Chemistry Scholarship Paper 2015

Question 1 (14 marks)

The reaction between magnesium powder and powdered copper(I) oxide is extremely violent and is often used in chemistry demonstrations. The word equation for the reaction is shown below:

magnesium + copper(I) oxide → copper + magnesium oxide

(a) What does this reaction tell you about the relative positions of magnesium and copper in the Reactivity Series?

_____

_____ [1]

(b) (i) Which substance is being reduced during the reaction?

_____ [1]

(ii) Why can this reaction be described as a REDOX reaction?

_____

_____ [2]

(c) In terms of the particles involved, explain why the reactants should be in the form of powders.

_____

_____ [2]

(d) If 10 grams of magnesium was used would you expect the mass of magnesium oxide produced to be greater or less than 10 grams? Explain your answer.

_____

_____

_____ [2]

The chemical equation for the reaction is given below. Because the equation is balanced it shows the **ratio** in which the reactants react and in which the products are produced.

$$Mg + Cu_2O \rightarrow 2\ Cu + MgO$$

The mass of an atom is measured in atomic mass units (amu). Magnesium atoms have a mass of 24 amu whereas copper atoms have a mass of 64 amu.

(e) Using the information given above, calculate the mass of copper that would be produced if 2.5 grams of magnesium reacted completely with copper(I) oxide. **Show all of your working.**

_____

_____

_____

_____ [3]

(f) When a teacher performed the reaction using 2.5 grams of magnesium she found that the mass of copper produced was less than the value she had calculated. Apart from any error in weighing out the reactants suggest **two reasons** why the amount of copper produced was less than expected.

_____

_____

_____

_____ [2]

(g) Although this reaction is extremely exothermic it does not begin until the reactants are at a high enough temperature. Suggest a reason for this.

_____

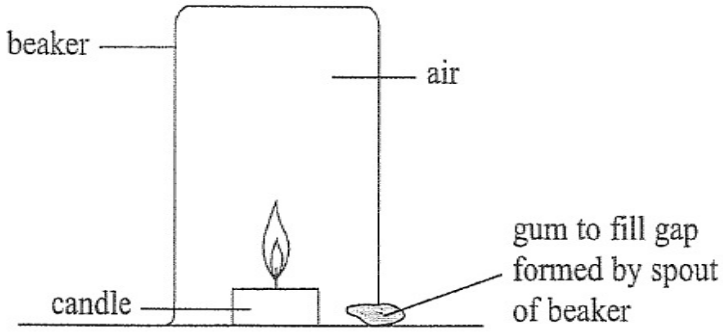
_____

_____ [1]

Question 2 (16 marks)

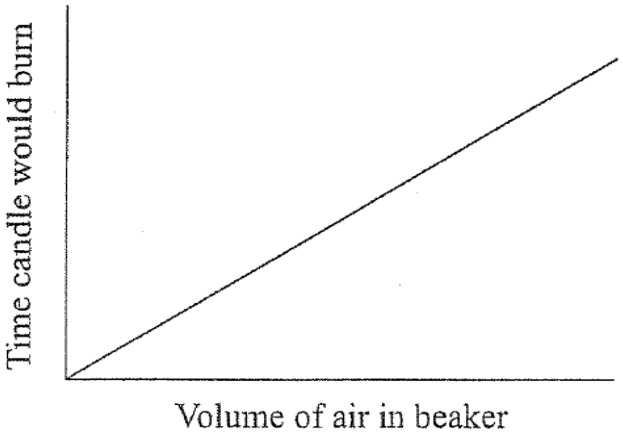
Air contains approximately 20% oxygen. When we burn a fuel in air it reacts with the oxygen.

A student investigated how long a candle would burn when covered by an upturned beaker (see the diagram below).



She repeated the experiment several times using different sizes of beaker.

(a) Before she started the experiment she sketched a graph to show how she thought the length of time the candle would burn would depend on the volume of air in the beaker.



Suggest why she thought the graph was this shape.

_____

_____

_____

_____ [2]

(b) Why is it important to seal the spout of the beaker with gum?

_____

_____ [1]

The results the student obtained are shown in the following table.

Beaker	Volume of air in beaker (cm^3)	Time for which candle burned (s)			Mean time (s)
		Run 1	Run 2	Run 3	
A	240	14	16	18	16
B	460	27	28	29	28
C	700	59	61	66	62
D	1020	68	69	73	70
E	1250	95	96	91	

(c) Suggest a method she could use to accurately measure the volume of the beaker used in each run.

_____

_____

_____ [1]

(d) Which beaker has results which are the most **reliable**? Explain your answer.

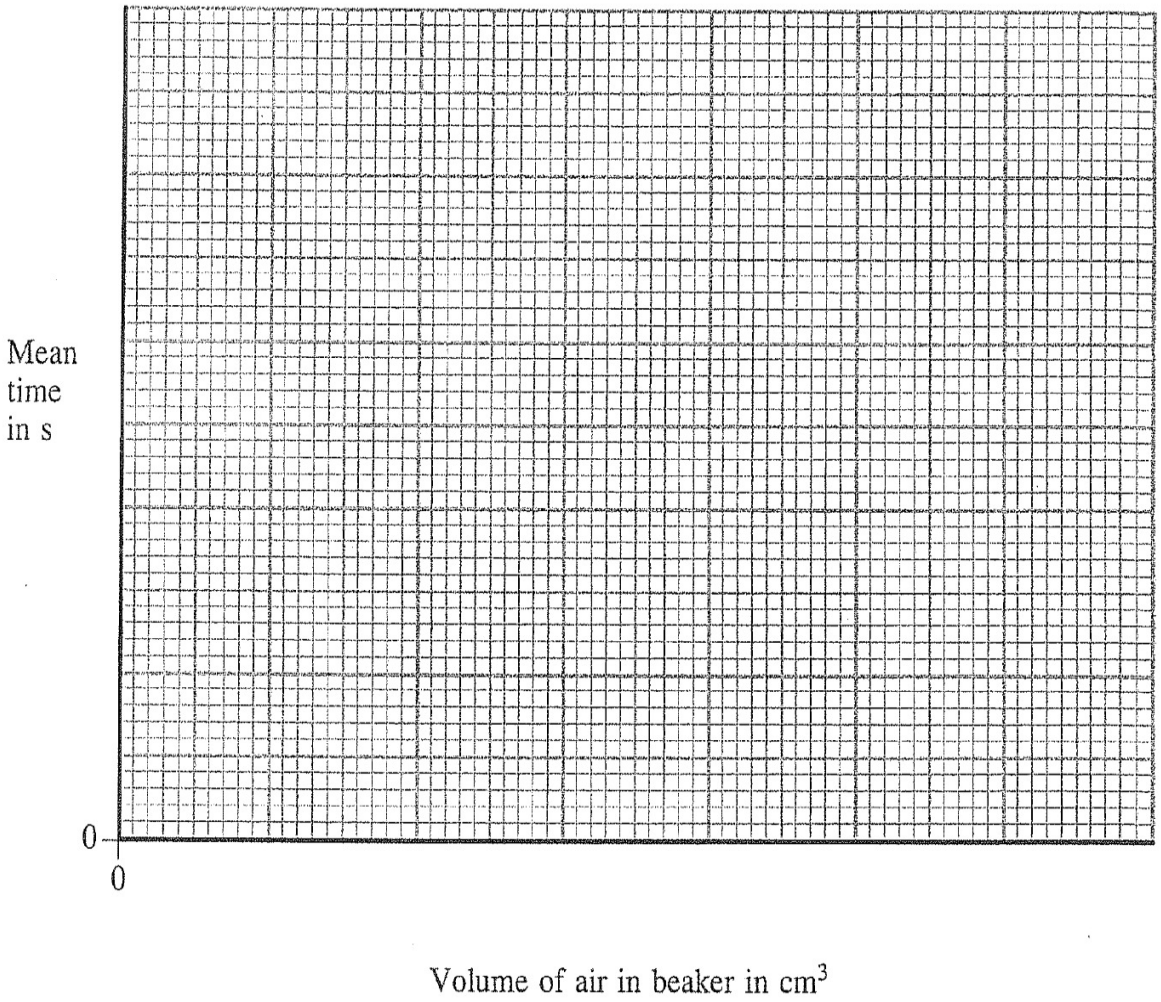
Most reliable results_____

Explanation_____

_____ [2]

(e) Calculate the mean time for beaker E. Write your answer in the space in the table. [1]

(f) (i) Draw a graph of the mean time for which the candle burned against volume of air in the beaker. [3]



(ii) One of the points on your graph is anomalous. Circle this point. [1]

(iii) Suggest and explain what may have happened in the experiment to produce this anomalous point.

_____

_____

_____

_____ [2]

(iv) She was unsure whether or not the graph line went through the origin. What further practical work should she do to help her decide?

_____

_____

_____ [1]

(g) Using the student's results, calculate how long a candle would burn in a 550 cm^3 beaker containing **pure oxygen**.

_____

_____

_____

_____ [2]

Total marks = 30

END OF PAPER