Quiz 10A
11 points

Name KEY
Maleckar/960/Fall 2009

1. Calculate the total pressure (in atm) of a mixture of 3.2g of He, 4.4g of O_2, and 2.7g of N_2, in a 2.5L flask at 20°C.

$(3.2g\ He)\left(\frac{mole}{4g}\right) = 0.80 moles\ He$

$(4.4g)\left(\frac{mole}{32g}\right) = 0.1375 moles\ O_2$

$(2.7g)\left(\frac{mole}{28g}\right) = 0.0964 moles\ N_2$

total moles = 1.0339 moles

$20°C + 273 = 293K$

$P = \frac{nRT}{V} = \frac{(1.0339)(.08206)(293)}{2.5L}$

$= 9.9 atm$

5 pts.

2. Calcium carbide reacts with water to produce acetylene gas, C_2H_2. Calculate the volume (in L) of acetylene produced at 25°C and 684mm Hg from 2.5g of CaC_2 and excess water.

$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

MW 64 26

$(2.5g\ CaC_2)\left(\frac{mole}{64g}\right)\left(\frac{1\ mole\ C_2H_2}{1\ mole\ CaC_2}\right) = 0.039\,06 moles\ C_2H_2$

$(684mm)\left(\frac{1atm}{760mm}\right) = 0.90 atm$

$25 + 273 = 298\ K$

$V = \frac{nRT}{P} = \frac{(0.039\,06)(.08206)(298)}{0.90} = 1.06L$

6 pts.

Quiz 10B **Name** KEY
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1. Uranium hexafluoride, UF_6, is a white solid that sublimes (vaporizes without melting) at 57°C under normal atmospheric pressure. What is the rms speed (in m/s) of a uranium hexafluoride molecule at 57°C?

UF_6 $MW = 238 + 6(19) = 352\ g/mole = 0.352\ kg/mole$

$T = 57 + 273 = 330\ K$

$$u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3(8.314)(330)}{0.352}} = 152.9\ m/s$$

6 pts.

2. The maximum safe pressure that a certain 4.00L vessel can hold is 3.50atm. If the vessel contains 0.410 moles of gas, what is the maximum temperature (in degrees Celcius) to which this vessel can be subjected?

$$T = \frac{PV}{nR} = \frac{(3.50)(4.00)}{(0.410)(.0806)} = 416.1\ K$$

-273

$= 143.1\ °C$

4 pts.

3. Which gas will effuse/diffuse faster, H_2S or $COCl_2$? H_2S 1pt
MW 34 98

↓ Equations/Constants are on the back ↓

Quiz 10C **Name** KEY
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1. A chemist vaporized a liquid compound and determined its density. If the density of the vapor at 90°C and 753mm Hg is 1.585 g/L, what is the molecular weight of the compound? $d = \frac{PM}{RT}$

$90 + 273 = 363K$

$(753mm)\left(\frac{1atm}{760mm}\right) = 0.9908 atm$

$M = \frac{dRT}{P} = \frac{\left(1.585 \frac{g}{L}\right)\left(.08206 \frac{L \cdot atm}{mole \cdot K}\right)(363K)}{.9908 atm}$

$= 47.65 \text{ g/mole}$

5 pts.

2. A given volume of nitrogen, N_2, required 68.3 seconds to effuse from a hole in a chamber. Under the same conditions, another gas required 85.6 seconds for the volume to effuse. What is the molecular weight of this gas?

$\frac{r_1}{r_2} = \frac{\frac{vol\ r_1}{time\ r_1}}{\frac{vol\ r_2}{time\ r_2}} = \sqrt{\frac{M_2}{M_1}}$

$\frac{\frac{vol}{68.3}}{\frac{vol}{85.6}} = \sqrt{\frac{M_2}{28}}$

$1.2533 = \frac{85.6}{68.3} = \sqrt{\frac{M_2}{28}}$

$1.5707 = \frac{M_2}{28}$

$M_2 = 43.98 \text{ g/mole}$

10 pts.

Quiz 10D **Name** KEY
11 points **Maleckar/960/Fall 2009**

1. Use the van der Waals equation to calculate the theoretical temperature of 1.000 mole of neon in a 55.0L container and at a pressure of 500 atm. a = 0.2135, b = 0.01709
$P = nRT/V-nb - n^2a/V^2$

$$500 = \frac{(1)(.08206)(T)}{55 - (1)(.01709)} - \frac{(1)^2(.2135)}{(55)^2}$$

$$500 = \frac{.08206T}{54.983} - 7.058\times10^{-5}$$

$$500.0000706 = \frac{.08206T}{54.983}$$

$$T = 335017\ K$$ yikes!

5 pts.

2. Formic acid, $HCHO_2$, decomposes when warmed with sulfuric acid, producing water and carbon monoxide.

$$HCHO_2(l) \rightarrow H_2O(l) + CO(g)$$

If 3.85L of carbon monoxide were collected over water at 25°C and 689 mm Hg, how many grams of formic acid were consumed? P_{H2O} @ 25°C = 23.78 mm Hg.

$$P_{CO} = 689 - 23.78 = 665.22\ mm\ Hg\left(\frac{1atm}{760mm}\right) = 0.875\ atm$$

$$n_{CO} = \frac{PV}{RT} = \frac{(.875)(3.85)}{(.0820)(298)} = 0.1378\ moles\ CO = .1378\ \text{moles } HCHO_2$$

$$(.1378\ moles)\left(\frac{46g}{mole}\right) = 6.34\ g\ HCHO_2$$

10 pts.

Quiz 10E **Name** KEY

11 points **Maleckar/960/Fall 2009**

★ The density of octane = .703 g/mL

1. Octane is combusted in your car ~~according~~ to the unbalanced reaction below.

$$2\,C_8H_{18} + 25\,O_2 \rightarrow 16\,CO_2 + 18\,H_2O$$

If 1.1L of octane is completely combusted in an endless supply of oxygen, how many L of CO_2 are produced? Assume the pressure is 745 mm Hg and the temp is 30°C.

$(1.1L)\left(\frac{1000mL}{1L}\right)\left(\frac{.703g}{mL}\right) = 773.3\,g$ octane

$(773.3g\,C_8H_{18})\left(\frac{mol}{114g}\right)\left(\frac{16\ moles\ CO_2}{2\ moles}\right) = 54.27$ moles CO_2

$\frac{745}{760} = .9803$ atm

$V = \frac{(54.27)(.08206)(303)}{.9803} = 1376\,L$

10 pts.

2. If it takes 10.6 hours for 1.00L of nitrogen, N_2, to effuse through the pores in a balloon, how long would it take for 1.00L of helium, He, to effuse under the same conditions?

$$\frac{\frac{1.00L}{10.6}}{\frac{1.00}{x}} = \sqrt{\frac{4}{28}}$$

$$\frac{x}{10.6} = \sqrt{\frac{4}{28}} = 0.37796$$

$x = 4.006$ hours.

5 pts.