

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)

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(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)



- (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)

- (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)

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

(1)

- (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)

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

(2)



- (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)

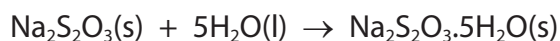
P

Q

(Total for Question 2 = 10 marks)



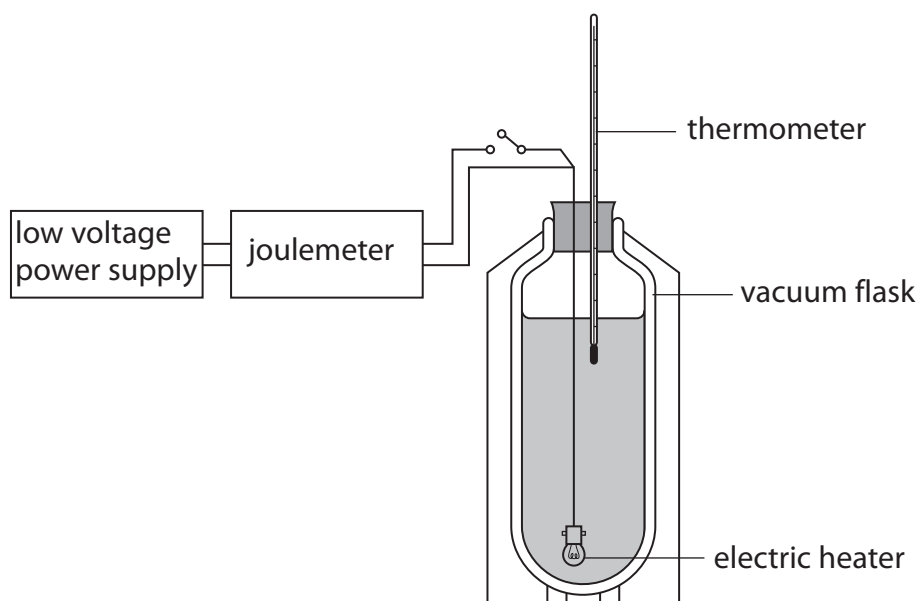
- 3 This question is about determining the enthalpy change of hydration of sodium thiosulfate.



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.

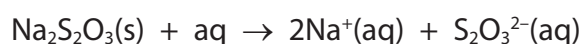
In this experiment, 1260 J was needed.



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

(2)

- (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.



Include a sign and units with your answer.

(2)

- (b) The experiment is repeated with 0.10 mol of hydrated sodium thiosulfate, Na₂S₂O₃·5H₂O, using the same electrical compensation calorimeter. To allow for the water of crystallisation, slightly less than 100 cm³ of water should be added.

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

[Density of water = 1.0 g cm⁻³]

(3)

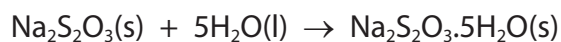


(ii) The enthalpy change determined for this reaction is $+43.1 \text{ kJ mol}^{-1}$.

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

(2)

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



(2)



- (c) (i) The temperature of the water is measured using a thermometer with an uncertainty of $\pm 0.1^\circ\text{C}$.
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)

(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)



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

(1)

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

(2)

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

(i) State how crystals are dried.

(1)

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

(1)

(Total for Question 4 = 11 marks)

TOTAL FOR PAPER = 50 MARKS



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