

Chapter 7 Practice Test

You are responsible for all of chapter 7's content. If you need more practice, complete all the problems at the end of the chapter and in your "Fast Track to a 5" or on the CD-rom for the class. You can also go to the following website:

<http://www.sciencegeek.net/APchemistry/APtaters/chap07rev.htm>

1. When ignited, a uranium compound burns with a green flame. The wavelength of the light given off by this flame is greater than that of
 - A) red light.
 - B) infrared light.
 - C) radio waves.
 - D) ultraviolet light.
 - E) none of these

2. Which one of the following types of radiation has the shortest wavelength, the greatest energy, and the highest frequency?
 - A) ultraviolet radiation
 - B) infrared radiation
 - C) visible red light
 - D) visible blue light
 - E) none because short wavelength is associated with low energy and low frequency, not high energy and high frequency

3. Which form of electromagnetic radiation has the longest wavelengths?
 - A) gamma rays
 - B) microwaves
 - C) radio waves
 - D) infrared radiation
 - E) x-rays

4. Which of the following frequencies corresponds to light with the longest wavelength?
 - A) $3.00 \times 10^{13} \text{ s}^{-1}$
 - B) $4.12 \times 10^5 \text{ s}^{-1}$
 - C) $8.50 \times 10^{20} \text{ s}^{-1}$
 - D) $9.12 \times 10^{12} \text{ s}^{-1}$
 - E) $3.20 \times 10^9 \text{ s}^{-1}$

5. Which of the following statements is (are) true?
- I. An excited atom can return to its ground state by absorbing electromagnetic radiation.
 - II. The energy of an atom is increased when electromagnetic radiation is emitted from it.
 - III. The energy of electromagnetic radiation increases as its frequency increases.
 - IV. An electron in the $n = 4$ state in the hydrogen atom can go to the $n = 2$ state by emitting electromagnetic radiation at the appropriate frequency.
 - V. The frequency and wavelength of electromagnetic radiation are inversely proportional to each other.
- A) II, III, IV
B) III, V
C) I, II, III
D) III, IV, V
E) I, II, IV

Use the following to answer questions 6-7:

From the following list of observations, choose the one that most clearly supports the following conclusion:

- a) emission spectrum of hydrogen
- b) the photoelectric effect
- c) scattering of alpha particles by metal foil
- d) diffraction
- e) cathode "rays"

6. Electrons have wave properties.

7. Electromagnetic radiation has wave characteristics.

8. Light can have a wavelength of 5.53×10^2 nm. The energy of a photon of light is

- A) 5.53×10^{-7} J
- B) 5.42×10^{14} J
- C) 3.59×10^{-19} J
- D) 1.10×10^{-31} J
- E) 2.78×10^{18} J

9. Which of the following is incorrectly paired?
- A) wavelength – λ
 - B) frequency – ν
 - C) speed of light – c
 - D) hertz – s^{-1}
 - E) x-rays – shortest wavelength
10. When a strontium salt is ignited, it burns with a red flame. The frequency of the light given off by this flame is greater than
- A) yellow light
 - B) infrared light
 - C) ultraviolet light
 - D) radio waves
 - E) x-rays
11. What is the wavelength of a photon of red light (in nm) whose frequency is 4.60×10^{14} Hz? Ignore significant figures for this problem.
- A) 652 nm
 - B) 1.53×10^6 nm
 - C) 153 nm
 - D) 460 nm
 - E) none of these
12. What is the energy of a photon of blue light that has a wavelength of 448 nm? Ignore significant figures for this problem.
- A) 4.48×10^{-7} J
 - B) 4.43×10^{-19} J
 - C) 6.69×10^{14} J
 - D) 8.90×10^{-32} J
 - E) 2.26×10^{18} J

13. When a hydrogen electron makes a transition from $n = 3$ to $n = 1$, which of the following statements is *true*?
- I. Energy is emitted.
 - II. Energy is absorbed.
 - III. The electron loses energy.
 - IV. The electron gains energy.
 - V. The electron cannot make this transition.
- A) I, IV
B) I, III
C) II, III
D) II, IV
E) V
14. 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 electron(s) 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.
15. When an electron in a 2p orbital of a lithium atom makes a transition to the 2s orbital, a photon of approximate wavelength 670.6 nm is emitted. The energy difference between these 2p and 2s orbitals is
- A) 2.962×10^{-28} J
 - B) 2.962×10^{-19} J
 - C) 2.962×10^{-17} J
 - D) 1.332×10^{-31} J
 - E) none of these
16. How many f orbitals have the value $n = 3$?
- A) 0
 - B) 3
 - C) 5
 - D) 7
 - E) 1

17. How many electrons in an atom can have the quantum numbers $n = 3, l = 2$?
- A) 2
 - B) 5
 - C) 10
 - D) 18
 - E) 6
18. How many electrons can be described by the quantum numbers $n = 3, l = 3, m_l = 1$?
- A) 0
 - B) 2
 - C) 6
 - D) 10
 - E) 14
19. Which of the following is *incorrect*?
- A) The continuous spectrum of hydrogen contains only four discrete colors.
 - B) Diffraction produces both constructive and destructive interference.
 - C) All matter displays both particle and wavelike characteristics.
 - D) Niels Bohr developed a quantum model for the hydrogen atom.
 - E) The lowest possible energy state of a molecule or atom is called its ground state.
20. How many d orbitals have $n = 3$?
- A) 2
 - B) 5
 - C) 10
 - D) 7
 - E) 18
21. How many electrons in an atom can have the quantum numbers $n = 4, l = 2$?
- A) 14
 - B) 12
 - C) 5
 - D) 10
 - E) 6

22. If $n = 2$, how many orbitals are possible?
- A) 3
 - B) 4
 - C) 2
 - D) 8
 - E) 6
23. A given set of p orbitals consists of _____ orbitals.
- A) 1
 - B) 2
 - C) 3
 - D) 4
 - E) 5
24. Which of the following is an incorrect designation for an atomic orbital?
- A) 1s
 - B) 3d
 - C) 1p
 - D) 4f
 - E) 6s
25. Which of the following atoms or ions has 3 unpaired electrons?
- A) N
 - B) O
 - C) Al
 - D) S^{2-}
 - E) Zn^{2+}
26. The electron configuration for the barium atom is:
- A) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
 - B) $[Xe] 6s^2$
 - C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
 - D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 - E) none of these

27. The electron configuration for the carbon atom is:
- A) $1s^2 2s^2 2p^2$
 - B) $[\text{He}] 2s^2 2p^2$
 - C) $[\text{Ne}] 2s^2 2p^2$
 - D) $1s^2 2p^4$
 - E) none of these
28. If $l = 3$, how many electrons can be contained in all the possible orbitals?
- A) 7
 - B) 6
 - C) 14
 - D) 10
 - E) 5
29. Which of the following combinations of quantum numbers is not allowed?
- | | n | l | $m_{(l)}$ | $m_{(s)}$ |
|----|-----|-----|-----------|-----------|
| A) | 1 | 1 | 0 | 1/2 |
| B) | 3 | 0 | 0 | -1/2 |
| C) | 2 | 1 | -1 | 1/2 |
| D) | 4 | 3 | -2 | -1/2 |
| E) | 4 | 2 | 0 | 1/2 |
30. Who was the first chemist to recognize patterns in chemical properties of the elements?
- A) Medeleev
 - B) Newlands
 - C) Meyer
 - D) Dobereiner
 - E) Bohr
31. The statement that "the lowest energy configuration for an atom is the one having the maximum number of unpaired electrons allowed by the Pauli principle in a particular set of degenerate orbitals" is known as
- A) the aufbau principle.
 - B) Hund's rule.
 - C) Heisenberg uncertainty principle.
 - D) the Pauli exclusion principle.
 - E) the quantum model.

32. Which of the following atoms would have the largest second ionization energy?
- A) Mg
 - B) Cl
 - C) S
 - D) Ca
 - E) Na
33. The electron configuration of Cr^{3+} is
- A) $[\text{Ar}]4s^23d^1$
 - B) $[\text{Ar}]4s^13d^2$
 - C) $[\text{Ar}]3d^3$
 - D) $[\text{Ar}]4s^23d^4$
 - E) none of these
34. An element has the electron configuration $[\text{Kr}] 5s^24d^{10}5p^2$. The element is a(n)
- A) nonmetal.
 - B) transition element.
 - C) metal.
 - D) lanthanide.
 - E) actinide.
35. An element with the electron configuration $[\text{Xe}] 6s^24f^{14}5d^7$ would belong to which class on the periodic table?
- A) transition elements
 - B) alkaline earth elements
 - C) halogens
 - D) rare earth elements
 - E) none of the above
36. The electron configuration for Cr^{2+} is
- A) $[\text{Ar}]4s^23d^4$
 - B) $[\text{Ar}]4s^13d^5$
 - C) **$[\text{Ar}]3d^4$**
 - D) $[\text{Ar}]4s^23d^2$
 - E) none of these

37. All halogens have the following number of valence electrons:

- A) 2
- B) 3
- C) 5
- D) 7
- E) none of these

38. Ti has _____ in its d orbitals.

- A) 1 electron
- B) 2 electrons
- C) 3 electrons
- D) 4 electrons
- E) none of these

Use the following to answer question 39-40:

Nitrogen has 5 valence electrons. Consider the following electron arrangements.

- a) $\begin{array}{c} 2s \\ \boxed{\uparrow\downarrow} \end{array} \quad \begin{array}{c} 2p \\ \boxed{\uparrow} \quad \boxed{\uparrow} \quad \boxed{\uparrow} \end{array}$
- b) $\begin{array}{c} 2s \\ \boxed{\uparrow} \end{array} \quad \begin{array}{c} 2p \\ \boxed{\uparrow\downarrow} \quad \boxed{\uparrow} \quad \boxed{\downarrow} \end{array}$
- c) $\begin{array}{c} 2s \\ \boxed{\uparrow} \end{array} \quad \begin{array}{c} 2p \\ \boxed{\uparrow\uparrow} \quad \boxed{\uparrow} \quad \boxed{\uparrow} \end{array}$
- d) $\begin{array}{c} 2s \\ \boxed{\uparrow\downarrow} \end{array} \quad \begin{array}{c} 2p \\ \boxed{\uparrow} \quad \boxed{\uparrow} \quad \boxed{} \end{array}$
- e) $\begin{array}{c} 2s \\ \boxed{\uparrow\downarrow} \end{array} \quad \begin{array}{c} 2p \\ \boxed{\uparrow\downarrow} \quad \boxed{\uparrow} \quad \boxed{\uparrow} \end{array}$

39. Which represents the ground state for N?

40. Which represents the ground state for the N^- ion?

41. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$ is the correct electron configuration for which of the following atoms?
- Ca
 - Ti
 - Ge
 - Zr
 - none of these
42. For which of the following elements does the electron configuration for the lowest energy state show a partially filled d orbital?
- Ti
 - Rb
 - Cu
 - Ga
 - Kr
43. The number of unpaired electrons in the outer subshell of a Cl atom is
- 0.
 - 1.
 - 2.
 - 3.
 - none of these
44. How many of the following electron configurations for the species in their ground state are correct?
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 - Mg: $1s^2 2s^2 2p^6 3s^1$
 - V: $[\text{Ar}] 3s^2 3d^3$
 - As: $[\text{Ar}] 4s^2 3d^{10} 4p^3$
 - P: $1s^2 2s^2 2p^6 3p^5$
- 1
 - 2
 - 3
 - 4
 - 5

45. A line in the spectrum of atomic mercury has a wavelength of 257 nm. When mercury emits a photon of light at this wavelength, the frequency of this light is
- A) $8.57 \times 10^{-16} \text{ s}^{-1}$
 - B) $7.73 \times 10^{-19} \text{ s}^{-1}$
 - C) $1.17 \times 10^{15} \text{ s}^{-1}$
 - D) $7.70 \times 10^1 \text{ s}^{-1}$
 - E) none of these
46. Which statements about hydrogen are true?
- I. H has a lower ionization energy than He.
 - II. H^- is smaller than H.
 - III. H bonds with the halogens to form polar covalent compounds.
 - IV. H is always a metal.
 - V. H does not have a second ionization energy.
- A) I, V
 - B) II, IV
 - C) I, III, V
 - D) II, IV, V
 - E) I, III, IV, V
47. Which of the following electron configurations are different from those expected?
- A) Ca
 - B) Sc
 - C) Ti
 - D) V
 - E) Cr
48. When electron configurations differ from expected, it is because orbitals want to be half-filled.
- A) True
 - B) False
49. Which of the following have 10 electrons in the d orbitals?
- A) Mn
 - B) Fe
 - C) Cu
 - D) Zn
 - E) two of the above

50. The first ionization energy of Mg is 735 kJ/mol. The second ionization energy is
- A) 735 kJ/mol
 - B) less than 735 kJ/mol
 - C) greater than 735 kJ/mol
 - D) More information is needed to answer this question.
 - E) none of these
51. List the following atoms in order of increasing ionization energy: Li, Na, C, O, F.
- A) $\text{Li} < \text{Na} < \text{C} < \text{O} < \text{F}$
 - B) $\text{Na} < \text{Li} < \text{C} < \text{O} < \text{F}$
 - C) $\text{F} < \text{O} < \text{C} < \text{Li} < \text{Na}$
 - D) $\text{Na} < \text{Li} < \text{F} < \text{O} < \text{C}$
 - E) $\text{Na} < \text{Li} < \text{C} < \text{F} < \text{O}$
52. Of the following elements, which has the lowest first ionization energy?
- A) Ba
 - B) Ca
 - C) Si
 - D) P
 - E) Cl
53. Which of the following atoms has the largest ionization energy?
- A) O
 - B) Li
 - C) N
 - D) Be
 - E) K
54. How many electrons in an atom can have the following quantum numbers:
- a) $n = 3$
 - b) $n = 2, l = 0$
 - c) $n = 2, l = 2, m_l = 0$
 - d) $n = 2, l = 0, m_l = 0, m_s = 1/2$

Answer Key

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

- 45. C
- 46. C
- 47. E
- 48. B
- 49. E
- 50. C
- 51. B
- 52. A
- 53. C
- 54. a) 18; b) 2; c) 0; d) 1