



PHYSICAL SCIENCES PAPER 2 MEMORANDUM

QUESTION 1

- 1.1 Carboxylic acids ü (1)
- 1.2 Electrolysis of sodium chloride ü (1)
- 1.3 Le Chateliers Principle ü (1)
- 1.4 Electrolysis ü (1)
- 1.5 Isomer ü (1)[5]

QUESTION 2

- 2.1 Fertilizer mixed in the ratio 3:1:5 (38%) contains 4.2% phosphorus. ü ü (2)
- 2.2 A cell with capacity 2Ah produces $2A \times 1H \times 60 \times 60 = 7200 As = 7200C$ ü ü (2)
- 2.3 The melting points and boiling points of alkanes increase with increasing molecular mass. ü ü (2)
- 2.4 The salt bridge of a Zn/Cu electrochemical cell must have a metal salt, e.g. KNO_3 , as the ions must be free to move in order to conduct electricity. ü ü (2)
- 2.5 The equilibrium constant is affected by temperature only. ü ü (2)[10]

QUESTION 3

- 3.1 C ü ü (2)
- 3.2 B ü ü (2)
- 3.3 B ü ü (2)
- 3.4 C ü ü (2)
- 3.5 D ü ü (2)[10]

SECTION A: SUBTOTAL = [25]

SECTION B

QUESTION 4

- 4.1.1 Particle size/surface area ü (1)

4.1.2 Reaction rate /time for reaction. (1)

4.1.3 Volume of acid.

Concentration of acid.

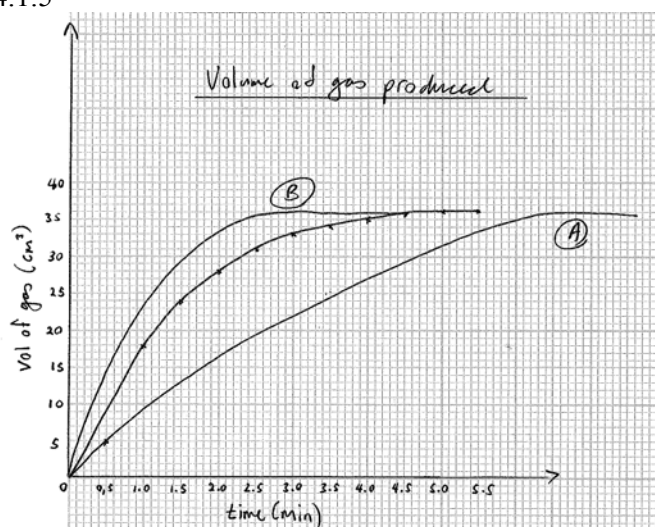
No. of tablets/mass of tablets.

Temperature

Any TWO relevant (2)

4.1.4 The smaller the particle size the faster the reaction rate (2) since there will be a greater surface area (2) \ more effective collisions between reactant particles.

4.1.5



Heading- 1 mark; scales- 1 mark; label of axes with unit- 1 mark; plotting of points- 2 marks; smooth curve- 1 mark (6)

4.2 The graph will be lower than the original graph in 4.1.5 (2) With lower concentration there are less particles to react therefore less effective collisions in a given unit of time (2), so the reaction rate is slower. Same final volume because the same mass metal carbonate is used with the same volume of acid. (4)

4.3 The graph will be above the original graph in 4.1.5. (2) Greater surface area will increase the chance of effective collisions. (2) Same final volume of gas when reaction is complete because the same mass metal carbonate is used with same volume and concentration of acid. (4)

4.4 5 minutes. (1)

4.5 Rate decreases progressively with time. (2) At the start of the reaction the number of reacting ions (H^+ , Cl^- , CO_3^{2-} , Ca^{2+}) are at a maximum and the reaction rate is high (2). As the ions react and ions are removed from the solution, the number of successful collisions decreases and the reaction rate decreases. (3)

4.6 $n = \frac{m}{M} = \frac{0.7}{100} = 0.007 \text{ mol}$ of $CaCO_3$

$CaCO_3 : HCl$

Mol ratio 1 : 2

0.007 : 0.014

\ Vol. of HCl

$V = \frac{n}{C} = \frac{0.014}{0.1} = 0.14 \text{ dm}^3$ (140 cm^3)

(6)[30]

QUESTION 5

5.1 If an external stress (change in temperature, change in pressure or change in concentration) is applied (2) to a system at chemical equilibrium, then the system will

change in such a way as to counteract the stress. ü

(2)

5.2 No, they were incorrect. ü Heating favours the endothermic reaction. ü As the colour changed from pink to blue when heated, the reverse reaction was favoured ü which is therefore endothermic. The forward reaction is thus exothermic. (4)

5.3 a decrease ü
b no effect ü
c increase ü
d increase ü
e no effect ü
f no effect ü (6)

5.4 a: Concentration of Cl^- is increased and reverse reaction is favoured ü
c: Exothermic reaction is favoured by lower temperature ü
e: Catalyst will only speed up the reaction. ü (3)

5.5 $K_c = \frac{[\text{Co}(\text{H}_2\text{O})_6^{+2}][\text{Cl}^-]}{[\text{CoCl}_4^{-2}][\text{H}_2\text{O}]^6}$ ü (2)

5.6 It is the number that shows us to what extent the reactants have changed into products ü or the ratio of product over reactants at equilibrium. ü (2)

5.7.1 10 seconds ü (1)

5.7.2 $[\text{Co}(\text{H}_2\text{O})_6]^{+2} + 4\text{Cl}^- \ll \text{CoCl}_4^{-2} + 6\text{H}_2\text{O}$ ü (1)

5.7.3 Water or cobalt(II)chloride was added to the system,. ü ü According to le Chateliers principle the system reacts to oppose the disturbance by favouring the forward reaction and the reaction rate increases until a new equilibrium is reached. ü ü (4)

5.7.4 A catalyst will have no effect on the equilibrium; it will speed up both the forward and reverse reactions equally. ü ü (2)[27]

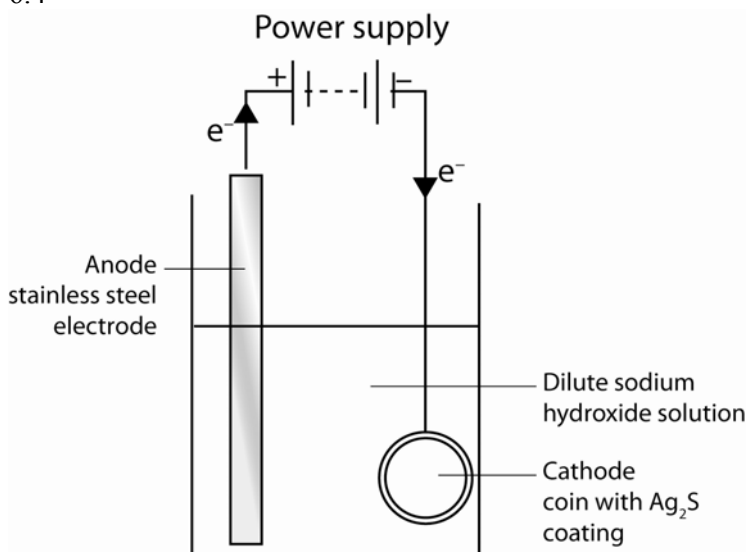
QUESTION 6

6.1 Electrical energy to chemical energy ü (1)

6.2 Reducing agent is the substance which donates electrons in a redox reaction. ü (1)

6.3 The direction of electron flow through the external circuit is from the steel electrode to the coin. ü ü (2)

6.4



Correct direction of current; ü Power supply; ü correctly drawn and labelled ü ü (5)

6.5.1 $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$ ü (1)

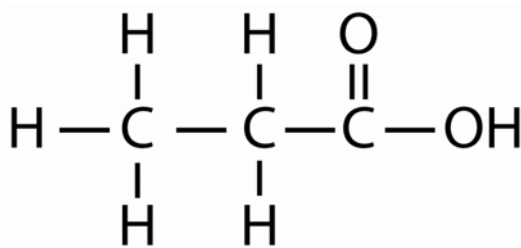
- 6.5.2 $\text{Ag}_2\text{S}(\text{s}) + 2\text{e}^- \rightarrow 2\text{Ag}(\text{s}) + \text{S}^{2-}(\text{aq})$ (1)
- 6.5.3 Cathode (1)
- 6.5.4 $2\text{Ag}_2\text{S}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{Ag}(\text{s}) + 2\text{S}^{2-}(\text{aq})$ (2)
- 6.6 An electrochemical cell is formed with aluminium as the anode and the silver core as the cathode. (1)
- $2\text{Al}(\text{s}) + 3\text{Ag}_2\text{S}(\text{s}) \rightarrow 6\text{Ag}(\text{s}) + 3\text{S}^{2-}(\text{aq}) + 2\text{Al}^{3+}(\text{aq})$ (1)
- Since the reaction has a positive emf, the reaction will occur and silver is not lost from the coin.
- $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$
- $= 0.71 - (-1.66)$
- $= 2.37 \text{ V}$ (4)[17]

QUESTION 7

- 7.1 Chemical energy to electrical energy. (1)
- 7.2 Primary cell (1)
- 7.3 A primary cell reaction takes place in one direction only, whereas a secondary cell the reaction is reversible. (2)
- 7.4 Cell capacity is a measure of the number of hours a cell can supply a certain amount of current before its voltage drops below an acceptable level. (2)
- 7.5 $q = It$
- $I = q/t = 50/5 = 10 \text{ A}$ (3)
- 7.6 Increase in temperature speeds up redox reaction. This happens even when the cell is not in use. Amount of chemicals is thus now less to produce electricity and the life span of the cell is less. (4)
- 7.7 Torch cells; camera; portable radio; laptop (3)
- 7.8 2 positives (1)
- allows for portable items and technology
 - rechargeable varieties reduce waste and pollution
 - quiet, reliable source of power
 - can be low cost, easy to use, widely available.
- 2 negatives (1)
- disposable lead to solid waste and pollution
 - may heat up, leak even explode
 - can be expensive
 - may have short life span and low power output.
- (4)[20]

QUESTION 8

- 8.1 A (1)
- 8.2 E and H (1)
- 8.3 $\text{C}_4\text{H}_8 + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CHBrCH}_2\text{Br}$ (3)
- Halogenation/addition reaction
- 8.4 Propyl pentanoate and water (2)
- 8.5 Ketones; propanone (2)
- 8.6 octanoic acid (1)
- 8.7.1 Methyl ethanoate (2)
- 8.7.2 methanol and ethanoic acid (2)
- 8.7.3 Propanoic acid (1)



ü ü (3)

8.7.4 Concentrated sulphuric acid (1)[18]

QUESTION 9

- 9.1 Reaction with oxygen (Combustion) releases a huge amount of energy. ü ü (2)
- 9.2 Boiling points increase ü as the molecular mass increases ü the covalent bond strength increases therefore increasing the boiling points. ü (3)
- 9.3 Hydrogen bonding. ü (1)
- 9.4 Van der Waals forces between alcohol molecules increase ü with increase in molecule size. Hydrogen bonds between alcohol molecules are stronger ü than Van der Waals forces between molecules of alkanes. ü (3)
- 9.5 $\text{CH}_4[\text{g}] + 2\text{O}_2[\text{g}] \rightarrow \text{CO}_2[\text{g}] + 2\text{H}_2\text{O}[\text{g}] + \text{energy}$ ü balancing ü (3)[12]