Write your name here

Surname	Other names

Edexcel GCE

Centre Number | Candidate Number

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Monday 9 January 2012 – Morning
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 ▶

7/7/5/3/
P 3 9 3 0 5 A 0 1 1 6

PEARSON

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

1 A series of tests was carried out on **A**, a white powder, which is known to contain one cation and one anion. Complete the table below. You may use names or formulae in your answers.

	Test	Observations	Inferences	
(a)	Carry out a flame test on **A**.	....	Cation is potassium	(1)
(b)	Add a mixture of dilute nitric acid and aqueous silver nitrate to an aqueous solution of **A**. Then add an excess of **dilute** aqueous ammonia to the mixture.	A yellow precipitate forms. When excess dilute aqueous ammonia is added	Anion is	(2)
(c)	Add an aqueous solution of bromine to an aqueous solution of **A**.	The colour of the solution of bromine is .... When bromine is added to an aqueous solution of **A** the colour of the mixture is	The change in colour is due to the formation of	(3)

P 3 9 3 0 5 A 0 2 1 6

	Test	Observations	Inferences
(d)	Add concentrated sulfuric acid to a **solid** sample of **A**.	A vigorous reaction occurs producing a black solid, a yellow solid, a gas with an unpleasant smell and some coloured fumes.	The black solid is .... and the yellow solid is ....

(2)

(Total for Question 1 = 8 marks)

2 A series of tests was carried out on a compound, **B**, which is known to contain **either** carbonate **or** sulfate (sulfate(VI)) ions as well as one cation.

Complete the inferences column. You may use names or formulae in your answers.

	Test	Observations	Inferences	
(a)	Carry out a flame test on **B**.	Yellow flame.	The cation in **B** is	(1)
(b)	Add aqueous barium chloride solution to an aqueous solution of **B**.	A white precipitate forms.	The precipitate could be either .... or	(2)
(c)	Add dilute hydrochloric acid to the mixture formed in (b) until there is no further change.	Some fizzing occurs and the precipitate dissolves.	The anion in **B** is .... and the fizzing is due to formation of	(2)

(d) The **formula** of **B** is

(1)

....

(Total for Question 2 = 6 marks)

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3 Magnesium carbonate reacts with dilute nitric acid as shown in the equation below.

$$MgCO_3(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + CO_2(g) + H_2O(l)$$

The enthalpy change for this reaction can be determined as follows:

Procedure

1. Weigh 3.50 g of finely powdered magnesium carbonate.
2. Transfer 50.0 cm^3 of 2.00 mol dm^{-3} nitric acid into a polystyrene cup and record the temperature of the acid.
3. Add the magnesium carbonate to the nitric acid.
4. Stir the mixture and record the maximum temperature reached.

Results

Temperature of nitric acid before addition of magnesium carbonate	21.0 °C
Final temperature of solution	29.7 °C

(a) Explain why the magnesium carbonate used in this experiment should be finely powdered rather than in lumps.

(1)

....

....

(b) (i) Calculate the number of moles of magnesium carbonate in 3.50 g.

[Assume the molar mass of magnesium carbonate is 84 g mol^{-1}.]

(1)

(ii) The volume of dilute nitric acid used contained 0.100 mol of HNO_3. Suggest why this amount is suitable.

(1)

....

....

....

(c) (i) Calculate the heat energy transferred, in joules, in this reaction between magnesium carbonate and nitric acid.

Use the expression

energy transferred (J) = mass of solution × specific heat capacity of solution × temperature rise

[Assume the mass of solution is 50 g and its specific heat capacity is 4.18 J g^{-1} °C^{-1}.]

(1)

(ii) Calculate the enthalpy change, ΔH, for the reaction of one mole of magnesium carbonate with nitric acid. Your answer should be in units of kJ mol^{-1}, expressed to **three** significant figures, and include a sign.

(2)

(d) (i) The nitric acid for this experiment could be measured using either a pipette or a measuring cylinder. Give **one** practical advantage of using each piece of apparatus.

(2)

Pipette ....

....

Measuring cylinder ....

....

(ii) The **total error** in measuring the mass of the magnesium carbonate was ±0.01 g. Calculate the percentage error in the weighing.

(1)

(e) State and explain the effect, if any, on the calculated enthalpy change, ΔH, if

(i) a copper calorimeter were used instead of the polystyrene cup.

(2)

....

....

....

....

(ii) 3.50 g of **damp** magnesium carbonate were used.

(2)

....

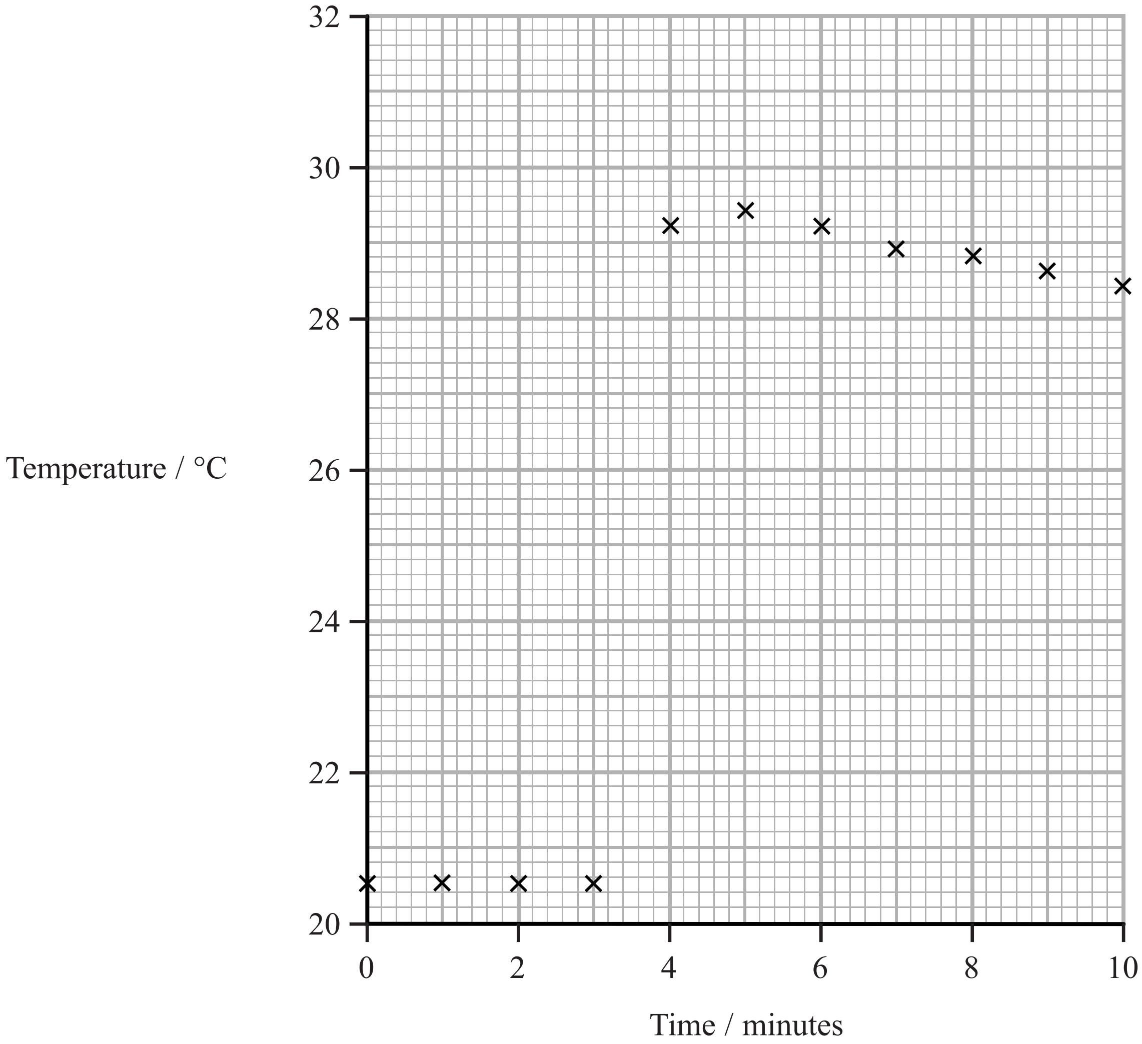
....

....

....

(f) The experiment was repeated with a change in the procedure. The temperature of the dilute nitric acid was measured every minute for three minutes. After exactly three and a half minutes, the magnesium carbonate was added and the mixture was stirred. The temperature of the mixture was then taken every minute for another six minutes.

A graph of the temperature readings against time using this procedure is shown opposite.



(i) Use this graph to calculate the maximum temperature change. Show your working on the graph.

(2)

Maximum temperature change = ... °C

(ii) Why does this method give a more accurate result than the original procedure?

(1)

....

....

....

(Total for Question 3 = 16 marks)

4 This question is about the alcohol, propan-1-ol.

(a) Give **two** observations when propan-1-ol reacts with a small piece of sodium.

(2)

Observation 1 ....

....

Observation 2 ....

....

(b) A student investigated the rate of reaction of propan-1-ol with sodium.

Suggest **one** suitable measurement which could be made to determine the rate of this reaction.

(1)

....

....

....

(c) A small amount of phosphorus(V) chloride (phosphorus pentachloride), PCl_5, is added to propan-1-ol in a test tube.

(i) Describe the appearance of the fumes at the mouth of the test tube.

(1)

....

(ii) An open bottle of concentrated ammonia is held near the mouth of the tube. Describe what would be seen at the mouth of the test tube.

(1)

....

....

(Total for Question 4 = 5 marks)

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5 Propanoic acid may be prepared by oxidizing propan-1-ol in acidic conditions.

$$CH_3CH_2CH_2OH \xrightarrow{\mathbf{X} + H_2SO_4} CH_3CH_2COOH$$

Procedure

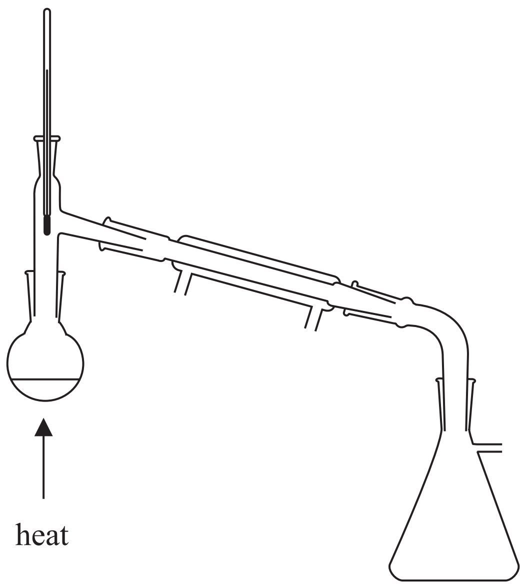
1. Pour 10 cm^3 of distilled water into a boiling tube and add 12 g of oxidizing agent **X**. Shake the mixture and leave **X** to dissolve.

2. Pour 3 cm^3 of propan-1-ol into a round-bottom flask and add 10 cm^3 of distilled water and a few anti-bumping granules. Set up the apparatus for heating under reflux.

3. Add 4 cm^3 of concentrated sulfuric acid, drop by drop, to the propan-1-ol. While the mixture is still warm, add the solution of oxidizing agent **X**, drop by drop. The energy released from the reaction should cause the mixture to boil without external heating.

4. When all of the solution of **X** has been added, use a low Bunsen burner flame to keep the mixture boiling for 10 minutes, not allowing any vapour to escape.

5. Distil the mixture in the flask using the apparatus shown below. Collect 5–6 cm^3 of distillate, which is an aqueous solution of propanoic acid.



(a) Suggest, by name or formula, a suitable oxidizing agent, **X**, for this reaction.

(1)

....

(b) What colour change does **X** undergo when it oxidizes propan-1-ol?

(1)

From .... to ....

(c) Draw a **labelled** diagram showing the apparatus for heating under reflux.

(2)

(d) Give **two** reasons why the escape of vapour in step 4 should be prevented.

(2)

Reason 1 ....

....

Reason 2 ....

....

(e) How does the reflux apparatus prevent escape of vapour?

(1)

....

....

(f) Some water can be removed from the distillate in step 5 by adding a solid drying agent. The solution of propanoic acid can then be decanted leaving the drying agent behind.

(i) Suggest a suitable solid drying agent.

(1)

....

(ii) Suggest why removing excess solid drying agent by decanting, rather than filtering through filter paper, improves the yield.

(1)

....

....

(g) In a larger scale preparation of propanoic acid, 10.0 g of propan-1-ol was used.

(i) Calculate the maximum mass of propanoic acid which could be formed from 10.0 g of propan-1-ol.

	Propan-1-ol	Propanoic acid
Molar mass / g mol^{-1}	60.1	74.1

(2)

(ii) After purification, 6.0 cm^3 of dry propanoic acid was obtained.

Calculate the percentage yield in the preparation.

The density of propanoic acid is 0.99 g cm^{-3}.

(2)

(h) In another experiment, the same reaction mixture (propan-1-ol, **X** and concentrated sulfuric acid) was heated in the apparatus shown in step 5. Identify the main organic product which would be collected and explain why propanoic acid is not produced.

(2)

Product ....

Explanation ....

....

(Total for Question 5 = 15 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1 (1)	2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	3 (13)	4 (14)	5 (15)	6 (16)	7 (17)	0 (8) (18)
							1.0 **H** hydrogen 1										4.0 **He** helium 2
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											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