**Quiz 9A**

# Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work. Where appropriate answers should be boxed for clarity, written to the correct number of significant figures, and, include the proper units.

1. Solid phosphorus, P4, reacts with hydrogen gas to produce phosphine, PH3, gas (16 points).
	1. If 12.9 g of phosphorus react with hydrogen gas at a pressure of 0.941 atm, a volume of 6.54 L, and a temperature of 84 °C, how many grams of phosphine can be produced? Use an ICE table.

First, calculate the number of moles of each reactant:

$$12.6 g P\_{4}×\frac{1 mol P\_{4}}{123.896 g P\_{4}}=0.104119584 mol P\_{4}$$

$$PV=nRT⇒n=\frac{PV}{RT}=\frac{(0.941 atm)(6.54 L)}{\left(0.08206 \frac{L atm}{mol K}\right)\left(84+273\right)K}=0.210071745 mol H\_{2}$$

Second, write the balanced chemical equation, complete the ICE table, and determine the limiting reagent by comparing ratios.

|  |  |  |  |
| --- | --- | --- | --- |
|  | P4 (g) +  | 6 H2 (g) → | 4 PH3 (g) |
| I | 0.104 mol  | 0.210 mol | 0 mol  |
| C | -x | -6x | +4x |
| E | 0.104 mol –x = 0.104 mol – 0.0350 mol =0.069 mol  | 0.210 mol -6x =0.210 mol – 6(0.0350 mol) =0 mol  | 4x =4(0.0350 mol) = 0.140 mol  |

To determine the limiting reagent compare ratios

$theoretical ratio: \frac{6 mol H\_{2}}{1 mol P\_{4}}$ > $actual ratio: \frac{0.210071745 mol H\_{2}}{0.104119584 mol P\_{4}}= \frac{2.017600695 mol H\_{2}}{1 mol P\_{4}}$

Therefore, the limiting reagent is H­2. So, now x can be found:

$$0.210 mol-6x=0 mol $$

$$0.210 mol=6x $$

$$0.0350 mol=x$$

Lastly, calculate the grams of phosphine produced:

$$0.140 mol PH\_{3}×\frac{33.998 g PH\_{3} }{1 mol PH\_{3}}=4.76 g PH\_{3}$$

* 1. If 4.11 g of phosphine are actually produced, what is the percent yield?

$$\%yield=\frac{m\_{actual}}{m\_{theoretical}}×100=\frac{4.11 g}{4.76 g}×100=86.3\%$$

* 1. How many grams of the excess reagent remain?

$$0.069 mol P\_{4}×\frac{123.896 g P\_{4}}{1 mol P\_{4}}=8.5 g P\_{4}$$

1. Suppose that hydrogen gas is collected over water at a total pressure of 743.3 torr and a temperature of 20 °C. What is the partial pressure of dry hydrogen gas (4 points)?

$$P\_{total}=P\_{H\_{2}}+P\_{H\_{2}O}⇒P\_{H\_{2}}= P\_{total}-P\_{H\_{2}O}=743.3 torr- 17.5 torr=725.8 torr $$

1. What are intermolecular forces? What are the three main types? Why are intermolecular forces important (5 points)?

Intermolecular forces are attractive forces that occur between molecules. Intermolecular forces are what living organisms depend on for many physiological processes. Intermolecular forces are also responsible for the existence of liquids and solids. Three types were discussed: London-dispersion forces, dipole forces, and hydrogen bonds.