

Please check the examination details below before entering your candidate information

Candidate surname					Other names							
<b>Pearson Edexcel</b>					Centre Number				Candidate Number			
International Advanced Level					<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>				<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>			
<b>Tuesday 22 October 2019</b>												
Morning (Time: 1 hour 20 minutes)					Paper Reference <b>WCH13/01</b>							
<b>Chemistry</b>												
<b>International Advanced Subsidiary Level</b>												
<b>Unit 3: Practical Skills in Chemistry I</b>												
<b>Candidates must have: Scientific calculator</b>								Total Marks				
<b>Ruler</b>												

### 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.
- There is a Periodic Table on the back cover of this paper.

### Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- 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** A series of tests is carried out on a solid compound **A** and an aqueous solution **B**.

(a) Compound **A** contains one cation and one anion.

Complete the inferences.

(i) A flame test is carried out on **A**.

(1)

Observation	Inference
Yellow flame colour	The <b>formula</b> of the cation in <b>A</b> is .....

(ii) A small amount of solid **A** is placed in a test tube and heated strongly.  
A glowing splint is held in the mouth of the test tube.

(2)

Observation	Inference
The glowing splint relights	The gas formed is ..... The <b>formula</b> of the anion in <b>A</b> could be .....

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(b) A series of tests is carried out on aqueous solution **B**.

Complete the inferences.

(i) A piece of magnesium ribbon is added to 5 cm<sup>3</sup> of **B** in a test tube.

A lighted splint is held over the mouth of the test tube.

(2)

Observation	Inference
Bubbles of gas are given off	The gas is
The gas burns with a squeaky pop	..... The <b>formula</b> of the cation in <b>B</b> is .....

(ii) Silver nitrate solution acidified with dilute nitric acid is added to another 5 cm<sup>3</sup> of **B** in a test tube.

(2)

Observation	Inference
White precipitate forms	The name or formula of the precipitate is
	..... The name or formula of solution <b>B</b> is .....

(Total for Question 1 = 7 marks)

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2 Tests are carried out to identify three organic liquids, **C**, **D** and **E**.

(a) A spatula measure of phosphorus(V) chloride,  $\text{PCl}_5$ , is added to each liquid in separate test tubes.

Any gas given off is tested with damp blue litmus paper.

Observation		
<b>C</b>	<b>D</b>	<b>E</b>
Misty fumes are given off	Misty fumes are given off	No change
Damp blue litmus paper turns red	Damp blue litmus paper turns red	

Identify, by name or formula, the misty fumes produced by liquids **C** and **D**.

(1)

(b)  $2\text{ cm}^3$  of aqueous sodium carbonate,  $\text{Na}_2\text{CO}_3(\text{aq})$ , is added to each liquid in separate test tubes.

Any gas given off is tested with limewater.

Observation		
<b>C</b>	<b>D</b>	<b>E</b>
Bubbles of a colourless gas are given off	No change	No change
Limewater turns cloudy		

Identify, by name or formula, the gas produced by liquid **C**.

(1)

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(c) Each of the compounds **C**, **D** and **E** contains three carbon atoms and one functional group, which is on the end of the carbon chain.

(i) Using this information and the results from parts (a) and (b), deduce the structures of **C** and **D**.

(2)

Structure of <b>C</b>	Structure of <b>D</b>

(ii) The mass spectrum of **E** has a molecular ion peak at  $m/z = 58$ .

Using this information and the information in (c), deduce the structure of **E**.

(1)

Structure of <b>E</b>

(iii) Give a chemical test and its positive result to confirm the identity of the functional group in **E**.

(2)

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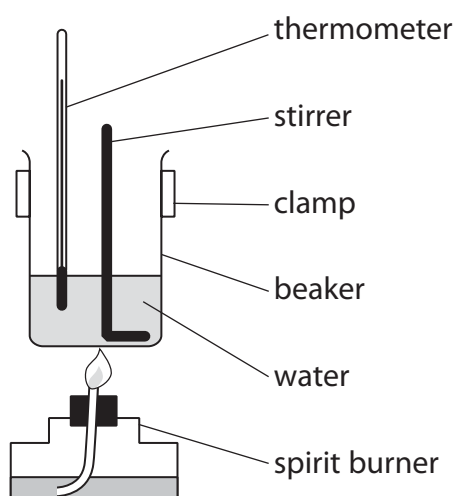
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- (d) The apparatus shown was used to find the enthalpy change of combustion of one of the liquids **C**, **D** or **E**.



- (i) List all the measurements you would make in carrying out this experiment. (3)

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- (ii) Give **two** ways, other than changing the measuring instruments or repeating the experiment, in which the accuracy of the results using this apparatus could be improved. (2)

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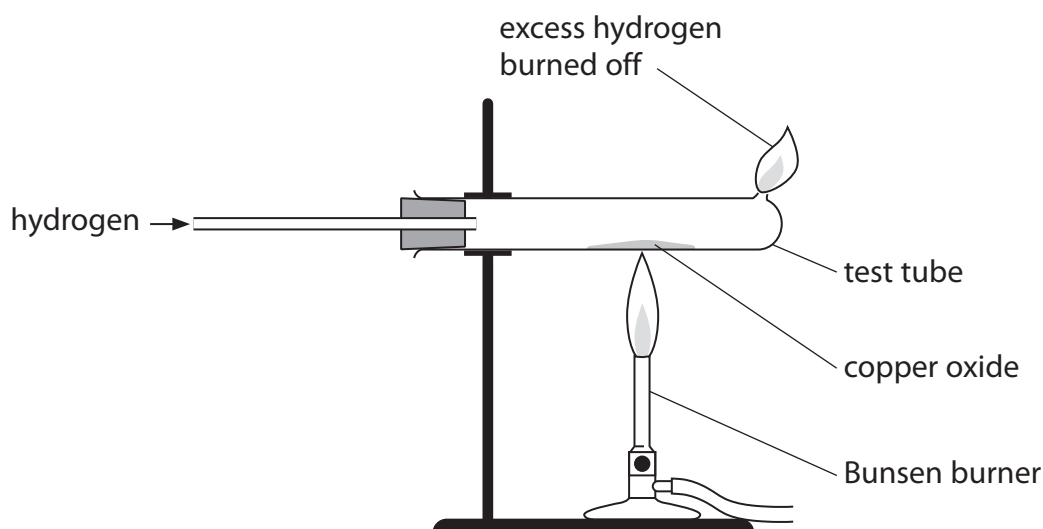
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(Total for Question 2 = 12 marks)



**3** An experiment is carried out to determine the formula of an oxide of copper.

A sample of the copper oxide is reduced to copper by hydrogen gas using the apparatus shown.



### Procedure

**Step 1** Weigh the empty test tube.

**Step 2** Place two spatula measures of copper oxide in the test tube and reweigh.

**Step 3** Pass hydrogen into the test tube and, after a delay of a few seconds, light the gas at the hole at the end of the test tube.

**Step 4** Start heating the copper oxide.

**Step 5** After the copper oxide has been completely reduced, turn off the Bunsen burner, but continue to pass hydrogen over the product until it has cooled down.

**Step 6** Weigh the test tube and copper.

(a) Give a reason why, in Step 3, there should be a delay of a few seconds before lighting the hydrogen at the end of the test tube.

(1)



(b) (i) Complete the table of results.

(1)

Measurement	Mass / g
Mass of test tube	40.27
Mass of test tube and copper oxide	43.42
Mass of test tube and copper	42.79
Mass of copper in copper oxide	
Mass of oxygen in copper oxide	

(ii) Use these results to calculate the formula of this copper oxide.

You must show your working.

[ $A_r$  values: Cu = 63.5 O = 16.0]

(3)





(c) The experiment was repeated. However, in Step 5, both the Bunsen burner and the hydrogen supply were turned off while the apparatus cooled.

- (i) State how the appearance of the solid in the test tube changes as the apparatus cools.

(1)

- (ii) Explain how this change in the procedure affects the calculated formula of the copper oxide.

(2)

**(Total for Question 3 = 8 marks)**

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4 An experiment is carried out to determine the molar mass of a solid acid,  $\text{H}_2\text{X}$ .

(a) Describe how  $250.0\text{ cm}^3$  of a standard solution should be prepared using a pre-weighed sample of  $1.13\text{ g}$  of  $\text{H}_2\text{X}$ .

(4)

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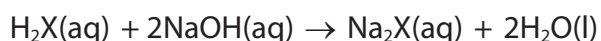
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(b)  $25.0\text{ cm}^3$  of this  $\text{H}_2\text{X}$  solution was pipetted into a conical flask and titrated with  $0.213\text{ mol dm}^{-3}$  sodium hydroxide solution.  
The equation for the reaction is



(i) The indicator used was phenolphthalein.

State the colour **change** at the end-point.

(1)

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## Results

Number of titration	1	2	3
Final burette reading / cm <sup>3</sup>	12.20	24.10	11.75
Initial burette reading / cm <sup>3</sup>	0.00	12.20	0.05
Volume of NaOH used / cm <sup>3</sup>	12.20	11.90	11.70

(ii) Using appropriate titrations, calculate the mean titre in cm<sup>3</sup>. (1)

(iii) Calculate the number of moles of H<sub>2</sub>X in the 250.0 cm<sup>3</sup> of solution. (3)

(iv) Calculate the molar mass of H<sub>2</sub>X, using your answer in (b)(iii) and the mass of H<sub>2</sub>X given. Give your answer to an appropriate number of significant figures. (2)

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(c) The maximum uncertainty **each** time a burette is read is  $\pm 0.05 \text{ cm}^3$ .

- (i) Calculate the percentage uncertainty in measuring the  $11.70 \text{ cm}^3$  of sodium hydroxide used in titration 3.

(1)

- (ii) The percentage uncertainties in the three titrations are similar.

Suggest how the percentage uncertainty in a burette measurement could be reduced, without changing the apparatus.  
Justify your answer.

(2)

(Total for Question 4 = 14 marks)



5 Limonene, an oil, can be extracted from oranges in four steps.

- (a) In Step 1, grated orange peel is added to some distilled water.  
The mixture is heated under reflux for about 10 minutes.

Draw a labelled diagram of the apparatus used to reflux the mixture.

(3)

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(b) In Step 2 the mixture from Step 1 is distilled. The distillate contains a mixture of limonene and water.

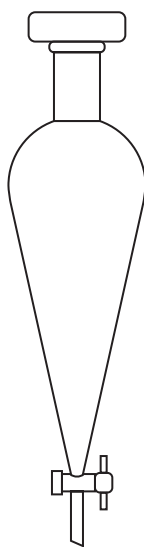
In Step 3 the limonene and water mixture from Step 2 is poured into a separating funnel and pentane is added.

Limonene is much more soluble in pentane than in water.

The density of pentane is  $0.626 \text{ g cm}^{-3}$

(i) Complete the diagram of the separating funnel by drawing the aqueous and pentane layers and labelling them.

(1)



(ii) Describe how the separating funnel is used to obtain the pentane layer.

(2)

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- (c) In Step 4 the pentane is allowed to evaporate in a fume cupboard, leaving limonene.

150 mg of limonene is produced from 23.0 g of orange peel.

Calculate the percentage of limonene, by mass, extracted from the orange peel.

(1)

- (d) 0.001 mol of limonene decolourised 0.32 g of bromine, Br<sub>2</sub>.

Explain what these results tell you about the structure of limonene.

[Use  $M_r(\text{Br}_2) = 160$ ]

(2)

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**(Total for Question 5 = 9 marks)**

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**TOTAL FOR PAPER = 50 MARKS**

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# The Periodic Table of Elements

1	2	3	4	5	6	7	0 (8)						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)						
6.9 <b>Li</b> lithium 3	9.0 <b>Be</b> beryllium 4	23.0 <b>Na</b> sodium 11	24.3 <b>Mg</b> magnesium 12	39.1 <b>K</b> potassium 19	40.1 <b>Ca</b> calcium 20	85.5 <b>Rb</b> rubidium 37	87.6 <b>Sr</b> strontium 38	132.9 <b>Cs</b> caesium 55	137.3 <b>Ba</b> barium 56	223 <b>Fr</b> francium 87	226 <b>Ra</b> radium 88	283 <b>Ac*</b> actinium 89	287 <b>Lr*</b> lawrencium 103
1.0 <b>H</b> hydrogen 1	4.0 <b>He</b> helium 2	10.8 <b>B</b> boron 5	12.0 <b>C</b> carbon 6	14.0 <b>N</b> nitrogen 7	16.0 <b>O</b> oxygen 8	19.0 <b>F</b> fluorine 9	20.2 <b>Ne</b> neon 10	27.0 <b>Al</b> aluminium 13	28.1 <b>Si</b> silicon 14	31.0 <b>P</b> phosphorus 15	32.1 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17	39.9 <b>Ar</b> argon 18
50.9 <b>V</b> vanadium 23	51.0 <b>Cr</b> chromium 24	54.9 <b>Mn</b> manganese 25	55.8 <b>Fe</b> iron 26	58.9 <b>Co</b> cobalt 27	58.7 <b>Ni</b> nickel 28	63.5 <b>Cu</b> copper 29	65.4 <b>Zn</b> zinc 30	69.7 <b>Ga</b> gallium 31	72.6 <b>Ge</b> germanium 32	74.9 <b>As</b> arsenic 33	79.0 <b>Se</b> selenium 34	79.9 <b>Br</b> bromine 35	83.8 <b>Kr</b> krypton 36
91.2 <b>Ti</b> titanium 22	92.9 <b>Nb</b> niobium 41	95.9 <b>Mo</b> molybdenum 42	101.1 <b>Ru</b> ruthenium 44	102.9 <b>Rh</b> rhodium 45	106.4 <b>Pd</b> palladium 46	107.9 <b>Ag</b> silver 47	112.4 <b>Cd</b> cadmium 48	114.8 <b>In</b> indium 49	118.7 <b>Sn</b> tin 50	121.8 <b>Sb</b> antimony 51	127.6 <b>Te</b> tellurium 52	126.9 <b>I</b> iodine 53	131.3 <b>Xe</b> xenon 54
47.9 <b>Ti</b> titanium 22	48.9 <b>V</b> vanadium 23	50.9 <b>Cr</b> chromium 24	54.9 <b>Mn</b> manganese 25	58.9 <b>Co</b> cobalt 27	58.7 <b>Ni</b> nickel 28	63.5 <b>Cu</b> copper 29	65.4 <b>Zn</b> zinc 30	69.7 <b>Ga</b> gallium 31	72.6 <b>Ge</b> germanium 32	74.9 <b>As</b> arsenic 33	79.0 <b>Se</b> selenium 34	79.9 <b>Br</b> bromine 35	83.8 <b>Kr</b> krypton 36
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138.9 <b>La*</b> lanthanum 57	178.5 <b>Hf</b> hafnium 72	180.9 <b>Ta</b> tantalum 73	183.8 <b>W</b> tungsten 74	186.2 <b>Re</b> rhenium 75	190.2 <b>Os</b> osmium 76	197.0 <b>Au</b> gold 79	200.6 <b>Hg</b> mercury 80	204.4 <b>Tl</b> thallium 81	207.2 <b>Pb</b> lead 82	209.0 <b>Bi</b> bismuth 83	209.0 <b>Po</b> polonium 84	210 <b>At</b> astatine 85	222 <b>Rn</b> radon 86
140 <b>Ce</b> cerium 58	141 <b>Pr</b> praseodymium 59	144 <b>Nd</b> neodymium 60	150 <b>Sm</b> samarium 62	152 <b>Eu</b> europium 63	157 <b>Gd</b> gadolinium 64	159 <b>Tb</b> terbium 65	163 <b>Dy</b> dysprosium 66	165 <b>Ho</b> holmium 67	167 <b>Er</b> erbium 68	169 <b>Tm</b> thulium 69	173 <b>Yb</b> ytterbium 70	175 <b>Lu</b> lutetium 71	
232 <b>Th</b> thorium 90	231 <b>Pa</b> protactinium 91	238 <b>U</b> uranium 92	242 <b>Pu</b> plutonium 94	243 <b>Am</b> americium 95	247 <b>Cm</b> curium 96	245 <b>Bk</b> berkelium 97	251 <b>Cf</b> californium 98	254 <b>Es</b> einsteinium 99	253 <b>Fm</b> fermium 100	256 <b>Md</b> mendelevium 101	254 <b>No</b> nobelium 102	257 <b>Lr</b> lawrencium 103	

Elements with atomic numbers 112-116 have been reported but not fully authenticated

\* Lanthanide series  
\* Actinide series

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