Marks 4

- A mass of 1.250 g of benzoic acid, $C_7H_6O_2$, underwent combustion in a bomb calorimeter. The heat of combustion of benzoic acid is –3226 kJ mol^{-1}. What is the change in internal energy during this reaction?

The molar mass of benzoic acid is:

molar mass = (7 × 12.01 (C) + 6 × 1.008 (H) + 2 × 16.00 (O)) g mol^{-1}
= 122.12 g mol^{-1}

The number of moles of benzoic acid in 1.250 g is therefore:

number of moles = mass / molar mass = 1.250 g / 122.12 g mol^{-1}
= 0.01024 mol

As combustion of 1 mol leads to a heat change of -3226 kJ, this quantity will generate an energy change of:

q **= (0.01024 mol) × (-3226 kJ mol^{-1}) = -33.02 kJ**

Answer: **-33.02 kJ**

If the heat capacity of the calorimeter is 10.134 kJ K^{-1}, calculate the temperature change that should have occurred in the apparatus.

The heat change, *q*, and temperature change, Δ*T*, are related by the heat capacity, *C*:

$$q = C\Delta T$$

or

$$\Delta T = q / C = 33.02 \text{ kJ} / 10.134 \text{ kJ K}^{-1} = 3.258 \text{ K}$$

An exothermic reaction will lead to a temperature increase in the apparatus.

Answer: +**3.258 K**