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National Senior Certificate

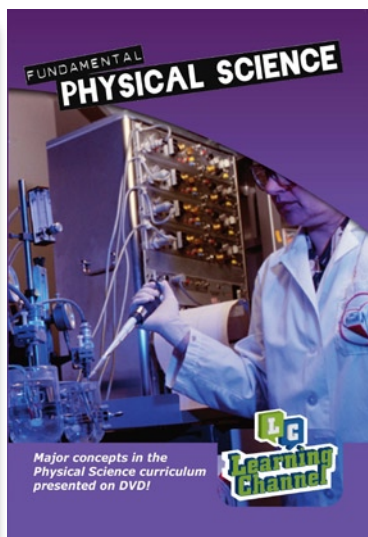
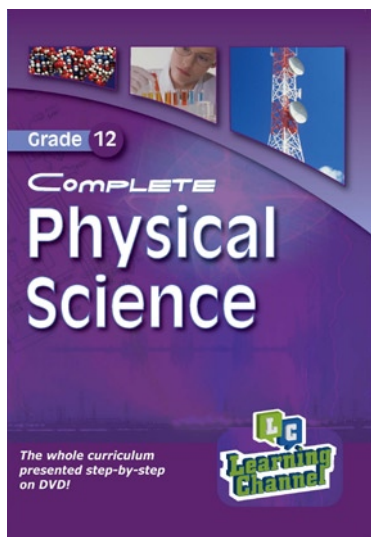
Grade 12

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 $2A \times 1h \times 60 \times 60 = 7200 \text{ As} = 7200C$ ✓✓ (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

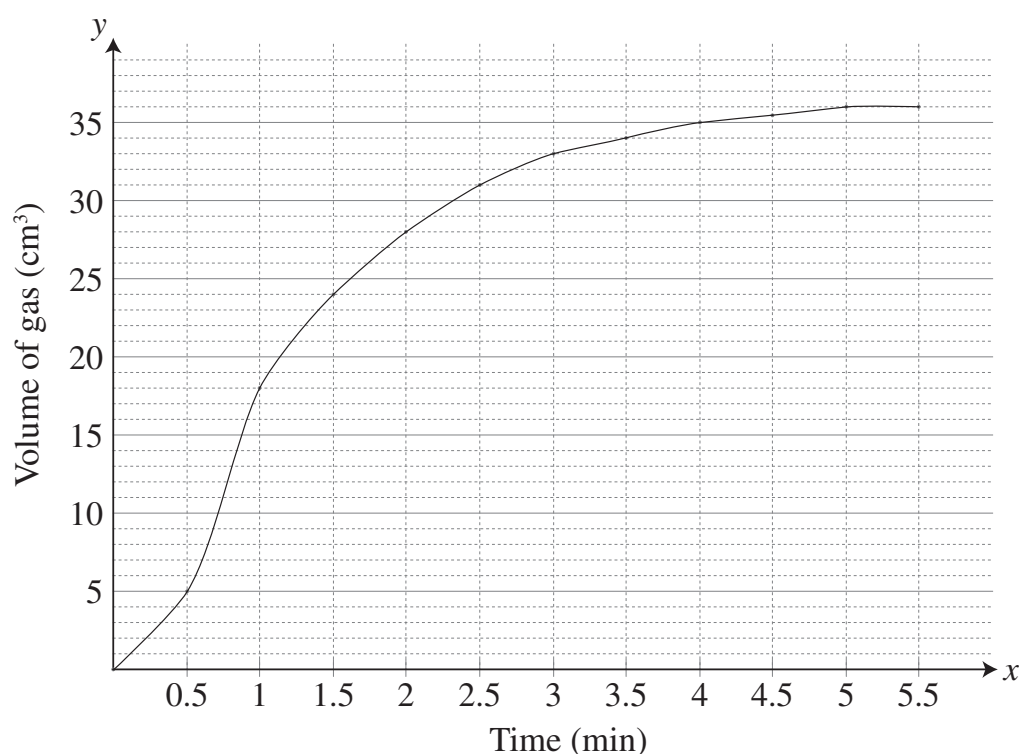
Number of tablets/mass of tablets.

Temperature

Any TWO relevant ✓✓ (2)

4.1.4 The smaller the particle size the faster the reaction rate ✓ since there will be a greater surface 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 $n = \frac{m}{M}$ ✓ $= \frac{0,7}{100}$ ✓ $= 0,007 \text{ mol}$ ✓ of CaCO_3

$\text{CaCO}_3 : \text{HCl}$

Mol ratio 1 : 2

0,007 : 0,014

∴ Vol. of HCl

$V = \frac{n}{C}$ ✓ $= \frac{0,014}{0,1}$ ✓ $= 0,14 \text{ dm}^3 (140 \text{ cm}^3)$ ✓ (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 $K_c = \frac{[\text{Co}(\text{H}_2\text{O})_6^{+2}][\text{Cl}^-]}{[\text{CoCl}_4^{-2}][\text{H}_2\text{O}]^6}$ ✓✓ (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 $[\text{Co}(\text{H}_2\text{O})_6]^{+2} + 4\text{Cl}^- \leftrightarrow \text{CoCl}_4^{-2} + 6\text{H}_2\text{O}$ ✓ (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)

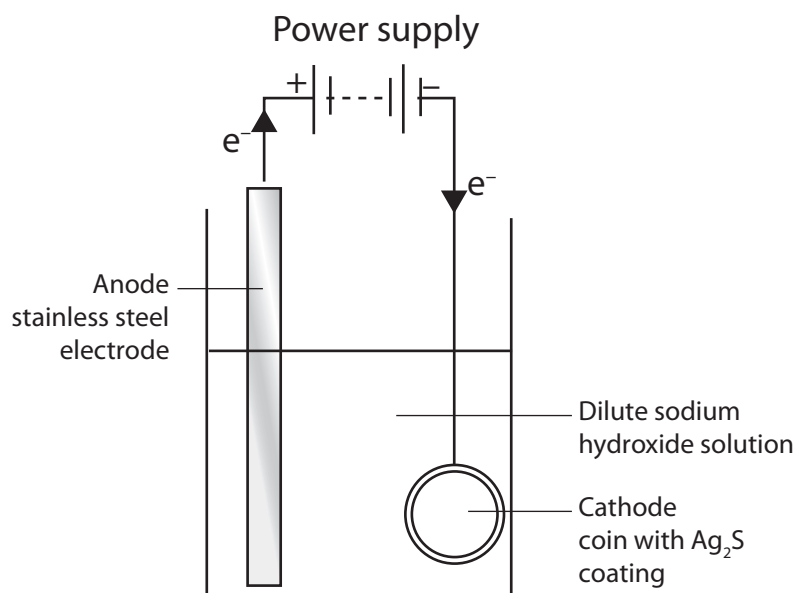
5.7.4 A catalyst will have no effect on the equilibrium. It will speed up both the forward and reverse reactions equally. ✓✓ (2)

[27]

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 $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$ ✓ (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 electro-chemical cell is formed with aluminium as the anode and the silver core as the cathode. ✓
- $2\text{Al}(\text{s}) + 3\text{Ag}_2\text{S}(\text{s}) \rightarrow 6\text{Ag}(\text{s}) + 3\text{S}^{2-}(\text{aq}) + 2\text{Al}^{3+}(\text{aq})$ ✓✓
- 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)

[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 ✓

$$\begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ | \quad | \quad || \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{OH} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$
 ✓✓ (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 $\text{CH}_4[\text{g}] + 2\text{O}_2[\text{g}] \rightarrow \text{CO}_2[\text{g}] + 2\text{H}_2\text{O}[\text{g}] + \text{energy}$ ✓ balancing ✓ (3)

[12]