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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

PHYSICAL SCIENCES P2: CHEMISTRY

SEPTEMBER 2015

MEMORANDUM

MARKS: 150

QUESTION 1

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

QUESTION 2

2.1		
2.1.1	U✓	(1)
2.1.2	S✓	(1)
2.1.3	P✓	(1)
2.1.4	Q and S✓	(1)
2.2		
2.2.1	2,2-Dibromo-4,4-dimethylpentane	

Marking Criteria:

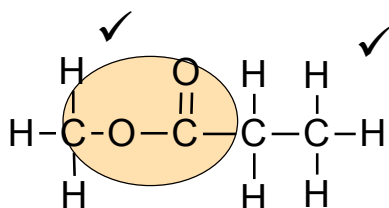
- Correct stem i.e pentane✓
- All substituents correctly identified✓
- Substituent correctly numbered, in alphabetical order, hyphens and commas correctly used✓

2.2.2	Hexan-3-one ✓✓	(3)
		(2)

2 or 0

2.3

2.3.1

**Marking criteria**

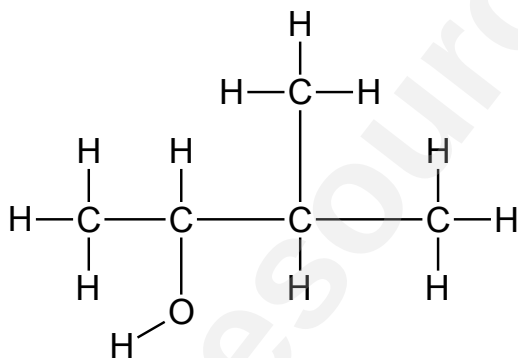
- Whole structure correct $\frac{2}{2}$
- Only functional group correct $\frac{1}{2}$

Notes:

- If two or more functional groups: $\frac{0}{2}$
- Condensed or semi-structural formula: $\frac{1}{2}$
- Molecular formula $\frac{0}{2}$

(2)

2.3.2

**Marking criteria**

- Four saturated C atoms in longest chain i.e. butane✓
- Methyl substituent on third C and –OH group on second C✓

Notes:

- if correct structure and number of bonds, but H atoms omitted: max $\frac{1}{2}$
- condensed or semi-structural formula: max $\frac{1}{2}$
- molecular formula: $\frac{0}{2}$

(2)

2.4

The carbon atom that bears the –OH group is bonded to only two alkyl groups.✓

(1)

[14]

QUESTION 3

- 3.1 The temperature ✓ at which the vapour pressure of a substance equals the ambient (atmospheric) pressure ✓ (2)
- 3.2 Carboxyl group ✓ (1)
- 3.3
- 3.3.1 Boiling point ✓ (1)
- 3.3.2 Molecular mass ✓ (1)
- 3.4
- Molecules in hexane are held together by weak London forces/ dispersion forces/ induced dipole forces/ London dispersion forces/ keesom forces ✓
 - Molecules in pentan-1-ol are, in addition to weak London forces, held together by strong hydrogen bonds ✓
 - Therefore intermolecular forces in an alcohol (pentan-1-ol) are stronger or need more energy than those in an alkane (hexane) ✓ (3)
- 3.5
- 3.5.1 (Compound) Z: Two sites for hydrogen bonding/ forms dimers ✓
(Compound) Y: One site for hydrogen bonding ✓ (2)
- 3.5.2 (Compound) Z ✓
It has a higher boiling point ✓ (2)

[12]**QUESTION 4**

- 4.1
- 4.1.1 H₂/ Hydrogen (gas) ✓
Accept:
Dihydrogen (1)
- 4.1.2 (catalytic) hydrogenation ✓ (1)
- 4.1.3 Pd (Palladium) ✓
OR
Ni (Nickel)
OR
Pt (Platinum) (1)
- 4.1.4 In the manufacture of margarine ✓ (1)

4.2

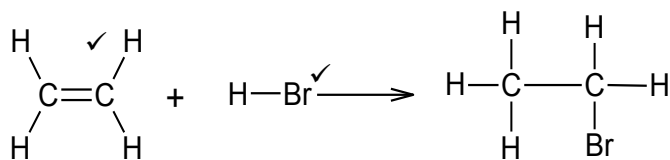
4.2.1 Addition ✓

Accept:

Hydrohalogenation/ Hydrobromination

(1)

4.2.2



(4)

4.2.3 Halo-alkanes/ Halogenoalkanes/ Alkylhalides ✓

Accept:

Organic halides

(1)

4.3

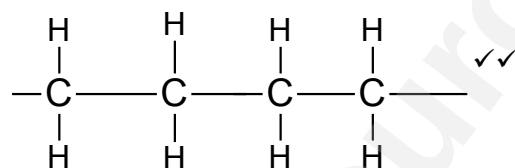
4.3.1 Ethene molecules combine to form the repeating unit of compound Q, a polymer. ✓✓

(2)

4.3.2 Addition ✓

(1)

4.3.3



(2)

[15]**QUESTION 5**

5.1 Conical (flask) ✓

OR

Erlenmeyer (flask)

(1)

5.2

5.2.1 Concentration ✓

(1)

5.2.2

Criteria for hypothesis:

Mark

Refers to relationship between dependent and independent variables	✓
Statement that can be proved correct or incorrect – prediction based on (prior) knowledge.	✓

Examples:

- Reaction rate (or volume of hydrogen gas produced per unit time) increases with increase in concentration.
OR
- Reaction rate (or volume of hydrogen gas produced per unit time) decreases with increase in concentration.
OR
- The higher the concentration (of HCl) the faster the rate of reaction. (2)

5.3 Mg is completely used up/ No more H₂(g) is being produced / The reaction has ceased✓ (1)

5.4 20 s✓ (1)

5.5 ⓪ (Experiment) 2 ✓
→ Higher (acid) concentration in experiment 2✓ (2)

5.6 A✓
Steeper slope/ greater gradient/ takes shorter time✓
(apply negative marking: do not attend to reasons or explanation when a learner has declared a statement True if it is actually False or vice versa) (2)

5.7 To make a fair test/ comparison✓ (1)

5.8 Reaction rate increases with increase in concentration (of HCl).✓
OR
Reaction rate (volume of hydrogen gas produced per unit time) decreases with a decrease in concentration (1)

5.9	OPTION 1: $n(\text{H}_2) = \frac{V}{V_m} \checkmark$ $= \frac{0,12}{24,0} \checkmark$ $= 0,005 \text{ mol}$ $\therefore m(\text{H}_2) = n \cdot M$ $= (0,005)(2) \checkmark$ $= 0,01 \text{ g} \checkmark$	OPTION 2: $n(\text{Mg}) = \frac{m}{M}$ $= \frac{0,12}{24} \checkmark$ $= 0,005 \text{ mol}$ $n(\text{H}_2) = 0,005 \text{ mol}$ $\therefore m(\text{H}_2) = n \cdot M$ $= (0,005)(2) \checkmark$ $= 0,01 \text{ g} \checkmark$	
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(4)

5.10 In terms of powder:

- Larger (exposed) surface area/ contact area✓
- Therefore there will be a larger number of effective collisions per unit time✓
(**OR:**Therefore frequency of effective collisions increases)

(2)

[18]**QUESTION 6**

6.1 One which is isolated from its surroundings/

One in which there is no mass transferred into or out of the system✓✓ (2)

6.2

CALCULATIONS USING MOLES:

Mark allocation:

- $n = \frac{m}{M}$ ✓
- $n_{\text{eq}}(\text{HgO}) = 0,32 \text{ mol}$ ✓
- $n_i(\text{HgO}) = 0,52 \text{ mol}$ ✓
- $\Delta(\text{HgO}) = \text{initial} - n_{\text{eq}}(\text{HgO})$ ✓
- Using ratio HgO: $\text{O}_2 = 2:1$ ✓
- Equil $n(\text{O}_2) = \text{initial} + \text{change}$ ✓
- Divide $n(\text{O}_2)$ by $0,25 \text{ dm}^3$ ✓
- Correct K_c expression (formula in square brackets) ✓
- Final answer: $0,40$ ✓

$$\begin{aligned}
 n(\text{HgO}) &= \frac{m}{M} \checkmark \\
 &= \frac{112,84}{217} \\
 &= 0,52 \text{ mol} \\
 n_{\text{eq}}(\text{HgO}) &= \frac{69,44}{217} \\
 &= 0,32 \text{ mol}
 \end{aligned}$$

	2HgO	2Hg	O ₂	
R	2	2	1	
I (mol)	0,52✓	0	0	
C (mol)	-0,20✓	+0,20	0,10	ratio✓
E (mol)	0,32✓	0,20	0,10✓	
$c = \frac{n}{V}$ (mol·dm ⁻³)	-	-	0,40	÷0,25✓

$$K_c = [O_2] \checkmark$$

$$= 0,40 \checkmark \quad (9)$$

6.3

6.3.1 Increases ✓ (1)

6.3.2 Remains the same ✓ (1)

6.3.3 Remains the same ✓ (1)

6.4

- Increase in pressure favours the reaction that leads to smaller number of moles/ volume of gas. ✓
 - Reverse reaction is favoured/ Equilibrium position shifts to the left ✓
- (2)

[16]**QUESTION 7**

7.1

7.1.1 Endothermic ✓ (1)

7.1.2 It can behave both as an acid and as a base ✓ (1)

7.1.3

$$K_w = [H^+][OH^-] = 2,92 \times 10^{-14} \checkmark$$

$$\text{In water } [H^+] = [OH^-] = 1,71 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3}$$

$$\therefore [H^+] = 1,71 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$\text{But pH} = -\log[H_3O^+] \checkmark$$

$$= -\log(1,71 \times 10^{-7})$$

$$= 6,77 \checkmark$$

(4)

7.2

7.2.1

OPTION 1:	OPTION 2:
$c = \frac{n}{V} \checkmark$ $0,5 = \frac{n}{0,2} \checkmark$ $\therefore n = 0,1 \text{ mol}$ $\therefore m(\text{NaOH}) = nM$ $= (0,1)(40) \checkmark$ $= 4 \text{ g} \checkmark$	$m(\text{NaOH}) = cMV \checkmark$ $= (0,5)(40) \checkmark (0,2) \checkmark$ $= 4 \text{ g} \checkmark$

(4)

7.2.2 No✓

(1)

7.2.3 The NaOH must be added to the less water, shaken to dissolve the NaOH and more water must then be added until the volume of the solution is 200 cm³.✓
 (If YES; apply negative marking: do not attend to reasons or explanation when a learner has declared a statement True if it is actually False or vice versa)

(1)

7.2.4 Burette (Buret)✓

OR

Pipette

(1)

7.2.5 Strong (acid)✓. Undergoes complete ionisation in water.✓

(2)

7.2.6 $n(\text{H}_2\text{SO}_4) = c \cdot V \checkmark$
 $= (0,1)(0,3) \checkmark$
 $= 0,03 \text{ mol} \checkmark$

(3)

7.2.7 POSITIVE MARKING FROM QUESTION 7.2.1

$$n(\text{NaOH}) = 0,1 \text{ mol}$$

$$\text{But } n(\text{NaOH}) : n(\text{H}_2\text{SO}_4) = 2:1 \checkmark$$

$$\therefore 0,03 \text{ mol H}_2\text{SO}_4 \text{ will neutralise } 0,06 \text{ mol NaOH}$$

$$\begin{aligned} \text{Excess } n(\text{NaOH}) &= 0,1 - 0,06 \\ &= 0,04 \text{ mol } \checkmark \end{aligned}$$

$$\begin{aligned} c(\text{NaOH}) &= \frac{n}{V} \\ &= \frac{0,04}{0,5} \checkmark \\ &= 0,08 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

OPTION 1:	OPTION 2:
$K_w = [\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$ $\therefore [\text{H}^+] = \frac{1 \times 10^{-14}}{0,08}$ $= 1,25 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3} \checkmark$	$\text{pOH} = -\log[\text{OH}^-]$ $= -\log(0,08)$ $= 1,0969$ $\text{pH} = 14 - 1,0969$ $= 12,9031$ $\therefore [\text{H}^+] = 10^{-12,9031}$ $= 1,25 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$ OR $[\text{H}^+] = 10^{-12,9031}$ $= 1,25 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$

(4)

[21]

QUESTION 8

8.1.1 The gain of electrons (by a chemical substance) $\checkmark$ (1)

8.1.2 A

 MnO_4^- is a stronger oxidizing agent $\checkmark$ than Cl_2 . $\checkmark$

Therefore it (MnO_4^-) will oxidise Cl^- ions to Cl_2 , a poisonous/ toxic/ noxious gas $\checkmark$

(B: apply negative marking: do not attend to reasons or explanation when a learner has declared a statement True if it is actually False or vice versa)

(3)

8.2

8.2.1 E $\checkmark$

(1)

8.2.2 Platinum/Pt $\checkmark$

OR

Graphite/C

(1)

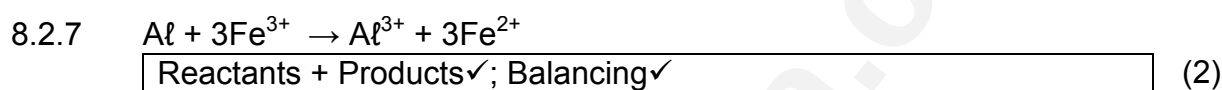
8.2.3 Y $\checkmark$

(1)

8.2.4 $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta} \checkmark$
 $= +0,77 - (-1,66) \checkmark$
 $= 2,43 \text{ V} \checkmark$ (3)

- 8.2.5 ANY ONE:
- Measure the concentrations of the electrolytes to ensure they are $1 \text{ mol} \cdot \text{dm}^{-3} \checkmark$
 - Measure the temperature to ensure it is $25^{\circ}\text{C} / 298 \text{ K} \checkmark$ (1)

8.2.6 This stops too much mixing of the contents of the salt bridge with the contents of the two beakers. $\checkmark$ (1)



[14]

QUESTION 9

- 9.1 A solution/ liquid/ dissolved substance that conducts electricity through the movement of ions. (1)
- 9.2 Cathode $\checkmark$ (1)
- 9.3
- 9.3.1 $\text{Ag}^{+} + \text{e}^{-} \rightarrow \text{Ag} \checkmark \checkmark$ (2)
- 9.3.2 AgNO_3 / Silver nitrate $\checkmark$
 Accept: CH_3COOAg / Silver Ethanoate (1)
- 9.4 Graphite is a conductor of electricity $\checkmark$
 OR
 Plastic is not a conductor of electricity
 (Plastic cannot conduct electricity and a conducting surface is needed to complete the circuit) (1)
- 9.5 To give it an even coat $\checkmark$
 (so that it gets plated evenly all over) (1)

9.6 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$
 $Q = I \cdot \Delta t$
 $= (0,193)(2500)$
 $= 482,5 \text{ C} \checkmark$
 $n(\text{e}^-) = \frac{Q}{F}$
 $= \frac{482,5}{96500}$
 $= 0,005 \text{ mol}$
 $\therefore n(\text{Ag}) = n(\text{e}^-) = 0,005 \text{ mol} \checkmark$
 $m(\text{Ag}) = n \cdot M = (0,005)(108) = 0,54 \text{ g} \checkmark$

OR

$$n(\text{e}^-) = \frac{Q}{Q_{1\text{mol}}}$$

$$= \frac{482,5}{1,6 \times 10^{-19} \times 6,02 \times 10^{23}}$$

$$= 0,005 \text{ mol}$$

$$\therefore n(\text{Ag}) = n(\text{e}^-) = 0,005 \text{ mol} \checkmark$$

$$m(\text{Ag}) = n \cdot M = (0,005)(108) = 0,54 \text{ g} \checkmark \quad (3)$$

[10]

QUESTION 10

- 10.1
- 10.1.1 Ammonia $\checkmark$ (1)
- 10.1.2 Pt-Rh/ Platinum -Rhodium $\checkmark$
OR Platinum/Pt $\checkmark$ (1)
- 10.1.3 Water gas $\checkmark$
OR
 Natural gas (methane) (1)
- 10.2 NH_4NO_3 / Ammonium nitrate $\checkmark$ (1)
- 10.3 It will lower the yield of nitrogen monoxide (NO), and therefore of nitric acid. (1)
- 10.4 **ANY ONE:**
- Enhances plant growth to produce more food $\checkmark$ for humans
 - Production and application of fertilisers result in job creation $\checkmark$
 - Selling of fertilisers stimulate the country's economy $\checkmark$ (1)

10.5

10.5.1 2:5:3✓

(1)

10.5.2 The **K** is higher and the **N** lower.✓ Higher **K** will enhance fruit development and lower **N** will prevent the plants from growing leaves instead of fruit.✓

(2)

[9]**TOTAL [150]**