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PREPARATORY EXAMINATION

2018

MARKING GUIDELINES

PHYSICAL SCIENCES: CHEMISTRY (PAPER 2) (10842)

10 pages

**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION**

**PHYSICAL SCIENCES
(Paper 2)**

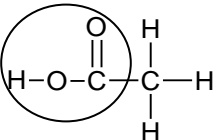
MARKING GUIDELINES

QUESTION 1

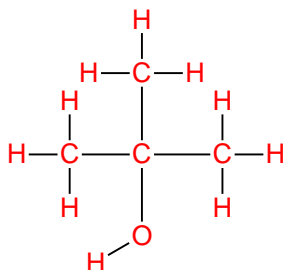
- 1 A ✓✓
- 2 B ✓✓
- 3 C ✓✓
- 4 B ✓✓
- 5 C ✓✓
- 6 A ✓✓
- 7 A ✓✓
- 8 C ✓✓
- 9 D ✓✓
- 10 D ✓✓

[20]

QUESTION 2

- 2.1 2.1.1 Compounds which have the same molecular formula but different structural formula. (two ✓✓ or zero) (2)
- 2.1.2 Methyl methanoate (2)
- 2.1.3  Marking guidelines:
 • functional group correct ✓
 • whole structure correct ✓ (2)
- 2.1.4 Ethanoic acid ✓ (1)
- 2.1.5 Carboxylic acids ✓ (1)
- 2.2 2.2.1 C_nH_{2n} ✓ (1)
- 2.2.2 2,5-dimethylhept-3-ene ✓ (2)

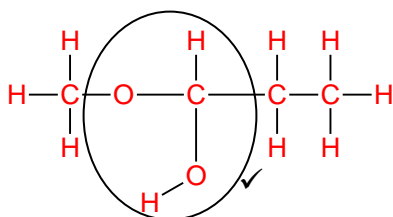
2.3

Marking guidelines:

- OH on middle C ✓
- complete structure correct ✓

(2)

2.4

Marking guidelines:

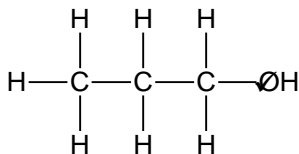
- ✓ functional group

(1)
[14]**QUESTION 3**

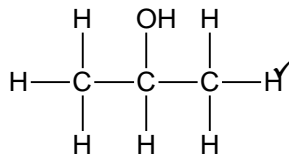
3.1 (Alcohols are flammable.) Do not bring it close to flames. ✓

(1)

3.2 3.2.1



propan-1-ol ✓



propan-2-ol ✓

(4)

3.2.2 propan-1-ol ✓

(1)

3.2.3 The position ✓ of the –OH group in a chain will influence the boiling point, because of the role of the intermolecular forces in branched structure.
OR

For a fair test, all alcohols need to be primary alcohols.

(1)

3.3 3.3.1 The melting point of butan-1-ol will be higher. ✓

Reasons:

- The hydrogen bond between butan-1-ol molecules are stronger than between the butan-2-ol molecules, because the hydroxyl group is more exposed in the butan-1-ol than in the butan-2-ol, which causes the hydrogen bond to have a stronger influence. ✓
- More energy is required to weaken IM Forces between the butan-1-ol molecules, causing a higher melting point. ✓
- Straight chains have a higher melting point than branched chains.

OR

- Butan-1-ol has a larger surface area (chain length)
- Therefore stronger IMF
- More energy needed to overcome IMF

Any TWO reasons

(3)

3.3.2 Butan-2-ol ✓

Reasons:

- If the hydroxyl group is on a terminal carbon atom, the intermolecular force (hydrogen bond) is stronger than when the –OH group is on the second carbon atom, where it is screened and has a smaller influence on the energy needed to cause a phase change (boil) in the second isomer, the butan-2-ol. ✓
- The boiling point of butan-2-ol will be lower and therefore the vapour pressure of butan-2-ol will be higher than the butan-1-ol. Less energy required to overcome the hydrogen bonds and to weaken the bonds. ✓

Any TWO reasons

(3)

3.3.3 Increase ✓

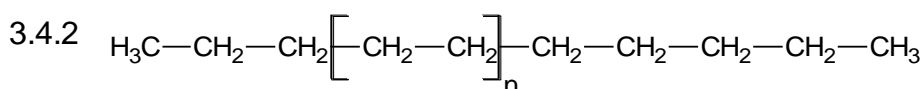
(1)

- 3.3.4
- Van der Waals forces (London forces) increase with an increase in molecular mass / chain length / size of molecule. ✓
 - The longer the chain, the higher the boiling point, the stronger the London forces. ✓

(2)

3.4 3.4.1 Polymerisation ✓

(1)



Ethene. ✓

(1)

3.4.3 Any ONE use:

Packaging material ✓
 Squeeze bottles
 Electrical insulation
 Industrial protective clothing
 Toys, etc.

(1)

[19]**QUESTION 4**4.1 4.1.1 Compound X = C₃H₅Br ✓

(1)

4.1.2 Addition / hydrohalogenation ✓

(1)

4.1.3 Propan-2-ol ✓

(1)

4.1.4 An alcohol; where the hydroxyl group is attached to a carbon atom which is bonded to two other carbon atoms. ✓

(1)

4.1.5 Prop-1-ene OR propene ✓

(1)

4.1.6 Dehydrohalogenation ✓

(1)

- 4.2 4.2.1 Elimination ✓ (1)
- 4.2.2 Hydration ✓ (1)
- 4.2.3 Hydrohalogenation ✓ (1)
- 4.2.4 H_2SO_4 ✓ (1)
- 4.2.5 2-bromo-2-methylpentane ✓ (2)
- [12]**

QUESTION 5

- 5.1 5.1.1 Use powdered CaCO_3 instead of lumps ✓
 Use of a more concentrated HCl solution ✓
 Heat the reaction mixture ✓
 Add a suitable catalyst
 Any THREE ways (3)
- 5.1.2 Measure rate of CO_2 formed by measuring the volume produced at certain time intervals. ✓✓
 Measure the rate at which the mass decreases, by placing the reaction container on a sensitive mass-meter and record the decrease in the mass per unit time. ✓✓ (4)
- 5.1.3 It is not a closed system. ✓
 The CO_2 gas escapes from the reaction. ✓ (2)
- 5.2 5.2.1 $5 \text{ cm}^3 / \text{min}$ OR $5 \text{ cm}^3 / \text{min}^{-1}$ ✓ (1)
- 5.2.2 Steeper gradient ✓ (1)
- 5.2.3 The rate of production of hydrogen gas will be faster per unit time ✓
 because the reaction proceeds at a higher rate at a higher temperature. ✓ (2)
- 5.2.4 The rate of production of hydrogen gas will increase as the length / surface area of the magnesium ribbon increases. ✓✓
DO NOT ACCEPT: Graph is directly proportional; does not go through the origin. (2)
- [15]**

QUESTION 6

6.1 If a stress is applied to a system in equilibrium, the system will respond in such a way as to relieve the stress and restore the equilibrium under a new set of conditions. ✓✓ (2)

6.2 6.2.1 A✓ (1)

6.2.2 The forward reaction is endothermic. ✓ Decreasing the temperature from the equilibrium system favours the reverse reaction. ✓ The reverse reaction is an exothermic reaction. Therefore more iodine and hydrogen molecules are formed and less HI will be in the reaction mixture. ✓ (3)

6.3 6.3.1 $K_c = [\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]$ ✓
 $= (1,34 \times 10^{-3})(1,34 \times 10^{-3})$ ✓
 $= 1,80 \times 10^{-6}$ ✓ (3)

6.3.2 INCREASES. ✓ (1)

6.3.3 When sodium ethanoate, CH_3COONa , dissolves in aqueous ethanoic (acetic) acid, CH_3COOH , it dissociates into Na^+ ions and acetate ions, CH_3COO^- . ✓ The acetate ion increases the total acetate ion concentration in the solution. ✓ The equilibrium re-establishes to the left and more ethanoic (acetic) acid forms, ✓ decreasing the $[\text{H}_3\text{O}^+]$ concentration, therefore the pH increases. (3)

6.4 6.4.1 0,5 mol of gas X_2Y_3 ✓ (1)

6.4.2

	$2\text{X}(\text{g})$	$3\text{Y}(\text{g})$	$\text{X}_2\text{Y}_3(\text{g})$
Initial no. of moles	4	4	0
No of moles formed	0	0	0,5
No of moles used	1	1,5	0
No of moles at equilibrium	3	2,5	0,5 ✓
Equilibrium concentration	1,5	1,25	0,25 ✓ ÷ 2
0,25			

$$K_c = \frac{[\text{X}_2\text{Y}_3]}{[\text{X}]^2[\text{Y}]^3} \quad \checkmark$$

$$= \frac{(0,25)}{(1,5)^2(1,25)^3} \quad \checkmark$$

$$= 0,057 \quad \checkmark$$

(6)
[20]

QUESTION 7

7.1 7.1.1 HSO_4^- ✓
DO NOT ACCEPT: Hydrogen sulphate ion (1)

7.1.2 CN^- ✓ (1)

7.2 7.2.1 $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + 2\text{HCl} \rightarrow 2\text{NaCl} + 11\text{H}_2\text{O} + \text{CO}_2$ (2)

7.2.2 Methyl orange ✓ (1)

7.2.3 Strong acid is titrated with a weak base / The equivalence point is in the pH range (3 – 4,4) / Low pH / Acidic solution after titration end point. Any ONE answer will be correct (2)

7.2.4 Red to yellow. ✓ (1)

7.2.5 **Option 1:**

$$c_{\text{HCl}} = \frac{n}{V} \quad \checkmark$$

$$\therefore n_{\text{HCl}} = CV$$

$$= 0,1 \times \frac{24,8}{1000}$$

$$= 2,48 \times 10^{-3} \text{ mol HCl} \quad \checkmark$$

1 mol Na_2CO_3 reacts with 2 mol HCl ✓

n (Na_2CO_3) in 500 cm^3 :

$$= \frac{(2,48 \times 10^{-3})}{2} \times \frac{500}{25}$$

$$= 2,48 \times 10^{-3} \text{ mol Na}_2\text{CO}_3 \quad \checkmark$$

$$n = \frac{m}{M}$$

$$m = nM$$

$$= 2,48 \times 10^{-3} \times 286 \text{ g} \cdot \text{mol}^{-1}$$

$$= 7,092 \text{ g} \quad \checkmark$$

Marking guidelines:

- Calculate n(HCl) ✓
- Use formula

$$C = \frac{n}{V} \quad \checkmark$$

- Use ratio, 1 : 2 ✓
- Calculate n(Na_2CO_3) ✓
- Calculate m of Na_2CO_3 ✓

Option 2:

$$\frac{n_a}{n_b} = \frac{C_a V_a}{C_b V_b} \quad \checkmark$$

$$\checkmark \frac{2}{1} = \frac{(0,1) \left(\frac{24.5}{1000} \right)}{(C_b) \left(\frac{25}{1000} \right)}$$

$$C_b = 0,0496 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

$$C = \frac{n}{V}$$

$$\begin{aligned} n &= (0,0496)(0,5) \\ &= 0,0248 \text{ mol Na}_2\text{CO}_3 \quad \checkmark \end{aligned}$$

$$n = \frac{m}{M}$$

$$m = nM = (0,0248) (286) = 7,093 \text{ g Na}_2\text{CO}_3 \quad \checkmark \quad (5)$$

7.2.6 Positive marking from question 7.2.6
% Na₂CO₃ in commercial washing soda:

$$= \frac{\text{actual mass}}{\text{theoretical mass}} \times 100 \quad \checkmark$$

$$= \frac{7,092}{7,6} \checkmark \times 100$$

$$= 93,32 \% \quad \checkmark$$

If answer of 7,093 g is used then the answer is 93,33 %

(3)
[16]

QUESTION 8

8.1 8.1.1 $\text{Mg}|\text{Mg}^{2+}||\text{Ag}^+|\text{Ag}$ (3)

8.1.2 Silver ✓ (1)

8.1.3 $E^\circ_{\text{cell}} = E^\circ_{\text{oxidising agent}} - E^\circ_{\text{reducing agent}}$
 $= 0,8 \text{ V} - (-2,36 \text{ V})$ ✓
 $= 3,16 \text{ V}$ ✓ (3)

8.1.4 25°C or 298 K ✓ (1)

8.1.5 $1 \text{ mol}\cdot\text{dm}^{-3}$ ✓ (1)

8.1.6 **Option 1**

The reaction rate is too low to supply enough charges to maintain a large enough current. ✓

Option 2

$$I = \frac{P}{V} = \frac{6 \text{ W}}{3 \text{ V}} = 2 \text{ A}$$

The light bulb is manufactured to operate effectively if it is connected to a source of 3 V which delivers a current of 2 A . Although the potential difference is sufficiently large, the current is probably too small (due to a too large internal cell resistance).

(3)
[12]

QUESTION 9

9.1 9.1.1 To the cathode ✓ (1)

9.1.2 $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$ ✓✓ (2)

9.1.3 Chlorine (Cl_2) gas ✓ (1)

9.2 9.2.1 The covering of the surface or an object with a thin layer of a metal by means of electrolysis. ✓✓ (2)

9.2.2 Any ONE use of electroplating.
 • Protection of the surface of a base metal. ✓
 • Decorative purposes. (1)

9.2.3 Negative electrode / cathode. ✓ (1)
[8]

QUESTION 10

10.1 10.1.1 Wheat ✓ (1)

10.1.2 Ammonium nitrate / NH_4NO_3 ✓ (1)

10.1.3 Wheat needs a soil low in potassium, medium in nitrogen and high in phosphorous. ✓ Nitrogen needs to be increased in the soil. ✓ More nitrogen needs to be added and ammonium nitrate has the most nitrogen. ✓ (3)

10.1.4 %nitrogen in $\text{NH}_4\text{NO}_3 = \frac{\text{mass nitrogen}}{\text{molar mass ammonium nitrate}} \times 100$ ✓
 $= \frac{28}{80} \times 100 = 35\%$ ✓ (4)

10.1.5 A Nitrogen / N_2 ✓
 B Hydrogen / H_2 ✓
 C Nitrogen dioxide / NO_2 ✓
 D Ammonium nitrate / NH_4NO_3 ✓
 E Ammonium sulphate / $(\text{NH}_4)_2\text{SO}_4$ ✓ (5)
[14]

TOTAL: 150