 1,01 V.

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, $M^{3+}(aq)$.



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 M^{3+} ions?

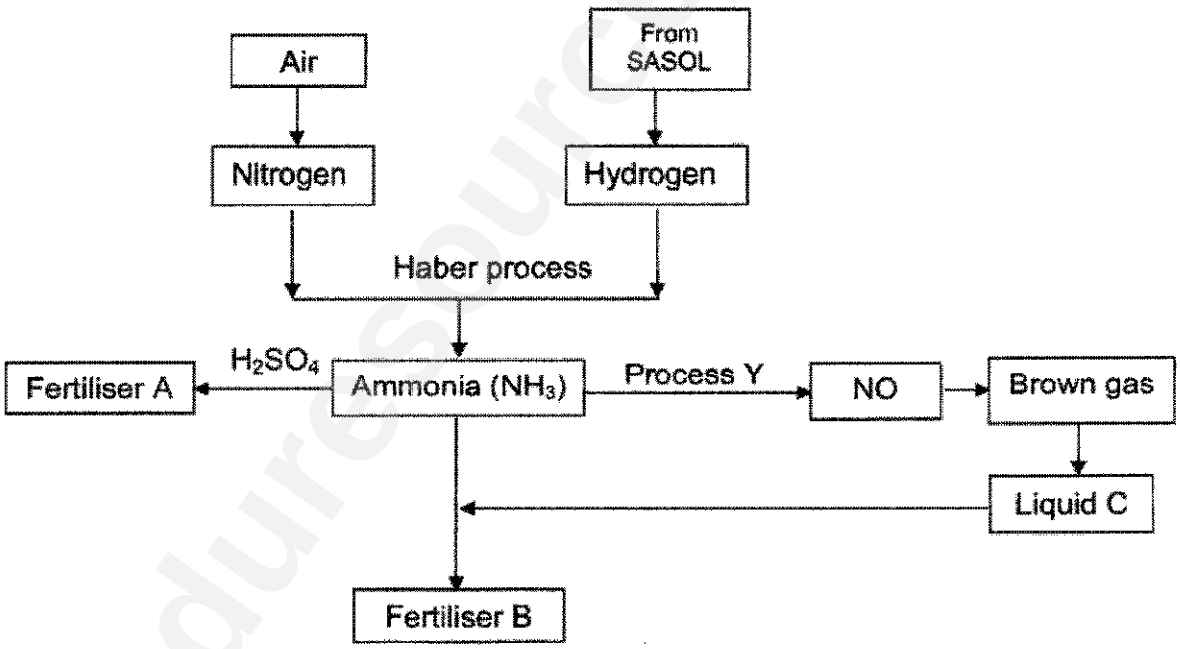
Write only INCREASE, DECREASE or HAVE NO EFFECT.
Give a reason for your answer. (2)

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)

9.2 Give the chemical FORMULAE or NAMES of fertilisers

9.2.1 A. (1)

9.2.2 B. (1)

9.3 Mention TWO ways in which the use of fertilisers cause damage to rivers and dams. (2)

9.4 A farmer stores fertilizers with NPK ratios 4:5:8 and 13:5:9.

The farmer wants to grow tomatoes and other fruit.

9.4.1 Explain the meaning of *NPK ratio.* (1)

9.4.2 Which ONE of these fertilizers is more suitable to grow fruit? (1)

9.4.3 Give a reason for the answer to Question 9.4.2. (2)

9.4.4 After a soil analysis, it is found that the soil has a shortage of potassium. The following two fertilizers are at your disposal.

Fertilizer D: 4:5:8 (25) **Fertiliser E: 13:5:9 (20)**

One of these fertilizers must be used to increase the potassium content of this soil.

By means of a calculation determine which of these two fertilizers, D or E, will be the most suitable. (3)

[16]

TOTAL: 150

END

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

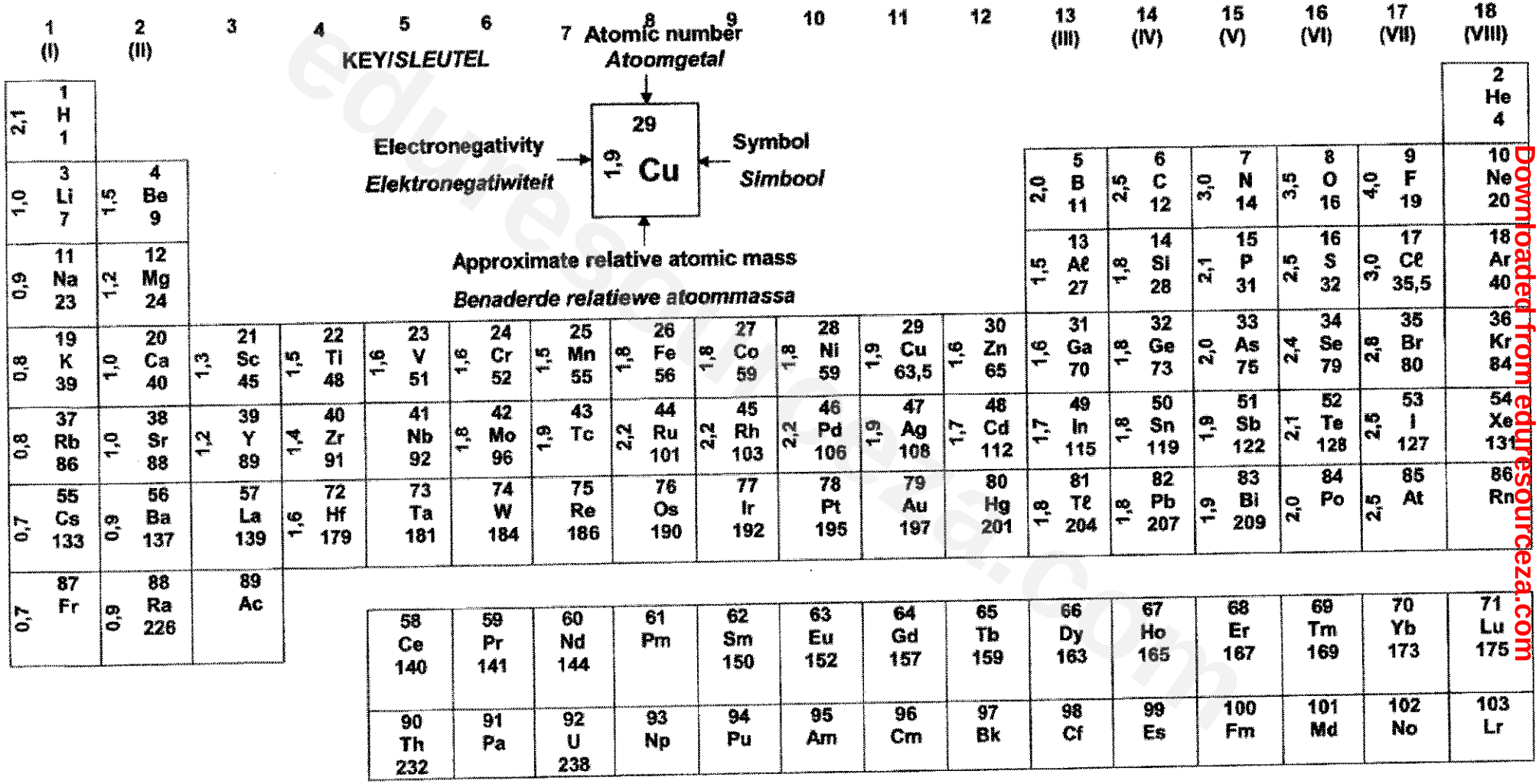
TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^θ	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^θ	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro se konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_M}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/by 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ Or/of $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ Or/of $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ / $E^\theta_{sel} = E^\theta_{oksideer\ middel} - E^\theta_{reduseer\ middel}$	

P.T.O.



1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
																	2 He 4
2,1 H 1												2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
1,0 Li 7	1,5 Be 9											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,9 Na 23	1,2 Mg 24											1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Cs 133	0,9 Ba 137	57 La 139	1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201						
0,7 87 Fr	0,9 88 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

TABLE 3: THE PERIODIC TABLE OF ELEMENTS / *TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

Half-reactions/*Halfreaksies*	E^{θ} (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(\ell) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(\ell)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	**0,00**
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	– 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	– 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	– 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	– 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	– 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	– 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	– 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	– 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	– 0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	– 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	– 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	– 1,18
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	– 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	– 2,36
$Na^+ + e^- \rightleftharpoons Na$	– 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	– 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	– 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	– 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	– 2,92
$K^+ + e^- \rightleftharpoons K$	– 2,93
$Li^+ + e^- \rightleftharpoons Li$	– 3,05

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	⇌	Li	− 3,05
$K^+ + e^-$	⇌	K	− 2,93
$Cs^+ + e^-$	⇌	Cs	− 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Na^+ + e^-$	⇌	Na	− 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Al^{3+} + 3e^-$	⇌	Al	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+ 1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

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ANSWER SHEET

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QUESTION 4.3.1

Hand in this ANSWER SHEET with your ANSWER BOOK.