Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | Candidate Number

Tuesday 23 October 2018

Morning (Time: 1 hour 15 minutes) | Paper Reference **WCH03/01**

Chemistry

Advanced Subsidiary
Unit 3: Chemistry Laboratory Skills I

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 units where appropriate.
- Check your answers if you have time at the end.

Turn over ▶

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

1 **W** is a white compound containing a Group 2 metal ion, an anion and water of crystallisation.

(a) **W** gives a red colour in a flame test.

(i) Describe how you would carry out a flame test.

(3)

(ii) Identify the metal ion by name or formula.

(1)

(b) **W** dissolves readily in distilled water to form a solution.

(i) Describe what you would **see** if some dilute sulfuric acid was added to this solution.

(1)

(ii) Write an ionic equation, with state symbols, for this reaction.

(2)

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(c) When **W** is heated in a test tube, a colourless solution forms.

As heating continues, drops of a liquid, **X**, condense at the top of the test tube. A white solid, **Y**, remains in the test tube.

On further heating, **Y** melts and a brown gas is given off. A glowing splint held just inside the test tube relights.

When heating is finished, a white solid, **Z**, remains in the test tube.

Identify, by name or formula, the substances **X**, **Y**, **Z** and the two gases given off.

(5)

X .....

Y .....

Z .....

Brown gas .....

Gas that relights a glowing splint .....

(d) A sample of **W** is heated until only solid **Z** is left.

(i) Describe how you would check that the reaction is complete.

(1)

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(ii) Calculate the formula of **W** given that 0.0100 mol of **W**, with mass 2.836 g, gave 0.0100 mol of **Z**, with mass 1.036 g.

(3)

(Total for Question 1 = 16 marks)

2 This question is about finding the identity of two organic liquids, **P** and **Q**, which have the same functional group.

P and **Q** are isomers containing carbon, hydrogen and oxygen only.

(a) When phosphorus(V) chloride is added to samples of **P** and **Q** in separate test tubes, a gas **R** is produced.

(i) Identify **R**, by name or formula.

(1)

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(ii) Give a possible reason why gas **R** forms steamy fumes when it mixes with moist air.

(1)

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(b) A few drops of acidified potassium dichromate(VI) are added to separate samples of **P** and **Q**, and the mixtures are heated.

The colour of both mixtures changes from orange to green.

(i) Identify the functional group present in **P** and **Q**.

(1)

.....

(ii) Give the **formula** for the ion responsible for the green colour of the mixtures.

(1)

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(c) State **two** observations you would make when a small piece of sodium is added to either liquid **P** or liquid **Q**.

(2)

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(d) The mass spectra of **P** and **Q** both have a molecular ion peak at $m/e = 60$.

The mass spectrum of **P** also has a peak at $m/e = 31$, which is **not** present in the mass spectrum of **Q**.

Give the formulae of the ions responsible for these peaks.

(2)

60 .....

31 .....

(e) Deduce the structural formulae of **P** and **Q**.

(2)

P

Q

(Total for Question 2 = 10 marks)

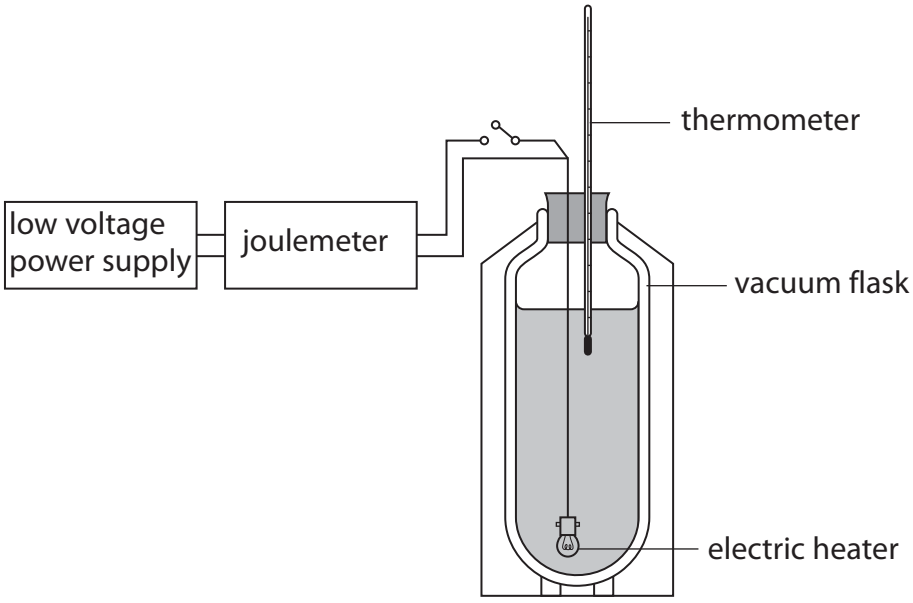
3 This question is about determining the enthalpy change of hydration of sodium thiosulfate.

$$Na_2S_2O_3(s) + 5H_2O(l) \rightarrow Na_2S_2O_3.5H_2O(s)$$

This enthalpy change cannot be measured directly.

(a) The enthalpy change when 0.10 mol of anhydrous sodium thiosulfate is dissolved in water to form a 1.0 mol dm^{-3} solution is determined.
This is carried out using an electrical compensation calorimeter.

An electrical compensation calorimeter consists of a vacuum flask with an electric heater and a thermometer, connected to a low voltage power supply and joulemeter.



The addition of the anhydrous sodium thiosulfate causes the temperature to rise by 3.0 °C.

The temperature is allowed to fall back to the starting value. The power supply is switched on and the joulemeter is used to measure the energy change required to produce the same rise in temperature.

In this experiment, 1260 J was needed.

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(i) Give **two** advantages of using an electrical compensation calorimeter compared to carrying out the reaction in a polystyrene cup.

(2)

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(ii) In this experiment, 1260 J was required to produce the same rise in temperature. Calculate the enthalpy change of solution for dissolving 1.0 mol of anhydrous sodium thiosulfate in water to form a 1.0 mol dm^{-3} solution.

$$Na_2S_2O_3(s) + aq \rightarrow 2Na^+(aq) + S_2O_3^{2-}(aq)$$

Include a sign and units with your answer.

(2)

(b) The experiment is repeated with 0.10 mol of hydrated sodium thiosulfate, $Na_2S_2O_3.5H_2O$, using the same electrical compensation calorimeter.
To allow for the water of crystallisation, slightly less than 100 cm^3 of water should be added.

(i) Calculate the amount of water that should be added.

[Density of water = 1.0 g cm^{-3}]

(3)

(ii) The enthalpy change determined for this reaction is +43.1 kJ mol^{-1}.

Explain the change in the use of the electrical compensation calorimeter needed to measure this enthalpy change.

(2)

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(iii) Calculate the enthalpy change of hydration of anhydrous sodium thiosulfate, using Hess's Law. Include a sign and units in your answer.

$$Na_2S_2O_3(s) + 5H_2O(l) \rightarrow Na_2S_2O_3.5H_2O(s)$$

(2)

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(c) (i) The temperature of the water is measured using a thermometer with an uncertainty of ±0.1 °C.
Calculate the percentage uncertainty for the measurement of the temperature rise of 3.0 °C.

(1)

(ii) The volume of water used in the first experiment is 100 cm^3.

This is measured with a 100 cm^3 measuring cylinder, reading to the nearest 1 cm^3.
Give a reason, in terms of uncertainties, why a measuring cylinder is used rather than a burette.

(1)

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(Total for Question 3 = 13 marks)

4 Obtaining pure, dry crystals of an inorganic salt from its solution is an important process in practical chemistry.

Another important process is obtaining a pure, dry organic liquid from a mixture of liquids.

(a) Both processes start by heating the mixtures.

(i) State the purpose of heating the salt solution.

(1)

(ii) Name the process used to separate two **miscible** liquids, stating why it works.

(2)

(b) Another step is to remove the impurities from both the crystals and the liquid by washing.

(i) Inorganic crystals are usually washed with distilled water.
State the **two** conditions needed to minimise the loss of product.

(2)

(ii) During the preparation of organic liquids such as halogenoalkanes, the crude product often contains acid impurities.
Name a suitable solution to remove these acid impurities.

(1)

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(c) (i) Name the process used to separate solid crystals from a solution.

(1)

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(ii) Name the piece of apparatus used to separate two **immiscible** liquids. State the property, other than immiscibility, that makes the separation possible.

(2)

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(d) Both inorganic crystals and organic liquids are usually dried.

(i) State how crystals are dried.

(1)

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(ii) Name a suitable substance for drying organic liquids.

(1)

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(Total for Question 4 = 11 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 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

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