

Name: KEY

Chem 11/0, Spring 2011  
Test 3A

I. Multiple Choice (52 pts): Clearly circle the correct answer.

1. What are all the possible  $m_l$  values for orbitals that have an  $n = 2$ ?

- C
- A) 0  
B) 0, 1  
C) -1, 0, 1  
D) -2, -1, 0, 1, 2  
E) None of these
- |     |     |          |
|-----|-----|----------|
| $n$ | $l$ | $m_l$    |
| 2   | 1   | -1, 0, 1 |
|     | 0   | 0        |

2. What two properties of light make it useful for studying atoms?

- E
- A) wavelength and frequency  
B) particle-like and color  
C) frequency and color  
D) wave-like and color  
E) wave-like and particle-like

3. What principal states the electrons are placed in orbitals starting from the lowest energy orbital?

- A
- A) Aufbau  
B) Heisenberg  
C) Einstein  
D) Pauli  
E) Schrödinger

4. Which element has the following noble gas configuration:  $[\text{Ar}]4s^23d^5$

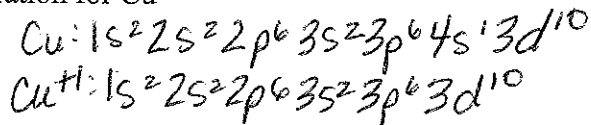
- C
- A) magnesium  
B) chromium  
C) manganese  
D) iron  
E) cobalt

5. Which one of the molecules/ions below is isoelectronic with  $\text{CO}_3^{2-}$   $4 + 3(6) + 2 = 24$

- B
- A)  $\text{SO}_3^{2-}$   $6 + 3(6) + 2 = 26$   
B)  $\text{NO}_3^-$   $5 + 3(6) + 1 = 24$   
C)  $\text{SO}_4^{2-}$   $6 + 4(6) + 2 = 32$   
D)  $\text{CO}_2^{2-}$   $4 + 2(6) + 2 = 18$   
E)  $\text{NO}_2^+$   $5 + 2(6) - 1 = 16$

6. What is the correct electron configuration for  $\text{Cu}^{+1}$

- A)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$   
B)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$   
C)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$   
D)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$   
E) None of these



7. Gallium is \_\_\_\_\_ magnetic and has \_\_\_\_\_ valence electrons(s)

- A) dia, 31  
B) dia, 3  
C) para, 31  
D) para, 3  
E) para, 13

8. Which element below has the smallest atomic radii?

- A) C  
B) S  
C) P  
D) Cl  
E) Ge

9. Which element below has the smallest first ionization energy?

- A) C  
B) S  
C) P  
D) Cl  
E) Ge

10. Which one of the following sets of quantum numbers cannot exist?

- A)  $n=1, l=0, m_l=0, m_s=1/2$   
B)  $n=7, l=3, m_l=-5, m_s=-1/2$   
C)  $n=4, l=0, m_l=0, m_s=1/2$   
D)  $n=8, l=0, m_l=0, m_s=1/2$   
E)  $n=3, l=3, m_l=0, m_s=-1/2$

11. Which of the following elements is not an exception to the octet rule when found in a molecule?

- A) H  
B) He  
C) B  
D) C  
E) S

12. The extent to which an element attracts bonding electrons is called:

- C
- A) ionization energy.
  - B) atomic size.
  - C) electronegativity.
  - D) isoelectronic structure.
  - E) resonance.

13. Which one of the following shapes most accurately describes a p-orbital?

- D
- A) basketball
  - B) football
  - C) pencil
  - D) infinity symbol
  - E) hockey puck

II. Part B: Clearly show all work for full credit.

1. (8 pts) One photon of an argon/krypton laser has energy equal to  $3.499 \times 10^{-22}$  kJ.

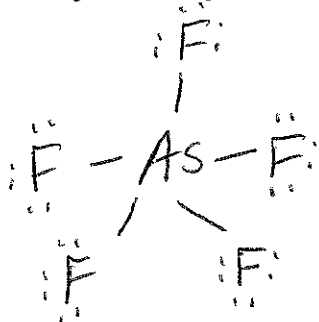
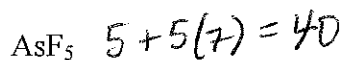
A. What is the frequency (in  $s^{-1}$ ) of the photon?

$$E = h\nu$$
$$\nu = \frac{E}{h} = \frac{3.499 \times 10^{-22} \text{ kJ}}{6.626 \times 10^{-34} \text{ J}\cdot\text{s}} \times \frac{1000 \text{ J}}{1 \text{ kJ}}$$
$$= 5.281 \times 10^{14} \text{ s}^{-1}$$

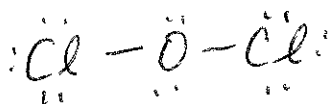
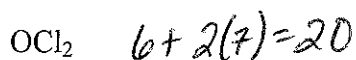
B. What is the wavelength (in m) of the photon?

$$\lambda \cdot \nu = c$$
$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \frac{\text{m}}{\text{s}}}{5.281 \times 10^{14} \text{ s}^{-1}} = 5.681 \times 10^{-7} \text{ m}$$

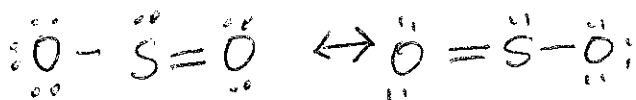
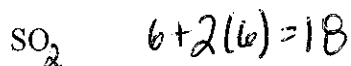
2.(40 pts) For each of the following molecules or ions: draw the correct Lewis Dot Structure, give the BD and NBD, determine the molecular geometry, give the hybridization of the central atom and determine if the molecule is polar or nonpolar. **Include all resonance structures.**



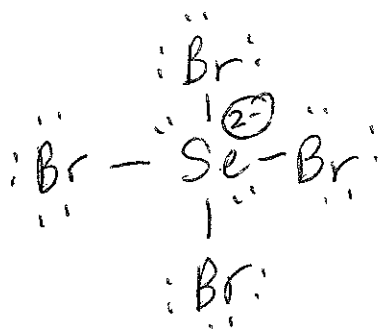
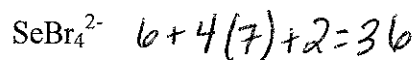
BD: 5  
 NBD: 0  
 Molecular Geometry: trig. bipyramidal  
 Hybridization: sp<sup>3d</sup>  
 Polarity: nonpolar



BD: 2  
 NBD: 2  
 Molecular Geometry: bent  
 Hybridization: sp<sup>3</sup>  
 Polarity: polar



BD: 2  
 NBD: 1  
 Molecular Geometry: bent  
 Hybridization: sp<sup>2</sup>  
 Polarity: polar



BD: 4  
 NBD: 2  
 Molecular Geometry: square planar  
 Hybridization: sp<sup>3d</sup>2  
 Polarity: nonpolar