PHYSICAL SCIENCE
GRADE 11
2023 November
CHEMISTRY PAPER 2
MARKS: 150
MARKING GUIDELINE

QUESTION 1

1.1	**A**	B	C	D	Linear
1.2	**A**	B	C	D	H_3O^+
1.3	A	B	**C**	D	(ii), (i), (iii)
1.4	A	**B**	C	D	Van der Waals forces.
1.5	A	**B**	C	D	molecules in 22,4 dm^3 of water at STP.
1.6	A	B	C	**D**	198 kJ of energy is required to produce 2 moles of SO_2.
1.7	A	B	**C**	D	$40kJ.mol^{-1}$ & 4
1.8	A	B	C	**D**	HNO_3 donates protons and is a Bronsted-Lowry acid
1.9	A	**B**	C	D	H_2O
1.10	**A**	B	C	D	+6
Total				/20	

QUESTION 2

2.1 Exothermic✓ The energy of the products is higher✓ than the energy of the reactants✓ (3)

2.2 $\Delta H = E_p - E_R$✓
$\Delta H = 10 - 45$✓
$\Delta H = -35kJ$✓ (3)

2.3 An unstable, temporary arrangement of atoms that forms just before atoms start to combine. ✓✓ (2)

2.4 103kJ ✓ (1)

2.5 Minimum energy required to initiate or start a reaction. ✓✓

OR

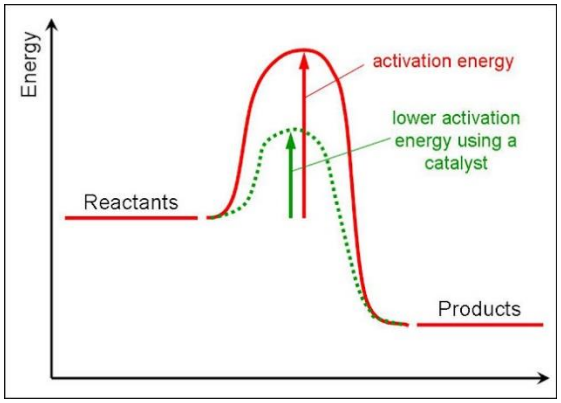
The minimum energy that must be absorbed by a system to cause it to react. (2)

2.6.1 It lowers the activation energy✓ and <u>increases the rate of the reaction</u>✓ (2)

2.6.2 Increase the rate of the reverse reaction✓✓ (2)

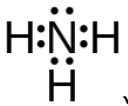
2.6.3 No (1)

2.6.4



Lower peak/activation energy✓

Products and reactants unaffected ✓ (2)

2.7  ✓✓ (2)

2.8 3 (Three) ✓ (1)

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QUESTION 3

3.1 The **temperature** at which the solid and liquid phases of a substance are at equilibrium. ✓✓ (2)

3.2 The intermolecular forces in HF are H-bonds. ✓
The intermolecular forces in HCl are v / d Waals forces/Dipole-dipole forces ✓
H bonds are stronger than v/d Waal forces/Dipole-dipole forces ✓ , therefore, the melting point of HF is higher. (3)

3.3 The intermolecular forces in HCl, HBr and HI are all v/d Waal forces/Dipole-dipole forces ✓that increase in strength with increasing molar mass. ✓ The melting points increase with increasing strength in intermolecular forces. ✓ (3)

3.4.1 A/ F_2✓ (1)

3.4.2 Lower the boiling point, the lower the IMF✓, therefore the higher vapour pressure. ✓ (2)

3.4.3 D/ I_2 ✓ (1)

3.5.1 The forces that hold atoms together within a molecule. ✓✓ (2)

3.5.2

ΔEN_{HBr} = 2,8 -2,1	ΔEN_{Br2} = 2,8 -2,8
ΔEN_{HBr} = 0,7 ✓	ΔEN_{Br2} = 0 ✓
Polar (covalent) bond ✓	Non-polar (covalent) bond✓

(4)

3.5.3 Linear✓ (1)

3.5.4 Intramolecular bonds ✓ (1)

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QUESTION 4

4.1.1 Simplest whole number ratio of elements in a molecule. ✓✓ (2)

4.1.2 Suppose there is a 100 g sample.

40% S = 40 g S
60% O = 60 g O

$n_{(S)} = \frac{m}{M_r} = \frac{40}{32}$✓ $= 1{,}25\ mol$

$n_{(O)} = \frac{m}{M_r} = \frac{60}{16}$✓ $= 3{,}75\ mol$

$\therefore n_{(S)} : n_{(O)}$

1,25 : 3,75✓

$\frac{1{,}25}{1{,}25} : \frac{3{,}75}{1{,}25}$✓

1 : 3

Empirical formula: SO_3✓ (5)

4.2.1 The reactant that will be used up first during a chemical reaction and consequently the determining factor in the amount of product that will form. ✓✓ (2)

4.2.2 $n_{(C_4H_{10})} = \frac{m}{M_r}$✓

$n_{(C_4H_{10})} = \frac{50}{(12\times4)+(1\times10)}$✓ $= 0{,}862\ mol$ $\quad n_{(O_2)} = \frac{50}{(16\times2)}$✓ $= 1{,}563 mol$

$n_{(C_4H_{10})} : n_{(O_2)}$

$\frac{0{,}862}{2} : \frac{1{,}563}{13}$✓

0,431: **0, 12**✓

Oxygen ✓ (6)

4.2.3 $n_{(O_2)} : n_{(H_2O)}$

13: 10✓

$1{,}563 : 1{,}563 \times \frac{10}{13} = 1{,}2 mol$✓

$m_{(H_2O)} = n.M$✓

$m_{(H_2O)} = (1{,}2)((1\times2)+16)$ ✓

$= 21{,}64g$✓ (5)

4.3.1 Standard temperature and pressure ✓ (1)

4.3.2 T = 273,15 K (0°C) OR

P = 1 atm (101,325 kPa) ✓ (1)

4.3.3 $n_{(CO_2)} = \frac{V}{V_M}$✓ $= \frac{1{,}2}{22{,}4}$✓ $= 0{,}054\ mol$

$m_{(CaCO_3)} = nM$

$m_{(CaCO_3)} = \frac{1}{1}(0{,}054)\big(40+12+3(16)\big)$✓

$m_{(CaCO_3)} = 5{,}4g$ ✓

$\%\ purity = \frac{mass\ of\ pure\ substance}{mass\ of\ impure\ substance} \times 100$ ✓

$= \frac{5{,}4}{6} \times 100$✓

$= 90\%$ ✓ (7)

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QUESTION 5

5.1 An acid is a proton / H^+ ion donor. ✓✓ (2)

5.2 H^+ (H_3O^+)✓ and OH^- ✓ (2)

5.3.1 Decomposition reaction ✓ (1)

5.3.2 $n_{Ca(HCO_3)_2} = cV$✓

$n_{Ca(HCO_3)_2} = (0{,}002)(150)$ ✓

$n_{Ca(HCO_3)_2} = 0{,}3\ mol$

$n_{CaCO_3} = n_{Ca(HCO_3)_2} \quad (ratio\ \ 1:1)$ ✓

$n_{CaCO_3} = 0{,}3\ mol$

$m_{CaCO_3} = nM$✓

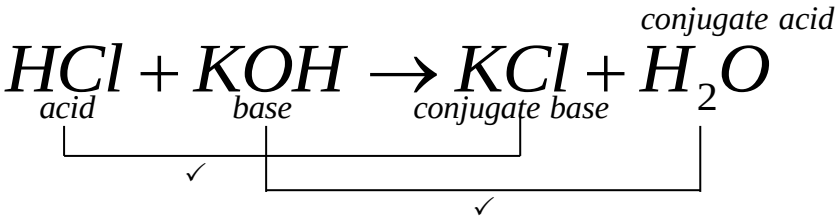
$m_{CaCO_3} = 0{,}3(40 + 12 + 3(16))$ ✓

$m_{CaCO_3} = 30g$ ✓ (6)

5.4.1 An acid is a substance that produces hydrogen ions (H^+)/hydronium ions (H_3O^+) when it dissolves in water.✓✓ (2)

5.4.2 HCl + KOH✓ → KCl + H_2O✓ (2)

5.4.3



(2)

5.4.4 $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$✓

$\frac{c_a(25)✓}{(0{,}15)(18{,}5)✓} = \frac{1}{1}$

$c_a = 0{,}111\ mol.dm^{-3}$ ✓ (4)

5.4.5 Phenolphthalein ✓ (1)

5.4.6 A base/substance that dissociates completely in water. ✓✓ (2)

5.4.7 The student should immediately place his/her arm under running water✓ to dilute and wash away the KOH(aq). Tell the teacher. (1)

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QUESTION 6

6.1 The increase in oxidation number of a substance.✓✓ (2)

6.2 Al. ✓ Lose electrons. ✓ (2)

6.3 Cu^{2+} ions ✓✓ (2)

6.4 $Cu^{2+}\checkmark + 2e^{-}\checkmark \rightarrow Cu\checkmark$
$Al\checkmark \rightarrow Al^{3+}\checkmark + 3e^{-}\checkmark$ (6)

6.6 3 e- ✓ ✓ (Al is oxidized. Al's oxidation number changes from 0 to +3, so it loses three electrons.) (2)

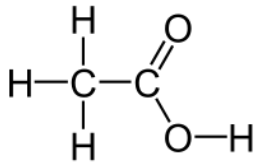
6.6 6 e-.✓✓ (The Cu^{2+} ion's oxidation number changes from +2 to 0, which means that each Cu^{2+} ion takes up 2 electrons, thus three mole will gain 6 electrons.) (2)

6.7 $Na + Ag^{+}\checkmark \rightarrow Na^{+} + Ag\checkmark$ balanced ✓ (3)

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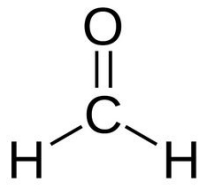
Question 7

7.1 Organic compounds that consist of hydrogen and carbon only✓✓ (2)

7.2.1  ✓✓ (2)

7.2.2 2-methyl✓butan-2-ol✓✓ OR 2-methyl-2-butanol (3)

7.2.3 Ketone✓ (1)

7.2.4  ✓✓ (2)

7.2.5 C_nH_{2n+2} ✓ (1)

7.3 Secondary Alcohol. ✓The carbon that holds the -OH group, is attached to two other carbon atoms. ✓ (2)

7.4.1 C✓ (1)

7.4.2 Ethyl✓ ethanoate✓ (2)

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TOTAL: 150