Education and Sport Development

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NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P2 MEMORANDUM

SEPTEMBER 2017

MARKS: 150

This memorandum consists of 12 pages.

QUESTION 1 (Start on a new page.)

1.1 C ✓✓ (2)

1.2 A ✓✓ (2)

1.3 B ✓✓ (2)

1.4 C ✓✓ (2)

1.5 A ✓✓ (2)

1.6 C ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 D ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION 2 (Start on a new page.)

2.1

2.1.1 E ✓ (1)

2.1.2 F ✓ (1)

2.1.3 B ✓ (1)

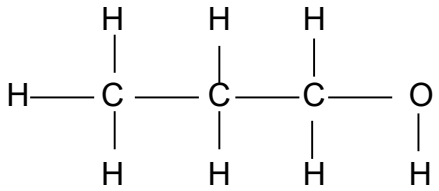
2.1.4 D✓ (1)

2.2 Butanal✓✓ (2)

2.3

2.3.1 Propyl ethanoate. ✓✓ (2)

2.3.2



✓✓

N.B. Accept condensed -OH

Marking criteria structural formula:
• **Three carbons in longest chain**
• **OH – group on terminal carbon**
Notes:
• **One or more H-atoms omitted: ½**
• **Condensed or semi-structural formula:1/2**

(2)

[10]

QUESTION 3 (Start on a new page.)

3.1

3.1.1 Substitution(halogenation/bromination) ✓ (1)

3.1.2 Substitution(hydrolysis) ✓ (1)

3.1.3 Elimination ✓ (1)

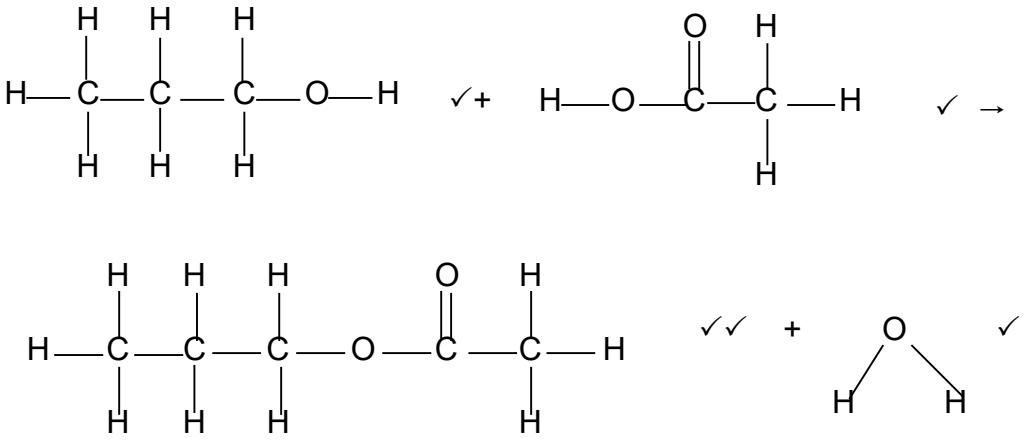
3.2 $CH_3CHBrCH_3 + KOH$✓$\rightarrow CH_3CHCH_2 + H_2O + KBr$ ✓ bal ✓ (3)

N.B. Max 1/3 if extra product or reactant is written

3.3

3.3.1 Ethanoic acid ✓ (1)

3.3.2



✓+ ✓ → ✓✓ + ✓

(6)

N.B. Accept linear molecule of water.

3.4

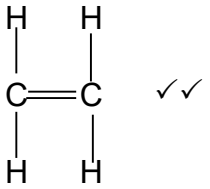
3.4.1 Heat/ Sunlight/ UV light or rays/ Sun rays. (1)

3.4.2 Hydrogen bromide. ✓ (1)

3.5

3.5.1 A polymer formed when two monomers combine through an addition reaction. ✓✓ (2)

3.5.2



✓✓

Marking criteria structural formula:
• Two carbons in chain • Whole structure correct
Notes:
• One or more H-atoms omitted ½ • Condensed or semi-structural formula 1/2

(2)

[19]

QUESTION 4 (Start on a new page.)

4.1

4.1.1 A series of organic compounds that can be described by the same general formula. ✓✓ (2)

OR

A series of organic compounds in which the members differ from the next with a $-CH_2$ group.

4.2 Alcohol. ✓ (1)

4.3

4.3.1 Molecular mass(of different homologous series). (1)

N.B. Accept surface area, chain length/contact area.

4.3.2 Vapour pressure. (1)

4.3.3 The larger the molecular mass, the lower the vapour pressure (2)

OR

The smaller the molecular mass, the higher the vapour pressure.

N.B. Accept surface area/chain length/contact area

4.4 Butane

- Weak✓ London forces between its molecules✓ (2)

OR

- London forces between its molecules✓
- less energy is needed for molecules to break out of liquid and form vapour ✓

- **Butan -1-ol**
- – alcohol, has stronger✓ hydrogen bonds between its molecules✓ (2)

OR

- Hydrogen bonds between its molecules. ✓
- lots of energy is needed for molecules to break out of liquid and form vapour✓

4.5 Compound **D**✓ or (Butanol)

- It has stronger hydrogen bonds between its molecules✓
- Therefore more energy is required to break the bonds between the molecules✓ (3)

N.B. Accept it has lowest vapour pressure.

[14]

QUESTION 5 (Start on a new page.)

5.1 $CO_2(g)$ forms during the reaction. ✓ (1)

5.2 40s. ✓ The mass of the beaker and its contents remained 60,00g. ✓ (2)

5.3

nCO_2 (reacted) = $\frac{m(CO_2)}{M(CO_2)}$ ✓

= $\frac{2,00}{44}$ ✓

= 0,05 mol✓

$V(CO_2)$ at STP = $n(CO_2)\ x\ Vm$ ✓

= (0 , 05 x 22 , 4) ✓

= 1,12 dm^3✓ (6)

OR

1 mol → 22,4 dm^3

0,05 mol → X

X = 1,12 dm^3

5.4

- More particles per unit volume. ✓
- More HCℓ molecules have enough kinetic energy and correct orientation. ✓
- More effective collisions take place per second/ per unit time. ✓ (3)

N.B. Accept: Higher frequency of effective collisions

[12]

QUESTION 6 (Start on a new page.)

6.1 A reversible reaction in which the rate of the forward reaction equals to the rate of the reverse reaction. ✓✓ (2)

6.1.1 $n(NH_3) = \frac{m}{M}$

$= \frac{25,5}{17}$ ✓

= 1,5 mol

	$N_{2(g)}$	$3H_{2(g)}$	$2NH_{3(g)}$	
Initial quantity(mol)	3	8	0	
Change in (mol)	0,75	2,25	1,5✓	Ratio ✓
Quantity at equilibrium(mol)	2,25✓	5,75✓	1,5	
Equilibrium concentration ($mol.dm^{-3}$)	0,45	1,15	0,3	Divide by 5✓

$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓

$= \frac{(0,3)^2}{(0,45)(1.15)^3}$ ✓

= 0,13✓ (9)

Wrong K_c expression Max 6/9

No Kc expression Max 8/9

6.1.2 Smaller than ✓

↙ K_c 1✓ (2)

6.1.3 ↙ Decrease✓

Increases in temperature favours the reverse reaction (endothermic reaction) ✓ less product is formed✓, K_c value decreases. ✓ (4)

N.B. a) Accept: **equilibrium position** shifts to the left.

b) The sign ↙ means negative marking in **6.1.2** & **6.1.3** above

[17]

QUESTION 7 (Start on a new page.)

7.1

7.1.1 A substance that can act as an acid and as a base. ✓✓ (2)

7.1.2 Acid. ✓
It is a proton donor/it donates a proton. ✓ (2)

7.1.3 PO^{3-}_4(aq) ✓ (1)

7.2

7.2.1 Basic. ✓ (1)

7.2.2 pH = - log $[H^+]$ ✓

13,3✓ = - log $[H^+]$

$[H^+]$ = 5,01 x 10^{-4} mol.dm^{-3}

[OH-] = $\frac{10^{-14}}{[H^+]}$ ✓

= $\frac{10^{-14}}{5,01x10^{-14}}$ ✓

= 0,2 mol.dm^{-3}✓ (5)

7.2.3 $\frac{CaVa}{CbVb} = \frac{n_a}{n_b}$ ✓ **N.B** Positive marking - 7.2.2 to 7.2.3.

$\frac{Ca(17,85)}{(0,2)(25)}$ ✓✓ = $\frac{1}{2}$ ✓

Ca = 0,14 mol.dm^{-3}✓ (5)

7.2.4 X + 16 +1 = 56

X = 39 g.mol^{-1}✓

X = K (potassium) ✓ (2)

[18]

QUESTION 8 (Start on a new page.)

8.1 A solution/ liquid/ dissolved substance that conducts electricity through movement of ions. ✓✓ (2)

8.2 Salt-bridge. ✓
- completes the circuit/ cell. ✓
- maintains the cell neutrality.
- supplies a path through which ions can move to restore neutrality. (2)

8.3 B ✓ Lead is a stronger reducing agent than than Pb✓ and Mg will be oxidised to Mg^{2+}. ✓ (3)

8.4 – $Pb(NO_3)_2$ or $Pb^{2+}(aq)$✓or any saline solution with the corresponding ion as the cathode. (2)

8.5

8.5.1 $Mg(s)$ ✓ → $Mg^{2+}(aq) + 2e^-$ ✓ (2)

Notes:
$Mg(s) \rightleftharpoons Mg^{2+}(aq) + 2e^-$ (1/2) $Mg^{2+}(aq) + 2e^- \leftarrow Mg(s)$ (2/2)

$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$ (0/2) $Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg(s)$ (0/2)

8.5.2 $Mg(g) \mid Mg^{2+}(aq)((1\ mol{\cdot}dm^{-3}) \parallel (1\ mol{\cdot}dm^{-3})H^+(aq) \mid H_2(g)\ Pt(s)$ (3)

OR

$Mg(g) \mid Mg^{2+}(aq) \parallel H^+(aq) \mid H_2(g)\ Pt(s)$

OR

$Mg(g) \mid Mg^{2+}\ (1\ mol{\cdot}dm^{-3}) \parallel H^+\ (1\ mol{\cdot}dm^{-3}) \mid H_2(g)\ Pt(s)$

OR

$Mg(g) \mid Mg^{2+} \parallel H^+ \mid H_2(g)\ Pt(s)$

8.6 - It has Pt as inert/ does not react with the H^+ ions OR acid.
- It has Pt as a conductor (of electricity) . (1)

[15]

QUESTION 9 (Start on a new page.)

9.1 Electrode where reduction takes place ✓✓ (2)

9.2 T ✓ the negative electrode/ cathode ✓ (2)

9.3 $Cu(s) \rightarrow Cu^{2+} + 2e^-$ ✓✓ (2)

Notes:

$Cu(s) \rightleftharpoons Cu^{2+}(aq) + 2e^-$ (1/2) $Cu^{2+}(aq) + 2e^- \leftarrow Cu(s)$ (2/2)

$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$ (0/2) $Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ (0/2)

(2)

9.5 Pt and Ag are both weaker reducing agents than copper and will be oxidised to form ions. ✓✓ (2)

OR

Cu is a stronger reducing agent than Ag & Pt, so it will reduce Ag & Pt.

9.6 The rate at which copper is oxidised at the anode is equal to the rate at which copper ions are reduced at the cathode. ✓✓ (2)

[10]

QUESTION 10 (Start on a new page.)

10.1 Ostwald (process). ✓ (1)

10.2.

10.2.1 Pt (Platinum) ✓ (Accept Nickel (Ni)
Temperature _+ 900 °C ✓ (2)

10.2.2 $4NH_3 + 5O_2(g)$ ✓ → $4NO(g)$ +6 H_2O ✓ bal ✓ (3)

10.2.3 Catalytic oxidation. ✓ (1)

10.2.4 Nitrogen dioxide/ Nitrogen(IV)oxide ✓ (1)

10.2.5 H_2O or Water ✓ (1)

10.3

10.3.1 KNO_3 ✓✓ (2)

10.3.2 $m(N) = \frac{22}{39}$ ✓✓ x 6,35 ✓

= 3,58 kg ✓ (4)

[15]

GRAND TOTAL: 150

PHYSICAL SCIENCES GRADE 12 PAPER 2 **ANALYSIS 2017**

Question No.		Taxonomy													Knowledge area				
		KNOWLEDGE, RECALL, Low Demand			COMPREHENSION, Basic Questions			APPLICATION, ANALYSIS, Problem Solving			SYNTHESIS, EVALUATION, Higher Abilities, Hard new problems, Challenge Level			TOTAL	MATTER & MATERIALS	CHEMICAL CHANGE	CHEMICAL SYSTEMS	TOTAL MARKS	Question Totals
	Content	E	M	D	E	M	D	E	M	D	E	M	D		Marks				
1.1	HOMOLOGOUS SERIES	2												2	2			2	
1.2	TYPEE OF REACTION		2											2	2			2	
1.3	IUPAC									2				2	2			2	
1.4	ENERGY DIAGRAM									2				2			2	2	
1.5	STOICHIOMETRY								2					2		2		2	
1.6	CHEMICAL EQUILIBRUM		2											2		2		2	
1.7	CHEMICAL EQUILIBRUM				2									2		2		2	
1.8	ACIDS & BASES					2								2		2		2	
1.9	ELECTROCHEMICAL CELL					2								2		2		2	
1.10	FERTILISERS									2				2			2	2	**20**
2.1.1	GENERAL FORMULA				1									1	1			1	
2.1.2	ALKANES				1									1	1			1	
2.1.3	ALCOHOLS				1									1	1			1	
2.2.1	MOLECULAR FORMULAE					1								1	1			1	
2.2.2	STRUCTURAL FORMULA								2					2	2			2	
2.2.3	IUPAC NAMING				2									2	2			2	
2.3.1	TYPES OF REACTION				1									1	1			1	
2.3.2	STRUCTURAL FORMULA							2						2	2			2	
2.3.3	ISOMER							2						2	2			2	**16**
3.1	TYPE OF REACTION					2								2	2			2	
3.2	TYPE OF REACTION					3								3	3			3	
3.3.1	FUNCTIONAL GROUP				1									1	1			1	
3.3.2	STRUCTURAL FORMULAE							6						6	6			6	
3.3.3	POLYMERS							4						4	4			4	
3.3.4	POLYMERS				1									1	1				**17**

4.1.1	HOMOLOGOUS SERIES		2										2	2			2		

4.1.2	HOMOLOGOUS SERIES		1										1		1		1		
4.2.1	REACTION RATE	1					1						1		1		1		
4.2.2	PHYSICAL PROPERTIES	1			1								1		1		1		

	Content	**E**	**M**	**D**	**E**	**M**	**D**	**E**	**M**	**D**	**E**	**M**	**D**		**Marks**				
4.3	PHYSICAL PROPERTIES							4						4	4			4	
4.4	PHYSICAL PROPERTIES						3							3	3			3	
4.5	PHYSICAL PROPERTIES		2											2		2		2	**13**
5.1	REACTION RATE				1									1		1		1	
5..2	REACTION RATE		2											2		2		2	
5..3	REACTION RATE									**6**				6		6		6	
5.4	REACTION RATE							**3**						3		3		3	**12**
6.1.1	REACTION RATE		2											2		2		2	
6.1.2	REACTION RATE									**9**				9		9		9	
6.1.3	APPLICATION OF EQUILIBRIUM				2									2		2		2	
6.1.4	APPLICATION OF EQUILIBRIUM								4					4		4		4	**17**
7.1.1	ACIDS & BASES		2											2		2		2	
7.1.2.	ACIDS & BASES					2								2		2		2	
7.1.3	ACIDS & BASES		1											1		1		1	
7.2.1	ACIDS AND BASES	1												1		1		1	
7.2.2	ACIDS & BASES								5					5		5		5	
7.2.3	ACIDS & BASES									5				5		5		5	
7.2.4	ACIDS & BASES					5					5			5		5		5	**18**
8.1.	ELECTROCHE-MICAL REACTIONS		2											2		2		2	
8..2	ELECTROCHE-MICAL REACTIONS						2							2		2		2	
8..3	ELECTROCHE-MICAL REACTIONS			2										2		2		2	
8.4	ELECTROCHE-MICAL REACTIONS				2									2		2		2	
8.5.1	ELECTROCHE-MICAL REACTIONS								2					2		2		2	
8.5.2	ELECTROCHE-MICAL REACTIONS									3				3		3		3	

8.6	ELECTROCHE-MICAL REACTIONS						1							1		1		1	
	ELECTROCHE-																		**14**
9.1	MICAL REACTIONS		1											1		1		1	
9.2	ELECTROCHEMI STRY (APPLICATION)				1									1		1		1	
9.3	ELECTROCHEMI STRY (APPLICATION)										3			3		3		3	
9.4	ELECTROCHEMI STRY (APPLICATION)		2											2		2		2	
9.5	ELECTROCHEMI STRY (APPLICATION)						2							2		2		2	
9.6	ELECTROCHE-MICAL REACTIONS					2								2		2		2	
9.7	ELECTROCHE-MICAL REACTIONS						2							2		2		2	
10.1	FERTILISERS	1												1			1	1	
10.2.1	FERTILISERS				2									2			2	2	
10.2.2	FERTILISERS					2								2			2	2	
10.2.3	FERTILISERS										3			3			3	3	
10.2.4	FERTILISERS				1									1			1	1	
10.3.1	FERTILISERS			1										1			1	1	
10.3.2	FERTILISERS							3						3			3	3	1**0**

ACTUAL MARKS				**28**			**51**			**56**			**8**			**45**		**89**	**16**	**150**
ACTUAL MARKS %				18,67%			34%			37,33%			5,26%			30%		59,33%	10,66%	100%
EXPECTED MARKS %				**15**			**35**			**40**			**10**			**48**		**84**	**18**	**150**