Exam 4a
Chem 1121
Summer 2008

Name: KEY

Take a deep breath, and relax! First, answer the questions you know how to do and then work on the more difficult problems. Don't forget to show all your work, so I can give you as much credit as possible.

Good Luck!

Andy

Q1. The reaction between stomach acid (HCl) and tums ($CaCO_3$) is given by the following **unbalanced** chemical equation:

$$2\,HCl + 1\,CaCO_3 \rightarrow 1\,CaCl_2 + 1\,H_2O + 1\,CO_2$$

a) [10 pts.] Balance the equation using the *lowest* set of whole number coefficients.

b) [7 pts.] Using the conversion factor method, calculate how many moles of CO_2 will be produced when 0.24 mol of HCl is neutralized.

$$0.24\,\text{mol HCl} \times \frac{1\,\text{mol } CO_2}{2\,\text{mol HCl}} = 0.12\,\text{mol } CO_2$$

c) [10 pts.] Using the conversion factor method, calculate the mass of CO_2 that will be produced from 0.450 g of $CaCO_3$

$CaCO_3$

$1\times Ca = 1\times 40.08$

$1\times C = 1\times 12.01$

$3\times O = 3\times 16.00$

100.09

(1) $0.450\,g\,CaCO_3 \times \frac{1\,\text{mol } CaCO_3}{100.09\,g\,CaCO_3} = 0.00450\,\text{mol } CaCO_3$

(2) $0.00450\,\text{mol } CaCO_3 \times \frac{1\,\text{mol } CO_2}{1\,\text{mol } CaCO_3} = 0.00450\,\text{mol } CO_2$

CO_2

$1\times C = 1\times 12.01$

$2\times O = 2\times 16.00$

44.01

(3) $0.00450\,\text{mol } CO_2 \times \frac{44.01\,g\,CO_2}{1\,\text{mol } CO_2} = 0.198\,g\,CO_2$

Q2. Convert the following masses to moles:
a) [5 pts.] 0.35 g of CH_2O, formaldehyde

CH_2O

$1\times C = 1\times 12.01$
$2\times H = 2\times 1.01$
$1\times O = 1\times 16.00$
30.03

$$0.35\,g\ CH_2O \times \frac{1\ mol\ CH_2O}{30.03\,g\ CH_2O} = 0.012\ mol\ CH_2O \quad (2\ s.f.)$$

b) [5 pts.] 12.0 g of $C_6H_{12}O_6$, glucose.

$C_6H_{12}O_6$

$6\times C = 6\times 12.01$
$12\times H = 12\times 1.01$
$6\times O = 6\times 16.00$
180.18

$$12.0\,g\ C_6H_{12}O_6 \times \frac{1\ mol\ C_6H_{12}O_6}{180.18\,g\ C_6H_{12}O_6} = 0.0666\ mol\ C_6H_{12}O_6 \quad (3\ s.f.)$$

Q3. [5 pts.] What mass would 0.50 mol of water, H_2O, weigh?

H_2O

$2\times H = 2\times 1.01$
$1\times O = 1\times 16.00$
18.02

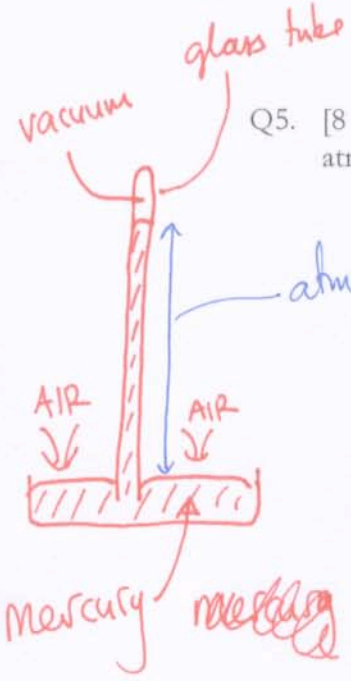
$$0.50\ mol\ H_2O \times \frac{18.02\,g\ H_2O}{1\ mol\ H_2O} = 9.0\,g\ H_2O \quad (2\ s.f.)$$

Q4. *Use the conversion factor method for both of the problems.*
[5 pts.] How many moles of glucose are contained in 0.200 L of a solution that is 0.34 M?

$$0.34\,M = \frac{0.34\ mol\ glucose}{1\ L} \Rightarrow 0.200\,L \times \frac{0.34\ mol\ glucose}{1\ L} = 0.068\ mol\ glucose$$

[5 pts.] What volume of 0.34 M glucose solution contains 1.00 mol glucose?

$$1.00\ mol\ glucose \times \frac{1\ L}{0.34\ mol\ glucose} = 2.9\,L \quad (2\ s.f.)$$



Q5. [8 pts.] Sketch a diagram of a toricelli barometer, and explain how it can be used to measure atmospheric pressure.

Q6. [6 pts.] The total pressure of a mixture of three gases is 452 mmHg. If two of the three gases have partial pressures of 124 mmHg and 201 mmHg, then what must be the partial pressure of the third gas?

$P_{TOT} = P_1 + P_2 + P_3 \Rightarrow P_{TOT} - P_1 - P_2 = P_3$

$\Rightarrow P_3 = 452\,mmHg - 124\,mmHg - 201\,mmHg = 127\,mmHg$

Q7. [10 pts.] Match the gas laws:

1) Boyle's Law (e)	a) $V \propto T$
2) Charles' Law (a)	b) $pV = nRT$
3) Avogadro's Law (d)	c) $p \propto T$
4) Gay Lussac's Law (c)	d) $V \propto n$
5) Ideal Gas Law (b)	e) $P \propto 1/V$

Q8. [7 pts.] A balloon of gas with a volume of 23.0 L at a pressure of 742 mmHg is squeezed so that its pressure becomes 921 mmHg. What will its new volume be?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$P_1V_1 = P_2V_2$

$\Rightarrow V_2 = \frac{P_1V_1}{P_2} = \frac{742\,mmHg \times 23.0\,L}{921\,mmHg} = 18.5\,L$

Q9. [7 pts.] What volume will 0.15 mol of a gas occupy if its temperature is 23 °C, and its pressure is 0.45 atm?

$pV = nRT$

$\Rightarrow V = \frac{nRT}{p}$

$n = 0.15 \text{ mol}$

$R = 0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}$

$T = 23 + 273 = 296 \text{ K}$

$p = 0.45 \text{ atm}$

$V = \frac{0.15 \text{ mol} \times 0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}} \times 296 \text{ K}}{0.45 \text{ atm}}$

$= 8.1 \text{ L}$ (2 s.f.)

Q10. [5 pts.] **Fill in the blanks.** The pressure of gas above a liquid is known as the vapor pressure. At the boiling point of a liquid, this pressure is equal to atmospheric pressure

Q11. [5 pts.] Using the kinetic theory of gases (the idea that gases are composed of a large number of tiny particles in a state of constant chaotic motion) explain what is responsible for the **pressure** of a gas?

The force of the gas particles colliding with the walls is responsible for the pressure ($p = \frac{f}{A}$)

BONUS QUESTION:

What is the name given to a solution that has the *maximum* amount of solute dissolved in a given amount of solvent.

Saturated