Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

International Advanced Level
Unit 6: Practical Skills in Chemistry II

Sample Assessment Materials for first teaching September 2018

Time: 1 hour 20 minutes

Paper Reference
WCH16/01

You must have:
Scientific calculator, ruler

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.*
- **Show all your working in calculations and include units where appropriate.**

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.*
- There is a Periodic Table on the back page 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.

Turn over ▶

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S 5 8 3 1 4 A 0 1 1 2

Pearson

Answer ALL the questions.

Write your answers in the spaces provided.

1 A series of tests was carried out on a pale green inorganic compound **A** which contained two cations and one anion.

(a) Dilute sodium hydroxide solution was added drop by drop to 5 cm^3 of an aqueous solution of **A** until there was no further reaction.

A green precipitate was formed which was filtered off and, after some time, turned into a brown solid.

(i) Give the **formula** of the cation in **A** shown by this test.

(1)

.....

(ii) Give the **formula** of the green precipitate.

(1)

.....

(iii) Identify, by name or formula, the brown solid.

(1)

.....

(iv) State the type of reaction that occurred when the green precipitate turned brown.

(1)

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(v) Give the reason why dilute sodium hydroxide is added drop by drop when testing for cations.

(1)

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(b) The filtrate was heated gently and an alkaline gas was given off.

(i) Describe a test and its positive result to show that the gas was alkaline.

(2)

(ii) Describe a further chemical test and its result to confirm that the gas was ammonia.

(2)

(c) A 1 cm^3 sample of an aqueous solution of **A** was acidified with dilute hydrochloric acid and a few drops of barium chloride solution were added. A white precipitate was formed which identified the anion in **A** as the sulfate ion.

(i) State the reason for the addition of dilute hydrochloric acid.

(1)

(ii) Bottles of solid barium chloride have the hazard label:

Give a precaution, other than wearing lab coats and goggles, that would reduce the risk in preparing a solution of barium chloride. Justify your choice.

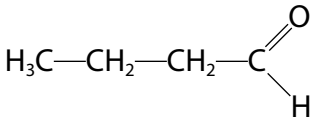
(1)

(d) Suggest a formula for **A**. Do not include water of crystallisation.

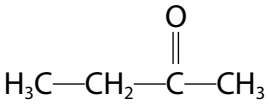
(1)

(Total for Question 1 = 12 marks)

2 A student was asked to investigate two liquids, labelled **X** and **Y**. One liquid was butanal and the other was butanone.



butanal



butanone

(a) Describe a test, including the expected observation, which would be positive for both liquids.

(2)

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.....

.....

(b) Describe two chemical tests, including the expected observations, which each give a positive result with butanal and no reaction with butanone.

(4)

Test 1.....

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Test 2.....

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.....

(c) State what is observed when an alkaline solution of iodine is added to butanone and the mixture warmed.

(1)

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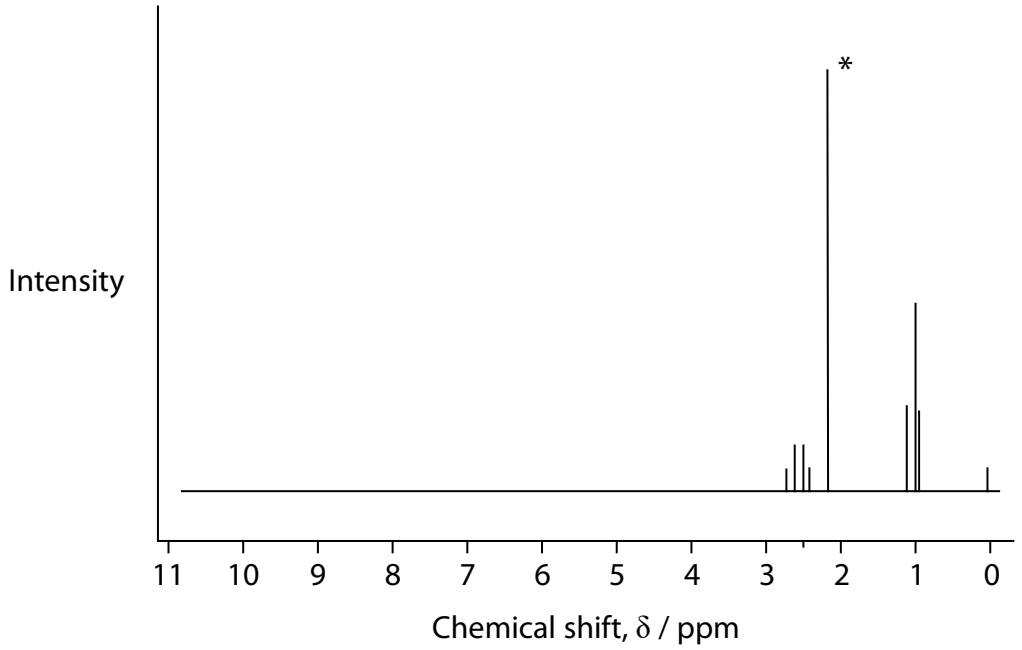
(d) The high resolution proton nuclear magnetic resonance (NMR) spectrum of **X** is shown.



(i) Deduce the identity of substance **X**. Refer only to the peak with the asterisk(*) which is a singlet with a relative peak area of three.

(3)

(ii) The proton NMR spectrum has a small peak with a chemical shift, $\delta = 0$ parts per million (ppm) which does not result from substance **X**.

Explain the presence of this small peak, identifying the compound responsible.

(2)

(Total for Question 2 = 12 marks)

3 This question is about the preparation of a complex salt of cobalt(III).

The overall equation for the formation of this complex salt is:

$$2HNO_3 + 2Co(NO_3)_2.6H_2O + H_2O_2 + 10NH_3 \rightarrow 2Co(NH_3)_5(H_2O)(NO_3)_3 + 12H_2O.$$

Procedure

Step **1** Add 3.6 g of hydrated cobalt(II) nitrate, $Co(NO_3)_2.6H_2O$, to 2.5 g of ammonium nitrate, NH_4NO_3, in a large beaker.

Step **2** Add just enough hot water to dissolve the two salts.

Step **3** Keeping the beaker warm on a hot plate, add 40 cm^3 of aqueous ammonia.

Step **4** Over a period of about 30 minutes, add a total volume of 25 cm^3 of 3.0% (3.0 g per 100 cm^3) hydrogen peroxide to the mixture. Allow the mixture to cool.

Step **5** Carefully add 40 cm^3 of concentrated nitric acid to the mixture and leave to stand for a further 10 minutes.

Step **6** To precipitate the complex salt, add cold ethanol to the mixture and filter the solid formed under reduced pressure.

Step **7** Recrystallise the complex salt.

(a) (i) The hydrogen peroxide is used to oxidise cobalt(II) to cobalt(III). The reduction half-equation is:

$$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O.$$

Deduce the ionic equation for the reaction of hydrogen peroxide with cobalt(II) ions.

State symbols are not required.

(1)

(ii) Show by calculation that there is sufficient hydrogen peroxide to oxidise all of the cobalt(II) ions.

(4)

(iii) In Step **4**, when an excess of hydrogen peroxide is added, bubbles are seen. The gas relights a glowing splint.
Identify the gas and write an equation for the formation of this gas.

(2)

(b) State the purpose of ethanol in Step **6** and why it is cold.

(2)

(c) Draw a labelled diagram of the apparatus used for filtration under reduced pressure in Step **6**.

(3)

(d) This complex salt can be recrystallised using ethanol as the solvent.

(i) State why the salt is dissolved in the **minimum** volume of hot ethanol.

(1)

(ii) The hot solution is filtered. Name the type of impurities removed in this filtration.

(1)

(iii) The solution is cooled and then filtered. Name the type of impurities removed in this filtration.

(1)

(iv) Describe the final stage required to obtain pure crystals of the complex salt.

(2)

(e) (i) One student found the yield of their complex salt to be 110%.

Suggest a possible reason for this.

(1)

.....

.....

(ii) A second student found the yield of their complex salt to be 80%.

On reweighing their salt after 24 hours, their yield had decreased to 75%.
Suggest a possible reason for this.

(1)

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(Total for Question 3 = 19 marks)

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4 A class of students was given an outline method for an experiment to determine the acid dissociation constant, K_a, of propanoic acid.

Step **1** Pipette 25.0 cm^3 of 0.1 mol dm^{-3} propanoic acid into a conical flask.

Step **2** Add 3 or 4 drops of phenolphthalein indicator to the solution in the conical flask.

Step **3** Fill a burette with sodium hydroxide solution.

Step **4** Add the sodium hydroxide solution from the burette to the conical flask until a pale pink colour remains after swirling.

Step **5** Use a pipette to transfer a further 25.0 cm^3 of the propanoic acid to the solution in the conical flask.

Step **6** Use a pH meter to measure the pH of this mixture.

The temperature of all solutions were maintained at 25 °C.

(a) State and justify why, before carrying out Step **1**, the pipette should be rinsed with propanoic acid after rinsing with deionised water.

(1)

(b) State and justify the effect, if any, on the value of K_a calculated if, in Step **3**, there is an air bubble in the tip of the burette.

(1)

(c) At the end of Step **4**, one student had a deep pink coloured solution in their conical flask.
Give a reason for the presence of this colour.

(1)

(d) The measurement uncertainty of the pipette is ±0.06 cm^3.

Calculate the percentage uncertainty when 25.0 cm^3 is added from the pipette.

(1)

(e) Describe how the pH meter should be calibrated before Step **6**.

(1)

(f) One student obtained a value of pH = 4.9 in Step **6**.

Calculate K_a, including units, giving your answer to an appropriate number of significant figures.

(2)

(Total for Question 4 = 7 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

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