Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Wednesday 8 May 2013 – 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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PEARSON

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

1 Tests were carried out on compounds **X**, **Y** and **Z**. Complete the tables below.

(a) Compound **X** is a white, water-soluble solid.

	Test	Observation	Inference (Name or formula)	
(i)	Flame test	Lilac flame	....	(1)
(ii)	To a solution of **X**, add barium chloride solution and acidify with hydrochloric acid	....	Sulfate ions absent	(1)
(iii)	To a solution of **X**, add dilute nitric acid followed by	....	Iodide ions present	(2)
(iv)	Add concentrated aqueous ammonia solution to the mixture remaining from test (iii)	....	Confirms presence of iodide ions	(1)

(v) The **formula** of **X** is: ....

(1)

(b) Compound **Y** is a white solid that is insoluble in water.

	Test	Observation	Inference (Name or formula)	
(i)	Flame test	Yellow-red (brick red) flame	....	(1)
(ii)	Add dilute hydrochloric acid to **Y** Bubble the gas through	The mixture fizzed and the solid .... It turned milky	 CO_2 evolved	(2)

(iii) The **formula** of **Y** is: ....

(1)

(c) **Z** is a colourless organic liquid with only one functional group. **Z** is completely miscible with water to form a neutral solution.

	Test	Observation	Inference	
(i)	Add bromine water to **Z**	No colour change	....	**(1)**
(ii)	Add solid phosphorus(V) chloride, PCl_5, to **Z**	Misty fumes (of hydrogen chloride)	....	**(1)**
(iii)	Warm **Z** with potassium dichromate(VI) solution and dilute sulfuric acid	Colour changes from orange to green	**Z** could be .... or	**(2)**

(d) The composition by mass of **Z** is C 60.0%, H 13.3%, O 26.7%.

(i) Calculate the empirical formula of **Z**.

(2)

(ii) The molecular formula of **Z** is the same as its empirical formula. Give the **displayed** formulae of the two possible isomers of **Z**.

(2)

(Total for Question 1 = 18 marks)

2 An experiment to determine the enthalpy change of reaction between aqueous copper(II) sulfate and zinc was carried out as follows.

1. 50.0 cm^3 of copper(II) sulfate solution, of concentration 1.00 mol dm^{-3}, was placed in a polystyrene cup.

2. The temperature of the solution was measured with a 0 – 110 °C thermometer and was found to be 23.0 °C.

3. Zinc powder with a mass of 5 g (an excess) was added to the solution with vigorous stirring and the highest temperature recorded was 69.5 °C.

(a) (i) Write the **ionic** equation for the reaction between zinc and aqueous copper(II) ions, including state symbols.

(2)

(ii) Calculate the quantity of heat energy produced in the experiment above, giving your answer in J. (Assume that the heat capacity of the mixture is 4.18 J g^{-1} $°C^{-1}$ and its density is 1.00 g cm^{-3}.) Use the expression

energy transferred in joules = mass × specific heat capacity × temperature change

(2)

(iii) Calculate the number of moles of copper(II) sulfate used in the experiment.

(1)

(iv) Use your answers from (a)(ii) and (a)(iii) to calculate the enthalpy change for the reaction in kJ mol^{-1}. Give your answer to **three** significant figures and include the appropriate sign.

(2)

(b) The thermometer used in this experiment gave an uncertainty in each temperature reading of ±0.5 °C.

(i) State the maximum temperature difference in this experiment that could have been obtained using this thermometer.

(1)

....

(ii) What is the percentage error in the temperature change using this thermometer?

(1)

(c) **Using the same equipment**, together with a stop clock, suggest a procedure that would improve the accuracy of this experiment by obtaining a more accurate temperature change. You must use the same mass of zinc powder and the same volume of 1.00 mol dm^{-3} copper(II) sulfate solution.

(4)

....

....

....

....

....

....

....

(Total for Question 2 = 13 marks)

3 Chloroalkanes and bromoalkanes can be made from alcohols by reaction of the alcohol with sodium chloride or bromide, in the presence of 50% aqueous sulfuric acid.

Iodoalkanes cannot be made from sodium iodide and sulfuric acid; red phosphorus and iodine can be used instead as the halogenating agent.

(a) (i) What would you **see** if concentrated sulfuric acid was added to solid sodium iodide? Give **two** observations.

(2)

1. ....

....

2. ....

....

(ii) Explain why sodium iodide and sulfuric acid cannot be used to make iodoalkanes from alcohols.

(2)

....

....

....

....

(b) Give the equation for the reaction between phosphorus and iodine to form phosphorus(III) iodide. State symbols are not required.

(1)

(c) A preparation of 1-iodobutane is given in outline below.

Procedure

1. Suitable quantities of red phosphorus and butan-1-ol are placed in a round-bottomed flask fitted with a reflux condenser.
2. The mixture is heated until it boils gently and then the heat source is removed.
3. A suitable quantity of powdered iodine is added in small portions down the condenser at a rate which just maintains gentle boiling. The reaction should be allowed to subside after each addition.
4. After the addition of iodine is complete, the mixture is heated under reflux for 30 – 60 minutes, until little or no iodine is visible.
5. The apparatus is allowed to cool and the condenser rearranged for distillation.
6. The crude 1-iodobutane is distilled off until the residue in the distilling flask is about one-fifth of its original volume. Double its volume of water is added and the distillation continued until no more oily drops condense into the receiver.
7. The crude 1-iodobutane is separated and washed with dilute sodium thiosulfate solution and then with dilute sodium carbonate solution.
8. The organic layer is separated and allowed to stand over anhydrous calcium chloride.

(i) What does the manner in which the iodine is added in **step 3** suggest about the nature of the reaction?

(1)

....

(ii) Completion of **step 4** requires that 'little or no iodine is visible'. State what you would look for in this step to ensure that this is true.

(1)

....

....

(iii) Draw the apparatus that is used in **step 6** for distillation.

(3)

(iv) Suggest why the first washing of the product in **step 7** is with dilute sodium thiosulfate solution rather than with water alone.

(1)

....

....

(v) State why calcium chloride used in **step 8** must be anhydrous.

(1)

....

....

(vi) To complete the preparation, after decanting the mixture from the calcium chloride, there should be a **step 9**. What is this step?

(1)

....

....

(d) Chloroalkanes can be made from an alcohol and phosphorus(V) chloride, PCl_5.
The equation for the reaction of butan-1-ol with PCl_5 is

$$CH_3CH_2CH_2CH_2OH + PCl_5 \rightarrow CH_3CH_2CH_2CH_2Cl + HCl + POCl_3$$

This reaction is not suitable for the manufacture of 1-chlorobutane on a large scale.

(i) In a laboratory preparation of 1-chlorobutane, 95.0 g of butan-1-ol was used. Calculate the maximum mass of 1-chlorobutane that could be obtained.

(Assume the molar masses are, in g mol^{-1}, butan-1-ol = 74.0, 1-chlorobutane = 92.5)

(2)

(ii) In practice, 95.3 g of 1-chlorobutane was obtained. Calculate the percentage yield.

(1)

(iii) Give **one** reason why the actual yield is lower than the maximum possible yield.

(1)

....

....

(iv) Give **two** reasons why this reaction would not be used industrially to make 1-chlorobutane.

(2)

....

....

....

....

(Total for Question 3 = 19 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