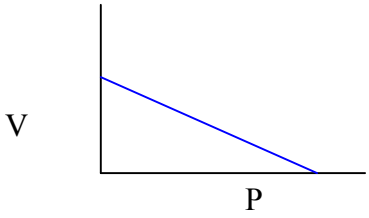
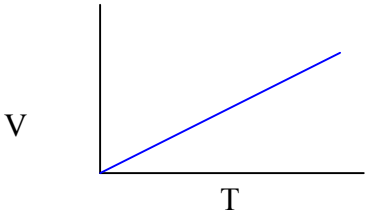
Name: _____ Date:_____

Chemistry 20 – Summative 2 Review KEY

1. Sketch a graph illustrating Boyle's Law



Sketch a graph illustrating Charles' Law



2. Convert the following using $^{o}C = K - 273.15$
1.00 atm = 101.3 kPa = 760 mmHg 1.0 psi = 6.9 kPa

250.4 K = ___-22.8_C 25.25 ^{o}C = __298.40_K 222 K = ___-51__^{o}C
200 kPa = ___1.50 x 10^3 mmHg 300kPa = _2.96__atm 45.0 psi = _311___kpa

3. What is SATP?
The temperature is ^{o}C ____25__ and ___298.15_K. The pressure is ____100.000__ kPa
4. What is STP?
The temperature is ^{o}C __0____ and ____273.15__K. The pressure is __101.325_ kPa

GAS LAWS - Combined ($P_1V_1T_2 = P_2V_2T_1$) and Ideal ($PV = nRT$)

5. A 10.0 L propane tank on a BBQ gas at 25.0^{o}C has a pressure of 150 kPa if the temperature drops to –25.0 what is the new pressure?

$P_2 = (P_1V_1T_2)/(V_2T_1) = (150kPa \times 10.0L \times 248K)/(10L \times 298K) = 125kPa$

6. A hot air balloon has a volume of 345 L at SATP, what is the new volume when the balloon is at 1000 m above the surface where the pressure is 80.0 kPa and 8.0^{o}C.

$V_2 = (P_1V_1T_2)/(P_2T_1) = (100kPa \times 345L \times 281.15K)/(80kPa \times 298.15K) = 4.1 \times 10^2 L$

7. A helium balloon at 22.0^{o}C aand 100 kPa has a volume of 5.55 L. Calculate the volume of the balloon after it rises 10 km up into the atmosphere where the temperature is –36.0^{o}C and the outside air pressure is 28.0 kPa.

$V_2 = (P_1V_1T_2)/(P_2T_1) = (100kPa \times 5.55L \times 237.15K)/(28kPa \times 298.15K) = 15.9L$

8. A 1.00 L container of $CO_{2\,(g)}$ in Mr. Urlacher's prep room is pressurized to 1100 kPa at 20.0^{o}C. What volume of gas would fill the room when the pressure in the room is 100 kPa at 20.0^{o}C?

$V_2 = (P_1V_1)/(P_2) = (1100kPa \times 1.00L)/(100kPa) = 11.0L$

9. Freon (CFC) is used in many air conditioners. If 500 mL of freon at 1.50 atm and 24.0^{o}C is compressed to 250 mL at 3.50 atm what is the final temperature of the gas. (K and ^{o}C)

$T_2 = (P_2V_2T_1)/(P_1V_1) = (354.55kPa \times 0.250L \times 297.15)/(151.95kPa \times 0.500L) = 347K = 73.7^{o}C$

10. One teaspoon of baking soda produces about 0.13 g of carbon dioxide during baking. What volume of gas is produced in a cake while baking at a temperature of 200^{o}C and a pressure of 100 kPa?

$V = (nRT)/(P) = (0.002953\ldots mol \times 8.314 \times 473K)/100kPa = 0.12L$

11. What is the mass of $He_{(g)}$ that fills a hot air balloon with volume of 1100 L and a pressure of 87.00 kPa and a temperature of 10.0°C?

m=(MPV)/(RT)=(4.00x87.00x1100)/(8.314x283.2)=163g

12. What volume would 5.00 g of methane occupy at STP?

V=(mRT)/(MP) = (5.00g x 8.314 x 273.15K)/(16.05g/mol x 101.325kPa) = 6.98L

13. What volume would 5.00 g of methane occupy at SATP

V=(mRT)/(MP) = (5.00g x 8.314 x 298.15K)/(16.05g/mol x 100.000kPa) = 7.72L

14. A BBQ propane tank holds 20 lbs of propane (20 lbs = 9.08 kg). If the tank was opened what volume would the gas take up at SATP?

V=(mRT)/(MP) = (9080g x 8.314 x 298.15K)/(44.11g/mol x 100.000kPa) = 5103 L

15. What is the pressure exerted on a compressor when a 5.00 L tank of is filled with 29.6 g of oxygen at 25°C?

P=(mRT)/(MV)=(29.6g*8.314(L*kPa)/(K*mol)298.15K)/(5.00L*32.00g/mol)=458 kPa

16. A 200 L propane tank is used to heat a home. The tank can be filled to a maximum pressure of 800 kPa at 30°C. What mass of gas can be added to the tank.?

m=(MPV)/(RT)=(44.11x800x200)/(8.314x303.2)=2.80 x 10^3g

17. At a vehicle manufacturing factory a technician adds 0.0794 g of a gas into each headlight bulb. The bulbs contain 10.00 mL of gas at 150 kPa and 25°C. Calculate the molar mass of this gas. What kind of gas is placed in vehicle headlights?

M=(mRT)/(PV) = (0.0794g x 8.314 x 298K)/(150kPa x 0.01000L) = 131.15g/mol = Xenon

18. A plant uses 9.86 L (17.5 g) of this gas per day at SATP? What is the molar mass of the gas? Identify the gas?

M=(mRT)/(PV)=(17.5x8.314x298.15)/(100.000x9.86)=44.00 g/mol (propane)

19. A company that produces natural gas creates 1.315 kg of polluting gas per day. The volume of this gas at 100.0 kPa and 20.0°C is 500.0 L. What is the molar mass of the gas and what is its identity.

M=(mRT)/(PV) = (1315g x 8.314 x 293K)/(100.0kPa x 500.0L) = 64.07g/mol

20. Design an experiment to test one of the gas laws (Boyles, Charles, or Ideal). Assume you have only everyday materials available to you , such as a pump, a pressure guage, a pail with lid, hot plate, scale, measuring tape, measuring cup or graduated cylinder, a balloon, and a thermometer.

Problem: How can we test _____ Law?
Hypothesis:
Variables - M
R
C
Materials used (from list above)
Procedure (step by step)
Observation Chart
Analysis formulae to be used

1. At a pressure of 95.0kPa a sample of gas has a volume of 415.0mL. What is the volume of the gas at 110kPa?

A: 360mL

2. A sample of oxygen has a volume of 15.0L at 125kPa. What will the volume of the oxygen gas be at a pressure of 75kPa?

A: 25L

3. A sample of gas has a volume of 1.73L at a pressure of 860mmHg. What must the pressure be on this sample for the volume to change to 2.40L?

A: 620mmHg

4. A sample of oxygen has a volume of 315mL at STP. What is the volume of the gas at 35°C?

A: 360mL

5. At 23°C, a sample of hydrogen gas has a volume of 29.00L. To what temperature must this gas be heated to change the volume to 64.00L?

A: 650K

6. 27.5L of chlorine gas at 109kPa and 23°C is changed to 84.0kPa and 40.0°C. What is the new volume?

A: 37L

7. A gas sample has a volume of 35.0L at 790mmHg and 22.0°C, What is the volume at STP (745mmHg)?

A: 34L

8. A sample of fluorine gas with a volume of 45.0L at STP is changed to 117kPa and 30.0°C. What is the new volume of the gas?

A: 43.2L

9. Find the molar mass of the following molecules:

a. NO_3^-

A: 62.01g/mol

b. CH_3COOH

A: 60.06g/mol

c. $PbSO_4$

A: 303.27g/mol

d. $Al_2(SO_4)_3$

A: 342.17g/mol

e. $(NH_4)_3PO_4$

A: 149.12g/mol

10. Calculate the mass of each of the following:
a. 0.705 mol of CO_2 at STP

A: 31.0g

b. 18.4 mol of $Ni(OH)_2$

A: $1.71x10^3$g

11. Calculate the number of moles of the following:

a. 0.115kg of CuS

A: 1.20mol

b. 4046mg of Au at STP

A: 0.02054mol

12. Calculate the volume of 28.897g of butane gas C_4H_{10} at 21.000°C and 134.000kPa?

A: 9.066L

13. What is the molar mass of 0.475g of an ideal gas that has a volume of 450mL at 175kPa and 15.0°C.

A: 14g/mol

14. Explain how you change Celsius to Kelvin.

A: add 273 to C to find K

15. Explain the difference between SATP and STP.

A: SATP is regular room temp, 100kPA, 298K, 24.8L/mol
STP is lab setting, 101.3kPa, 273K, 22.4L/mol

16. Describe the difference between real and ideal gases

Real Gases	Ideal Gases
Have mass	Have no (point) mass
Have forces of attraction	Have no forces of attraction
Move in curved lines	Move in straight lines
Have inelastic collisions	Have perfectly elastic collisions

17. Explain the Kinetic Molecular Theory and its applications to this unit.

- Everthing is made of molecules
- Molecules are always moving
- There are forces of attraction and repulsion between molecules

Gas laws are directly influenced by the KMT. We use ideal gases to see the effect of changes applied to a system.

RXN TYPE BALANCED CHEMICAL EQUATION

. Single Replacement (SR) _2_ $NaCl_{(aq)}$ + _1_ $Br_{2\,(l)}$ → _2_ $NaBr_{(aq)}$ + _1_ $Cl_{2\,(aq)}$

2. Double Replacement (DR) _1_ $Ca(NO_3)_{2\,(aq)}$ + _2_ $KOH_{(aq)}$ → _2_ $KNO_{3\,(s)}$ + _1_ $Ca(OH)_{2(s)}$

3. HC Combustion (HC) _2_ $C_4H_{10(g)}$ + _13_ $O_{2\,(g)}$ → _8_ $CO_{2\,(g)}$ + _10_ $H_2O_{\,(g)}$

4. Formation (F) _6_ $F_{2\,(aq)}$ + _1_ $P_{4\,(s)}$ → _4_ $PF_{3\,(aq)}$

5. Double Replacement (DR) _1_ $H_3PO_{4\,(aq)}$ + _3_ $NaOH_{\,(aq)}$ → _1_ $Na_3PO_{4\,(aq)}$ + _3_ $HOH_{\,(l)}$

6. Decomposition (D) _2_ $Cr_2O_{3\,(s)}$ → _4_ $Cr_{\,(s)}$ + _3_ $O_{2\,(g)}$

7. Single Replacement (SR) _2_ $Fe_{\,(s)}$ + _6_ $HCl_{\,(aq)}$ → _2_ $FeCl_{3\,(aq)}$ + _3_ $H_{2\,(g)}$

8. Single replacement (SR) _1_ $CH_3 - CH_{3\,(g)}$ + _1_ $Br_{2\,(aq)}$ → _1_ $CH_2Br - CH_3$ + _1_ HBr (g)

9. Write balanced chemical equations for the following reactions. Include states and reaction type. If you CANNOT balance the reaction you probably did not write the proper chemical formula.

A. *zinc is added to aqueous tin (II) chloride to form zinc chloride and tin.*
$Zn_{(s)} + SnCl_{2(aq)} \rightarrow ZnCl_{2(aq)} + Sn_{(s)}$ Single Replacement

B. *Propane is burned in a barbeque using oxygen and making carbon dioxide and water vapor.*
$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$ Hydrocarbon Combustion

C. *When heated copper (II) sulfate pentahydrate form copper (II) sulfate and water*
$CuSO_4 \bullet 5\ H_2O_{(aq)} \rightarrow CuSO_{4(aq)} + 5\ H_2O_{(l)}$ Decomposition

D. *acetic acid is added to a solution of barium hydroxide to produce barium acetate and water (write water as HOH $_{(l)}$ it is easier to balance with hydroxide)*

Reaction Prediction
$CH_3COOH_{(l)} + Ba(OH)_{2(aq)} \rightarrow BaCH_3COO_{(aq)} + HOH_{(l)}$ Double replacement

E. A solution of lead (II) nitrate is added to a solution of sodium chloride
$Pb(NO_3)_{2(aq)} + 2\ NaCl_{(qq)} \rightarrow PbCl_{2(s)} + 2\ NaNO_{3(aq)}$ Double Replacement

F. 2,2 dimethyl decane$_{(l)}$ is burned.
$2C_{12}H_{26(l)} + 37O_{2(g)} \rightarrow 24CO_{2(g)} + 26H_2O_{(g)}$ Hydrocarbon Combustion

G. $Al_{(s)}$ is added to excess copper (II) nitrate solution.
$2\ Al_{(s)} + 3\ Cu(NO_3)_{2(aq)} \rightarrow 2\ Al(NO_3)_{3(aq)} + 3\ Cu_{(s)}$ Single Replacement

H. 3 hexyne$_{(l)}$ is added to excess fluorine$_{(aq)}$. The product is a liquid .
$C_6H_{10(l)} + F_{2(aq)} \rightarrow C_6H_9F_{4(aq)}$ Formation Reaction

I. butanoic acid $_{(l)}$ is added to ethanol to form a solid ester
$C_3H_7COOH_{(aq)} + C_2H_5OH_{(l)} \rightarrow H_2O_{(l)} + C_4H_7COOC_2H_{5(s)}$ Double Replacement

J. *When hydrogen is added to an open flame it produces a "pop" sound.*

What is the limiting and excess reagent in a chemical reactions?
$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$

For each of the following questions

1. Balance Chemical reaction and list information given and required.
2. Find number of moles "n" from given information (identify limiting reagent if required)
3. Use a mole ratio from given → required $\frac{n_g}{coeff_g} = \frac{n_r}{coeff_r}$
4. Solve for unknown using the appropriate formula

1. 10.0 g of lithium is added to 10.0 g of nitrogen what mass of product will be produced? Which substance is the limiting reagent? Which substance is in excess?

$3Li_{(s)} + N_{(g)} \rightarrow Li_3N_{(aq)}$

$n = \frac{m}{M} = \frac{10.0g}{6.49g/mol} = \frac{1.540\ldots mol}{3} = 0.513\ldots$ mol of lithium

$n = \frac{m}{M} = \frac{10.0g}{14.01g/mol} = \frac{0.714\ldots mol}{1} = 0.714\ldots$ mol of nitrogen

Lithium is the limiting reagent.

$\frac{1.540\ldots mol}{3} = \frac{x}{1} = 0.513\ldots$mol of lithium nitride

$m = nM = 0.513\ldots mol \times 33.48\ g/mol =$ **17.2 g**

2. 20.0 mL of 0.250 mol/L $Ba(OH)_{2\,(s)}$ is added to 50.0 mL of 0.222 mol/L $Ga(CH_3COO)_{3\,(aq)}$. Which substance is the limiting reagent? Which substance is in excess?

$3\ Ba(OH)_{2\,(aq)} + 2\ Ga(CH_3COO)_{3(aq)} \rightarrow 3\ Ba(CH_3COO)_{2(aq)} + 2\ Ga(OH)_{3\,(s)}$

$n = cv = 0.250 mol/L \times 0.0200\ L = \frac{0.00500\ mol}{3} = 0.00166\ldots$ mol of barium hydroxide

$n = cv = 0.222 mol/L \times 0.0500\ L = \frac{0.0111 mol}{2} = 0.00555$ mol of gallium acetate

Barium hydroxide is the limiting reagent

3. What mass of lead (II) nitrate is required to react with excess potassium iodide to produce 4.26 g of lead (II) iodide?

$Pb(NO_3)_{2\,(aq)} + 2\ KI_{(aq)} \rightarrow PbI_{2\,(s)} + 2\ KNO_{3\,(aq)}$

4. What is the concentration of 25.0 mL of $NaOH_{(aq)}$ used to neutralize an acid spill when 18.25 mL of 0.100 mol/L $HCl_{(aq)}$?

5. What volume of hydrogen gas is produced at SATP when a 1.68 g of magnesium is totally dissolved in excess nitric acid?

$Mg_{(s)} + 2\ HNO_{3\,(ag)} \rightarrow H_{2\,(g)} + Mg(NO_3)_{2\,(ag)}$

1.68 g SATP

v = ?

$m = n/M = 1.68g / 24.31\ g/mol = \frac{0.0691\ldots\ mol}{1} = \frac{x}{1} = 0.0691\ldots\ mol\ of\ H_{2\,(g)}$

$v = nRT/P = \frac{0.0691\ldots\ mol \times 8.314\ L*kPa/mol*K \times 298.15\ K}{100.00\ kPa} =$ **1.71 L**

6. Sulphur is burned by reacting with oxygen to form a dangerous gas $SO_{2\,(g)}$.
In a combustion furnace 2.20 kg of sulfur is burned. What volume of oxygen is required at 560 kPa and 450°C?

7. What is the concentration of 30.0 mL Na_2CO_3 when it is neutralized by 250 mL of 0.100 mol/L $H_3BO_{3\,(aq)}$?

$3\ Na_2CO_{3\,(aq)} + 2\ H_3BO_{3\,(aq)} \rightarrow 3\ H_2CO_{3\,(aq)} + 2\ Na_3BO_{3\,(aq}$

v= 30.0 mL c= 0.100 mol/L
v = 250 mL

$n = cv = 0.100\ mol/L \times 0.250\ L = \frac{0.0250\ mol}{2} = \frac{x}{3} =$

$c = n/v = /0.0300\ L =$ **0.833 mol/L of Na_2CO_3**

8. A 50.0 g candle ($C_{25}H_{52\,(s)}$) is burned until there are 16.0 g left. What volume of carbon dioxide is produced at 18.2°C and 99.5 kPa?

$\underset{34.0\ g}{1\ C_{25}H_{52\,(s)}} + 38\ O_{2(g)} \rightarrow \underset{v = ?}{25\ CO_{2(g)}} + 26\ H_2O_{(g)}$

$n = m/M = 34.0g / 352.77\ g/mol = \frac{0.0964\ \ldots\ mol}{1} = \frac{x}{25} = 2.41\ \ldots\ mol$

$v = nRT/P = \frac{2.41\ \ldots\ mol \times 8.314\ L*kPa/mol*K \times 291.4\ K}{99.5\ kPa} =$ **58.7 L**

9. 3.00 g of benzoic acid are added to excess methanol. What mass of ester will be created?

$C_6H_5COOH_{\,(aq)} + CH_3OH_{\,(aq)} \rightarrow C_8H_8O_{\,(aq)} + H_2O_{\,(l)}$

3.00g excess

$n=m/M\ \ 3.00g/\ 122.13g/mol = \frac{0.0246mol}{1} = \frac{x}{1} = 0.0246mol$

$m=nM\ \ 0.0246mol \times 120.16g/mol = 2.96\ g$

10. Calculate the concentration of hydrochloric acid using bromothymol blue as an indictor

Titration of 25.0 mL of $HCl_{(aq)}$ with 0.465 mol/L $Na_2CO_{3\,(aq)}$				
TRIAL	1	2	3	4
Final buret reading (mL)	18.4	33.6	48.7	37.0
Initial buret reading (mL)	0.1	18.4	33.6	22.0
Volume of $Na_2CO_{3\,(aq)}$ added (mL)	~~18.3~~	15.2	15.1	15.0
Color at endpoint	blue	green	green	green

$Na_2CO_{3\,(aq)} + 2\,HCl_{(aq)} \rightarrow H_2CO_{3\,(aq)} + 2\,NaCl_{(aq)}$
v= 15.1 mL v = 25.0 mL
c= 0.465 mol/L

$n = cv = 0.465\ mol/L \times 15.1\ mL = \frac{7.02\ mmol}{1} = \frac{x}{2} = 14.0\ mmol$

$c = n/v\ 14.0\ mmoL\ /25.0\ mL = 0.562\ mol/L$

KEY

Mogck

Updated May 2015

Practice Test

1. The number of moles of ethane, C2H6, that can react with 9 moles of oxygen, O2, according to the equation 2C2H6(g) + 7O2 → 4CO2(g) + 6H2O(l) is:

$$\#\ mol\ C_2H_6 = 9\ mol\ O_2 \times \frac{2\ C_2H_6}{7\ O_2} = \boxed{2.57\ mol\ C_2H_6}$$

2. How many grams of copper(II)chloride is needed to react with 19.0g of iron, according to the following equation: 3CuCl2 + 2Fe → 3Cu + 2FeCl3

$$\#g\ CuCl_2 = 19g\ Fe \times \frac{1\ mol}{55.85g} \times \frac{3\ CuCl_2}{2\ Fe} \times \frac{134.45g}{1\ mol} = \boxed{68.61g}$$

3. How many grams of ammonia is produced when 12.0g of nitrogen gas is reacted according to the following equation: 3H2 + N2 → 2NH3

$$\#g\ NH_3 = 12g\ N_2 \times \frac{1\ mol}{28.02g} \times \frac{2\ NH_3}{1\ N_2} \times \frac{17.04g}{1\ mol} = \boxed{14.6g\ NH_3}$$

4. Given the following BALANCED equation: 4NH3 + 5O2 → 6H2O + 4NO

   If 2.30moles of ammonia (NH3) are consumed, how many moles of NO are produced?

$$\#\ mol\ NO = 2.30\ mol\ NH_3 \times \frac{4\ NO}{4\ NH_3} = \boxed{2.30\ mol\ NO}$$

5. Consider the following BALANCED equation:

   2NaOH(s) + CO2(g) → Na2CO3(s) + H2O(l)

   Assuming that there is an excess of carbon dioxide, what is the mass of sodium hydroxide that is needed to produce 22.0g of sodium carbonate?

$$\#g\ NaOH = 22g\ Na_2CO_3 \times \frac{1\ mol}{105.99g} \times \frac{2\ NaOH}{1\ Na_2CO_3} \times \frac{40g}{1\ mol} = \boxed{16.61g\ NaOH}$$

6. When the reaction $Al_2(SO_4)_3 + 3CaCl_2 \rightarrow 2AlCl_3 + 3CaSO_4$ is balanced, using simplest whole numbers, the quantity of calcium chloride used is

balanced = 3 mol $CaCl_2$

7. Consider the following BALANCED equation:

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

What volume of C_2H_6 at STP is required to produce 8.0g of water?

$$\#L\ C_2H_6 = 8\ g\ H_2O \times \frac{1\ mol}{18.02\ g} \times \frac{2\ C_2H_6}{6\ H_2O} \times \frac{22.4\ L}{1\ mol} = 3.315\ L\ C_2H_6$$

8. Consider the following BALANCED equation:

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

What mass of oxygen is required to react completely with 16.2L of C_2H_6 at STP?

$$\#g\ O_2 = 16.2\ L\ C_2H_6 \times \frac{1\ mol}{22.4\ L} \times \frac{7\ O_2}{2\ C_2H_6} \times \frac{32\ g}{1\ mol} = 81\ g\ O_2$$

9. 20g of cadmium reacts with 0.790g of sulphur to produce cadmium sulphide as shown by $Cd(s) + S(s) \rightarrow CdS(s)$ What is the limiting reagent?

$$\#g\ CdS = 20\ g\ Cd \times \frac{1\ mol}{112.41\ g} \times \frac{1\ CdS}{1\ Cd} \times \frac{144.48\ g}{1\ mol} = 25.71\ g$$

$$\#g\ CdS = 0.79\ g\ S \times \frac{1\ mol}{32.07\ g} \times \frac{1\ CdS}{1\ S} \times \frac{144.48\ g}{1\ mol} = 3.56\ g$$

S is Limiting Reagent

10. Consider the BALANCED equation:

$$2KClO_3(s) + 3S(s) \rightarrow 2KCl(s) + 3SO_2(g)$$

If 29.4g of potassium chlorate were to react with 7.2g of sulphur, what is the mass of potassium chloride that is formed?

$$\#g\ KCl = 29.4\ g\ KClO_3 \times \frac{1\ mol}{122.55\ g} \times \frac{2\ KCl}{2\ KClO_3} \times \frac{74.55\ g}{1\ mol} = 17.88\ g$$

$$\#g\ KCl = 7.2\ g\ S \times \frac{1\ mol}{32.07\ g} \times \frac{2\ KCl}{3\ S} \times \frac{74.55\ g}{1\ mol} = 11.16\ g$$

The following 3 questions (11-13) refer to the info below.

30.0g of potassium is reacted with 12.0g of nitrogen, according to the following BALANCED equation: 6K + N2 → 2K3N

11. Which chemical is the limiting reagent?

K is LR

$$\#g\ K_3N = 30g\ K \times \frac{1mol}{39.10g} \times \frac{2\ K_3N}{6\ K} \times \frac{131.31g}{1\ mol} = \boxed{33.58g}$$

$$\#g\ K_3N = 12g\ N_2 \times \frac{1mol}{28.02g} \times \frac{2\ K_3N}{1\ N_2} \times \frac{131.31g}{1\ mol} = 112.47g$$

12. How much excess is there for the other chemical?

$$\#g\ N_2 = 30.0g\ K\ (LR) \times \frac{1mol}{39.10g} \times \frac{1\ N_2}{6\ K} \times \frac{28.02g}{1\ mol} = \boxed{3.58g\ N_2\ Reacts}$$

Excess = 12g - 3.58g = 8.42g not used N_2

13. How many grams of potassium nitride can be produced?

Did work on #11

33.58g K_3N max yield

The following 3 questions (14-16) refer to the info below.

20.0g of potassium is reacted with 11.0g of nitrogen, according to the following BALANCED equation: 6K + N2 → 2K3N

14. Which chemical is the limiting reagent?

K is LR

$$\#g\ K_3N = 20g\ K \times \frac{1mol}{39.10g} \times \frac{2\ K_3N}{6\ K} \times \frac{131.31g}{1\ mol} = \boxed{22.39g}$$

$$\#g\ K_3N = 11g\ N_2 \times \frac{1mol}{28.02g} \times \frac{2\ K_3N}{1\ N_2} \times \frac{131.31g}{1\ mol} = 103.099g$$

15. How much excess if there for the other chemical?

$$\#g\ N_2 = 20g\ K \times \frac{1mol}{39.10g} \times \frac{1\ N_2}{6K} \times \frac{28.02g}{1\ mol} = \boxed{2.39g\ N_2\ reacts}$$

Excess = 11g N_2 - 2.39g N_2 = 8.611g N_2 not used

16. How many grams of potassium nitride can be produced?

Did work on #14

22.39g K_3N max yield

Use the following reaction for questions 17 to 20

$4CH_3NO_2(l) + 3O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l) + 2N_2(g)$

17. What mass of H2O is produced when 22.7g of CH3NO2 is burned?

$$\#g\ H_2O = 22.70g\ CH_3NO_2 \times \frac{1mol}{61.05g} \times \frac{6\ H_2O}{4\ CH_3NO_2} \times \frac{18.02g}{1mol} = \boxed{10.05\ g}$$

18. What combined volume of gas at STP is produced if 3.36g of CH3NO2 is burned?

$$\#L\ CO_2 = 3.36g\ CH_3NO_2 \times \frac{1mol}{61.05g} \times \frac{4\ CO_2}{4\ CH_3NO_2} \times \frac{22.4\ L}{1\ mol} = 1.23\ L$$

$$\#L\ N_2 = 3.36g\ CH_3NO_2 \times \frac{1mol}{61.05g} \times \frac{2\ N_2}{4\ CH_3NO_2} \times \frac{22.4\ L}{1mol} = 0.616\ L$$

Total Gas = 1.85 L (added up)

19. What volume of O2 at STP is required to produce 2.78g of CO2?

$$\#L\ O_2 = 2.78g\ CO_2 \times \frac{1mol}{44.01g} \times \frac{3\ O_2}{4\ CO_2} \times \frac{22.4\ L}{1\ mol} = \boxed{1.06\ L\ O_2}$$

20. What mass of N2 is produced when 0.490g of CO2 is produced?

$$\#g\ N_2 = 0.490g\ CO_2 \times \frac{1mol}{44.01g} \times \frac{2\ N_2}{4\ CO_2} \times \frac{28.04g}{1\ mol} = \boxed{0.156\ g\ N_2}$$

Use the following reaction for questions 21 to 22

A 8.79mL sample of H3PO4 is titrated with 97.8mL of 0.789M of NaOH.

$2NaOH + H_3PO_4 \rightarrow Na_2HPO_4 + 2H_2O$

21. What is the molar concentration of pure H3PO4?

$$\frac{\#mol}{L} = \frac{0.789\ mol}{L} \times 0.0978\ L \times \frac{1\ H_3PO_4}{2\ NaOH} \times \frac{1}{0.00879\ L} = \boxed{4.389\ \frac{mol}{L}}$$

22. Calculate the density of pure H3PO4?

$$\frac{\#g}{mL} = \frac{4.389\ mol}{L}\ H_3PO_4 \times \frac{1L}{1000mL} \times \frac{98.0g}{1mol} = \boxed{0.430\ g/mL}$$

Use the following information for questions 23-24:

Before analyzing a fertilizer sample containing NH4NO3, a chemist makes a test solution by dissolving 66.3g of pure NH4NO3 and diluting it to 150.0mL. If the chemist wishes to carry out the titration reaction

$$NH_4NO_3(aq) + NaOH(aq) \rightarrow NH_3(g) + H_2O(l) + NaNO_3(aq)$$

Such that the reaction requires 43.0mL of NaOH when 19.5mL of solution is titrated,

amount of NH_4NO_3 used

23. What is the molarity of the NaOH she should use?

step 1 find molarity of solution used in titration

$$\frac{\#\,mol}{L}\ NH_4NO_3 = 66.3\,g \times \frac{1\,mol}{80.06\,g} \times \frac{1}{0.150\,L} = 5.52\ \frac{mol}{L}\ NH_4NO_3$$

step 2 do the stoich using solution conc. as given.

$$\frac{\#\,mol}{L}\ NaOH = \frac{5.52\,mol}{L} \times 0.0195\,L \times \frac{1\,NaOH}{1\,NH_4NO_3} \times \frac{1}{0.043\,L} = \boxed{2.50\ \frac{mol}{L}}$$

24. What volume of NH3 at STP would be produced?

$$\#\,L\ NH_3 = \frac{5.52\,mol}{L}\ NH_4NO_3 \times 0.0195\,L \times \frac{1\,NH_3}{1\,NH_4NO_3} \times \frac{22.4\,L}{1\,mol}$$

$$\#\,L\ NH_3 = \boxed{1.092\ L\ NH_3}$$

$$\%\ Yield\ (products) = \frac{obtained}{expected} \times 100\%$$

$$\%\ Yield\ (reactants) = \frac{used}{required} \times 100\%$$

Reminders for questions 25-28!

Use the following reaction for question 25-28

$$2FeO + 2C + O_2 \rightarrow 2Fe + 2CO_2$$

25. A 13.4g FeO sample has a 56.0% yield. What mass of Fe can the sample produce?

$$\#g\ Fe\ (expected) = 13.4\,g\ FeO \times \frac{1\,mol}{71.85\,g} \times \frac{2\,Fe}{2\,FeO} \times \frac{55.85\,g}{1\,mol} = 10.416\,g\ Fe\ expected$$

$$\#g\ produced\ (obtained) = 10.416 \times 0.56 = \boxed{5.83\,g\ Fe}$$

26. A 33.9g FeO sample produces 85.8g of Fe. What is the % yield of the reaction?

must be major impurities in that Fe!

$$\#g\ Fe\ (expected) = 33.90\,g\ FeO \times \frac{1\,mol}{71.85\,g} \times \frac{2\,Fe}{2\,FeO} \times \frac{55.85\,g}{1\,mol} = 26.35\,g\ Fe\ expected$$

$$\%\ Yield = \frac{85.8\,g\ obtained}{26.35\,g\ expected} \times 100\% = \boxed{325.62\%}$$

Whoa!

27. A 460.4g FeO pure sample produces 324.8g of Fe. What is the % yield of the reaction?

$$\#g\ Fe\ (expected) = 460.4\,g\ FeO \times \frac{1\,mol}{71.85\,g} \times \frac{2\,Fe}{2\,FeO} \times \frac{55.85\,g}{1\,mol} = 357.875\,g\ Fe\ expected$$

good yield!

$$\%\ Yield = \frac{324.8\,g\ obtained}{357.875\,g\ expected} \times 100\% = \boxed{90.76\%}$$

nice!

28. What mass of FeO with a yield of 56.8% is needed to make 34.9g of solid iron?

$$\#g\ FeO\ used\ if\ pure = 34.9\,g\ Fe \times \frac{1\,mol}{55.85\,g} \times \frac{2\,FeO}{2\,Fe} \times \frac{71.85\,g}{1\,mol} = 44.898\,g$$

44.898 g used if the rxn was perfect... but its NOT!

$$\#g\ FeO\ required = \frac{44.898\,g\ FeO}{0.568} = \boxed{79.046\,g\ FeO\ required}$$