Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2022

Centre Number

Candidate Number

# Chemistry

## Assessment Unit AS 3

*assessing*
Module 3: Basic
Practical Chemistry

**Practical Booklet A**

**[SCH31]**

*SCH31*

**MONDAY 9 MAY, MORNING**

**TIME**

1 hour 15 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
**You must answer the questions in the spaces provided.**
**Do not write outside the boxed area on each page or on blank pages.**
Complete in black ink only. **Do not write with a gel pen.**
Answer **all** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 25.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Periodic Table of the Elements (including some data) is provided.
**You may not have access to notes, textbooks and other material to assist you.**
**Safety glasses should be worn at all times and care should be taken during this practical examination.**

13003

**1** You are provided with a sample of solid labelled **X**.

**(a)** Place a spatula measure of **X** on a watch glass. Dip nichrome wire into some deionised water and into **X**. Place in a blue Bunsen burner flame and observe the colour produced through cobalt glass. Record your observation below.

_____ [1]

**(b)** Add a half spatula measure of **X** to a test tube. In a fume cupboard, place the test tube in a test tube rack and add 5 drops of concentrated sulfuric acid. Record your observations below.
Leave this test tube in the fume cupboard.

_____

_____

_____ [2]

**(c)** Weigh out approximately 10 g of **X** in a 100 $cm^3$ beaker and dissolve completely in approximately 50 $cm^3$ of deionised water.

Carry out the following tests using the solution of **X**.

**All volumes in the following tests are approximate and may be measured using a measuring cylinder or a graduated disposable pipette.**

**Record all observations.**

**(i)** Place 5 $cm^3$ of the solution of **X** in a test tube. Add 2 $cm^3$ of silver nitrate solution. Then add 5 $cm^3$ of ammonia solution.

_____

_____ [2]

**(ii)** In a fume cupboard, place 5 $cm^3$ of the solution of **X** in a test tube. Add 5 $cm^3$ of chlorine water.

_____

_____ [1]

**(iii)** Place 5 $cm^3$ of the solution of **X** in a test tube. Add 1 $cm^3$ of lead(II) nitrate solution dropwise. Shake gently.

_____ [1]

**Retain the remaining solution of X for use in part (d).**

**(d)** Using a 6 V power pack and graphite electrodes, pass a direct current through the remaining solution of **X** in the beaker for 3 minutes. Do not allow the electrodes to touch.

Record what you observe.

_____

_____

_____

_____ [2]

**Retain the resulting solution for use in part (e).**

**[Turn over**

**(e)** Use the solution which was formed in **(d)** for the following tests.

**All volumes are approximate and may be measured using a measuring cylinder or a graduated disposable pipette.**

**Record all observations.**

**(i)** Place 5 $cm^3$ of the solution formed in **(d)** in a test tube. Add 2 drops of starch solution. Stopper and shake gently.

_____ [1]

**(ii)** Place 5 $cm^3$ of the solution formed in **(d)** in a second test tube. Add 2 $cm^3$ of heptane. Stopper and shake gently for 1 minute.

_____

_____ [2]

**2 (a)**

- Weigh out approximately 20.0 g, 15.0 g, 10.0 g and 5.0 g of solid **X** into separate weighing boats. Record the masses to 1 decimal place in the table below.
- Using a measuring cylinder, add 50 $cm^3$ of deionised water to a polystyrene cup which is placed in a 250 $cm^3$ beaker.

  **Record all temperatures to the nearest whole number.**
- Place a thermometer in the polystyrene cup and record the initial temperature of the water.
- Add the first mass of solid **X** to the deionised water in the polystyrene cup and stir using the thermometer.
- Record the final temperature when there is no further temperature change.
- Calculate the temperature change using the equation below and record this in the table.

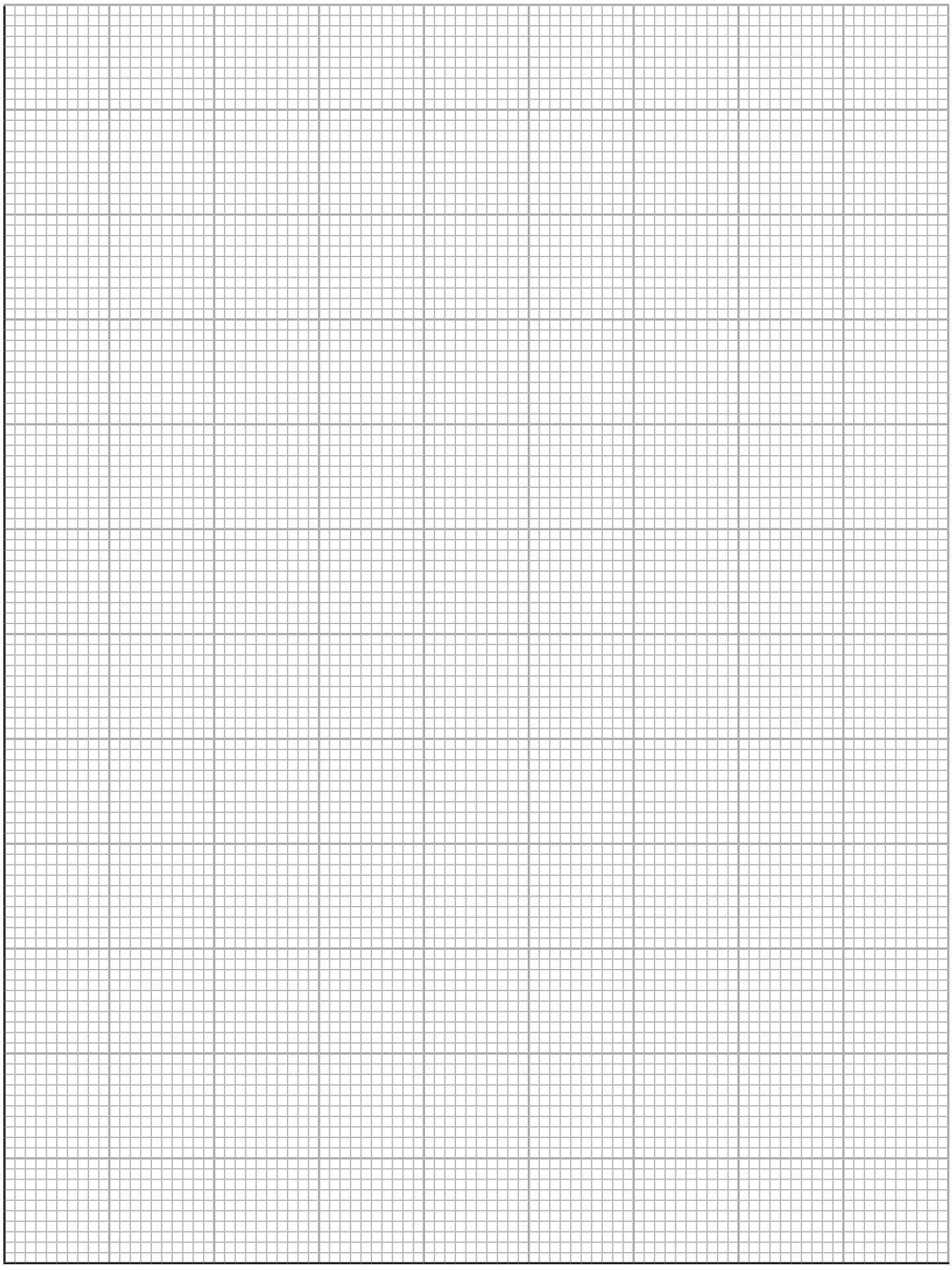
  **temperature change = initial temperature – final temperature**
- Repeat the experiment for the other three masses of solid **X**. The polystyrene cup may be rinsed with deionised water between each test.

| Mass of X /g | Initial temperature /°C | Final temperature /°C | Temperature change /°C |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

[5]

**[Turn over**

**(b)** Plot a graph of temperature change against mass of **X** on the axes below. Label the axes. Draw a **straight best fit line starting at the origin**. [4]



**(c)** The gradient of this straight best fit line is calculated using:

$$\text{gradient} = \frac{\text{change in temperature change}}{\text{change in mass}}$$

From your graph calculate the gradient of the straight best fit line you have drawn. Show your working out.

[3]

**(d)** Using the gradient calculated in **(c)** and the expression below, calculate the enthalpy change when 1 mole of **X** dissolves in water.

$$\text{enthalpy change (kJ mol}^{-1}) = \frac{\text{gradient} \times 50.0 \times 4.2 \times 166}{1000}$$

[1]

**THIS IS THE END OF THE QUESTION PAPER**

**DO NOT WRITE ON THIS PAGE**

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| **Total Marks** | |

**Examiner Number**

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## General Information

1 tonne = $10^6$ g
1 metre = $10^9$ nm
One mole of any gas at 293 K and a pressure of 1 atmosphere ($10^5$ Pa) occupies a volume of 24 $dm^3$
Avogadro Constant = $6.02 \times 10^{23}$ $mol^{-1}$
Planck Constant = $6.63 \times 10^{-34}$ J s
Specific Heat Capacity of water = 4.2 J $g^{-1}$ $K^{-1}$
Speed of Light = $3 \times 10^8$ m $s^{-1}$

## Characteristic absorptions in IR spectroscopy

| Wavenumber/$cm^{-1}$ | Bond | Compound |
|---|---|---|
| 550–850 | C–X (X = Cl, Br, I) | Haloalkanes |
| 750–1100 | C–C | Alkanes, alkyl groups |
| 1000–1300 | C–O | Alcohols, esters, carboxylic acids |
| 1450–1650 | C=C | Arenes |
| 1600–1700 | C=C | Alkenes |
| 1650–1800 | C=O | Carboxylic acids, esters, aldehydes, ketones, amides, acyl chlorides |
| 2200–2300 | C≡N | Nitriles |
| 2500–3200 | O–H | Carboxylic acids |
| 2750–2850 | C–H | Aldehydes |
| 2850–3000 | C–H | Alkanes, alkyl groups, alkenes, arenes |
| 3200–3600 | O–H | Alcohols |
| 3300–3500 | N–H | Amines, amides |

## Proton Chemical Shifts in Nuclear Magnetic Resonance Spectroscopy (relative to TMS)

| Chemical Shift | Structure | |
|---|---|---|
| 0.5–2.0 | –C**H** | Saturated alkanes |
| 0.5–5.5 | –O**H** | Alcohols |
| 1.0–3.0 | –N**H** | Amines |
| 2.0–3.0 | –CO–C**H** | Ketones |
| | –N–C**H** | Amines |
| | $C_6H_5$–C**H** | Arene (aliphatic on ring) |
| 2.0–4.0 | X–C**H** | X = Cl or Br (3.0–4.0) |
| | | X = I (2.0–3.0) |
| 4.5–6.0 | –C=C**H** | Alkenes |
| 5.5–8.5 | RCON**H** | Amides |
| 6.0–8.0 | –$C_6$**H**$_5$ | Arenes (on ring) |
| 9.0–10.0 | –C**H**O | Aldehydes |
| 10.0–12.0 | –COO**H** | Carboxylic acids |

These chemical shifts are concentration and temperature dependent and may be outside the ranges indicated above.

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# Data Leaflet

## Including the Periodic Table of the Elements

For the use of candidates taking
Advanced Subsidiary and
Advanced Level Examinations

**Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations**

## gce a/as examinations

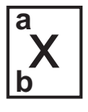
# chemistry

# THE PERIODIC TABLE OF ELEMENTS

| I | II | | | | | | | | | | | III | IV | V | VI | VII | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Group | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 H Hydrogen 1 | | | | | | | | | | | | | | | | | 4 He Helium 2 |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | 11 B Boron 5 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulfur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 48 Ti Titanium 22 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | 98 Tc Technetium 43 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 139 La* Lanthanum 57 | 178 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 |
| 223 Fr Francium 87 | 226 Ra Radium 88 | 227 Ac† Actinium 89 | 261 Rf Rutherfordium 104 | 262 Db Dubnium 105 | 266 Sg Seaborgium 106 | 264 Bh Bohrium 107 | 277 Hs Hassium 108 | 268 Mt Meitnerium 109 | 271 Ds Darmstadtium 110 | 272 Rg Roentgenium 111 | 285 Cn Copernicium 112 | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 145 Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 159 Tb Terbium 65 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 |
| 232 Th Thorium 90 | 231 Pa Protactinium 91 | 238 U Uranium 92 | 237 Np Neptunium 93 | 242 Pu Plutonium 94 | 243 Am Americium 95 | 247 Cm Curium 96 | 245 Bk Berkelium 97 | 251 Cf Californium 98 | 254 Es Einsteinium 99 | 253 Fm Fermium 100 | 256 Md Mendelevium 101 | 254 No Nobelium 102 | 257 Lr Lawrencium 103 |

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series




**a** = relative atomic mass (approx)
**x** = atomic symbol
**b** = atomic number

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