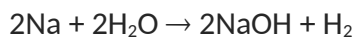


### Answer on Question #79848, Chemistry/ General Chemistry

Find the enthalpy change per mole of sodium when sodium reacts with water. 13 grams of sodium reacts with 247 cm<sup>3</sup> of water, producing a temperature change from 298 K to 339.7 K. The specific heat capacity of water is 4.18 J/K g.

#### Answer



$$\Delta H_{\text{rxn}} = -q$$

$$q = cm\Delta T$$

where

q is amount of heat absorbed/released

c is specific heat of solution (in such calculation an assumption is made that  $c_{\text{solution}} = c_{\text{water}}$ )

m is mass of solution

$\Delta T$  is temperature change

Find mass of solution:

$$m_{\text{solution}} = m(\text{H}_2\text{O}) + m(\text{Na}) - m(\text{H}_2)$$

$$m(\text{H}_2\text{O}) = V(\text{H}_2\text{O}) \times \rho(\text{H}_2\text{O}) = 247 \text{ cm}^3 \times 1 \text{ g/cm}^3 = 247 \text{ g}$$

$$m(\text{Na}) = 13 \text{ g}$$

Find  $m(\text{H}_2)$ :

$$n(\text{Na}) = m/M = 13 \text{ g} / 23 \text{ g/mol} = 0.57 \text{ mol.}$$

According to equation mole ratio  $n(\text{Na}):n(\text{H}_2) = 2:1$ , then  $n(\text{H}_2) = n(\text{Na})/2 = 0.57/2 = 0.29 \text{ mol.}$

$$m(\text{H}_2) = n \times M = 0.29 \text{ mol} \times 2 \text{ g/mol} = 0.58 \text{ g}$$

$$m_{\text{solution}} = 247 \text{ g} + 13 \text{ g} - 0.58 \text{ g} = 259.42 \text{ g}$$

$$q = 4.18 \text{ J/K g} \times 259.42 \text{ g} \times (339.7 \text{ K} - 298 \text{ K}) = 45218 \text{ J}$$

The temperature of solution increased because heat was absorbed by the solution ( $q > 0$ ).

Then  $\Delta H_{\text{rxn}} = -q = -45218 \text{ J}$  per 0.57 mol of Na

Find  $\Delta H_{\text{rxn}}$  per 1 mole of Na

$$\Delta H_{\text{rxn}} = -45218 \text{ J} / 0.57 \text{ mol} = -79331 \text{ J/mol} \cong -79 \text{ kJ/mol}$$

Answer: -79 kJ/mol