

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 O₂, and 2.7g of N₂, in a 2.5L flask at 20°C.

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

$$20^\circ\text{C} + 273 = 293\text{K}$$

$$(4.4g) \left(\frac{\text{mole}}{32g} \right) = 0.1375 \text{ moles O}_2$$

$$P = \frac{nRT}{V} = \frac{(1.0339)(0.08206)(293)}{2.5\text{L}}$$

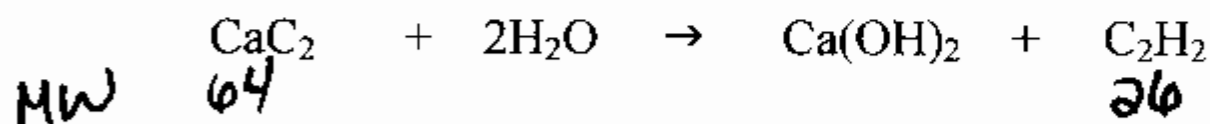
$$(2.7g) \left(\frac{\text{mole}}{28g} \right) = 0.0964 \text{ moles N}_2$$

$$= 9.9 \text{ atm}$$

$$\text{total moles} = 1.0339 \text{ moles}$$

5 pts.

2. Calcium carbide reacts with water to produce acetylene gas, C₂H₂. Calculate the



volume (in L) of acetylene produced at 25°C and 684mm Hg from 2.5g of CaC₂ and excess water.

$$(2.5g \text{ CaC}_2) \left(\frac{\text{mole}}{64g} \right) \left(\frac{1 \text{ mole C}_2\text{H}_2}{1 \text{ mole CaC}_2} \right) = 0.03906 \text{ moles C}_2\text{H}_2$$

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

$$25 + 273 = 298 \text{ K}$$

$$V = \frac{nRT}{P} = \frac{(0.03906)(0.08206)(298)}{0.90} = 1.06 \text{ L}$$

6 pts.

Quiz 10B
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1. Uranium hexafluoride, UF_6 , is a white solid that sublimates (vaporizes without melting) at $57^\circ C$ under normal atmospheric pressure. What is the rms speed (in m/s) of a uranium hexafluoride molecule at $57^\circ C$?

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

$$T = 57 + 273 = 330 \text{ K}$$

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

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?

$$T = \frac{PV}{nR} = \frac{(3.50)(4.00)}{(0.410)(8.314)} = 416.1 \text{ K}$$

-273

$$= 143.1^\circ C$$

4 pts.

3. Which gas will effuse/diffuse faster, H_2S or $COCl_2$?

MW 34 98

H_2S 1 pt

↓ Equations/Constants are on the back ↓

Quiz 10C
11 points

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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?

$$d = \frac{PM}{RT}$$

$$90 + 273 = 363K$$

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

$$M = \frac{dRT}{P} = \frac{(1.585 \frac{\text{g}}{\text{L}}) \left(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \right) (363\text{K})}{0.9908\text{atm}}$$

$$= 47.65 \text{ g/mole}$$

5 pts.

2. A given volume of nitrogen, N₂, 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?

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

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

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

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

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

6 pts.

Quiz 10D
11 points

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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. $a = 0.2135$, $b = 0.01709$

$$P = nRT/V - nb - n^2a/V^2$$

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

$$500 = \frac{.08206T}{54.983} - 7.058 \times 10^{-5}$$

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

$$T = 335017 \text{ K} \quad \text{yikes!}$$

5 pts.

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



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? $P_{\text{H}_2\text{O}} @ 25^\circ\text{C} = 23.78 \text{ mm Hg}$.

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

$$n_{\text{CO}} = \frac{PV}{RT} = \frac{(0.875)(3.85)}{(0.08206)(298)} = 0.1378 \text{ moles CO} = \text{moles HCHO}_2$$

$$(0.1378 \text{ moles}) \left(\frac{46 \text{ g}}{\text{mole}} \right) = 6.34 \text{ g HCHO}_2$$

6 pts.

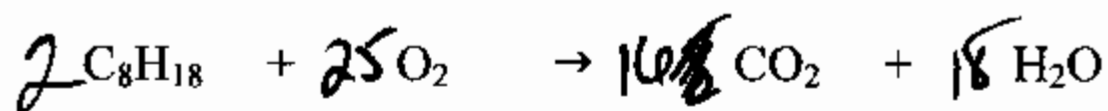
Quiz 10E

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* The density of octane is .703g/ml

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



If 1.1L of octane is completely combusted in an endless supply of oxygen, how many L of CO₂ are produced? Assume the pressure is 745 mm Hg and the temp is 30°C.

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

$$(773.3g C_8H_{18}) \left(\frac{1 \text{ mole}}{114g} \right) \left(\frac{16 \text{ moles } CO_2}{2 \text{ moles } C_8H_{18}} \right) = 54.27 \text{ moles } CO_2$$

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

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

6 pts.

2. If it takes 10.6 hours for 1.00L of nitrogen, N₂, 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?

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

5 pts.

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

$$x = 4.006 \text{ hours.}$$