

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 1) Which one of the following is correct? 1) \_\_\_\_\_  
A)  $v \div \lambda = c$       B)  $v = c\lambda$       C)  $v\lambda = c$       D)  $\lambda = c v$       E)  $v + \lambda = c$
- 2) The photoelectric effect is \_\_\_\_\_. 2) \_\_\_\_\_  
A) a relativistic effect  
B) the ejection of electrons by a metal when struck with light of sufficient energy  
C) the darkening of photographic film when exposed to an electric field  
D) the production of current by silicon solar cells when exposed to sunlight  
E) the total reflection of light by metals giving them their typical luster
- 3) Low-frequency electromagnetic fields with potential biological effects have frequencies of \_\_\_\_\_ Hz. 3) \_\_\_\_\_  
A) 100-10,000  
B) 1-1000  
C)  $10^{-5}$ - $10^{-9}$   
D)  $10^{-3}$ - $10^{-5}$   
E) 400-700
- 4) In the Bohr model of the atom, \_\_\_\_\_. 4) \_\_\_\_\_  
A) electron paths are controlled by probability  
B) electrons travel in circular paths called orbitals  
C) electrons can have any energy  
D) electron energies are quantized  
E) both A and C
- 5) According to the Heisenberg Uncertainty Principle, it is impossible to know precisely both the position and the \_\_\_\_\_ of an electron. 5) \_\_\_\_\_  
A) mass  
B) shape  
C) momentum  
D) velocity  
E) color
- 6) The de Broglie wavelength of a \_\_\_\_\_ will have the shortest wavelength when traveling at 30 cm/s. 6) \_\_\_\_\_  
A) car  
B) planet  
C) hydrogen atom  
D) uranium atom  
E) marble

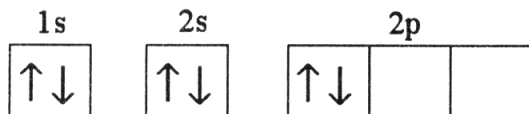
- 7) The uncertainty principle states that \_\_\_\_\_. 7) \_\_\_\_\_  
 A) it is impossible to know the exact position and momentum of an electron  
 B) there can only be one uncertain digit in a reported number  
 C) it is impossible to know anything with certainty  
 D) matter and energy are really the same thing  
 E) it is impossible to know how many electrons there are in an atom
- 8) All of the orbitals in a given electron shell have the same value of the \_\_\_\_\_ quantum number. 8) \_\_\_\_\_  
 A) azimuthal      B) psi      C) principal      D) magnetic      E) spin
- 9) All of the orbitals in a given subshell have the same value of the \_\_\_\_\_ quantum number. 9) \_\_\_\_\_  
 A) azimuthal      B) magnetic      C) principal      D) A and B      E) B and C
- 10) Which one of the following is not a valid value for the magnetic quantum number of an electron in a 5d subshell? 10) \_\_\_\_\_  
 A) 2      B) 1      C) 0      D) 3      E) -1
- 11) Which of the subshells below do not exist due to the constraints upon the azimuthal quantum number? 11) \_\_\_\_\_  
 A) 2s  
 B) 2p  
 C) 2d  
 D) all of the above  
 E) none of the above
- 12) Which of the subshells below do not exist due to the constraints upon the azimuthal quantum number? 12) \_\_\_\_\_  
 A) 4f  
 B) 4p  
 C) 4d  
 D) 4s  
 E) none of the above
- 13) An electron cannot have the quantum numbers  $n = \underline{\hspace{2cm}}$ ,  $l = \underline{\hspace{2cm}}$ ,  $m_l = \underline{\hspace{2cm}}$ . 13) \_\_\_\_\_  
 A) 1, 1, 1      B) 2, 0, 0      C) 3, 2, 1      D) 2, 1, -1      E) 3, 1, -1
- 14) An electron cannot have the quantum numbers  $n = \underline{\hspace{2cm}}$ ,  $l = \underline{\hspace{2cm}}$ ,  $m_l = \underline{\hspace{2cm}}$ . 14) \_\_\_\_\_  
 A) 1, 0, 0      B) 3, 2, 1      C) 3, 2, 3      D) 6, 1, 0      E) 3, 2, -2
- 15) Which one of the following is an incorrect subshell notation? 15) \_\_\_\_\_  
 A) 4f      B) 3d      C) 2p      D) 2d      E) 3s
- 16) Which one of the following is an incorrect orbital notation? 16) \_\_\_\_\_  
 A) 3p<sub>y</sub>      B) 4s      C) 4d<sub>xy</sub>      D) 3f      E) 2s
- 17) Which quantum number determines the energy of an electron in a hydrogen atom? 17) \_\_\_\_\_  
 A)  $l$       B)  $n$       C)  $E$       D)  $m_l$       E)  $n$  and  $l$

- 18) Which one of the quantum numbers does not result from the solution of the Schroedinger equation? 18) \_\_\_\_\_
- A) azimuthal
  - B) spin
  - C) principal
  - D) angular momentum
  - E) magnetic
- 19) Which quantum numbers must be the same for the orbitals that they designate to be degenerate in a one-electron system (such as hydrogen)? 19) \_\_\_\_\_
- A)  $n$ ,  $l$ , and  $m_l$
  - B)  $n$  only
  - C)  $l$  and  $m_l$
  - D)  $m_l$  only
  - E)  $n$  and  $l$  only
- 20) Which one of the following represents an acceptable set of quantum numbers for an electron in an atom? (arranged as  $n$ ,  $l$ ,  $m_l$ , and  $m_s$ ) 20) \_\_\_\_\_
- A) 5, 4, -5, 1/2
  - B) 3, 3, 3, -1/2
  - C) 2, 2, -1, -1/2
  - D) 3, 3, 3, 1/2
  - E) 1, 0, 0, 1/2
- 21) Which one of the following represents an acceptable possible set of quantum numbers (in the order  $n$ ,  $l$ ,  $m_l$ ,  $m_s$ ) for an electron in an atom? 21) \_\_\_\_\_
- A) 2, 2, 0, 1/2
  - B) 2, 0, 1, -1/2
  - C) 2, 0, 2, +1/2
  - D) 2, 1, 0, 0
  - E) 2, 1, -1, 1/2
- 22) Which one of the following represents an impossible set of quantum numbers for an electron in an atom? (arranged as  $n$ ,  $l$ ,  $m_l$ , and  $m_s$ ) 22) \_\_\_\_\_
- A) 2, 1, -1, -1/2
  - B) 5, 4, -3, -1/2
  - C) 5, 4, -3, 1/2
  - D) 1, 0, 0, 1/2
  - E) 3, 3, 3, 1/2

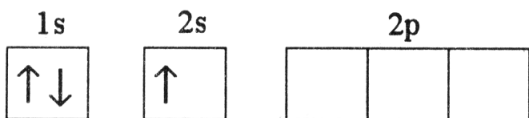
23) Which electron configuration represents a violation of the Pauli exclusion principle?

23) \_\_\_\_\_

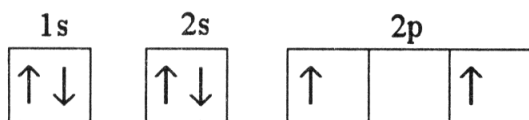
A)



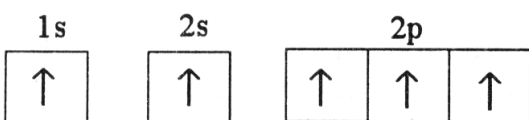
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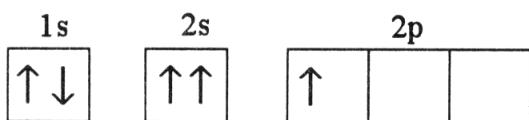
C)



D)



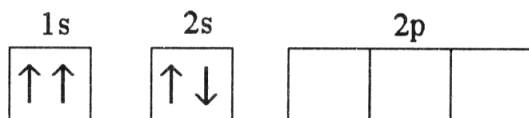
E)



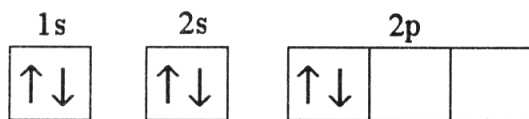
24) Which electron configuration represents a violation of the Pauli exclusion principle?

24) \_\_\_\_\_

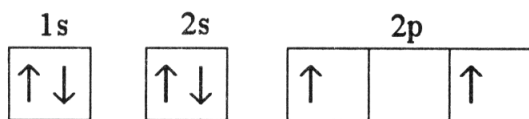
A)



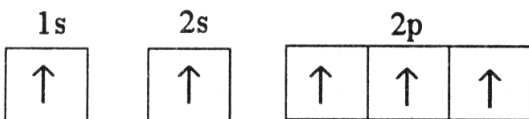
B)



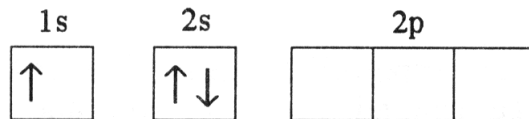
C)



D)



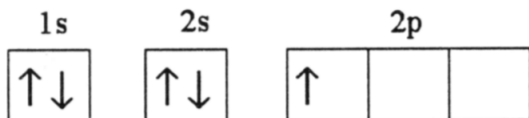
E)



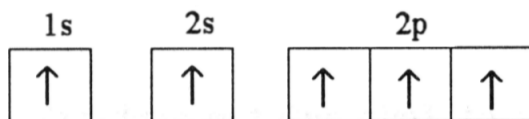
25) Which electron configuration represents a violation of the Pauli exclusion principle?

25) \_\_\_\_\_

A)



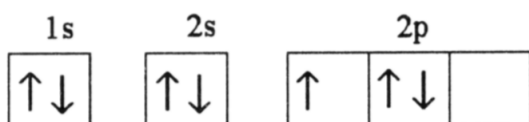
B)



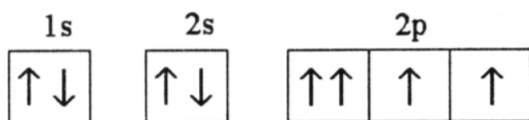
C)



D)



E)



26) In a  $p_x$  orbital, the subscript x denotes the \_\_\_\_\_ of the electron.

26) \_\_\_\_\_

- A) spin of the electrons
- B) probability of the shell
- C) size of the orbital
- D) energy
- E) axis along which the orbital is aligned

27) The \_\_\_\_\_ orbital is degenerate with  $5p_y$  in a many-electron atom.

27) \_\_\_\_\_

- A)  $5d^2$
- B)  $4p_y$
- C)  $5p_x$
- D)  $5d_{xy}$
- E)  $5s$

28) Which set of three quantum numbers  $(n, l, m_l)$  corresponds to a 3d orbital?

28) \_\_\_\_\_

- A) 3, 3, 2
- B) 3, 2, 2
- C) 3, 2, 3
- D) 2, 3, 3
- E) 2, 1, 0

29) At maximum, an f-subshell can hold \_\_\_\_\_ electrons, a d-subshell can hold \_\_\_\_\_ electrons, and a p-subshell can hold \_\_\_\_\_ electrons.

29) \_\_\_\_\_

- A) 14, 8, 2
- B) 2, 6, 10
- C) 2, 8, 18
- D) 14, 10, 6
- E) 2, 12, 21

30) Which one of the following orbitals can hold two electrons?

30) \_\_\_\_\_

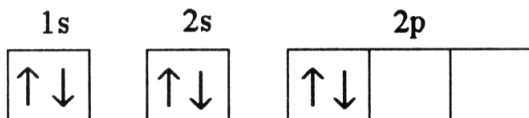
- A) 3s
- B)  $2p_x$
- C)  $4d_{xy}$
- D) all of the above
- E) none of the above

- 31) In which orbital does an electron in a phosphorus atom experience the greatest effective nuclear charge? 31) \_\_\_\_\_  
 A) 1s                      B) 2s                      C) 2p                      D) 3s                      E) 3p
- 32) Which of the following is a valid set of four quantum numbers? ( $n, l, m_l, m_s$ ) 32) \_\_\_\_\_  
 A) 2, 1, +2, +1/2  
 B) 2, 1, 0, +1/2  
 C) 1, 1, 0, -1/2  
 D) 2, 2, 1, -1/2  
 E) 1, 0, 1, +1/2
- 33) Which of the following is not a valid set of four quantum numbers? ( $n, l, m_l, m_s$ ) 33) \_\_\_\_\_  
 A) 3, 1, -1, -1/2  
 B) 2, 0, 0, +1/2  
 C) 1, 1, 0, +1/2  
 D) 2, 1, 0, -1/2  
 E) 1, 0, 0, +1/2
- 34) Which quantum numbers must be the same for the orbitals that they designate to be degenerate in a many-electron system? 34) \_\_\_\_\_  
 A)  $m_s$  only  
 B)  $n, l$ , and  $m_l$   
 C)  $n$  and  $l$  only  
 D)  $n$  only  
 E)  $n, l, m_l$ , and  $m_s$
- 35) Which one of the following is the correct electron configuration for a ground-state nitrogen atom? 35) \_\_\_\_\_
- A)
- |    |    |    |   |   |
|----|----|----|---|---|
| 1s | 2s | 2p |   |   |
| ↑↓ | ↑↓ | ↑  | ↑ | ↑ |
- B)
- |    |    |    |   |   |
|----|----|----|---|---|
| 1s | 2s | 2p |   |   |
| ↑↓ | ↑↑ | ↑  | ↑ | ↑ |
- C)
- |    |    |    |   |  |
|----|----|----|---|--|
| 1s | 2s | 2p |   |  |
| ↑↓ | ↑↓ | ↑↓ | ↑ |  |
- D)
- |    |    |    |   |   |
|----|----|----|---|---|
| 1s | 2s | 2p |   |   |
| ↑↑ | ↑↓ | ↑  | ↑ | ↑ |
- E) None of the above is correct.

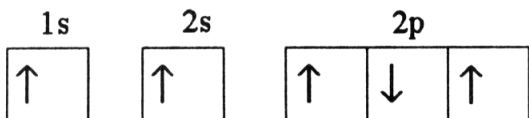
36) Which electron configuration denotes an atom in its ground state?

36) \_\_\_\_\_

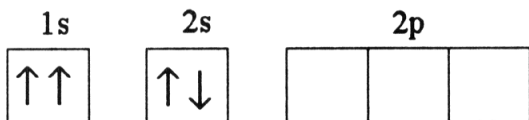
A)



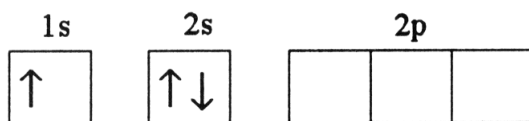
B)



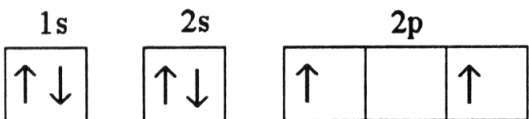
C)



D)



E)



37) The ground-state electron configuration of the element \_\_\_\_\_ is  $[\text{Kr}]5s^14d^5$ .

37) \_\_\_\_\_

- A) Cr                      B) Tc                      C) Mo                      D) Mn                      E) Nb

38) The ground-state electron configuration of \_\_\_\_\_ is  $[\text{Ar}]4s^13d^5$ .

38) \_\_\_\_\_

- A) Mn                      B) V                      C) Fe                      D) Cr                      E) K

39) The ground state electron configuration of Fe is \_\_\_\_\_.

39) \_\_\_\_\_

- A)  $1s^22s^22p^63s^23p^63d^64s^2$   
 B)  $1s^22s^22p^63s^23p^64s^24d^6$   
 C)  $1s^22s^23s^23p^{10}$   
 D)  $1s^22s^23s^23p^63d^6$   
 E)  $1s^22s^22p^63s^23p^64s^2$

40) The ground state electron configuration of Ga is \_\_\_\_\_.

40) \_\_\_\_\_

- A)  $1s^22s^23s^23p^63d^{10}4s^24p^1$   
 B)  $1s^22s^22p^63s^23p^64s^24d^{10}4p^1$   
 C)  $1s^22s^22p^63s^23p^63d^{10}4s^24d^1$   
 D)  $[\text{Ar}]4s^23d^{11}$   
 E)  $1s^22s^22p^63s^23p^63d^{10}4s^24p^1$

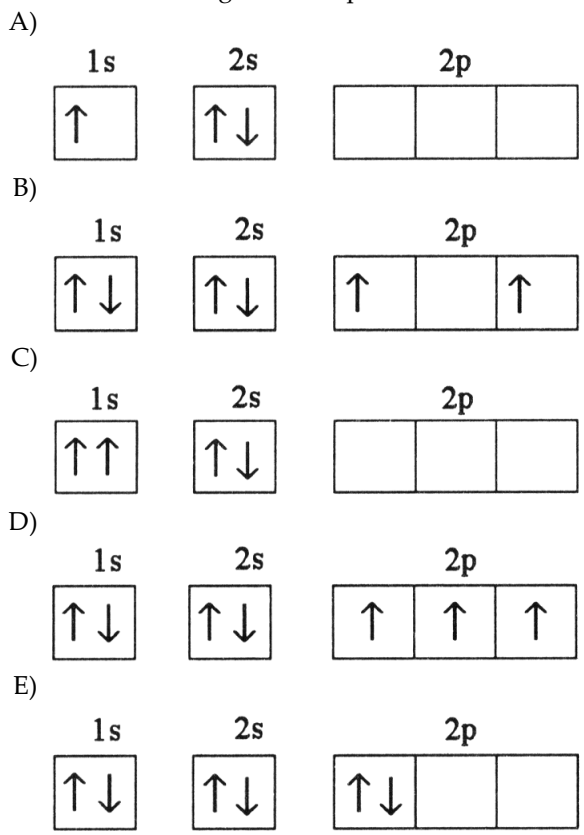
41) Which one of the following configurations depicts an excited oxygen atom? 41) \_\_\_\_\_

A)  $1s^2 2s^2 2p^2 3s^2$   
 B)  $1s^2 2s^2 2p^2$   
 C)  $[\text{He}] 2s^2 2p^4$   
 D)  $1s^2 2s^2 2p^4$   
 E)  $1s^2 2s^2 2p^1$

42) Which one of the following configurations depicts an excited carbon atom? 42) \_\_\_\_\_

A)  $1s^2 2s^2 2p^1 3s^1$   
 B)  $1s^2 2s^2 2p^1$   
 C)  $1s^2 2s^2 2p^3$   
 D)  $1s^2 2s^2 2p^2$   
 E)  $1s^2 2s^2 3s^1$

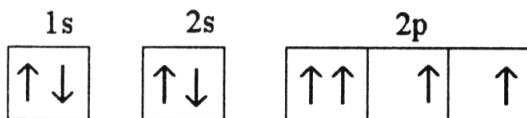
43) Which electron configuration represents a violation of Hund's rule for an atom in its ground state? 43) \_\_\_\_\_



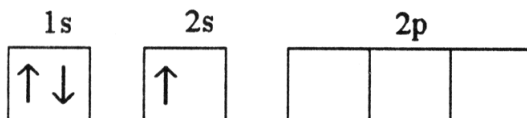


44) Which electron configuration represents a violation of Hund's rule for an atom in its ground state? 44) \_\_\_\_\_

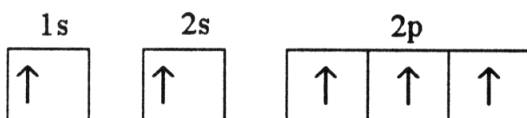
A)



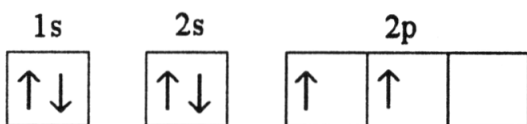
B)



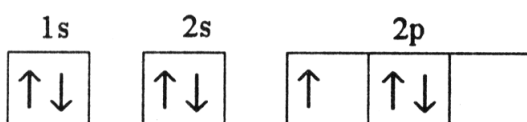
C)



D)

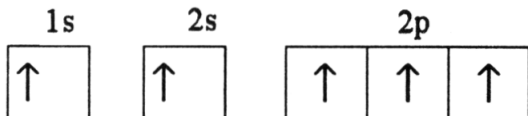


E)

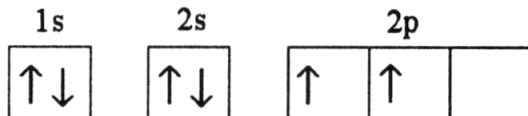


45) Which electron configuration represents a violation of Hund's rule for an atom in its ground state? 45) \_\_\_\_\_

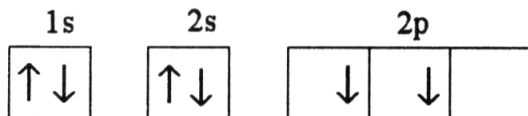
A)



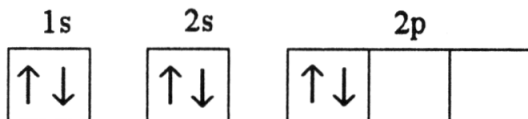
B)



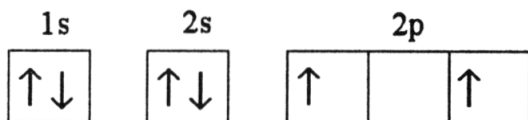
C)



D)



E)



46) Which of the following elements has a ground-state electron configuration different from the predicted one? 46) \_\_\_\_\_

- A) Ca                      B) Cu                      C) Xe                      D) Cl                      E) Ti

47) Which two elements have the same ground-state electron configuration? 47) \_\_\_\_\_

- A) Cu and Ag  
 B) Fe and Cu  
 C) Cl and Ar  
 D) Pd and Pt  
 E) No two elements have the same ground-state electron configuration.

48) The valence shell of the element X contains 2 electrons in a 5s subshell. Below that shell, element X has a partially filled 4d subshell. What type of element is X? 48) \_\_\_\_\_

- A) alkali metal  
 B) main group element  
 C) transition metal  
 D) halogen  
 E) chalcogen

## Answer Key

Testname: PRACTICE PROBLEMS CHAPTER 6

- 1) C
- 2) B
- 3) B
- 4) D
- 5) C
- 6) B
- 7) A
- 8) C
- 9) D
- 10) D
- 11) C
- 12) E
- 13) A
- 14) C
- 15) D
- 16) D
- 17) B
- 18) B
- 19) B
- 20) E
- 21) E
- 22) E
- 23) E
- 24) A
- 25) E
- 26) E
- 27) C
- 28) B
- 29) D
- 30) D
- 31) A
- 32) B
- 33) C
- 34) C
- 35) A
- 36) E
- 37) C
- 38) D
- 39) A
- 40) E
- 41) A
- 42) A
- 43) E
- 44) E
- 45) D
- 46) B
- 47) E
- 48) C