Stoichiometry/Equilibrium Review

Reactions Secondary Topic

Mass ⟷ Moles ⟷ particles

Write in the conversion equivalency for each arrow.
If you can't do this make sure it is on your note card

(#6-1) For the following determine the number of molecules

1. 9.8 moles of O_2 $\frac{6.022E23}{1\,mol} = 5.89E24$
2. 5.00 moles of H_2O $5.00\,mol \mid \frac{6.022E23}{1\,mol} = 3.01E24$
3. 2.3 x 10^{12} molecules of H_2 $2.3E12 \mid \frac{1\,mol}{6.022E23} = 3.82E-12$
4. 3.2 x 10^{28} molecules of C_2H_4 $3.2E28 \mid \frac{1\,mol}{6.022E23} = 53100\,mols$
5. ~~H_2~~ $O_2 = 32\,g/mol$
6. ~~NaOH~~ $Fe_2O_3 = 159.6\,g/mol$
7. 5.3 moles of O_2 $5.3\,mol \mid \frac{32\,g}{1\,mol} = 169\,g$
8. 45.2 moles Fe_2O_3 $45.2\,mol \mid \frac{159.6\,g}{1\,mol} = 7182\,g$

(#6-1) For the following determine the number of moles found in each mass

9. 22.0 grams of O_2 $22g \mid \frac{1\,mol}{32\,g} = 0.687$
10. 305.6 grams of Fe_2O_3 $305.6 \mid \frac{1\,mol}{159.6\,g} = 0.0219$

(#6-2) For the following determine the number of moles using the following equation

$N_2 + 2\ O_2 = 2NO_2$

11. If one used 6 moles of O_2, how many moles of NO_2 would be formed?
$6\,O_2 \mid \frac{2\,NO_2}{2\,O_2} = 6\,mol\,NO_2$
12. If one formed 4.2 moles of NO_2, how many moles of N_2 are needed?
$4.2\,mol\,NO_2 \mid \frac{1\,N_2}{2\,NO_2} = 2.1\,mol$

(#6-2) Determine the mass (in grams) using the following equation

$3\ H_2O_2 + 4\ Al \rightarrow 2\ Al_2O_3 + 3H_2$

13. 90.2 grams of Al was added to an excess of hydrogen peroxide, how much mass of aluminum oxide was formed?

g → mol mol → grams

$90.2 \mid \frac{1\,mol}{27\,g} \mid \frac{2\,mol}{4\,mol} \mid \frac{102\,g}{1\,mol} = 170.3\,g\ Al_2O_3$

1025 mol
51 48
Al_2O_3

14. 25g of C_2H_4 reacts with 25g of oxygen via the reaction below.

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

I .89 .781
C -.26 -.781 +.52 .52
E 0

Q: Indicate which reactant is limiting (2 points)

Answer Student A: A student indicated that the O_2 is the limiting reactant due to the quantities being equal and the O_2 is being used up faster.

a. How many of the two points would you award the student and why?

① - True greater use. -1 quantities need to be in moles.

b. In the space below show all work needed to fill out an ISE table above.

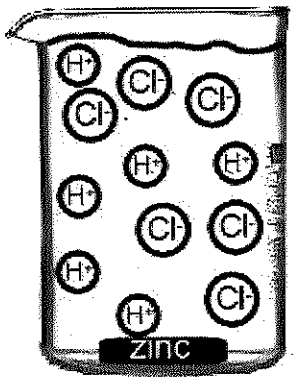
$25g \left| \frac{1\ mol}{28\ g} \right. = 0.89$ $\quad$ $25g \left| \frac{1\ mol}{32\ g} \right. = 0.781 \left| \frac{1}{3} \right. =$ $\quad$ $.781 \left| \frac{2}{3} \right. = .52$

c. At STP, how many liters of CO_2 will be produced from this reaction above?

$.52 \left| \frac{22.4\ L}{1\ mol} \right. = 11.2L$

15. In the beakers above there is a particulate representation of a beaker containing excess zinc and a solution of hydrochloric acid. The zinc and the HCl will react according to the reaction below.

$$2HCl(aq) + Zn(s) \rightarrow ZnCl_{2(aq)} + H_{2\,(g)}$$



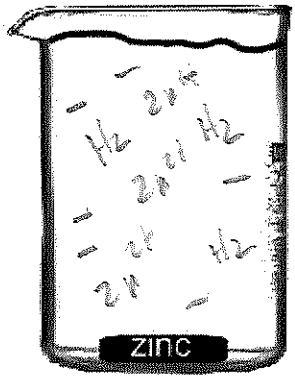
a. Is this a solubility or redox reaction? Justify.

$H^+ \rightarrow H_2^0$ or $Zn^0 \rightarrow Zn^{2+}$

b. Write out the half reactions for this reaction and make sure your electrons are balanced.

$2H^+ + 2e^- \rightarrow H_2$ $\quad$ 0V

$Zn^0 \rightarrow Zn^{2+} + 2e^-$ $\quad$ +.76V



c. Calculate the voltage for the reaction above.

$0 + .76V = .76V$

d. Draw the beaker after the reaction has gone to completion.

e. Is there a spectator in this reaction? If so, what?

$2H^+ + Zn \rightarrow H_2 + Zn^{2+}$

I .6 2x
S -.6 -.3 +.3 +.3
E 0 .3 .3

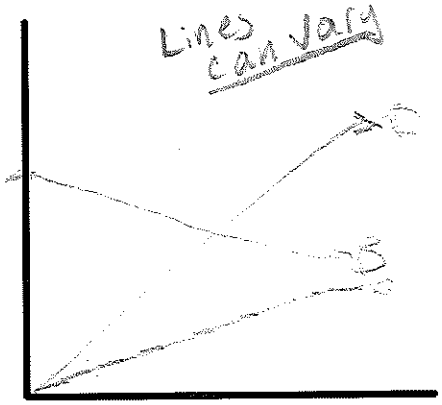
↑ excess

$$2A(s) + B(aq) \leftrightarrow C(aq) + 2D(g) + Energy$$

1. Write the equilibrium expression using molarity for the reaction above. $K_c = \frac{[C][D]^2}{[B]}$
2. Write the equilibrium expression using atmospheres for the reaction above. $K_p = \frac{P(D)^2}{1}$

A 10L container has a 1.0M solution of B and 50g of A at the bottom of a beaker. After the reaction proceeds for 10 hours the concentration of B appears to have stopped changing. It is now 0.15M Answer the following questions.

3. Student Hypothesis: Over the course of the reaction the concentration of A did not change and therefore the quantity of A also did not change. Justify or nullify.
   A was lost, but Conc. did NOT change.
4. Determine the concentration of each item at equilibrium. (create an ISE table in the space below)
5. Determine the K_c for the reaction.
6. At STP determine the pressure of D in the container.
7. Determine K_p
8. On the graph below draw a proportional graph showing the concentrations of each item over time.



2A + B → C + 2D

I = 1.0 0

C = −x +x +2x

E = .15 (.85) (1.7)

$x = .85$

$\frac{(.85)(1.7)}{.85} = 1.7$

$P = \frac{nRT}{V} = \frac{MRT}{1} = 1.7 \cdot .0821 \cdot 298 = 41.5$

$K_p = (41.5)^2 = 1729$

1. (#6-1) A 0.5 mole sample of Hydrobromic Acid will have a mass of
   a. 80.9 grams
   b. 40.5 grams
   c. 22.4g
   d. 6.022 E23

HBr → 80 → 40

1 gram of CH_4 reacts with 1 gram of O_2 via combustion. Answer the following questions relative to the reaction.

2. (#1-2) The overall balanced reaction represented below
   a. $CH_4 + O \Rightarrow C + H + O$
   b. $CH_4 + O_2 \Rightarrow CO_2 + H_2O$
   c. $CH_4 \Rightarrow C + O_2 + C$
   d. $CH_4 + 2O_2 \Rightarrow CO_2 + 2H_2O$

$$2C_2H_{2(g)} + 5O_{2(g)} \Rightarrow 2H_2O_{(g)} + 4CO_{2(g)}$$

Acetylene is a common fuel used in welding. Answer the following questions.

3. (#6-1) If you have 10 grams of C_2H_2 and 10 grams of O_2, which of the following correctly describes the quantities of particles?
   a. The quantities of particles are equal
   b. You have more C_2H_2
   c. You have more O_2
   d. This question would require the number of moles to answer and that was not given.

$10\,g\,C_2H_2 \cdot \frac{1\,mol}{26\,g} = \frac{10}{26}$ mol

$10\,g\,O_2 \cdot \frac{1\,mol}{32\,g} = \frac{10}{32}$ mol

4. (#6-2) If 1 mole of each reactant were used what would be the limiting reactant?
   a. C_2H_2
   b. CO_2
   c. O_2
   d. H_2O

5. (#6-1) Each substance used in the reaction above was analyzed and the following was determined. The sample was massed to contain 13g and found to contain 0.5 moles. Which substance was being analyzed?

a. C_2H_2 c. CO_2

b. O_2 d. H_2O

$\frac{g}{mol} = \frac{13}{.5} = 26\frac{g}{mol}$

6. (#6-2 & #6-1)A sample of 13 grams of C_2H_2 is reacted with excess oxygen. How much H_2O and CO_2 will be produced respectively?

a. .5g and .5g c. .5 mol and 1 mol

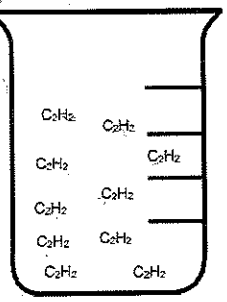
b. .5g and 1g d. 13g and 26g

(13g) $13g = \frac{1}{2}mol \left|\frac{2}{2}\right. = .5mol$ $\frac{4}{2} = 1.0mol$ (22g)

7. (#6- 2 & #6-3) A sample of C_2H_2 is going to be burned. How many molecules of O_2 would be needed here?

$2C_2H_{2(g)} + 5O_{2(g)} \Rightarrow 2H_2O_{(g)} + 4CO_{2(g)}$

10 2



$\frac{12}{2}\left|\frac{5}{2}\right. = 25$

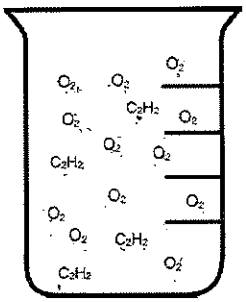
a. 0 c. 10

b. 5 d. 25

8. (#6-2 & #6-3) A sample of C_2H_2 is going to be burned. Which of the following pictures would represent the substance after the reaction has gone to completion?

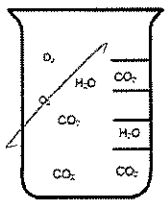
$2C_2H_2 + 5O_2 \Rightarrow 2H_2O + 4CO_2$

4 12

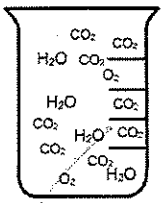


$\frac{12}{5}\left|\frac{2}{5}\right. = 4.8$ $\frac{12}{5}\left|\frac{2}{5}\right. = 4.8\ (5)$ $\frac{12}{5}\left|\frac{4}{5}\right. = 9.6\ (10)$

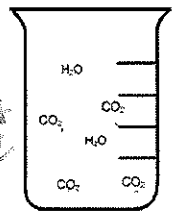
a.



b.

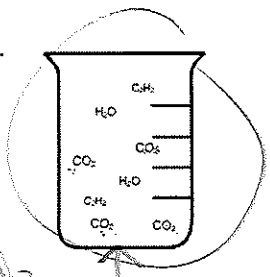


c.



$\frac{4}{2}$

d.



No O_2 20 C_2H_2

all gases → 13g → ½ mol → 1/2 = 1 mol = 22.4L

____ 9. (#6- 1)If the 13g sample of C_2H_2 (prior to burning) were to be stored in a balloon at STP, how large would that balloon be?

a. 5 mol
b. 22.4L
c. 11.2L
d. 3.01 E23 L

____ 10. (#6-1) Which of these substances contains *more* than 1 mole of particles

a. 1 mol C_2H_4 b. 20L O_2 (STP) c. 17g H_2O d. 51g CO_2

less 18 = 1 mol more g/g/g/mol

____ 11. The equilibrium expression for K_c for the system

$CO_{2(g)} + CaO_{(s)} \rightarrow CaCO_{3(s)}$ is

a. $[CaCO_3]/[CO_2][CaO]$
b. $[CaCO_3]/[CO_2]$
c. $[CO_2]$
d. $1/[CO_2]$
e. $[CO_2][CaO]$

_____ 12. In which of the following does the reaction go the least to completion (see the following K values)

a. 10E5
b. 10E3
c. 10E0
d. 10E-3
e. 10E-5

largest

____13. Consider the reaction system

$Br_2(g) + Cl_2(g) \leftrightarrow 2BrCl(g)$

$\frac{(.015)^2}{(.006)(.0095)} = 3.9$

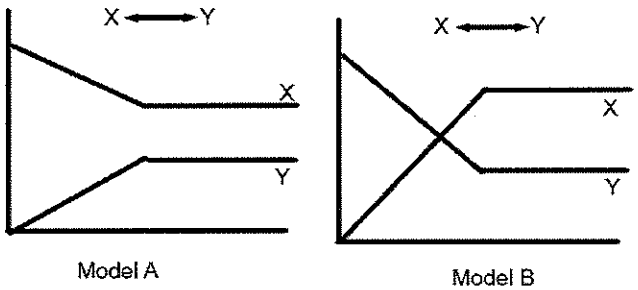
At a given temperature. When the system is at equilibrium, the molar concentrations of Br_2, Cl_2 and BrCl are 0.0060M, 0.0095M, and 0.015M, respectively. The value of Kc for this system is

a. 0.025
b. 3.9
c. 27
d. 53
e. 260

Shift to Reactants

____ 14. Which of the following charts shows a reaction with a Q>K as it approaches equilibrium?

a. Model A only
b. Model B only
c. Both A and B
d. Neither A or B



Model A Model B

____15. Consider the reaction system

$AgNO_3(aq) + PbNO_3(aq)$

Two solutions of soluble ionic substances are mixed which of the following would accurately represent the products

a. $AgNO_3(aq) + PbNO_3(s)$
b. $AgNO_3(s) + PbNO_3(aq)$
c. $AgNO_3(s) + PbNO_3(s)$
d. No reaction will take place
e. A reaction will take place, but the result is not listed here.

No Solid Formed