PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



EXAM QUESTION PACK

SECTION 3: PHYSICAL CHEMISTRY (PACK 4)

SCORE	PERCENTAGE
/42	%

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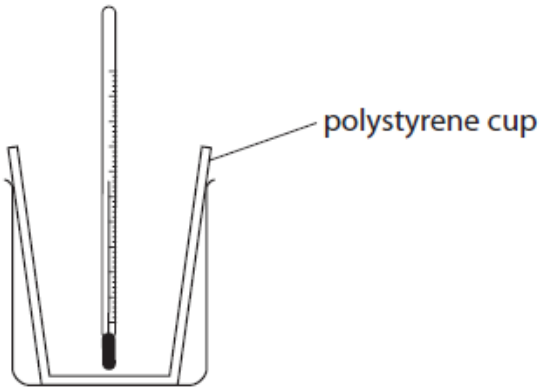
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Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A student uses this apparatus to investigate the reaction between zinc and copper(II) sulfate solution.



This is the student's method.

- add 50.0 cm^3 of copper(II) sulfate solution to the polystyrene cup
- record the initial temperature
- add excess zinc and stir
- record the highest temperature of the mixture

An exothermic reaction occurs.

(a) State what is meant by the term **exothermic**.

(1)

.....

.....

(b) This is the equation for the reaction.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

(i) What is the name of this type of reaction?

(1)

☒ **A** combustion

☒ **B** decomposition

☒ **C** displacement

☒ **D** neutralisation

(ii) Apart from the temperature increasing, give two other observations that the student could make during the reaction.

(2)

1 .....

.....

2 .....

.....

(iii) State why silver does not react with copper(II) sulfate solution.

(1)

.....

.....

(c) The table shows the student's results.

volume of copper(II) sulfate solution	50.0 cm^3
initial temperature of copper(II) sulfate solution	20.5 °C
highest temperature of mixture	37.0 °C

Calculate the heat energy change (Q) in kJ.

[for the solution, c = 4.2 J/g/°C mass of 1.00 cm^3 of solution = 1.00 g]

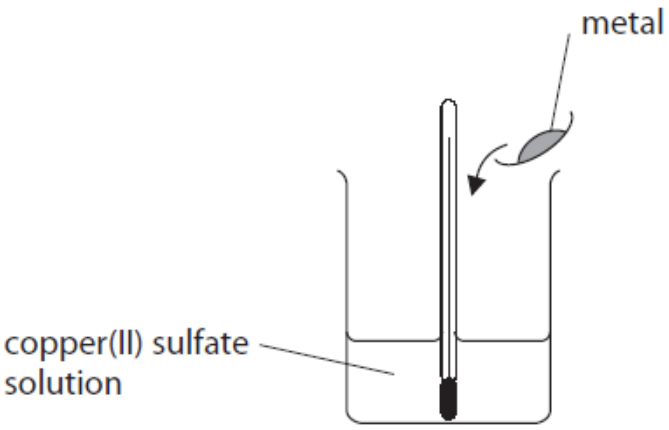
(4)

Q= ..... kJ

(Total for question = 9 marks)

Q2.

A student uses this apparatus to investigate the temperature changes that occur when metals are added to copper(II) sulfate solution.

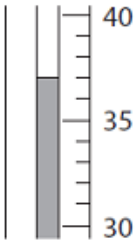
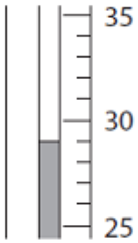
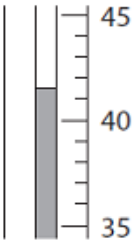
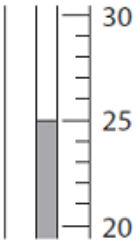
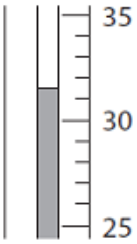


This is the student's method.

- add a sample of aluminium to a beaker containing 25 cm^3 of copper(II) sulfate solution
- stir the mixture and record the highest temperature reached

The student repeats the experiment four times, using the same amount of a different metal each time.

(a) The table shows the thermometer readings for each metal.

	Aluminium	Iron	Magnesium	Silver	Zinc
Thermometer reading					
Highest temperature reached in °C				25.0	

Complete the table by recording the highest temperature reached for each metal, giving all temperatures to the nearest 0.5 °C.

(2)

(b) The initial temperature of the copper(II) sulfate solution in each experiment is 25.0 °C.

(i) Suggest why magnesium produces the largest temperature rise.

(1)

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(ii) Explain why there is no temperature change with silver.

(2)

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(c) In the experiment with magnesium, using 25 cm^3 of solution means that the copper(II) sulfate is in excess.

In another experiment, the student uses the same amount of magnesium but adds it to 50 cm^3 of copper(II) sulfate solution.

Explain how the change in volume affects the temperature rise.

(2)

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(d) In another experiment, the student adds a metal to 45 cm^3 of copper(II) sulfate solution

and obtains a temperature rise of 15.0 °C.

The mass of 1.0 cm^3 of the solution is 1.0 g.

The specific heat capacity, c, of the solution is 4.2 J/g/°C.

Calculate the heat energy, *Q*, in kilojoules (kJ), released in this reaction.

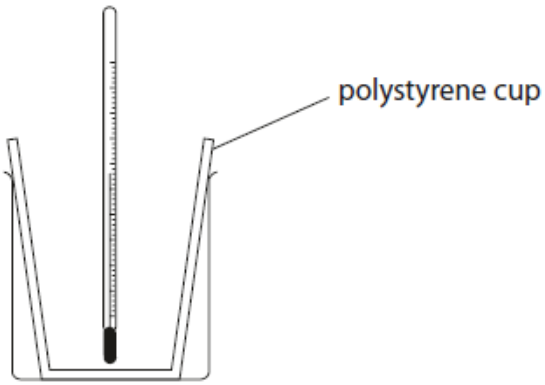
(4)

Q ..... kJ

(Total for question = 11 marks)

Q3.

A student uses this apparatus to investigate the temperature change that occurs when ammonium nitrate is dissolved in water.



She uses this method.

- put 100 cm^3 of water into the polystyrene cup and measure the initial temperature of the water
- add 8.00 g of ammonium nitrate and stir
- record the lowest temperature reached by the solution

The table shows her results.

Initial temperature of water in °C	20.0
Lowest temperature of solution in °C	14.2

(a) Use the results of the experiment to explain what type of reaction is taking place when ammonium nitrate is added to water.

(2)

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(b) Show that the heat energy change, Q, is about 2400 J.

[mass of 1.00 cm^3 of solution = 1.00 g]

[for the solution, c = 4.18 J/g/ °C]

(3)

Q = ... *J*

(c) Use your answer to part (b) to calculate the enthalpy change, ΔH, in kilojoules per mole of ammonium nitrate.

[M_r of ammonium nitrate = 80.0]

Include a sign in your answer.

(4)

ΔH = ... kJ/mol

(Total for question = 9 marks)

Q4.

The table gives information about some lead compounds.

Compound	Formula	Appearance	Solubility in water
lead(II) oxide	PbO	yellow solid	insoluble
lead(IV) oxide	PbO_2	brown solid	insoluble
red lead oxide	Pb_3O_4	red solid	insoluble
lead(II) nitrate	$Pb(NO_3)_2$	white solid	soluble

(a) When a sample of red lead oxide is heated, it changes into a yellow solid and a gas forms that relights a glowing splint.

Complete the word equation for this reaction.

(2)

red lead oxide → ..... +
.....

(b) A sample of one of the oxides of lead contains 86.6% lead and 13.4% oxygen by mass.

Show by calculation that the sample is lead(IV) oxide, PbO_2

[A_r of Pb = 207 A_r of O = 16]

(3)

(c) Red lead oxide reacts with warm dilute nitric acid.

(i) Complete the chemical equation for the reaction.

Pb_3O_4(.....) + $4HNO_3$(.....) → .....$Pb(NO_3)_2$(aq) + PbO_2(s) + ...H_2O(l)

(2)

(ii) A student is given a sample of solid red lead oxide and some dilute nitric acid.

Describe how the student could obtain a pure dry sample of lead(II) nitrate crystals.

(6)

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(Total for question = 13 marks)

Q1.