Level 3 Certificate and Extended Certificate in Applied Science

KEY CONCEPTS IN SCIENCE

Unit Number: ASC1

Section B – ASC1/C (Chemistry)

Thursday 22 June 2017 Morning

Time allowed: 1 hour 30 minutes. You are advised to spend approximately 30 minutes on this section

Materials

For this paper you must have:

- a calculator
- Periodic table
- Formula sheet

Instructions

- Use black ink or black ball-point pen.
- Answer all questions in each section.
- You must answer the questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.
- The total time for all three sections of this paper is one-and-a-half hours.

Information

- You will be provided with a copy of the Periodic Table and formula sheet.
- There are three sections in this paper:
  - Section A – Biology
  - Section B – Chemistry
  - Section C – Physics.
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60 and the maximum mark for this section is 20.

Advice

Read each question carefully.
Section B – Chemistry

Answer all questions in this section.

01 Chemical engineers should always consider the enthalpy changes involved in chemical processes. Neutralisation reactions are exothermic and so temperatures within reaction vessels must be monitored.

01.1 On Figure 1 draw the reaction profile you would expect for an exothermic reaction. [3 marks]

![Figure 1](Reaction pathway)

01.2 Draw a line on Figure 1 to show the activation energy. [1 mark]

01.3 All acids contain hydrogen ions, H⁺ and an anion. Sulfuric acid contains the anion SO₄²⁻. State the formula for sulfuric acid. [1 mark]

________________________________________________________________________________
________________________________________________________________________________
A technician is asked to determine the enthalpy of neutralisation for the reaction between sodium hydroxide, NaOH and hydrochloric acid, HCl.

\[
\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}
\]

Describe how the technician could do the experiment using:

- a polystyrene cup
- a thermometer
- 2 mol dm\(^{-3}\) NaOH
- 2 mol dm\(^{-3}\) HCl.

In your description **you should** include:

- the other apparatus to be used
- the measurements to be made
- the precautions to be taken to ensure the results are valid
- how the results should be presented
- how the enthalpy of neutralisation will be calculated.

[5 marks]
Material scientists need a thorough understanding of the bonding and structure of compounds to predict the properties of materials. Different formulas give different information about compounds. An empirical formula is appropriate for an ionic compound and a molecular formula for a covalent compound.

02.1 State what is meant by an ionic bond. [2 marks]

02.2 State what is meant by a covalent bond. [2 marks]

02.3 State what is meant by an empirical formula. [2 marks]
Compound X contains the elements carbon, hydrogen and chlorine. Analysis of a sample of X shows that it contains 24.35% of carbon and 4.05% of hydrogen by mass.

Calculate the empirical formula of compound X.

Empirical formula of X is _____________________________

Another compound, Y, has an empirical formula of CNO₂H₄. The relative molecular mass, $M_r$, of Y is 124.

Calculate the molecular formula of compound Y.

Molecular formula of Y is _____________________________

END OF QUESTIONS
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