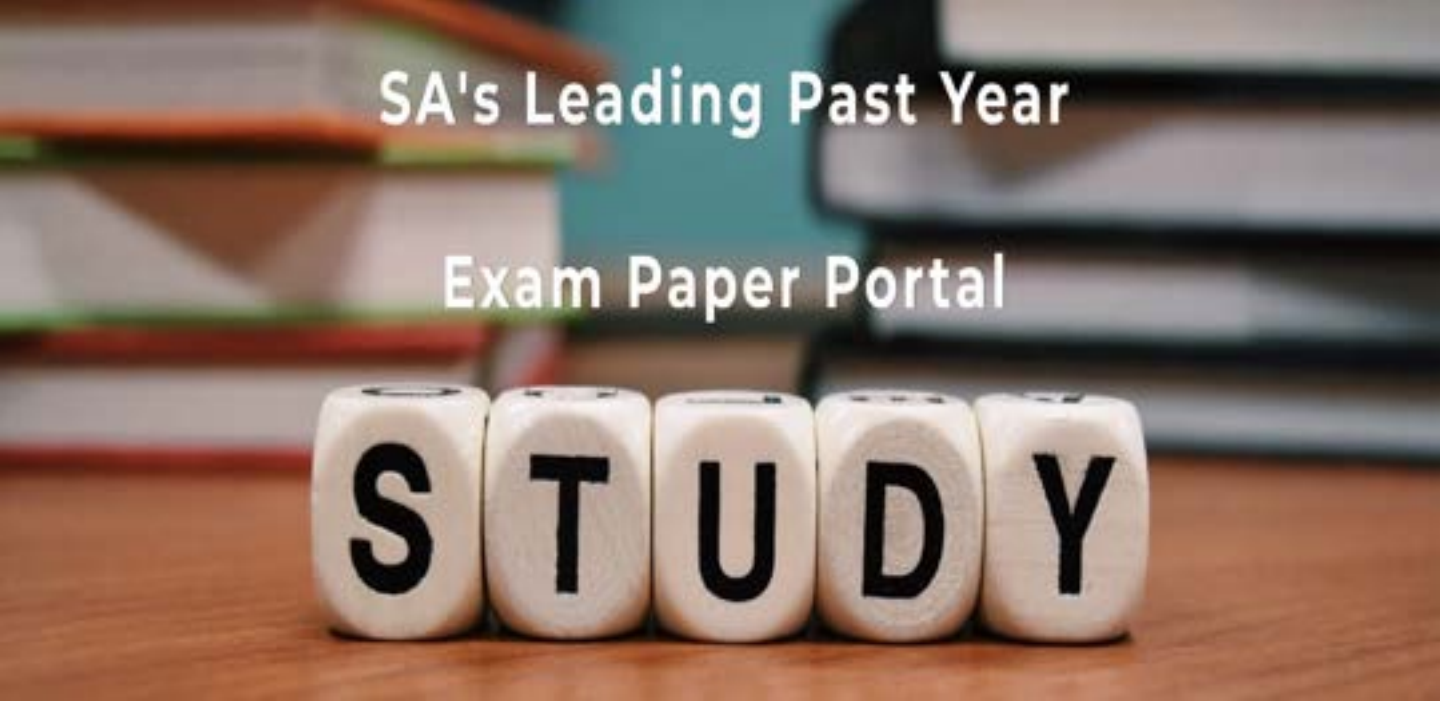

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PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY

NATIONAL

MARKS : 150

TIME : 3hours

This memorandum consists of 10 pages.

The marking guidelines as per 2014 Examination Guidelines, pages 34-37 must be applied when marking this Paper.

QUESTION 1

1.1 C ✓✓ (2)

1.2 B✓✓ (2)

1.3 D✓✓ (2)

1.4 B✓✓ (2)

1.5 A✓✓ (2)

1.6 C✓✓ (2)

1.7 B✓✓ (2)

1.8 A✓✓ (2)

1.9 C✓✓ (2)

1.10 D✓✓ (2)
[20]

QUESTION 2

2.1. H ✓✓ (2)

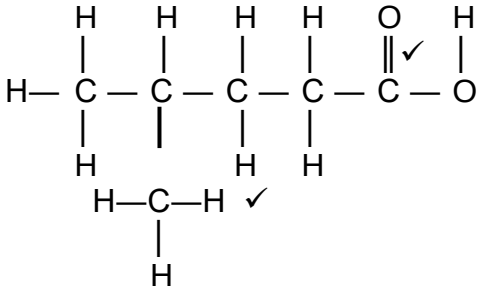
2.2 A ✓ (1)

2.3 B ✓✓ (2)

2.2.1 chloroethene *accept* 1-chloroethene ✓✓ (2)

2.2.2 2-methylpentan-2-ol *accept* 2–methyl– 2-pentanol✓✓ (2)

2.3



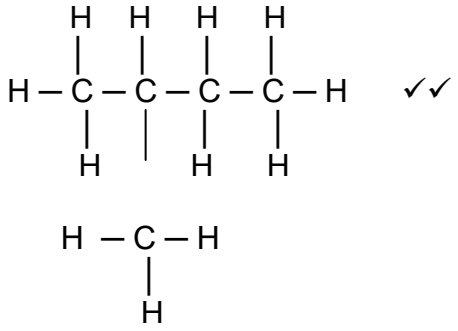
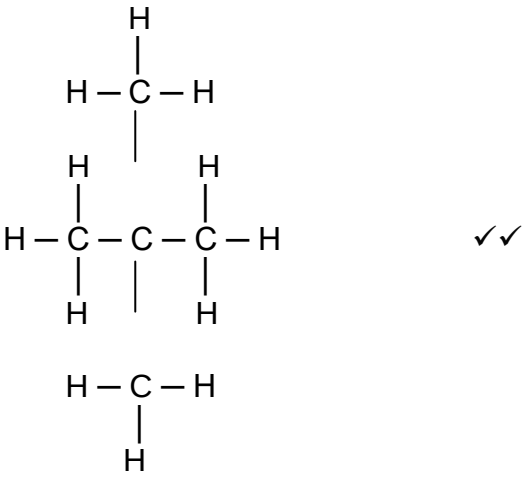
Functional group correct ✓ rest of structure correct ✓ (2)
[10]

QUESTION 3

3.1.1 Boiling does not involve breaking the chemical (intra molecular) bonds between atoms.✓
OR Boiling involves breaking the intermolecular forces between molecules.✓ (1)

3.1.2 Pentane has a longer chain of carbons than methane, therefore a greater surface area✓. Hence more sites for London force attraction✓ and stronger intermolecular forces. More energy is needed to break the stronger intermolecular forces.✓ (3)

3.1.3

OPTION 1:	**OPTION 2:**
2-methylbutane ✓ (or methylbutane)  ✓✓	2,2-dimethylpropane ✓ (or dimethylpropane)  ✓✓ (3)

3.2 The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓ (2)

3.3.1 D ✓✓ (2)

3.3.2 A ✓✓ (2)

3.4 The carboxylic acid has the strongest intermolecular forces, ✓
because there are two sites for hydrogen bonding in each carboxylic acid molecule.✓ The stronger the intermolecular forces the lower the vapour pressure (at a given temperature). ✓ The graph indicates that D has the lowest vapour pressure. (3)

[16]

QUESTION 4

4.1.1 methyl✓ ethanoate ✓ (2)

4.1.2

M ($C_3H_6O_2$) = 74

n = $\frac{m}{M}$ ✓

= $\frac{68,88}{74}$ ✓

= 0,93 mol

M (CH_4O) = 32

1 : 1 (alcohol : acid)

m = $\frac{0,93 \times 32}{}$ ✓

= 29,78 g

% purity : $\frac{29,78}{50}$ x 100 = 59,57 % ✓ (5)

4.2.1 A - hydration (or addition) ✓

C - substitution ✓

D - dehydration (or elimination) ✓

E - combustion ✓ (4)

4.2.2 (i) Dissolve C_2H_5Cl in ethanol. ✓

(ii) Add concentrated NaOH solution. ✓

(iii) Heat the mixture. ✓ (3)

4.2.3 H_2SO_4 OR sulphuric acid ✓ (1)

4.2.4 Polythene OR Polyethene ✓ (1)

4.2.5 The chemical process in which longer chain hydrocarbon molecules are broken down to shorter molecules✓ at high temperatures (*and pressures*)✓. (2)

4.2.6 C_4H_{10} ✓✓ (2)

[20]

QUESTION 5

5.1 The amount of product formed/reactant used up✓ per unit time✓ (per second). (2)

5.2 concentration of HCl✓ (1)

5.3 Product CO_2 is an insoluble gas✓ and escapes from the beaker. ✓ (2)

5.4 Calcium carbonate is used up✓ and the reaction stops, no more CO_2 formed. ✓ (2)

5.5.1 graph B✓ (1)

5.5.2 graph D ✓ (1)

5.5.3 graph C✓ (1)

5.6 graph C✓.
Catalyst speeds up the rate of reaction✓, therefore gradient ✓of graph will be steepest for same initial mass. ✓ (4)

5.7 Remains the same. ✓ (1)
[15]

QUESTION 6

6.1.1 Increases ✓ (1)

6.1.2 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓ ✓ (2)

6.1.3 Increase in temperature increases K_c ✓
Increase in K_c indicates that the forward reaction has been favoured ✓,
Increase in temperature favours the endothermic reaction ✓,
Therefore the forward reaction is endothermic ✓. (4)

6.1.4 Add a catalyst ✓
Increase pressure OR decrease volume of container ✓ (2)

6.2

	A_2 +	2B →	2AB
Initial (mol)	x	2	0 ✓
Used / formed	-0,2	-0,4	0,4 ✓ (✓)
Equilibrium (mol)	x – 0,2	1,6	0,4 ✓
[equilibrium]	x – 0,2	1,6	0,4 ✓

RATIO

Addition for **all** three

For conc. only ✓

	A_2 +	2B →	2AB
Initial conc.(mol.dm^{-3})	x	2	0 ✓
Used / formed	-0,2	-0,4	0,4 ✓ (✓)
[equilibrium]	x – 0,2	1,6	0,4 ✓

RATIO

Addition for **all** three

$K_c = \frac{[AB]^2}{[A_2][B]^2}$ ✓

$= \frac{(0,4)^2}{(x - 0,2)(1,6)^2}$ ✓

$= 0,5$

$\therefore 0,5[(x - 0,2)(1,6)^2] = (0,4)^2$

$\therefore 1,28x - 0,256 = 0,16$

$\therefore X = 0,325$ mol ✓

Marking criteria:
- Initial mol/conc correctly indicated. ✓
- Mol/conc of AB produced = 0,4.✓
- Ratio applied correctly. ✓
- Equilibrium mol: ✓ initial – used / Initial + produced
  OR
  Equilibrium conc: ✓✓ initial – used / Initial + produced
- Equilibrium mol ÷ 1 = eq conc. ✓
- Correct Kc expression. ✓
- Substitution of eq conc to Kc expression. ✓
- Final answer. ✓

Wrong K_c expression – (Max.: 4/8)
Wrong values on the table but used in the calculation (positive marking) - (Max.: 3/8) no mark for answer.

(8)
[17]

QUESTION 7

7.1.1

Option 1:

pH = - log $[H_3O^+]$ ✓
= 1

$\therefore [H_3O^+] = 10^{-1} = 0,1$ ✓
$\therefore$ [HCl] = 0,1 mol.dm^{-3} ✓

Option 2:

pH = - log $[H_3O^+]$ ✓
= 1

$\therefore$ [HCl] = 0,1 mol.dm^{-3} ✓✓

(3)

7.1.2 increase ✓ (1)

7.1.3 $Mg(OH)_2(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + 2H_2O(l)$ (3)

Reactants ✓ Products ✓ Balancing ✓

7.2 When an acid reacts with a base✓ to produce a salt and water. ✓ OR
Chemically equivalent quantities of acid and base are reacted. ✓✓ (2)

7.3

Option 1:

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ ✓

n(NaOH) = c x V ✓ = 0,1 x 0,012✓ = 0,0012 mol

$n(H_2SO_4)$ = ½ x n(NaOH) ✓ = 0,0006 mol

$V(H_2SO_4)$ = n/C = 0,0006 / 0,05 = 0,012 dm^3

$V(H_2SO_4)$ that reacts with $Ba(OH)_2$ = 54 – 12 ✓ = 42 cm^3 (OR 0,054 - 0,012 = 0,042 dm^3)

$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$ ✓

$n(H_2SO_4)$ that reacts with $Ba(OH)_2$ = c x V = 0,05 x (42 x 10^{-3} mol) = 0,0021 mol

$n(Ba(OH)_2)$ = 1 x 0,0021 = 0,0021 mol

$[Ba(OH)_2]$ = n/v = 0,0021 x 0,048 ✓ = 0,04375 mol·dm^{-3} ✓

7.3

Option 2:	**Option 3:**
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$✓ $n(NaOH) = c \times V$ ✓ $= 0,1 \times 0,012$✓ $= 0,0012$ mol $n(H_2SO_4) = ½ \times n(NaOH)$ ✓ $= 0,0006$ mol $n(H_2SO_4)_{tot} = c \times V$ $= 0,05 \times (54 \times 10^{-3})$ $= 0,0027$ mol $n(H_2SO_4)_{with}\ Ba(OH)_2$ $= 0,0027 - 0,0006$ ✓ $= 0,0021$ mol $Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$✓ $n(Ba(OH)_2) = 1 \times 0,0021$ $= 0,0021$ mol $[Ba(OH)_2] = n / v = 0,0021 \times 0,048$ ✓ $=$ $0,04375$ mol·dm^{-3} ✓	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$✓ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b}$ ✓ $\frac{1}{2}$ ✓ $= \frac{V_a \times 0,05}{0,1 \times 12}$ ✓ $V_a = 12$ cm^3 $V(H_2SO_4)_{with}\ Ba(OH)_2 = 54 - 12$ ✓ $= 42$ cm^3 $Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$ ✓ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b}$ $\frac{1}{1} = \frac{0,05 \times 42}{48 \times c_b}$ ✓ $[Ba(OH)_2] = 0,04375$ mol·dm^{-3} ✓

(8)

[17]

QUESTION 8

8.1.1 Pt or the electrode where oxygen reacts or where peroxide is formed✓ (1)

8.1.2 $Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (2)

$Cu \rightleftharpoons Cu^{2+} + 2e^-$ (1) $Cu \leftarrow Cu^{2+} + 2e^-$ (0)

8.1.3 $O_2 + 2H^+ + 2e^-$ ✓ $\rightarrow H_2O_2$ ✓ (2)

8.1.4 $E^{\ominus}_{cell} = E^{\ominus}_{cathode} - E^{\ominus}_{anode}$ ✓
$= 0,68$ ✓ $- 0,34$ ✓
$= 0,34$ V ✓ (4)

8.2 $2Ce + 3Pd^{2+}$ ✓ $\rightarrow 2Ce^{3+} + 3Pd$ ✓ (balance ✓) (3)

[12]

QUESTION 9

9.1 Electrical energy to chemical energy. ✓ (1)

9.2 Decrease in mass/ decrease in size/ gets used up/ errosion✓✓ (2)

9.3 Oxidation ✓ (1)

9.4

9.4.1 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

Note:
Marking rule 3.3

9.4.2 Silver nitrate OR $AgNO_3$✓
OR
Silver ethanoate/silver acetate ✓
CH_3COOAg/ $AgC_2H_3O_2$/ $AgCH_3CO_2$
OR
Ag^+ ions (1)

9.5 Rate of oxidation is equal to the rate of reduction. ✓✓

ACCEPT: Reduction and oxidation take place simultaneously✓✓ (2)

[9]

QUESTION 10

10.1.1 $2SO_2 + O_2 \rightleftharpoons 2SO_3$ ✓✓ (ACCEPT: $2SO_2 + O_2 \rightarrow 2SO_3$ ✓✓) (2)

10.1.2 Step 2 ✓ (1)

10.1.3 Vanadium pentoxide ✓ (1)

10.2.1 Fertilisers must replenish nutrients used by growing of crops. ✓ (1)

10.2.2 **Any ONE:**

Excessive fertiliser seeps/washes into groundwater and contaminates Drinking Water **OR**
Excessive fertiliser run-off can lead to eutrophication which depletes aquatic life which serves as a food source **OR**
Excessive fertilisation can damage a crop which leads to a smaller harvest. ✓ (1)

10.2.3 Eutrophication ✓ (1)

10.2.4 $(NH_4)_2SO_4$ ✓✓ (2)

10.3.1 Total percentage of active fertiliser. *OR* Combined percentage of N, P and K.✓
(1)

10.3.2 **OPTION 1**

$13 = \frac{5}{x}$ ✓ x 26 ✓

x = 10 ✓

thus N = 3✓

N:P:K = 3: 2 : 5 (4)

OPTION 2

(N + P + K) in the bag = 26/100 x 20 = 5,2 kg

K in the bag = 13/100 x 5,2 = 2,6 kg

2,6/5,2 x 100 ✓ = 50% = 5 parts ✓

P = 2 parts = 20 % ✓

Therefore, N = 30% = 3 parts

Unknown component = 3. ✓ (4)
[14]

