Chem101A-GLENN
Quiz 1-A

NAME KEY - A
(First) (Last)

Show your work for each question. Please BOX your final answer.

1. Check one: ☐ I am an enrolled student.

☐ I am on the waitlist.

2. A chemist mixes 2.00 g sample of $NH_3(g)$ with 4.00 g of $O_2(g)$ and a reaction occurs according to the following chemical equation:

$$4\ NH_3(g)\ +\ 5\ O_2(g)\ \longrightarrow\ 4\ NO(g)\ +\ 6\ H_2O\ (g)$$

a) Which species is the limiting reactant? [2 points]

$2.00\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.034\ g\ NH_3} \times \frac{5\ mol\ O_2}{4\ mol\ NH_3} \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = 7.525\ g\ O_2$ required

* Only have 4.00 g O_2 available!

O_2 is the limiting reactant!

* Note that you must consider the mole ratio that the O_2 and NH_3 react in!! (Not just the amounts available...)

b) How ~~much~~ many grams NO(g) can be produced? [2 points]

$4.00\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} \times \frac{4\ mol\ NO}{5\ mol\ O_2} \times \frac{30.01\ g}{1\ mol\ NO} = 3.00\ g\ NO$

theoretical yield

c) If the reaction in this problem had a 79.8% yield, what was the actual yield of NO(g)? [2 points]

79.8% of $3.00\ g = 0.798 \cdot 3.00\ g = 2.394\ g\ NO$

actual yield

3) A compound containing only carbon and hydrogen is analyzed using combustion analysis. When a 2.731 g sample is burned in the presence of excess oxygen, 4.232 g of H_2O are produced. What is the empirical formula of the compound? [3 points]

$$4.232\,g\,H_2O \times \frac{1\,mol\,H_2O}{18.016\,g\,H_2O} \times \frac{2\,mol\,H}{1\,mol\,H_2O} = 0.46980\,mol\,H$$

$$0.46980\,mol\,H \times \frac{1.008\,g\,H}{1\,mol\,H} = 0.473563\,g\,H$$

$$2.731\,g\,compound - 0.473563\,g\,H = 2.257744\,g\,C$$

$$2.257744\,g\,C \times \frac{1\,mol\,C}{12.01\,g\,C} = 0.187963\,mol\,C$$

$0.46980\,mol\,H / 0.187963 = 2.499 \times 2 = 5\,mol\,H$

$0.187963\,mol\,C / 0.187963 = 1 \times 2 = 2\,mol\,C$

$\boxed{C_2H_5}$

3) A 5.83 gram sample of an unknown metal M reacts completely with carbon monoxide to form 16.96 grams of a metal carbonyl compound with the formula $M(CO)_4$. Identify the unknown metal M. [3 points]

$5.83\,g\,M$

$16.96\,g\,M(CO)_4$

$16.96 - 5.83\,g = 11.13\,g\,CO$ (in the compound)

$$11.13\,g\,CO \times \frac{1\,mol\,CO}{28.01\,g\,CO} \times \frac{1\,mol\,M}{4\,mol\,CO} = 0.0993395\,mol\,M$$

$$molar\,mass\,of\,M = \frac{5.83\,g\,M}{0.0993395\,mol\,M}$$

$= 58.6876\,g/mol$

$\boxed{58.69\,g/mol}$

$\boxed{Ni,\ Nickel}$

Chem101A-GLENN
Quiz 1-B

NAME KEY-B
(First) (Last)

Show your work for each question. Please BOX your final answer.

1. Check one: ☐ I am an enrolled student.

☐ I am on the waitlist.

2. A chemist mixes 3.00 g sample of $N_2H_4(l)$ with 2.00 g of $N_2O_4(g)$ and a reaction occurs according to the following chemical equation:

$$2\ N_2H_4(l)\ +\ N_2O_4(g)\ \longrightarrow\ 3\ N_2(g)\ +\ 4\ H_2O\ (g)$$

a) Which species is the limiting reactant? [2 points]

$2.00\,g\ N_2H_4 \times \frac{1\,mol\ N_2H_4}{32.052\,g\ N_2H_4} \times \frac{1\,mol\ N_2O_4}{2\,mol\ N_2H_4} \times \frac{92.02\,g}{1\,mol\ N_2O_4} = 4.3064\,g\ N_2O_4$ required

* Only 2.00 g N_2O_4 is available!

N_2O_4 is the limiting reactant

b) How ~~much~~ many grams $N_2(g)$ can be produced? [2 points]

$2.00\,g\ N_2O_4 \times \frac{1\,mol\ N_2O_4}{92.02\,g\ N_2O_4} \times \frac{3\,mol\ N_2}{1\,mol\ N_2O_4} \times \frac{28.02\,g\ N_2}{1\,mol\ N_2} = 1.83\,g\ N_2$ theoretical yield

c) If the reaction in this problem had a 79.8% yield, what was the actual yield of N_2? [2 points]

$79.8\%\ of\ 1.83\,g = 0.798 \times 1.83\,g = 1.46\,g\ N_2$ actual yield

$$0.947269 \text{ mol H} \times \frac{1.008 \text{ g H}}{1 \text{ mol H}} = 0.954847 \text{ g H}$$

$$5.829 \text{ g compound} - 0.954847 \text{ g H} = 4.87415 \text{ g C}$$

$$4.87415 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 0.4058412 \text{ mol C}$$

$0.947269 \text{ mol H} / 0.4058412 = 2.334 \rightarrow \times 3 = 7 \text{ mol H}$

$0.405842 \text{ mol C} / 0.4058412 = 1 \rightarrow = 3 \text{ mol C}$

$\boxed{C_3H_7}$

4) A 7.95 gram sample of an unknown metal M reacts completely with carbon monoxide to form 33.64 grams of a metal carbonyl compound with the formula $M(CO)_6$. Identify the unknown metal M. [3 points]

7.95 g M

$33.64 \text{ g } M(CO)_6$

$33.64 \text{ g} - 7.95 \text{ g} = 25.69 \text{ g CO (in compound)}$

$$25.69 \text{ g CO} \times \frac{1 \text{ mol CO}}{28.01 \text{ g CO}} \times \frac{1 \text{ mol M}}{6 \text{ mol CO}} = 0.152862 \text{ mol M}$$

$$\text{molar mass of M} = \frac{7.95 \text{ g M}}{0.152862 \text{ mol M}} = 52.0077 \text{ g/mol}$$

52.00 g/mol

Cr, chromium