Write your name here

Surname	Other names

Centre Number

Candidate Number

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Thursday 13 May 2010 – 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 ▶

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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 Group 1 cation and one anion.

(a) (i) Describe how you would carry out a flame test on compound **A**.

(3)

....

....

....

....

....

....

(ii) In a flame test, compound **A** gives a red flame. Deduce the formula of the cation present.

(1)

....

(b) On prolonged strong heating, compound **A** forms a white solid, **B**, and a gas. The gas turns limewater milky.

(i) Identify, by name or formula, the compound that is dissolved in water to make limewater.

(1)

....

(ii) Suggest the formula for the anion in compound **A**. Justify your answer.

(2)

....

....

....

(c) When water is added to the white solid, **B**, it dissolves completely and exothermically to form solution **C**.

(i) Identify, by name or formula, the anion present in **B**.

(1)

....

(ii) Identify, by name or formula, the anion present in **C**.

(1)

....

(iii) Suggest a test for the anion present in **C**. Give the result of your test.

(2)

Test ....

Result ....

(d) Suggest the **formula** of compound **A**.

(1)

....

(Total for Question 1 = 12 marks)

2 This question is about two isomeric halogenoalkanes, **P** and **Q**.

(a) A hot aqueous solution of silver nitrate is added to each halogenoalkane. Both halogenoalkanes react to form a yellow precipitate.

(i) Identify, by name or formula, this yellow precipitate.

(1)

....

(ii) The isomers have relative molecular mass 169.9. Deduce the molecular formula of the isomers.

(1)

(iii) Halogenoalkane **P** forms the yellow precipitate faster than halogenoalkane **Q**. Draw a displayed formula for halogenoalkane **P**.

(1)

(iv) Give the name or structural formula of the alcohol, **R**, formed by the reaction of halogenoalkane, **P**, with hot aqueous silver nitrate.

(1)

....

(b) When **R** is boiled with a mixture of potassium dichromate(VI) and dilute sulfuric acid, the organic product **S** forms.

(i) Give the colour change you would expect to see.

(2)

From .... **to** ....

(ii) Give the **name** of **S**.

(1)

....

(iii) Give the type of reaction involved in the conversion of **R** to **S**.

(1)

....

(Total for Question 2 = 8 marks)

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3 The purity of a sample of potassium iodate(V) was determined by titration.

The steps of the experimental procedure are as follows.

1. 0.100 g of the sample was dissolved in water in a beaker and the solution made up to 100 cm^3 in an appropriate flask.

2. A 10.0 cm^3 portion of this solution of potassium iodate(V) was transferred to a conical flask.

3. An excess of both potassium iodide solution and sulfuric acid were then added to the conical flask. This produced a solution, **T**, containing iodine.

4. Solution **T** was titrated with 0.0200 mol dm^{-3} sodium thiosulfate solution using a suitable indicator.

5. Steps 2, 3 and 4 were repeated twice.

(a) (i) Name the piece of apparatus used to remove the 10.0 cm^3 portions of potassium iodate(V) solution (step 2).

(1)

....

(ii) Name the indicator you would use for the titration and give the colour change you would expect to see (step 4).

(2)

Indicator ....

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

(b) The following results were obtained for the titrations.

Titration number	1	2	3
Final burette reading / cm^3	19.50	33.20	46.95
Initial burette reading / cm^3	5.00	19.50	33.20
Titre / cm^3			

(i) Complete the table by calculating the titres.

(1)

(ii) Explain why the correct value for the mean titre is 13.73 cm^3.

(1)

....

....

....

(iii) Calculate the number of moles of sodium thiosulfate in the mean titre.

(1)

(c) The ionic equation for the reaction between iodine and sodium thiosulfate in the titration is shown below.

$$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$$

Calculate the number of moles of iodine in solution **T** using this equation and your answer to (b)(iii).

(1)

(d) The ionic equation for the reaction of iodate(V) ions with iodide ions is shown below.

$$IO_3^-(aq) + 5I^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$$

Using this equation and your answer to (c), calculate the number of moles of iodate(V) ions which reacted to produce solution **T**.

(1)

(e) (i) Name the appropriate flask used in step 1.

(1)

(ii) Describe how you would make up exactly 100 cm^3 of potassium iodate(V) solution in this flask, ready for step 2.

(3)

(iii) Calculate the number of moles of potassium iodate(V) in 100 cm^3 of the solution, using your answer to (d).

(1)

(iv) Calculate the mass of potassium iodate(V) in the sample.

[Assume the molar mass of potassium iodate(V) is 214 g mol^{-1}]

(1)

(v) Calculate the percentage purity of the sample.

(1)

(f) Suggest the most significant hazard in step 3.

(1)

(Total for Question 3 = 16 marks)

4 An experiment to prepare 0.100 mol of 1-bromobutane uses the reaction of butan-1-ol with hydrogen bromide.

Hydrogen bromide is formed in the reaction mixture from potassium bromide and moderately concentrated sulfuric acid.

The process has an 80 % yield after purification of the 1-bromobutane.

$$KBr + H_2SO_4 \rightarrow KHSO_4 + HBr$$

$$CH_3CH_2CH_2CH_2OH + HBr \rightarrow CH_3CH_2CH_2CH_2Br + H_2O$$

The steps of the experimental procedure are as follows.

1. Add measured amounts of potassium bromide and butan-1-ol to 10 cm^3 of water into a 50 cm^3 two-necked flask.

2. Fit the two-necked flask with a reflux condenser and a tap funnel.

3. Immerse the flask in a beaker of cold water and add 10 cm^3 of concentrated sulfuric acid from the tap funnel, a few drops at a time.

4. Remove the flask from the cold water and close the tap on the tap funnel. Heat the mixture under reflux for 30 minutes.

5. Allow the mixture to cool. Then set up the apparatus for distillation. Boil the mixture and collect the distillate in a measuring cylinder.

6. Transfer the distillate to a separating funnel. The distillate consists of two layers, an aqueous layer and impure 1-bromobutane. Separate the two layers.

7. Wash the impure 1-bromobutane with concentrated hydrochloric acid and separate the two layers.

8. Wash the 1-bromobutane layer with sodium hydrogencarbonate solution, releasing any gas formed.

9. Collect the 1-bromobutane layer in a conical flask and add anhydrous sodium sulfate.

10. Decant the 1-bromobutane into a 50 cm^3 flask.

Data

Property	Butan-1-ol	1-bromobutane	Water
Density / g cm^{-3}	0.81	1.3	1.0
Molar mass / g mol^{-1}	74	137	18
Boiling temperature / °C	117.3	101.7	100.0

(a) (i) Show, by calculation, that 0.125 mol of butan-1-ol is needed to make 0.100 mol of 1-bromobutane.

(2)

(ii) Calculate the volume of 0.125 mol of butan-1-ol, in cm^3.

(2)

(iii) Calculate the minimum mass of potassium bromide required in step 1.

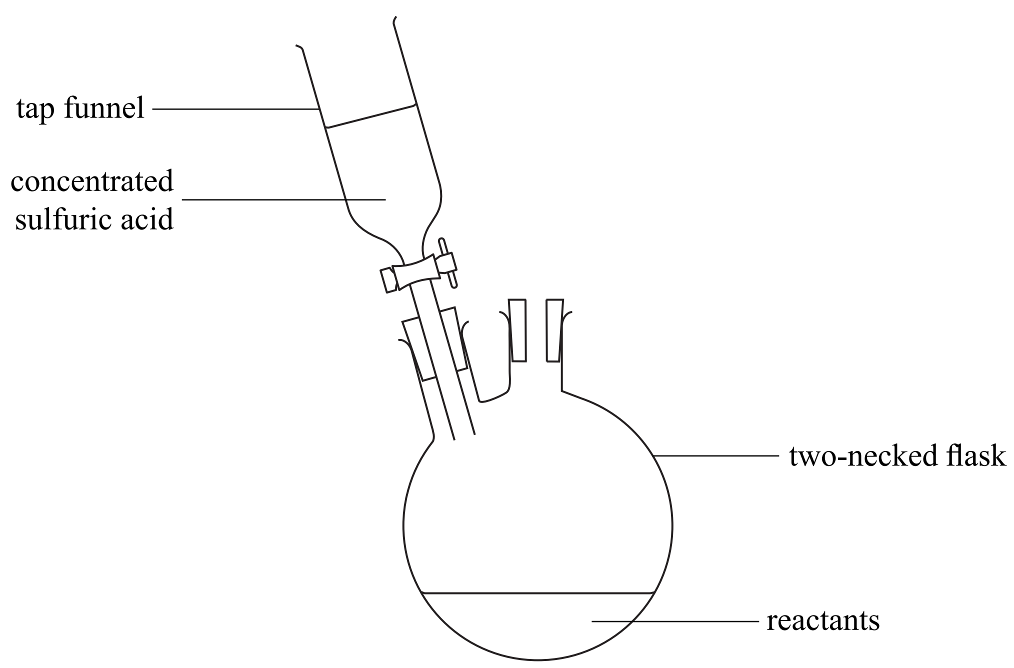
[The molar mass of potassium bromide is 119 $g\ mol^{-1}$]

(1)

(b) Complete and label the diagram below of the apparatus assembled in steps 1, 2 and 3.

[You may assume that the apparatus is suitably clamped.]

(4)



(c) (i) State, with a reason, whether the upper or lower layer contains 1-bromobutane in step 6.

(1)

....

....

(ii) The product is washed with concentrated hydrochloric acid in step 7 to remove unreacted butan-l-ol. In step 8, why is the product then washed with sodium hydrogencarbonate solution and what causes a build up of gas?

(2)

....

....

....

....

(d) (i) What further step is necessary to purify the 1-bromobutane obtained in step 10?

(1)

....

(ii) How does the step in (d)(i) give information about the purity of the product?

(1)

....

....

(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

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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