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National Senior Certificate
Grade 12
Physical Science
Paper 2

MEMORANDUM

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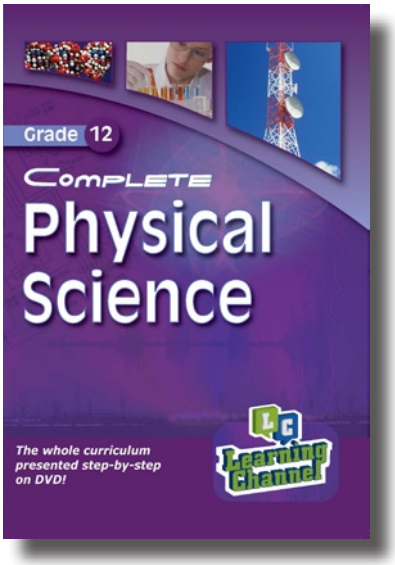


SECTION A

QUESTION 1

1.1 Carboxylic acids ✓ (1)

1.2 Electrolysis of sodium chloride ✓ (1)

1.3 Le Chateliers Principle ✓ (1)

1.4 Electrolysis ✓ (1)

1.5 Isomer ✓ (1)

[5]

QUESTION 2

2.1 Fertiliser mixed in the ratio 3:1:5 (38%) contains 4.2% phosphorus. ✓✓ (2)

2.2 A cell with the capacity 2Ah produces 2A × 1H × 60 × 60 = 7200 As = 7200C ✓✓ (2)

2.3 The melting points and boiling points of alkanes increase with increasing molecular mass. ✓✓ (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. ✓✓ (2)

2.5 The equilibrium constant is affected by temperature only. ✓✓ (2)

[10]

QUESTION 3

3.1 C ✓✓ (2)

3.2 B ✓✓ (2)

3.3 B ✓✓ (2)

3.4 C ✓✓ (2)

3.5 D ✓✓ (2)

[10]

SECTION A: SUBTOTAL = [25]

SECTION B

QUESTION 4

4.1 4.1.1 Particle size/surface area ✓ (1)

4.1.2 Reaction rate/time for reaction. ✓ (1)

4.1.3 Volume of acid

Concentration of acid

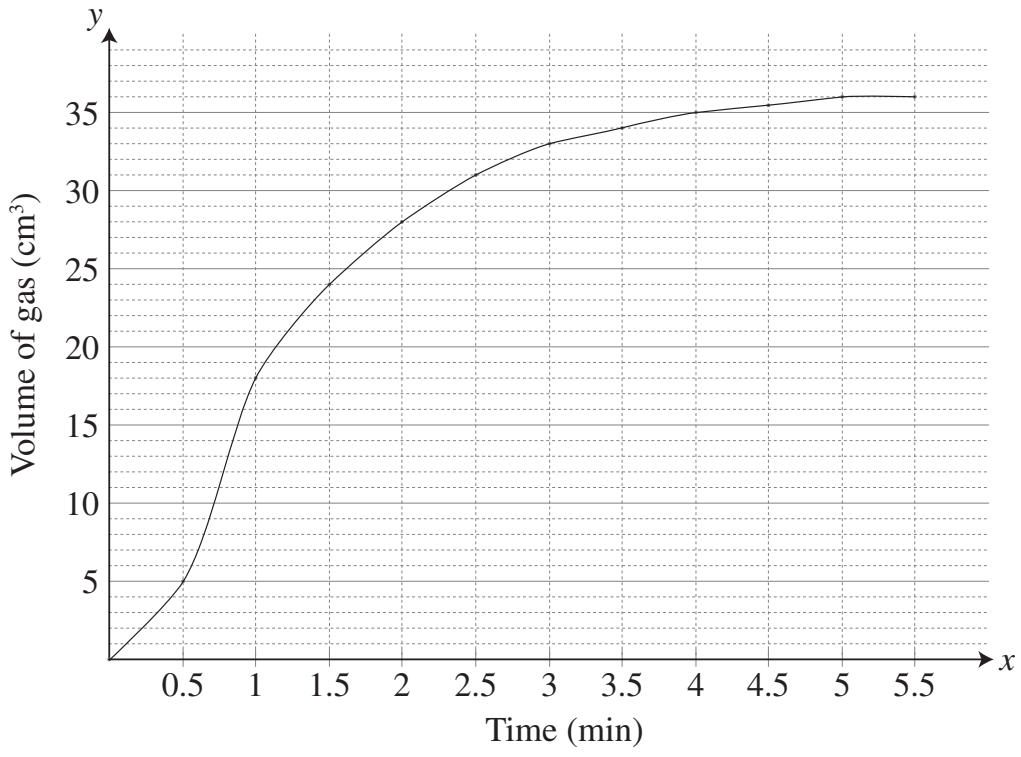
Number of tablets/mass of tablets.

Temperature

Any TWO relevant ✓✓ (2)

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

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. ✓✓ With lower concentration there are less particles to react therefore less effective collisions in a given unit of time, ✓ 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 ✓✓. Greater surface area will increase the chance of effective collisions. ✓ Same final volume of gas when reaction is complete because the same mass metal carbonate is used with the same volume and concentration of acid. ✓ (4)

4.4 5 minutes. ✓ (1)

4.5 Rate decreases progressively with time. ✓ 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. ✓ 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 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 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 ✓to a system at chemical equilibrium, then the system will change in such a way as to counteract the stress. ✓ (2)

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

5.3 a: decrease ✓

b: no effect ✓

c: increase ✓

d: increase ✓

e: no effect ✓

f: no effect ✓ (6)

5.4 a: Concentration of Cl^- is increased and reverse reaction is favoured. ✓

c: Exothermic reaction is favoured by lower temperature. ✓

e: Catalyst will only speed up the reaction. ✓ (3)

5.5 $Kc = \frac{[Co(H_2O)_6^{+2}][Cl^-]}{[CoCl_4^{-2}][H_2O]^6}$ ✓✓ (2)

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

5.7 5.7.1 10 seconds ✓ (1)

5.7.2 $[Co(H_2O)_6]^{+2} + 4Cl \leftrightarrow CoCl_4^{-2} + 6H_2O$ ✓ (1)

5.7.3 Water or cobalt(II) chloride was added to the system,. ✓✓ 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. ✓✓ (4)

5.7.4 A catalyst will have no effect on the equilibrium. It will speed up both the forward and reverse reactions equally. ✓✓ (2)

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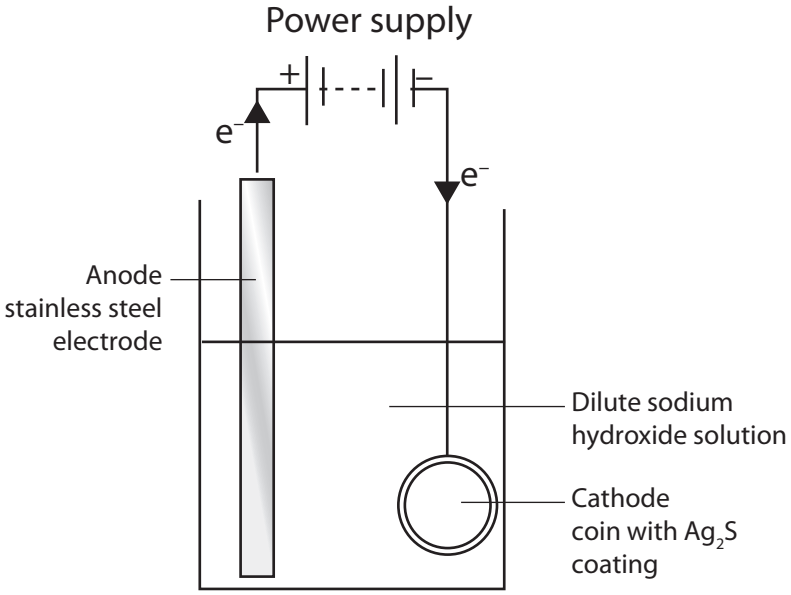
QUESTION 6

6.1 Electrical energy to chemical energy ✓ (1)

6.2 A reducing agent is the substance which donates electrons in a redox reaction. ✓ (1)

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

6.4



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

6.5 6.5.1 $2H_2O\ (l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$ ✓ (1)

6.5.2 $Ag_2S\ (s) + 2e^- \rightarrow 2Ag(s) + S^{-2}(aq)$ ✓ (1)

6.5.3 Cathode ✓ (1)

6.5.4 $2Ag_2S\ (s) + 2H_2O\ (l) \rightarrow O_2(g) + 4H^+(aq) + 4Ag(s) + 2S^{-2}(aq)$ ✓✓ (2)

6.6 An electro-chemical cell is formed with aluminium as the anode and the silver core as the cathode. ✓

$2Al(s) + 3Ag_2S\ (s) \rightarrow 6Ag(s) + 3S^{-2}(aq) + 2Al^{+3}(aq)$ ✓✓

Since the reaction has a positive emf, the reaction will occur and silver is not lost from the coin.

E cell = E cathode – E anode

= 0.71 – (–1.66)

= 2.37 V ✓ (4)

[18]

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 in 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 $q = It$ ✓

$I = \frac{q}{t} = \frac{50}{5}$ ✓ $= 10A$ ✓ (3)

7.6 An increase in temperature speeds up redox reaction. ✓ This happens even when the cell is not in use. ✓ The 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, lap top ✓✓ ✓ (3)

7.8 two positives: ✓✓

– 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.

two negatives: ✓✓

– Disposable, which leads to solid waste and pollution.

– May heat up, leak even explode.

– Can be expensive.

– May have a short life span and low power output. (4)

[20]

QUESTION 8

8.1 A ✓ (1)

8.2 E and H ✓ (1)

8.3 $C_4H_8 + Br_2 \rightarrow CH_3CH_2CHBrCH_2Br$ ✓✓ (3)

Halogenation/addition reaction ✓

8.4 Propyl pentanoate ✓ and water ✓ (2)

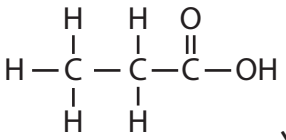
8.5 Ketones ✓; propanone ✓ (2)

8.6 octanoic acid ✓ (1)

8.7 8.7.1 Methyl ethanoate ✓✓ (2)

8.7.2 methanol ✓ and ethanoic acid ✓ (2)

8.7.3 Propanoic acid ✓



✓✓ (3)

8.7.4 Concentrated sulphuric acid ✓ (1)

[18]

QUESTION 9

9.1 Reaction with oxygen (combustion) releases a huge amount of energy. ✓✓ (2)

9.2 Boiling points increase ✓as the molecular mass increases. ✓ The covalent bond strength increases therefore increasing the boiling points. ✓ (3)

9.3 Hydrogen bonding. ✓ (1)

9.4 Van der Waals forces between alcohol molecules increase ✓ with an increase in molecule size. Hydrogen bonds between alcohol molecules are stronger ✓ than Van der Waals forces between the molecules of alkanes. ✓ (3)

9.5 $CH_4[g] + 2O_2[g]$ ✓ $\rightarrow CO_2[g] + 2\ H_2O[g]$ + energy ✓ balancing ✓ (3)

[12]