Laney College Chem 30A
Professor Scott Beaver

Homework #7
4/2/2016

Name: _____

1. How many moles of the products (Fe_2O_3 and H_2O) form in a complete reaction of 1.00 mol $Fe(OH)_3$?

$$2\ Fe(OH)_3\ (s) \rightarrow Fe_2O_3\ (s) + 3\ H_2O\ (g)$$

1.00 mol $Fe(OH)_3$? mol ? mol

$1.00\ mol\ Fe(OH)_3 \left(\frac{1\ mol\ Fe_2O_3}{2\ mol\ Fe(OH)_3}\right) = 0.500\ mol\ Fe_2O_3$ (3 s.f.)

$1.00\ mol\ Fe(OH)_3 \left(\frac{3\ mol\ H_2O}{2\ mol\ Fe(OH)_3}\right) = 1.50\ mol\ H_2O$

2. How many moles of product form when 0.0050 mol of H_3PO_4 reacts completely with NaOH? And how many moles of NaOH are consumed?

$$H_3PO_4\ (aq) + 3\ NaOH\ (aq) \rightarrow Na_3PO_4\ (aq) + 3\ H_2O\ (l)$$

0.0050 mol H_3PO_4 ? mol ? mol ? mol

$0.0050\ mol\ H_3PO_4 \left(\frac{3\ mol\ NaOH}{1\ mol\ H_3PO_4}\right) = 0.015\ mol\ NaOH$ (2 s.f.)

$0.0050\ mol\ H_3PO_4 \left(\frac{1\ mol\ Na_3PO_4}{1\ mol\ H_3PO_4}\right) = 0.0050\ mol\ Na_3PO_4$

$0.0050\ mol\ H_3PO_4 \left(\frac{3\ mol\ H_2O}{1\ mol\ H_3PO_4}\right) = 0.015\ mol\ H_2O$

3. How many moles of reactants (C_2H_6 and O_2) are required to form 6.25 moles of CO_2? How many moles of water are formed?

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

? mol ? mol 6.25 mol CO_2 ? mol

$(6.25\ mol\ CO_2)\left(\frac{2\ mol\ C_2H_6}{4\ mol\ CO_2}\right) = 3.13\ mol\ C_2H_6$ (3 s.f.)

$(6.25\ mol\ CO_2)\left(\frac{7\ mol\ O_2}{4\ mol\ CO_2}\right) = 10.9\ mol\ O_2$

$(6.25\ mol\ CO_2)\left(\frac{6\ mol\ H_2O}{4\ mol\ CO_2}\right) = 9.38\ mol\ H_2O$

4. Provide molar masses for the following, with units.

NaCl	58.44 g/mol	C_3H_8	44.094 g/mol
O_2	32.00 g/mol	$(NH_4)_2SO_4$	132.154 g/mol
N_2O_5	108.02 g/mol	Na^+	22.99 g/mol

↳ same as Na, because an electron has no mass.

5. a. How many moles of P_4O_{10} in 10.08 grams?

$$(10.08\ g\ P_4O_{10})\left(\frac{mol\ P_4O_{10}}{283.89\ g\ P_4O_{10}}\right) = 0.03551\ mol\ P_4O_{10}$$

b. How many moles of H_2 (hydrogen gas) in 10.08 grams?

$$(10.08\ g\ H_2)\left(\frac{mol\ H_2}{2.016\ g\ H_2}\right) = 5.000\ mol\ H_2 \quad (4\ sf.)$$

c. How many moles of O_2 (diatomic oxygen gas) in 1.432 g?

$$(1.432\ g\ O_2)\left(\frac{mol\ O_2}{32.00\ g\ O_2}\right) = 0.04475\ mol\ O_2$$

d. How many moles of O (oxygen atoms) in 1.432 g?

$$(1.432\ g\ O)\left(\frac{mol\ O}{16.00\ g\ O}\right) = 0.08950\ mol\ O \quad (4\ sf.)$$

e. How many molecules of water (H_2O) in 1.0 g?

$$(1.0\ g\ H_2O)\left(\frac{mol\ H_2O}{18.016\ g\ H_2O}\right)\left(\frac{6.022 \times 10^{23}\ molecules\ H_2O}{mol\ H_2O}\right) = 3.343 \times 10^{22}\ molecules\ H_2O$$

Avogadro II

6. How many grams of the products (Fe_2O_3 and H_2O) form in a complete reaction of 10.00 grams $Fe(OH)_3$?

$$2\ Fe(OH)_3\ (s) \rightarrow Fe_2O_3\ (s) + 3\ H_2O\ (g)$$

10.00 g $Fe(OH)_3$? g ? g

$$(10.00\text{ g } Fe(OH)_3)\left(\frac{\text{mol } Fe(OH)_3}{106.87\text{ g } Fe(OH)_3}\right)\left(\frac{1\text{ mol } Fe_2O_3}{2\text{ mol } Fe(OH)_3}\right)\left(\frac{159.69\text{ g } Fe_2O_3}{\text{mol } Fe_2O_3}\right)$$

$$= 7.471\text{ g } Fe_2O_3$$

$$(10.00\text{ g } Fe(OH)_3)\left(\frac{\text{mol } Fe(OH)_3}{106.87\text{ g } Fe(OH)_3}\right)\left(\frac{3\text{ mol } H_2O}{2\text{ mol } Fe(OH)_3}\right)\left(\frac{18.02\text{ g } H_2O}{\text{mol } H_2O}\right)$$

$$= 2.529\text{ g } H_2O$$

7. How many grams of product form when 25.3 grams of H_3PO_4 reacts completely with NaOH? And how many grams of NaOH are consumed?

$$H_3PO_4\ (aq) + 3\ NaOH\ (aq) \rightarrow Na_3PO_4\ (aq) + 3\ H_2O\ (l)$$

25.3 g H_3PO_4 ? g ? g ? g

NaOH:
$$(25.3\text{ g } H_3PO_4)\left(\frac{\text{mol } H_3PO_4}{98.00\text{ g } H_3PO_4}\right)\left(\frac{3\text{ mol } NaOH}{1\text{ mol } H_3PO_4}\right)\left(\frac{40.00\text{ g } NaOH}{\text{mol } NaOH}\right)$$

$$= 31.0\text{ g } NaOH$$

Na_3PO_4:
$$(25.3\text{ g } H_3PO_4)\left(\frac{\text{mol } H_3PO_4}{98.00\text{ g } H_3PO_4}\right)\left(\frac{1\text{ mol } Na_3PO_4}{1\text{ mol } H_3PO_4}\right)\left(\frac{163.94\text{ g } Na_3PO_4}{\text{mol } Na_3PO_4}\right)$$

$$= 42.3\text{ g } Na_3PO_4$$

H_2O by balance: # grams product = # grams reactant = 31.0 g + 25.3 g = 56.3 g

grams H_2O = 56.3 g − 42.7 g = 13.6 g H_2O

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8. Which is the limiting reactant when 5.00 g of C_2H_6 and 15.00 g O_2 are combusted? What is the theoretical yield for CO_2 and water, in grams?

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

5.00 g 15.00 g ? g ? G

C_2H_6: $(5.00\ g\ C_2H_6)\left(\frac{mol\ C_2H_6}{30.07\ g\ C_2H_6}\right)\left(\frac{4\ mol\ CO_2}{2\ mol\ C_2H_6}\right)\left(\frac{44.01\ g\ CO_2}{mol\ CO_2}\right)$

$= 14.6\ g\ CO_2$

O_2: $(15.00\ g\ O_2)\left(\frac{mol\ O_2}{32.00\ g\ O_2}\right)\left(\frac{4\ mol\ CO_2}{7\ mol\ O_2}\right)\left(\frac{44.01\ g\ CO_2}{mol\ CO_2}\right)$

$= 11.79\ g\ CO_2$

theoretical yield → start w/ LIMITING REACTANT (O_2)

$(15.00\ g\ O_2)\left(\frac{mol\ O_2}{32.00\ g\ O_2}\right)\left(\frac{6\ mol\ H_2O}{7\ mol\ O_2}\right)\left(\frac{18.02\ g\ H_2O}{mol\ H_2O}\right)$

$= 7.240\ g\ H_2O$

Limiting reactant: O_2

Name: _____

9. **Balance** the below equation. What is the **limiting reactant** when 12.0g of propane (C_3H_8) reacts with 30.0 g oxygen? What is the **theoretical yield for CO_2**? How many grams of **excess reactant** remain?

(1) $C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$

12.0 g 30.0 g

C_3H_8: $(12.0\text{ g } C_3H_8)\left(\frac{\text{mol } C_3H_8}{44.09\text{ g } C_3H_8}\right)\left(\frac{3\text{ mol } CO_2}{1\text{ mol } C_3H_8}\right)\left(\frac{44.01\text{ g } CO_2}{\text{mol } CO_2}\right)$

$= 35.9\text{ g } CO_2$

O_2: $(30.0\text{ g } O_2)\left(\frac{\text{mol } O_2}{32.00\text{ g } O_2}\right)\left(\frac{3\text{ mol } CO_2}{5\text{ mol } O_2}\right)\left(\frac{44.01\text{ g } CO_2}{\text{mol } CO_2}\right)$

$= 24.8\text{ g } CO_2$

Limiting reactant: O_2

CO_2 theoretical yield: 24.8 g CO_2

Excess reactant: ~~_____~~

Name: _____

9. Calculate the **theoretical yield for AgCl** given 15.6 grams of ~~NaCl~~ $CaCl_2$ react with excess $AgNO_3$. What is the **percent yield** if an experiment produces 23.3 grams of AgCl?

$$2\,AgNO_3 + CaCl_2 \rightarrow 2\,AgCl + Ca(NO_3)_2$$

excess 15.4g ?

$$(15.4\text{ g } CaCl_2)\left(\frac{\text{mol } CaCl_2}{110.98\text{ g } CaCl_2}\right)\left(\frac{2\text{ mol AgCl}}{1\text{ mol } CaCl_2}\right)\left(\frac{143.32\text{ g AgCl}}{\text{mol AgCl}}\right)$$

$$= 40.3\text{ g AgCl}$$

$$\%\text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100\%$$

$$= \frac{23.3\text{ g}}{40.3\text{ g}} \times 100\% = 57.8\%$$

AgCl theoretical yield: 40.3 g AgCl

AgCl percent yield: 57.8%