



NATIONAL SENIOR CERTIFICATE EXAMINATION  
SUPPLEMENTARY 2014

**PHYSICAL SCIENCES: PAPER II**

**MARKING GUIDELINES**

Time: 3 hours

200 marks

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These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

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## QUESTION 1

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

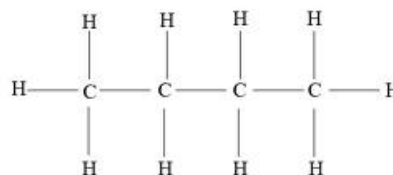
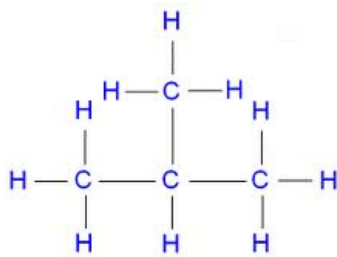
[20]

## QUESTION 2

- 2.1 Alkanes.  $C_nH_{2n+2}$  (2)

- 2.2 2.2.1 Substances with the same molecular formula but different structural formula. (2)

2.2.2



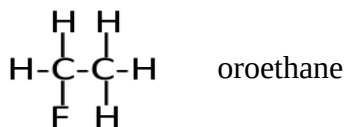
(2)

- 2.2.3 2 – methylpropane  
butane (2)

- 2.2.4 Butane —longer chain, greater electron cloud density---stronger Van der Waals/intermolecular forces. (3)

- 2.3  $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$  correct products  
react with  $O_2$   
correct balancing (3)

2.4



(2)

- 2.5 Destroy the ozone layer/increase in skin cancers (any 2 reasons) (2)

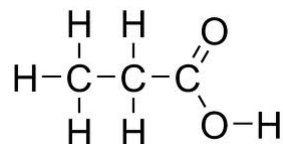
[18]

### QUESTION 3

3.1 3.1.1 carbonyl group (2)

3.1.2 C (2)

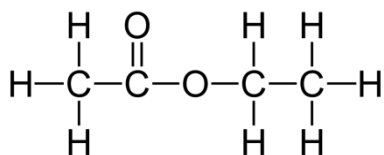
3.1.3 (2)



3.1.4 C<sub>3</sub>H<sub>6</sub> (2)

3.2 3.2.1 ethanol (2)

3.2.2 (3)



3.2.3 Acts as a catalyst and a dehydrating agent. (2)

3.2.4 Esters are flammable and must therefore preferably be heated over a water bath./Cannot be heated directly over a naked flame. (2)

**[17]**

## QUESTION 4

4.1 4.1.1 An organic molecule containing carbon and hydrogen atoms only. (2)

4.1.2  $\text{CH}_3\text{CH}_3 \rightarrow \text{CH}_2 = \text{CH}_2 + \text{H}_2$  OR  $\text{C}_2\text{H}_6 \rightarrow \text{C}_2\text{H}_4 + \text{H}_2$  (2)

4.2 4.2.1 During addition polymerisation monomers will bond to each other at high pressure and temperature in the presence of a catalyst to form a long carbon chain (polymer). OR other acceptable definitions (2)

4.2.2 (2)

4.2.3 (2)

4.2.4 (3)

4.2.5 Thermoplastics can be re-melted and/or re-moulded. (2)

4.3 4.3.1 condensation polymer (1)

4.3.2 water (1)

4.3.3 (4)  
[21]

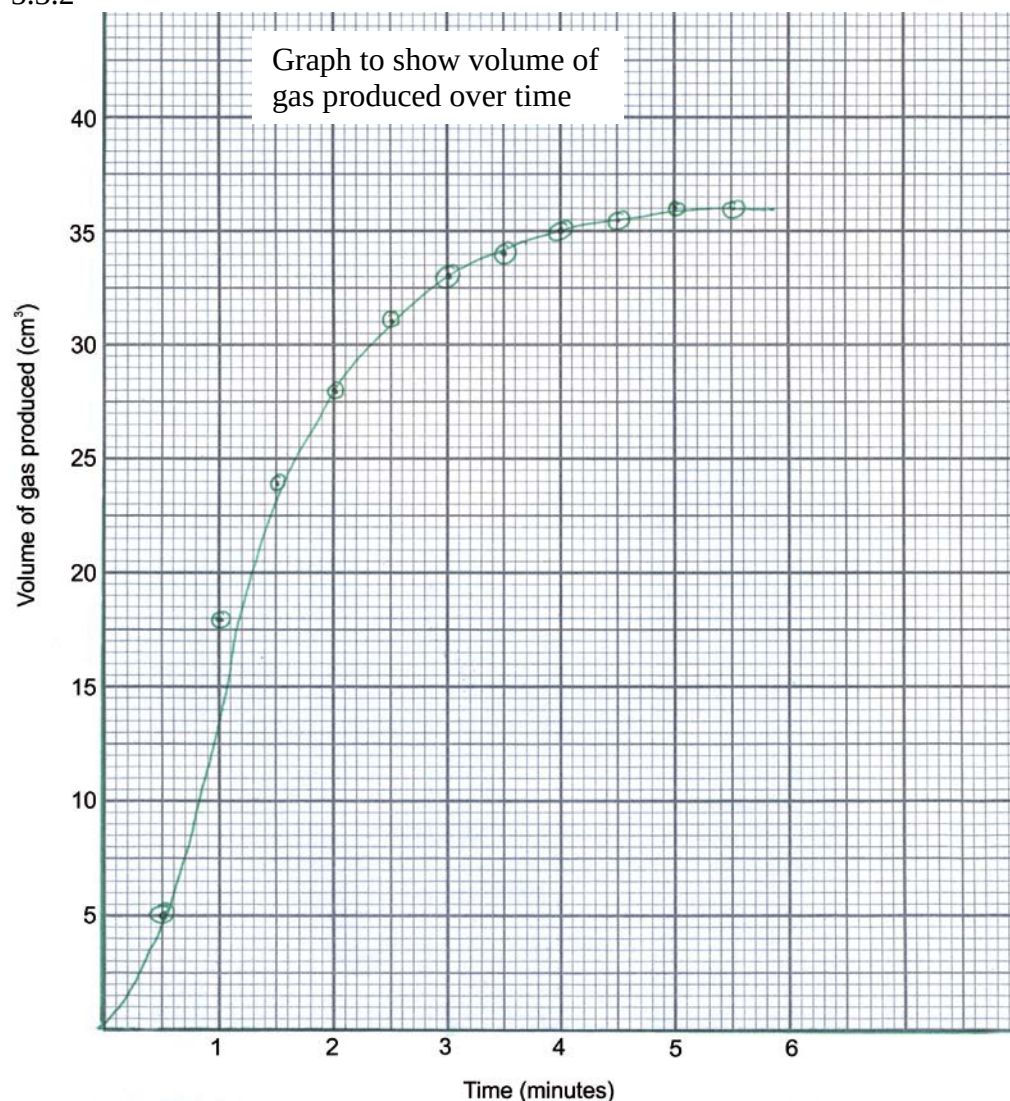
## QUESTION 5

5.1 What is the relationship between temperature and the reaction rate of an antacid tablet with water? **OR** What happens to the reaction rate of the antacid tablet with water when the temperature changes? **OR** How does the temperature influence the time of dissolution of an antacid tablet in water? **OR** any other reasonable answer. (2)

5.2 The reaction rate (of an antacid tablet with water) will increase/decrease with an increase/decrease in temperature **OR** The higher/lower the temperature the faster/slower the rate of dissolution/reaction. Any combination. (2)

5.3 5.3.1 Volume of acid **OR** concentration of acid **OR** number or mass of tablets. (Any 2) (2)

5.3.2



Mark allocation

| Description                                                                                                                                                                 |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"> <li>• Heading</li> <li>• Axes correctly labelled</li> <li>• Scale</li> <li>• Points plotted correctly</li> <li>• Smooth curve</li> </ul> |  |

(5)

5.3.3 5 minutes (1)

- 5.3.4
- Rate initially increases and then begins to decrease.
  - Initially high concentration of reactants – more frequent and effective collisions of particles with sufficient  $E_k$  and correct orientation.
  - As reaction proceeds – concentration of reactants decreases, less frequent effective collisions of particles with sufficient  $E_k$  and correct orientation.
- (4)

5.3.5  $n = m/M = 0,7/100 = 0,007 \text{ mol}$   
 $\text{CaCO}_3 : 2\text{HCl}$   
 $0,007 : 0,014$   
 $c = n/v$ , hence  $v = n/c = 0,014/0,1 = 0,14 \text{ dm}^3$  i.e.  $140 \text{ cm}^3$  (4)  
**[20]**

## QUESTION 6

6.1 The point in a reversible chemical reaction at which the rate of the forward reaction is equal to the rate of the reverse reaction. (2)

6.2 6.2.1 Increase (1)

6.2.2 Decrease (1)

6.2.3 Decrease (1)

6.3 6.3.1 The higher the temperature the lower the yield. A moderate temperature speeds up the rate sufficiently to compensate for the loss in yield. (3)

6.3.2 Increases: The high pressure favours the reaction that produces less molecules, hence the forward reaction is favoured, i.e. more  $\text{SO}_3$  is formed. (3)

6.3.3 
$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 [\text{O}_2]}$$

$$= (0,2/2)^2 / (0,2/2)^2 * (0,4/2)$$

$$= 5$$
 (5)

6.3.4 Remains the same. (2)

6.4 6.4.1  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$  (2)

6.4.2 Exothermic. When the temperature is decreased the rate of the reaction represented by the solid line is affected (decreased) more, therefore it is endothermic, therefore, dotted line exothermic. (3)

6.4.3 (A new) equilibrium has been established. (1)  
**[24]**

### QUESTION 7

- 7.1 Temp of 25 °C (298 K) and electrolyte concentration of 1 mol·dm<sup>-3</sup> (2)
- 7.2  $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}}$   
 $1,05 = E_X - (-0,25)$   
 $E_X = 0,8\text{V}$  (3)
- 7.3 Ag/silver (1)
- 7.4  $\text{Ag}^+ + 1\text{e}^- \rightarrow \text{Ag}$  (2)
- 7.5 Ni (2)
- 7.6
- Connects two half cells together to make a circuit.
  - Maintains half cell neutrality. (2)
- 7.7 Becomes zero. (1)
- [13]**

### QUESTION 8

- 8.1 The decomposition of a substance in solution by means of an electric current. (2)
- 8.2 Anode.  $\text{Cu(s)} \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$  (2)
- 8.3  $\text{CuSO}_4(\text{aq})$ /any soluble copper salt. (1)
- 8.4 To be used for applications that require high electrical conductivity. (2)
- 8.5 To ensure that Ag, Au and Pt impurities are not oxidised while in the anode. (2)
- 8.6 8.6.1  $n = m/M = 3,2/63,5 = 0,05 \text{ mol}$  (2)
- 8.6.2  $Q = I\Delta t = 8 \times 1\,200 = 9\,600 \text{ C}$   
 $9\,600 / 1,6 \times 10^{-19} = 6 \times 10^{22} \text{ electrons}$   
 OR  
 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$   
 2 : 1  
 $\therefore 0,1 : 0,05$   
 No. of mol of  $\text{e}^- = 0,1 \text{ mol}$   
 1 mol of  $\text{e}^-$  requires 96 500 C  
 $\therefore \text{charge required} = 0,1 \times 96\,500$   
 $= 9\,650 \text{ C}$   
 $\text{No. of electrons} = \frac{9\,650}{1,6 \times 10^{-19}}$   
 $\therefore \text{no. of electrons} = 6,03 \times 10^{22} \text{ electrons}$  (4)

8.7     8.7.1    Electroplating (coating a metal with a different metal) and the Hall-Heroult Process (extraction of aluminium from its ore). (2)

8.7.2    Zinc is a stronger reducing agent than iron because it has a more negative  $E^\circ$  value. Zn will be oxidised in preference to Fe and therefore protect the Fe from being oxidised (rusting). (3)

**[20]**

## QUESTION 9

9.1      $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$  (2)

9.2      $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$   
           $= -0,83 - (1,36)$   
           $= -2,19 \text{ V}$   
Answer is negative, therefore, not spontaneous (4)

9.3      $\text{Na}^+$  (1)

9.4     Reactive material might react with the reactants and contaminate the products. (1)

9.5     In a single container the chlorine will react with the water to form chlorine water or, the chlorine will react with the hydroxide ions to form bleach, or products formed will be contaminated.  $\text{Cl}_2$  and  $\text{H}_2$  gas can react explosively if allowed to mix. (1)

9.6     Membrane is an ion selective membrane which only allows  $\text{Na}^+$  cations to move through. Cell is more efficient as it prevents contamination due to other ions moving through. (3)

9.7     For potential uncontrolled chlorine gas and other emissions. (2)

**[14]**

## QUESTION 10

- 10.1 10.1.1 Chemical to electrical. (2)
- 10.1.2 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. Total charge the cell can deliver. (2)
- 10.1.3 Capacity = amperes  $\times$  hours = Q  
 $= 1\,500 \times 3\,600$   
 $= 5,4 \times 10^6 \text{C}$   
 $W = VQ$   
 $= 1,5 \times 5,4 \times 10^6$   
 $= 8,1 \times 10^6 \text{J}$  (4)
- 10.1.4 Increase in temperature speeds up the redox reaction. This happens when the cell is not in use. There are now less chemicals to produce electricity and the life span of the cell is less. (3)
- 10.1.5 It can be recycled. (2)
- 10.1.6 The larger cell has more electrolyte so the electrochemical reaction continues for longer. (2)
- 10.2 10.2.1 They are cells that can be discharged and recharged  
 (are reusable)  
 (are rechargeable) (2)
- 10.2.2 Sulphuric acid (1)
- 10.2.3 Ox :  $\text{PbSO}_4 + 2\text{H}_2\text{O} \rightarrow \text{PbO}_2 + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$   
 Red :  $\text{PbSO}_4 + 2\text{e}^- \rightarrow \text{Pb} + \text{SO}_4^{2-}$   
 Nett :  $2\text{PbSO}_4 + 2\text{H}_2\text{O} \rightarrow \text{PbO}_2 + \text{Pb} + 2\text{SO}_4^{2-} + 4\text{H}^+$   
 (–1 for any incorrect chemical species) (3)
- 10.2.4 • Concentration will increase.  
 • As recharges, more  $\text{SO}_4^{2-}(\text{aq})$  will be produced which will increase the  $\text{H}_2\text{SO}_4$  concentration. (3)
- 10.2.5  $E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$   
 $= +1,69 - (-0,36)$   
 $= 2,05 \text{ V}$   
 $\therefore E^\theta_{\text{cell (total)}} = 2,05 \times 6$   
 $= 12,3 \text{ V}$  (3)
- 10.2.6 Will reduce the internal resistance of cells. (2)
- 10.2.7  $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$  (2)

10.2.8 Rate of discharge increases causing the concentration of the electrolyte  $\text{H}_2\text{SO}_4$  to decrease (density of  $\text{H}_2\text{SO}_4$  electrolyte decreases). This will cause the battery capacity to decrease.

**OR**

A large current flows because of the low internal resistance and this could cause the cell to explode.

(2)  
[33]

**Total: 200 marks**