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 statements is *false?*

|  |  |  |
| --- | --- | --- |
|   | a.  | The first word in the name of a binary molecular compound is the name of the element appearing first in the chemical formula, including a prefix to indicate the number of atoms of that element in the molecule |
|   | b.  | The same two nonmetals often form more than one binary compound |
|   | c.  | If an element has no prefix in the name of a binary molecular compound, you may assume that there is only one atom of that element in the molecule |
|   | d.  | A compound whose formula ends in O5 is a hexaoxide rather than a pentoxide |
|   | e.  | The numerical prefix used in chemical names for the number 2 is *di*- |

1. Which of the following statements is *true*?

|  |  |  |
| --- | --- | --- |
|   | a.  | The dark bands in a rainbow are examples of line spectra |
|   | b.  | The light from neon signs is used as a source for producing continuous spectra |
|   | c.  | The light from standard light bulbs is used as a source for producing line spectra |
|   | d.  | A continuous spectrum consists of an uninterrupted distribution of colored light |
|   | e.  | A continuous spectrum results when light from a heated elemental substance passes through a prism |

1. Complete the statement with the *best* choice: Excited states for the hydrogen atom are states in which:

|  |  |  |
| --- | --- | --- |
|   | a.  | electrons are found after they have released energy |
|   | b.  | electrons are more stable than in the ground state  |
|   | c.  | the electron has more energy than in the ground state |
|   | d.  | electrons orbit in opposite directions as in the ground state |
|   | e.  | electrons orbit closer to the nucleus than in the ground state |

1. Which of the following elements has the Lewis symbol below, where Sy represents the elemental symbol?



|  |  |  |
| --- | --- | --- |
|   | a.  | Li |
|   | b.  | Mg |
|   | c.  | Ga |
|   | d.  | Sn |
|   | e.  | Bi |

1. Which of the following provides the *best* explanation for the many chemical similarities between sodium and potassium?

|  |  |  |
| --- | --- | --- |
|   | a.  | Both have atomic masses between 20 and 40 u |
|   | b.  | Both have an *ns*1 electron configuration for their highest occupied energy level |
|   | c.  | Both are main group elements |
|   | d.  | Both are solids at room temperature and pressure |
|   | e.  | The atomic numbers of the two elements differ by less than ten |

1. The general term to indicate a negatively charged ion is:

|  |  |  |
| --- | --- | --- |
|   | a.  | a cation |
|   | b.  | an anion |
|   | c.  | a hydrated ion |
|   | d.  | an isoelectron |
|   | e.  | a valence ion |

|  |  |
| --- | --- |
| Element | Electronegativity |
| H | 2.1 |
| N | 3.0 |
| O | 3.5 |
| P | 2.1 |
| S | 2.5 |

1. Arrange the following bonds in order of *increasing* polarity.

|  |  |  |
| --- | --- | --- |
|   | a.  | H–O < H–N < H–S < H–P |
|   | b.  | H–P < H–S < H–N < H–O |
|   | c.  | H–N < H–O < H–P < H–S |
|   | d.  | H–S < H–P < H–O < H–N |
|   | e.  | H–P < H–S < H–O < H–N |

1. Consider the following general wedge-and-dash diagram: 
Which of the following has this structure?

|  |  |  |
| --- | --- | --- |
|   | a.  | BF3 |
|   | b.  | CH2O |
|   | c.  | AlCl3 |
|   | d.  | COCl2 |
|   | e.  | PH3 |

1. Which of the following *best* describes hydrocarbons?

|  |  |  |
| --- | --- | --- |
|   | a.  | Alkanes in which a hydrogen atom is replaced by a hydroxyl group |
|   | b.  | Binary compounds of carbon and hydrogen |
|   | c.  | Organic compounds containing water and carbon |
|   | d.  | Covalently bonded carbon compounds which have intermolecular force attractions to hydrogen compounds |
|   | e.  | Compounds which are formed by the reaction of a naturally occurring carbon-containing substance and water |

1. \_\_\_\_\_\_ must be worn during lab?
2. Goggles
3. Close-toed shoes
4. Gloves
5. a & b
6. 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. Answer the following questions about the condensed electron configuration: [Ne] 3s2 3p4 (8 points)
			2. How many core electrons are present? 10
			3. How many valence electrons are present? 6
			4. What element has the above electron configuration? S
			5. Write the most likely condensed electron configuration when the element undergoes a complete reduction.

S2- [Ne] 3s2 3p6 or [Ar]

1. Technetium has the electron configuration of Tc: [Kr] 5s1 4d6 (9 points).
	1. Write the complete electron configuration.

Tc: 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p6 5s1 4d6

* 1. How many core electrons are there? 36
	2. How many d electrons are there total? 16
	3. Write the orbital diagram of the non-core electrons of the technetium atom.

 ↑↓ ↑ ↑ ↑ ↑ 4d

Tc: ↑ 5s

* 1. Write the condensed electron configuration for the technetium(IV) ion.

Tc4+ : [Kr] 5s0 4d3

1. Answer the following questions (3 points)?
	1. How many sublevels are there with n =2 in an atom? \_\_2\_\_
	2. How many 4 p orbitals are there in an atom? \_\_3\_\_\_
	3. What is the maximum number of electrons in a set of 4p orbitals? \_\_\_6\_\_\_
2. Rank, visible light, gamma rays, and microwaves in order of increasing energy (3 points).

 Decreasing energy: Gamma rays > visible light > microwaves

 Increasing energy: Microwaves < visible light < gamma rays

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

More metallic Mg or S

Larger atomic radii K or Rb

More electronegative Ca or Se

Smaller cation Li+ or Cs+

Highest ionization energy K or P

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. What is the difference between an isomer and a resonance structure (5 points)?

Isomers have the same chemical formula but different structural connectives; while resonance structures have the same connectivity, but different arrangements of electrons.

1. Both dinitrogen monoxide (order of atoms NNO) and acetylene, H2C2, are linear molecules. Draw a Lewis structure for each and explain their polarities using dipole moments where appropriate (6 points).

(Electronegativities: H =2.1, C = 2.4, N = 3.0, O = 3.5).



Acetylene is a nonpolar molecule. But, dinitrogen monoxide is a polar molecule with the dipole moment pointing towards the oxygen atom.

1. Answer the following questions about ozone, O3 (6 points).
	1. Draw the Lewis structure; be sure to draw any resonance structures if appropriate.



* 1. Electron pair geometry trigonal planar
	2. Molecular shape bent
	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). 

