Chemistry 6A F2007

Dr. J.A. Mack

Friday!

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Draw and describe the following molecule:

NH_4^+

8 + 4×(2) = 16 electrons needed

5 + 4×(1) – 1 = 8 electrons needed

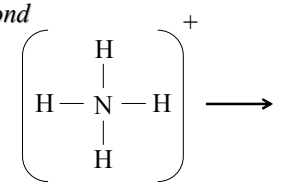
16 – 8 = 8 electrons shared

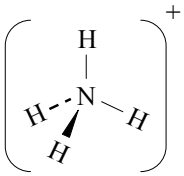
remove one for the charge!

N must go into the center since H can only have one bond

4 bonds

Tetrahedral shape!





What is the net ionic equation for the reaction of aqueous lithium hydroxide and aqueous nitric acid?

Molecular Equation:

$$LiOH(aq) + HNO_3(aq) \rightarrow H_2O(l) + LiNO_3(aq)$$

balanced? *yes!*

Ionic Equation:

$$Li^+(aq) + OH^-(aq) + H^+(aq) + NO_3^-(aq) \rightarrow$$

Net Ionic Equation: $H_2O(l) + Li^+(aq) + NO_3^-(aq)$

$$OH^-(aq) + H^+(aq) \rightarrow H_2O(l)$$

Which of the following chemical equations is an acid-base reaction?

a) $2\ HCl(aq) + Zn(s) \rightarrow H_2(g) + ZnCl_2(aq)$

b) $HCl(aq) + NH_3(aq) \rightarrow NH_4Cl(aq)$

c) $HCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + HNO_3(aq)$

d) $Ba(OH)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2\ NaOH(aq)$

e) $2\ NaOH(aq) + CuCl_2(aq) \rightarrow Cu(OH)_2(s) + 2\ NaCl(aq)$

If you chose "b" you are correct!

a) is a RedOx reaction and c) to e) are precipitation reactions!

Which species in the reaction below undergoes reduction?

$$\underset{0}{Sn(s)} + \underset{+1}{2\ H^+(aq)} \rightarrow \underset{+2}{Sn^{2+}(aq)} + \underset{0}{H_2(g)}$$

What is the oxidation number of phosphorus in P_2O_5?

O = –2

10 ÷ 2 = +5 P_2O_5 5×(–2) = –10

P = +5

All of the following are oxidation-reduction reactions EXCEPT

+2, –2 +1, –2 +2, –2, +1

a) $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$

b) $H_2(g) + Br_2(g) \rightarrow 2\ HBr(g)$

c) $Ca(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$

d) $2\ NaBr(aq) + F_2(g) \rightarrow 2\ NaF(aq) + Br_2(g)$

e) $2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$

If you chose "a" you are correct!

Predict the products of the following reactions:

magnesium metal reacts with chlorine gas to form…

$$Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$$ *balanced?*

Yep!

Solutions of nitric acid and sodium carbonate are mixed…

$$2\ HNO_3(aq) + Na_2CO_3(aq) \rightarrow H_2O(l) + CO_2(g) + 2\ NaNO_3(aq)$$

balanced?

Nope!

Which is an acid neutralization reaction?

Energy and Chemical Reactions

All chemical processes are accompanied by energy changes:

If a reaction gives off energy (***heat***), it is an ***exothermic*** reaction.

Reactants ⟶ Products + ***Energy***

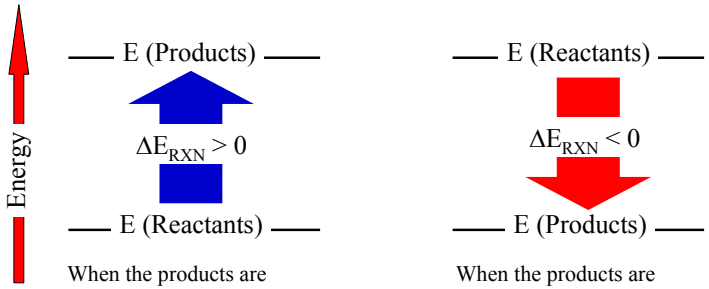
If a reaction absorbs energy (***heat***), it is an ***endothermic*** reaction.

Energy + Reactants ⟶ Products

Energy can be treated as part of the reactants or products!

Energy and Chemical Reactions

Reactants ⟶ Products



When the products are higher in energy than the reactants, the rxn is:

Endothermic

When the products are lower in energy than the reactants, the rxn is:

Exothermic

Thermochemical Equations:

When the reaction is reversed , the sign of ΔH reverses:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ $\Delta H = -802$ kJ

Exothermic

$CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$ $\Delta H = +802$ kJ

Endothermic

The amounts of substances and heat are expressed per moles.

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) + 185$ kJ

1 mole 1 mole 2 mole

How many kJ of energy are released when 23.7 g of hydrogen are reacted with excess chlorine to form hydrogen chloride.

$$23.7\text{g } H_2 \times \frac{1\text{mol } H_2}{2.02\text{g } H_2} \times \frac{185\text{kJ}}{1\text{mol } H_2} \times \frac{10^3\text{J}}{1\text{kJ}} = 2.17 \times 10^6\text{J}$$

Stoichiometric balancing coefficients

They are the numbers in front of the chemical formulas.

They give the ***ratio*** of reactants and products.

ratio ⟶ ***Conversion factors***

The balancing coefficients allow us to convert between numbers of reactants and products.

Stoichiometry: The branch of chemistry that deals with the mole proportions of chemical reactions.

Stoichiometric ratio: The ratio of any two species (reactants or products) in a balanced chemical reaction.

$$2A + 3B \longrightarrow A_2B_3$$

2 A's combine with 3B's

CONVERSION FACTORS!!!

$$\frac{2A}{3B} \qquad \frac{3B}{2A}$$

Since the individual ratios must scale to moles, we can write:

$$\frac{2A}{3B} \longrightarrow \frac{2 \text{ mols A}}{3 \text{ mols B}}$$

The molar ratios allow us to relate the amounts of reactants and products in a chemical equation.

i.e. $3 \text{ mols B} \times \frac{2 \text{ mols A}}{3 \text{ mols B}} = 2 \text{ mols A}$

Consider the following reaction:

ammonia is formed from its elements:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

1 mol 3 mol 2 mol

$$\frac{1 \text{ mol } N_2}{3 \text{ mol } H_2}$$

Consider the following reaction:

ammonia is formed from its elements:

$$3\ H_2(g) + N_2(g) \longrightarrow 2\ NH_3(g)$$

Write all of the molar ratio conversion factors for this reaction:

how many should there be? six… 3×2

$$\frac{3\text{mol } H_2}{1\text{mol } N_2} \quad \frac{1\text{mol } N_2}{2\text{mol } NH_3} \quad \frac{3\text{mol } H_2}{2\text{mol } NH_3}$$

$$\frac{1\text{mol } N_2}{3\text{mol } H_2} \quad \frac{2\text{mol } NH_3}{1\text{mol } N_2} \quad \frac{2\text{mol } NH_3}{3\text{mol } H_2}$$

Given the following reaction, how many moles of nitrogen are needed to completely react 9 moles of hydrogen?

$$3\ H_2(g) + N_2(g) \longrightarrow 2\ NH_3(g)$$

$$9\ \text{mol } H_2 \times \frac{1\text{mol } N_2}{3\text{mol } H_2} = 3\ \text{mol of } N_2$$

How many mols of ammonia will be produced?

$$3\ \text{mol of } N_2 \times \frac{2\text{mol } NH_3}{1\text{mol } N_2} = 6\ \text{mol } NH_3$$

Give the following reaction

$$2C_2H_6\ (g) + 7\ O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$$

How many moles of water are produced when 3 mols of oxygen react?

$$3.0\ \text{mol } O_2 \times \frac{6\ \text{mol } H_2O}{7\ \text{mol } O_2} = 2.6\text{mol } H_2O$$

2 sig. figs. — *exact conversion factor* — *2 sig. figs.*

How many moles of C_2H_6 must react to produce 1.75 mols of CO_2?

$$1.75\ \text{mol } CO_2 \times \frac{2\ \text{mol } C_2H_6}{4\ \text{mol } CO_2} = 0.875\ \text{mol } C_2H_6$$