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15a) $\Delta H = \frac{-891\text{ kJ}}{2\text{ mol } H_2O_{(l)}} = \boxed{\frac{-446\text{ kJ}}{1\text{ mol } H_2O}}$

b) $\Delta H = \frac{-891\text{ kJ}}{2\text{ mol } O_2} = \boxed{\frac{-446\text{ kJ}}{1\text{ mol } O_2}}$

16. a) $\Delta H = \frac{+90.7\text{ kJ}}{1\text{ mol Hg}} \rightarrow \boxed{\text{90.7 kJ required}}$ to produce 1 mol Hg

b) $\frac{+90.7\text{ kJ}}{\frac{1}{2}\text{ mol } O_2} = \frac{181.4\text{ kJ}}{\text{mol } O_2} \rightarrow \boxed{\text{181.4 kJ required}}$ to produce 1 mol O_2

c) $\Delta H = 2(-90.7\text{ kJ}) = -181.4\text{ kJ} \rightarrow \boxed{\text{181.4 kJ released}}$

30. $\Delta E = q + w$

$= -125\text{ kJ} + 104\text{ kJ} = \boxed{-21\text{ kJ}}$

34. a) $\Delta E = q + w$

$= -23\text{ J} + 100.\text{ J} = \boxed{77\text{ J}}$

b) $w = -P\Delta V = -(1.90\text{ atm})(2.80\text{ L} - 8.30\text{ L})$

$= 10.5\ \cancel{\text{atm}}\cdot\text{L} \times \frac{101.3\text{ J}}{\text{L}\cdot\cancel{\text{atm}}} = 1060\text{ J}$

$\Delta E = q + w$

$= 350.\text{ J} + 1060\text{ J} = \boxed{1410\text{ J}}$

c) $w = -P\Delta V = -(1.00\text{ atm})(29.1\text{ L} - 11.2\text{ L})$

$= -17.9\text{ atm}\cdot\text{L} \times \frac{101.3\text{ J}}{\text{L}\cdot\text{atm}} = -1810\text{ J}$

$\Delta E = q + w =$ ~~1037J~~ $1037\text{ J} + -1810\text{ J} = \boxed{-770\text{ J}}$

44. a) exothermic – combustion of gas releases heat

b) ~~exo~~ exothermic – condensation releases heat

c) endothermic – $CO_{2(s)} \rightarrow CO_{2(g)}$

d) endothermic – $F_{2(g)} \rightarrow 2F_{(g)}$ energy is required to break the bond.

46. a) $\Delta H = \frac{-572\text{ kJ}}{2\text{ mol } H_2O} = \frac{-286\text{ kJ}}{1\text{ mol}} \rightarrow \boxed{286\text{ kJ evolved}}$

b) $4.03\text{ g } H_2 \times \frac{1\text{ mol } H_2}{2.016\text{ g } H_2} \times \frac{-572\text{ kJ}}{2\text{ mol } H_2} = -572\text{ kJ} \rightarrow \boxed{572\text{ kJ released}}$

c) $186\text{ g } O_2 \times \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \times \frac{-572\text{ kJ}}{1\text{ mol } O_2} = -3320\text{ kJ} \rightarrow \boxed{3320\text{ kJ released}}$

d) $n_{H_2} = \frac{PV}{RT} = \frac{(1.0\text{ atm})(2.0\times10^5\text{ L})}{(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{K mol}})(298\text{ K})} = 8.2\times10^6\text{ mol } H_2$

$8.2\times10^6\text{ mol } H_2 \times \frac{-572\text{ kJ}}{2\text{ mol } H_2} = -2.3\times10^9\text{ kJ} \rightarrow \boxed{2.3\times10^9\text{ kJ of heat released!}}$

50. a) $\underbrace{2HF_{(g)}}_{2\text{ mol}} \rightarrow \underbrace{H_{2(g)} + F_{2(g)}}_{2\text{ mol}}$ $\Delta H = \Delta E + P\Delta V$

$\Delta V = 0 \quad \therefore \quad \Delta H = \Delta E$

b) $\underbrace{N_{2(g)} + 3H_{2(g)}}_{4\text{ mol}} \rightarrow \underbrace{2NH_{3(g)}}_{2\text{ mol}}$

$\Delta V < 0 \quad \therefore \quad \Delta H < \Delta E$

c) $\underbrace{4NH_{3(g)} + 5O_{2(g)}}_{9\text{ mol}} \rightarrow \underbrace{4NO_{(g)} + 6H_2O_{(g)}}_{10\text{ mol}}$

$\Delta V > 0 \therefore \Delta H > \Delta E$

52. a) $q = mc\Delta T$

$= (150.0\text{ g})(0.24\text{ J}/^\circ\text{C g})(298\text{ K} - 273\text{ K})$

$= (150.0\text{ g})(0.24\ \frac{\text{J}}{\text{g}^\circ\text{C}})(25^\circ\text{C}) = 900\text{ J} = \boxed{9.0\times10^2\text{ J}}$

2 s.f.

b) $\frac{0.24\text{ J}}{\cancel{\text{g}}^\circ\text{C}} \times \frac{107.9\ \cancel{\text{g Ag}}}{1\text{ mol }\cancel{\text{Ag}}} = \boxed{\frac{26\text{ J}}{\text{mol}^\circ\text{C}}}$

c) $q = mc\Delta T$ $\quad 1.25\text{ kJ} \times \frac{1000\text{ J}}{1\text{ kJ}} = 1250\text{ J}$

$1250\text{ J} = m(\frac{0.24\text{ J}}{\text{g}^\circ\text{C}})(15.2^\circ\text{C} - 12.0^\circ\text{C})$

$1250 = m(0.24)(3.2)$

$m = 1627.6\text{ g} = \boxed{1600\text{ g}}$

54. $q = mc\Delta T$

$585\text{ J} = (125.6\text{g})(c)(53.5°C - 20.0°C)$

$585 = (125.6)(c)(33.5)$

$c = \boxed{0.139 \frac{J}{g°C}}$

$\frac{0.139\text{J}}{\cancel{g}°C} \times \frac{200.6\cancel{g}}{1\text{mol Hg}} = \boxed{\frac{27.9\text{ J}}{\text{mol}°C}}$

56. $q_{cold} = (90.0\text{g})(4.184 \frac{J}{g°C})(37.0°C - 22.0°C)$

$= (90.0)(4.184)(15.0) = 5648.4\text{J}$

$q_{cold} = -q_{Hot}$

$5648.4\text{J} = -(m)(4.184 \frac{J}{g°C})(37.0°C - 55.0°C)$

$5648.4 = -(m)(4.184)(-18.0)$

$m = \boxed{75.0\text{g}}$

62. $\underline{1}\,NaOH + \underline{1}\,HCl \rightarrow H_2O + NaCl$

100.0mL of 1.0M (.10mol) — 100.0mL of 1.0M (.10mol) ← everything reacts!

Volume of sol'n = 100.0mL + 100.0mL = 200.0mL

mass of sol'n = $200.0\text{mL} \times \frac{1\text{g}}{1\text{mL}} = 200.0\text{g}$

$q = mc\Delta T = (200.0\text{g})(4.184 \frac{J}{g°C})(31.3°C - 24.6°C)$

$= 5606.56\text{ J} = 5.60 \times 10^3\text{ J}$ of heat lost or 5.60kJ

$\Delta H = \frac{-5.60\text{kJ}}{.10\text{mol}}$

$= \boxed{-56.0 \frac{kJ}{mol}}$

$100.0\text{mL} \times \frac{1\text{L}}{1000\text{ mL}} = .1000\text{L} \times \frac{1.0\text{Mol}}{\text{L}} = \boxed{.10\text{ mol HCl}}$

66. $\underline{2}HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2H_2O$ $\Delta H = -118\ kJ$

$$\underset{HCl}{100.0\ mL} \rightarrow .1000\ L \times \frac{0.500\ mol\ HCl}{L} \times \frac{-118\ kJ}{2\ mol\ HCl} = {}^{-}2.95\ kJ \text{ heat released}$$

$$\underset{Ba(OH)_2}{300.0\ mL} \rightarrow .3000\ L \times \frac{0.100\ mol\ Ba(OH)_2}{L} \times \frac{-118\ kJ}{1\ mol\ Ba(OH)_2} = -3.54\ kJ \text{ heat released}$$

HCl produces the smaller amt. of heat, ∴ it is limiting.

$q = 2.95\ kJ = 2950\ J$

$q = mc\Delta T$

$2950\ J = (400.0\ g)\left(4.184\ \frac{J}{g°C}\right)(\Delta T)$

$\Delta T = 1.79°C$

$\Delta T = T_f - T_i$

$1.79°C = T_f - 25.0°C$

$T_f = \boxed{26.8°C}$