Write your name here

| Surname | Other names |
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**Edexcel GCE**

| Centre Number | Candidate Number |
|---|---|
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# Chemistry

## Advanced Subsidiary

## Unit 3B: Chemistry Laboratory Skills I Alternative

Monday 11 January 2010 – Afternoon
**Time: 1 hour 15 minutes**

Paper Reference
**6CH07/01**

**Candidates may use a calculator.**

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

### Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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**Answer ALL the questions. Write your answers in the spaces provided.**

**1** Compound **A** is a white solid that contains one cation and one anion.

(a) A flame test is carried out on compound **A** by mixing the solid with concentrated hydrochloric acid and using a piece of wire to place some of the solution formed in a Bunsen flame. The flame is coloured yellow.

(i) Name a material from which the wire is made.

Suggest ONE reason why this material is used.

**(2)**

Name .....

Reason .....

.....

(ii) Identify, by name or formula, the cation present in compound **A**.

**(1)**

.....

(b) When aqueous silver nitrate solution is added to a solution of compound **A**, a cream precipitate forms. The cream precipitate dissolves in concentrated aqueous ammonia solution.

(i) **Name** the cream precipitate formed when aqueous silver nitrate is added to the solution of compound **A**.

**(1)**

.....

(ii) Give the **formula** of the anion in compound **A**.

**(1)**

.....

(iii) Describe what you would see if the cream precipitate in (b)(i) was left in sunlight.

**(1)**

.....

.....

(c) Concentrated sulfuric acid is added to compound **A** in a test tube. Steamy fumes are seen at the mouth of the test tube.

After a few minutes, the contents of the test tube turn brown. A gas is given off which is tested with a piece of filter paper soaked in a solution of aqueous acidified potassium dichromate(VI). The paper turns green.

(i) Identify, by name or formula, the steamy fumes formed initially.

**(1)**

.....

(ii) Describe a further test you could carry out to confirm the identity of the steamy fumes. Give the result of your test.

**(2)**

Test .....

Result .....

.....

(iii) Identify, by name or formula, the substance responsible for the brown colour in the test tube.

**(1)**

.....

(iv) Name the gas which turned the filter paper green. Suggest the type of reaction by which this gas was formed from sulfuric acid.

**(2)**

Gas .....

Type of reaction .....

.....

**(Total for Question 1 = 12 marks)**

**2** This question is about two isomeric alcohols, **X** and **Y**, each with molar mass 60 g mol$^{-1}$.

A solution of potassium dichromate(VI) in dilute sulfuric acid is added to each alcohol. Both alcohols cause the same colour change of the mixture on heating.

(a) A colourless liquid, **B**, is distilled from the mixture containing alcohol **X**.

The liquid **B** forms a red precipitate when it is boiled with Benedict's or Fehling's solution.

Give the displayed formula of liquid **B**, and the name of alcohol **X**.

**(2)**

Liquid **B**

Name of alcohol **X** .....

(b) A colourless liquid, **C**, is distilled from the mixture containing alcohol **Y**.

**C** does **not** react when it is boiled with Benedict's or Fehling's solution.

Give the **names** of liquid **C** and alcohol **Y**.

**(2)**

Liquid **C** .....

Alcohol **Y** .....

**(Total for Question 2 = 4 marks)**

**3** This question is about calcium hydroxide, $Ca(OH)_2$.

The solubility of calcium hydroxide in water can be found by titrating a saturated solution of calcium hydroxide with hydrochloric acid of known concentration.

(a) Describe how you would make a saturated solution of calcium hydroxide suitable for use in this titration. Do not describe the subsequent titration procedure.

**(2)**

.....

.....

.....

.....

(b) 10.0 $cm^3$ portions of the saturated solution are placed in a conical flask and titrated with 0.0500 mol $dm^{-3}$ hydrochloric acid added from a burette.

(i) Name the apparatus used to measure the 10.0 $cm^3$ portions.

**(1)**

.....

(ii) Suggest a suitable indicator for this titration and state the colour change you would expect to see at the end-point.

**(2)**

Indicator .....

Colour change from ..... to .....

(c) The following results were obtained:

| Titration numbers | 1 | 2 | 3 |
|---|---|---|---|
| Final burette reading / $cm^3$ | 19.20 | 28.05 | 37.10 |
| Initial burette reading / $cm^3$ | 10.00 | 19.20 | 28.15 |
| Titre / $cm^3$ | 9.20 | 8.85 | |

(i) Fill in the third titre value in the table.

**(1)**

(ii) Suggest why the first titre should be disregarded.

**(1)**

.....

.....

(iii) Calculate the mean titre.

**(1)**

..... $cm^3$

(iv) Calculate the number of moles of hydrochloric acid in the mean titre.

**(1)**

(v) The equation for the reaction is

$$Ca(OH)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$$

Calculate the number of moles of calcium hydroxide in a 10.0 $cm^3$ portion of the saturated solution.

**(1)**

(vi) Calculate the concentration of calcium hydroxide in mol $dm^{-3}$.

**(1)**

(vii) Calculate the solubility of calcium hydroxide in g $dm^{-3}$.

**(1)**

(d) The standard enthalpy change for the reaction of calcium hydroxide with hydrochloric acid was found by reacting 0.0100 mol of solid calcium hydroxide with 50.0 $cm^3$ of a 1.00 mol $dm^{-3}$ solution of hydrochloric acid (an excess), in a polystyrene cup. The temperature rose from 21.2 °C to 26.7 °C.

(i) Calculate the energy, in joules, transferred in the reaction. Use the expression

Energy transferred = mass × specific heat capacity × temperature change

[Assume density of solution = 1.0 g $cm^{-3}$,
specific heat capacity of solution = 4.18 J $g^{-1}$ °$C^{-1}$]

**(1)**

(ii) Calculate the standard enthalpy change, $\Delta H^{\ominus}$, for the reaction. Include a sign and units in your answer.

**(2)**

(iii) Calculate the percentage error in the temperature change caused by an uncertainty of 0.1°C in each thermometer reading.

**(2)**

(iv) The experiment was repeated using 50.0 $cm^3$ of a 1.00 mol $dm^{-3}$ solution of nitric acid instead of the hydrochloric acid. Explain why the temperature change was the same in both experiments.

**(1)**

(v) The experiment was repeated again using 25 $cm^3$ of 2.00 mol $dm^{-3}$ hydrochloric acid. Predict the temperature change in this experiment.

**(1)**

(vi) Which of the experiments in (iv) and (v) gave the least error in the temperature change? Justify your answer.

**(1)**

**(Total for Question 3 = 20 marks)**

**4** An experiment to prepare a sample of 2-chloro-2-methylpropane uses the reaction of 2-methylpropan-2-ol with concentrated hydrochloric acid.

$$(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + H_2O$$

**The steps of the experimental procedure are as follows**

1. Place 0.20 mol of 2-methylpropan-2-ol and 70 $cm^3$ of concentrated hydrochloric acid in a large conical flask.
2. Stopper and shake the flask at intervals, releasing any pressure after each shaking.
3. Separate the 2-chloro-2-methylpropane from the aqueous solution using a separating funnel.
4. To the 2-chloro-2-methylpropane in the separating funnel, add 20 $cm^3$ of sodium hydrogencarbonate solution. Shake the separating funnel, carefully releasing carbon dioxide frequently.
5. Separate the 2-chloro-2-methylpropane and repeat the washing with sodium hydrogencarbonate solution until this washing step is no longer necessary.
6. Transfer the 2-chloro-2-methylpropane to a small conical flask and add a suitable drying agent.
7. Filter off the drying agent, collecting the 2-chloro-2-methylpropane into a distillation flask. Heat the flask, collecting the fraction that distils off between 50 °C and 52 °C.

**Data**

| Property | 2-methylpropan-2-ol | 2-chloro-2-methylpropane |
|---|---|---|
| Density / g $cm^{-3}$ | 0.789 | 0.842 |
| Molar mass / g $mol^{-1}$ | 74.1 | 92.6 |
| Boiling temperature / °C | 82.4 | 50.8 |

(a) Calculate the volume of 2-methylpropan-2-ol used in the preparation.

**(1)**

(b) Draw a diagram of a separating funnel that could be used in step 3.
Label the 2-chloro-2-methylpropane layer.

**(2)**

(c) (i) Suggest why the product is washed with sodium hydrogencarbonate solution (step 4).

**(1)**

.....

.....

.....

(ii) How would you know that no further washing with sodium hydrogencarbonate was necessary?

**(1)**

.....

.....

(d) Suggest a suitable drying agent to dry the 2-chloro-2-methylpropane (step 6).

**(1)**

(e) Draw a labelled diagram of the apparatus you would use to carry out the final distillation (step 7).

**(4)**

(f) A reaction produced 18.7 $cm^3$ of 2-chloro-2-methylpropane starting from 0.20 mol 2-methylpropan-2-ol. Calculate the percentage yield of the product of this reaction.

**(2)**

(g) A suitable chemical test for the chlorine in a chloroalkane, such as 2-chloro-2-methylpropane, is to add the chloroalkane to a mixture of aqueous silver nitrate solution and ethanol.

(i) Suggest why ethanol is added to the mixture.

**(1)**

.....

.....

(ii) Give the expected result of this test.

**(1)**

.....

**(Total for Question 4 = 14 marks)**

**TOTAL FOR PAPER = 50 MARKS**

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# The Periodic Table of Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 (8) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1.0 H hydrogen 1 | | | | | | | | | | (18) 4.0 He helium 2 |
| (1) | (2) | | Key: relative atomic mass / atomic symbol / name / atomic (proton) number | | | | | | | | | (13) | (14) | (15) | (16) | (17) | |
| 6.9 Li lithium 3 | 9.0 Be beryllium 4 | | | | | | | | | | | 10.8 B boron 5 | 12.0 C carbon 6 | 14.0 N nitrogen 7 | 16.0 O oxygen 8 | 19.0 F fluorine 9 | 20.2 Ne neon 10 |
| 23.0 Na sodium 11 | 24.3 Mg magnesium 12 | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | 27.0 Al aluminium 13 | 28.1 Si silicon 14 | 31.0 P phosphorus 15 | 32.1 S sulfur 16 | 35.5 Cl chlorine 17 | 39.9 Ar argon 18 |
| 39.1 K potassium 19 | 40.1 Ca calcium 20 | 45.0 Sc scandium 21 | 47.9 Ti titanium 22 | 50.9 V vanadium 23 | 52.0 Cr chromium 24 | 54.9 Mn manganese 25 | 55.8 Fe iron 26 | 58.9 Co cobalt 27 | 58.7 Ni nickel 28 | 63.5 Cu copper 29 | 65.4 Zn zinc 30 | 69.7 Ga gallium 31 | 72.6 Ge germanium 32 | 74.9 As arsenic 33 | 79.0 Se selenium 34 | 79.9 Br bromine 35 | 83.8 Kr krypton 36 |
| 85.5 Rb rubidium 37 | 87.6 Sr strontium 38 | 88.9 Y yttrium 39 | 91.2 Zr zirconium 40 | 92.9 Nb niobium 41 | 95.9 Mo molybdenum 42 | [98] Tc technetium 43 | 101.1 Ru ruthenium 44 | 102.9 Rh rhodium 45 | 106.4 Pd palladium 46 | 107.9 Ag silver 47 | 112.4 Cd cadmium 48 | 114.8 In indium 49 | 118.7 Sn tin 50 | 121.8 Sb antimony 51 | 127.6 Te tellurium 52 | 126.9 I iodine 53 | 131.3 Xe xenon 54 |
| 132.9 Cs caesium 55 | 137.3 Ba barium 56 | 138.9 La* lanthanum 57 | 178.5 Hf hafnium 72 | 180.9 Ta tantalum 73 | 183.8 W tungsten 74 | 186.2 Re rhenium 75 | 190.2 Os osmium 76 | 192.2 Ir iridium 77 | 195.1 Pt platinum 78 | 197.0 Au gold 79 | 200.6 Hg mercury 80 | 204.4 Tl thallium 81 | 207.2 Pb lead 82 | 209.0 Bi bismuth 83 | [209] 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 | | | | | | | |

Elements with atomic numbers 112-116 have been reported but not fully authenticated

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * Lanthanide series | 140 Ce cerium 58 | 141 Pr praseodymium 59 | 144 Nd neodymium 60 | [147] Pm promethium 61 | 150 Sm samarium 62 | 152 Eu europium 63 | 157 Gd gadolinium 64 | 159 Tb terbium 65 | 163 Dy dysprosium 66 | 165 Ho holmium 67 | 167 Er erbium 68 | 169 Tm thulium 69 | 173 Yb ytterbium 70 | 175 Lu lutetium 71 |
| * Actinide series | 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 |