

## Exam 3

## Multiple Choice

Identify the choice that best completes the statement or answers the question.

Record your name on the top of this exam and on the scantron form.

Record the test ID letter in the top right box of the scantron form.

Record all of your answers on the scantron form.

1. Which combination of atoms is most likely to produce a compound with covalent bonds?

- a. Ca and F  
b. Al and Ge  
c. S and Fe  
**d. O and Cl**

*non-metal + non-metal*

2. Place the following atoms in order of **increasing** atomic radii: Mg, F, P, and O.

- a. F < O < P < Mg**  
b. O < F < Mg < P  
c. P < Mg < F < O  
d. Mg < P < O < F

*As you ↑ on p-table radii decreases*

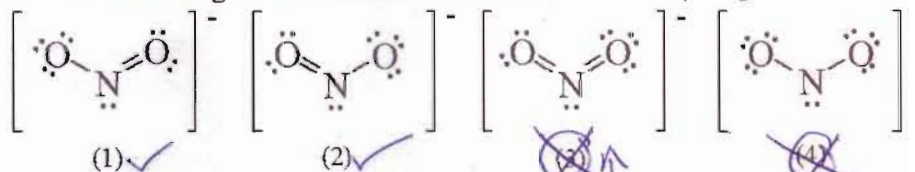
*As you → on p-table radii decreases*

3. How many electrons can be described by the quantum numbers  $n = 5$ ,  $l = 1$ ,  $m_s = +1/2$ ?

- a. 1  
**b. 3**  
c. 5  
d. 6

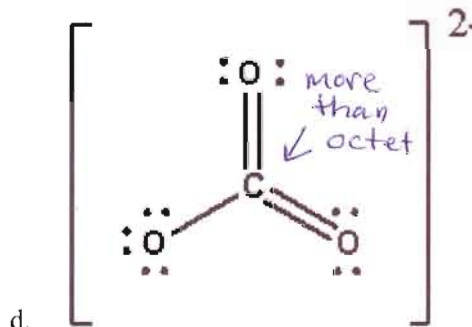
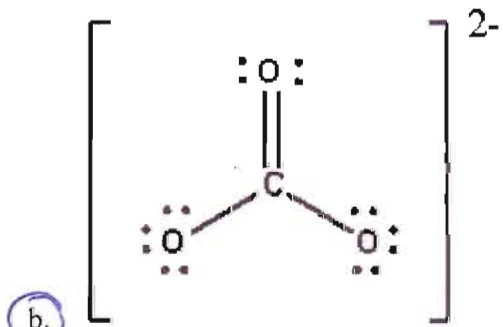
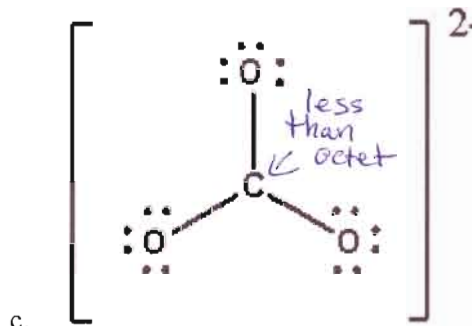
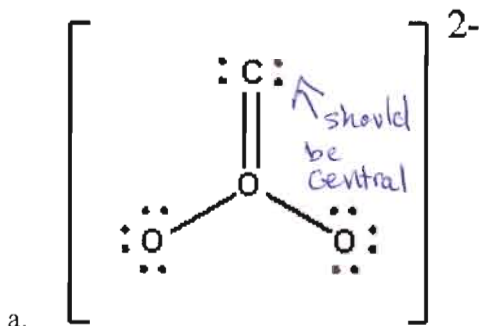
*l = 1 - p-orbitals, 3 orbitals*

4. Which of the following are resonance structures for nitrite ion,  $\text{NO}_2^-$ ?



- a. 1 and 2**  
b. 2 and 4  
c. 3 and 4  
d. 1, 2, and 3  
e. 2, 3, and 4

5. Which of the following is the best Lewis structure for  $\text{CO}_3^{2-}$ ?



6. Predict the hybridization of the central atom in  $\text{SO}_3^{2-}$ .

- a.  $sp$   
 b.  $sp^2$   
 c.  $sp^3$   
 d.  $sp^3d$

7. The general trend in electronegativity is to \_\_\_\_\_ as you go down the periodic table and \_\_\_\_\_ as you go right across the periodic table?

- a. increase, increase  
 b. decrease, increase  
 c. decrease, decrease  
 d. increase, decrease

8. For which of the following elements is the **second** ionization energy greatest?

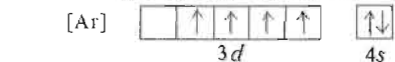
- a. Mg  
 b. Al  
 c. Na *breaks noble gas config*  
 d. Sc  
 e. Ti

9. If the ground state electron configuration of an element is  $[\text{Ar}]3d^{10}4s^24p^4$ , what is the typical charge on the monatomic anion of the element?

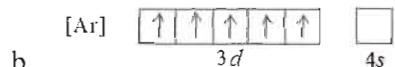
- a. 4+  
b. 2+  
c. 1-  
d. 2-

*need to use 2e- to get to full p or noble gas config.*

10. What is the correct orbital box diagram for the ground state electron configuration of Cr?

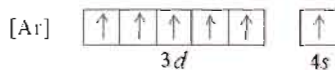
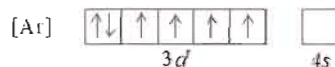


a.



b.

c.

*half-filled*

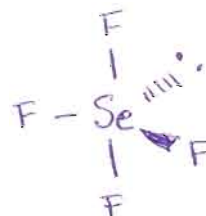
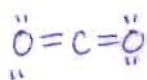
d.

11. Which of the following molecules or ions are isoelectronic:  $\text{SO}_2$ ,  $\text{CO}_2$ ,  $\text{NO}_2^+$ ,  $\text{ClO}_2^-$ ?

- a.  $\text{SO}_2$  and  $\text{CO}_2$   
b.  $\text{SO}_2$  and  $\text{NO}_2^+$   
c.  $\text{CO}_2$  and  $\text{ClO}_2^-$   
d.  $\text{CO}_2$  and  $\text{NO}_2^+$   
e.  $\text{SO}_2$ ,  $\text{NO}_2^+$ , and  $\text{ClO}_2^-$

12. Which one of the following molecules is polar?

- a.  $\text{CO}_2$   
b.  $\text{KrF}_4$   
c.  $\text{KrF}_2$   
d.  $\text{SeF}_4$



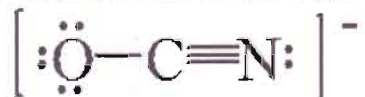
13. Use VSEPR theory to predict the molecular geometry of  $\text{BrF}_5$ .

- a. tetrahedral  
b. see-saw  
c. trigonal-bipyramidal  
d. square-pyramidal  
e. octahedral

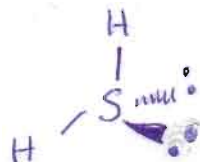
14. In molecules, as bond order **increases**,
- bond length decreases and bond energy increases.
  - bond length is unchanged and bond energy increases.
  - bond length increases and bond energy is unchanged.
  - both bond length and bond energy decrease.
15. Which of the following elements is most likely to form a molecular structure that **disobeys the octet rule**?
- B
  - C
  - N
  - O
  - F

16. Which of the following elements is a *d*-block element?
- C
  - Cs
  - Cd
  - Cf

17. One resonance structure for  $\text{OCN}^-$  ion is drawn below. What is the formal charge on each atom?



- O atom = 0, C atom = 0, and N atom = 0
  - O atom = 0, C atom = 0, and N atom = -1
  - O atom = -1, C atom = 0, and N atom = 0
  - O atom = -1, C atom = -1, and N atom = +1
  - O atom = +1, C atom = 0, and N atom = -2
18. How many lone **pairs** of electrons are assigned to the sulfur atom in  $\text{H}_2\text{S}$ ?
- 0
  - 1
  - 2
  - 3
  - 4

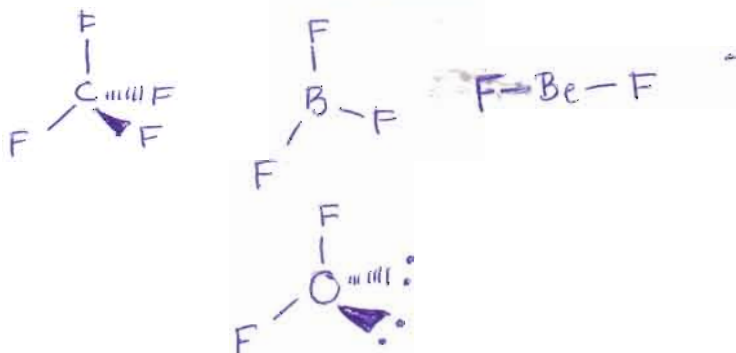


19. What is the ground state electron configuration for  $\text{Cr}^{2+}$ ?
- $[\text{Ar}]3d^6$
  - $[\text{Ar}]3d^4$
  - $[\text{Ar}]3d^24s^2$
  - $[\text{Ar}]3d^44s^2$

20. Which of the following statements is/are **CORRECT**?
- A diamagnetic substance is attracted to a magnetic field.
  - An atom with an even number of electrons must be diamagnetic.
  - 3. Atoms with one or more unpaired electrons are paramagnetic.
- a. 1 only  
b. 2 only  
 c. 3 only  
d. 1 and 2  
e. 1, 2, and 3
21. The change in energy for the following reaction is referred to as the \_\_\_\_\_ for oxygen.
- $$\text{O}(\text{g}) + \text{e}^- \rightarrow \text{O}^-(\text{g})$$
- a. oxidation number  
 b. electron affinity  
c. electronegativity energy  
d. first ionization energy  
e. second ionization energy
22. Which of the following statements is/are **CORRECT**?
- 1. The number of hybrid orbitals equals the number of atomic orbitals that are used to create the hybrids.
  - HF is formed from the overlap of a hydrogen 1s orbital with a fluorine 2s orbital.
  - The merging of an s orbital and a p orbital creates a pi-bond.
- a. 1 only  
b. 2 only  
c. 3 only  
d. 2 and 3  
e. 1, 2, and 3
23. Which of the following statements concerning potassium is/are **CORRECT**?
- 1. Potassium is paramagnetic.
  - Potassium is a p-block element.
  - Potassium has two valence shell electrons.
- a. 1 only  
b. 2 only  
c. 3 only  
d. 1 and 2  
e. 2 and 3

24. Which of the following molecules has the **smallest** bond angle between any **two fluorine atoms**?

- a.  $\text{CF}_4$   
 b.  $\text{BF}_3$   
 c.  $\text{BeF}_2$   
 d.  $\text{OF}_2$



25. Which element has the electron configuration  $[\text{Ar}]3d^{10}4s^2$ ?

- a. Cu  
 b. Zn  
 c. Cd  
 d. Ag

26. Estimate the  $\Delta H$  for the following reaction.



Bond	Bond Enthalpy (kJ/mol-rxn)	Bond	Bond Enthalpy (kJ/mol-rxn)
N-H	391	N-N	163
N-N	163	N=N	418
H-H	436	N≡N	941

Using average bond energies, calculate the enthalpy of reaction.

- a. -231 kJ  
 b. -667 kJ  
 c. -86 kJ  
 d. 350 kJ

Bond breaking

$$\begin{aligned} 4 \text{ N-H bonds @ } 391 &= 1564 \text{ kJ/mol} \\ \text{N-N bond @ } 163 &= 163 \text{ kJ/mol} \\ \hline &1727 \text{ kJ/mol} \end{aligned}$$

Bonds formed

$$\begin{aligned} 1 \text{ N} \equiv \text{N bond @ } 941 &= 941 \text{ kJ/mol} \\ 2 \text{ H-H bonds @ } 436 &= 872 \text{ kJ/mol} \\ \hline &1813 \text{ kJ/mol} \end{aligned}$$

$$1727 - 1813 = -86 \text{ kJ}$$