Calorimetry (23, 24, 25)

23) ① $Q = mc\Delta T$ (water)

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

$Q = 4692.8\,J$

② $n = \frac{m}{M}$ (substance)

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

$n = 0.016\,mol$

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

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

$= -293\,kJ/mol$

24) ① $Q = mc\Delta T$ (water)

Total V

$Q = (250g + 150g)(4.19)(20.49 - 20)$

$Q = 821.24\,J$

② $n = C \cdot V$

*Use C and V for N_2SO_4, stated in question

$n = (0.2M)(0.150L)$

$n = 0.03\,mol$

③ $\Delta H_x = \frac{-Q}{n}$

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

$= -27.4\,kJ/mol$

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

$NH_3 + HCl \rightarrow NH_4Cl$

$n_{NH_3} = (0.1L)(0.2M)$ $n_{HCl} = (0.2L)(0.2M)$
$= 0.02 mol$ $= 0.04 mol$

less of this, use this to calculate moles

• You've been given ΔH_x (amount of energy released per mole of ammonia.

$NH_3 + HCl \rightarrow NH_4Cl + 53.6kJ$

$\therefore \Delta H_x = -53.6 kJ$.

① Find n ($n = C \cdot V$) [For NH_3]

$n = (0.1L)(0.2M)$
$= 0.02 mol$

② Find Q ($Q = -\Delta H_x \cdot n$)

$Q = -53.6 \times 0.02$
$Q = 1.072 kJ$
$= 1072 J$

③ Find ΔT ($\Delta T = Q/mc$)

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

Dimensional Analysis

Calorimetry (#23, 24, 25)

23) $m_{N_2} = 0.37\,g$ $\quad M_{N_2} = 22.99\,g/mol$

$m_{H_2O} = 175\,g$ $\quad c = 4.19\,J/g^\circ C$

$T_I = 19.3$

$T_F = 25.7$ $\Big\} \Delta T = 6.4^\circ C$

$$\frac{4.19\,J}{g^\circ C_{H_2O}} \times \frac{175\,g_{H_2O}}{1} \times \frac{6.4^\circ C}{1} \times \frac{22.99\,g_{NaCl}}{mol} \times \frac{1}{0.37\,g_{NaCl}} \times \frac{1\,kJ}{1000\,J}$$

q $\qquad$ n

$$\Delta H_x = -(291.59\,kJ/mol)$$

$$= \underline{292\,kJ/mol}$$

24) Find enthalpy (kJ/mol for $N_{22}SO_4$) *use C and V of Na_2SO_4

$V_{BaCl_2} = 250mL = 250g$ $\quad C_{BaCl_2} = 0.12\,mol/L$ $\quad c = 4.19\,\frac{J}{g^\circ C}$

$V_{Na_2SO_4} = 150mL = 150g$ $\quad C_{Na_2SO_4} = 0.200\,mol/L$

$\Delta T = 0.49^\circ C$

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

$$\Delta H_x = -(27\,375\,J/mol) = -27.4\,kJ/mol$$

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

$$NH_3 + HCl \rightarrow NH_4Cl + 53.6\ kJ$$

$n_{NH_3} = (0.1L)(0.2M) = 0.02\ mol$ $\quad n_{HCl} = (0.2L)(0.2M) = 0.04\ mol$

less of this, ∴ use this to find moles.

$$NH_3 + HCl \rightarrow NH_4Cl + \underline{53.6\ kJ}$$

You've been given ΔH_x, 53.6 kJ of energy released per mole of NH_3

$\therefore \Delta H_x = -53.6\ kJ/mol$

$$\frac{g\,^\circ C}{4.19\ J} \times \frac{1}{(100+200)\,300\ g} \times \frac{-53\,600\ J}{1\ mol} \times \frac{0.200\ mol}{L} \times \frac{0.1\ L}{1}$$

(ΔH_x; For NH_3)

$= -(-0.85\ ^\circ C)$

$= 0.85\ ^\circ C$