**Exam 3: Chem 1114 Spring 2018**

**Version B 70 points**

**Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Show work for all numeric problems of no credit**

1. A fixed quantity of ideal gas at constant temperature is initially at a pressure of 1 atm and a

volume of 5 L. The volume is then changed to 2.5 L. What is the new pressure ?

***T1=T2=> P1V1=P2V2***

***1\*5=P2\*2.5 => P2=5/2.5=2 atm***

new pressure=\_\_2\_\_\_atm (2 pts)

1. An unknown gas can have one of six identities:

O2 N2 CO2 H2O SO2 H2

MW 32 28 44 18 64 2

A 1 gram sample of the gas occupies 1.00 L at 300 K and a pressure of 0.559 atm. Which gas are you working with ? (show work.) R=0.082 atm L/K mol

*n=PV/RT = 0.559\*1/(300\*0.08206)=0.0.02271 mol*

*MW = #g/#mol = 1/0.02271=44 g/mol=> CO2*

\_CO2\_ gas ID (4 pts)

2. A nitrogen oxide compound NxOy decomposes to form N2 and O2.

The possible choices for the compound are:

NO2🡪 ½ N2 + O2 *=> 1.5 mol out*

NO 🡪 ½ N2 + ½ O2 *=> 1 mol out*

N2O4 🡪 N2 + 2O2 *=> 3 mol out*

The Ideal Gas fairy informs you that 1 mole of the mystery gas decomposes to N2 and O2 which then occupies 100 L at 0.7389 atm and 300 K. R=0.0821 atm L/K mol

What is the identity of the original NxOy compound ? (show work)

***nprod =PV/RT = 0.7389\*100/(0.08206\*300) = 3 => N2O4***

\_N2O4\_\_ NxOy ID (**4 pts)**

3. A sample of gas weighing 50 grams occupies 20 L at 0.61545 atm and 300 K. Given that

R=0.082 atm L/K mole what is the molecular weight of the gas ?

***n=PV/RT = 0.61545\*20/(0.08206\*300)=0.5 mol MW = #g/#mol= 50/0.5=100***

MW(g/mol)=\_\_100\_\_ ( 4 pts)

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**Exam 3B (continued) p. 2/5**

4.1 Circle all the true features of the Ideal Gas law below: (2 points)

a) PV=nRT irrespective of gas identity b) R is a fixed constant for all gases

c) Equal pressures, equal moles d) It explains why gases condense

5.1 A tennis ball is about 2 inches (0.166 ft) in diameter. A pair of students have assigned the baseball the role of atomic nucleus. About how many miles away would the electron cloud be? (12 inches =1 foot; 1 mile =5280 feet).

2\*100,000 inches/12 in ft-1=16,666 ft=16,666 ft/5280 ft mil-1~3.16 miles

Radius of electron cloud\_\_\_\_\_~3.2 \_\_\_\_\_\_\_\_ miles

2 pts

5.2. The ~ proton mass/electron mass (Mp/Me) is:

a) 1:2000

b) 1:1

c) 2000:1

d) 1:100,000

5.3 The relative mass of protons (p) to neutrons(n) is

a)p=1; n=0.005 b)n=1, p=2000

c)p=1; n=1 d) p=10, n=20

5.4. According to Rutherford’s model of the atom:

a) the nucleus is a small dot in the center of a diffuse cloud of electrons

b) the positive and negative material of an atom are smeared out in a `plum pudding’ fashion

c) electrons orbit in circles around a nucleus

d) neutrons exist.

5.5. According to Bohr’s model of the atom:

a) electrons are like chocolate chips embedded in a `cookie dough’ of positive matter.

b) electrons are a diffuse, unstructured cloud centered on a tiny, positively charged nucleus.

c) neutrons circulate around a nucleus of electrons and protons

d) electrons exist in rigid circular orbits around a positively charged nucleus.

8.1. Provide the complete electronic configurations for the elements below: (2 pts each)

1. Si\_\_\_\_\_\_\_\_\_1s22s22p63s23p2\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Mg\_\_\_\_\_\_\_\_\_1s22s22p63s2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Na\_\_\_\_\_\_\_\_\_\_1s22s22p63s1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) P\_\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8.2. Provide the correct pigeonhole descriptions for the elements and ions below:

Remember to subtract electrons if the element is +charged. (4 pts each/ 12 pts total)

1. Cu [ Ar ] [Ar] 3d104s1
2. Ni [Ar ] [Ar]3d104s0
3. Fe2+ [Ar ] [Ar]3d54s1

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**Exam 3B (continued) p. 3/3**

9.1 Predict the likely formulas for the ionic compounds below: (2 pts each/ 6 pts total)

1. Ca + O= \_\_\_\_\_\_\_\_\_CaO\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Na + P= \_\_\_\_\_\_\_Na3P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Ca + Si = \_\_\_\_\_\_\_Ca2Si\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9.2 Draw the Lewis structures for the compounds below assuming the octet rule is strictly

obeyed. Make sure to show all lone pairs and formal charge (if present) (3 pts each)

a) b) c)







**CO2 COCl2 O2**

9.3. What are the formal charges for each element in the structures below ? ( 4 pts)





a) b)

B

S\_\_\_0\_\_\_ O\_\_\_\_0\_\_\_\_ P\_0\_\_\_\_ ClB\_\_\_+1\_

10.1 Circle the best (most stable) electronic structure of the compounds below assuming

that the best structure is the one that minimizes formal charge. (2 pts each)

a) b) c)







**POCl3SO2  SiOCl2**

**10.4 T/F and fill in (3 points)**

a) covalent bonds all contain 2 electrons T F

b) An Ideal Gas **also** obeys the combined gas law: P1V1/T1=P2V2/T2  T F

d) Cats rule. Dogs drool (except Haley’s puppy) T T

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