Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Advanced Subsidiary

Unit 3: Chemistry Laboratory Skills I

Monday 7 November 2016 – Morning
Time: 1 hour 15 minutes

Paper Reference
WCH03/01

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 ▶

P50705A

5/6/6/6/5/

P 5 0 7 0 5 A 0 1 1 6

PEARSON

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

1 A white solid, **A**, has one metal cation and an anion consisting of two or more elements.

(a) A flame test is carried out on compound **A** by mixing the solid with concentrated hydrochloric acid and using a wire to place some of the mixture formed in the hottest part of a Bunsen flame.

(i) The wire is made from a metal or an alloy. Name a suitable material for the wire and give **one** reason why this material is used.

(2)

Material .....

Reason .....

.....

(ii) Suggest **one** reason for using hydrochloric acid in this test, rather than another strong acid.

(1)

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.....

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(iii) In a flame test for solid **A**, a red colour is observed. Identify, by name or formula, one Group 1 metal ion and one Group 2 metal ion that could be present.

(2)

Group 1 metal ion .....

Group 2 metal ion .....

(b) When solid **A** is added to water, some dissolves to form a colourless solution.

When phenolphthalein is added to this mixture, it turns pink.

When dilute hydrochloric acid is added to the mixture, the temperature increases and a colourless solution forms, but no gas is given off.

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

(1)

.....

(ii) Write the **ionic** equation for the reaction that causes the temperature to increase. State symbols are not required.

(1)

(c) When dilute sulfuric acid is added to the solution of **A**, a white precipitate forms.

(i) Name the white precipitate.

(1)

.....

(ii) Write the **ionic** equation, including state symbols, for the formation of this precipitate.

(1)

(d) Give the formula of the white solid, **A**.

(1)

(Total for Question 1 = 10 marks)

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2 **P**, **Q** and **R** are different halogenoalkanes with the general formula C_3H_7X.

(a) 2 cm^3 of ethanol is added to three test tubes in a water bath at 50 °C.

Three drops of **P** are added to the first test tube, three drops of **Q** to the second and three drops of **R** to the third.

2 cm^3 portions of aqueous silver nitrate solution are added to each test tube.

Explain why ethanol is added to each test tube.

(1)

.....

.....

.....

(b) Cream coloured precipitates form in the test tubes containing **P** and **Q**. These precipitates are **soluble** in concentrated ammonia solution.

A yellow coloured precipitate forms in the test tube which contains **R**. This precipitate is **insoluble** in concentrated ammonia solution.

Deduce the identity of the halogen present in each halogenoalkane.

(2)

P and **Q** .....

R .....

(c) The mass spectrum of **P** includes a peak at $m/e = 29$ but neither **Q** nor **R** has a peak at this value.

(i) Suggest the identity of the positive ion responsible for this peak at $m/e = 29$.

(1)

.....

(ii) Deduce the structural formulae of the three halogenoalkanes.

(3)

P

Q

R

(Total for Question 2 = 7 marks)

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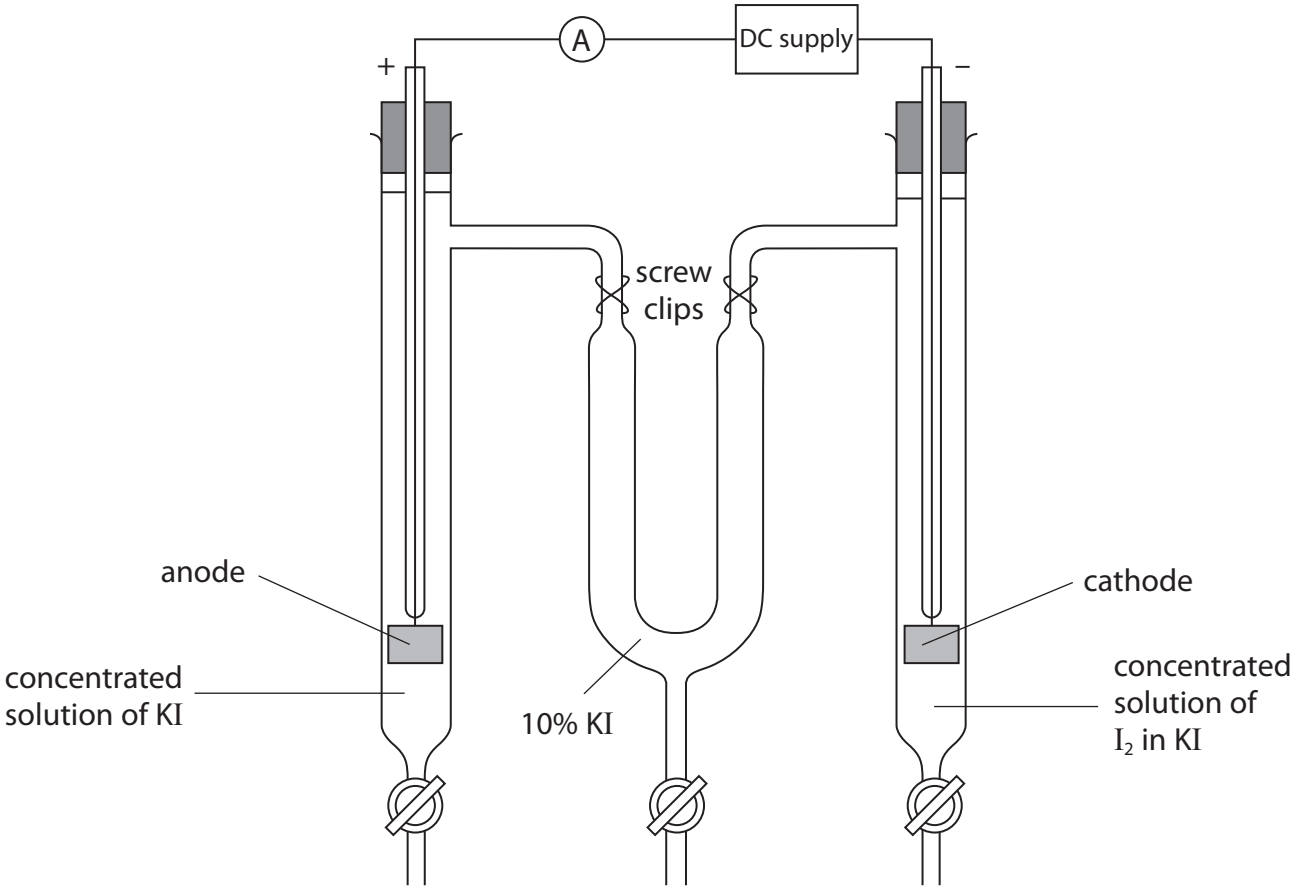
3 An iodine coulometer can be used to find the equation for the reaction between iodine and sodium thiosulfate.



An iodine coulometer

The DC supply is switched on for 15.0 minutes.

The constant current, measured by the ammeter, is 0.200 A.

The screw clips are closed, the left-hand bung is removed and the contents of the anode (positive electrode) tube are run into a 100 cm^3 volumetric flask. The tube and electrode are rinsed with a little distilled water and the washings added to the volumetric flask. The solution in the volumetric flask is made up to the mark with distilled water and mixed thoroughly.

10.0 cm^3 portions of the contents of the volumetric flask are now titrated with 0.0100 mol dm^{-3} sodium thiosulfate solution.

(a) (i) Name the indicator used for the titration, and give the colour change seen at the end-point.

(2)

Indicator .....

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

(ii) State the appearance of the titration mixture just before the indicator is added.

(1)

.....

.....

(b) Calculate the number of moles of electrons transferred from the iodide ions to form iodine in the experiment. Use the expression

$$\text{number of moles of electrons} = \frac{\text{current (A)} \times \text{time (s)}}{96\,500}$$

(1)

(c) The total volume of solution in the volumetric flask is 100 cm^3.

10.0 cm^3 portions of the mixture are titrated with 0.0100 mol dm^{-3} sodium thiosulfate solution.

The results are given in the table below.

Titration number	1	2	3	4
Second reading / cm^3	19.45	38.05	19.05	38.25
First reading / cm^3	0.00	19.45	0.00	19.55
Titre / cm^3				

(i) Complete the table.

(1)

(ii) Which result(s) should be discarded? Give a reason for your answer.

(2)

.....

.....

.....

.....

(iii) Calculate the mean titre for the remaining values.

(1)

(iv) Calculate the number of moles of thiosulfate ions in this mean titre.

(1)

(v) Calculate the number of moles of thiosulfate ions needed to react with the total amount of iodine in the 100 cm^3 of solution in the flask.

(1)

(d) (i) Complete the ionic half-equations for the oxidation of thiosulfate ions and the oxidation of iodide ions.

(2)

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

$2I^-(aq) \rightarrow I_2(aq)$

(ii) In part (b), you calculated the number of moles of electrons lost when the iodide ions are oxidised to form the amount of iodine in the flask.

In part (c)(v), you calculated the number of moles of thiosulfate ions required to reduce this iodine back to iodide ions.

Show that the results calculated from the two experiments are consistent with your ionic half-equations.

(1)

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(e) (i) The uncertainty in each burette reading is ±0.05 cm^3 and the uncertainty in the volume reading for the pipette is ±0.04 cm^3. Calculate the percentage uncertainties for the first burette titre and for the pipette volume of 10.0 cm^3.

(2)

Burette uncertainty = ... %

Pipette uncertainty = ... %

(ii) Explain whether these uncertainties are significant in this experiment.

(1)

.....

.....

(Total for Question 3 = 16 marks)

4 A student investigates the oxidation of the alcohol, propan-1-ol.

(a) To oxidise propan-1-ol to form propanal, the following procedure is used.

- Place about 20 cm^3 of dilute sulfuric acid in a boiling tube.
- Add about 3 g of sodium dichromate(VI) and 2–3 anti-bumping granules.
- Shake the contents of the boiling tube until the solid is fully dissolved.
- Place about 1 cm^3 of propan-1-ol in a pear-shaped flask.
- Keep the pear-shaped flask cool and slowly add the contents of the boiling tube.
- Add the apparatus needed for immediate distillation of the product.
- Gently distil the product directly from the reaction mixture.

(i) Sodium dichromate(VI) is a carcinogen.

It is often supplied as a fine powder.

Suggest the particular hazard associated with the compound being a fine powder.

Give a suitable safety precaution.

(2)

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(ii) Explain why anti-bumping granules are added and how they work.

(2)

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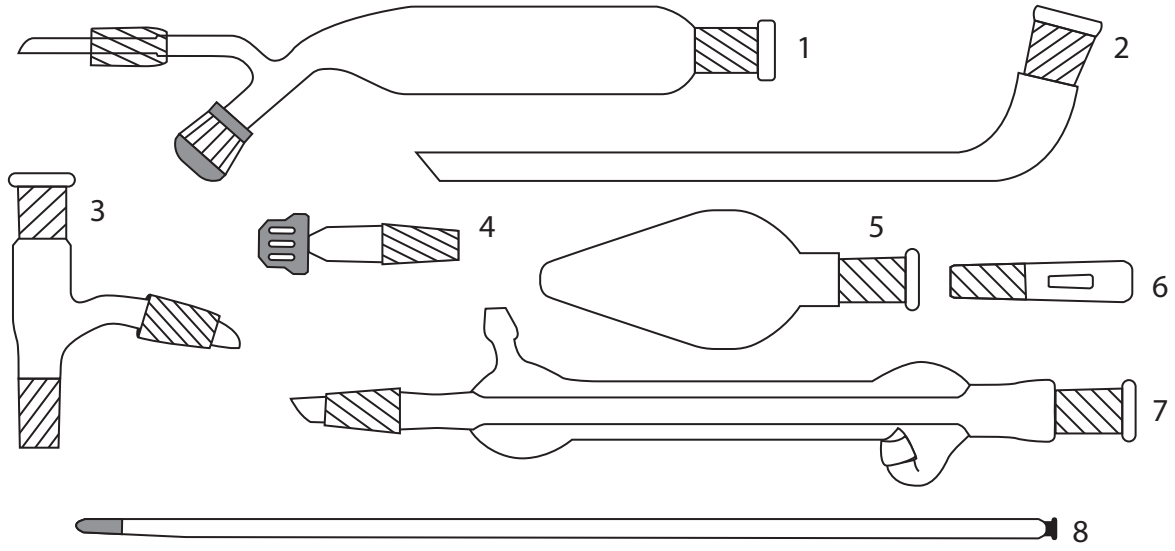
(iii) Select from the apparatus below, the apparatus you would use for distillation.



You should identify each piece of apparatus by number or name and state how you would connect them together for the preparation of propanal.

You should also name a suitable collecting vessel not shown above.

You should **not** draw a diagram.

(3)

(b) The oxidation of propan-1-ol to form propanoic acid is a reaction which involves two steps. These are heating under reflux and distillation.

Differences in the quantities and concentrations of the reactants are also involved, compared to the preparation of propanal.

(i) Give these differences in the quantities and concentrations of reactants. Precise amounts and concentrations are not required.

Justify your answer.

(2)

(ii) When carrying out the heating under reflux step, a Liebig condenser is used in the top of a pear-shaped flask.

State the direction of water flow in the reflux condenser and what will happen if the water flows in the wrong direction.

(1)

(iii) Explain why the condenser is needed in the reflux process and how it works.

(2)

(c) (i) Describe the appearance of propanal and of propanoic acid.

(1)

Propanal .....

Propanoic acid .....

(ii) Suggest a chemical test that would positively identify the functional group of each product after purification. Give the result of each test.

(4)

Test for propanal

Test for propanoic acid

(Total for Question 4 = 17 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
																	(18)
							1.0 H hydrogen 1										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									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

* 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