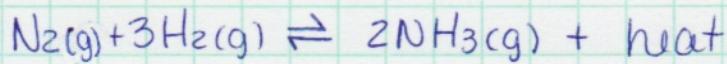


- Reaction Rates & Equilibrium



1. Adding more N_2 shifts equilibrium to the right.
2. Removing H_2 shifts equilibrium to the left.
3. Adding more NH_3 shifts equilibrium to the left.
4. Increasing temperature shifts equilibrium to the left.
5. Decreasing volume will shift equilibrium to the right because there are less mols of gas on the right side of the equation.

- Electrons

$$1. \text{ speed of light} = \text{wavelength} \times \text{frequency}$$
$$c = \lambda \times \nu$$

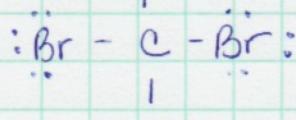
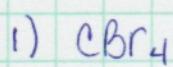
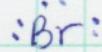
Increasing frequency (ν) will decrease wavelength (λ)

$$2) \text{ energy} = \text{Planck's constant} \times \text{frequency}$$
$$E = h \times \nu$$

Decreasing energy will decrease frequency (ν)

- 3) When heated the electrons in an atom absorb specific amounts of energy and move from one energy level to a higher energy level. This makes the electron unstable so it splits out a photon of light which has a frequency in the visible light part of the electromagnetic spectrum.

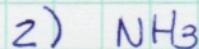
- Bonding



$$\text{C}: 1 \times 4e^- = 4e^-$$

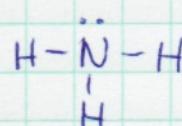
$$\text{Br}: 4 \times 7e^- = 28e^-$$

$$\underline{32e^-}$$



$$\text{N}: 1 \times 5e^- = 5e^-$$

$$\text{H}: 3 \times 1e^- = 3e^-$$



$$\frac{32e^-}{2} = 16 \text{ prs.} - 4 \text{ lines}$$

$$= 12 \text{ lone prs.}$$

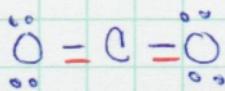
$$\frac{8e^-}{2} = 4 \text{ prs.} - 3 \text{ lines}$$

$$= 1 \text{ lone pr.}$$

(4)

3) CO₂

$$\begin{array}{l} \text{C: } 1 \times 4e^- = 4e^- \\ \text{O: } 2 \times 6e^- = 12e^- \\ \hline 16e^- \end{array}$$



$$\frac{16e^-}{2} = 8 \text{ prs} - 2 \text{ lins} \\ = 6 \text{ lone prs}$$

- Heat and Energy

$$q = mC\Delta T$$

$$\Delta T = T_f - T_i$$

- 1) If q is positive, process is endothermic (absorbing heat)
- 2) If q is negative, process is exothermic (releasing heat)

$$3) q = mC\Delta T$$

$$\begin{array}{l} q = 1251 \text{ J} \\ m = 35.2 \text{ g} \\ \Delta T = 25^\circ\text{C} \end{array}$$

$$\begin{array}{l} 1251 \text{ J} = (35.2 \text{ g}) C (25^\circ\text{C}) \\ \frac{1251 \text{ J}}{880 \text{ g}^\circ\text{C}} = \frac{(35.2 \text{ g}) C}{880 \text{ g}^\circ\text{C}} \end{array}$$

$$1.4 \text{ J/g}^\circ\text{C} = C$$

- Solutions

• Factors that affect how fast a solute can dissolve.

- 1) Stirring - more collisions b/w solute & solvent
- 2) Increasing Surface Area (breaking into pieces) - more solute available to be dissolved by the solvent
- 3) Increasing Temperature - increases speed of solute & solvent particles leading to more collisions

$$1) M = \frac{n}{V}$$


$$n = \frac{15.0 \text{ g Mg(OH)}_2}{58.33 \text{ g}} = .257 \text{ mol}$$

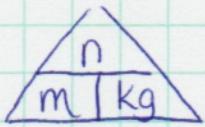
$$M = \frac{.257 \text{ mol}}{.400 \text{ L}} = .643 \text{ M}$$

$$V = 400 \text{ mL} = .400 \text{ L}$$

$$2) V = \frac{n}{M} = \frac{.137 \text{ mol}}{.76 \text{ M}} = .18 \text{ L}$$

$$3) n = M \cdot V \quad n = (1.23 \text{ M})(1.00 \text{ L}) = \frac{1.23 \text{ mol NH}_3}{1 \text{ mol}} \left| \frac{17.04 \text{ g}}{1 \text{ mol}} \right. = [21.0 \text{ g NH}_3]$$

$$4. m = \frac{n}{kg}$$



$$n = \frac{19.0\text{g NaCl}}{58.44\text{g}} \Big| \frac{1\text{mol}}{1\text{mol}} = .325\text{mol}$$

$$kg = 121\text{kg}$$

$$m = \frac{.325\text{mol}}{121\text{kg}} = .00269\text{m}$$

$$5. n = \frac{100.0\text{g CaCO}_3}{100.09\text{g}} \Big| \frac{1\text{mol}}{1\text{mol}} = .999\text{mol}$$

$$kg = 140.0\text{kg}$$

$$m = \frac{.999\text{mol}}{140.0\text{kg}} = .00714\text{m}$$

Colligative Properties

- Boiling Point Elevation - adding solute to a solvent raises the boiling pt because the solute particles physically block the solvent particles from escaping from the liquid to the gas state.
- Freezing Point Depression - adding solute to a solvent lowers the freezing pt. Because the solute particles physically interfere with the formation of the solid crystal.

$$\begin{aligned} 1) \Delta T_f &= k_f \cdot i \cdot m \\ \Delta T_f &= ? \\ k_f &= 1.86^\circ\text{C/m} \\ i &= 1 \\ m &= 1.78\text{m} \end{aligned}$$

$$\begin{aligned} \Delta T_f &= (1.86^\circ\text{C/m})(1)(1.78\text{m}) \\ \Delta T_f &= 3.3^\circ\text{C} \end{aligned}$$

$$\begin{aligned} m &= \frac{n}{kg} \\ n &= \frac{85.3\text{g O}_2}{32.00\text{g}} \Big| \frac{1\text{mol O}_2}{1\text{mol}} = 2.67\text{mol} \\ kg &= 1500\text{g} = 1.500\text{kg} \\ m &= \frac{2.67\text{mol}}{1.500\text{kg}} = 1.78\text{m} \end{aligned}$$

$$\begin{array}{rcl} \text{old } T_f & = & 0^\circ\text{C} \\ - \frac{\Delta T_f}{\text{new } T_f} & = & -3.3^\circ\text{C} \\ \hline \text{new } T_f & = & -3.3^\circ\text{C} \end{array}$$

(6)

- Acids & Bases

- Arrhenius acid - gives off H^{1+} ions in solution
- Arrhenius base - gives off OH^{1-} ions in solution
- Brønsted-Lowry acid - donates H^{1+}
Brønsted-Lowry base - accepts H^{1+}
Conjugate acid - what the base becomes after accepting H^{1+}
Conjugate base - what is left over after the acid donates H^{1+}

- strong acid - 100% completely breaks apart into ions
weak acid - 5% breaks apart into ions

4 strong acids

HCl	HNO_3
HI	H_2SO_4
HBr	$HClO_4$

$$◦ pH = -\log [H^{1+}] \quad pH + pOH = 14$$

$$1. \quad pH = -\log [4.04 \times 10^{-5}] = 4.4$$

(for HBr)

$$2. \quad pOH = -\log [8.88 \times 10^{-8}] = 7.1 \quad pH + 7.1 = 14$$

(for KOH)

$$pH = 14 - 7.1 = 6.9$$

$$3. \quad M = \frac{n}{V}$$

$$n = \frac{45.0 \text{ g } HNO_3}{163.02 \text{ g}} / 1 \text{ mol} = .274 \text{ mol}$$

$$V = 500. \text{ mL} = .5 \text{ L}$$

$$M = \frac{.274 \text{ mol}}{.5 \text{ L}} = 0.548 \text{ M}$$

$$pH = -\log [0.548]$$

$$pH = 2.25$$

$$4. \quad M = \frac{n}{V}$$

$$n = \frac{45.0 \text{ g } NaOH}{140.02 \text{ g}} / 1 \text{ mol} = 0.321 \text{ mol}$$

$$V = 500. \text{ mL} = .5 \text{ L}$$

$$M = 0.321 \text{ mol} / .5 \text{ L} = 0.642 \text{ M}$$

$$pOH = -\log [2.25]$$

$$pOH = 2.25$$

$$pH = 14 - 2.25 = 11.75$$

$$pH = 11.75$$

②