AQA – Energetics – AS Chemistry P1

1. June/ 2020/Paper_1/No.4

0 4 This question is about enthalpy changes.

0 4 . 1 State the meaning of the term enthalpy change as applied to a chemical reaction.

[1 mark]

0 4 . 2 A student determines the enthalpy change for the reaction between calcium carbonate and hydrochloric acid.

$$CaCO_3(s) + 2\,HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

The student follows this method:

- measure out 50 cm^3 of 1.00 mol dm^{-3} aqueous hydrochloric acid using a measuring cylinder and pour the acid into a 100 cm^3 glass beaker
- weigh out 2.50 g of solid calcium carbonate on a watch glass and tip the solid into the acid
- stir the mixture with a thermometer
- record the maximum temperature reached.

The student uses the data to determine a value for the enthalpy change.

Explain how the experimental method and use of apparatus can be improved to provide more accurate data.

Describe how this data from the improved method can be used to determine an accurate value for the temperature change.

[6 marks]

0 4 . 3 In a different experiment 50.0 cm^3 of 0.500 mol dm^{-3} aqueous hydrochloric acid are reacted with 50.0 cm^3 of 0.500 mol dm^{-3} aqueous sodium hydroxide.

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) \quad \Delta H = -57.1 \text{ kJ mol}^{-1}$$

The initial temperature of each solution is 18.5 °C

Calculate the maximum final temperature of the reaction mixture.

Assume that the specific heat capacity of the reaction mixture, $c = 4.18 \text{ J K}^{-1} \text{ g}^{-1}$

Assume that the density of the reaction mixture = 1.00 g cm^{-3}

[5 marks]

Final temperature _____ °C

0 4 . 4 Suggest how, without changing the apparatus, the experiment in Question **04.3** could be improved to reduce the percentage uncertainty in the temperature change.

[1 mark]

_____

_____

_____

2. June/ 2020/Paper_1/No.20

Two reactions of iron with oxygen are shown.

$$Fe(s) + \frac{1}{2}O_2(g) \rightarrow FeO(s) \qquad \Delta H = -272 \text{ kJ mol}^{-1}$$

$$2\,Fe(s) + \frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s) \qquad \Delta H = -822 \text{ kJ mol}^{-1}$$

What is the enthalpy change, in kJ mol^{-1}, for this reaction?

$$2\,FeO(s) + \frac{1}{2}O_2(g) \rightarrow Fe_2O_3(s)$$

[1 mark]

A +550 ⬭

B –278 ⬭

C –1094 ⬭

D –1372 ⬭

3. June/ 2019/Paper_1/No.1(1.5)

0 1 . 5 Hydrogen fluoride reacts with ethyne (C_2H_2) as shown in the equation. All compounds are in the gaseous state.

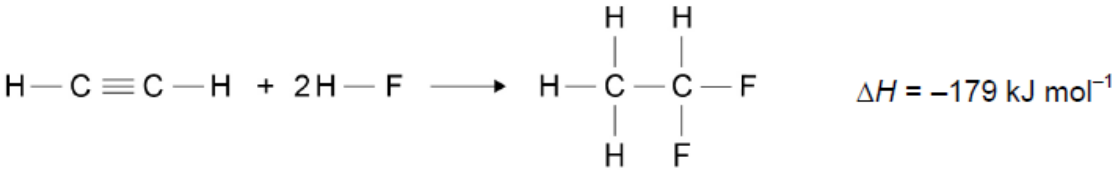

Table 1 shows some mean bond enthalpy data.

Table 1

Bond	C–H	C≡C	H–F	C–C
Mean bond enthalpy / kJ mol^{-1}	412	837	562	348

Use the data in **Table 1** to calculate a value for the bond enthalpy of a C–F bond in the product.

[3 marks]

C–F bond enthalpy _____ kJ mol^{-1}

4. June/ 2019/Paper_1/No.14

Which equation represents the reaction that has a standard enthalpy change equal to the standard enthalpy of formation for barium chloride?

[1 mark]

A $Ba(g) + Cl_2(g) \rightarrow BaCl_2(s)$ ⬭

B $Ba^{2+}(g) + 2Cl^-(g) \rightarrow BaCl_2(s)$ ⬭

C $Ba(s) + Cl_2(g) \rightarrow BaCl_2(s)$ ⬭

D $Ba^{2+}(s) + 2Cl^-(g) \rightarrow BaCl_2(s)$ ⬭

5. June/ 2019/Paper_1/No.20

Some fuel in a spirit burner is burned, and the heat produced is used to heat a container of water.

In this experiment:

The mass of water heated = m g

The temperature rise = y °C

The specific heat capacity of water = c J K^{-1} g^{-1}

What is the amount of heat energy absorbed by the water?

[1 mark]

A mcy ⬭

B $mc(y + 273)$ ⬭

C y / mc ⬭

D $(y + 273) / mc$ ⬭

6. June/ 2021/Paper_1/No.7

0 7 This question is about combustion.

0 7 . 1 State the meaning of the term standard enthalpy of combustion.

[2 marks]

0 7 . 2 A student does an experiment to determine the enthalpy of combustion of propan-1-ol ($CH_3CH_2CH_2OH$, M_r = 60.0).
Combustion of 0.497 g of propan-1-ol increases the temperature of 150 g of water from 21.2 °C to 35.1 °C

Calculate a value, in kJ mol^{-1}, for the enthalpy of combustion of propan-1-ol in this experiment.

The specific heat capacity of water is 4.18 J K^{-1} g^{-1}

[3 marks]

Enthalpy of combustion _____ kJ mol^{-1}

0 7 . 3 The enthalpy of combustion determined experimentally is less exothermic than that calculated using enthalpies of formation.

Give **one** possible reason for this, other than heat loss.

[1 mark]