Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Monday 13 November 2017 – Morning
Time: 1 hour 15 minutes

Paper Reference
WCH06/01

Candidates must have: Scientific 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.
- Try to answer every question.
- Check your answers if you have time at the end.
- Show all your working in calculations and include units where appropriate.

Turn over ▶

P50790A

6/6/1/5/5/5/

P 5 0 7 9 0 A 0 1 1 6

Pearson

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

1 Compound **A** is an ionic, crystalline solid containing two cations and one anion. Compound **A** dissolves in warm water to form a green solution, **B**.

(a) Give the **formulae** of two cations which could be responsible for the green colour of solution **B**.

(2)

.....

.....

(b) When aqueous sodium hydroxide is added to solution **B**, a green precipitate forms. When excess aqueous sodium hydroxide is added, this precipitate dissolves to form a different green solution, **C**.

(i) Give the **formula** of the cation in solution **B** identified by this test.

(1)

.....

(ii) Give the **formula** of the anion responsible for the green colour in solution **C**.

(1)

.....

(c) The green solution **C** is divided into two portions.

(i) When aqueous hydrogen peroxide is added to the first portion of solution **C**, a yellow solution is formed.

Give the **name**, including the relevant oxidation number, of the ion responsible for the yellow colour.

(1)

.....

(ii) When the second portion of solution **C** is heated, a gas is produced that turns damp red litmus paper blue.

Identify, by name or formula, the gas produced and write the **ionic** equation for its formation. State symbols are not required.

(2)

Gas .....

Ionic equation

(d) When dilute hydrochloric acid, followed by aqueous barium chloride, is added to solution **B**, a white precipitate forms.

Identify, by name or formula, the white precipitate formed.

(1)

.....

(e) Suggest the **formula** of compound **A**. Ignore any water of crystallisation.

(1)

.....

(Total for Question 1 = 9 marks)

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2 Two **neutral** organic compounds, **D** and **E**, contain the elements carbon, hydrogen and oxygen only.

(a) Use this information, and the observations of the two tests on compound **D**, to complete the table.

Test	Observations	Inferences
(i) Add a spatula measure of phosphorus(V) chloride to **D**	Steamy fumes are formed that turn damp blue litmus paper red	The gas produced is ..... The group present in **D** is ..... **(2)**
(ii) Add a few drops of **D** to acidified potassium dichromate(VI) solution and heat the mixture	The solution stays orange	State what additional information this gives about the structure of **D** .... **(1)**

(b) The mass spectrum of compound **D** has the molecular ion peak at $m/e = 74$.

Draw the **displayed** formula of compound **D**.

(1)

(c) The results of two tests on compound **E** are shown in the table. Complete the table.

Test	Observation	Inferences
(i) Add a few drops of **E** to a solution of 2,4-dinitrophenylhydrazine	An orange precipitate forms	The functional group in **E** could be .... **(1)**
(ii) Add a few drops of **E** to Fehling's solution and heat the mixture	Solution stays blue	The name of the functional group in **E** is ..... **(1)**

(d) (i) **E** could be one of two **unbranched** isomers, each containing five carbon atoms per molecule. Use this information, and the results of tests (c)(i) and (c)(ii), to suggest the structure of each isomer.

(2)

Isomer 1	Isomer 2

(ii) State the reagents that could be used in a test to distinguish between the two isomers identified in (d)(i).

Describe the observations that you would expect when each isomer is tested.

(3)

Reagents .....

Observations in test with

isomer 1 .....

.....

isomer 2 .....

.....

(Total for Question 2 = 11 marks)

3 Aqueous hydrogen peroxide is a colourless solution which decomposes slowly at room temperature to form water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The concentration of hydrogen peroxide can be expressed as 'x volume', where 1 cm^3 of hydrogen peroxide solution decomposes to produce x cm^3 of oxygen at room temperature and pressure.

A bottle of aqueous hydrogen peroxide is labelled '20 volume'.

(a) Calculate the concentration of 20 volume hydrogen peroxide in mol dm^{-3}.

[Molar volume of oxygen at room temperature and pressure = 24.0 dm^3 mol^{-1}]

(3)

(b) A student carried out a titration to check the accuracy of this concentration by following the procedure outlined below.

Step **1** Use a pipette, fitted with a pipette filler, to transfer 10.0 cm^3 of the aqueous hydrogen peroxide to a 250 cm^3 volumetric flask.

Step **2** Make up the solution to the mark with distilled water.

Step **3** Fill a burette with 0.0200 mol dm^{-3} potassium manganate(VII) solution.

Step **4** Use a pipette, fitted with a pipette filler, to transfer 25.0 cm^3 of the **diluted** hydrogen peroxide solution to a conical flask. Add approximately 25 cm^3 of dilute sulfuric acid to the flask and titrate the mixture with the potassium manganate(VII) solution.

Step **5** Repeat the titration until concordant results are obtained.

(i) State what the student should do to the pipette before using it to measure the volume of solution in Step **1**.

(1)

.....

.....

(ii) State what the student should do to the **diluted** hydrogen peroxide solution made up in Step **2**, before using it.

(1)

.....

(iii) State a check on the burette that the student should make before taking the initial burette reading in Step **4**.

Assume the burette is vertical, securely clamped and in good working order.

(1)

.....

(iv) State the apparatus the student should use to measure approximately 25 cm^3 of dilute sulfuric acid in Step **4**.

(1)

.....

(v) State the colour change at the end point of the titration.

(1)

From ..... to .....

(vi) Describe what is meant by the term **concordant results** in titrations.

(1)

.....

.....

(vii) The mean titre of the 0.0200 mol dm^{-3} potassium manganate(VII) solution was 15.80 cm^3.

Using information from the procedure and the value of the mean titre, calculate the concentration in mol dm^{-3} of the **original** hydrogen peroxide solution used in Step **1**.

The equation for the reaction is

$$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$$

(4)

(c) The uncertainty in each burette reading is ±0.05 cm^3.

Calculate the percentage uncertainty in a titre of 15.80 cm^3.

(1)

(d) Suggest the reason why the concentration of a 20 volume solution of hydrogen peroxide decreases, over a period of time.

(1)

.....

.....

(Total for Question 3 = 15 marks)

4 There are two esters with the formula $C_6H_5COOC_3H_7$, which contain a phenyl group.

(a) One of the esters, labelled **X**, was used to prepare a sample of pure benzoic acid using the following procedure.

Step **1** Place 3.0 cm^3 of **X**, 10 cm^3 of dilute sodium hydroxide solution and 10 cm^3 of ethanol in a pear-shaped flask.

Step **2** Heat the mixture in the flask, under reflux, for 20 minutes.

Step **3** Pour the contents of the flask into a beaker and place the beaker in an ice bath.

Step **4** Add 5 drops of methyl orange indicator to the beaker and stir the solution.

Step **5** Add 1 cm^3 portions of dilute hydrochloric acid to the mixture in the beaker until the solution is acidic. Benzoic acid forms as a solid.

Step **6** Filter the benzoic acid under reduced pressure.

Step **7** Recrystallise the benzoic acid using water as the solvent.

Step **8** Weigh the dry benzoic acid crystals obtained.

(i) Suggest a reason for adding ethanol to the mixture of ester **X** and dilute sodium hydroxide solution in Step **1**.

(1)

.....

.....

(ii) Explain why the mixture is heated under reflux in Step **2**.

(2)

Reason for heating .....

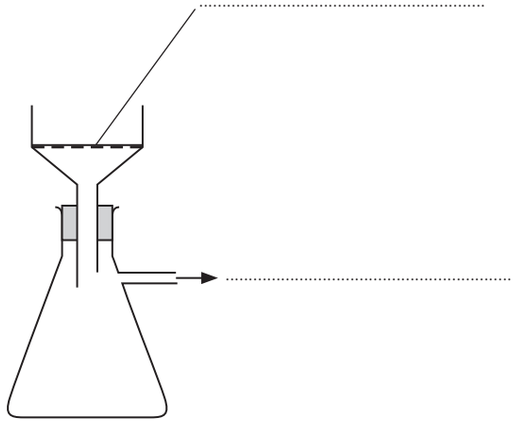
.....

Reason for refluxing .....

.....

(iii) Label the diagram of the apparatus used to filter the benzoic acid under reduced pressure in Step **6** and give a reason why this type of filtration is used rather than normal filtration.

(3)



Reason.....

.....

(iv) Describe the **first** stage in the recrystallisation process in Step **7**.

(1)

.....

.....

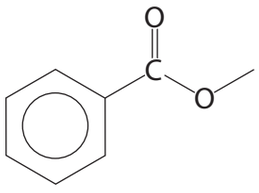
(v) Calculate the percentage yield of benzoic acid, C_6H_5COOH, in a preparation in which 1.45 g of benzoic acid is prepared from 3.0 cm^3 of **X**, $C_6H_5COOC_3H_7$.

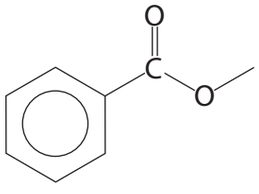
[The density of **X** is 1.02 g cm^{-3}.]

(4)

(b) Complete the structures of the two esters with the formula $C_6H_5COOC_3H_7$, showing clearly the structure of the C_3H_7 groups.

(2)





(c) The part of the high resolution proton nmr spectrum of **X** corresponding to the C_3H_7 group consists of two peaks, P and Q.

Peak P is split into seven.

Peak Q is a doublet.

Draw the structure of **X** and label the protons responsible for peaks P and Q.

(2)

(Total for Question 4 = 15 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)
							1.0 H hydrogen 1										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									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	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
* Actinide series	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