Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Tuesday 16 May 2017 – Afternoon
Time: 1 hour 15 minutes

Paper Reference
WCH06/01

Candidates may use a calculator.

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.
- 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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P 4 8 3 8 6 A 0 1 1 6

Pearson

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

1 Malachite is a green mineral which has been widely used to make jewellery and decorative objects, including vases and fireplaces. Malachite is a basic carbonate with the formula $Cu_2CO_3(OH)_2$.

The use of malachite is limited by its reactivity. It reacts readily with mineral acids and on heating the following decomposition occurs at about 300 °C.

$$Cu_2CO_3(OH)_2 \rightarrow 2CuO + H_2O + CO_2$$

(a) (i) Give **two** observations that you would expect to make when a sample of powdered malachite is heated in a boiling tube.

(2)

(ii) Describe a **chemical** test that you could use to show that water is formed. Give the positive result of the test.

(2)

(iii) Describe a **chemical** test that you could use to show that carbon dioxide is formed. Give the positive result of the test.

(2)

(b) (i) Give **two** observations that you would expect to make when dilute sulfuric acid is added to a sample of powdered malachite in a boiling tube.

(2)

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(ii) Write the equation for the reaction of dilute sulfuric acid with malachite. State symbols are not required.

(1)

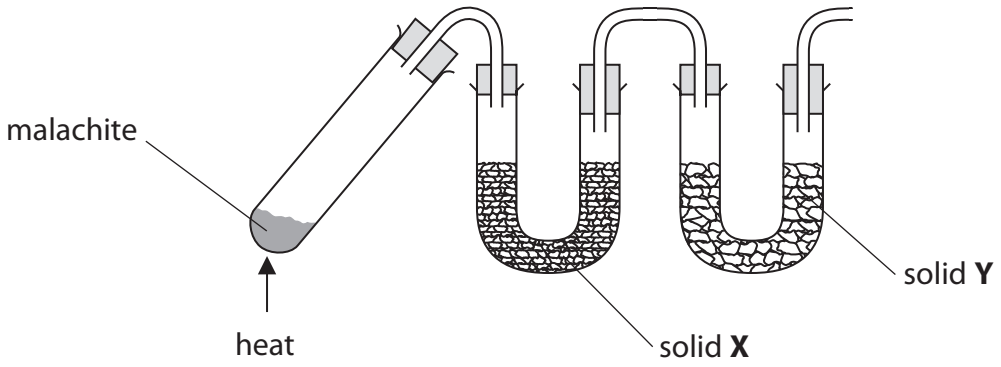
(iii) When the reaction of dilute sulfuric acid with malachite was complete, a solution of compound **M** was added to the reaction mixture until no further change occurred. The final solution was a deep blue colour.

Identify compound **M**.

(1)

.....

(c) The apparatus below was used to confirm the formula of a sample of malachite. Solid **X** absorbs water and solid **Y** absorbs carbon dioxide. The malachite was heated until the decomposition was complete.



(i) Suggest a suitable substance to use as solid **X**.

(1)

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(ii) Suggest a suitable substance to use as solid **Y**.

(1)

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(iii) How would you show that the decomposition was complete?

(1)

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(iv) State the measurements that you would make in carrying out this experiment to confirm the formula of malachite.

(2)

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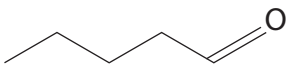
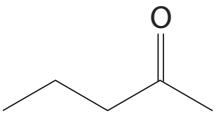
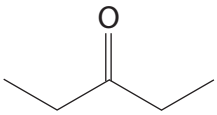
(Total for Question 1 = 15 marks)

2 This question is about the three isomeric carbonyl compounds shown in the table.

	pentanal
	pentan-2-one
	pentan-3-one

(a) (i) Each of these compounds was subjected to three chemical tests.

Complete the table below to show the observation for each test.
If appropriate, write 'no change'.

(5)

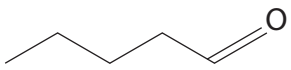
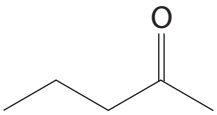
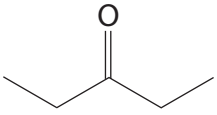
Test	Observations		
	pentanal	pentan-2-one	pentan-3-one
2,4-dinitro-phenylhydrazine			
Tollens' reagent			
Iodoform test			

(ii) Name the reagents that are required for the iodoform test, and describe the procedure for carrying out this test.

(3)

(b) On the structures in the table below, circle the proton environments in each molecule that would produce a peak in its nmr spectrum, indicating clearly if any of these environments are identical. Hence give the number of **different** proton environments in each molecule.

(3)

Structure	Number of different proton environments
	
	
	

(Total for Question 2 = 11 marks)

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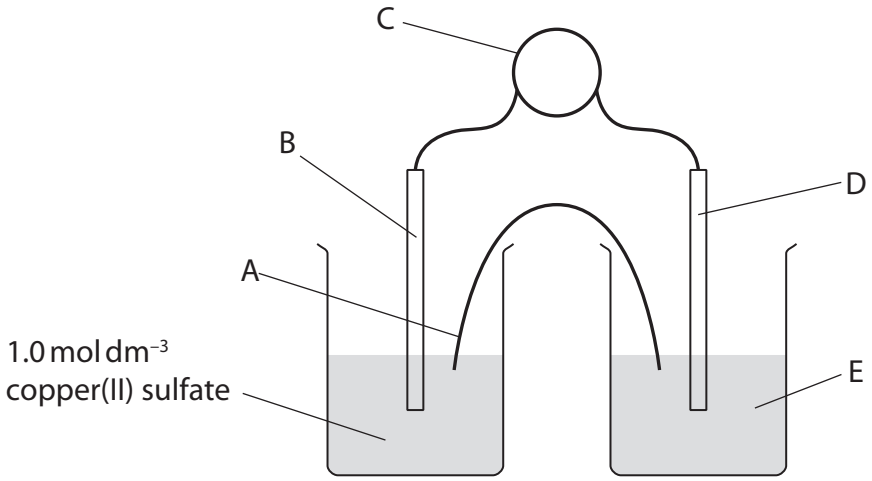
3 A student measured the standard emf of a cell which uses the following half-reactions:

$$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s) \qquad E^{\ominus} = +0.34\,V$$

$$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq) \qquad E^{\ominus} = +0.77\,V$$

The following apparatus was provided:



(a) Identify the parts of the apparatus.

(i) Instrument C

(1)

.....

(ii) The metal used for B

(1)

.....

(iii) The metal used for D

(1)

.....

(iv) The components needed to make item A

(2)

.....

.....

(v) Solution E

(2)

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(b) Using the apparatus above, the student obtained a value of $E^{\ominus}_{cell} = +0.35$ V for the cell reaction.

(i) Write the equation for the cell reaction. State symbols are not required.

(1)

(ii) Calculate the percentage error in the student's measurement compared with the value calculated using the data at the start of the question.

(2)

(c) In a further experiment, the student investigated the effect of changing the concentration of the copper(II) sulfate solution on its electrode potential.

The following results were obtained:

$[CuSO_4(aq)]$ / mol dm^{-3}	Electrode potential (E) / V	$\log_{10}[CuSO_4(aq)]$
1.0	0.35	0.0
0.10	0.31	−1.0
0.010	0.28	−2.0
0.0050	0.27	−2.3
0.0010	0.24	−3.0

(i) Outline how you would use the apparatus available in a school laboratory to prepare, as accurately as possible, at least 100 cm^3 of a 0.10 mol dm^{-3} solution of copper(II) sulfate, starting from the 1.0 mol dm^{-3} copper(II) sulfate solution.

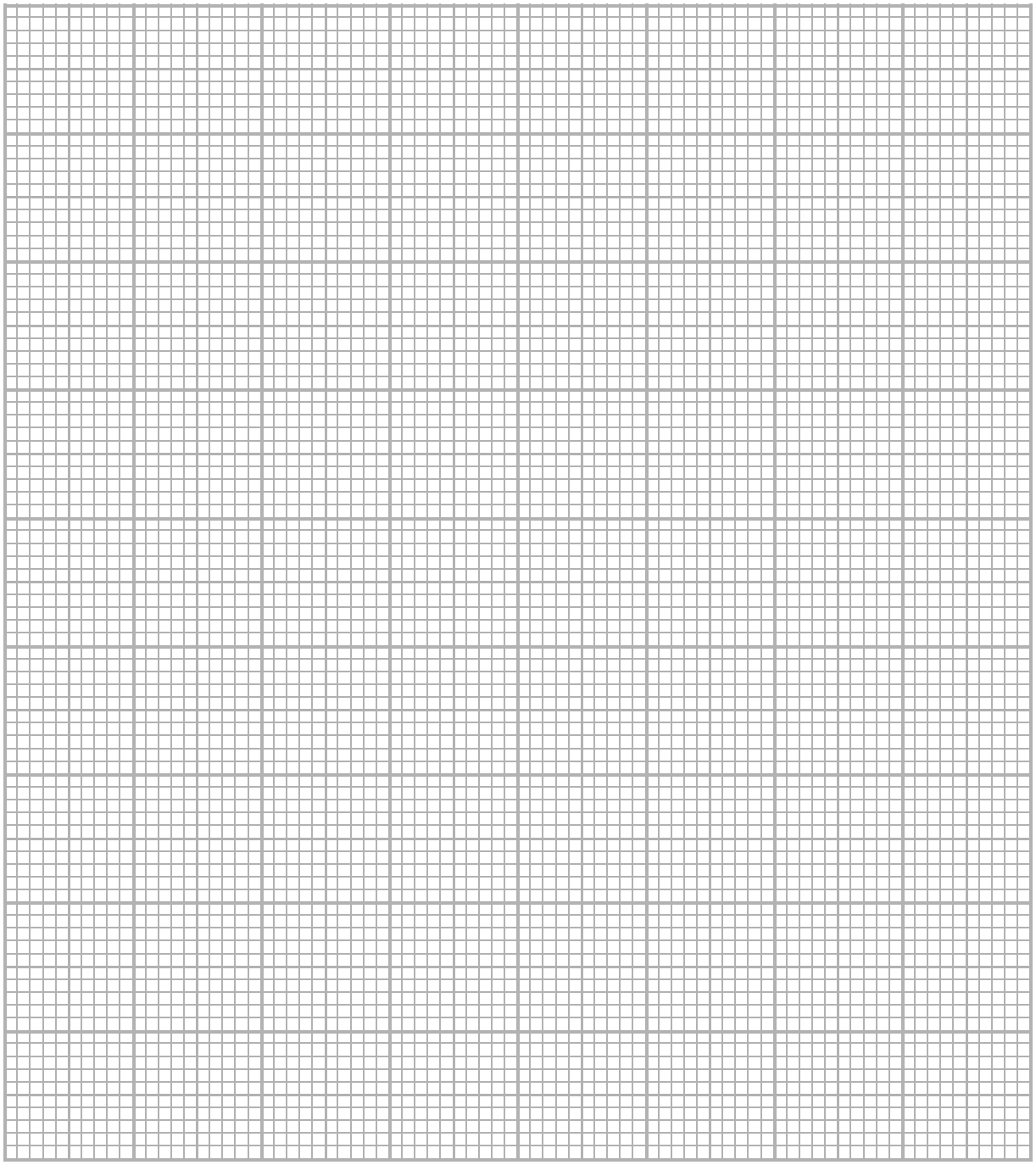
(3)

(ii) The student was advised that the results would be more accurate if the measurements were made starting from the most dilute solution and working in order to the most concentrated. Explain why working from high to low concentration would be less accurate.

(1)

(iii) Plot a graph of electrode potential, *E*, (on the vertical axis) against $\log_{10}[Cu^{2+}]$.
Use appropriate scales, and label the axes of the graph.

(3)



(iv) State the relationship between the electrode potential of the $Cu^{2+}(aq)|Cu$ half-cell and the concentration of the copper(II) ions.

(1)

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.....

(Total for Question 3 = 18 marks)

4 The preparation of 1-methyl-2-nitrobenzene (2-nitrotoluene) is similar to the preparation of nitrobenzene. The following sequence gives the procedure in outline.

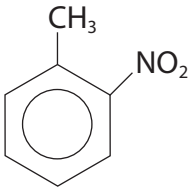
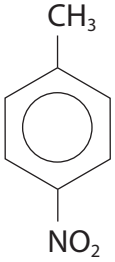
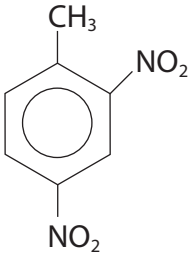
Step **1** A nitrating mixture is prepared by mixing 12.5 cm^3 of concentrated sulfuric acid with 10.6 cm^3 of concentrated nitric acid. Both acids are pre-cooled and the mixing is carried out very slowly.

Step **2** 9.20 g of methylbenzene is placed in a round bottom flask and the nitrating mixture is added very slowly while cooling the mixture. When mixing is complete, the mixture is allowed to warm to room temperature and then stirred for two hours.

Step **3** The reaction mixture is poured into water. The organic layer is separated and sodium hydrogencarbonate solution is added.

Step **4** The organic layer is separated again, and a drying agent is added before the mixture is distilled.

Some of the physical properties of 1-methyl-2-nitrobenzene and the other significant organic products of this sequence are shown in the table.

Name	Structure	Melting temperature / °C	Boiling temperature / °C
1-methyl-2-nitrobenzene		−10.4	222
1-methyl-4-nitrobenzene		51.6	238
1-methyl-2,4-dinitrobenzene		70	300 (decomposes)

(a) Complete the table of hazard symbols for nitric acid.

(1)

		
Corrosive	Toxic	

(b) Explain why in Step **1** the components of the nitrating mixture are pre-cooled and mixed very slowly.

(1)

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(c) Explain why Step **2** is carried out so that the reaction mixture is always at or below room temperature.

(1)

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(d) State why sodium hydrogencarbonate solution is added in Step **3**.

(1)

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(e) Suggest the temperature **range** at which 1-methyl-2-nitrobenzene would be collected in the distillation.

(1)

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(f) Suggest the best way to obtain some pure 1-methyl-2,4-dinitrobenzene after the distillation.

(1)

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(Total for Question 4 = 6 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
																	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				1.0 H hydrogen 1					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

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