Marks
6

- High-purity benzoic acid, C_6H_5COOH, (ΔH°_{comb} = –3227 kJ mol^{-1}) is used to calibrate a bomb calorimeter that has a 1.000 L capacity. A 1.000 g sample of C_6H_5COOH is placed in the bomb calorimeter, along with 750 mL of pure H_2O(l), and the remaining 250 mL cavity is filled with pure O_2(g) at 10.00 atm. The C_6H_5COOH is ignited and completely burned, causing the temperature of the water and the bomb calorimeter to rise from 27.20 ºC to 33.16 ºC. Write the chemical equation corresponding to the standard enthalpy of combustion (ΔH°_{comb}) of C_6H_5COOH.

Given that H_2O(l) has a heat capacity of 4.184 J K^{-1} g^{-1} and a density of 0.997 g mL^{-1}, calculate the heat capacity of the bomb calorimeter itself (in units of J K^{-1}). Ignore the heat capacity of the gases and of C_6H_5COOH.

Answer:

If 30.0% of the CO_2 produced dissolves in the water, calculate the final total pressure (in atm) inside the 250 mL cavity of the bomb calorimeter. Assume oxygen is insoluble in water and ignore the vapour pressure of water.

Answer: