Answer on Question #81387, Chemistry/ General Chemistry

Mothballs are composed primarily of the hydrocarbon naphthalene (C10H8). When 1.274 g of naphthalene burns in a bomb calorimeter, the temperature rises from 26.214 ∘C to 30.284 ∘C.

Find ΔrH for the combustion of naphthalene at 298 K. When considering phase, assume all reactants and products are at 298 K.

Solution

It seems like some data is missing in the task like heat capacity of calorimeter, but we can take some value as an example to show how to calculate $\Delta_r H$, for example, let heat capacity of calorimeter to be 5.11 kJ/^{0}C.

Then, the amount of heat released upon combustion to calorimeter:

q_{cal}=(heat capacity of calorimeter)$\times\Delta T$ =5.11 kJ/^{0}C $\times$(30.284-26.214)^{o}C =20.78 kJ

$q_{rxn} = -q_{cal}$

q_{rxn} = -20.78 kJ

$n(C_{10}H_8)$= m/M = 1.274 g/128 g/mol =0.00995 mol

q_{rxn}(per mole) =q_{rxn} /$n(C_{10}H_8)$ = -20.78 kJ/0.00995 mol = -2088.44 kJ/mol

$C_{10}H_8$ (s)+12 O_2(g) $\rightarrow$10 CO_2(g) + 4H_2O(l) -2088.44 kJ
Δn= 10-12= -2 mol
$\Delta H = \Delta E + \Delta nRT$= -2088440 J + (-2 mol)$\times$8.314 J/mol$\times$K $\times$298 K = -2093395 J =-2093 kJ

Answer: -2093 kJ