GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

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 ✓✓

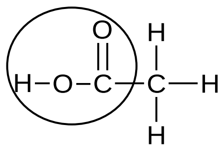
9 D ✓✓

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)

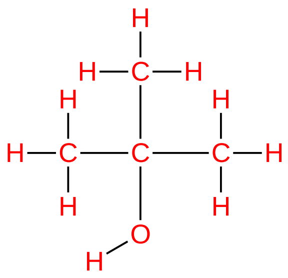
2.1.4 Ethanoic acid✓ (1)

2.1.5 Carboxylic acids✓ (1)

2.2 2.2.1 C_nH_{2n}✓ (1)

2.2.2 2,5-dimethyl✓hept-3-ene✓ (2)

2.3

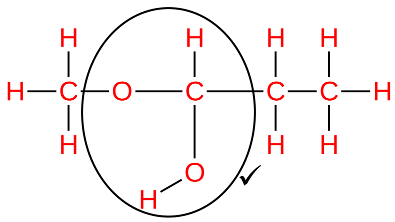


Marking guidelines:

- OH on middle C ✓
- complete structure correct ✓

(2)

2.4



Marking guidelines:

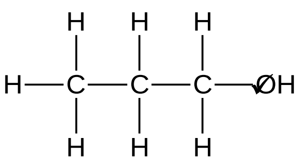
✓ functional group

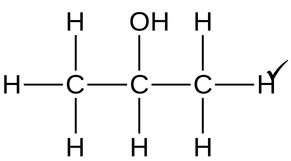
(1)
[14]

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 <u>position</u>✓ 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)

3.4.2 $H_3C—CH_2—CH_2\left[—CH_2—CH_2\right]_n—CH_2—CH_2—CH_2—CH_2—CH_3$

Ethene. ✓ (1)

3.4.3 Any ONE use:

Packaging material ✓
Squeeze bottles
Electrical insulation
Industrial protective clothing
Toys, etc. (1)

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QUESTION 4

4.1 4.1.1 Compound X = C_3H_5Br ✓ (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)

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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 cm^3 / min OR 5 cm^3 / 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)

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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 <u>forward reaction is endothermic</u>.✓ 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 $K_c = [H_3O^+][CH_3COO^-]$ ✓

$= (1,34 \times 10^{-3})(1,34 \times 10^{-3})$ ✓

$= 1,80 \times 10^{-6}$ ✓ (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 $[H_3O^+]$ concentration, therefore the pH increases. (3)

6.4 6.4.1 0,5 mol of gas X_2Y_3 ✓ (1)

6.4.2

	2X(g)	3Y(g)	X_2Y_3(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			

✓ ratio used

$$K_c = \frac{[X_2Y_3]}{[X]^2[Y]^3} \checkmark$$

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

$= 0,057$ ✓ (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 $Na_2CO_3.10H_2O + 2HC\ell \rightarrow 2NaC\ell + 11H_2O + CO_2$ ✓ ✓ (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:**

$c_{HC\ell} = \frac{n}{V}$ ✓

$\therefore n_{HC\ell} = CV$

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

$= 2,48 \times 10^{-3}$ mol $HC\ell$ ✓

1 mol Na_2CO_3 reacts with 2 mol $HC\ell$ ✓

n (Na_2CO_3) in 500 cm^3:

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

$= 2,48 \times 10^{-3}$ mol Na_2CO_3 ✓

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

m = nM

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

= 7,092 g ✓

Marking guidelines:

- Calculate n($HC\ell$) ✓
- Use formula $C = \frac{n}{V}$ ✓
- Use ratio, 1 : 2 ✓
- Calculate n(Na_2CO_3) ✓
- Calculate m of Na_2CO_3 ✓

Option 2:

$$\frac{n_a}{n_b} = \frac{C_aV_a}{C_bV_b} \quad ✓$$

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

C_b = 0,0496 mol·dm^{-3} ✓

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

n = (0,0496)(0,5)

= 0,0248 mol Na_2CO_3 ✓

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

m = nM = (0,0248) (286) = 7,093 g Na_2CO_3 ✓ (5)

7.2.6 Positive marking from question 7.2.6
% Na_2CO_3 in commercial washing soda:

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

$$= \frac{7,092}{7,6} ✓ \times 100$$

= 93,32 % ✓

If answer of 7,093 g is used then the answer is 93,33 % (3)

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QUESTION 8

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

8.1.2 Silver ✓ (1)

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

8.1.4 25°C or 298 K ✓ (1)

8.1.5 $1\ mol{\cdot}dm^{-3}$ ✓ (1)

8.1.6 **Option 1**

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

Option 2

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

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 $2H_3O^{+} + 2e^{-} \rightarrow H_2 + 2H_2O$ ✓✓ (2)

9.1.3 Chlorine ($C\ell_2$) 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 $\%\text{nitrogen in } NH_4NO_3 = \frac{\text{mass nitrogen}}{\text{molar mass ammonium nitrate}} \times 100$ ✓

$= \frac{28✓}{80✓} \times 100 = 35\%$ ✓ (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 / $(NH_4)_2SO_4$ ✓ (5)

[14]

TOTAL: 150