Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International Advanced Level

Centre Number | Candidate Number

Tuesday 22 October 2019

Morning (Time: 1 hour 20 minutes) | Paper Reference **WCH13/01**

Chemistry

International Advanced Subsidiary Level
Unit 3: Practical Skills in Chemistry I

Candidates must have: Scientific calculator
Ruler

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.
- 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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Pearson

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 **formula** of the cation in **A** 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 **formula** of the anion in **A** could be ....

(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^3 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 burns with a squeaky pop	The gas is .... The **formula** of the cation in **B** is ....

(ii) Silver nitrate solution acidified with dilute nitric acid is added to another 5 cm^3 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** is ....

(Total for Question 1 = 7 marks)

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

(a) A spatula measure of phosphorus(V) chloride, PCl_5, is added to each liquid in separate test tubes.
Any gas given off is tested with damp blue litmus paper.

Observation		
C	**D**	**E**
Misty fumes are given off Damp blue litmus paper turns red	Misty fumes are given off Damp blue litmus paper turns red	No change

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

(1)

....

(b) 2 cm^3 of aqueous sodium carbonate, $Na_2CO_3(aq)$, is added to each liquid in separate test tubes.
Any gas given off is tested with limewater.

Observation		
C	**D**	**E**
Bubbles of a colourless gas are given off Limewater turns cloudy	No change	No change

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

(1)

....

(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 **C**	Structure of **D**

(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 **E**

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

(2)

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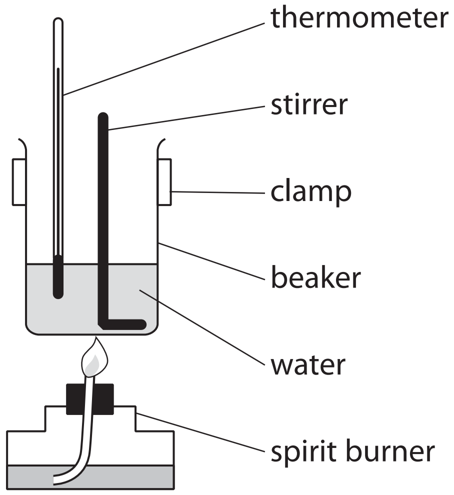
....

(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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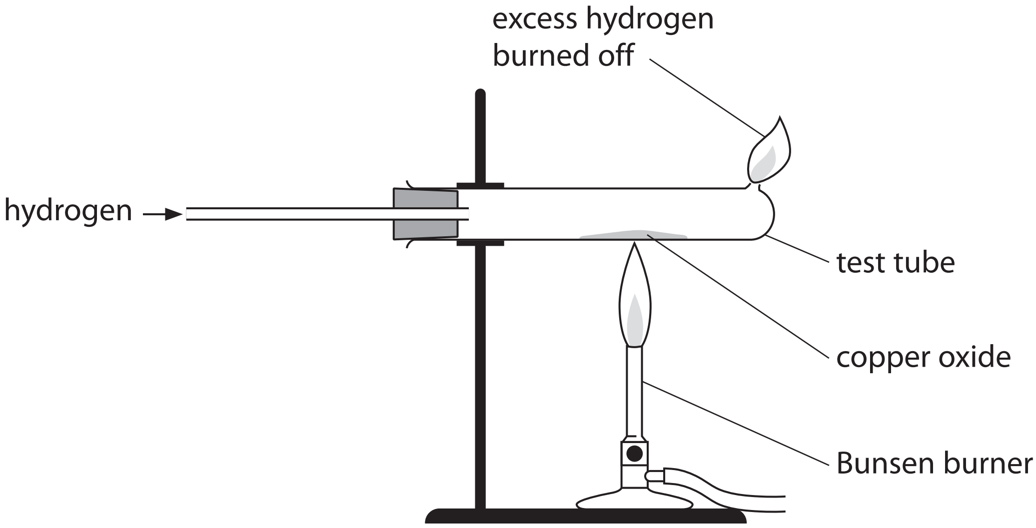
(Total for Question 2 = 12 marks)

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)

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

(2)

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(Total for Question 3 = 8 marks)

4 An experiment is carried out to determine the molar mass of a solid acid, H_2X.

(a) Describe how 250.0 cm^3 of a standard solution should be prepared using a pre-weighed sample of 1.13 g of H_2X.

(4)

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(b) 25.0 cm^3 of this H_2X solution was pipetted into a conical flask and titrated with 0.213 mol dm^{-3} sodium hydroxide solution.
The equation for the reaction is

$$H_2X(aq) + 2NaOH(aq) \rightarrow Na_2X(aq) + 2H_2O(l)$$

(i) The indicator used was phenolphthalein.

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

(1)

....

Results

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

(ii) Using appropriate titrations, calculate the mean titre in cm^3.

(1)

(iii) Calculate the number of moles of H_2X in the 250.0 cm^3 of solution.

(3)

(iv) Calculate the molar mass of H_2X, using your answer in (b)(iii) and the mass of H_2X given.
Give your answer to an appropriate number of significant figures.

(2)

(c) The maximum uncertainty **each** time a burette is read is ± 0.05 cm^3.

(i) Calculate the percentage uncertainty in measuring the 11.70 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)

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....

(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)

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

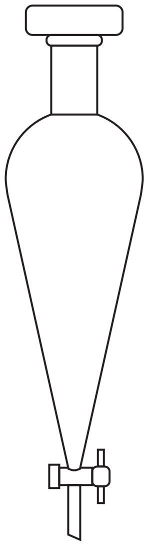
In Step **3** the limonene and water mixture from Step **2** is poured into a separating funnel and pentane is added.

Limonene is much more soluble in pentane than in water.

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

(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_2.

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

[Use M_r (Br_2) = 160]

(2)

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(Total for Question 5 = 9 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

Key

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

1	2											3	4	5	6	7	0 (8)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(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