Exam 2

# Part 1: Multiple Choice (2 points each)

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

1. Which of the following is not a diatomic molecule or ion?
	1. Oxygen gas
	2. Fluorine gas
	3. Iron metal
	4. Mercury(I)/mercurous ion
	5. none of the above
2. When pouring a liquid form a reagent bottle
	1. you should pour away from the label.
	2. you should hold the lid between the your fingers.
	3. you should pour the liquid into a beaker and then into a graduated cylinder.
	4. a and b only
	5. all of the above
3. Which of the following samples contains six moles of atoms?
	1. 1 mole of carbon dioxide, CO2
	2. 3 moles of sodium chloride, NaCl
	3. 6 moles of oxygen gas, O2
	4. 1 mole of sucrose, C12H22O11
	5. 4 moles of mercury liquid, Hg

1. State the type of bond(s) in the Lewis structure for water.
	1. Ionic bonds
	2. Nonpolar covalent bonds
	3. Pure polar covalent bonds
	4. Polar covalent bonds
	5. none of the above
2. What is the empirical formula for a compound whose molecular formula is C2H2O4?
	1. CHO
	2. C2H2O2
	3. C4H4O­8
	4. C4H2O2
	5. none of the above
3. Eighteen valence electrons are present in the Lewis structure of
	1. carbon dioxide, CO2
	2. dinitrogen monoxide, N2O
	3. sulfur dioxide, SO2
	4. lithium nitride, Li3N
	5. barium phosphate, Ba3(PO4)2
4. Which species is isoelectronic with krypton?
	1. Bromide, Br-
	2. Telleride, Te2-
	3. Cesium, Cs+
	4. Iron(II), Fe2+
	5. Argon, Ar
5. The electron sea model explains the behavior of
6. ionic solids.
7. molecular solids.
8. metal solids.
9. most gases.
10. orbitals.
11. Which element has the most metallic character?
	1. Silver, Ag
	2. Gallium, Ga
	3. Boron, B
	4. Barium, Ba
	5. Phosphorus, P

Answer the following questions about the graph below:

1. Can the y-intercept be read directly from the graph?
	1. Yes, 0 bacteria
	2. Yes, -51.2 bacteria
	3. Yes 100 days
	4. No, 1 day
	5. No

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

Larger anion metallic I- or S2-

Larger atomic radii K or Rb

More electronegative Ca or Se

Smaller cation Li+ or Cs+

Highest ionization energy K or P

1. Technetium forms three monoatomic ions, Tc4+, Tc6+, Tc7+. From this sublevel do you expect electrons are lost in forming these ions? (Hint: It is possible for electrons other than those in the s and p sublevels to be involved in forming ions.) (7 points)
	1. In forming the Tc7+ ion are:
		1. electron(s) lost from the 4s orbital? \_\_\_\_\_no\_\_\_\_
		2. electron(s) lost from the 5p orbital? \_\_\_\_\_no\_\_\_\_\_
		3. electron(s) lost from the 4d orbital? \_\_\_\_yes\_\_\_\_\_\_
	2. To support your answer, complete the following. It is OK to use the noble gas core notation.
		1. Electron configuration of technetium: Tc: [Kr] 5s24d5
		2. Electron configuration of Tc4+ Tc4+: [Kr] 4d3
2. Indicate if the following sections of orbital diagrams are or are not possible and explain your reason. When the section is possible, indicate the element it represents (4 points).

 1s 2s 2p 3s

1. ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓

This is possible. The element is magnesium.

 1s 2s 2p 3s

1. ↑↓ ↑↓ ↑↓ ↑↓ ↑ ↑↓↑

This is not possible. The 2p sublevel would fill before the 3s, which is the Aufbau principle. Secondly, only two electrons are allowed in an orbital, which is the Pauli Exclusion Principle.

1. Predict the electron pair geometry, molecular shape, bond angle, and polarity of the following molecules by drawing the Lewis structure and using VSEPR theory (15 points).
	1. Chloramine, NH2Cl



* 1. Sulfur trioxide, SO3



1. Complete the following table (18 points):

|  |  |  |
| --- | --- | --- |
| Name | Formula  | Ionic, Covalent, Acid, Hydrate?  |
| Nickel(II) fluoride hexahydrate | NiF2 ∙ 6 H2O | Hydrate |
| Potassium hydroxide | KOH | Ionic |
| Boron trihydride  | BH3 | Covalent |
| Iron(III) oxide  | Fe2O3 | Ionic |
| Water | H2O | Covalent |
| Lead(II) sulfite | PbSO3 | Ionic |
| Sodium bicarbonate | NaHCO3 | Ionic |
| Strontium chloride | SrCl2 | Ionic |
| Copper(II) nitrate trihydrate | Cu(NO3)2 ∙ 3 H2O | Hydrate  |

1. Complete the following table (9 points):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Acid Name | Acid Formula | Mono, di, or triprotic acid?  | Anion Name  | Anion Formula |
| Chloric acid | HClO3 (aq) | Monoprotic | Chlorate ion | ClO3- |
| Phosphoric acid | H3PO4 (aq) | Triprotic | Phosphate ion | PO43-  |
| Hydrofluoric acid | HF (aq) | Monoprotic | Fluoride ion | F- |

1. Identify the bond of greatest polarity in each of the following set of bonds (4 points):
	1. H-Cl, H-O, H-Br
	2. O-F, O-P, O-Al
	3. H-Cl, Br-Br, B-N
	4. Al-Cl, C-N, Cl-F
2. A compound responsible for the odor of garlic has a molecular weight of 146 g/mol. A 0.650 g sample of the compound contains 0.321 g of carbon, 0.044 g of hydrogen, and 0.285 g of sulfur (18 points).
	1. What is the empirical formula of the compound?

$$0.321 g C×\frac{1 mol C}{12.01 g C}=\frac{0.02672772689 mol C}{0.008889582034 mol S}=3.006634821≈3$$

$$0.044 g H×\frac{1 mol H}{1.008 g H}=\frac{0.04365079365 mol H}{0.008889582034 mol S}=4.910331384≈5$$

$$0.285 g S×\frac{1 mol S}{32.06 g S}=\frac{0.008889582034 mol S}{0.008889582034 mol S}=1=1$$

Empirical formula is C3H5S

 This problem can also be solved by find the percent of each element first.

* 1. What is the empirical mass?

$$\left(12.011\frac{g}{mol}\right)3 +\left(1.008\frac{g}{mol}\right)5+ \left(32.061\frac{g}{mol}\right)1=73.134 \frac{g}{mol}$$

* 1. What is the molecular formula of the compound?

$$\frac{molecular mass}{empirical mass}=\frac{146 g/mol }{73.134 g/mol}=1.9964335494≈2$$

(C3H5S)2 =C6H10S2

* 1. What is the percent sulfur in garlic?

$$\frac{32.061 g/mol}{73.134 g/mol}×100\%=43.839\% S or \frac{0.285 g S}{0.650 g sample}×100\%=43.8\% S$$

* 1. How many atoms of carbon are in the 0.650 g sample?

$$0.650 g C\_{6}H\_{10}S\_{2}×\frac{1 mol C\_{6}H\_{10}S\_{2}}{146 g C\_{6}H\_{10}S\_{2}}×\frac{6 mol C}{1 mol C\_{6}H\_{10}S\_{2}}×\frac{6.022×10^{23} atoms C}{1 mol C}=1.61×10^{22} atoms C$$

Or

$$0.321 g C×\frac{1 mol C}{12.011 g C}×\frac{6.022×10^{23} atoms C}{1 mol C}=1.61×10^{22} atoms C$$