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✓

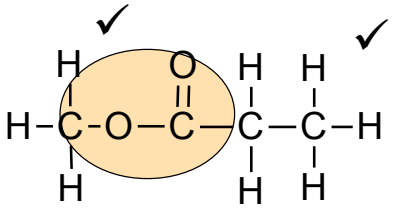
(3)

2.2.2 Hexan-3-one ✓✓ (2)

2 or 0

2.3

2.3.1



Marking criteria

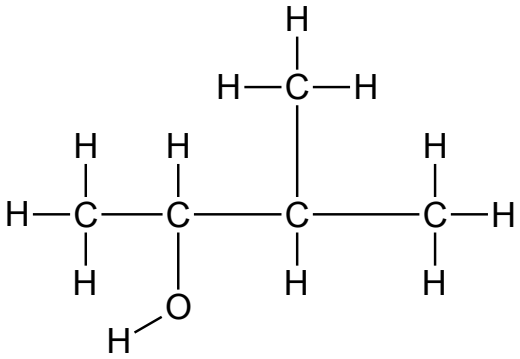
- Whole structure correct $2/2$
- Only functional group correct $1/2$

Notes:

- If two or more functional groups: ' $0/2$
- Condensed or semi-structural formula: $1/2$
- Molecular formula $0/2$

(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 $1/2$
- condensed or semi-structural formula: max $1/2$
- molecular formula: $0/2$

(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 H_2/ Hydrogen (gas)✓
Accept:
Dihydrogen (1)

4.1.2 (catalytic) hydrogenation✓ (1)

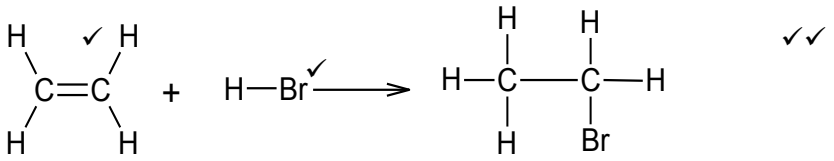
4.1.3 Pd (Palladium)✓
OR
Ni (Nickel)
OR
Pt (Platinum) (1)

4.1.4 In the manufacture of margarine✓ (1)

4.2

4.2.1 Addition ✓
Accept:
Hydrohalogenation/ Hydrobromination (1)

4.2.2



✓✓ (4)

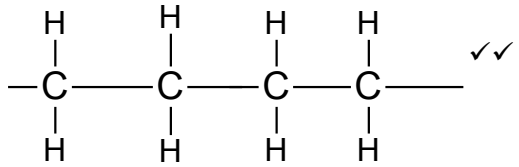
4.2.3 Halo-alkanes/ Halogenoalkanes/ Alkylhalides✓
Accept:
Organic halides (1)

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)

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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 $H_2(g)$ is being produced / The reaction has ceased✓ (1)

5.4 20 s✓ (1)

5.5 ⊙ (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:	**OPTION 2:**	
$n(H_2) = \frac{V}{V_m}$ ✓ $= \frac{0,12}{24,0}$ ✓ $=0,005$ mol $\therefore m(H_2) = n \cdot M$ $= (0,005)(2)$✓ $= 0,01$ g✓	$n(Mg) = \frac{m}{M}$ $= \frac{0,12}{24}$ ✓ $= 0,005$ mol $n(H_2) = 0,005$ mol $\therefore m(H_2) = n \cdot M$ $= (0,005)(2)$✓ $= 0,01$ g✓	

(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:
• $n = \frac{m}{M}$ ✓
• $n_{eq}(HgO) = 0,32$ mol✓
• $n_i(HgO) = 0,52$ mol✓
• $\Delta(HgO)$ = initial – $n_{eq}(HgO)$✓
• Using ratio HgO: O_2 = 2:1✓
• Equil $n(O_2)$ = initial + change✓
• Divide $n(O_2)$ by 0,25 dm^3✓
• Correct K_c expression (formula in square brackets)✓
• Final answer: 0,40 ✓

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

	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✓	
$c=\frac{n}{V}$ ($mol\cdot dm^{-3}$)	-	-	0,40	÷0,25✓

$K_c = [O_2]$✓
$= 0,40$✓ (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 $K_w = [H^+][OH^-] = 2,92 \times 10^{-14}$✓
In water $[H^+]=[OH^-]= 1,71 \times 10^{-7}\ mol\cdot dm^{-3}$
$\therefore\ [H^+] = 1,71 \times 10^{-7}\ mol\cdot dm^{-3}$✓
But $pH = -\log[H_3O^+]$✓
$= -\log (1,71 \times 10^{-7})$
$= 6,77$✓ (4)

7.2

7.2.1

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

(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 cm^3.✓
(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 $n(H_2SO_4) = c \cdot V$✓
= (0,1)(0,3)✓
= 0,03 mol✓ (3)

7.2.7 POSITIVE MARKING FROM QUESTION 7.2.1

n(NaOH) = 0,1 mol

But n(NaOH) : n(H_2SO_4) = 2:1✓

∴ 0,03 mol H_2SO_4 will neutralise 0,06 mol NaOH

Excess n(NaOH) = 0,1 – 0,06

= 0,04 mol ✓

$c(NaOH) = \frac{n}{V}$

$= \frac{0,04}{0,5}$ ✓

= 0,08 mol·dm^{-3}

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

(4)

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QUESTION 8

8.1.1 The gain of electrons (by a chemical substance) ✓ (1)

8.1.2 A

MnO_4^- is a stronger oxidizing agent✓ than $C\ell_2$.✓

Therefore it (MnO_4^-) will oxidise $C\ell^-$ ions to $C\ell_2$, a poisonous/ toxic/ noxious gas✓

(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✓ (1)

8.2.2 Platinum/Pt ✓

OR

Graphite/C (1)

8.2.3 Y✓ (1)

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

8.2.5 ANY ONE:
- Measure the concentrations of the electrolytes to ensure they are 1 mol·dm^{-3}✓
- Measure the temperature to ensure it is 25 °C/ 298 K✓ (1)

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

8.2.7 $A\ell + 3Fe^{3+} \rightarrow A\ell^{3+} + 3Fe^{2+}$
Reactants + Products✓; Balancing✓ (2)

[14]

QUESTION 9

9.1 A solution/ liquid/ dissolved substance that conducts electricity through the movement of ions. (1)

9.2 Cathode ✓ (1)

9.3
9.3.1 $Ag^{+} + e^{-} \rightarrow Ag$✓✓ (2)

9.3.2 $AgNO_3$/ Silver nitrate ✓
Accept: CH_3COOAg/ Silver Ethanoate (1)

9.4 Graphite is a conductor of electricity✓
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 ✓
(so that it gets plated evenly all over) (1)

9.6 $Ag^+ + e^- \rightarrow Ag$

$Q = I \cdot \Delta t$

$= (0,193)(2500)$

$= 482,5\ C$✓

$n(e^-) = \frac{Q}{F}$

$= \frac{482,5}{96500}$

$= 0,005\ mol$

∴ $n(Ag) = n(e^-) = 0,005\ mol$ ✓

$m(Ag) = n \cdot M = (0,005)(108) = 0,54\ g$✓

OR

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

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

$= 0,005\ mol$

∴ $n(Ag) = n(e^-) = 0,005\ mol$ ✓

$m(Ag) = n \cdot M = (0,005)(108) = 0,54\ g$✓ (3)

[10]

QUESTION 10

10.1

10.1.1 Ammonia ✓ (1)

10.1.2 Pt-Rh/ Platinum -Rhodium✓
OR Platinum/Pt✓ (1)

10.1.3 Water gas✓
OR
Natural gas (methane) (1)

10.2 NH_4NO_3/ Ammonium nitrate ✓ (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 ✓ for humans
- Production and application of fertilisers result in job creation✓
- Selling of fertilisers stimulate the country's economy✓ (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]