Write your name here

Surname	Other names

Centre Number | | | | | |

Candidate Number | | | | |

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Wednesday 9 May 2012 – 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 ▶

P39310A

7/5/5/5/

P 3 9 3 1 0 A 0 1 1 6

PEARSON

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

1 A student is given aqueous solutions of:

- sodium chloride, NaCl(aq)
- potassium iodide, KI(aq)
- dilute hydrochloric acid, HCl(aq)
- dilute nitric acid, HNO_3(aq)

The solutions are labelled **A**, **B**, **C** and **D**, but not necessarily in the order listed above.

The student carried out two tests on each solution.

Test 1

1. The student put a 1 cm depth of each of the solutions **A**, **B**, **C** and **D** into separate test tubes.
2. The student added one spatula measure of solid sodium carbonate, Na_2CO_3, to each test tube.
3. The student's observations were recorded as shown in Table 1 below, in the column labelled Test 1.

Test 2

1. The student put a 1 cm depth of each of the solutions **A**, **B**, **C** and **D** into separate test tubes.
2. The student added an equal volume of aqueous silver nitrate solution, $AgNO_3$, to each test tube.
3. The student's observations were recorded as shown in Table 1 below, in the column labelled Test 2.

Table 1

	Observations	
Solution	**Test 1**	**Test 2**
A	Effervescence	No reaction
B	No reaction	Yellow precipitate
C	No reaction	White precipitate
D	Effervescence	White precipitate

(a) Use the results of the tests to identify each of the four solutions using the letters **A**, **B**, **C** and **D** in Table 2.

(3)

Table 2

Name of solution	Letter
Sodium chloride solution	
Potassium iodide solution	
Dilute hydrochloric acid	
Dilute nitric acid	

(b) Explain how the observations allowed the student to distinguish between dilute hydrochloric acid and sodium chloride solution.

(1)

.....

.....

.....

(c) Give the ionic equation, including state symbols, for the reaction of solution **B** in **Test 2**.

(2)

(d) What would you expect to **see** when dilute ammonia solution is added to the white precipitate formed by solution **C** in **Test 2**?

(1)

.....

.....

(Total for Question 1 = 7 marks)

2 A series of tests was carried out on a white powder, **E**, which is known to be a Group 2 nitrate.

(a) Complete the inference column for each test in the table below by giving a name or formula.

(4)

Test	Observation	Inference
Carry out a flame test on **E**.	Pale green flame	The metal ion is .....
Add dilute sulfuric acid to an aqueous solution of **E**.	White precipitate	The precipitate is .....
Heat a sample of **E** very strongly. Test any gases given off with a glowing splint.	A brown gas is evolved The glowing splint relights	The brown gas is ..... The gas which relights the glowing splint is .....

(b) The **formula** of **E** is .....

(1)

(c) Write an equation to show the reaction which occurs when a sample of **E** is heated very strongly. State symbols are **not** required.

(2)

(Total for Question 2 = 7 marks)

3 (a) Two colourless liquids, **X** and **Y**, both with the formula $C_4H_{10}O$, are oxidized on heating with acidified potassium dichromate(VI) solution to form different carboxylic acids.

(i) Give the colour change you would expect to observe when each reaction takes place.

(2)

From ..... to .....

(ii) Give the two possible structural formulae for the compounds **X** and **Y** which both have the formula $C_4H_{10}O$.

(2)

First possible structural formula

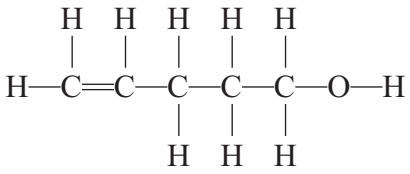
Second possible structural formula

(b) A colourless liquid, **Z**, also with the formula $C_4H_{10}O$, resists oxidation on heating with acidified potassium dichromate(VI) solution.

Give the structural formula for liquid **Z**.

(1)

(c) An organic compound, **W**, has the displayed formula



(i) A few drops of bromine water were added to a sample of **W** in a test tube and the mixture shaken.

Give the colour change you would expect to observe.

(2)

From ..... to .....

(ii) Give the displayed formula of the product formed in (c)(i).

(1)

(iii) What would you expect to **see** when a small quantity of phosphorus(V) chloride was added to a sample of **W** in a test tube?

(1)

.....

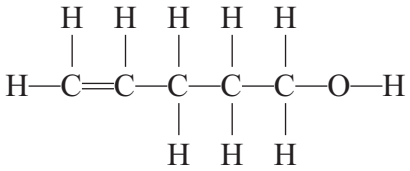
.....

(iv) Give the displayed formula of the **organic** product formed in (c)(iii).

(1)

(v) Identify, by **name**, the two functional groups present in compound **W**.

(2)



First functional group

.....

Second functional group

.....

(Total for Question 3 = 12 marks)

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4 In two similar, separate experiments, the enthalpy changes for the reactions of potassium hydrogencarbonate, $KHCO_3$, and potassium carbonate, K_2CO_3, with excess dilute hydrochloric acid were determined.

(a) The first experiment was to find the enthalpy change, ΔH_1, for the reaction

$$KHCO_3(s) + HCl(aq) \rightarrow KCl(aq) + H_2O(l) + CO_2(g)$$

Measurement	Reading
Mass of solid potassium hydrogencarbonate added to hydrochloric acid	3.48 g
Volume of hydrochloric acid	25.0 cm^3
Temperature of hydrochloric acid before addition of solid potassium hydrogencarbonate	22.0 °C
Final temperature of solution	12.0 °C

(i) Calculate the heat energy absorbed, in joules, by the reaction of $KHCO_3(s)$ with the solution of dilute hydrochloric acid.

Use the expression

energy absorbed (J) = 25.0 × 4.18 × temperature change

(1)

(ii) Calculate the number of moles of $KHCO_3(s)$ used.
Molar mass of $KHCO_3(s)$ is 100 g mol^{-1}.

(1)

(iii) Use your answers to (a)(i) and (ii) to calculate, in kJ mol^{-1}, the enthalpy change, ΔH_1, when one mole of $KHCO_3(s)$ reacts completely with the acid. Include the sign for ΔH_1.

(2)

(b) In the second experiment, the enthalpy change for the reaction between potassium carbonate and dilute hydrochloric acid was calculated from the results.

$$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$$

The molar enthalpy change, ΔH_2, for this reaction was calculated to be –34.0 kJ mol^{-1}.

(i) State **one** way in which the temperature change is different when equal numbers of moles of potassium hydrogencarbonate and potassium carbonate react separately with the same volume of excess dilute hydrochloric acid.

(1)

.....

.....

.....

(ii) Give **one** assumption made when calculating the values of ΔH_1 and ΔH_2 from experimental results.

(1)

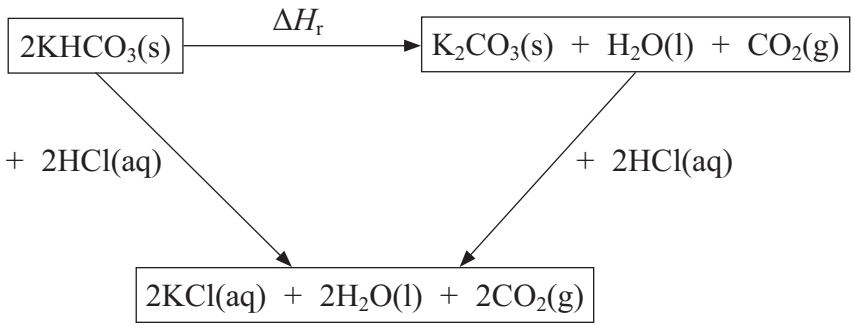
.....

.....

(c) The values of ΔH_1 and ΔH_2 may be used to determine the enthalpy change for the following reaction (ΔH_r).

$$2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(l) + CO_2(g)$$

A Hess cycle based on these reactions is shown below.



(i) Use Hess's Law to complete an expression for ΔH_r in terms of ΔH_1 and ΔH_2.

(1)

ΔH_r =

(ii) Calculate the value of ΔH_r in kJ mol^{-1}. Include a sign in your answer.

(2)

(Total for Question 4 = 9 marks)

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5 A student carried out an experiment to determine the value of **x** in the formula of hydrated sodium bromide, $NaBr \cdot \mathbf{x}H_2O$.

Hydrated sodium bromide is heated until all the water of crystallization is removed. Anhydrous sodium bromide, NaBr, is formed.

The student was given the following instructions.

- Weigh a sample of the hydrated sodium bromide crystals in a pre-weighed crucible.
- Heat the crucible containing the sample to remove the water of crystallization.
- Allow the crucible to cool and then reweigh the crucible.

The student's results are shown in the table below.

(a) Complete the table.

(2)

Mass of crucible empty / g	18.02
Mass of crucible + contents before heating / g	21.49
Mass of crucible + contents after heating / g	20.51
Mass of contents before heating / g	3.47
Mass of contents after heating / g	
Mass of water removed / g	

(b) (i) Calculate the number of moles of water removed on heating the hydrated sodium bromide crystals.

(1)

(ii) Calculate the number of moles of anhydrous sodium bromide, NaBr, formed after heating.

(2)

(iii) Use your answers from (b)(i) and (ii) to calculate the value of **x**. Give your answer to **two** significant figures.

(2)

(c) Each mass reading in the table has a maximum error of ±0.005 g.

Calculate the percentage error in the mass of the contents of the crucible before heating the 3.47 g of crystals.

(2)

(d) The correct value for **x** is 2.

Two possible errors that might occur during the experiment are described below.

For each error, predict the effect the error would have on

- the apparent mass of water removed
- the calculated value of **x**

(i) Carbon from the Bunsen burner flame was deposited on the crucible during heating.

(2)

Apparent mass of water removed:

.....

Value of **x**:

.....

(ii) A few crystals of hydrated sodium bromide jumped out of the crucible during heating.

(2)

Apparent mass of water removed:

.....

Value of **x**:

.....

(e) Suggest **two** improvements to the experiment, other than changing the balance, that would help to achieve a more accurate result.

(2)

First improvement

.....

.....

Second improvement

.....

.....

(Total for Question 5 = 15 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
																	(18)
																	4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass **atomic symbol** name atomic (proton) number				1.0 H hydrogen 1					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