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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

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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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 $\text{Cu}_2\text{CO}_3(\text{OH})_2$.

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 .



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

(2)

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

(2)

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

(2)

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(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)

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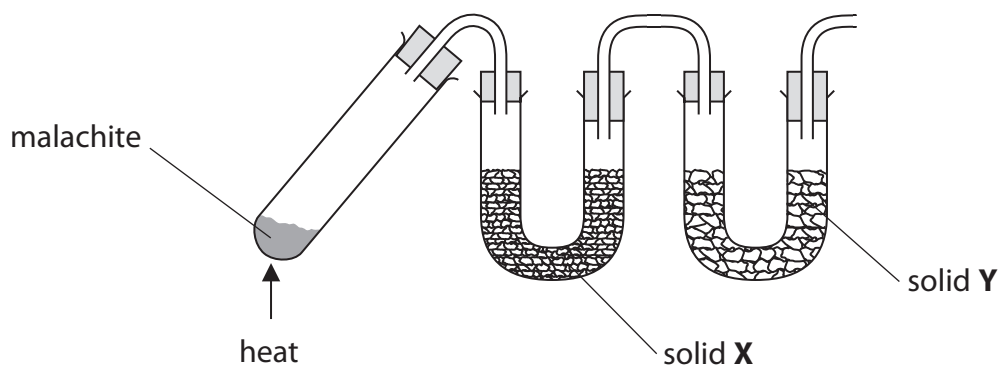
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- (c) The apparatus below was used to confirm the formula of a sample of malachite. Solid **X** absorbs water and solid **Y** absorbs carbon dioxide. The malachite was heated until the decomposition was complete.



- (i) Suggest a suitable substance to use as solid **X**. (1)

- (ii) Suggest a suitable substance to use as solid **Y**. (1)

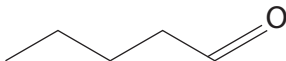
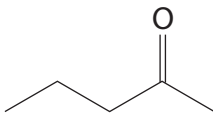
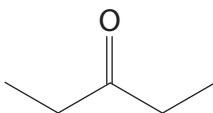
- (iii) How would you show that the decomposition was complete? (1)

- (iv) State the measurements that you would make in carrying out this experiment to confirm the formula of malachite. (2)

(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)

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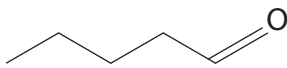
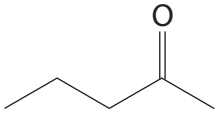
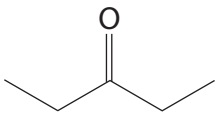
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(b) On the structures in the table below, circle the proton environments in each molecule that would produce a peak in its nmr spectrum, indicating clearly if any of these environments are identical. Hence give the number of **different** proton environments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

(3)

Structure	Number of different proton environments
	
	
	

(Total for Question 2 = 11 marks)



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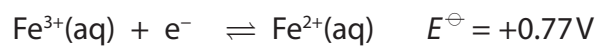
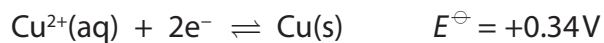
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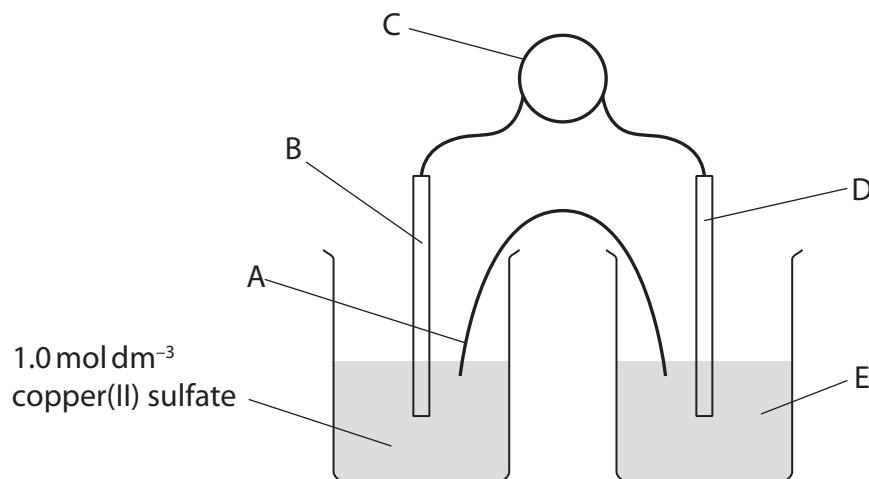
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3 A student measured the standard emf of a cell which uses the following half-reactions:



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 $E_{\text{cell}}^{\ominus} = +0.35 \text{ V}$ 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)

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- (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:

$[\text{CuSO}_4(\text{aq})]$ $/\text{mol dm}^{-3}$	Electrode potential (E) $/\text{V}$	$\log_{10}[\text{CuSO}_4(\text{aq})]$
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)

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- (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)

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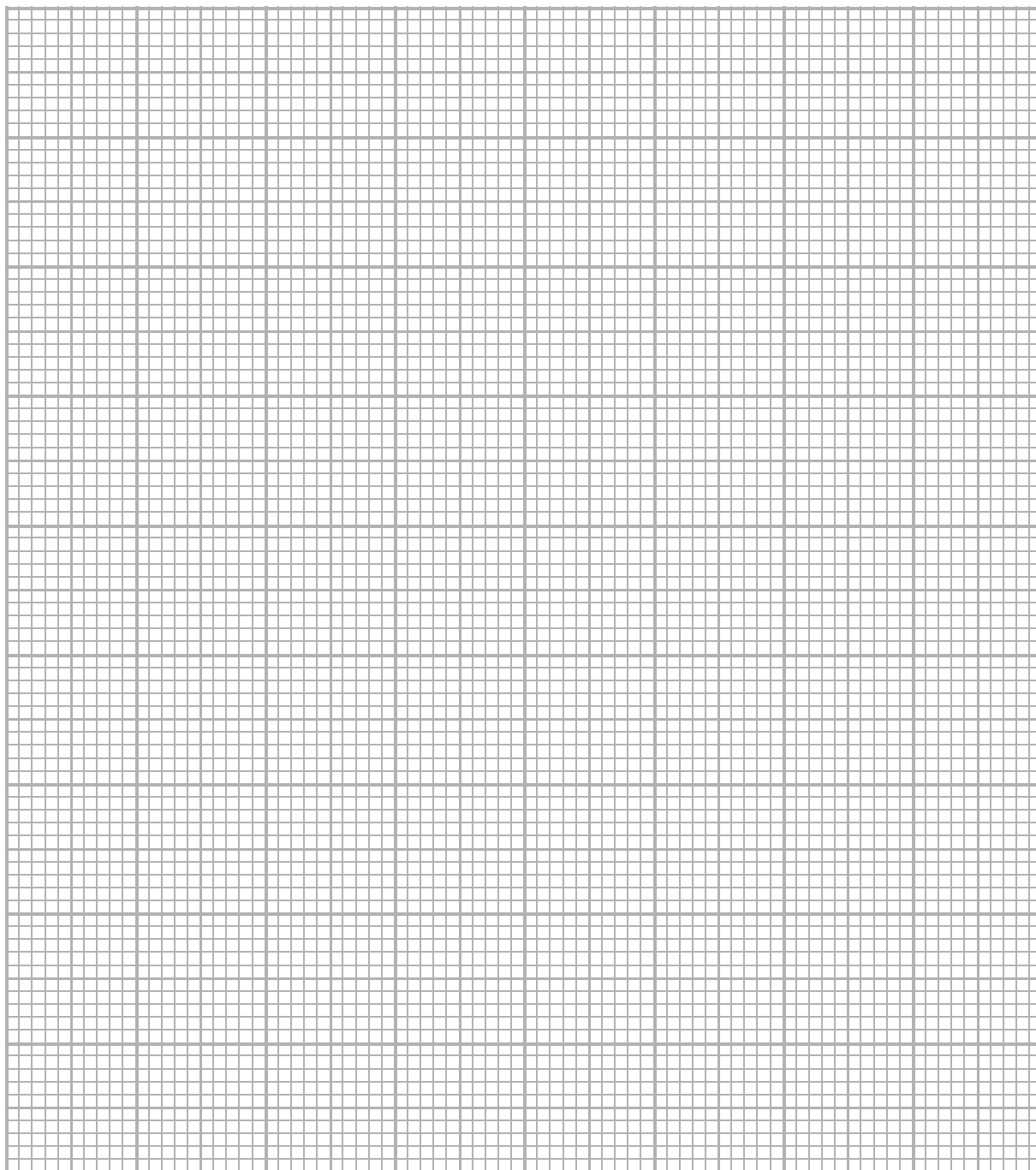
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(iii) Plot a graph of electrode potential, E , (on the vertical axis) against $\log_{10}[\text{Cu}^{2+}]$.
Use appropriate scales, and label the axes of the graph.

(3)



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

(1)

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(Total for Question 3 = 18 marks)

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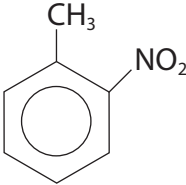
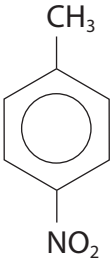
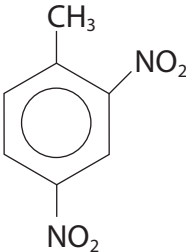


P 4 8 3 8 6 A 0 1 1 1 6

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 cm³ of concentrated sulfuric acid with 10.6 cm³ 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)



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(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)

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

(1)

(Total for Question 4 = 6 marks)

TOTAL FOR PAPER = 50 MARKS



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The Periodic Table of Elements

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1	2	6.9	Li	lithium	3	9.0	Be	beryllium	4	23.0	Na	sodium	11	24.3	Mg	magnesium	12	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	4.0	He	helium	2																								
		39.1	K	potassium	19	40.1	Ca	calcium	20	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	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	126.9	Te	tellurium	52	131.3	Xe	xenon	54				
		132.9	Cs	caesium	55	137.3	Ba	barium	56	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	[210]	At	astatine	85	[222]	Rn	radon	86				
		[223]	Fr	francium	87	[226]	Ra	radium	88	[261]	Rf	rutherfordium	104	[262]	Db	dubnium	105	[266]	Sg	seaborgium	106	[147]	Pm	promethium	61	[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	150	Sm	samarium	62	152	Eu	europlium	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	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	mendeleevium	101	254	No	nobelium	102	257	Lr	lawrencium	103																

* Lanthanide series

* Actinide series

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