Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

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 ▶

P46942A

5/5/5/5/3/3/

P 4 6 9 4 2 A 0 1 1 6

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.

	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)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

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

(2)

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

(2)

(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 .....

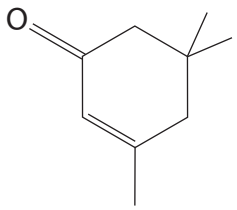
(Total for Question 1 = 13 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



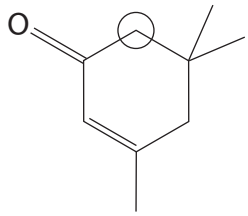
(a) There are two functional groups present in isophorone.

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

(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)

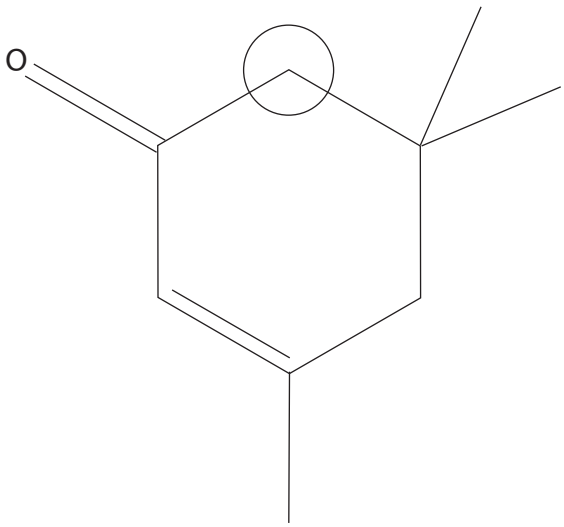
.....

.....

.....

(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 ($FeSO_4.7H_2O$) 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

$$Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$$

(2)

(ii) Why was the reaction mixture filtered?

(1)

.....

.....

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

(2)

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

Taking the formula of the crystals as $FeSO_4.7H_2O$, calculate the mass of iron(II) sulfate-7-water obtained by this student. Assume that the iron filings were pure.

(3)

(b) A second student dissolved 6.75 g of their prepared crystals in about 150 cm^3 of dilute sulfuric acid in a beaker and used this solution to prepare exactly 250.0 cm^3 of a solution for titration.

25.0 cm^3 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 cm^3 of the solution for titration from the solution obtained by dissolving 6.75 g of the crystals in 150 cm^3 of dilute sulfuric acid.

(3)

(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)

(iii) Describe the end point of the titration.

(1)

(iv) Using 6.75 g of their crystals and the method described in (b), the student obtained a mean titre of 25.35 cm^3.

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

$$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

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)

(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 ± 0.9%.

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

(2)

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

(1)

(Total for Question 3 = 21 marks)

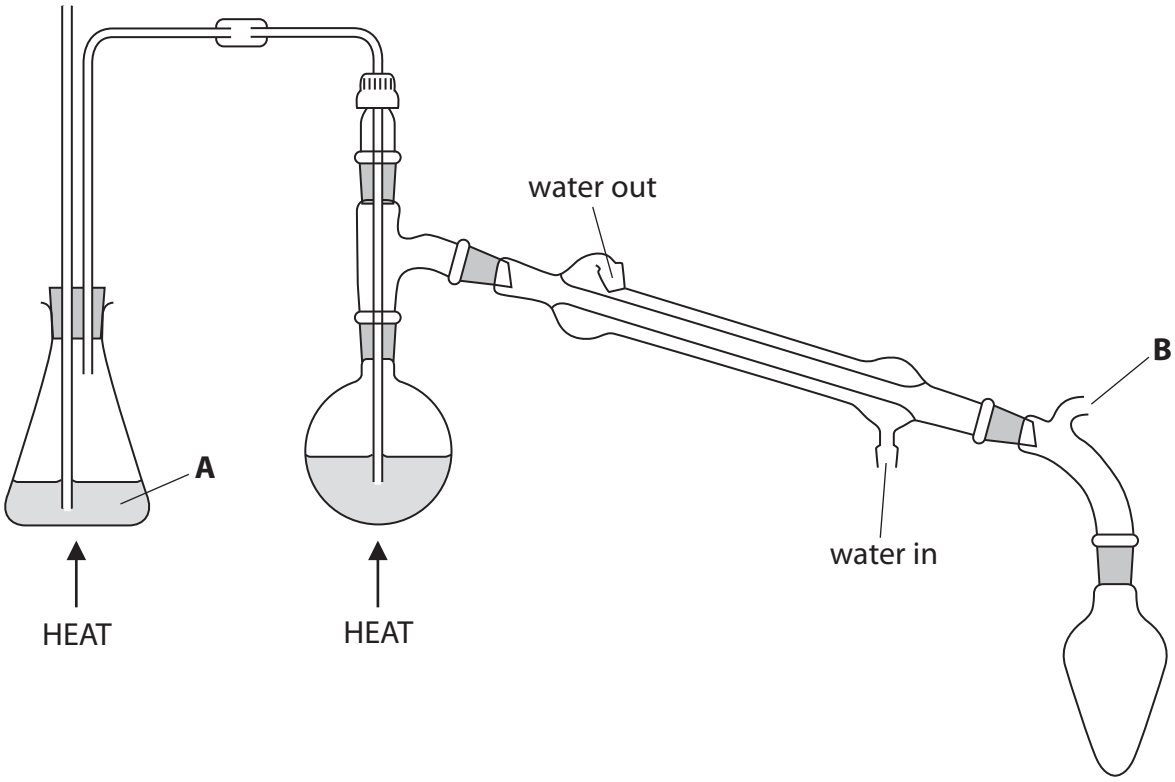
BLANK PAGE

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**.

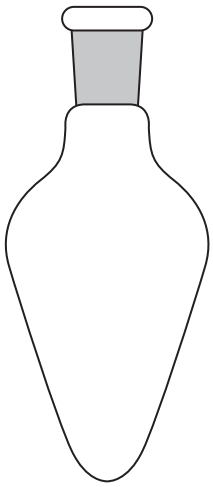
(1)

.....

.....

(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)

.....

.....

.....

.....

.....

.....

(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

BLANK PAGE

The Periodic Table of Elements

1 (1)	2 (2)											3 (13)	4 (14)	5 (15)	6 (16)	7 (17)	0 (8) (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	(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							

Key: relative atomic mass / **atomic symbol** / name / atomic (proton) number

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

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

* Lanthanide series

* Actinide series