

Write your name here

Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Thursday 28 January 2016 – Afternoon

Time: 1 hour 15 minutes

Paper Reference

WCH06/01

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 ►

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PEARSON

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

1 The inorganic salt **A** has one cation and one anion. Complete the table below.

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	Test	Observations	Inferences	
(a)	Observe the appearance of A	A is a brown powder	The part of the Periodic Table in which the metal element in A is likely to be found is	(1)
(b)	Dissolve A in the minimum volume of concentrated hydrochloric acid	A yellow solution forms	The formula of the cation in A could be	(1)
(c)	Gradually dilute a portion of the solution from (b) with distilled water	The yellow solution turns dark green then pale blue	The formula of the cation in A is confirmed as	(1)
(d)	Place a sample of solid A in a test tube and heat it strongly	A pale green gas is evolved which turns damp blue litmus paper red and then bleaches it A white solid residue remains	The gas is So the anion in A is	(2)
(e)	Add dilute hydrochloric acid to the white solid obtained in (d) Shake the mixture vigorously	A colourless solution forms The colourless solution turns blue	The white solid is The type of reaction which results in the change from colourless to blue is	(2)



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(f) Suggest a further test to confirm the identity of the cation in **A**. Give the result of the test.

(2)

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(g) Suggest a test to confirm the identity of the anion in **A**. Give the result of the test.

(2)

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(h) Give the formulae of the ions that give the yellow colour to the solution described in (b), and the green colour to the solution described in (c).

(2)

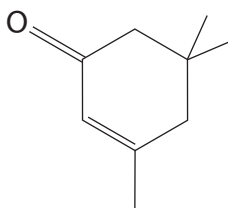
Yellow colour

Green colour

(Total for Question 1 = 13 marks)



- 2 Isophorone is a colourless liquid with a peppermint smell, found in cranberries. The structure of isophorone is shown below.



- (a) There are two functional groups present in isophorone.

Name these functional groups and describe a **chemical** test and its result that could be used to identify each functional group.

(4)

Functional group	Test	Result

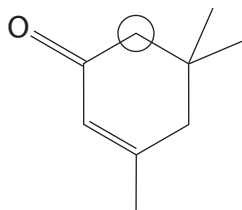
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- (b) Isophorone has several proton environments that would produce peaks in its proton nuclear magnetic resonance (nmr) spectrum. One of the environments is circled on the structure of isophorone shown below.



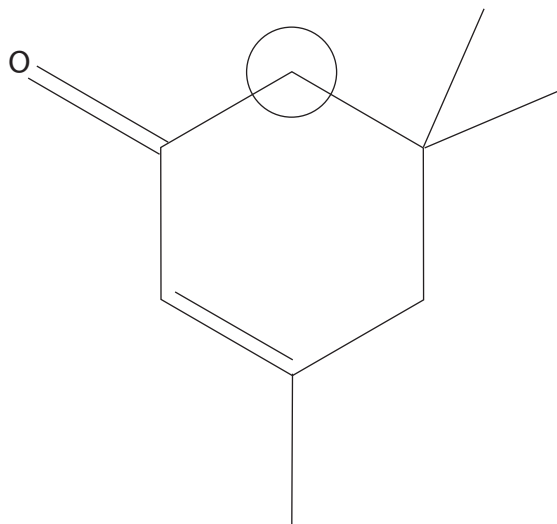
- (i) The circled proton environment produces a peak in the low resolution nmr spectrum.

State and explain the splitting pattern that you would expect in this peak in the **high** resolution proton nmr spectrum of the molecule.

(1)

- (ii) On the structure of isophorone shown below, circle each of the other proton environments that would produce a peak in the **low** resolution proton nmr spectrum of the molecule. Indicate clearly if any of the proton environments are identical.

(2)



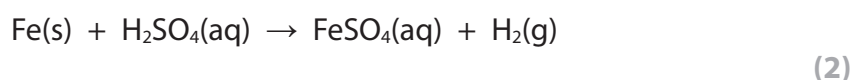
(Total for Question 2 = 7 marks)



3 This question is about a student experiment to prepare crystals of iron(II) sulfate-7-water ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) and then to determine the number of moles of water of crystallization in the sample which they have prepared.

(a) Each student was given 5.00 g of iron filings which was added to excess dilute sulfuric acid, warmed and allowed to stand until no further reaction occurred. The resulting solution was cooled and filtered, and the required crystals were obtained from the filtrate.

(i) Calculate the minimum volume of dilute sulfuric acid of concentration 2.00 mol dm^{-3} required to react completely with 5.00 g of pure iron filings. The equation for this reaction is



(ii) Why was the reaction mixture filtered? (1)

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(iii) Describe how pure crystals of iron(II) sulfate-7-water are obtained from the filtrate.

(2)

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(iv) One student obtained a yield of 89.5% from this preparation.

Taking the formula of the crystals as $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, calculate the mass of iron(II) sulfate-7-water obtained by this student. Assume that the iron filings were pure.

(3)

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(b) A second student dissolved 6.75 g of their prepared crystals in about 150 cm³ of dilute sulfuric acid in a beaker and used this solution to prepare exactly 250.0 cm³ of a solution for titration.

25.0 cm³ samples of this final solution were further acidified with dilute sulfuric acid.

These samples were titrated with potassium manganate(VII) solution to determine the number of moles of water of crystallization per mole of iron(II) sulfate.

(i) Describe in outline how you would prepare the 250.0 cm³ of the solution for titration from the solution obtained by dissolving 6.75 g of the crystals in 150 cm³ of dilute sulfuric acid.

(3)

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(ii) Suggest what would happen to the solution of iron(II) sulfate if it was prepared using distilled water, rather than dilute sulfuric acid as the solvent. Describe and explain what you would see.

(2)

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(iii) Describe the end point of the titration.

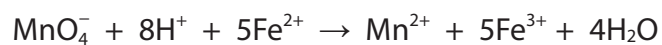
(1)

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(iv) Using 6.75 g of their crystals and the method described in (b), the student obtained a mean titre of 25.35 cm³.

The concentration of the potassium manganate(VII) solution was 0.0195 mol dm⁻³ and the equation for the titration reaction is



Calculate the molar mass of the crystals and hence the number of moles of water of crystallization per mole of iron(II) sulfate in the student's crystals. You must show your working.

(4)

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P 4 6 9 4 2 A 0 9 1 6

(c) A third student carried out the experiment described in (b) and found that there was 7.1 mol of water of crystallization per mole of the iron(II) sulfate.

- (i) The **total** experimental uncertainty associated with the determination of the molar mass is approximately $\pm 0.9\%$.

Use these data to show that the result obtained by this student is within this experimental uncertainty.

(2)

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- (ii) Most of the students in the class obtained values higher than the Data Book value of 7. Suggest a reason for this.

(1)

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(Total for Question 3 = 21 marks)



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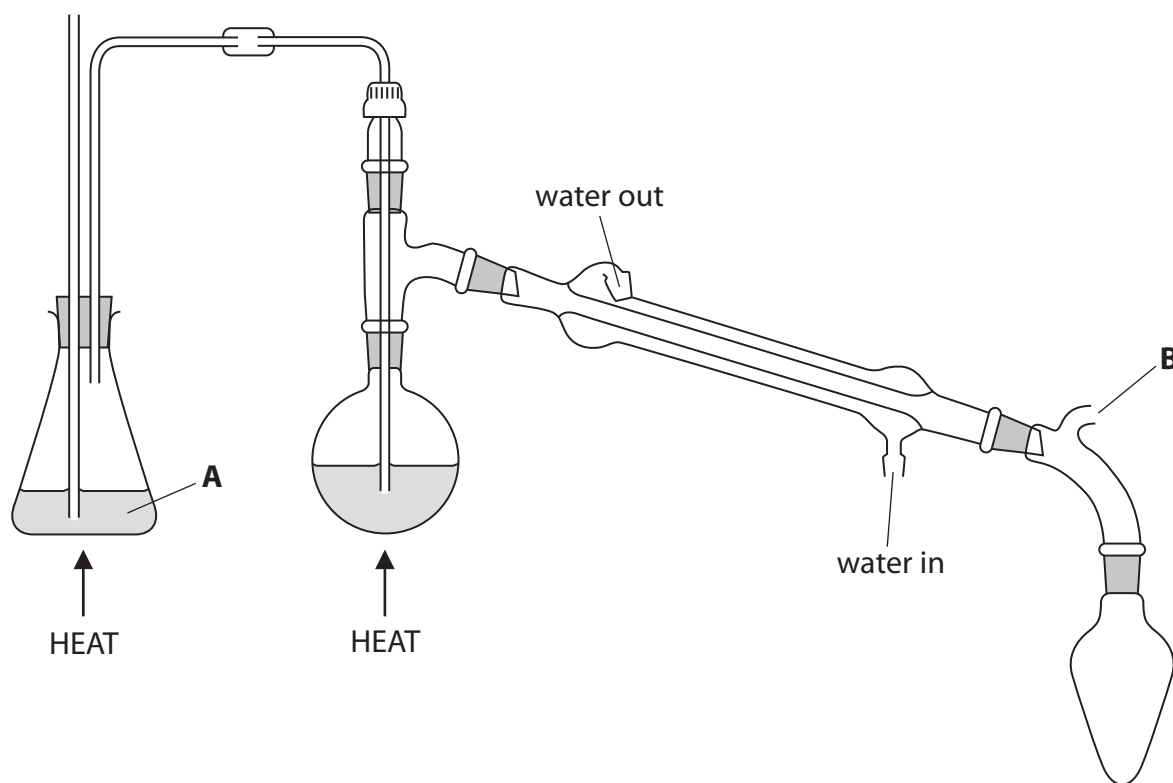
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4 Steam distillation is one method used to separate organic compounds from mixtures.

Some information about nitrobenzene is summarised in the table below.

Molecular formula	$C_6H_5NO_2$
Appearance	Oily yellow liquid
Density	1.20 g cm^{-3}
Boiling temperature	211°C
Solubility in water	0.19 g / 100 g of water at 20°C

(a) The diagram below shows a steam distillation apparatus used to extract nitrobenzene from a reaction mixture.



(i) Identify substance **A**.

(1)

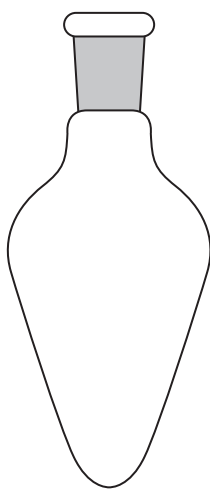


(ii) Explain the purpose of the part of the apparatus labelled **B**.

(1)

(iii) On the diagram below, draw and label the contents of the receiver at the end of the steam distillation.

(2)



(b) The nitrobenzene may be further purified by simple distillation.

Describe the steps needed **before** the product of steam distillation can be further distilled. Any apparatus or chemicals needed for these steps should be named but practical details are **not** required.

(3)

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(c) A bottle of nitrobenzene has the hazard labels shown below.

Symbol		
Meaning		

- (i) Complete the table above with the meaning of each symbol. (1)
- (ii) Suggest **one** change or addition to the **apparatus** in part (a) that would reduce the risk from **both** these hazards. (1)

(Total for Question 4 = 9 marks)

TOTAL FOR PAPER = 50 MARKS



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The Periodic Table of Elements

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6.9	Li	lithium	3	9.0	Be	beryllium	4	45.0	Sc	scandium	21	47.9	Ti	titanium	22	50.9	V	vanadium	23	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	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	101.1	Ru	ruthenium	44	106.4	Pd	palladium	46	107.9	Ag	silver	47	112.4	In	indium	49	114.8	Sn	tin	50	118.7	Sb	antimony	51	121.8	Te	tellurium	52	127.6	I	iodine	53	126.9	Xe	xenon	54	132.9	Cs	caesium	55	137.3	Ba	barium	56	138.9	La*	lanthanum	57	178.5	Hf	hafnium	72	178.5	Ta	tantalum	73	180.9	W	tungsten	74	183.8	Re	rhenium	75	186.2	Os	osmium	76	190.2	Ir	iridium	77	192.2	Pt	platinum	78	195.1	Au	gold	79	197.0	Hg	mercury	80	200.6	Tl	thallium	81	204.4	Pb	lead	82	207.2	Bi	bismuth	83	209.0	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	261	Db	dubnium	105	262	Sg	seaborgium	106	264	Bh	bohrium	107	266	Hs	hassium	108	271	Ds	darmstadtium	110	271	Rg	roentgenium	111	140	Ce	cerium	58	141	Pr	praseodymium	59	144	Nd	neodymium	60	150	Sm	samarium	62	152	Eu	europium	63	157	Gd	gadolinium	64	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	251	Cf	californium	98	253	Fm	fermium	100	254	Es	einsteinium	99	256	Md	mendeleevium	101	257	Lr	lawrencium	103

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

* Lanthanide series
* Actinide series



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