AQA – Energetics – A2 Chemistry P3

1. June/ 2020/Paper_3/No.5

0 5 A bomb calorimeter can be used for accurate determination of the heat change during combustion of a fuel.

A bomb calorimeter is a container of fixed volume that withstands the change in pressure during the reaction.

The fuel is mixed with pure oxygen in the calorimeter, ignited and the temperature change is recorded.

The total heat capacity (C_{cal}) of the calorimeter is calculated using a fuel for which the heat change is known.

In an experiment to calculate C_{cal}, 2.00 g of hexane (M_r = 86.0) is ignited.
A temperature change (ΔT) of 12.4 °C is recorded.

Under the conditions of the experiment, 1.00 mol of hexane releases 4154 kJ of energy when combusted.

0 5 . 1 The heat energy released in the calorimeter, $q = C_{cal}\Delta T$

Calculate the heat capacity (C_{cal}) in kJ K^{-1}

[3 marks]

C_{cal} _____ kJ K^{-1}

0 5 . 2 When the experiment is repeated with 2.00 g of octane (M_r = 114.0) the temperature change recorded is 12.2 °C

Calculate the heat change, in kJ mol^{-1}, for octane in this combustion reaction.

If you were unable to calculate a value for C_{cal} in Question **05.1**, use 6.52 kJ K^{-1} (this is **not** the correct value).

[2 marks]

Heat change _____ kJ mol^{-1}

0 5 . 3 State why the heat change calculated from the bomb calorimeter experiment is **not** an enthalpy change.

[1 mark]

0 5 . 4 The thermometer used to measure the temperature change of 12.2 °C in Question **05.2** has an uncertainty of ± 0.1 °C in each reading.

Calculate the percentage uncertainty in this use of the thermometer.

Suggest **one** change to this experiment that decreases the percentage uncertainty while using the same thermometer.

[2 marks]

Percentage uncertainty _____

Change _____

2. June/ 2020/Paper_3/No.9

Which reaction has an enthalpy change equal to the standard enthalpy of formation of silver iodide?

[1 mark]

A $Ag(g) + \frac{1}{2} I_2(g) \rightarrow AgI(s)$ ⬭

B $Ag(s) + \frac{1}{2} I_2(s) \rightarrow AgI(s)$ ⬭

C $Ag^+(g) + I^-(g) \rightarrow AgI(s)$ ⬭

D $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$ ⬭

3. June/ 2020/Paper_3/No.10

Some bond enthalpies are given.

Bond	C–H	O–H	O=O	C=O
Bond enthalpy/ kJ mol^{-1}	412	463	496	743

Which is the enthalpy change of this reaction in kJ mol^{-1}?

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

[1 mark]

A +698 ⬭

B +228 ⬭

C –228 ⬭

D –698 ⬭

4. June/ 2019/Paper_3/No.1(1.4)

0 1 . 4 The initial rate of the reaction between sodium thiosulfate and hydrochloric acid can be monitored by measuring the time taken for a fixed amount of sulfur to be produced.

Describe an experiment to investigate the effect of temperature on the initial rate of this reaction.

Include

- a brief outline of your method
- how you will measure the time taken for a fixed amount of sulfur to be formed
- how you will present your results in graphical form
- a sketch of the graph that you would expect.

[6 marks]

5. June/ 2019/Paper_3/No.8

Nitrogen dioxide is produced from ammonia and air as shown in these equations

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g) \qquad \Delta H = -909 \text{ kJ mol}^{-1}$$

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g) \qquad \Delta H = -115 \text{ kJ mol}^{-1}$$

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

$$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$$

[1 mark]

A –679 ⬭

B –794 ⬭

C –1024 ⬭

D –1139 ⬭

6. June/2021/Paper_3/No.18

A mixture of 2 dm^3 of hydrogen and 1 dm^3 of oxygen is at room temperature.

Which statement is correct?

[1 mark]

A There is no reaction to form water because the molecules do not collide with sufficient energy. ⬭

B There is no reaction to form water because the molecules do not collide with sufficient frequency. ⬭

C The mean velocity of the hydrogen molecules is less than that of the oxygen molecules. ⬭

D The partial pressure of each gas is the same. ⬭

7. June/2021/Paper_3/No.19

Which statement about the distribution curve of molecular energies in an ideal gas at a given temperature is correct?

[1 mark]

A There are no molecules with zero energy. ⬭

B The curve is symmetrical about the maximum. ⬭

C Changing the temperature has no effect on the position of the maximum. ⬭

D Most molecules have the mean energy. ⬭