

| | Points Earned | Points Possible |
|---------------------------|---------------|------------------------|
| Part 1 multiple choice | | 30 |
| Page 2 | | 9 |
| Page 3 | | 15 |
| Page 4 | | 20 |
| Page 5 | | 16 |
| Page 6 Extra credit | | 10 + 5 extra credit |
| | | |
| Total | | 100 |

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

$$N_A = 6.022 \times 10^{23}/\text{mol}$$

$$PV=nRT$$

$$R=0.0821 \text{ L atm/mol K} = 62.4 \text{ L torr.mol K}$$

$$760 \text{ torr} = 760 \text{ mm Hg} = 1.00 \text{ atm} = 101 \text{ kPa} = 14.7 \text{ psi} = 29.9 \text{ in Hg}$$

$$K = ^\circ\text{C} + 273.16$$

$$0^\circ\text{C} = 273.16 \text{ K}$$

Grossmont College
Periodic Table

| | | | | | | | | | | | | | | | | | |
|------------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | | | | | | | | | | | VIIA | | | | NOBLE GASES | |
| IA 1 H 1.008 | IIA | | | | | | | | | | | | | | | 1 H 1.008 | 2 He 4.002 |
| 3 Li 6.941 | 4 Be 9.012 | | | | | | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 |
| 11 Na 23.00 | 12 Mg 24.30 | IIIB | IVB | VB | VIB | VIIIB | VIII | VIII | VIII | IB | IIB | 13 Al 27.00 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.06 | 17 Cl 35.45 | 18 Ar 39.95 |
| 19 K 39.10 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.90 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.70 | 29 Cu 63.55 | 30 Zn 65.38 | 31 Ga 69.72 | 32 Ge 72.59 | 33 As 74.92 | 34 Se 78.96 | 35 Br 79.90 | 36 Kr 83.80 |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.94 | 43 Tc (99) | 44 Ru 101.1 | 45 Rh 102.9 | 46 Pd 106.4 | 47 Ag 107.9 | 48 Cd 112.4 | 49 In 114.8 | 50 Sn 118.7 | 51 Sb 121.8 | 52 Te 127.6 | 53 I 126.9 | 54 Xe 131.3 |
| 55 Cs 132.9 | 56 Ba 137.3 | 57 La 138.9 | 72 Hf 178.5 | 73 Ta 180.9 | 74 W 183.9 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.1 | 79 Au 197.0 | 80 Hg 200.6 | 81 Tl 204.4 | 82 Pb 207.2 | 83 Bi 209.0 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra 226.0 | 89 Ac 227.0 | 104 Rf (261) | 105 Db (262) | 106 Sg (263) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 ?? (269) | | | | | | | | |

| | | | | | | | | | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 58 Ce 140.1 | 59 Pr 140.9 | 60 Nd 144.2 | 61 Pm (147) | 62 Sm 150.4 | 63 Eu 152.0 | 64 Gd 157.3 | 65 Tb 158.9 | 66 Dy 162.5 | 67 Ho 164.9 | 68 Er 167.3 | 69 Tm 168.9 | 70 Yb 173.0 | 71 Lu 175.0 |
| 90 Th 232.0 | 91 Pa 231.0 | 92 U 238.0 | 93 Np (237) | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (251) | 99 Es (252) | 100 Fm (257) | 101 Md (258) | 102 No (259) | 103 Lr (260) |

Part 1 – Multiple Choice (30 points)

- Which does not exist as an electron sublevel?
 - 4d
 - 4f
 - 4p
 - 4s
 - All of the above exist as electron sublevels
- How many orbitals are contained in the 2p sublevel?
 - 6
 - 1
 - 3
 - 2
 - 4
- What is the number of valence electrons in a halogen?
 - 2
 - 5
 - 7
 - 8
 - 9
- Which element is in the p-block of the periodic table?
 - Eu
 - Li
 - Na
 - B
 - V
- As one progresses left to right across a period on the periodic table, first ionization energy generally
 - Decreases
 - Increases
 - Remains the same
 - Unable to determine
- As the difference in electronegativity between two atoms increases, the percent of ionic character of a bond between those two atoms
 - Increases
 - Decreases
 - Remains the same
 - Unable to determine
- Atoms of the nonmetallic elements generally form ions by
 - Losing electrons, forming positive ions
 - Losing electrons, forming negative ions
 - Gaining electrons, forming positive ions
 - Gaining electrons, forming negative ions
- A Ca^{+2} ion has an electron configuration that is isoelectronic with
 - Neon
 - Argon
 - Krypton
 - Xenon
 - None of the above
- The volume of a gas must always decrease when
 - Temperature decreases and pressure increases
 - Temperature decreases and pressure decreases
 - Temperature increases and pressure increases
 - Temperature increases and pressure decreases

10. As the number of molecules in a gas sample increases, temperature and volume remaining constant, the pressure exerted by the gas
- a. Remains the same
 - b. Increases
 - c. Decreases
 - d. Unable to determine
11. Which phase change is sublimation?
- a. Gas to liquid
 - b. Solid to liquid
 - c. Solid to gas
 - d. Liquid to gas
12. Which is a polar molecule?
- a. HCl
 - b. Cl₂
 - c. CCl₄
 - d. CO₂
13. As the attractive forces between the molecules of a liquid increase, its volatility
- a. Remains the same
 - b. Decreases
 - c. Increases
 - d. Is not related to attractive forces
14. At which external pressure will water boil at the highest temperature?
- a. 1.0 atm
 - b. 2.0 atm
 - c. 0.5 atm
 - d. 1.5 atm
 - e. Unable to determine
15. 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. 900. torr
 - b. 300. torr
 - c. 760. torr
 - d. 1000 torr

Part 2 –Problems and Questions (70 points)

1. (4 points) Write the complete electron configuration for calcium.



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



Write the electron configuration of a V⁺² ion.



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



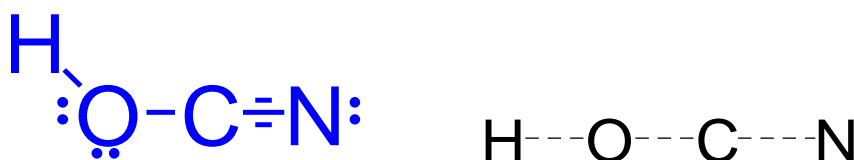
4. (5 points) Is a negative ion larger or smaller than the atom from which it is formed.

Larger

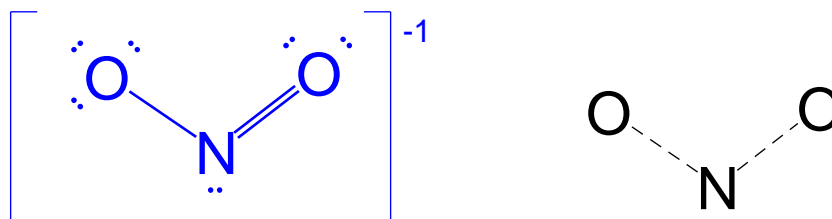
Why?

There are more electrons with the same positive charge in the nucleus. More electrons spread out more.

5. (6 points) Draw a lewis electron dot structure for the following ions/molecules. Be sure to show all bonds and lone pairs. The skeleton structures are given.
- a. HOCN



b. NO_2^{-1}



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

| | Orbital geometry | Molecular geometry |
|---|------------------|--------------------|
| a. $\begin{array}{c} \text{Cl} \\ \\ \text{F}-\text{C}^*-\text{Cl} \\ \\ \text{F} \end{array}$ | tetrahedral | Tetrahedral |
| b. $\begin{array}{c} \text{Cl} \\ \\ \text{:O:}^* \\ \\ \text{Cl} \end{array}$ | tetrahedral | Bent |
| c. $\begin{array}{c} \text{CH}_3 \\ \\ \text{*N}=\text{CH}_2 \\ \text{:} \end{array}$ | Trigonal planar | Bent |

7. (4 points) If the pressure of hydrogen gas in a cylinder is 731 torr, what is the pressure in atmospheres?

$$? \text{ atm} = 731 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = \boxed{0.962 \text{ atm}}$$

8. (5 points) A balloon is filled with argon gas at a pressure of 972 torr. Its volume is 3.23 L. What will the new volume be if the pressure of argon is decreased to 803 torr?

$$P_1 V_1 = P_2 V_2 \rightarrow V_2 = V_1 \left(\frac{P_1}{P_2} \right) = 3.23 \text{ L} \left(\frac{972 \text{ torr}}{803 \text{ torr}} \right) = \boxed{3.91 \text{ L}}$$

9. (5 points) An aerosol can contains nitrogen at a pressure of 6.83 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 53°C?

$$\frac{P_1}{V_1} = \frac{P_2}{V_2} \rightarrow P_2 = P_1 \left(\frac{V_2}{V_1} \right) = 6.83 \text{ atm} \left(\frac{326 \text{ K}}{298 \text{ K}} \right) = 7.47 \text{ atm}$$

10. (5 points) If 7.53 grams of carbon dioxide are introduced into a 4.00 L container at 2.99 atm, what will its temperature be (in °C)?

$$P = 2.99 \text{ atm}$$

$$V = 4.00 \text{ L}$$

$$n = 7.53 \text{ g CO} \times \frac{1 \text{ mol CO}}{44.01 \text{ g CO}} = 0.171 \text{ mol CO}$$

$$PV = nRT$$

$$T = \frac{PV}{nR} = \frac{(4.00 \text{ L})(2.99 \text{ atm})\text{mol K}}{(0.171 \text{ mol})(0.0821 \text{ L atm})} = 851 \text{ K or } 579^\circ\text{C}$$

11. (6 points) Calculate the volume of one mole of Xenon gas at 25°C and 3.00 atm pressure.

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(1 \text{ mol})(0.0821 \text{ L atm})(298 \text{ K})}{(3.00 \text{ atm})\text{mol K}} = 8.16 \text{ L}$$

What is its density?

$$d = \frac{g}{L} = \frac{131.3 \text{ g}}{1 \text{ mol Xe}} \times \frac{1 \text{ mol Xe}}{8.16 \text{ L}} = \frac{16.1 \text{ g}}{L}$$

12. (5 points) Calculate the volume of ammonia, NH₃, that can be produced by the reaction of 3.54 L of hydrogen gas and excess nitrogen gas at 25°C and 470 torr.
 $2 \text{ N}_2(\text{g}) + 3 \text{ H}_2(\text{g}) \rightarrow 2 \text{ NH}_3(\text{g})$

$$? \text{ L NH}_3 = 3.54 \text{ L H}_2 \times \frac{2 \text{ L NH}_3}{3 \text{ L H}_2} = \boxed{2.36 \text{ L NH}_3}$$

13. (5 points) Explain using kinetic molecular theory why a gas is less dense than a liquid.

In gases the molecules are spread apart while in liquids they are touching. Since there are more molecules in the same volume for a liquid, it is more dense than a gas.

14. (5 points) Which liquid is more viscous, water or motor oil? In which liquid do you suppose the intermolecular attractions are stronger? Explain.

Motor oil is more viscous. This is probably because the intermolecular forces in the oil are stronger. Stronger intermolecular forces mean the molecules stick together better making the liquid more viscous.

Extra credit (5 points)

Did you attend an event celebrating March as Science Month in San Diego?

If so, what event did you attend?

Tell me what you learned from attending that Science Month event.