SCH4U

Name:

Date:

Part A - Multiple Choice

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

- 1. Who postulated that electrons must fill the lowest available energy level?
 - a. Schodinger
 - b. Bohr
 - c. Aufbau
 - d. Heisenberg
 - e. None of the above
- 2. What experimental evidence led Bohr to believe that electrons can possess only specific amounts of energy?
 - a. most alpha particles went straight through the gold foil
 - b. some alpha particles were deflected by the gold foil
 - c. the line spectra produced by excited atoms
 - d. atoms are electrically neutral
 - e. none of the above
- 3. Which atoms could have the valence electron configuration shown below?
 - ^↓ $\uparrow \downarrow \uparrow \downarrow \uparrow \downarrow$ S р
 - a. N³⁻

- d. Cl¹⁻
- b. O²⁻ e. all of the above
- c. Ar
- 4. Which of the following is the electron configuration for aluminum ion in the ground state?
 - a. $1s^22s^22p^63s^23p^1$
- d. $1s^22s^22p^6$
- b. $1s^22s^22p^63s^13p^2$

e. 1s²2s²2p⁵3s¹3p¹

c. $1s^22s^22p^63s^13p^1$

- 5. Which of the following is true of electron orbitals?
 - a. They are three-dimensional
 - b. They can contain maximum of two electrons
 - c. Their shapes are predicted by Schrodinger's equation
 - d. all of the above
 - e. none of the above
- 6. Which of the following sets of quantum numbers (written in the following order, n, l, m, ms) would represent the 23rd electron of lead?
 - a. 4, 2, 3, -1/2
 - b. 3, 2, 0, ¹/₂
 - c. 3, 2, 1, -1/2
 - d. 4, 2, -1, ½
 - e. Two of the above are possible

- 7. The total number of orbitals in energy level, n = 4, is
 - a. 16 d. 32
 - b. 7 e. 9
 - c. 8
- 8. Which one of the following quantum numbers would not be found for a valence electron of phosphorus?
 - a. m/=0 d. /=0
 - b. /= 2 e. m_/ = -1
 - c. n = 3
 - 9. The magnetic quantum number (m_l) describes the
 - a. orientation in space of the orbital
 - b. average distance of the electron from the nucleus
 - c. shape of the orbital
 - d. direction of spin of the electron
 - 10. Choose the correct set of quantum numbers for an electron in the 3p orbital:
 - a. 1, 0, -1, -1/2
 - b. 3, 0, -1, -1/2
 - c. 3, 1, 1 +1/2
 - d. 2, 1, 1, -1/2
 - 11. Which of the following statements is incorrect?
 - a. In a non-polar covalent bond, the electrons are shared unequally.
 - b. A very electronegative element tends to have a partial negative charge in a covalent bond, or it tends to form a negative ion.
 - c. A dipole is a pair of opposite charges of equal magnitude at a specific distance from each other.
 - d. The most electronegative element in the periodic table is fluorine.
 - e. If two atoms are joined by a bond have an electronegativity difference of two or more, generally the bond will be more than 50% ionic.
 - $_{-}$ 12. Which shape and bond angle are predicted by VSEPR theory for H₂O?
 - a. linear, 180°

d. bent, 109.5°

b. bent, 120°

e. bent, less than 109.5°

- c. bent, less than 120°
- .
- _ 13. In the molecule shown below, there are:



- a. 3 atoms with sp^3 hybridization.
- b. two "tetrahedral" carbon atoms.
- c. six atoms with incomplete valence shell.
- d. 2 atoms that lie at the centre of a planar triangle surrounded by other atoms.
- e. 10 sigma bonds and 2 pi bonds.

- 14. What is the H-C-H bond angle in CH₄?
 - a. 180°
 - b. 90°
 - c. 104.5°
- 15. The ion PCl_4^- has a structure that would be described as? d. T-shaped
 - a. octahedral
 - b. Square planar
 - c. trigonal pyramidal
 - 16. Which of the following substances would not be polar?
 - a. Hydrogen chloride
- d. sulfur dioxide

b. Ammonia

e. Carbon disulfide

d. 120°

e. 109.5°

e. see-saw

- c. Water
- 17. What does a double bond consist of?
 - a. none of the other choices is correct.
 - b. Two sigma bonds
 - c. Two pi bonds
 - d. One sigma and a pi bond
 - e. Two sp³ bonds
- In which molecule is sp² hybrid orbitals used? 18.
 - a. CH₄
 - b. SF₆ e. AsCl₃
 - e. C₂H₄
- 19. What is the hybridization of the oxygen atom in the following compound?



- a. sp³
- b. sp²

d. sp³d² e. sp

- p² C.
- 20. Which of the following species would have a square planar geometry/shape?
 - a. CF₄
 - b. BF₄¹⁻ c. PF₄¹⁻

- d. SF₄
 - e. XeF₄

- d. HCN

Part B - Short Answer

1. Red light in fireworks is often produced from strontium salts. This red light has a wavelength of 6.50×10^2 nm. What is the energy of this light? [4]

(N.B. Planck's constant = 6.63×10^{-34} J.s & speed of light is 3.00×10^8 m/s)

2. Draw the orbital diagram for Sn^{4+} ion in the ground state. [2]

3. The ground state electron configuration of some elements is not what would be predicted. Write the PREDICTED electron configuration for ⁷⁹Au, then show the ACTUAL electron configuration and explain why it occurs. (You may use the noble gas notation, if you like). [3 marks]

4. Discuss *two* important ideas of the quantum mechanical theory of the atom, and the scientists who proposed these ideas. [4]

5. Grade 11 students are often not surprised to learn that the compound, PCl₃ exists. However, they would find the existence of PCl₅ surprising. Describe fully how this latter compound (PCl₅) can be formed. In your answer, state specifically, the type of hybrid orbitals utilized by the central atom and the type of bonds found within the compound.

[4]

- 6. For each of the following particles, do the following: CO_3^{-2} BBr₃ XeF₂ ICl₅
 - a) Draw the structure/geometry as predicted by the VSEPR theory
 - b) Name the shape of the geometry as predicted by the VSEPR theory
 - c) Indicate the bond angle(s) found in the particle
 - d) Indicate the polarity of the particle

Particle	Structure/geometry	Shape	Bond angle(s)	Polarity
CO_{3}^{-2}				
BBr _a				
0013				
VaF				
Xer ₂				