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ST BENEDICT'S

SUBJECT
GRADE
EXAMINER

Chemistry Prelim

12

Mr du Toit

NAME

MARKING GUIDELINES

DATE

MARKS

MODERATOR

DURATION

27 September 2021

200

Mrs Govender
Mr McCoy

QUESTION 1 - MULTIPLE CHOICE

20 MARKS

1.1 C ✓✓

1.2 A ✓✓

1.3 D ✓✓

1.4 C ✓✓

1.5 C ✓✓

1.6 B ✓✓

1.7 D ✓✓

1.8 C ✓✓

1.9 C ✓✓

1.10 B ✓✓

QUESTION 2 – GOVENDER**22 MARKS**

2.1 Homogeneous mixture of solute and solvent ✓✓ AON (2)

2.2 Water ✓ (1)

2.3 $c = \frac{n}{V}$ ✓ formula

$$0,25 = \frac{n}{0,25} \text{ ✓conv}$$

$$n = 0,0625 \text{ mol of } Na_2O$$

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

$$0,0625 = \frac{m}{62} \text{ ✓molar mass}$$

$$m = 3,88 \text{ g} \text{ ✓ answer} \quad (4)$$

2.4 $MgO \xrightarrow{H_2O} Mg^{2+} + O^{2-}$ ✓ (-1 for no water) (2)

2.5 $Na_2O: O^{2-}$

1:1 ✓ratio

$$\therefore 0,0625 \text{ mol of } O^{2-}$$

$$n = 0,5 \times 0,1 = 0,05 \text{ mol of } MgO \text{ ✓answer}$$

$MgO: O^{2-}$

1:1 **coe from 2.4 (balancing)**

$$\therefore 0,05 \text{ mol of } O^{2-}$$

$$c = \frac{0,0625 + 0,05}{0,25 + 0,1} \text{ ✓adding moles}$$

$$= 0,32 \text{ mol} \cdot \text{dm}^{-3} \text{ of } O^{2-} \text{ ✓answer} \quad (5)$$

2.6 2.6.1 A transfer of electrons and subsequent electrostatic attraction ✓✓ AON (2)

- 2.6.2 Both Na_2O and MgO experience **ionic bonds** (between ions) ✓
The ions of Na_2O have 1+ and 1- charges and the ions of MgO have 2+ and 2- charges ✓**difference in charge**
The electrostatic force between the ions in MgO are stronger than the electrostatic forces between ions in Na_2O ✓**comparison**
More energy is required to overcome stronger electrostatic forces ✓ (4)
- 2.6.3 SiO_2 is a giant covalent structure ✓ which has a higher boiling point than magnesium oxide which is a giant ionic substance ✓. (2)
-

QUESTION 3 - GOVENDER

20 MARKS

- 3.1 bond which occurs between atoms within molecules ✓✓ AON (2)
- 3.2 Electronegativity difference (END) = $3 - 3,2 = 0,9$ (greater than zero) ✓
 Unequal sharing of electron (bonding pair) ✓
 Polar covalent bonds ✓ (3)
- 3.3 A weak force of attraction between molecules, ions, or atoms of noble gases
 ✓✓ AON (2)
- 3.4 The positive hydrogen (naked proton) of the NH_3 ✓ attracts the lone pair of
 electrons ✓ on the nitrogen of a neighbouring NH_3 ✓ (3)
- 3.5 Both water and ammonia experience hydrogen bond forces between molecules
 ✓
 Water experiences 4 hydrogen bonds per molecule ✓ and ammonia
 experiences 2 hydrogen bonds per molecule ✓
 More energy is required to **overcome** more hydrogen bond forces ✓ (4)
- 3.6 3.6.1 The **net** change of chemical potential energy of the system ✓✓ AON (2)
- 3.6.2 Energy absorbed = $941 + 3(432) = 2237 \text{ kJ}$ ✓
 Energy released = $(2)(3)(391) = 2346 \text{ kJ}$ ✓
 $\Delta H = -109 \text{ kJ}$ ✓ (3)
- 3.6.3 Exothermic ✓ (accept *endothermic* if 3.6.2 is positive) (1)
-

QUESTION 4 - MCCOY**20 MARKS**

4.1 Change in concentration per unit time of either a reactant or product ✓✓AON (2)

4.2 B ✓ (1)

4.3 $Average\ rate = \frac{\Delta light\ intensity}{\Delta time}$

$$= \frac{10 - 6}{0 - 50} \checkmark \text{subs}$$

$$= -0,08 \checkmark \text{answer } cd.s^{-1} \checkmark \text{unit} \quad (3)$$

4.4 $n = c.V = (0,1)(0,5) = 0,05 \text{ mol of } HCl \checkmark \text{answer}$

$n = c.V = (2)(0,5) = 1 \text{ mol of } Na_2S_2O_3 \checkmark \text{answer}$

$Na_2S_2O_3 : HCl$

1:2

$n = 0,025 \text{ mol of } Na_2S_2O_3 \text{ required } \checkmark \text{ratio}$

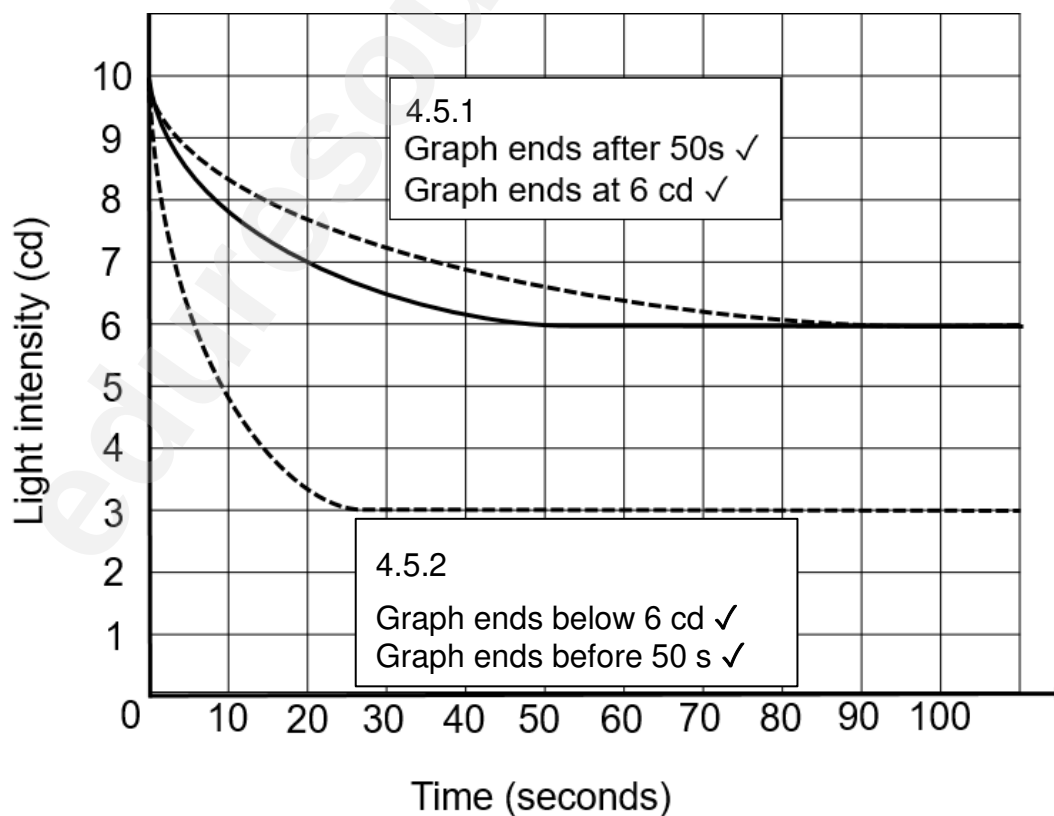
If HCl is limiting then $0,025 \text{ mol } Na_2S_2O_3 \text{ required.}$

$1 \text{ mol of } Na_2S_2O_3 \text{ available (which is enough)} \checkmark \text{statement}$

No marks for stating HCl limiting.

(4)

4.5



(4)

- 4.6 The lower temperature means lower average kinetic energy ✓
Fewer collisions per unit time ✓
Fewer effective collisions per unit time ✓
Lower reaction rate (shallower gradient) ✓ (4)
- 4.7 No. Water is also produced ✓ which is clear ✓ (2)
-

QUESTION 5 – DU TOIT

25 MARKS

5.1 $n = \frac{V}{V_m}$ ✓ formula

$n = \frac{62,4}{104}$ ✓ subs

$= 0,6 \text{ mol}$ ✓ answer

(3)

5.2

MOLES	4NH ₃	5O ₂ (g)	⇌	4NO(g)	6H ₂ O(g)
Ratio	4	5		4	6
Initial (mol)	2	1		0	0
Change (mol)	-0,4	-0,5		+0,4	+0,6
Equilibrium (mol)	1,6	0,5		0,4	0,6 coe from 5.1
Equilibrium (mol·dm ⁻³)	0,8	0,25		0,2	0,3

$$= \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$$

$$= \frac{(0,2)^4(0,3)^6}{(0,8)^4(0,25)^5}$$

$$= 2,92 \times 10^{-3}$$

✓ Change row

✓ Equilibrium row

✓ Divide by 2

✓ Kc expression sub numerator

✓ Kc expression sub denominator

✓ Answer

(6)

5.3 Kc is less than 1. ✓ Poor yield. ✓ (coe from 5.2)

(2)

5.4 a substance that increases the rate of the reaction ✓ but remains unchanged at the end of the reaction ✓

(2)

5.5 No effect ✓

Catalysts increases the rate of **both** forward and reverse reactions ✓
to the **same extent**. ✓

(3)

5.6 Exothermic ✓✓

(2)

5.7.1

Stress: decrease in pressure

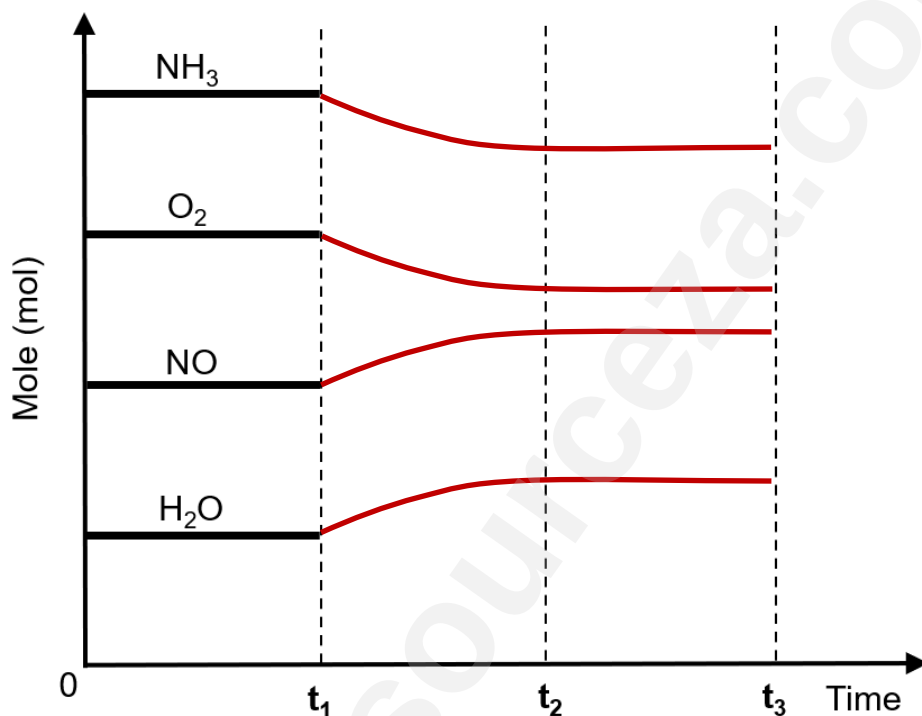
Response: forward reaction is (initially) favoured ✓

Reason : The forward and reverse reaction rates will (suddenly/instantaneously) decrease. ✓ The forward reaction will decrease less ✓ than the reverse reaction rate. ✓

Answer: The yield of products increases

(4)

5.7.2



✓ Products increase and reactants decrease

(coe from 5.7.1 if **reverse favoured** then products decrease and reactants increases)✓ gradual change to t_2 ✓ flat lines from t_2 to t_3 (-1 if spiked at t_1)

(3)

QUESTION 6 – GOVENDER

17 MARKS

6.1 Proton donor ✓ (1)

6.2 Carboxyl group ✓ (1)

6.3 $(\text{COOH})_2 + \text{Ca} \rightarrow (\text{COO})_2\text{Ca} + \text{H}_2$ ✓ (3)6.4.1
a reaction of an ion (from a salt) with water ✓✓ (2)6.4.2
 $(\text{COO})_2^{2-} + 2\text{H}_2\text{O} \rightleftharpoons (\text{COOH})_2 + 2\text{OH}^-$
✓ reactants ✓ products ✓ balanced
(–1 no double arrow) (3)6.5.1
the point where an acid and base have reacted so neither is in excess ✓✓ (2)6.5.2
 $n_b = (0,4)(0,02) = 8 \times 10^3 \text{ mol of base} \checkmark \text{answer}$
 $n_a = \frac{8 \times 10^3}{2} \checkmark \text{ratio} = 4 \times 10^3 \text{ mol of acid} \checkmark \text{answer}$
 $m = (4 \times 10^3)(90) \checkmark = 0,36 \text{ g of acid}$
 $\% \text{purity} = \frac{0,36}{1} \times 100 = 36\% \checkmark \text{answer}$ (5)

QUESTION 7 – MCCOY

28 MARKS

- 7.1 The electrical potential of the SHE is arbitrarily defined as **0,0 V** at 25°C✓ so that it can act as a **reference point** ✓ from which to calculate the cell potential of the chlorine half- cell. (2)
- 7.2 The electrode where reduction takes place. ✓✓ **AON** (2)
- 7.3 $\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-$ ✓ (1)
- 7.4 $\text{Pt}(\text{s}) \mid \text{H}_2(\text{g}, 1\text{atm}) \mid \text{H}^+(\text{aq}, 1\text{mol}\cdot\text{dm}^{-3}) \parallel$
 $\text{Cl}_2(\text{g}, 1\text{atm}) \mid \text{Cl}^-(\text{aq}, 1\text{mol}\cdot\text{dm}^{-3}) \mid \text{Pt}(\text{s})$ at 25°C
- ✓ hydrogen-half cell as anode
 ✓ inert electrodes at start and end
 ✓ phases and conditions
 ✓ correct order: reducing agent I oxidised species II oxidising agent I reduced species (4)
- 7.5 Reactants are gaseous and aqueous and would require a surface ✓ (location) where the oxidation-reduction (electron transfer) can occur ✓ (2)
- 7.6.1
 $\text{HF} + \text{H}_2\text{O} \rightleftharpoons \text{F}^- + \text{H}_3\text{O}^+$
 ✓ reactants ✓products ✓double arrow (3)
- 7.6.2
 HF is a weak acid ✓ and does not ionise completely ✓
 The concentration of hydrogen/ hydronium ions will not be standard (1 mol.dm⁻³) ✓ (3)
- 7.7 $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$
 $1,8\checkmark = 1,36\checkmark - E^\circ_{\text{anode}}$
 $E^\circ_{\text{anode}} = -0,44 \text{ V } \checkmark$
 $\therefore \text{M} = \text{Fe } \checkmark$ (4)
- 7.8 Y to X ✓ (1)

7.9 Any one of the following:

Make the salt bridge shorter or wider.

Use a more conductive electrolyte/ salt bridge solution

Increase surface area of electrodes ✓ (1)

7.10 As chlorine is reduced to form chloride ions, the chloride ions entering the solution around the positive electrode makes the solution more negative (less positive). ✓

To maintain electrical neutrality in the solution of the cathode-half cell, the K^+ ions ✓

in the salt bridge (attracted to the negative solution) migrates from the salt bridge into the solution of chloride ions. ✓ (3)

7.11 $Fe + Cu^{2+} \checkmark \rightarrow Fe^{2+} + Cu \checkmark$ (2)

QUESTION 8 – DU TOIT

14 MARKS

8.1.1

electrical energy → chemical potential energy ✓ (1)

8.1.2

oxygen ✓ (1)

8.1.3

In the dilute solution there is relatively more water. ✓

Water is a stronger reducing agent than chloride ions. Water is oxidised to oxygen. ✓

 $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$ ✓ (3)

8.1.4

sodium chloride ✓ and sodium hydroxide ✓ (2)

8.2.1

A substance that accepts electrons. ✓ (1)

8.2.2

silver ions ✓ (1)

8.2.3

$$q = It$$

$$q = 0,3(5 \times 60) = 90 \text{ C} \checkmark \text{answer}$$

$$q = nF$$

$$90 = n(96500) \checkmark \text{subs}$$

$$n = 9,32 \times 10^{-4} \text{ mol of electrons}$$

$$n\text{Ag} = 9,32 \times 10^{-4} \text{ mols of Ag} \checkmark$$

$$m = (9,32 \times 10^{-4})(108)$$

$$m = 0,10 \text{ g} \checkmark (4)$$

8.2.4

Bubbles of gas would be seen. ✓ (1)

QUESTION 9 – DU TOIT**22 MARKS**

9.1 ANY TWO of the following: ✓✓

Four valence electrons

Can form long chains

Can form double/ triple bonds with itself

Can form cyclic compounds

(2)

9.2.1

penta✓-1,2-diene ✓

propane✓-1,3-diol ✓

(4)

9.2.2

a) compounds having the same molecular formula but different structural formulae ✓✓ **AON**

(2)

b) Chain isomers. ✓ Different lengths of parent chain. ✓

(2)

c) C. ✓ It has a greater contact surface area ✓

(2)

9.2.3

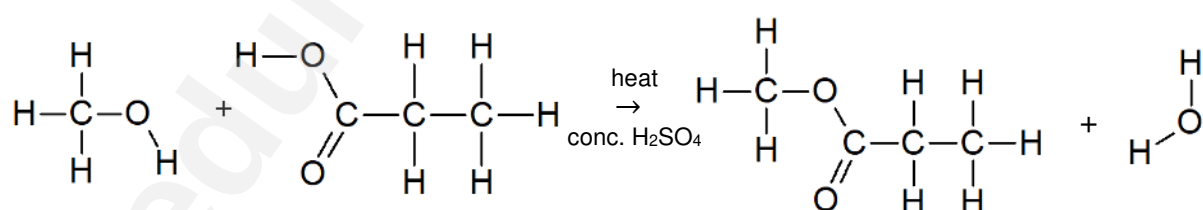
a) a compound containing only carbon and hydrogen atoms✓ in which there is at least one double and/or triple bond between carbon atoms ✓

(2)

b) B ✓

(1)

9.2.4

a) Esterification between CH_3OH and $\text{CH}_3\text{CH}_2\text{COOH}$ 

✓ structural formula for methanol

✓ structural formula for propanoic acid

✓ structural formula for methyl propanoate

✓ structural formula for water

✓ reaction conditions

(5)

b) Butan✓oic acid✓

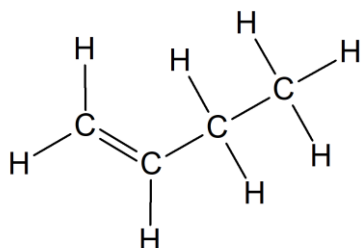
(2)

QUESTION 10 – MCCOY**12 MARKS**

10.1 Elimination ✓ (1)

10.2 Water ✓ (1)

10.3



✓ 4 carbons

✓ double bond after carbon 1 (2)

10.4 Hydrohalogenation ✓ (1)

10.5 2-bromo ✓ butane ✓ (2)

10.6.1



✓ four carbons ✓ hydroxyl on carbon 1 (2)

10.6.2



✓ reactants ✓ products ✓ balanced