Key

Station 1

Unit 4 Redox and Electrochemistry

Learning Target 4A

1. Define the terms oxidation and reduction below.

Oxidation - losing electrons / charge is increased

Reduction - gaining electrons / charge is lowered

Learning Target 4B

2. Which of the following are redox reactions? How do you know?

a. $\overset{+1}{H_2}\overset{+6}{S}\overset{-2}{O_4} + 2\overset{+1}{Na}\overset{-2}{O}\overset{+1}{H} \rightarrow 2\overset{+1}{H_2}\overset{-2}{O} + \overset{+1}{Na_2}\overset{+6}{S}\overset{-2}{O_4}$

(b.) $\overset{+1}{K_2}\overset{-2}{S} + \overset{0}{Ca} \rightarrow 2\overset{0}{K} + \overset{+2}{Ca}\overset{-2}{S}$

(c.) $2\overset{0}{Na} + \overset{+2}{Cu}(\overset{+5}{N}\overset{-2}{O_3})_2 \rightarrow \overset{0}{Cu} + 2\overset{+1}{Na}\overset{+5}{N}\overset{-2}{O_3}$

Each equation circled shows something oxidized (increasing in charge) and something reduced (decreasing in charge).

Learning Target 4C

Use the following equation for questions

$$\overset{0}{2Na} + \overset{+2}{Cu}(\overset{+5}{N}\overset{-2}{O_3})_2 \rightarrow \overset{0}{Cu} + 2\overset{+1}{Na}\overset{+5}{N}\overset{-2}{O_3}$$

3. Write oxidation numbers for each of the elements (or ions) above.

4. How many electrons are being transferred in this equation?

2 electrons

Learning Target 4D

5. What is being oxidized, what is being reduced?

a. oxidized: Na

b. reduced: Cu

6. Write the oxidation and reduction half reactions below.

a. oxidation: $2\overset{0}{Na} \longrightarrow 2\overset{+1}{Na} + 2e^-$

b. reduction: $2e^- + \overset{+2}{Cu} \longrightarrow \overset{0}{Cu}$

Learning Target 4E

7. What is the spectator ion in the equation above?

$\overset{-1}{NO_3}$

Its charge doesn't change

$$Fe_2(CO_3)_3 + 3Ag_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 3Ag_2CO_3$$

8. If you start with 3.4 moles of $Fe_2(CO_3)_3$, how many moles of $Fe_2(SO_4)_3$ will be produced?

$$3.4 \text{ mol } Fe_2(CO_3)_3 \times \frac{1 \text{ mol } Fe_2(SO_4)_3}{1 \text{ mol } Fe_2(CO_3)_3} = \boxed{3.4 \text{ mol } Fe_2(SO_4)_3}$$

9. If you want to make 5.8 moles of Ag_2CO_3, how many moles of $Fe_2(CO_3)_3$ should you start with?

$$5.8 \text{ mol } Ag_2CO_3 \times \frac{1 \text{ mol } Fe_2(CO_3)_3}{3 \text{ mol } Ag_2CO_3} = 1.93 \text{ mol } Fe_2(CO_3)_3$$

Station 2

Unit 5 Reaction Rates and Equilibrium

Learning Target 5A

1. You are reacting 1M sulfuric acid and 2.0g of solid Copper. List 5 ways to speed up this reaction below.

(1) increase temperature
(2) increase surface area
(3) increase concentration
(4) increase [redacted] amount of stirring
(5) add a catalyst

Learning Target 5B

2. Which of the following reactions would happen the most slowly? Explain.

(a.) 1M sulfuric acid at 25 degrees C. ← has the lowest concentration and the lowest temperature

b. 2M sulfuric acid at 25 degrees C

c. 6M sulfuric acid at 50 degrees C.

3. The chemical reaction that represents burning methane gas in the lab is as follows:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

If 1 Joule of energy is release every 10 seconds, what steps can be taken to decrease the time to 5 seconds (make the reaction rate faster?)

~~a.~~ use more concentrated methane, providing more particles which would ~~decrease~~ the chance of an oxygen particle colliding with a methane particle

~~b.~~ use ~~less~~ concentrated methane, providing ~~fewer~~ particles which would decrease the chance of an oxygen particle colliding with a methane particle

(c.) use more concentrated methane, providing more particles which would increase the chance of an oxygen particle colliding with a methane particle

~~d.~~ use ~~less~~ concentrated methane, providing fewer particles which would increase the chance of a oxygen particle colliding with a methane particle

Learning Target 5G

Use the following reaction to answer the questions below.

$$NH_3 + HCl \leftrightarrows NH_4Cl$$

4. Which way would the reaction shift if ammonia (NH_3) is added?

To the right

5. List 2 ways you could shift the reaction to the left?

(1) Add more NH_4Cl
(2) Remove some NH_3 or HCl
(3) Decrease the pressure
(4) Increase the volume

Station 3

Unit 6 Stoichiometry (G-J)

Learning Target 6G

1. Find the molar mass of the following elements and compounds:

a. Mg

24.3 amu

b. O_2

16 x 2 = **32 amu**

c. $Ca(OH)_2$

Ca: 40
O: 16 x 2 = 32
H: 1 x 2 = 2

74 amu

d. $Al_2(SO_4)_3$

Al: 27 x 2 = 54
S: 32 x 3 = 96
O: 16 x 12 = 192
342

342 amu

Learning Target 6H

2. A 1.2 mole sample of LiBr will have a what mass? Describe in words how you found this answer.

$$1.2 \text{ mol LiBr} \times \frac{86.8 \text{ g LiBr}}{1 \text{ mol LiBr}} = 104.2 \text{ g LiBr}$$

I knew Li has an atomic mass of 6.9 and 79.9, so 1 mole of LiBr would have 86.8 g (6.9+79.9) in 1 mole. I then used dimensional analysis to cancel out the mol LiBr unit & convert into g LiBr.

3. Show your work for determining the number of moles in 10.2g of CO_2.

$$10 \text{ g } CO_2 \times \frac{1 \text{ mol } CO_2}{44 \text{ g } CO_2} = .23 \text{ mol } CO_2$$

CO_2 molar mass
C: 12
O: 16 x 2 = 32

4. Show the dimensional analysis for turning 5.8g of BF_3 into moles.

$$5.8 \text{ g } BF_3 \times \frac{1 \text{ mol } BF_3}{67.8 \text{ g } BF_3} = .086 \text{ mol } BF_3$$

BF_3 molar mass
B: 10.8
F: 19 x 3

Learning Target 6I

5. Show your work for determining the number of molecules in 0.75 mol of AgCl (AKA particles)

$$.75 \text{ mol AgCl} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol AgCl}} =$$

6. Show your work for determining the number of moles in 4.52×10^{24} molecules. (AKA particles)
(More on back)

$$4.52 \times 10^{24} \text{ particles} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} =$$

Learning Target 6J

Use the following equation to answer questions 5-9.

$$\_1\_ Li_2SO_4 + \_1\_ MgCO_3 \rightarrow \_1\_ Li_2CO_3 + \_1\_ MgSO_4$$

7. Balance the equation above.

8. What is the correct mole to mole ration between Li_2SO_4 and $MgCO_3$?

1:1

9. What is the correct mole to mole ration between $MgSO_4$ and $MgCO_3$?

1:1

Use the following equation to answer the question below.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

10. How many moles of CH_4 are required to completely react with 1.2 moles of O_2?

$$1.2 \text{ mol } O_2 \times \frac{1 \text{ mol } CH_4}{2 \text{ mol } O_2} = \boxed{.6 \text{ mol } CH_4}$$

Station 4

Unit 6 Stoichiometry (K-N)

Learning Target 6K

Use the following equation to answer the questions below.

$1Mg\ (s) + 2\ HCl\ (aq) \rightarrow 1MgCl_2\ (aq) + 1H_2(g)$

1. If you start with 5.6g of Mg, how many moles of Hydrogen has would be produced?

$$5.6\ g\ Mg \times \frac{1\ mol\ Mg}{24.3\ g\ Mg} \times \frac{1\ mol\ H_2}{1\ mol\ Mg} = \boxed{.23\ mol\ H_2}$$

2. If you start with 10.2mol of HCl, how many grams of $MgCl_2$ would be produced?

$$10.2\ mol\ HCl \times \frac{1\ mol\ MgCl_2}{2\ mol\ HCl} \times \frac{95.3\ g\ MgCl_2}{1\ mol\ MgCl_2} = \boxed{486\ g\ MgCl_2}$$

Molar mass of $MgCl_2$

Mg : 24.3

Cl_2 : 35.5 x 2 = 71

3. If you need to make 50g of $MgCl_2$, how many grams of HCl should you start with?

$$50\ g\ MgCl_2 \times \frac{1\ mol\ MgCl_2}{95.3\ g\ MgCl_2} \times \frac{2\ mol\ HCl}{1\ mol\ MgCl_2} \times \frac{36.5\ g\ HCl}{1\ mol\ HCl} = \boxed{38.3\ g\ HCl}$$

Learning Target 6L

4. If 2.0 moles of Mg is reacted with 3.0 moles of HCl, what is the limiting reactant?

$$2\ mol\ Mg \times \frac{1\ mol\ H_2}{1\ mol\ Mg} \times \frac{2\ g\ H_2}{1\ mol\ H_2} = 4\ g\ H_2$$

$$3\ mol\ HCl \times \frac{1\ mol\ H_2}{2\ mol\ HCl} \times \frac{2\ g\ H_2}{1\ mol\ H_2} = 3\ g\ H_2$$

3 moles of HCl because it produces less product (H_2).

Learning Target 6M

5. If 4.5 moles of Mg are reacted with 3.5 moles of HCl, what is the excess reactant?

$$4.5\ mol\ Mg \times \frac{1\ mol\ MgCl_2}{1\ mol\ Mg} = 4.5\ mol\ MgCl_2$$

$$3.5\ mol\ HCl \times \frac{1\ mol\ MgCl_2}{2\ mol\ HCl} = 1.75\ mol\ MgCl_2$$

4.5 mol of Mg because it could make more product if there was more of the limiting reactant (HCl).

6. If you did #5 in the lab, what chemicals would be found in the container when the reaction was over?

Excess Mg
& the products ($MgCl_2$ & H_2)

Learning Target 6N

7. If 2.5g of $MgCl_2$ are created in the lab, but 3.05g are predicted using stoichiometry, what is the percent yield?

$$\text{Percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

$$\frac{2.5\text{g } MgCl_2}{3.05\text{g } MgCl_2} \times 100 = \boxed{82\% \text{ yield}}$$

Station 5

Unit 7 Solutions and Unit 8 Acids and Bases

Learning Target 7D

1. How many moles of $Mg_3(PO_4)_2$ are in 0.55L of a 0.85M solution?

$M = \frac{mol}{L}$ $.85 = \frac{mol}{.55}$ $mol = .47$

.47 moles of $Mg_3(PO_4)_2$

2. How many moles of NaBr are in 40mL of a 1.7M solution?

$M = \frac{mol}{L}$ $.04\left(1.7 = \frac{mol}{.04}\right).04$ $mol = .068$

$40mL \times \frac{1L}{1000mL} = .04$

.068 moles

Learning Target 8F

3. Label each of the following as describing an acid or a base?
   a. accept a proton (hydrogen) base
   b. donate a proton (hydrogen) acid
   c. ionize to produce H+ acid
   d. ionize to produce OH- base

Use the list below to answer the following questions.

a. HBr
b. HN_4Cl
c. $Fe(OH)_3$
d. HNO_3
e. $Mg(OH)_2$
f. CuI_2

4. Which of the substances above are acids?

a, b, d

5. Which are bases?

c, e

6. Which are salts?

f

Learning Target 8J

7. What is the pH of a 0.001M solution of HNO_3?

$pH = -\log[H^+]$ $pH = -\log(.001)$ $pH = 3$

8. What is the pH of a 0.00023M solution of H_2SO_4?

$pH = -\log[H^+]$ $pH = -\log(.00023)$ $pH = 3.64$

9. Circle the substance below with the highest pH.

a 0.1M HCl, $-\log(.1)$ 1

b. 0.0001MHCl, $-\log(.0001)$ 4

c. 0.1M $Ca(OH)_2$, $pOH = -\log[OH]$ $pOH = 1$ $pH = 14 - pOH$ $pH = 13$ * highest pH

d. 0.0001M $Ca(OH)_2$ $pOH = 4$ $pH = 14 - 4$ $pH = 10$

Learning Target 8O

10. If 10mL of 0.2M HCl were titrated with 10mL of 0.2M NaOH, would the solution be acid, basic, or neutral?

Neutral - the acids balances out the bases

11. If 25mL of 0.1M HCl were titrated with 10mL of 0.1M LiOH, would the pH be greater, than equal to, or less than 7?

Less than 7 because there's more HCl than LiOH (and their concentrations are the same).

12. If 35mL of 0.5M HCl were titrated with 50mL 0.6M NaOH, what would be the expected pH (greater than, equal to, or less than 7)?

Greater than 7
There's more of the base AND the base is stronger than the acid.

Station 6

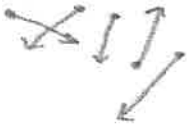
Unit 9 Thermochemistry

Learning Target 9A

1. Draw a diagram of molecules at low energy vs. molecules at high energy.

molecules at low energy

molecules at high energy



Learning Target 9E

2. Does energy move from hot to cold or cold to hot?

hot to cold

Substance	Specific Heat J/g°C
Air	1.01
Aluminum	0.902
Copper	0.385
Gold	0.129
Iron	0.450
Mercury	0.140
NaCl	0.864
Ice	2.03
Water	4.18

Learning Target 9H

3. Of the choices above, which material would have the smallest temperature change if 100J of energy were added to a 10 g sample?

Water because it has the highest specific heat (4.18 J/g°C)

4. Which material above would require the most energy to increase its temperature by 10 degrees Celsius? Which would require the least?

Water would require the most (highest specific heat)
Gold would require the least (lowest specific heat)

5. Of the following options, which material would require ~~more~~ most energy to heat from 20 to 40 degrees Celsius?

a. Aluminum .902
b. Copper .385
c. Iron .45
d. Gold .129

$E = m\ C_p\ \Delta T$ (energy, mass, specific heat, temperature)

Learning Target 9I

6. If heat was added to 100g of water and the temperature of the water increased from 10°C to 20°C, how much energy was added?

$E = (100g)(4.18\ J/g°C)(20° - 10°)$

$E = 4,180\ J$

7. If 1gram of gold is given 500J of energy and at a temperature of 23°C, what would the temperature of the gold rise to?

$500J = (1g)(.129\ J/g°C)(T_f - 23°)$

$\frac{500}{.129} = \frac{.129(T_f - 23)}{.129}$

$3875 = T_f - 23$

$+23 \quad +23$

$3898 = T_f$

$T_f = 3898°C$

*get specific heat (look up on google)

8. If 4,000J of energy were added to 5.5grams of Aluminum at 16°C, what would be the final temperature of the Aluminum?

$4000 = (5.5)(.902)(T_f - 16)$

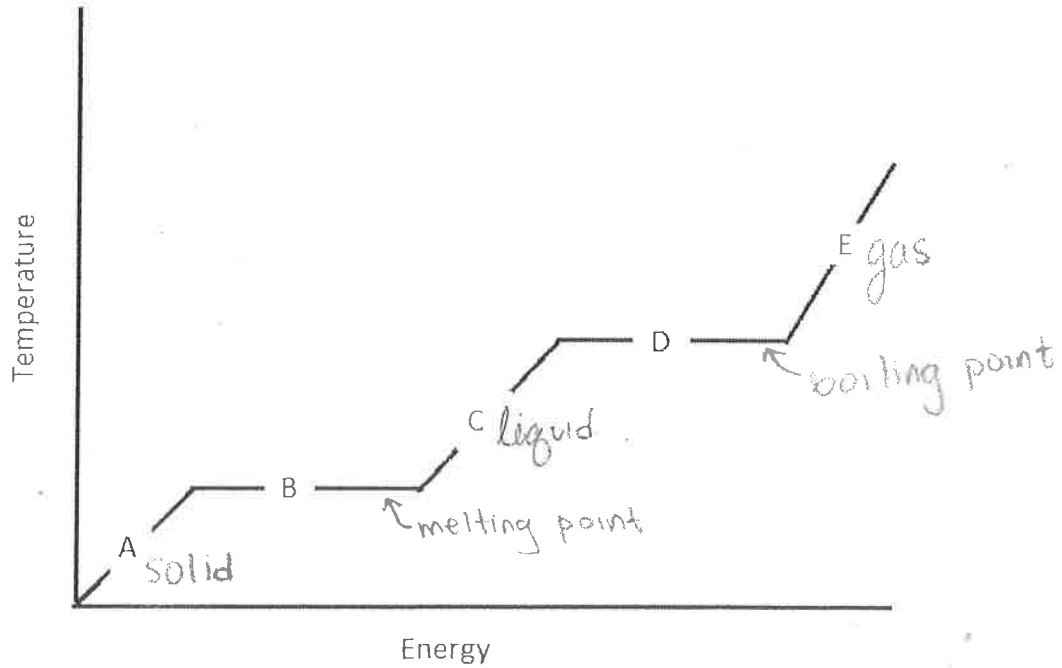
$\frac{4000}{4.961} = \frac{4.961(T_f - 16)}{4.961}$

$806.29 = T_f - 16$

$+16 \quad +16$

$T_f = 822.3°C$

Learning Target 9M



9. Label ~~Solid~~, ~~Liquid~~, ~~Gas~~, Melting, and Boiling in the diagram above.
10. Does the graph above show an endothermic or exothermic reaction?

exothermic - releases heat & increases temperature

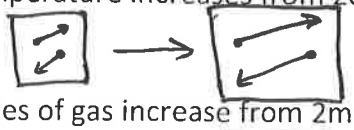
Station 7

Unit 10 Gases

Learning Target 10B

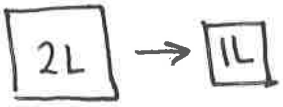
1. Draw diagrams (that include the molecules) to represent the following changes.

   a. Temperature increases from 200K to 300K



   b. moles of gas increase from 2mol to 4mol

   c. volume decreases from 2L to 1L



Learning Target 10D

2. Draw graphs representing the following relationships.

   a. Temperature vs. Volume

   b. Pressure vs. Volume

Learning Target 10F

3. If the pressure of a container increases, what happens to the volume? Explain.

Volume decreases. Volume & pressure are inversely related.

4. If the temperature decreases, what happens to pressure? Explain.

Pressure decreases. Pressure and temperature are directly related

5. If a gas has a volume of 10L at a pressure of 0.85atm, what would happen to pressure if the volume is increased to 15L?

$V_1 = 10L$
$P_1 = .85atm$
$P_2 = ?$
$V_2 = 15mL$

$P_1V_1 = P_2V_2$

$\frac{(.85)(10)}{15} = \frac{P_2(15)}{15}$

$P_2 = 5.67\ atm$

6. If a gas starts at a pressure of 14.4psi at 25° C and the pressure is increased to 12.2psi, what would happen to temperature if volume and moles remain constant?

$P_1 = 14.4$ psi
$T_1 = 25°C$
$P_2 = 12.2$ psi
$T_2 = ?$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\quad \frac{25 \times 12.2}{14.4} = \frac{14.4\,T_2}{14.4}$

$\frac{14.4}{25} = \frac{12.2}{T_2}$

$\boxed{T_2 = 21.18°C}$

Learning Target 10G

7. A container has a volume of 1.5L at a temperature of 279K and a pressure of 1.2atm. How many moles of gas are in the container?

$PV = nRT$ $\quad \frac{(1.2)(1.5)}{(.082)(279)} = \frac{n(.082)(279)}{(.082)(279)}$

$\boxed{n = .079 \text{ moles}}$

8. 5.7grams of calcium carbonate (100.08 g $CaCO_3$ = 1 mol $CaCO_3$) is placed in a 3.0 L evacuated container and allowed to completely decompose according to the equation

$$CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$$

if after the reaction the temperature of the system is 271 K, what is the final pressure in the container?

$P = ?$
$V = 3L$
$n = ?$
$R = .082$
$T = 271$

Step 1 : solve for n

$5.7\text{g } CaCO_3 \times \frac{1 \text{ mol } CaCO_3}{100.08 \text{ g } CaCO_3} = .057 \text{ mole}$

Step 2 : solve for P

$\frac{P(3)}{3} = \frac{(.057)(.082)(271)}{3}$

$\boxed{P = 1.27 \text{ atm}}$