Exam 2

# Part 1: Multiple Choice (2 points each)

## Directions: Please circle the *best* answer for each of the following questions.

1. Consider the following image of two atoms interacting. Each small dot represents an instantaneous position of an electron and the circles represent the nuclei. The bond is best described as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



* 1. nonpolar ionic
	2. coordinate covalent
	3. polar ionic
	4. polar covalent
	5. metallic
1. The Bohr model of the atom assumes that which of the following quantities for the electron in a hydrogen atom is/are quantized? i. Speed; ii. Direction of spin axis; iii. Energy; iv. Radius of its orbit.
	1. iii only
	2. i and iii
	3. iii and iv
	4. i, iii, and iv
	5. i, ii, and iii

1. Which of the following has the bond angle of 120°?
	1. 
	2. 
	3. 
	4. 
2. How many water molecules are associated with each formula unit of anhydrous cobalt(II) perchlorate in Co(ClO4)2 · 6 H2O?
	1. 2
	2. 3
	3. 4
	4. 5
	5. 6
3. From the following, pick those that are not empirical formulas:

i. C2H8 ii. C2H3 iii. C6H6 iv. C7H6 v. C7H21

1. i and ii
2. ii and iv
3. iv and v
4. i, iii, and v
5. i,, ii, and iii
6. How does a phosphorus atom achieve an octet of electrons?
	1. By gaining 3 electrons.
	2. By losing 3 electrons.
	3. By gaining 5 electrons.
	4. By losing 5 electrons.
	5. By gaining 8 electrons.
7. Which of the following is the common name for the compound H2O?
	1. Dihydrogen oxide
	2. Dihydrogen monoxide
	3. Hydrogen hydroxide
	4. Monohydrogen hydroxide
	5. Water
8. Which of the following defines a correct relationship for electromagnetic radiation?
	1. $λ∝ν$
	2. $λ∝E$
	3. $E∝\frac{1}{ν}$
	4. $ν≈c$
	5. $λ=\frac{c}{ν}$
9. Which of the following statements is/are correct?
	1. Because it is the standard, carbon has a molar mass of exactly one gram per mole.
	2. The phrase “molar mass of iodine” is not ambiguous, but the phrase “molar mass of potassium” is.
	3. The molar mass of a substance is the mass in grams of one mole of the substance.
	4. The formula masses of ionic compounds are always larger, numerically, than the molar mass of those compounds.
	5. none of the above
10. To find the slope of a best fit straight line you should
	1. find the y-intercept first
	2. use data points to find your slope
	3. use points off of your line
	4. none of the above
	5. all of the above

# Part 2: Short Answer

## Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

1. Identify each of the following atoms/ions by their electron configurations (6 points):

|  |  |  |  |
| --- | --- | --- | --- |
|  | Complete electron configuration | Condensed electron configuration | Atom/Ion |
|  | 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p3 (a neutral particle)  | [Ar] 4s2 3d10 4p3  | As |
|  | 1s2 2s2 2p6 3s2 3p6 (an ion with a negative two charge) | [Ar] | S2- |

1. Using the periodic table, indicate which member of each pair is (5 points).

Less metallic Mg or S

Smaller atomic radii K or Rb

Less electronegative Ca or Se

Larger cation Li+ or Cs+

Lowest ionization energy K or P

1. Potassium is a highly reactive metal, while argon is an inert gas. Explain this difference based on their electron configurations and dot structure (6 points).

K: 1s2 2s2 2p6 3s2 3p6 4s1 = [Ar] 4s1 $\dot{K}$

Ar: 1s2 2s2 2p6 3s2 3p6 $\begin{matrix}\ddot{:Ar:}\\..\end{matrix}$

Potassium has one valence electron thus making it very reactive. It will lose its one valence electron to become isoelectronic with argon and obtain a stable valence shell. Argon is a noble gas and already has eight valence electrons and thus a complete and stable valence shell.

1. White phosphorus is one of several forms of phosphorus and exists as a waxy solid consisting of P4 molecules.
	1. How many atoms are present in 0.350 mol of P4 (5 points)?

$$0.350 mol P\_{4}×\frac{4 mol P atoms}{1 mol P\_{4}}×\frac{6.022 ×10^{23} atoms P}{1 mol P}=8.43×10^{23} atoms P$$

Or

$$0.350 mol P\_{4}×\frac{6.022 ×10^{23} molecules P\_{4}}{1 mol P\_{4}}×\frac{4 atoms P}{1 mol P\_{4}}=8.43×10^{23} atoms P$$

* 1. What is the empirical formula for this molecule? \_\_\_P\_\_\_\_
1. Answer the following questions about a nonmetal (X) with 7 valence electrons (4 points):
	1. Draw the likely Lewis dot structure 
	2. How many bonds is it likely to form? 1
	3. How many lone pairs is it likely to have? 3
	4. What group is nonmetal X found in? 7A/halogens
2. Allyl sulfide, (C3H5)2S, is the substance that gives garlic its characteristic odor (14 points).
	1. Calculate the molar mass of allyl sulfide.

molar mass = (2)(3)(12.011 g/mol) + (2)(5)(1.008 g/mol) + (1)(32.061 g/mol)

 = 72.066 g/mol + 10.08 g/mol + 32.061 g/mol

 = 114.207 g/mol

 = 114.21 g/mol

* 1. What is the percent S in allyl sulfide?

$$\%S= \frac{mass S}{total mass}×100\%=\frac{32.061 g/mol}{114.21 g/mol}×100\%=28.072\% S$$

* 1. How many moles of sulfur are in 23.2 g allyl sulfide?

$$23.2 g (C\_{3}H\_{5})\_{2}S×\frac{1 mol (C\_{3}H\_{5})\_{2}S}{114.21 g (C\_{3}H\_{5})\_{2}S}×\frac{1 mol S}{1 mol (C\_{3}H\_{5})\_{2}S}=0.203 mol S$$

* 1. How many grams of carbon are in 4.20 x 1023 molecules of allyl sulfide?

$$4.20×10^{23}molecules (C\_{3}H\_{5})\_{2}S×\frac{1 mol (C\_{3}H\_{5})\_{2}S}{6.02×10^{23} molecules (C\_{3}H\_{5})\_{2}S}×\frac{6 mol C}{1 mol (C\_{3}H\_{5})\_{2}S}×\frac{12.011 g C}{1 mol C}=50.3 g C$$

* 1. What is the empirical formula for allyl sulfide? \_\_\_\_(C3H5)2S or C6H10S\_\_\_\_\_\_
1. Complete the following table (22 points):

|  |  |  |
| --- | --- | --- |
| Name | Formula  | Ionic, Covalent, Acid, Hydrate?  |
| Magnesium sulfate heptahydrate | MgSO4 ∙ 7 H2O | Hydrate |
| Hydrochloric acid | HCl (aq) | Acid |
| Chromium(VI) nitrate | Cr(NO3)6 | Ionic |
| Phosphorus pentafluoride | PF5 | Covalent |
| Acetic acid | HC2H3O2 (aq) | Acid |
| Nickel(II) phosphate | Ni3(PO­4)2 | Ionic |
| Sodium hydroxide | NaOH | Ionic |
| Oxygen gas | O2  | Covalent |
| Ammonia | NH3 | Covalent |
| Ammonium sulfide | (NH4)2S | Ionic |
| Copper(I) carbonate | Cu2CO3 | Ionic  |

1. Answer the following questions about the nitrate ion, NO3-. Draw the Lewis structure, be sure to draw any resonance structures if appropriate (10 points).



* 1. Electron pair geometry trigonal planar
	2. Molecular shape trigonal planar
	3. Bond Angle 120°
1. For methyl ethanoate, CH3COOCH3, identify the electron pair geometry, molecular geometry and bond angle around each central atom (8 points). 

