**Exam 3: Chem 1114 Spring 2018**

**Version A 70 points**

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

**Show work for all numerical problems below or no credit will be given**

1. A fixed quantity of ideal gas is heated from 100 K to 300 K at fixed pressure. The initial volume is 1 liter. What is the final volume ?

*P1=P2=> V1/T1=V2/T2*

*1/100-V2/300=> V2=300/100 L= 3 L* Final V=\_\_\_\_\_3\_\_\_\_\_ L (2 pts)

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

O2 N2 CO2 H2O SO2 H2

MW 32 28 44 18 64 2

A 1.0 gram sample of the gas occupies 3.00 L at 300 K and a pressure of 0.2563 atm. Which gas are you working with ? (show work.) R=0.082 atm L/K mol

*n= PV/RT= 3\*0.2564/(0.082\*300)=0.031245*

*MW= #g/#mol =1/0.031245=32 g/mol=> O2*

\_\_*O2*\_\_\_\_ gas ID

**4 pts**

3. 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 gas out*

NO 🡪 ½ N2 + ½ O2*=> 1 mol gas out*

N2O4 🡪 N2 + 2O2 *=> 3 mol gas out*

The Ideal Gas fairy informs you that 1 mole of the mystery gas decomposes to N2 and O2 which then occupies 24.6 L at 1 atm and 300 K. R=0.082 atm L/K mol

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

***n(final) = PV/RT= 24.6\*1/(0.082\*300)=1=> NO***

\_\_\_*NO*\_\_\_\_ NxOy ID **4 pts**

3. A sample of gas weighing 20 grams occupies 2 L at 1.23 atm and 300 K. Given that

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

***n=PV/RT= 1.23\*2/(0.082\*300) =0.1 mol => MW = #g/#mol= 20 g/0.1 mol= 200 g/mol***

MW(g/mol)=\_\_\_**200**\_\_ 4 pts

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**Exam 3A (continued) p. 2/3**

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

a) R varies with temperature b) PV=nRT irrespective of gas identity

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

5.1. The ~ ratio of the electron orbit radius / nuclear radius is:

a) 1:100,000

b) 10:1

c) 100,000:1

d) 100,:1

e) 1,000,000:1

5.2 The relative mass of protons (p) to neutrons(n) to electrons ( e) is:

a)p=n=1, p/e =100,000/1 b)p=e=1, p/n =2000/1

c)p=n=1, p/e =2000/1 d) p=e=2000, p/n=1/2000

5.3. 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 don’t exist.

5.4. 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.

5.5. A dried pea is about 1/16 in (=0.00521 ft) in radius. A pair of students have assigned the

pea the role of atomic nucleus. About how many feet (ft) away would the electron cloud be

(to the nearest foot) ?

0.0625 \*100,000=6250 in => 6250/12 ft=520.8 ft~521 ft

Radius of electron cloud\_\_\_521\_\_\_\_\_\_\_\_\_\_ ft

2 pts

6.1. Provide the complete electronic configurations for these elements: (2 pts ea/8 pts total)

1. Al\_\_\_\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p1\_\_\_\_\_\_\_\_\_\_
2. S\_\_\_\_\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p4\_\_\_\_\_\_\_\_
3. O\_\_\_\_\_\_\_\_\_\_\_\_\_1s22s22p4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) Cl\_\_\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p5\_\_\_\_\_\_\_\_

6.2. 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. Fe+2 [ Ar ] [Ar]3d104so
2. V [ Ar ] [Ar] 3d54so
3. Cr+1 [ Ar ] [Ar] 3d54so

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

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

1. Ca + S= \_\_\_\_\_\_\_\_CaS\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. K + P= \_\_\_\_\_\_\_\_\_\_\_K3P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Li + O = \_\_\_\_\_\_\_\_\_Li2O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

obeyed. Make sure to show all lone pairs: (3 pts each/9 pts total)

a) b) c)







**CO COCl2 SO2**

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

A





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)







**SO2 SiOCl2  POCl**3

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

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

b) All covalent bonds contain 4 electrons T F

c) Cats rule. Dogs drool (except Haley’s dog). T T

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