Chemistry 20 - Unit 4 - Gas Stoichiometry

Name: _____

1.00000 atm = 760.000 mmHg = 101.325 kPa R = 8.314 (L*kPa)/(K*mol) pV = nRT $T_K = T_{°C} + 273.15$

1) A balanced chemical equation includes simple coefficients in front of the chemical formulas.
   a) What do these coefficients represent?

The ratios of the amounts of each chemical that will react/be produced in a reaction.

   b) What is the term for the overall relationship of chemical amounts of all reactants and products?

Stoichiometry.

2) A chemical laboratory technician plans to react 3.50 g of lead(II) nitrate with excess potassium bromide in solution. Predict the mass of precipitate expected.

Pb^{2+} NO_3^- K^+ Br^-

$Pb(NO_3)_{2(aq)} + 2KBr_{(aq)} \rightarrow 2KNO_{3(aq)} + PbBr_{2(s)}$

3.50 g, 331.22 g/mol | Excess | m = ?? , 367.0 g/mol

$n_{PbNO_3} = 3.50\,g \times \frac{mol}{331.22\,g} = 0.0106\,mol$

$n_{PbBr} = 0.0106 \times \frac{1}{1} = 0.0106\,mol$

$m_{PbBr_2} = 0.0106\,mol \times 367.0\,g/mol = \boxed{3.88\,g}$

3) When calculating a percent yield for a reaction, where do the values for the actual yield and for the predicted yield come from?

actual = what is directly measured (in lab)
predicted = what is calculated (stoich)

4) A solution made by dissolving 9.8 g of barium chloride is to be completely reacted with 2.00 L of 0.127M sodium sulfate solution containing dissolved sodium sulfate.
   a) Predict the mass of precipitate expected.

$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow 2NaCl_{(aq)} + BaSO_{4(s)}$

9.8 g, 208.23 g/mol | ~~2.00 L, 0.127 M, 0.254 mol~~ Excess | 233.40 g/mol

$n_{BaCl_2} = 9.8\,g \times \frac{mol}{208.23\,g} = 0.047\,mol$

$n_{BaSO_4} = 0.047\,mol \times \frac{1}{1} = 0.047\,mol$

$m_{BaSO_4} = 0.047\,mol \times \frac{233.40\,g}{mol} = \boxed{11\,g}$

If 10.0 g of precipitate actually formed, calculate the percent yield.

$\frac{act}{per} \times 100\% = \frac{10.0\,g}{11\,g} \times 100\% = \boxed{91\%}$

Does the percent yield result indicate the reaction went as expected?

Yes. most of the original mass was recoved.

101.325 kPa
O_2 // 273.15K CH_3OH

5) What volume of oxygen at STP is needed to completely burn 15 g of methanol in a fondue burner?

$$2CH_3OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$$

15g, V=?

32.05g/mol

$n_{CH_3OH} = 15g \times \frac{1\,mol}{32.05g} = 0.47\,mol$

$n_{O_2} = 0.47\,mol \times \frac{3}{2} = 0.70\,mol$

$V_{O_2} = \frac{nRT}{P} = \frac{(0.70)(8.3145)(273.15)}{101.325}$

$= 16L$

6) As recently as the early 20th century, pinches of sulfur were sometimes burned in sickrooms. The pungent choking fumes produced were supposed to be effective against the "evil humours" of the disease. In fact, the sulfur dioxide gas produced is toxic and extremely irritating to lung tissue, where it dissolves to form sulfurous acid. Even today, a surprising number of people still believe that medicines are more likely to be effective if they have unpleasant tastes or odours.

100.00kPa 298.15K

a) What volume of $SO_{2(g)}$ at SATP will be produced from the burning of 1.0g of sulfur?

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$$

1.0g, V=??

32.07g/mol

$n_S = 1.0g \times \frac{mol}{32.07g} = 0.031\,mol$

$n_{SO_2} = 0.031\,mol \times \frac{1}{1} = 0.031\,mol$

$V_{SO_2} = \frac{nRT}{P} = \frac{(0.031)(8.3145)(298.15)}{(100.00)}$

$= 0.77L$

7) When 340.8 grams of ammonia ($NH_{3(g)}$) combusts, it produces the highly toxic $NO_{2(g)}$ and $H_2O_{(g)}$.

a) Write a balanced chemical equation detailing this reaction.

$$4NH_{3(g)} + 7O_{2(g)} \rightarrow 4NO_{2(g)} + 6H_2O_{(g)}$$

340.8g, ??

17.04g/mol

b) Calculate how many moles of ammonia combust.

$n_{NH_3} = 340.8g \times \frac{mol}{17.04g} = 20.00\,mol$

c) If this reaction takes place at a pressure of 100.0 kPa and a temperature of ~~35.85~~ °C, what volume of nitrogen dioxide is produced?

309.00K

$n_{NO_2} = 20.00\,mol \times \frac{4}{4} = 20.00\,mol$

$V_{NO_2} = \frac{nRT}{P} = \frac{(20.00)(8.3145)(309.00)}{100.0kPa}$

$= 513.8L$