

Multiple Choice (4 points each): Answer on blue form; be sure to code in your name and ID.

Answers

1. The Bohr model of the atom works reasonably well in the calculation of energy levels in hydrogen. What other systems can be described by this model?
 - a. only hydrogen and helium
 - b. any one electron system
 - c. all elements in the lithium family
 - d. only hydrogen
 - e. all elements in the helium family

2. Which of the following statements are true?
 1. An excited atom can return to a lower energy level by absorbing light energy.
 2. An atom can be excited by emitting light energy.
 3. As the energy of electromagnetic radiation increases, its frequency increases.
 4. The frequency and wavelength of light are inversely proportional.
 - a. 2 and 3
 - b. 1 and 3
 - c. 1 and 2
 - d. 3 and 4
 - e. 2 only

3. Which statement best describes the path of an electron as it moves in a p orbital?
 - a. It has a high probability of being somewhere within a dumbbell-shaped orbital.
 - b. It travels in an orbit around the nucleus.
 - c. It travels around the nucleus in a figure-eight on the surface of a spherical orbital.
 - d. It is found randomly around the nucleus within a spherical orbital.
 - e. It is contained within a dumbbell-shaped orbital.

4. What is the total number of orbitals associated with the $n = 3$ level?
 - a. 9
 - b. 6
 - c. 3
 - d. 18
 - e. 5

5. Which of the following atomic orbital designations is impossible?
 - a. 2p
 - b. 3s
 - c. 4f
 - d. 2d
 - e. 2s

1. b

2. d

3. a

4. a

5. d

6. Which of the following electronic configurations represents a diamagnetic atom?

- | | 1s | 2s | 2p | | |
|----|----------------------|----------------------|----------------------|---------------------|---------------------|
| a. | $\uparrow\downarrow$ | $\uparrow\downarrow$ | \uparrow | $\underline{\quad}$ | $\underline{\quad}$ |
| b. | $\uparrow\downarrow$ | $\uparrow\downarrow$ | \uparrow | \uparrow | \uparrow |
| c. | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\underline{\quad}$ | $\underline{\quad}$ | $\underline{\quad}$ |
| d. | $\uparrow\downarrow$ | $\uparrow\downarrow$ | \uparrow | \uparrow | $\underline{\quad}$ |
| e. | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow$ | \uparrow | \uparrow |

6. c

7. The ground-state electron configuration of oxygen is

- a. $1s^2 2s^2 2p^4$
- b. $1s^2 2s^2 2p^3$
- c. $1s^2 2s^2 2p^6$
- d. $1s^2 2s^2 2p^5$
- e. $1s^2 2s^2 2p^4 3s^1$

7. a

8. The electron configuration of chromium as an ion is $[\text{Ar}] 3d^4$. What is the charge on this chromium ion?

- a. 2+
- b. 3-
- c. 3+
- d. 2-
- e. 4+

8. a

9. Manganese is in the 2+ state. How many 3d orbitals are empty?

- a. 4
- b. 2
- c. 1
- d. 0
- e. 3

9. d

10. In an isoelectronic series the size of the particles decreases as

- a. shielding decreases
- b. nuclear charge decreases
- c. pairing energy increases
- d. nuclear charge increases
- e. shielding increases

10. d

11. Which of the following elements has the highest first ionization energy?

- a. Li
- b. Na
- c. K
- d. Rb
- e. Be

11. e

12. The values of successive ionization energies of the elements 12. b
- a. indicates that the second ionization energy is always greater than the third ionization energy.
 - b. suggests that the electrons in atoms are arranged in shells consisting of noble-gas-like cores and outer, chemically active electrons.
 - c. suggests that each electron in an atom is arranged in a separate shell.
 - d. indicates that for B to Ne, the third ionization energy is less than the first ionization energy.
 - e. indicates that the arrangement of electrons in an atom is not related to the ionization energy.
13. Sodium and potassium have similar chemical and physical properties. This is best explained by the fact that both elements 13. d
- a. are in period 1 of the periodic table.
 - b. are active metals.
 - c. have relatively low first ionization energies.
 - d. have the same outer electronic configuration.
 - e. have low relative atomic masses.
14. A bond in which an electron pair is equally shared by two atoms is 14. b
- a. polar covalent
 - b. nonpolar covalent
 - c. coordinate covalent
 - d. dipolar
 - e. ionic
15. $\text{Na}^{2+}\text{O}^{2-}$ is less stable than $[\text{Na}_2]^{2+}\text{O}^{2-}$. This lesser stability is due to 15. c
- a. the very small size of the Na^{2+} ion
 - b. the large size of the O^{2-} ion relative to Na^{2+}
 - c. more energy being required to ionize sodium than would be realized in the attraction between Na^{2+} and O^{2-}
 - d. the instability of oxide ions in the presence of 2+ ions
 - e. the statement is false, both materials are stable
16. Which compound contains both ionic and covalent bonds? 16. d
- a. NaH
 - b. C_3H_8
 - c. PF_3
 - d. MgSO_3
 - e. KF

17. Ionic crystals are
a. soft
b. good electrical conductors
c. low melting
d. hard
e. nonbrittle 17. d
18. Which of these compounds would be expected to have the highest melting point?
a. CsI
b. CF₄
c. BF₃
d. NaF
e. MgO 18. e
19. Which one of the following molecules possesses a double bond?
a. CO
b. I₂
c. COCl₂
d. SF₄
e. C₂H₂ 19. c
20. The number of unshared pairs of electrons around the central atom in ClO₂⁻ is
a. 1
b. 3
c. 4
d. 2
e. 0 20. d
21. How many resonance forms are possible for the Lewis structure of SO₃?
a. 2
b. 4
c. 0
d. 5
e. 3 21. e
22. Which of the following statements about resonance is not true?
a. A single Lewis formula does not provide an adequate representation of the bonding.
b. Resonance describes the bonding as intermediate between the contributing resonance formulas.
c. Resonance describes the oscillation and vibration of electrons.
d. The contributing resonance formulas differ only in the arrangement of the electrons.
e. Resonance describes a more stable situation than does any one contributing resonance formula. 22. c

23. Which one of the following molecules violates the octet rule for electron distribution around the central atom? 23. b
- a. SiH_4
 - b. SF_4
 - c. COF_2
 - d. S_2Cl_2
 - e. PBr_3
24. Polarity of a bond depends on the electronegativity difference between atom centers. Which one of the following molecules has the bond with the greatest polarity? 24. d
- a. ICl
 - b. IBr
 - c. IAt
 - d. IF
 - e. I_2
25. Using bond energies, calculate the heat of reaction. 25. d
- $$\text{CH}_4 + 4\text{F}_2 \rightarrow \text{CF}_4 + 4\text{HF}$$
- Bond Energies: CH (414 kJ/mol), F_2 (155 kJ/mol), CF (439kJ/mol), HF (565 kJ/mol)
- a. 510
 - b. -510
 - c. 1740
 - d. -1740
 - e. 435