

# Calorimetry (23, 24, 25)

23) ①  $Q = mc\Delta T$  (water)

$$Q = (175 \text{ g}) \left( \frac{4.19 \text{ J}}{\text{g}^\circ\text{C}} \right) (25.7 - 19.3)$$

$$Q = 4692.8 \text{ J}$$

②  $n = \frac{m}{M}$  (substance)

$$n = \frac{0.37 \text{ g}}{23 \text{ g/mol}}$$

$$n = 0.016 \text{ mol}$$

③  $\Delta H_x = \left( \frac{-Q}{n} \right)$

$$\Delta H_x = \frac{-4697.8 \text{ J}}{0.016 \text{ mol}} = -293\,300 \text{ J/mol}$$
$$= -293 \text{ kJ/mol}$$

24) ①  $Q = mc\Delta T$  (water)

$$Q = (250 \text{ g} + 150 \text{ g}) (4.19) (20.49 - 20)$$

$$Q = 821.24 \text{ J}$$

②  $n = C \cdot V$

Use C and V for  $\text{N}_2\text{SO}_4$ , stated in question

$$n = (0.2 \text{ M}) (0.150 \text{ L})$$

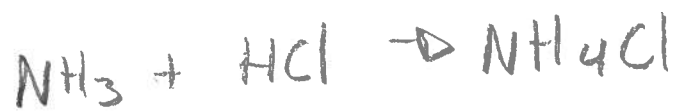
$$n = 0.03 \text{ mol}$$

③  $\Delta H_x = \frac{-Q}{n}$

$$= \frac{-821.24 \text{ J}}{0.03 \text{ mol}} = -27\,374 \text{ J/mol}$$

$$= -27.4 \text{ kJ/mol}$$

25) Two volumes and two concentrations ...  
 must find LR

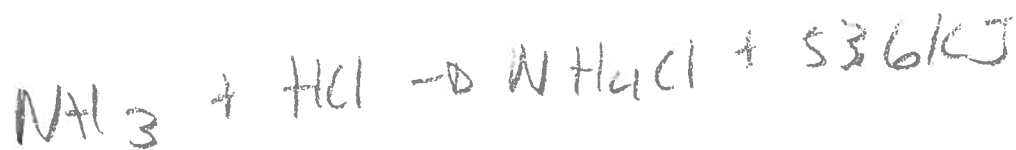


$$n_{\text{NH}_3} = (0.1\text{L})(0.2\text{M}) = 0.02\text{mol}$$

$$n_{\text{HCl}} = (0.2\text{L})(0.2\text{M}) = 0.04\text{mol}$$

less of this, use this to calculate mols.

You've been given  $\Delta H_x$  (amount of energy released per mole of ammonia.



$$\therefore \Delta H_x = -53.6\text{kJ}$$

① Find  $n$  ( $n = C \cdot V$ ) [For  $\text{NH}_3$ ]

$$n = (0.1\text{L})(0.2\text{M}) = 0.02\text{mol}$$

② Find  $Q$  ( $Q = -\Delta H_x \cdot n$ )

$$Q = -53.6 \times 0.02$$

$$Q = 1.072\text{kJ}$$

$$= 1072\text{J}$$

③ Find  $\Delta T$  ( $\Delta T = Q/mc$ )

$$\Delta T = \frac{1072}{(4.19)(100+200)} = 0.85$$

$$\Delta T = 0.85^\circ\text{C}$$

# Dimensional Analysis

## Calorimetry (#23, 24, 25)

$$23) m_{N_2} = 0.37 \text{ g}$$

$$m_{H_2O} = 175 \text{ g}$$

$$T_i = 19.3$$

$$T_f = 25.7$$

$$\Delta T = 6.4^\circ\text{C}$$

$$M_{N_2} = 22.99 \text{ g/mol}$$

$$c = 4.19 \text{ J/g}^\circ\text{C}$$

$$\underbrace{\frac{4.19 \text{ J}}{\text{g}^\circ\text{C}} \times \frac{175 \text{ g}_{H_2O}}{1} \times \frac{6.4^\circ\text{C}}{1}}_Q \times \underbrace{\frac{22.99 \text{ g}_{N_2}}{\text{mol}} \times \frac{1}{0.37 \text{ g}_{N_2}} \times \frac{1 \text{ kJ}}{1000 \text{ J}}}_n$$

$$\Delta H_x = -(291.59 \text{ kJ/mol})$$
$$= \underline{292 \text{ kJ/mol}}$$

24) Find enthalpy (kJ/mol) for  $N_2SO_4$  <sup>use C and V</sup> of  $N_2SO_4$

$$V_{BaCl_2} = 250 \text{ mL} = 250 \text{ g}$$

$$V_{N_2SO_4} = 150 \text{ mL} = 150 \text{ g}$$

$$\Delta T = 0.49^\circ\text{C}$$

$$C_{BaCl_2} = 0.12 \text{ mol/L} \quad c = 4.19 \frac{\text{J}}{\text{g}^\circ\text{C}}$$

$$C_{N_2SO_4} = 0.200 \text{ mol/L}$$

$$\frac{4.19 \text{ J}}{\text{g}^\circ\text{C}} \times \frac{(250 \text{ g} + 150 \text{ g}) 400 \text{ g}}{1} \times \frac{0.49^\circ\text{C}}{1} \times \frac{1 \text{ L}}{0.200 \text{ mol}} \times \frac{1}{0.150 \text{ L}}$$

$$\Delta H_x = -(27375 \text{ J/mol}) = -27.4 \text{ kJ/mol}$$

25) I have two volumes, two concentrations ...  
must find limiting reagent of question



$$n_{\text{NH}_3} = (0.1\text{L})(0.2\text{M}) = 0.02 \text{ mol}$$

$$n_{\text{HCl}} = (0.2\text{L})(0.2\text{M}) = 0.04 \text{ mol}$$

less of this,  $\therefore$  use this to find moles.



You've been given  $\Delta H_r$ , 53.6 kJ of energy released per mole of  $\text{NH}_3$

$$\therefore \Delta H_r = -53.6 \text{ kJ/mol}$$

$$\frac{\text{g}^\circ\text{C}}{\text{J}_{\text{H}_2\text{O}}} \times \frac{1}{(100+200) \text{ 300g}_{\text{H}_2\text{O}}} \times \frac{\Delta H_r}{1 \text{ mol}} \times \frac{\text{For NH}_3}{0.200 \text{ mol}} \times \frac{0.02}{1}$$

$$= -(-0.85^\circ\text{C})$$

$$= 0.85^\circ\text{C}$$