Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 19 January 2026

Afternoon (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.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 ▶

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

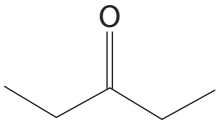
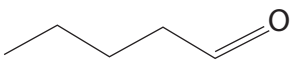
1 This question is about different tests used to distinguish substances.

(a) For each of the pairs of substances, give one **chemical** test that could be used to distinguish between them.

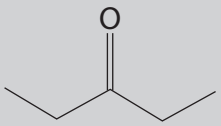
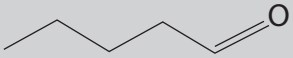
(i) $Fe^{2+}(aq)$ and $Cr^{3+}(aq)$

(3)

Test	Result for $Fe^{2+}(aq)$	Result for $Cr^{3+}(aq)$

(ii)  and 

(3)

Test	Result for 	Result for 

(iii) CH_3CHO and CH_3CH_2CHO

(3)

Test	Result for CH_3CHO	Result for CH_3CH_2CHO

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(b) Complete the table to show how you could use **low resolution** proton NMR spectroscopy to distinguish between 2-methylpropan-2-ol and butan-2-ol.

(2)

	2-methylpropan-2-ol	butan-2-ol
Number of peaks		
Relative peak areas		

(Total for Question 1 = 11 marks)

2 This question is about the carboxylic acid, ethanoic acid, CH_3COOH.

(a) Ethanoic acid can be made by oxidising ethanol with acidified potassium dichromate(VI) solution.

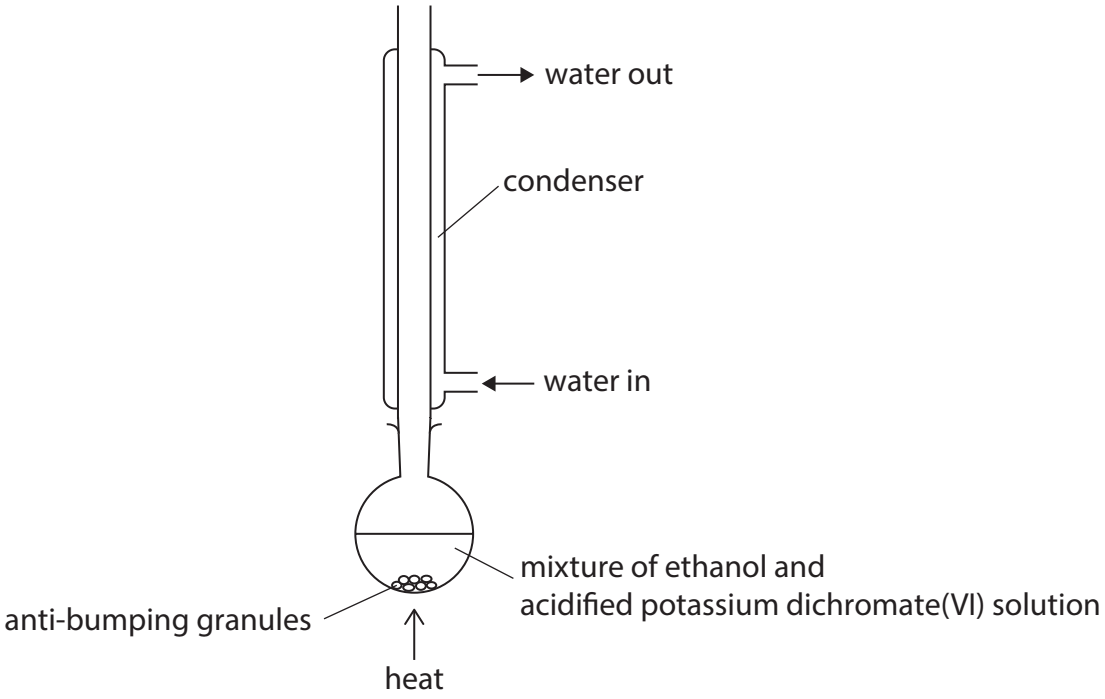
(i) State the colour change during this oxidation reaction.

(1)

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(ii) The mixture is heated under reflux using the apparatus shown.



Explain how the condenser works **and** why it is important in this reaction.

(2)

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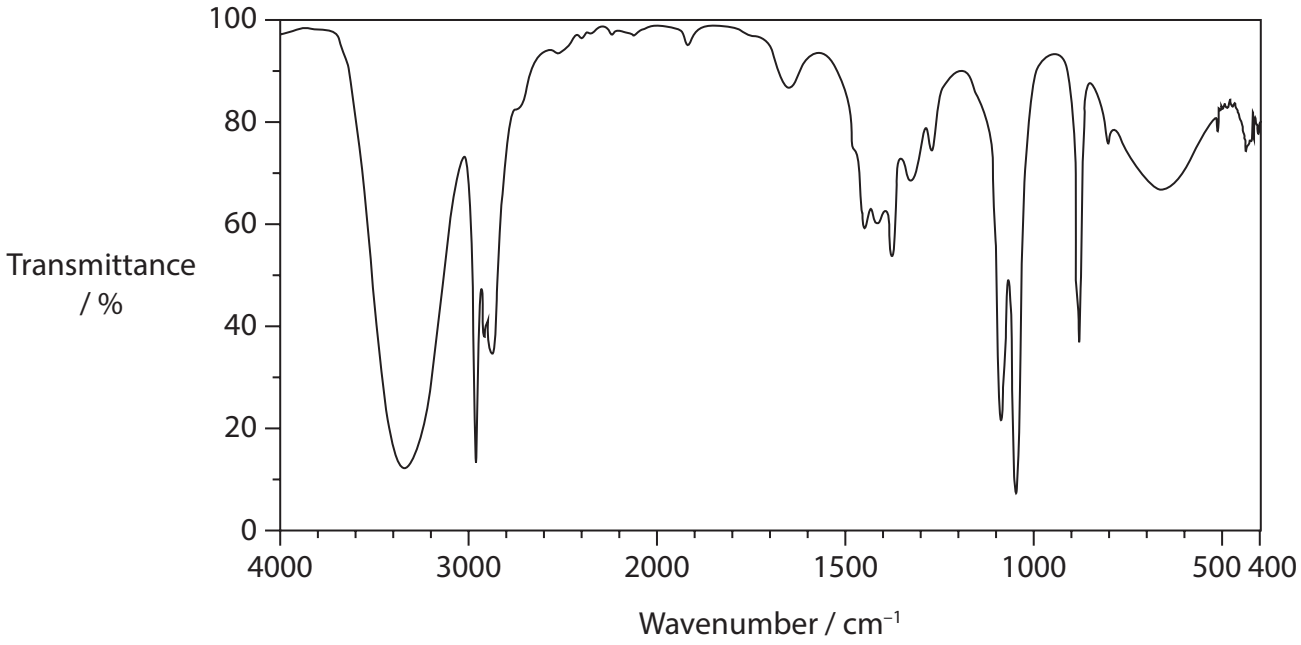
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(iii) The infrared spectrum of the ethanol is shown.



Absorption data

O—H stretching vibrations in alcohols	3750 – 3200 cm^{-1}
O—H stretching vibrations in carboxylic acids	3300 – 2500 cm^{-1}
C═O stretching vibrations in aldehydes	1740 – 1720 cm^{-1}
C═O stretching vibrations in carboxylic acids	1725 – 1700 cm^{-1}

Describe how the infrared spectrum of ethanoic acid would differ from that of ethanol.
Include the bonds and absorption data to justify your answer.

(2)

(b) An experiment was carried out to determine the acid dissociation constant, K_a, for ethanoic acid.

Procedure

Step **1** 20.0 cm^3 of a 0.100 mol dm^{-3} solution of ethanoic acid was placed in a conical flask.

Step **2** A burette was washed with distilled water and then rinsed with a 0.100 mol dm^{-3} solution of sodium hydroxide. The burette was then filled with this solution of sodium hydroxide.

Step **3** A pH probe was placed in the conical flask and portions of the sodium hydroxide solution were added with swirling.

Step **4** After each addition of sodium hydroxide solution, the pH of the mixture was recorded.

Step **5** A graph of pH against the volume of sodium hydroxide solution added was plotted.

(i) Name the most suitable piece of apparatus to measure the 20.0 cm^3 of ethanoic acid in Step **1**.

(1)

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(ii) State why the burette was rinsed with the 0.100 mol dm^{-3} solution of sodium hydroxide after washing with distilled water in Step **2**.

(1)

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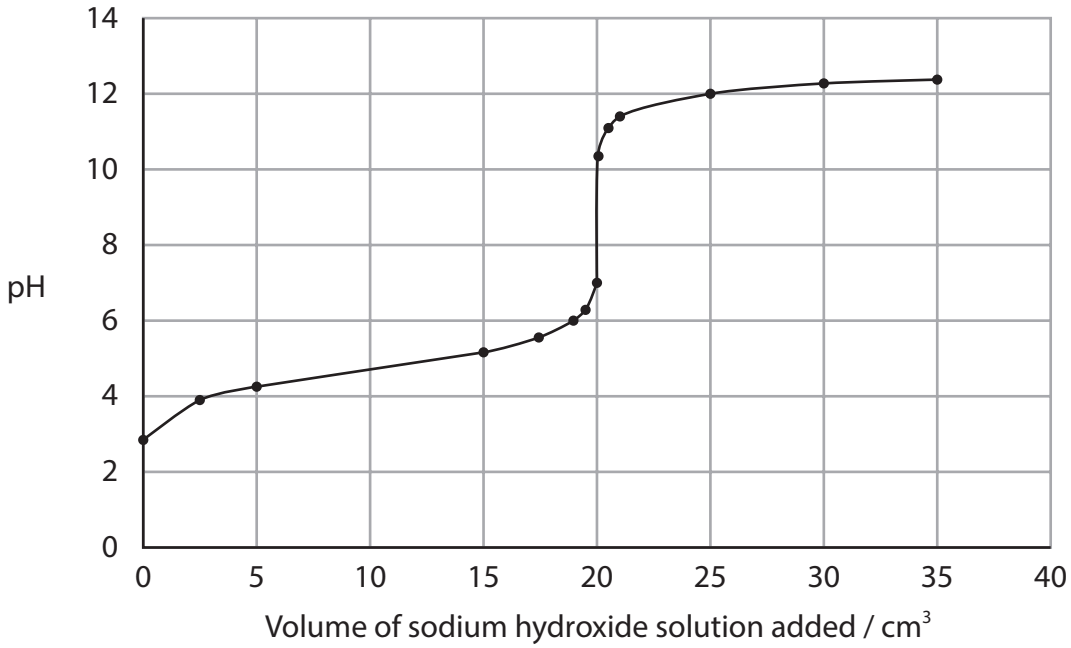
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(c) The graph of pH against the volume of sodium hydroxide solution added is shown.



(i) Suggest why the sodium hydroxide solution is not added in equal portions during the experiment.

(1)

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(ii) Calculate a K_a value for ethanoic acid, justifying your answer.

(3)

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(d) Propyl ethanoate can be made from ethanoic acid.

(i) Name the reagents and reaction conditions for this preparation.

(2)

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(ii) Write an equation for this reaction.
State symbols are not required.

(1)

(Total for Question 2 = 14 marks)

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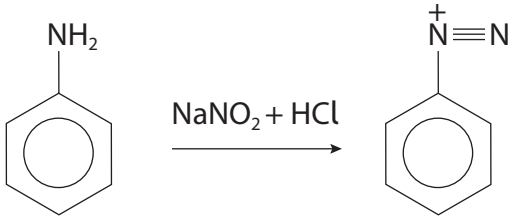
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3 This question is about the preparation of the azo dye 4-hydroxyazobenzene.

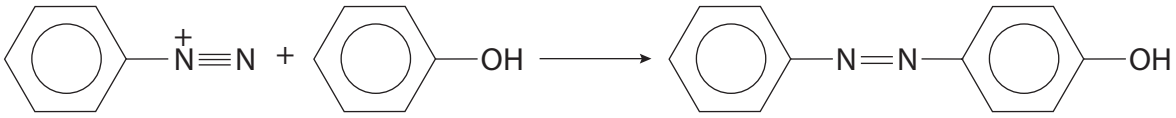
Procedure

Step **1** 10 cm^3 of phenylamine was dissolved in 10 cm^3 of hydrochloric acid and the mixture cooled.

Step **2** An aqueous solution of sodium nitrite, $NaNO_2$, was added to the mixture from Step **1**, forming a diazonium ion.



Step **3** 1.1 g of phenol was dissolved in 10 cm^3 of dilute sodium hydroxide and this mixture was added to the diazonium ion, forming the azo dye 4-hydroxyazobenzene.



diazonium ion phenol azo dye 4-hydroxyazobenzene

Step **4** The impure 4-hydroxyazobenzene was purified by recrystallisation.

(a) (i) The reaction in Step **2** is exothermic and the diazonium ion is very unstable and breaks down if the temperature exceeds 10 °C.

Explain how the reaction in Step **2** should be carried out in order to keep the temperature below 10 °C.

(3)

(ii) If the temperature is allowed to rise above 10 °C, the diazonium ion reacts with water to form phenol as well as an unreactive gas and one other product.

Use this information to write the equation for this reaction.
State symbols are not required.

(2)

(b) The process of recrystallisation in Step **4** involves

- dissolving the impure 4-hydroxyazobenzene in the minimum volume of hot solvent
- filtering the solution whilst hot
- cooling the filtrate to produce crystals of 4-hydroxyazobenzene
- vacuum filtering to isolate the crystals of 4-hydroxyazobenzene
- washing the crystals of 4-hydroxyazobenzene with cold solvent and drying them.

(i) Explain what properties the solvent must have to make it suitable for the recrystallisation of 4-hydroxyazobenzene.

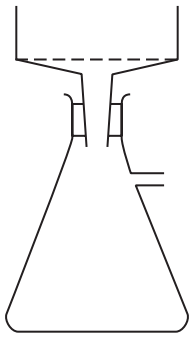
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(ii) Complete the diagram of the apparatus used for vacuum filtration.
Include labels.

(2)



(iii) Explain why the crystals of 4-hydroxyazobenzene are washed with **cold** solvent.

(2)

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(iv) State how the melting temperature can be used to show the purity of the 4-hydroxyazobenzene after recrystallisation.

(1)

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(Total for Question 3 = 12 marks)

4 A group of students carried out an experiment to identify the metal, M, in a crystalline hydrated d-block metal nitrate, $M(NO_3)_2 \cdot 6H_2O$.

On heating the hydrated metal nitrate, the water of crystallisation is driven off first and then the metal nitrate thermally decomposes.

$$M(NO_3)_2 \cdot 6H_2O(s) \rightarrow M(NO_3)_2(s) + 6H_2O(g)$$

$$M(NO_3)_2(s) \rightarrow MO(s) + 2NO_2(g) + \tfrac{1}{2}O_2(g)$$

Procedure

Step **1** A weighed sample of the hydrated metal nitrate was placed in a pre-weighed test tube.

Step **2** The test tube was heated until only the anhydrous metal oxide remained.

Step **3** The test tube and contents were allowed to cool and then reweighed.

(a) Give **two** observations that would be made during heating.

(2)

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(b) The students suggested two methods to ensure that the hydrated metal nitrate had lost all its water of crystallisation and thermally decomposed completely.

Method **1** Heat the test tube containing the hydrated metal nitrate and weigh the test tube and contents every 2 minutes. Stop heating when the mass does not change.

Method **2** Whilst heating the test tube containing the hydrated metal nitrate, test for oxygen gas being given off in the mouth of the test tube. Stop heating when the test is negative.

One of the hazard warning signs for the metal nitrate is shown.



(i) Identify the hazard indicated by the sign.

(1)

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(ii) Describe the test, with the positive result, for oxygen.

(1)

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(iii) Suggest a reason why Method **2** could potentially be dangerous by referring to the hazard in (b)(i).

(2)

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(c) In an experiment, 2.16 g of hydrated metal nitrate was heated. The combined total volume of NO_2 and O_2 produced was 436 cm^3, at room temperature and pressure (r.t.p.).

$$M(NO_3)_2 \cdot 6H_2O(s) \rightarrow MO(s) + 2NO_2(g) + \tfrac{1}{2}O_2(g) + 6H_2O(g)$$

(i) Calculate the relative atomic mass of M.

[Data: The molar volume of gas at r.t.p. = 24 dm^3]

(5)

(ii) Metal M is a d-block element.

Suggest the identity of metal M and the colour of the hydrated metal nitrate crystals.

(2)

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(Total for Question 4 = 13 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
							1.0 H hydrogen 1										(18) 4.0 He helium 2
(1)	(2)		Key: relative atomic mass / atomic symbol / name / atomic (proton) number									(13)	(14)	(15)	(16)	(17)	
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	(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

* Actinide 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
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

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