Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 20 minutes

Paper reference **WCH16/01**

Chemistry

International Advanced Level
UNIT 6: Practical Skills in Chemistry II

You must have:
Scientific calculator, ruler

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

Turn over ▶

P71874A

Q:1/1/1/1/1/

P 7 1 8 7 4 A 0 1 1 6

Pearson

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

1 A student investigates two aqueous solutions, each containing a salt.
Each salt has one cation and one anion.
Solution **A** is blue. Solution **B** is orange.

Solution	Observation when aqueous sodium hydroxide is added	Observation when dilute nitric acid and aqueous silver nitrate are added
A	blue precipitate insoluble in excess sodium hydroxide	white precipitate in a blue solution
B	solution changes from orange to yellow gas evolved on warming which turns damp red litmus paper blue	red precipitate

(a) (i) Identify, by name or formula, the salt in **A**.

(2)

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(ii) The white precipitate is separated from the solution.

Give a test on the precipitate and its positive result to confirm the identity of the anion in **A**.

(2)

Test

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Result

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(b) (i) Identify, by name or formula, the gas given off when **B** is warmed with aqueous sodium hydroxide.

(1)

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(ii) Give the **formulae** of the ions of the salt in **B**.

(2)

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(Total for Question 1 = 7 marks)

2 A student is asked to identify three colourless liquids labelled **C**, **D** and **E**.
The compounds are all non-cyclic isomers with the formula $C_5H_{10}O$.

(a) (i) The student carries out three tests on separate samples of each compound.

Complete Table **1** to show the observations that the student makes.

(3)

	Observations on addition of reagents			
Sample	2,4-dinitro phenylhydrazine (Brady's reagent)	Fehling's or Benedict's solution and warm	I_2(aq) and NaOH(aq) and warm	Functional group
C	orange precipitate			$R\text{-}COCH_3$
D			pale yellow precipitate antiseptic smell	$R\text{-}CH(OH)CH_3$
E	orange precipitate			R-CHO

Table **1**

(ii) Identify, by name or formula, the pale yellow precipitate that forms when iodine and sodium hydroxide are added to a sample of **D**.

(1)

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(b) (i) The orange precipitates produced on the addition of Brady's reagent to samples of **C** and **E** are called derivatives.
The melting temperatures of derivatives are used to confirm the identity of compounds.

Solids are recrystallised so that their melting temperatures may be determined accurately.

Describe in outline the procedure for the recrystallisation of a solid.

(4)

(ii) The melting temperatures of the derivatives of the reaction of Brady's reagent with some aldehydes and ketones are shown.

Carbonyl compound	Melting temperature of the derivative / °C
3-methylbutanal	123
2-ethylbutanal	134
pentan-2-one	144
cyclopentanone	146
pentan-3-one	156

Table **2**

The melting temperature of the recrystallised derivative of sample **C** is found to be 138–140 °C.

Suggest the identity of compound **C**.
Justify your choice, using the information at the start of the question and the data in Tables **1** and **2**.

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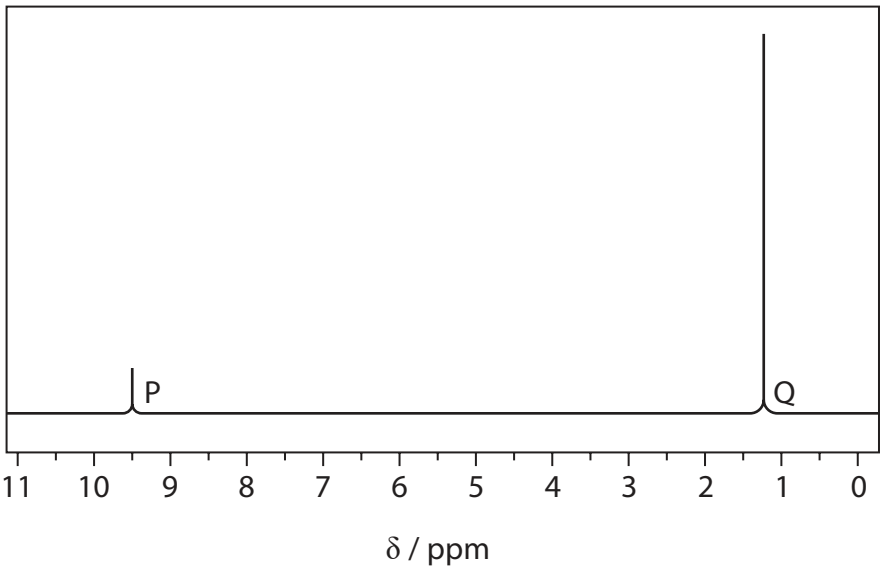
(c) The **high** resolution proton NMR spectrum of **E** is shown.



The relative numbers of protons responsible for the singlet peaks shown are P = 1 and Q = 9.

Use this information and the results of the tests in (a) to draw the displayed formula of **E**, labelling the proton environments.

(2)

(Total for Question 2 = 12 marks)

3 Brass is an alloy of copper. The percentage by mass of copper in a sample of brass can be determined by a three-stage process.

Stage **1** Oxidation of the copper to copper(II) ions with excess concentrated nitric acid.

Stage **2** Reduction of the copper(II) ions to copper(I) ions with excess iodide ions.

Stage **3** Titration of the iodine produced in Stage **2** against a standard solution of sodium thiosulfate.

(a) In Stage **1**, 2.53 g of brass is carefully warmed with 25 cm^3 concentrated nitric acid in a 250 cm^3 beaker.

The equation for the oxidation of copper metal by nitric acid is shown.

$$Cu(s) + 4H^+(aq) + 2NO_3^-(aq) \rightarrow Cu^{2+}(aq) + 2NO_2(g) + 2H_2O(l)$$

(i) State two hazards in this experiment, giving the precautions you would take to minimise the risk associated with each hazard.
Assume safety spectacles and a laboratory coat are worn.

(2)

(ii) State what would be **seen** during the reaction.

(2)

(iii) Excess nitric acid must be neutralised before the iodide ions are added in Stage **2**.

Sodium carbonate solution is slowly added to the cooled solution. The solution is neutralised when a faint precipitate appears.

Suggest why the solution is cooled before the addition of the sodium carbonate solution.

(1)

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(iv) Ethanoic acid solution is added, drop by drop, to the neutralised mixture until the precipitate redissolves.

Describe how the solution in the beaker should then be made into 250.0 cm^3 of a homogeneous solution before Stage **2**.

(3)

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(b) In Stage **2**, 25.0 cm^3 portions of the solution from Stage **1** are transferred into conical flasks.
10 cm^3 of a solution of potassium iodide is added to each flask and the mixtures are swirled. Copper(I) iodide is precipitated.

The redox equation for the reaction between copper(II) ions and iodide ions is shown.

$$2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq)$$

The standard electrode potentials for the half-equations are

Reduction	$Cu^{2+} + e^- \rightleftharpoons Cu^+$	$E^{\ominus} = +0.15\,V$
Oxidation	$I_2 + 2e^- \rightleftharpoons 2I^-$	$E^{\ominus} = +0.54\,V$

(i) Use the electrode potential data to explain why the redox reaction might not be expected to be feasible.

(2)

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(ii) Explain why the redox reaction does, in fact, take place.

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(c) The procedure in Stage **3** is shown:

- the iodine produced in each flask from Stage **2** is titrated with 0.095 mol dm^{-3} sodium thiosulfate solution until the iodine colour is pale yellow
- a few drops of starch indicator are added
- sodium thiosulfate is added drop by drop with swirling until the end-point is reached
- the titration is repeated until two concordant titres are obtained.

(i) Give a possible reason why the starch indicator is added when the iodine colour is pale yellow rather than at the start of the titration.

(1)

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(ii) Give the colour **change** at the end-point of the reaction.

(1)

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(iii) The results of the titration are shown.

Titration number	1	2	3
Final burette reading / cm^3	27.05	28.65	27.45
Initial burette reading / cm^3	0.00	2.00	1.00
Titre / cm^3	27.05	26.65	

Complete the table and calculate the mean titre of the concordant results.

(1)

(iv) The redox equation for the reaction between copper(II) ions and iodide ions is shown.

$$2Cu^{2+}(aq) + 4I^{-}(aq) \rightarrow 2CuI(s) + I_2(aq)$$

The reaction of sodium thiosulfate solution with iodine is shown.

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

Calculate the percentage by mass of copper in the 2.53 g of brass.

[A_r Cu = 63.5]

(3)

(v) Nitric acid reacts with iodide ions to form iodine.

In another experiment the nitric acid was **not** neutralised before the start of Stage **2**.

Explain the effect on the value obtained for the percentage of copper in the sample.

(2)

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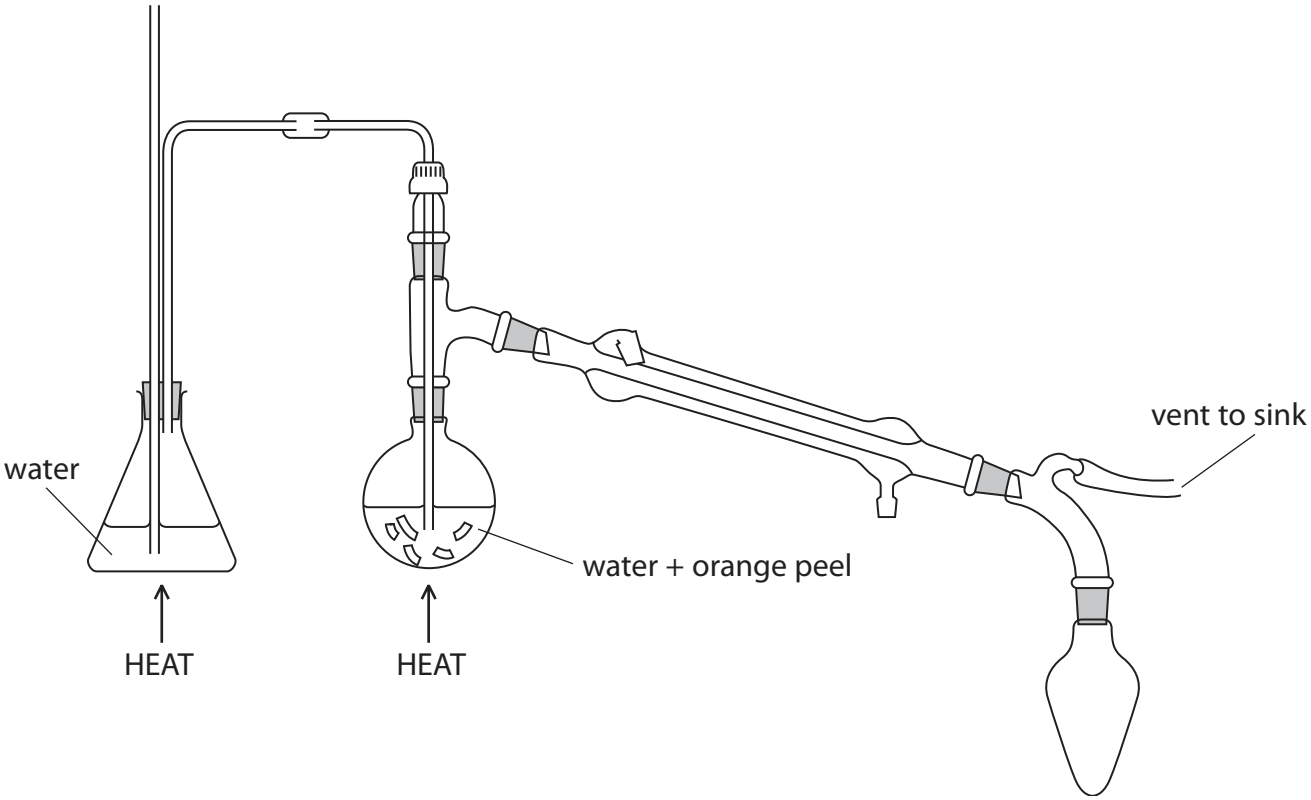
(Total for Question 3 = 20 marks)

4 Limonene is a liquid hydrocarbon which has a boiling temperature of 176 °C and a density of 0.851 g cm^3.

It can be obtained from orange peel using steam distillation.

The distillation apparatus is shown.



(a) (i) Label the diagram to show the direction of the water flow in the condenser.

(1)

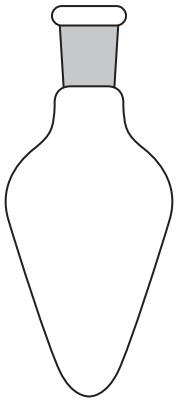
(ii) Give a reason for using steam distillation to extract limonene.

(1)

(iii) The distillate may be collected in a pear-shaped flask.

Complete a labelled diagram showing the distillate.
You should show clearly the limonene layer.

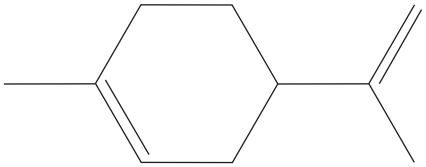
(1)



(b) Limonene exists as optical isomers.

(i) Identify the chiral carbon on the diagram.

(1)



(ii) The limonene extracted from orange peel is D-limonene.

State how the presence of a single optical isomer could be confirmed, naming the apparatus used. No experimental details are required.

(2)

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(iii) A student obtained 1.20 cm^3 of limonene.

Calculate the amount, in moles, of limonene produced.

(3)

(c) Limonene reacts with acidified potassium manganate(VII).

(i) Give the colour change for this reaction.

(1)

(ii) Draw the structure of the organic product which might be expected when **excess** acidified potassium manganate(VII) reacts with limonene.

(1)

(Total for Question 4 = 11 marks)

TOTAL FOR PAPER = 50 MARKS

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