**Exam 3: Chem 1114 Fall 2014**

**Version A 100 points**

**Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 pt**

1.1. Pressure is a measure of Force/ \_\_\_\_\_\_\_\_**\_Area**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1.2 Given the following conversions:

1 atm = 15 psi 1 atm= 760 mm Hg 1 atm = 101 kPa 1 atm =32 feet of H2O

a) Convert 300 psi to atm 300 psi=: \_\_\_\_\_300/15=20\_\_\_\_\_\_\_\_\_atm

b) Convert 64 feet of H2O to mm Hg: 64 feet of H2O=\_(64/32) \*760=1520\_mm Hg 2 pts

c) Convert 404 kPa to psi: 404 kPa = \_\_\_\_(404/101)\_\*15=60\_\_\_\_\_\_\_\_\_\_\_\_\_ psi 2 pts

1.3. Air pressure on Mount Everest is: higher lower the same

as air pressure on the coast of Italy. (circle your choice)

2.1. A gas at fixed volume is initially at T1= 600 K. It is heated to T2= 900 K where it attains a

pressure, P2, of 18 atm. What was the initial pressure, P1 ?

P1~~V~~/T1=P2~~V~~/T2

P1/600=18/900=>P1 =600\*18/900=12 atm P1= \_\_\_\_\_12\_\_\_\_\_\_\_\_\_atm

**(3 pts)**

2.2. A gas at fixed pressure changes volume from V1= 100 L to V2= 300 L. The initial

temperature, T1, was 227 oC. Given that T(K) =273 + T(oC), what is the final temperature

T2 in K ?

~~P~~V1/T1=~~P~~V2/T2

100/(227+273) = 300/T2

100/500=300/T2 => T2 =500\*300/100=1500 K

T2=\_\_1500\_\_\_\_\_\_\_K

(3 pts)

2.3 A gas at fixed temperature starts at a pressure P1=3 atm. It ends at pressure

P2=0.4 atm and a volume , V2, of 15 L . What was the intial gas volume , V1 ?

P1V1/~~T~~=P2V2/~~T~~

3\*V1=0.4\*15=> V1 =0.4\*15/3=2

V1 = \_\_\_2\_\_\_\_\_\_ L

(3 pts)

\_\_\_\_/17

**Exam 3A (continued) p. 2/5 Pinitial(N2) =8 atm Pinitial (H2) = 4 atm**

**V­initial (N2) = 3 Vinitial(H2) =1**



3.1. Two gas volumes initially separated

by a closed stopcock have the individual

volumes and pressures shown.

What will be the final pressure in the two volumes once open the stopcock and let the H2 and N2 mix ? P1(N2)\*V1(N2) =8\*3=P2(N2)\*4=> P2(N2)=8\*3/4=6

P1(H2)\*V1(H2) =4\*1=P2(H2)\*4=> P2(H2)=4\*1/4=1

P2(N2)+P2(H2) = 7

Final pressure=\_\_7\_\_\_\_\_\_ atm

(4 pts)

3.2 Suppose that all the N2 gas initially on the left side of the system above is now forced

into the right hand volume along with the H2, leaving the left volume empty.

What is the final pressure now ?

P1 (H2) =4=P2(H2)

P1 (N2)V1(N2) = 8\*3=P2(N2)\*1=>P2(N2)=24

P2(N2)+P2(H2) = 4+24=28 Final pressure = \_\_28\_\_\_\_\_\_atm

(5 pts)

3.3) A sample of gas weighing 25 grams occupies 5 L at 2.46 atm and 300 K. Given that

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

**n=PV/RT=2.46\*5/(0.082\*300)=0.5 mol**

**MW=g/mol=25/0.5=50**

MW(g/mol)=\_\_50\_\_\_\_\_

(4 pts)

3.4 A 0.56 g quantity of CO (MW=28 g/mol) occupies 2 L at a pressure of 0.328 atm. Given

R=0.082 atm L/K mol, what temperature T (in K) is the CO at?

0.56/28=n=0.02 PV/nR = T= 0.328\*2/(0.082\*0.02)=400 K

T=\_\_\_\_\_400\_\_\_\_\_\_\_\_K

(4 pts)

3.5. A gas in a piston is cooled at constant P=1 atm to 100 K after which the piston is locked into a fixed volume and 50% of the gas removed. The gas is then re- heated to 600 K. What is the final pressure in the locked piston ?

Removing half the gas, P🡪 ½=P1

Since V is constant: P1/T1=P2/T2 => (½)/100 = P2/600=> P2=3

Pfinal=\_\_\_\_\_3\_\_\_\_\_\_\_atm

\_\_\_\_/20 ( 3 pts)

**Exam 3A (continued) p. 3/5**

4.1 Circle all the features of the kinetic theory of gases in the list below : (2 pts)

a) gas particles have no mass b) gas particles have no volume

c) gas particles undergo elastic collisions d) gas particles interact with each other

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

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

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

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

a) 1:1

b) 10:1

c) 1000:1

d) 100,000:1

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 gold leaf experiment:

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.

5.4. A baseball is about 1.5 inches in radius. A pair of students have assigned the baseball the role of atomic nucleus, and assigned the radius of the electron cloud the distance of 2.5 miles. Compute their implied ratio of the electron cloud radius to the nuclear radius, given: 12 inches=1 foot 1 mile =5280 feet

2.5 mile\*5280 ft\*12 in/ft=158400 vs. 1.5 => ratio of 158400/1.5=105600

Electronic radius/nuclear radius=\_\_105600\_\_\_\_\_\_\_

(don’t round ! ) 3 pts

5.5. If the relative density of the electron is taken to be 1, what is the relative density of a

proton given that it has 10‑15 the volume and 2000 times the mass of an electron ?

d(proton) =2000/10‑15 -2\*1018

relative density of proton/electron= \_\_2\*1018\_\_\_\_\_\_

\_\_\_\_/13 (3 pts)

**Exam 3A (continued) p 4/5**

6.1) Given that the wavelength of a wave of light is 6\*10-5 m, what is the frequency, f, of the light in s-1 given c= 3\*108 m/s

*λ\*f=c=3\*108 m/s*

*f=3\*108/6\*10-5 =5\*1012* f=\_\_\_\_\_5\*1012\_\_\_\_\_\_\_\_\_\_\_ s\_1

(2 pts)

6.2) A wave is found to have a frequency, f, of 5,000/s and a wavelength of 2\*10-5 m. What is the speed of the wave, v in /s?

f\*λ=v

5000\*2\*10-5=0.1 v = \_\_\_\_0.1\_\_\_\_\_\_\_\_\_\_\_ m/s

(2 pts)

6.3) A photon has an energy of 3.980\*10-16 J. What is the wavelength, λ, of the photon in

meters(m) given c= 3\*108 m/s and h=6.63\*10‑34 J\*s.

E=hc/λ=6.63\*10‑34\*3\*108/λ=1.989\*10‑25/λ= 3.98\*10-16 => λ~5\*10-10 m

λ= \_\_\_\_5\*10-10 \_\_\_\_\_\_\_\_\_\_ m

(3 pts)

7.1.) DeBroglie theorized:

a) H atom is a series of circular electron orbits

b) Plum Pudding model of atom

c) matter has wave-like properties: mv=h/λ

d) E=mc2

7.2 )Bohr theorized:

a) H atom is a series of circular electron orbits

b) Plum Pudding model of atom

c) matter has wave-like properties: mv=h/λ

d) E=mc2

7.3. The symbols s,p,d,f

a) refer to the character of emissions lines of atoms observed by spectroscopists

b) were invented by Bohr to describe his electron orbits

c) specify particular wavelengths of light emitted by molecules

d) is derived from the Pax Romana characters SPQR

7.4. Rutherford’s atom:

a)resulted from observations of the Photoelectric effect

b) arose from observations derived from the Cathode Ray Tube

c) resulted from observations of the scattering of alpha particles through gold leaf

d)came from pure theory

\_\_\_/11

**Exam 3A (continued) p. 5/5**

8.1. Provide the complete electronic configurations for the elements below:

(2 pts each/6 pts total)

1. Al\_\_\_\_\_\_\_\_\_1s22s22p63s23p1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Cl\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Ca\_\_\_\_\_\_\_\_\_\_\_1s22s22p63s23p64s2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

(3 pts each/ 9 pts total

1. Cu+ [Ar ]
2. Ni [Ar ]
3. Cr+ [Ar ]

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

1. Ca + P= \_\_\_\_\_\_Ca3P2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. C + O= \_\_\_\_\_\_CO2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Li + N = \_\_\_\_\_\_\_\_\_Li3N\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

making sure to show all lone pairs: (3 pts each/9 pts total)





:C≡O:

**CO COCl2 SO2**

9.3. What are the formal charges for each element in the structures below ? ( 9 pts)

A





0

B

B

A

S\_\_\_0\_\_\_ O\_\_\_\_\_0\_\_\_ C\_\_\_\_0\_\_ OA\_\_\_-1\_\_\_\_ OB\_\_\_0 P\_\_0\_\_ O \_0\_\_\_ ClA\_\_0\_\_ ClB\_\_+1

\_\_\_/39