Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | Candidate Number

Wednesday 15 May 2019

Afternoon (Time: 1 hour 15 minutes) | Paper Reference **WCH06/01**

Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

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.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

Turn over ▶

P56132A

2/2/1/1/1/1/

P 5 6 1 3 2 A 0 1 1 6

Pearson

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

1 This question is about five inorganic compounds (**A**, **B**, **C**, **D** and **E**).

(a) Compounds **A** and **B** contain s-block elements.

(i) In flame tests, **A** gave a yellow colour and **B** gave a yellow-red colour.

Identify the s-block metal ions in **A** and **B**.

(1)

The metal ion in **A** .....

The metal ion in **B** .....

(ii) Give the colour of the precipitate formed when concentrated sodium hydroxide solution is added to an aqueous solution of **B**.

(1)

.....

(iii) Compound **A** is a carbonate.

Write an **ionic** equation for the reaction that takes place when dilute hydrochloric acid is added to an aqueous solution of **A**. Include state symbols.

(2)

(iv) Compound **B** is a halide.

Identify, by name or formula, a reagent that may be used to test for halide ions in an **aqueous** solution of **B**.

(1)

.....

(b) Compounds **C**, **D** and **E** are nitrates of d-block elements.

Aqueous sodium hydroxide is added, drop by drop, until in excess to separate solutions of **C**, **D** and **E**.

(i) Compound **C** forms an off-white precipitate which darkens on standing in air.

Identify the precipitate, by name or formula, and explain why it darkens.

(2)

.....

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.....

(ii) Compound **D** forms a white precipitate which dissolves in excess sodium hydroxide to form a colourless solution containing a complex ion.

Write the **formula** of this complex ion.

(1)

.....

(iii) Compound **E** forms a green precipitate which does **not** dissolve in excess sodium hydroxide.

The precipitate turns brown on standing in air.

Identify, by name or formula, the compound **E** and the brown solid.

(2)

Compound **E** .....

Brown solid .....

(Total for Question 1 = 10 marks)

2 This question is about three organic compounds: **X**, **Y** and **Z**.
X, **Y** and **Z** have the same molecular formula, $C_6H_{12}O$.

The table shows the observations made in some chemical tests on **X**, **Y** and **Z**.

	Observations with reagent				
Compound	Sodium metal	Bromine water	Acidified sodium dichromate(VI)	Brady's reagent (2,4-DNPH)	Iodine in aqueous sodium hydroxide
X	No change	No change	No change	Orange precipitate	Pale yellow precipitate
Y	Effervescence	Decolourises	Turns green	No change	No change
Z	Effervescence	No change	No change	No change	No change

(a) Use information from the table to answer the following questions.

(i) State what can be deduced about **X** from the positive test results.

(2)

(ii) Name the functional **groups** present in **Y**.

(2)

(iii) Complete the equation for the reaction between **Z** and sodium metal. State symbols are not required.

(1)

$C_6H_{12}O + Na \rightarrow$

(b) The **high** resolution proton nmr spectrum of compound **X** has only two peaks which are singlets with relative peak areas of 1 : 3.

(i) State what can be deduced from the presence of only two peaks in the nmr spectrum.

(1)

.....

.....

(ii) State what can be deduced from the fact that these peaks are singlets.

(1)

.....

.....

(iii) Use the nmr information, your answer to (a)(i) and the molecular formula to deduce the structure of **X**.

(1)

(c) Compound **Y** is straight-chained and does **not** have geometric or optical isomers.

(i) State what can be deduced from the fact that **Y** does not exist as geometric isomers.

(1)

.....

.....

(ii) State what can be deduced from the fact that **Y** does not have optical isomers.

(1)

.....

.....

(iii) Use information about **Y**, your answer to (a)(ii) and the molecular formula to deduce the structure of **Y**.

(1)

(d) (i) Deduce the type and classification of the functional group present in **Z**, using observations from the table.

(1)

.....

(ii) Compound **Z** contains a five-membered carbon ring.

Deduce the structure of **Z** using this information, your deduction in (d)(i) and the molecular formula.

(1)

(Total for Question 2 = 13 marks)

3 This question is about the analysis of iron supplements used to prevent or treat iron deficiency anaemia.

A student used the following procedure to analyse iron tablets containing iron in the form of hydrated iron(II) sulfate, $FeSO_4.7H_2O$.

Procedure

Step **1** Grind up **two** iron tablets with a little dilute sulfuric acid using a pestle and mortar.

Step **2** Transfer the resulting paste into a 100.0 cm^3 volumetric flask. Rinse the apparatus used with dilute sulfuric acid, transferring all washings to the volumetric flask.

Step **3** Add sufficient dilute sulfuric acid to the volumetric flask to make up the solution to exactly 100.0 cm^3. Stopper the flask and invert it several times.

Step **4** Using a pipette, transfer 10.0 cm^3 of the solution to a conical flask and titrate it with 0.00500 mol dm^{-3} potassium manganate(VII) solution.

Step **5** Repeat Step **4** until concordant results are obtained.

The overall equation for the reaction occurring in the titration is

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

(a) (i) Give the reason why the titration in Step **4** does **not** require the addition of an indicator.

(1)

.....

.....

(ii) Give the colour **change** at the end-point.

(1)

.....

(b) The student decided to take the burette readings from the top of the liquid level rather than from the bottom of the meniscus.

Suggest the effect of this, if any, on the titre values. Justify your answer.

(2)

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.....

.....

.....

.....

(c) Results of the titrations are given in the table.

Titration number	1	2	3	4
Burette reading (final) / cm^3	10.85	21.40	31.60	42.40
Burette reading (initial) / cm^3	0.00	10.85	21.40	32.10
Titre / cm^3	10.85			

(i) Complete the table and use the concordant values to calculate the mean titre.

(2)

(ii) Use your mean titre and information from the procedure to calculate the mass of hydrated iron(II) sulfate, $FeSO_4.7H_2O$, present in **one** iron tablet.

Give your answer to an appropriate number of significant figures.

(5)

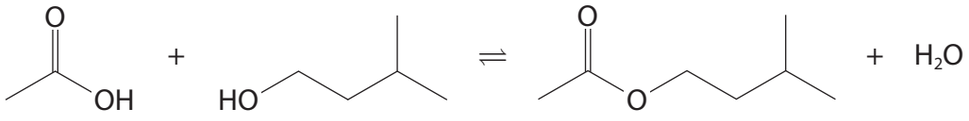
(d) The uncertainties in the burette and pipette measurements are $\pm 0.05\,cm^3$ and $\pm 0.06\,cm^3$ respectively.

Calculate which of these pieces of apparatus gives the greater percentage uncertainty in this experiment.

(2)

(Total for Question 3 = 13 marks)

4 This question is about the laboratory preparation of 3-methylbutyl ethanoate, an ester used as a banana flavouring in foods.



ethanoic acid 3-methylbutan-1-ol 3-methylbutyl ethanoate

Procedure

Step **1** Add 7.5 cm^3 of 3-methylbutan-1-ol, 10 cm^3 of ethanoic acid and 2 cm^3 of concentrated sulfuric acid to a round-bottom flask.

Step **2** Add a few anti-bumping granules and heat the mixture under reflux for 35 minutes.

Step **3** Transfer the cooled reaction mixture to a separating funnel. Add 30 cm^3 of distilled water and washings from the flask. Shake the mixture, allow to separate and discard the aqueous layer.

Step **4** Wash the organic layer with 15 cm^3 of sodium hydrogencarbonate solution, releasing the build up of pressure. Discard the aqueous layer and repeat until the aqueous layer is slightly alkaline.

Step **5** Transfer the organic layer to a boiling tube and dry with anhydrous magnesium sulfate.

Step **6** Decant the organic layer into a clean round-bottom flask and distil. Collect the fraction boiling between 140 °C and 144 °C in a pre-weighed test tube.

Data

Compound	Molar mass / g mol^{-1}	Density / g cm^{-3}	Boiling temperature / °C
3-methylbutan-1-ol	88.0	0.81	131
ethanoic acid	60.0	1.05	118
3-methylbutyl ethanoate	130.0	0.88	142

(a) State the purpose of the concentrated sulfuric acid and of the anti-bumping granules added to the round-bottom flask.

(2)

Concentrated sulfuric acid in Step **1** .....

.....

Anti-bumping granules in Step **2** .....

.....

(b) Draw a labelled diagram of the apparatus used to heat the reaction mixture under reflux in Step **2**.

(2)

(c) Draw a diagram of the separating funnel in Step **3**, clearly labelling the aqueous and organic layers.

(2)

(d) Give the reason why the organic layer is washed with sodium hydrogencarbonate solution in Step **4** and suggest how the alkalinity of the aqueous layer should be confirmed.

(2)

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.....

.....

(e) Explain why the distillate is **not** collected below 140 °C in Step **6**.

(2)

(f) A student prepared 4.75 g of 3-methylbutyl ethanoate starting with 7.5 cm^3 of 3-methylbutan-1-ol and excess ethanoic acid.

(i) Calculate the percentage yield of 3-methylbutyl ethanoate.

(3)

(ii) Give the main reason why the yield is significantly less than 100%.

Do not consider errors in the experimental procedure or transfer losses.

(1)

(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

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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

* 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