Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

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) (18)
							1.0 H hydrogen 1										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

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
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

* Lanthanide series

* Actinide series