Sample Quiz 201for Spring 2011
Good Luck!

Useful Information

Planck's constant $h = 6.626 \times 10^{-34}$ J.s

Avogadro's Number $= 6.023 \times 10^{23}$ mole^{-1}

Speed of light $c = 2.998 \times 10^{8}$ m/s

Bohr's Energy levels $E_n = -2.178 \times 10^{-18}$ J $\times (1/n^2)$

1 pm = 10^{-12} m

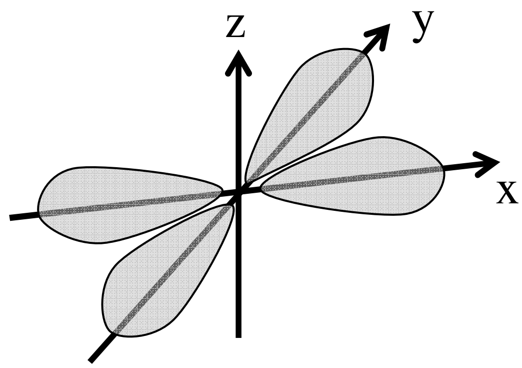
Electronegativities on the Pauling Scale:
X (Al) =1.5 , (I) =2.5 , (Si) =1.8, (Cl) = 3.0, (P) =2.1 .

Calculators are allowed.
Periodic tables are provided

Note: problems in red are not included for your exam

1. This shape represents which kind of orbital?

a) d_{z2}
b) d_{x2-y2}
c) p_z
d) d_{yz}
e) d_{xy}



2. Which of the following pairs of molecules/ions has a linear geometry?

a) NO_2, CO_2
b) NO_2^-, NO_2
c) I_3^-, SO_2
d) SO_2, CO_2
e) I_3^-, CO_2

3. Which of the following species has a tetrahedral molecular structure?

a) PCl_5
b) $NH4^+$
c) O_3
d) SO_3
e) ClO_3^-

4. Which of the following molecules has a dipole moment?

a) PCl_5
b) CF_4
c) CO_2
d) BeH_2
e) none of these

5. Which of these atoms should have three unpaired electrons in the ground state?

a) Al
b) Se
c) Sc
d) Li
e) Co

6. What are the bond angles for each of the following fluorides?

I) BF_3 II) BeF_2 III) CF_4

a) I =109.5° , II = 90° , III = 120°
b) I =109.5° , II = 180° , III = 120°
c) I =120° , II = 180° , III = 109.5°
d) I =120° , II = 90° , III = 120°
e) I =90° , II = 120° , III = 109.5°

7. Which of the following sets of quantum numbers are allowed for an electron in a one-electron atom?

a) $n = 3, l = 2, m_l = 1, m_s = 0$
b) $n = 2, l = 0, m_l = 0, m_s = -1/2$
c) $n = 7, l = 0, m_l = -1, m_s = +1/2$
d) $n = 3, l = -3, m_l = -2, m_s = +1/2$
e) $n = 3, l = 2, m_l = -2, m_s = -3/2$

8. Which series of quantum numbers describes the highest (energy) occupied orbital in a ground state of **At** atom?

a) n=6, l=0
b) n=6, l=2
c) n=5, l=2
d) n=4, l=3
e) n=6, l=1

9. An atom of silicon in its ground state has how many electrons with quantum number l=1?

a) 14
b) 2
c) 8
d) 6
e) 28

10. Which of the following will have the longest de Broglie wavelength?

a) a proton moving at 1000 m/s
b) an electron moving at 10000 m/s
c) an electron moving at 1000 m/s
d) a proton moving at 10000 m/s
e) a hydrogen atom moving at 10000 m/s

11. In the Paschen Series of the Hydrogen atom, $\mathbf{n}_{lower} = 3$. Calculate the longest wavelength possible for a transition in this series.

a) 1200 nm
b) 465 nm
c) 650 nm
d) 1875 nm
e) 2300 nm

12. The number of angular nodes in a 3s orbital is:

a) 0
b) 1
c) 2
d) 3
e) 4

13. Which of the following is a reasonable criticism of the Bohr model of the atom?

a) It makes no attempt to explain why the negative electron does not eventually fall into the positive nucleus.
b) It does not adequately predict the line spectrum of hydrogen.
c) It does not adequately predict the ionization energy of the valence electrons for elements other than hydrogen.
d) It does not adequately predict the ionization energy of the 1st energy level electrons for one-electron species for elements other than hydrogen.
e) It shows the electrons to exist outside of the nucleus.

14. A true result of the Heisenberg uncertainty principle is:

a) Very precise measurement of the location of an electron is not possible.
b) Very precise measurements of the momentum of an electron is not possible.
c) All moving particles have wave character.
d) Very precise simultaneous measurements of the location and velocity of an electron are not possible.

15. For which of the following transitions does the light emitted have the longest wavelength in the hydrogen atom?

a) $n = 4$ to $n = 3$
b) $n = 4$ to $n = 2$
c) $n = 4$ to $n = 1$
d) $n = 3$ to $n = 2$
e) $n = 2$ to $n = 1$

16. Which of the following electron configurations is correct?

a) Mo: $[Kr]5s^2 4d^5$
b) Ca: $[Ar]4s^2 3d^{10}$
c) Ga: $[Kr]3d^{10} 4s^2 4p^2$
d) Bi: $[Xe]6s^2 4f^{14} 5d^{10} 6p^3$
e) Br: $[Kr]3d^{10} 4s^2 4p^7$

17. Consider the following electron configuration for an element: $[Kr]5s^2 4d^{10} 5p^3 6s^1$. Which of the following statements is true?
a) This electron configuration is not possible because it does not comply with the Pauli exclusion principle.
b) This electron configuration is not possible because it is against Hund's rule.
c) The element described by this electron configuration is Cs
<u>d) The element described by this electron configuration is Te</u>
e) None of the above.

18. Which of the following bonds is the most polar?
a) Al–I
b) Si–I
c) Al–Cl
d) Si–Cl
e) Al–P

19. Consider the following atomic orbital for Hydrogen:

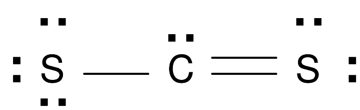
$$\psi = \frac{\sqrt{2}}{81\sqrt{\pi}}\left(\frac{1}{a_o}\right)^{3/2}\left(\frac{r}{a_o}\right)\left[6-\left(\frac{r}{a_o}\right)\right]\exp(-r/3a_o)\cos\theta$$

where a_o is the bohr radius, r is the distance from the nucleus, and θ is the angle the electron makes with the z axis. What can you conclude based on the above wavefunction?

a) This orbital has four total nodes.
b) This orbital has two radial nodes and two angular nodes.
c) This orbital is described by a principal quantum number n = 3
d) A radial node exists at a position of $3a_o$
e) None of the above can be concluded from the information provided.

20. Which of the following is the most likely resonance structure of CS_2 (Carbon is the central atom)?

a)



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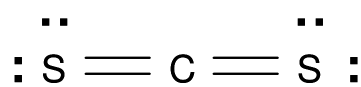
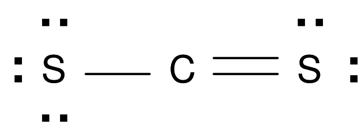


c)



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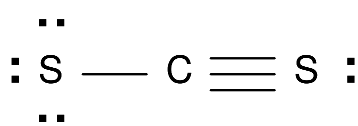
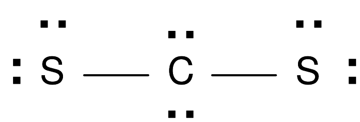


e)



Other sample questions

Q1 Which of these experiments characterizes light as a particle?

a) Millikan experiment
b) Rutherford experiment
c) Compton experiment
d) Diffraction by a prism
e) Thomson's cathode rays

Q2 Which of the following statements is <u>true</u>?

a) The exact location of an electron can be determined if we know its energy
b) An electron in a 2s orbital has the same energy as an electron in a 2p orbital in Li because the energy only depends on the principal quantum number n
c) Ni has 2 unpaired electrons in its 3d orbital
d) Only three quantum numbers are needed to uniquely describe an electron
e) In the buildup of atoms, electrons occupy the 4f orbitals before the 6s orbitals