



eduresourceza.com

25 JULY 2022

MEMO

Question 1: Multiple Choice

- | | |
|-----------|------------|
| 1.1. C ✓✓ | 1.6. D ✓✓ |
| 1.2. C ✓✓ | 1.7. B ✓✓ |
| 1.3. A ✓✓ | 1.8. D ✓✓ |
| 1.4. A ✓✓ | 1.9. D ✓✓ |
| 1.5. B ✓✓ | 1.10. B ✓✓ |

[10 x 2 = 20 marks]

Question 2: Chemical Bonding and Intermolecular Forces

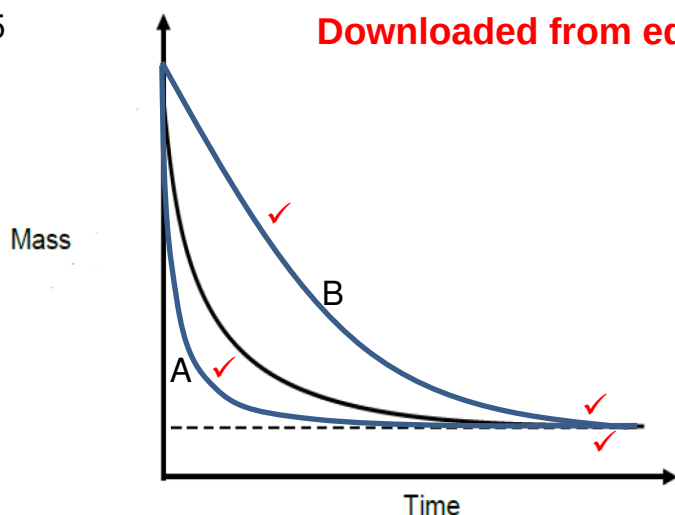
- 2.1 A bond which occurs between atoms ✓ within molecules ✓. (2)
- 2.2 Polar ✓ covalent ✓ (2)
- 2.3 NH_4Cl ✓✓ (2)
- 2.4 NH_4Cl is an ionic substance / made up of NH_4^+ ions and Cl^- ions ✓.
The ions have many strong ✓ ionic bonds / electrostatic forces of attraction ✓ between them.
Large amount of energy ✓ needed to break the many strong ionic bonds between the ions. (4)
- 2.5 In molten ✓ or aqueous ✓ state. Ions would be freed from the crystal lattice to be able to carry a current ✓. (3)
- 2.6 $n(\text{Cl}_2) = \frac{m}{M} = \frac{142\text{g}}{71\text{g/mol}} = 2 \text{ mol}$ ✓
 $n(\text{H}_2) = \frac{m}{M} = \frac{10\text{g}}{2\text{g/mol}} = 5 \text{ mol}$ ✓
Ratio of $\text{Cl}_2 : \text{H}_2 = 1:1$ OR If 2 mol Cl_2 reacts then 2 mol H_2 reacts ✓
 H_2 is in excess ✓. (5)

[18 marks]

Question 3: Rates of Reaction

- 3.1 The SI unit ✓ for amount ✓ of substance. (2)
- 3.2 $n = \frac{V}{V_m} = \frac{0,270\text{dm}^3}{22,4 \text{ dm}^3/\text{mol}} = 0,012\text{mol}$ ✓ (3)
- 3.3 $n(\text{CuCO}_3)_{\text{that reacts}} = 0,012 \times \frac{1}{1} = 0,012\text{mol}$ ✓
 $m(\text{CuCO}_3)_{\text{that reacts}} = nM = (0,012)(123,5) = 1,49\text{g}$ ✓
 $\% \text{ purity} = \frac{1,49}{3} \times 100 = 49,62\%$ ✓ (5)
- 3.4.1 The change in concentration ✓ per unit time ✓ of either a reactant or product. (2)
- 3.4.2 No ✓. Gradient is not yet zero ✓ and more product is still forming ✓. (3)
- 3.4.3 (a) $\text{Rate} = \frac{\Delta y}{\Delta x} = \frac{165-164,85}{10} = \frac{0,15}{10} = 0,015\text{g.s}^{-1}$ ✓ (2)
- (b) $\text{Rate} = \frac{\Delta y}{\Delta x} = \frac{164,775-164,70}{20} = \frac{0,075}{20} = 0,00375\text{g.s}^{-1}$ ✓ (2)
- 3.4.4 Rate in (a) is faster than in (b) ✓.
Rate slows down as the reaction proceeds ✓ as the reactant is getting used up ✓ / there are fewer reactant particles present per unit volume ✓ and hence fewer collisions ✓. (3)

3.5



Downloaded from eduresourceza.com

- A: Steeper initial gradient ✓
Same final mass ✓
B: Initial gradient less steep ✓
Same final mass ✓

(4)

- 3.6 The concentration is decreased, so there are fewer particles per unit volume ✓.
Thus fewer particles with sufficient kinetic energy for collisions to be successful ✓.
There will be fewer effective collisions per unit time ✓, and a slower reaction rate ✓. (4)
[30 marks]

Question 4: Chemical Equilibrium

- 4.1 A closed system (in chemistry) is one in which mass is conserved inside the system ✓ but energy can enter or leave the system freely ✓. (2)

- 4.2 5 min ✓. (1)

- 4.3 $K_C = \frac{[C_2H_6]^2 [O_2]}{[C_2H_4]^2 [H_2O]^2}$ ✓ (2)

- 4.4 $2,0 = \frac{[C_2H_6]^2 (0,08)}{(0,40)^2 (0,28)^2}$ ✓ (2)

$$[C_2H_6]^2 = \frac{(2,0)(0,40)^2 (0,28)^2}{(0,08)} = 0,3136$$

$$[C_2H_6] = 0,56 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

$$n = cV = (0,56)(3) \checkmark = 1,68 \text{ mol} \checkmark \quad (4)$$

- 4.5
- | | | | | | | | |
|-----|--------------|-----|------------|----------------------|--------------|-----|----------|
| | $2C_2H_4(g)$ | $+$ | $2H_2O(g)$ | $\rightleftharpoons$ | $2C_2H_6(g)$ | $+$ | $O_2(g)$ |
| I | | | | | 1,20 ✓ | | 0 |
| C | | | | | +0,48 ✓ | | +0,24 ✓ |
| E | | | | | 1,68 ✓ | | 0,24 ✓ |
| [E] | | | | | | | 0,08 |

$$(O_2) \text{ at equilibrium} = cV = (0,08)(3) = 0,24 \text{ mol} \checkmark$$

$$n(O_2) \text{ produced} = 0,24 - 0 = 0,24 \text{ mol} \checkmark$$

$$n(C_2H_6) \text{ produced} = 0,24 \times \frac{2}{1} = 0,48 \text{ mol} \checkmark$$

$$n(C_2H_6) \text{ at equilibrium} = 1,68 \text{ mol} \checkmark$$

$$n(C_2H_6) \text{ initially present} = 1,68 - 0,48 = 1,20 \text{ mol} \checkmark \quad (5)$$

- 4.6 Decrease ✓ in pressure ✓ (2)

- 4.7 When an external stress (change in pressure, temperature or concentration) is applied to a system in chemical equilibrium ✓, the equilibrium point will change in such a way as to counteract the stress ✓. (2)

- 4.8 Stress: Increase temperature

Response: [reactants] decreases and [products] increases ✓, so the forward reaction is favoured ✓.

Reason: According to LCP, the reaction that counteracts the stress and decreases the temperature is favoured ✓. Thus the endothermic reaction is favoured ✓.

Forward reaction is therefore endothermic ✓. (5)

- 4.9 No effect ✓ ✓ (2)

- 4.10 ethanol ✓ ✓ (2)

Downloaded from eduresourceza.com

[27 marks]

Question 5: Acids and Bases

- 5.1 An acid that only ionises partially ✓ in an aqueous solution ✓. (2)
- 5.2.1 It is able to donate more than one ✓ proton ✓. (2)
- 5.2.2 $[PO_4^{3-}] = [H_3O^+] \times \frac{1}{3} \checkmark = (1,68 \times 10^{-2}) \times \frac{1}{3} = 5,6 \times 10^{-3} \text{ mol. dm}^{-3} \checkmark$
- $$K_a = \frac{[PO_4^{3-}][H_3O^+]^3 \checkmark}{[H_3PO_4] \checkmark}$$
- $$7,3 \times 10^{-4} = \frac{(5,6 \times 10^{-3})(1,68 \times 10^{-2})^3 \checkmark}{[H_3PO_4] \checkmark}$$
- $$[H_3PO_4] = \frac{(5,6 \times 10^{-3})(1,68 \times 10^{-2})^3}{7,3 \times 10^{-4}} = 3,64 \times 10^{-5} \text{ mol. dm}^{-3} \checkmark \quad (6)$$
- 5.2.3 $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$
- $$(1,68 \times 10^{-2}) \checkmark [OH^-] = 1 \times 10^{-14} \checkmark$$
- $$[OH^-] = \frac{1 \times 10^{-14}}{1,68 \times 10^{-2}} = 5,95 \times 10^{-13} \text{ mol. dm}^{-3} \checkmark \quad (3)$$
- 5.3.1 A solution of known ✓ concentration ✓. (2)
- 5.3.2 $n(NaOH) = cV = (2)(0,030 \checkmark) = 0,060 \text{ mol} \checkmark$
- $$n(H_3PO_4) = 0,060 \times \frac{1}{3} = 0,020 \text{ mol} \checkmark$$
- $$c(H_3PO_4) = \frac{n}{V} = \frac{0,02}{0,015 \checkmark} = 1,33 \text{ mol. dm}^{-3} \checkmark \quad (5)$$
- 5.3.3 sodium phosphate ✓✓ (2)
- 5.3.4 A reaction of an ion (from a salt) ✓ with water ✓. (2)
- 5.3.5 phenolphthalein ✓ (1)
- 5.3.6 NaOH is a strong base and H_3PO_4 is a weak acid ✓.
- PO_4^{3-} will react with water to produce hydroxide ions ✓.
- (or $PO_4^{3-} + 2H_2O \rightleftharpoons H_3PO_4 + 2OH^-$)
- Excess OH^- in solution results in a basic solution ✓.
- Indicator that changes colour in basic range (phenolphthalein) required ✓. (4)

[29 marks]

Question 6: Galvanic Cell

- 6.1 A substance that donates ✓ electrons ✓. (1 mark for "undergoes oxidation" or similar.) (2)
- 6.2 Statement ✓ that links the variables ✓. E.g. The zinc-silver cell produces the greatest emf/ Zinc is the best reducing agent, followed by iron and then metal X/ The greater the emf produced in the cell, the greater the reducing ability of the metal attached to Ag. (2)
- 6.3 Repeat ✓ the experiment several times for each metal ✓. (2)
- 6.4 salt bridge ✓ (1)
- 6.5 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)
- 6.6 Ag^+ cations are being used up in the silver half-cell ✓.
- Cations from the salt bridge move into the silver half-cell ✓ and some NO_3^- anions move from the silver electrolyte into the salt bridge ✓ to maintain electrical neutrality. (3)
- 6.7 $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$
- $$0,94 \checkmark = 0,8 - X \checkmark$$
- $$X = -0,14 \text{ V} \checkmark$$
- Thus Sn ✓ (tin ✓) (5)

[17 marks]

Question 7: Electrolysis

- 7.1.1 brine ✓ (1)
- 7.1.2 electrical energy ✓ to chemical potential energy ✓. (2)
- 7.1.3 ONLY Allows only positive ions ✓ to pass through to make sure no Cl^- ions ✓ enter the NaOH solution / no OH^- ions go back to the anode. (2)
- 7.1.4 $2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-$ ✓✓ (2)

7.1.5 H₂O is a stronger oxidising agent than Na⁺ ions. Thus H₂O will undergo reduction at the cathode in preference to Na⁺. ✓

OR

Na⁺ ions are a weaker oxidising agent than H₂O. Thus H₂O will undergo reduction at the cathode in preference to Na⁺. [NB! Sodium ions okay, but NOT Na ions] (3)

7.2.1 $q = It = (2,50A)(1,28 \times 60 \times 60) = (2,50)(4608s) = 11520C$ ✓ (3)

7.2.2 $n(e^-) = \frac{q}{F} = \frac{11520}{96500} = 0,12 \text{ mol}$ ✓

Group 2 metal ion will have a charge of 2+, so it will gain 2 e⁻ when reduced at the cathode. ie. Ratio of metal ions to electrons is 1:2 ✓

$n(\text{metal ions}) = 0,12 \times \frac{1}{2} = 0,06 \text{ mol}$ ✓

$M = \frac{m}{n} = \frac{5,253}{0,06} = 88$ ✓

Thus metal is strontium / Sr ✓.

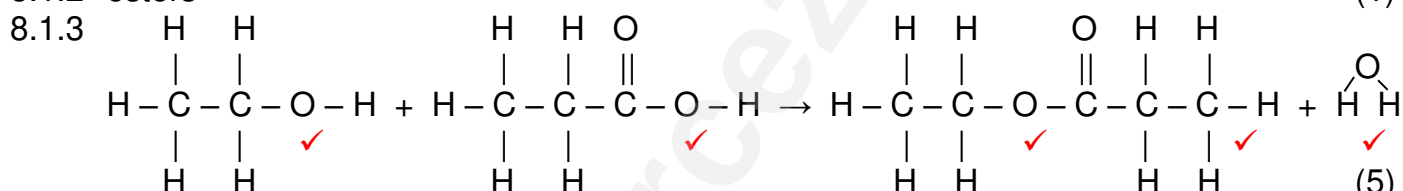
(5)

[18 marks]

Question 8: Organic Chemistry

8.1.1 A series of similar compounds which have the same functional group ✓ and have the same general formula ✓, in which each member differs from the previous one by a single CH₂ unit ✓. (3)

8.1.2 esters ✓ (1)



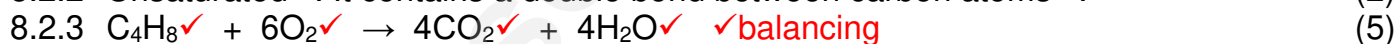
8.1.4 Heat ✓ and concentrated sulphuric acid catalyst ✓. (2)

8.1.5 Compound having the same molecular formula ✓ but different structural formula ✓. (2)

8.1.6 pentanoic acid ✓✓ (2)

8.2.1 2-methyl ✓ prop-1-ene ✓ OR methyl ✓ propene ✓ (no spaces) (2)

8.2.2 Unsaturated ✓. It contains a double bond between carbon atoms ✓. (2)



8.3 D < A < B ✓

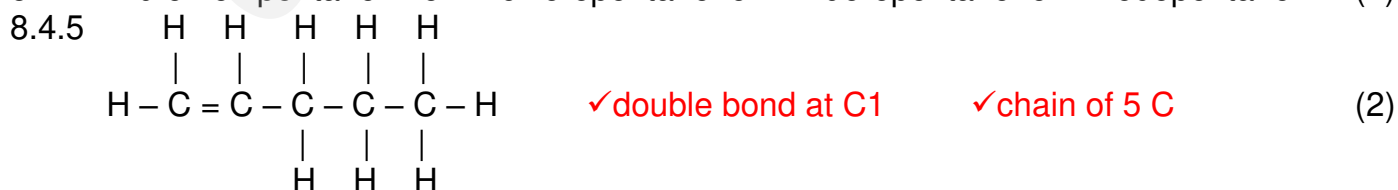
The predominant intermolecular forces in D are London forces ✓, which are weaker than the dipole-dipole forces between molecules of compound A ✓, which are weaker than the the hydrogen bonds between molecules of compound B ✓. The stronger the forces, the more energy is needed to break the forces and hence the higher the boiling points ✓. (5)

8.4.1 An atom or a group of atoms ✓ that form the centre of chemical activity in the molecule ✓. (2)

8.4.2 hydroxyl group ✓ (1)



8.4.4 1-bromo ✓ pentane ✓ or 1-chloropentane or 1-fluoropentane or 1-iodopentane (2)



8.4.6 dehydration ✓ (NOT elimination) (1)

8.4.7 addition ✓ (accept hydrohalogenation); HBr ✓ (2)

[41 marks]

[TOTAL = 200 MARKS]