AQA – Energetics – AS Chemistry P2

1. June/ 2020/Paper_2/No.1(1.1-1.2)

0 1 This question is about 1-chloropropane.

0 1 . 1 Define the term standard enthalpy of formation.

[2 marks]

0 1 . 2 The equation for a reaction used to manufacture 1-chloropropane is

$$3\,CH_3CH_2CH_2OH(l) + PCl_3(l) \rightarrow 3\,CH_3CH_2CH_2Cl(l) + H_3PO_3(s)$$

The enthalpy change for this reaction, ΔH, is -114 kJ mol^{-1}

Table 1 contains some standard enthalpy of formation data.

Table 1

Substance	$PCl_3(l)$	$CH_3CH_2CH_2Cl(l)$	$H_3PO_3(s)$
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	–339	–130	–972

Calculate a value for the standard enthalpy of formation of propan-1-ol using the enthalpy change for the reaction and data from **Table 1**.

[3 marks]

Standard enthalpy of formation _____ kJ mol^{-1}

2. June/ 2020/Paper_2/No.21

Some enthalpy change data are shown.

$$C(s) + 2H_2(g) \rightarrow CH_4(g) \qquad \Delta H = -75 \text{ kJ mol}^{-1}$$
$$H_2(g) \rightarrow 2H(g) \qquad \Delta H = +436 \text{ kJ mol}^{-1}$$

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

$$CH_4(g) \rightarrow C(s) + 4H(g)$$

[1 mark]

A –947 ⬭

B –361 ⬭

C +361 ⬭

D +947 ⬭

3. June/ 2020/Paper_2/No.22

The temperature changed from 21.8 °C to 19.2 °C during a calorimetry experiment.

The uncertainty of each reading of the thermometer is ±0.1 °C

What is the percentage uncertainty in the temperature change?

[1 mark]

A 0.5% ⬭

B 1.0% ⬭

C 3.8% ⬭

D 7.7% ⬭

4. June/ 2020/Paper_2/No.23

An experiment is done to determine the enthalpy of combustion of a fuel using a calorimeter containing water.

b = mass of fuel burned / g
w = mass of water heated / g
ΔT = temperature rise of water / K
M_r = relative molecular mass of fuel
c = specific heat capacity of water / J K^{-1} g^{-1}

Which expression gives the enthalpy of combustion (in J mol^{-1}), assuming there is no heat loss?

[1 mark]

A $-\frac{c\,w\,\Delta T\,M_r}{b}$ ⬭

B $-\frac{c\,b\,\Delta T M_r}{w}$ ⬭

C $-\frac{c\,b\,w\,M_r}{\Delta T}$ ⬭

D $-\frac{c\,b\,w\,\Delta T}{M_r}$ ⬭

5. June/ 2019/Paper_2/No.3

0 3 This question is about enthalpy changes.

0 3 . 1 A student determined the enthalpy of combustion of cyclohexane (C_6H_{12}).

The student
- placed a pure sample of cyclohexane in a spirit burner
- placed the spirit burner under a beaker containing 50.0 g of water and ignited the cyclohexane
- extinguished the flame after a few minutes.

The results for the experiment are shown in **Table 1**.

Table 1

Initial temperature of the water / °C	19.1
Initial mass of spirit burner and cyclohexane / g	192.730
Final mass of spirit burner and cyclohexane / g	192.100

The student determined from this experiment that the enthalpy of combustion of cyclohexane is –1216 kJ mol^{-1}

Use the data to calculate the final temperature of the water in this experiment.

The specific heat capacity of water = 4.18 J K^{-1} g^{-1}
The relative molecular mass (M_r) of cyclohexane = 84.0

[4 marks]

Final temperature of the water _____ °C

0 3 . 2 A data book value for the enthalpy of combustion of cyclohexane is –3920 kJ mol^{-1}

The student concluded that the temperature rise recorded in the experiment was smaller than it should have been.

Suggest a practical reason for this.

[1 mark]

_____

_____

_____

0 3 . 3 **Table 2** gives some values of standard enthalpies of combustion ($\Delta_c H^{\ominus}$).

Table 2

Substance	C(s)	$H_2(g)$	$C_6H_{12}(l)$
Standard enthalpy of combustion, $\Delta_c H^{\ominus}$ / kJ mol^{-1}	–394	–286	–3920

Use the data in **Table 2** to calculate the enthalpy change for the reaction represented by this equation

$$6\,C(s) + 6\,H_2(g) \rightarrow C_6H_{12}(l)$$

[3 marks]

Enthalpy change _____ kJ mol^{-1}

6. June/ 2021/Paper_2/No.7(7.4-7.5)

0 7 . 4 A student investigated the combustion of propanone (C_3H_6O) using calorimetry.

A copper calorimeter containing water was heated by the complete combustion of some propanone. The student did not record the final temperature of the water.

Table 3 shows the student's results.

Table 3

Mass of propanone burned / g	1.18
Mass of water / g	260
Initial temperature of water / °C	22.3
Final temperature of water / °C	Not recorded

Use the results in **Table 3** to calculate a value for final temperature of the water in the experiment.

Assume that no heat was lost in the experiment and that the heat capacity of the calorimeter is negligible.

For propanone, enthalpy of combustion = –1786 kJ mol^{-1}

For water, specific heat capacity = 4.18 J g^{-1} K^{-1}

[4 marks]

Final temperature of water _____ °C

0 7 . 5 Butan-1-ol can be added to petrol for cars.

An equation for the complete combustion of gaseous butan-1-ol is shown.

$$C_4H_9OH(g) + 6\,O_2(g) \rightarrow 4\,CO_2(g) + 5\,H_2O(g) \quad \Delta H = -2504 \text{ kJ mol}^{-1}$$

Table 4 shows some mean bond enthalpy data.

Table 4

Bond	C=O	C–H	C–O	O–H	O=O
Mean bond enthalpy / kJ mol^{-1}	805	412	360	463	496

Use these data to calculate a value for the mean C–C bond enthalpy in gaseous butan-1-ol.

[3 marks]

C–C bond enthalpy _____ kJ mol^{-1}