Level 3 Certificate and Extended Certificate in Applied Science
KEY CONCEPTS IN SCIENCE

Unit Number: ASC1
Section B – ASC1/C (Chemistry)

Tuesday 23 January 2018 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
- formulae 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.

Information
- You will be provided with a copy of the Periodic Table and formulae 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.

---

For Examiner's Use
Examiner's Initials

<table>
<thead>
<tr>
<th>Question</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>
Analytical chemists use indicators and pH curves to determine the end point of a titration. **Figure 1** shows titration curves for combinations of different acids and bases.

All solutions have the same concentration.
Select from A, B, C and D the curve produced by the addition of:

ethanoic acid (a weak acid) to 25 cm$^3$ of sodium hydroxide ____________
ammonia solution (a weak base) to 25 cm$^3$ of hydrochloric acid ____________
hydrochloric acid to 25 cm$^3$ of sodium hydroxide ____________

Table 1 shows some acid–base indicators and the pH ranges over which they change colour.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>pH range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromophenol blue</td>
<td>3.0–4.6</td>
</tr>
<tr>
<td>Phenol red</td>
<td>6.8–8.2</td>
</tr>
<tr>
<td>Bromothymol blue</td>
<td>6.0–7.6</td>
</tr>
<tr>
<td>Thymolphthalein</td>
<td>9.3–10.5</td>
</tr>
</tbody>
</table>

State which indicator from Table 1 could be used in the titration that produces curve D but not in the titration that produces curve C.

Explain your choice.

Indicator
Explanation

Question 1 continues on the next page
An analytical chemist at a vinegar manufacturer used titration to monitor the concentration of ethanoic acid in vinegar.

The chemist:

- diluted 50.0 cm$^3$ of the vinegar with distilled water to make a total volume of 500 cm$^3$
- titrated a 25.0 cm$^3$ sample against a standard solution of 0.100 mol dm$^{-3}$ NaOH.

$$\text{NaOH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$$

sodium hydroxide + ethanoic acid $\rightarrow$ sodium ethanoate + water

The results are shown in Table 2.

**Table 2**

<table>
<thead>
<tr>
<th>Volume / cm$^3$</th>
<th>Rough</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At start</strong></td>
<td>0.00</td>
<td>20.20</td>
<td>0.00</td>
<td>14.45</td>
</tr>
<tr>
<td><strong>At end</strong></td>
<td>20.20</td>
<td>39.40</td>
<td>14.45</td>
<td>33.55</td>
</tr>
<tr>
<td><strong>Used</strong></td>
<td>20.20</td>
<td>19.20</td>
<td>14.45</td>
<td>19.10</td>
</tr>
</tbody>
</table>

Calculate the average volume of sodium hydroxide used in the experiment. [1 mark]

Average volume = ____________________________ cm$^3$

Calculate the number of moles of sodium hydroxide used in the experiment. Use your answer from Question 01.3. [1 mark]

Number of moles used = ____________________________
State the number of moles of ethanoic acid that reacted with the number of moles of sodium hydroxide in Question 01.4.

[1 mark]

______________________________________________________________

______________________________________________________________

Calculate the concentration of the **original** sample of ethanoic acid.

[2 marks]

Concentration = _______________________________ mol dm\(^{-3}\)

Turn over for the next question
Research chemists use trends in the properties of some elements to predict the properties of other elements.

Table 3 shows the values of atomic radii for the elements in Group 0 that the research chemist found.

Table 3

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Atomic Radius /m x 10(^{-12})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helium</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>Neon</td>
<td>10</td>
<td>58</td>
</tr>
<tr>
<td>Argon</td>
<td>18</td>
<td>106</td>
</tr>
<tr>
<td>Krypton</td>
<td>36</td>
<td>116</td>
</tr>
<tr>
<td>Xenon</td>
<td>54</td>
<td>140</td>
</tr>
<tr>
<td>Radon</td>
<td>86</td>
<td>150</td>
</tr>
</tbody>
</table>

Plot a graph of atomic radius against atomic number on Figure 2.

Draw a line of best fit.

[2 marks]
Identify the anomalous result. [1 mark]

Explain why atomic radius increases as atomic number increases in Group 0. [2 marks]
A large proportion of the elements of the Periodic Table are metals.

Aluminium is a metal widely used in the aerospace industry.

Give the electron configuration of an atom of aluminium, Al.  

________________________________________________________________________________
________________________________________________________________________________

Describe the bonding in aluminium. Include a labelled diagram in your answer.

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

END OF QUESTIONS
There are no questions printed on this page
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED