Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Thursday 25 January 2018 – Afternoon
Time: 1 hour 15 minutes

Paper Reference
WCH06/01

Candidates must have: Scientific calculator

Total Marks

Instructions

- Use **black** ink or **black** 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.
- Try to answer every question.
- Check your answers if you have time at the end.
- Show all your working in calculations and include units where appropriate.

Turn over ▶

Pearson

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

1 A series of tests is carried out on a solid compound, **X**.
X contains one cation and one anion.
Complete the Inference column in the table.

	Test	Observation	Inference	
(a)	Record the appearance of **X**	Yellow crystalline solid	....	**(1)**
(b)	Carry out a flame test on **X**	Yellow flame	....	**(1)**
(c)	Add a few cm^3 of dilute sulfuric acid to a small amount of solid **X** in a test tube. Shake the test tube gently	Solid **X** dissolves and an orange solution is formed	The orange solution contains the anion with the **formula**	**(1)**
(d)	To the solution formed in (c), add a few drops of ethanol and warm the mixture carefully	Orange solution turns green	....	**(2)**
(e)	To half of the green solution formed in (d), add aqueous sodium hydroxide, drop by drop, until in excess	A green precipitate initially forms which dissolves in excess sodium hydroxide to form a green solution	The **formula** of the green precipitate is .... The **formula** of the ion responsible for the colour of the green solution formed is	**(2)**

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

	Test	Observation	Inference	
(f)	To the remaining half of the green solution formed in (d), add a spatula measure of zinc powder	Green solution turns blue	The **formula** of the ion responsible for the colour of the blue solution formed is .... The role of zinc in this reaction is	**(2)**
(g)	Filter off the excess zinc from the mixture remaining after (f), collecting the filtrate in a test tube. Shake the test tube vigorously for a few minutes	Blue solution turns green	The **formula** of the ion responsible for the colour of the green solution is .... Type of reaction that has occurred is	**(2)**

(Total for Question 1 = 11 marks)

2 A series of tests is carried out on two organic compounds, **Y** and **Z**.

Each molecule of **Y** and **Z** contains

- **three** carbon atoms
- **one** functional group.

(a) Complete the Inference column, taking the information above into account. You should state what **further** information the tests and observations give you about the original compound **Y**.

	Test	Observation	Inference about compound **Y**	
(i)	Add a small spatula measure of phosphorus(V) chloride to 1 cm^3 of **Y** in a test tube. Test any fumes given off with damp blue litmus paper	Steamy fumes are given off which turn damp blue litmus paper red	....	**(1)**
(ii)	Add 2 cm^3 of sodium carbonate solution to 1 cm^3 of **Y** in a test tube	No change	....	**(1)**
(iii)	Add 2 cm^3 of sodium hydroxide solution to 1 cm^3 of **Y** in a test tube. Add iodine solution, drop by drop, until the iodine is just in excess	A pale yellow solid with an antiseptic smell forms	....	**(1)**

(iv) Use your inferences in (a)(i) to (iii), and the information from the beginning of the question, to identify compound **Y**, by writing its name or formula.

(1)

(v) The mass spectrum of compound **Y** has a peak at $m/e = 45$.
Give the formula of the species responsible for this peak and explain how this species is formed from a molecule of compound **Y**.

(2)

Species responsible:

How this species is formed from a molecule of compound **Y**:

....

....

(b) Two tests are carried out on compound **Z**. Complete the table by filling in the Inference column.

	Test	Observation	Inference	
(i)	Add a small spatula measure of phosphorus(V) chloride to 1 cm^3 of **Z** in a test tube. Test any fumes given off with damp blue litmus paper	Steamy fumes are given off which turn damp blue litmus paper red	The steamy fumes are	**(1)**
(ii)	Add 2 cm^3 of sodium carbonate solution to 1 cm^3 of **Z** in a test tube Bubble any gas formed through limewater	Vigorous fizzing occurs The limewater turns milky	The **functional group** present in compound **Z** is	**(1)**

(iii) Use your inferences in (b)(i) and (b)(ii), and the information from the beginning of the question, to identify compound **Z**, by writing its name or formula.

(1)

(Total for Question 2 = 9 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

3 An experiment is carried out to investigate the kinetics of the reaction between iodine and propanone in the presence of hydrogen ions.

The chemical equation for the reaction is

$$CH_3COCH_3 + I_2 \rightarrow CH_3COCH_2I + H^+ + I^-$$

The rate equation for the reaction is

$$\text{rate} = k\,[CH_3COCH_3]^a\,[H^+]^b\,[I_2]^c$$

where a, b and c are the orders with respect to the species shown in the rate equation. It is known that a, the order with respect to propanone, is 1.

Procedure:

- Propanone, water and dilute hydrochloric acid are placed in a conical flask in a water bath
- Once the temperature of the mixture has equilibrated, a solution of iodine in potassium iodide is added and a clock is started
- At suitable time intervals, a known volume of the reaction mixture is transferred into a series of flasks numbered 1 to 6.
  Each flask contains excess aqueous sodium hydrogencarbonate solution which quenches the reaction
- The contents of each flask are titrated with a solution of sodium thiosulfate of known concentration.

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

(a) The following data were obtained in an experiment carried out at 25 °C.

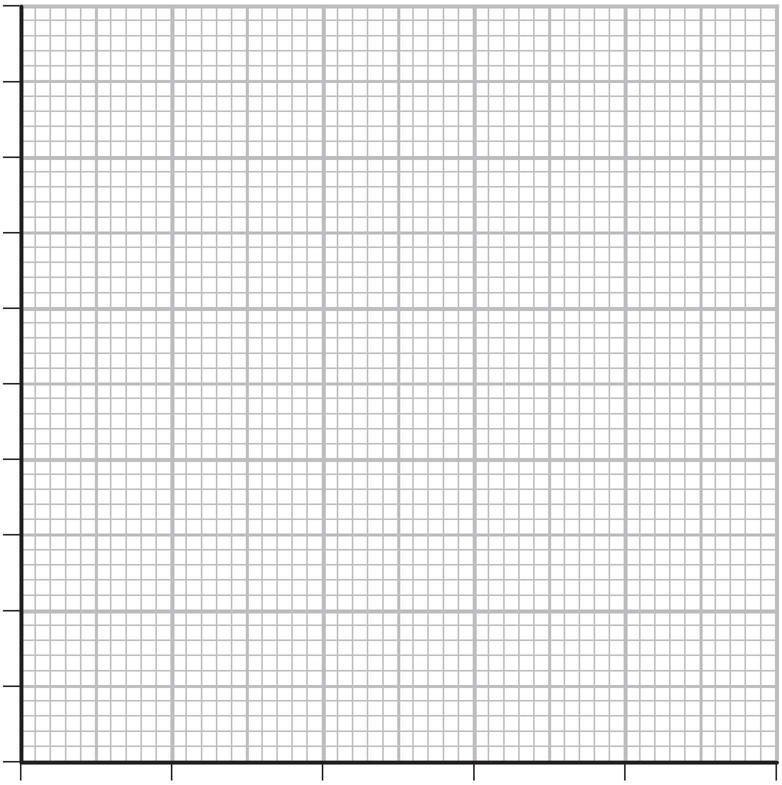
Flask number	1	2	3	4	5	6
Time / min	2	6	10	12	14	18
Volume of sodium thiosulfate / cm^3	18.80	14.40	10.40	8.20	6.00	2.00

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(i) Plot a graph of volume of sodium thiosulfate (*y*-axis) against time (*x*-axis).

Label the axes.

(4)



(ii) The order with respect to iodine can be determined from the graph plotted in (a)(i). Explain why the actual concentration of iodine does **not** need to be calculated in this experiment.

(1)

....

....

(iii) In this experiment, the concentrations of both the propanone and the hydrochloric acid are chosen so as to be in large **excess**.
Explain why this is necessary when determining *c*, the order with respect to iodine.

(2)

....

....

....

....

(iv) Give the value of c, the order with respect to iodine.
Justify your answer.

(2)

....

....

....

....

(b) (i) State the indicator used in the iodine-thiosulfate titration.
Describe the colour change that is observed at the end-point.

(2)

Indicator ....

Colour change at end-point .... to ....

(ii) The indicator named in (b)(i) should not be added at the start of the titration.
State when the indicator is added to the mixture in the conical flask and explain why it should **not** be added at the start.

(2)

....

....

....

....

(c) The titre obtained from the sample at 18 minutes has the greatest uncertainty.
Explain why this is so.

(1)

....

....

(d) In a similar experiment, the concentration of the hydrochloric acid was doubled whilst keeping all other variables the same.
The gradient of the graph plotted with these data was double the gradient of the graph plotted in (a)(i).

Deduce the value of *b*, the order with respect to hydrogen ions, and justify your answer.
(2)

....

....

....

....

(e) Suggest an alternative practical technique which can be used to monitor the progress of the reaction. Justify your choice.

$$CH_3COCH_3 + I_2 \rightarrow CH_3COCH_2I + H^+ + I^-$$

(2)

....

....

....

....

(Total for Question 3 = 18 marks)

4 The compound 2-ethanoylaminobenzoic acid, $C_9H_9NO_3$, is extremely reactive and is only prepared under strictly controlled conditions.

The steps of the procedure to prepare this compound and determine its melting temperature are as follows:

Step **1** Transfer 3.70 g of 2-aminobenzoic acid, $C_7H_7NO_2$, to a dry 50 cm^3 pear-shaped flask fitted with a reflux condenser

Step **2** Add 7.0 cm^3 of ethanoyl chloride (an excess) by pouring it carefully down the reflux condenser

Step **3** Heat the contents of the pear-shaped flask slowly to boiling, and heat under reflux for 15 minutes

Step **4** Allow the mixture to cool and then add 5.0 cm^3 of water

Step **5** Heat the solution slowly to boil it for a few minutes

Step **6** Allow the solution to cool slowly to room temperature

Step **7** Collect the crystals of 2-ethanoylaminobenzoic acid using suction filtration

Step **8** Recrystallise the 2-ethanoylaminobenzoic acid

Step **9** Determine the melting temperature of the pure dry crystals of 2-ethanoylaminobenzoic acid.

(a) Explain, in terms of changes of state, how the process of heating under reflux works and give **two** reasons why it is often necessary to heat chemicals under reflux as in Step **3**.

(3)

....

....

....

....

....

....

....

....

(b) (i) Give the reason why water is added in Step **4**.

(1)

....

....

(ii) Suggest why the reaction mixture was cooled before the water was added in Step **4**.

(1)

....

....

(c) Suggest **two** advantages of using suction filtration in Step **7** compared to normal filtration.

(2)

....

....

....

....

(d) Give **two** features of the results of the melting temperature determination in Step **9** that would confirm the crystals of 2-ethanoylaminobenzoic acid were pure.

(2)

....

....

....

....

(e) In the balanced equation for this reaction, the mole ratio of 2-aminobenzoic acid, $C_7H_7NO_2$: 2-ethanoylaminobenzoic acid, $C_9H_9NO_3$, is 1 : 1.

In an experiment, 3.70 g of 2-aminobenzoic acid, $C_7H_7NO_2$, produced 2.42 g of 2-ethanoylaminobenzoic acid, $C_9H_9NO_3$.

Calculate the percentage yield of the product in this reaction.

(3)

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

BLANK PAGE

BLANK PAGE

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

BLANK PAGE

P 5 1 9 4 1 A 0 1 5 1 6

The Periodic Table of Elements

Key
relative atomic mass **atomic symbol** name atomic (proton) number

1.0 **H** hydrogen 1

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)
																	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