	Points Earned	Points Possible
Part 1 multiple choice		22
Page 2		14
Page 3		17
Page 4		25
Page 5		22
Total		100

All work must be shown to receive credit. Show all answers to the proper number of significant figures.

N_A = 6.022 x 10^{23}/mol

PV=nRT

R=0.0821 L atm/mol K= 62.4 L torr.mol K

760 torr = 760 mm Hg = 1.00 atm = 101 kPa = 14.7 psi = 29.9 in Hg

K = ^{o}C+273.16

0^oC=273.16 K

Part 1 – Multiple Choice (22 points)

1. The characteristic bright line spectrum of an element is produced when electron(s)
   a.   Are absorbed into the nucleus
   b.   Move backwards in their orbitals
   c.   Move to higher energy levels
   d.   Fall back to lower energy levels
   e.   Are emitted as gamma radiation

2. Which does not exist as an electron sublevel?
   a.   3f   c.   3d
   b.   3p   d.   3s
   e.   All of the above exist as electron sublevels

3. What is the maximum number of electrons that can occupy an orbital?
   a.   1   d.   4
   b.   3   e.   6
   c.   2

4. How many valence electrons are in an aluminum atom in the ground state?
   a.   13   d.   2
   b.   5   e.   3
   c.   1

5. The number of electrons in a triple covalent bond is
   a.   2   c.   6
   b.   3   d.   8

6. As the difference in electronegativity between two atoms increases, the percent of ionic character of a bond between those two atoms
   a.   Decreases   c.   Remains the same
   b.   Increases   d.   Unable to determine

7. Which series is ranked in order of increasing electronegativity?
   a.   C, Si, P, Se   d.   Sr, Sn, N, O
   b.   O, S, Se, Te
   c.   Cl, S, P, Si

8. As the number of molecules in a gas sample increases, temperature and volume remaining constant, the pressure exerted by the gas
   a.   Increases
   b.   Decreases
   c.   Remains the same
   d.   Unable to determine

9. Which of the following does not contain a polar covalent bond?
   a. Cl_2 c. HOH
   b. CH_4 d. CH_3OH

10. The volume of a gas must always increase when
    a. Temperature increases and pressure increases
    b. Temperature decreases and pressure decreases
    c. Temperature increases and pressure decreases
    d. Temperature decreases and pressure increases

11. A mixture of gases consists of helium at a partial pressure of 400. torr, neon at a partial pressure of 300. torr, and argon at a partial pressure of 200. torr. What is the total pressure of this mixture of gases?
    a. 300. torr   c. 900. torr
    b. 760. torr   d. 1000 torr

Part 2 –Problems and Questions (78 points)

1. (5 points) Write the complete electron configuration for neon.

   Ne $1s^2 \, 2s^2 \, 2p^6$

   What is a cation that is isoelectronic with neon?

   $Na^{+1}, Mg^{+2}, Al^{+3}$

   What is an anion that is isoelectronic with neon?

   F^{-1}, O^{-2}, N^{-3}

2. (5 points) Write the shorthand electron configuration for cobalt.

   Co [Ar] $4s^2 \, 3d^7$

   Write the electron configuration of a Co^{+2} ion.

   Co^{+2} [Ar] $3d^7$

3. (4 points) Rank the following elements in order of increasing atomic radius. P, Cl, Ga, As

   Cl<P<As<Ga

4. (5 points) Is a positive ion is larger or smaller than the atom from which it is formed.
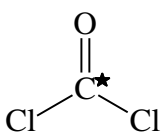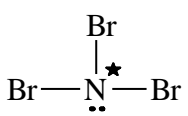
It is smaller

Why?

The positive charge of the nucleus can pull fewer electrons closer.

5. (6 points) Draw a lewis electron dot structure for the following molecules. Be sure to show all bonds and lone pairs.
   a. NBr_3

   b. C_2H_2

6. (6 points) Tell the orbital and molecular geometry of the central atom(*)for each of the following structures.

	Orbital geometry	Molecular geometry
a.	Trigonal planar	Trigonal planar
b.	tetrahedral	Trigonal pyramidal
c.	linear	linear

7.   (5 points) Draw the lewis electron dot structure for a carbonate ion (CO_3^{-2}) and show the three resonance structures

8.   (5 points) Explain how polar bonds differ from nonpolar bonds. How do you know if a bond is polar? Give an example of a polar and a nonpolar bond.

Polar bonds have positive and negative ends.

Polar bonds have atoms with different electronegativities bonded together

A polar bond H-F   A nonpolar bond Cl-Cl

9. (5 points) If the pressure of hydrogen gas in a cylinder is 651 torr, what is the pressure in atmospheres?

$$? \, atm = 651 \, torr \times \frac{1 \, atm}{760 \, torr} = 0.857 \, atm$$

10. (5 points) Explain using kinetic theory why the pressure of a gas increases when the temperature increases.

As the temperature of a gas increases, the molecules begin moving faster and hitting the walls of the container harder which results in an increase in pressure.

11. (5 points) A balloon is filled with argon gas at a pressure of 955 torr. Its volume is 5.20 L. What will the new volume be if the pressure of argon is decreased to 803 torr?

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$V_2 = V_1 \left(\frac{P_1}{P_2}\right) = 5.20 \, L \left(\frac{955 \, torr}{803 \, torr}\right) = 6.18 \, L$$

12. (5 points) An aerosol can contains nitrogen at a pressure of 5.33 atm in a 25°C room. What will the new pressure of nitrogen in the can be if it is left in the trunk of a car which reaches 73°C?

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$P_2 = P_1 \left(\frac{T_2}{T_1}\right) = 5.33 \ atm \left(\frac{346 \ K}{298 \ K}\right) = 6.19 \ atm$$

13. (5 points) If 58.3 grams of carbon dioxide are introduced into a 9.00 L container at 3.99 atm, what will its temperature be (in °C)?

$$58.3 \ g \ CO_2 \times \frac{1 \ mol \ CO_2}{44.01 \ g \ CO_2} = 1.32 \ mol \ CO_2$$

$$PV = nRT$$

$$T = \frac{PV}{nR} = \frac{(3.99 \ atm)(9.00 \ L)mol \ K}{(1.32 \ mol)(0.0821 \ L \ atm)} = 331 \ K = 58°C$$

14. (7 points) Calculate the volume of one mole of Xenon gas at 25°C and 1.50 atm pressure.

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(1 \ mol)(0.0821 \ L \ atm)(298 \ K)}{(1.50 \ atm)mol \ K} = 16.3 \ L$$

What is its density?

$$d = \frac{mass}{volume} = \left(\frac{131.3 \ g \ Xe}{mol}\right)\left(\frac{1 \ mol}{16.3 \ L}\right) = 8.06 \ g \ Xe/L$$

15. (5 points) Calculate the volume of ammonia, NH_3, that can be produced by the reaction of 1.86 L of hydrogen gas and excess nitrogen gas at 25°C and 470 torr.
   $2 \ N_2(g) + 3 \ H_2(g) \rightarrow 2 \ NH_3(g)$

$$? \ L \ NH_3 = 1.86 \ L \ H_2 \times \frac{2 \ L \ NH_3}{3 \ L \ H_2} = 1.24 \ L \ NH_3$$