

CHEM 1100 Exam 5 Dr. Stone

$$E = h\nu \qquad \nu = c/\lambda \qquad h = 6.626 \times 10^{-34} \text{ Jsec}$$

$$c = 2.997 \times 10^8 \text{ m/sec}$$

$$1/\lambda = 1.097 \times 10^{-2} \text{ nm}^{-1}(1/m^2 - 1/n^2) \qquad R = 0.0821 \text{ (L*atm)/(mole*K)}$$

$$\lambda = h/mv \qquad PV = nRT \qquad 0.62 \text{ mile} = \text{km}$$

$$\Delta x m \Delta v \leq h/4\pi \qquad 2.206 \text{ lbs} = \text{kg}$$

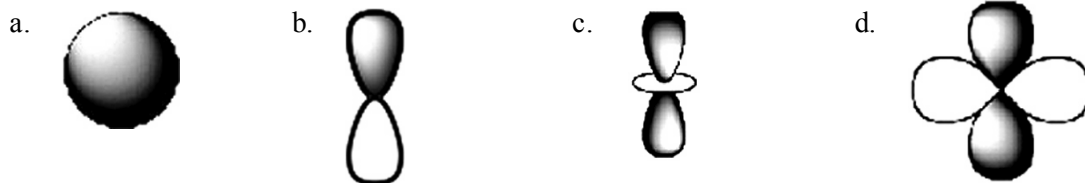
$$J = \text{kgm}^2/\text{sec}^2 \qquad R = 8.314 \text{ J/(mole*K)}$$

$$q = C_p * m * T \qquad E_{KE} = 1/2mv^2 \qquad E = E_{KE} + \phi \quad (\phi = \text{work function})$$

Multiple Choice: There are 19 multiple choice questions worth 4 points each. There are 5 work out problems worth 6 points each. Therefore, there are 6 bonus points on this test. Put your answers on this exam and on your scantron. Identify the choice that best completes the statement or answers the question.

- Which statement about electromagnetic radiation is correct?
 - Electromagnetic radiation consists of oscillating electric and magnetic fields.
 - Electromagnetic radiation is only emitted by the star in our solar system.
 - All electromagnetic radiation is visible to the eye.
 - Electromagnetic radiation spans a narrow range of wavelengths, from gamma rays to radio waves.
 - The frequency and wavelength of electromagnetic radiation are not related to each other.
- Which of the following types of electromagnetic radiation has the shortest wavelength?
 - gamma rays
 - X-rays
 - radio waves
 - infrared
 - visible
- Which of the following photons has the highest frequency?
 - a photon from an Nd:YAG laser with $\lambda = 1,064 \text{ nm}$
 - a photon from an Ar⁺ laser with $\lambda = 514.5 \text{ nm}$
 - a photon from a Kr⁺ laser with $\lambda = 647 \text{ nm}$
 - a photon from an ArF laser with $\lambda = 193 \text{ nm}$
 - a photon from an He-Ne laser with $\lambda = 633 \text{ nm}$
- Which of the following photons has the lowest energy?
 - a photon from a green laser pointer with $\lambda = 532 \text{ nm}$
 - a photon from a tanning bed with $\lambda = 325 \text{ nm}$
 - a photon from a telescope with $\lambda = 700 \text{ nm}$
 - a photon from a quasar with $\lambda = 125 \text{ nm}$
 - a photon from a red LED bulb with $\lambda = 635 \text{ nm}$
- Which of the following objects, all moving at the same speed, will have the largest de Broglie wavelength?
 - a proton
 - an electron
 - a bowling ball
 - a neon atom
 - a neutron

6. Which of the following represents a p orbital?



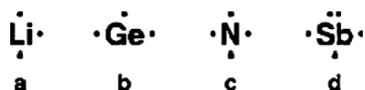
7. Which of the following elements has the ground-state electron configuration $1s^2 2s^2 2p^3$?

- a. B b. C c. N d. O e. F

8. How many valence electrons does aluminum have?

- a. 1 b. 2 c. 3 d. 11 e. 13

9. Which one of the following Lewis symbols for these atoms is correct?



- a. c. b. d. c. b. d. a

10. How many valence electrons are there in SF_4 ?

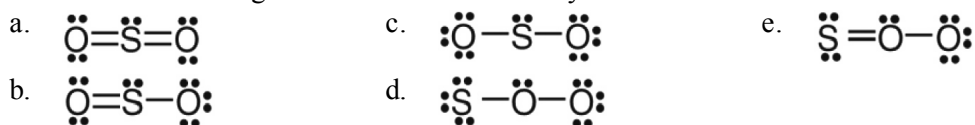
- a. 13 b. 28 c. 21 d. 34 e. 40

11. Which statements correctly describe a polar covalent bond?

- I. Electrons are shared but not equally by the two atoms.
 II. One atom has a small negative charge, and the other atom has a small positive charge.
 III. The bond dipole is zero.
 IV. One or more electrons are transferred from one atom to a second atom.

- a. I and II only c. III and IV only e. I and IV only
 b. II and III only d. I and III only

12. Use the formal charge as a criterion to identify the Lewis structure below that is most stable.



13. Which of the following atoms can have an expanded octet?

- a. S b. C c. N d. B e. Be

14. An element can form single, double, triple, and quadruple bonds between its atoms. Which will be the shortest?

- a. single b. double c. triple d. quadruple

15. In a chemical reaction, bonds are broken and new bonds are formed. Which one of the following statements regarding bond energies is correct?

- a. Energy is released when bonds are broken.
 b. Energy is required to break bonds.
 c. Energy is released when bonds are broken and less stable bonds are formed.
 d. Bond energies and bond lengths generally are not correlated; that is, they vary independently.
 e. Bond energies and bond order are unrelated to each other.

16. Which electron-pair geometry corresponds to a molecule that has three charge clouds and no lone pairs?
- linear
 - trigonal planar
 - tetrahedral
 - trigonal bipyramidal
 - octahedral
17. Determine the molecular geometry of CF_2Cl_2 .
- linear
 - bent
 - trigonal bipyramidal
 - tetrahedral
 - trigonal pyramidal
18. Which of the following molecules has a trigonal planar molecular geometry?
- H_2O
 - SO_2
 - PCl_5
 - CO_2
 - BF_3
19. Which of the following molecules or ions is *not* polar?
- O_3
 - H_2O
 - SO_2
 - PCl_5
 - Cl_2

Short Answer

20. (5 points) Draw the Lewis structure for Xenon tetrafluoride and answer the following questions:
- Structure:
 - What is the hybridization of the bonded orbitals?
 - Molecular shape:
 - Is it polar or non polar?
21. (5 points) Ozone is toxic in the troposphere and beneficial in the stratosphere.
- Draw the Lewis structure for ozone, include the formal charges for each atom.
 - What is the hybridization of the bonded orbitals?
 - What is the molecular shape?
 - Is ozone polar or non polar?

22. (5 points) What is the DeBroglie wavelength for an electron (mass = 9.11×10^{-31} kg) that is traveling at a speed of 3.20×10^6 m/sec? Show your work.
23. (5 points) What is the kinetic energy of an electron that is ejected when light with a wavelength of 250nm hits Barium metal? (The work function of barium is $\phi = 4.3 \times 10^{-19}$ J.) Show your work.
24. (5 points) What is the frequency (ν , in Hz) of the photons emitted by a He-Ne laser with a wavelength (λ) of 632.8 nm? Show your work.
25. (5 points) Determine the wavelength of the line in the hydrogen atom spectrum corresponding to the $n_1 = 3$ to $n_2 = 4$ transition. Show your work.

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Answer Section****MULTIPLE CHOICE**

1. A
2. A
3. D
4. C
5. B
6. B
7. C
8. C
9. B
10. D
11. A
12. A
13. A
14. D
15. B
16. B
17. D
18. E
19. D

SHORT ANSWER

20. XeF₄, please look in the book for the correct Lewis structure
sp³d²
square planar
non polar
21. O=O, please look in the book or in the powerpoint slides for the correct structure
-1 +1 0
sp²
bent
polar
22. 2.27×10^{-10} m
23. 3.65×10^{-19} J
24. 4.74×10^{14} Hz
25. 1,875 nm