Exothermic & Endothermic Reactions

Total mark – 19

Q1.

A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

1. Measure 50 cm^3 of hydrochloric acid into a polystyrene cup.
2. Measure the temperature of the hydrochloric acid.
3. Add one spatula of metal powder to the hydrochloric acid and stir.
4. Measure the highest temperature the mixture reaches.
5. Calculate the temperature increase for the reaction.
6. Repeat steps 1 to 5 three more times.
7. Repeat steps 1 to 6 with different metals.

The table below shows the student's results.

Metal	Temperature increase in °C				Mean temperature increase in °C
	Trial 1	Trial 2	Trial 3	Trial 4	
Cobalt	6	7	5	9	7
Magnesium	54	50	37	55	**X**
Zinc	18	16	18	20	18

(a) Calculate the mean temperature increase **X** for magnesium in the table above.

Do **not** include the anomalous result in your calculation.

_____

_____

X = _____ °C

(2)

(b) Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use the table above.

Most reactive _____

_____

Least reactive _____

(1)

(c) The range of measurements either side of the mean shows the uncertainty in the mean temperature increase.

Complete the sentence.

Use the table above.

The mean temperature increase for zinc is 18 ± _____ °C

(1)

(d) What type of variable is the volume of hydrochloric acid in this investigation?

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

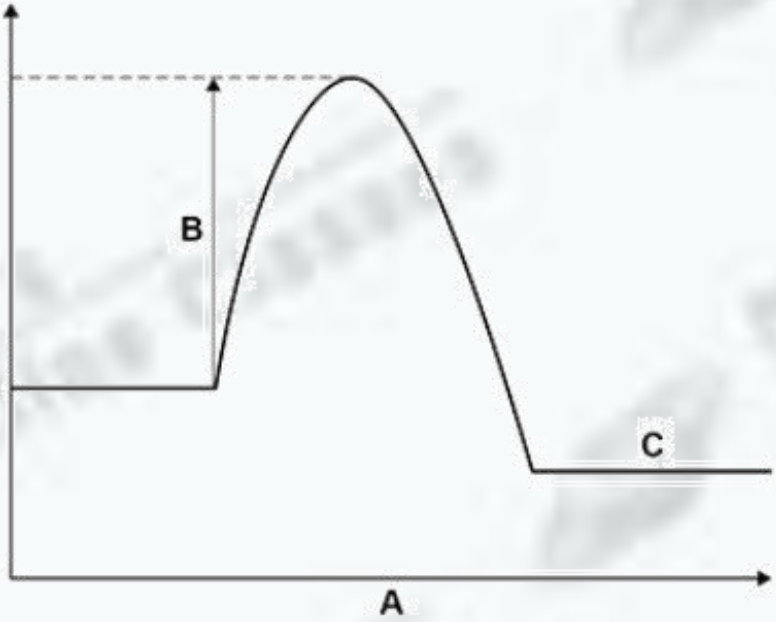
(1)

(e) Suggest **one** way of improving **step 3** in the method to give results which are more repeatable.

_____

_____

(1)



What do labels **A**, **B** and **C** represent on the figure above?

Choose answers from the box.

activation energy	**energy**	**overall energy change**
products	**progress of reaction**	**reactants**

A _____

B _____

C _____

(3)

Q2.

This question is about the reaction between hydrogen sulfide (H_2S) and oxygen.

The equation for the reaction is:

$$2\ H_2S(g) + 3\ O_2(g) \rightarrow 2\ H_2O(g) + 2\ SO_2(g)$$

(a) What does $H_2O(g)$ represent?

_____

(1)

(b) Calculate the volume of oxygen required to react with 50 cm^3 of hydrogen sulfide.

_____

_____

Volume = _____ cm^3

(1)

(c) **Figure 1** shows part of the reaction profile for the reaction.

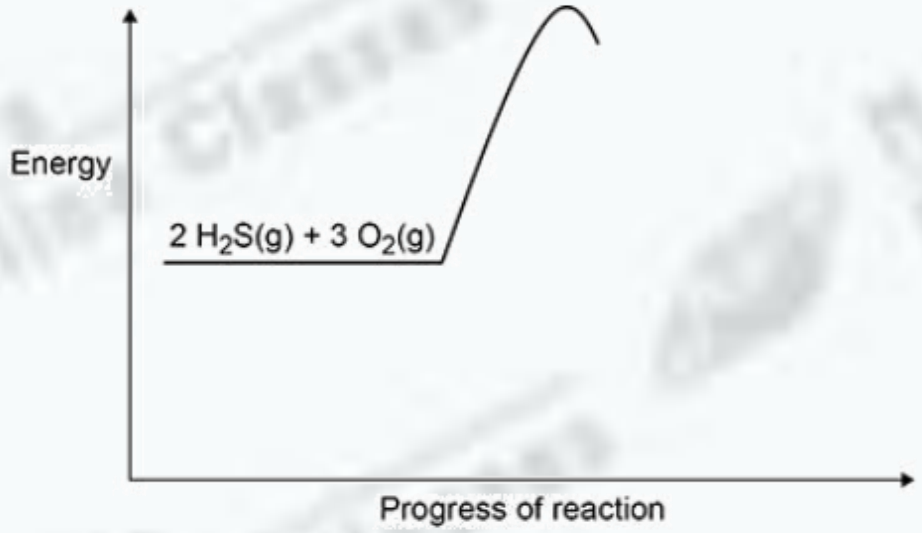
The reaction is exothermic.

Complete **Figure 1**.

You should:

- complete the profile line
- label the activation energy
- label the overall energy change.

Figure 1



(3)

(d) **Figure 2** shows the displayed formula equation for the reaction of hydrogen sulfide with oxygen.

Figure 2

The table below shows some of the bond energies.

Bond	H—S	O=O	H—O	S=O
Energy in kJ/mol	364	498	464	**X**

In the reaction the energy released forming new bonds is 1034 kJ/mol greater than the energy needed to break existing bonds.

Calculate the bond energy **X** for the bond.

Use **Figure 2** and the table above.

_____

_____

X = _____ kJ/mol

(5)