CHEM-1311; QUIZ # 5; FALL 2011

1. Which word best describes the phenomenon which gives rise to a rainbow?
   A) reflection
   B) dispersion
   C) diffraction
   D) interference
   E) deflection

2. Contact lenses can focus light due to the _____ of the waves.
   A) diffraction
   B) reflection
   C) refraction
   D) dispersion
   E) interference

3. Select the arrangement of electromagnetic radiation which starts with the lowest energy and increases to greatest energy.
   A) radio, visible, infrared, ultraviolet
   B) infrared, visible, ultraviolet, microwave
   C) visible, ultraviolet, infrared, gamma rays
   D) X-radiation, visible, infrared, microwave
   E) microwave, infrared, visible, ultraviolet

4. Electromagnetic radiation of 500 nm wavelength lies in the _____ region of the spectrum.
   A) infrared
   B) visible
   C) ultraviolet
   D) X-ray
   E) γ-ray

5. Green light has a wavelength of 5200 Å. Calculate the energy of one photon of green light.
   A) 3.4×10^{-40} J
   B) 3.4×10^{-30} J
   C) 3.8×10^{-29} J
   D) 3.4×10^{-27} J
   E) 3.8×10^{-19} J

6. A photon has an energy of 5.53×10^{-17} J. What is its frequency in s^{-1}?
   A) $3.66 \times 10^{-50}\ s^{-1}$
   B) $1.20 \times 10^{-17}\ s^{-1}$
   C) $3.59 \times 10^{-9}\ s^{-1}$
   D) $2.78 \times 10^{8}\ s^{-1}$
   E) $8.35 \times 10^{16}\ s^{-1}$

7. A modern compact fluorescent lamp contains 1.4 mg of mercury. If each mercury atom in the lamp were to emit a single photon of wavelength 254 nm, how many joules of energy would be emitted?
   A) 7.8×10^{-19} J
   B) 3.3 J
   C) 6.6×10^{2} J
   D) 3.3×10^{3} J
   E) 4.2×10^{18} J

8. What type of spectrum, if any, would be produced if the light radiated by a heated atomic gas were to be dispersed through a prism?
   A) a continuous band of color
   B) a continuous band of color with some dark lines (missing wavelengths)
   C) only blue light
   D) only red light
   E) discrete lines of different colors

9. Excited hydrogen atoms radiate energy in the
   A) infrared region only.
   B) visible region only.
   C) ultraviolet region only.
   D) visible and ultraviolet regions only.
   E) infrared, visible, and ultraviolet regions.

10. The size of an atomic orbital is associated with
    A) the principal quantum number (n).
    B) the angular momentum quantum number (l).
    C) the magnetic quantum number (m_l).
    D) the spin quantum number (m_s).
    E) the angular momentum and magnetic quantum numbers, together.

11. The shape of an atomic orbital is associated with
    A) the principal quantum number (n).
    B) the angular momentum quantum number (l).
    C) the magnetic quantum number (m_l).
    D) the spin quantum number (m_s).
    E) the magnetic and spin quantum numbers, together.

12. The orientation in space of an atomic orbital is associated with
    A) the principal quantum number (n).
    B) the angular momentum quantum number (l).
    C) the magnetic quantum number (m_l).
    D) the spin quantum number (m_s).
    E) none of the above.

13. Atomic orbitals developed using quantum mechanics
    A) describe regions of space in which one is most likely to find an electron.
    B) describe exact paths for electron motion.
    C) give a description of the atomic structure which is essentially the same as the Bohr model.
    D) allow scientists to calculate an exact volume for the hydrogen atom.
    E) are in conflict with the Heisenberg Uncertainty Principle.

14. The energy of an electron in the hydrogen atom is determined by
    A) the principal quantum number (n) only.
    B) the angular momentum quantum number (l) only.
    C) the principal and angular momentum quantum numbers (n & l).
    D) the principal and magnetic quantum numbers (n & m_l).
    E) the principal, angular momentum and magnetic quantum numbers.

15. Which of the following is a correct set of quantum numbers for an electron in a $3d$ orbital?
    A) $n = 3, l = 0, m_l = -1$
    B) $n = 3, l = 1, m_l = +3$
    C) $n = 3, l = 2, m_l = 3$
    D) $n = 3, l = 3, m_l = +2$
    E) $n = 3, l = 2, m_l = -2$

16. Which one of the following sets of quantum numbers can correctly represent a $3p$ orbital?
    A) $n = 3$ $l = 1$ $m_l = 2$
    B) $n = 1$ $l = 3$ $m_l = 3$
    C) $n = 3$ $l = 2$ $m_l = 1$
    D) $n = 3$ $l = 1$ $m_l = -1$
    E) $n = 3$ $l = 0$ $m_l = 1$

17. Consider the following adjectives used to describe types of spectrum:
    continuous line atomic emission absorption
    How many of them are appropriate to describe the spectrum of radiation absorbed by a sample of mercury vapor?
    A) one
    B) two
    C) three
    D) four
    E) five

18. "Each electron in an atom must have its own unique set of quantum numbers" is a statement of
    A) the aufbau principle.
    B) the Pauli exclusion principle.
    C) Hund's rule.
    D) the periodic law.
    E) Heisenberg's principle.

19. The effective nuclear charge for an atom is less than the actual nuclear charge due to
    A) shielding.
    B) penetration.
    C) paramagnetism.
    D) electron-pair repulsion.
    E) relativity.

20. In many-electron atoms, which quantum numbers specify the energy of an electron?
    A) n and l
    B) n and m_l
    C) l and m_l
    D) n and m_s
    E) n, l, and m_l

21. Which of the following sublevels is filled last? 3*d*, 4*s*, 4*p*, 4*d*, 5*s*
    A) 3*d*
    B) 4*s*
    C) 4*p*
    D) 4*d*
    E) 5*s*

22. "Electrons added to atomic orbitals of the same energy will remain unpaired with parallel spins until the subshell is more than half-filled" is a statement of
    A) the aufbau principle.
    B) Hund's rule.
    C) the Pauli exclusion principle.
    D) the periodic law.
    E) the singularity rule.

23. Which one of the following statements about atomic structure and quantum numbers is incorrect?
    A) In a given atom, the maximum number of electrons having principal quantum number $n = 3$, is 18.
    B) The number of orbitals in a given *f* subshell is 7.
    C) For $n = 4$, the largest possible value of l is 3.
    D) For $n = 4$, the largest possible value of m_l is 2.
    E) The following set of quantum numbers for a single orbital is not allowed: $n = 3$, $l = 1$, $m_l = -2$.

24. In a single atom, what is the maximum number of electrons which can have quantum number $n = 4$?
    A) 16
    B) 18
    C) 32
    D) 36
    E) none of the above

25. Select the correct set of quantum numbers (n, l, m_l, m_s) for the highest energy electron in the ground state of potassium, K.
    A) 4, 1, –1, ½
    B) 4, 1, 0, ½
    C) 4, 0, 1, ½
    D) 4, 0, 0, ½
    E) 4, 1, 1, ½

26. Select the correct set of quantum numbers (n, l, m_l, m_s) for the highest energy electron in the ground state of tin, Sn.
    A) 5, 2, –1, ½
    B) 5, 2, 0, ½
    C) 5, 1, 2, ½
    D) 5, 1, 0, ½
    E) 5, 2, 1, ½

27. Which of the following electron configurations is impossible?
    A) $1s^2 2s^2 2p^6 3s^2 3p^4$
    B) $1s^2 2s^2 2p^5 3s^1 3p^4$
    C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
    D) $1s^2 2s^2 2p^6 3s^3 3p^4$
    E) $1s^1 2s^2 2p^6 3s^2 3p^4$

28. Select the correct electron configuration for sulfur ($Z = 16$).
    A) $1s^2 1p^6 2s^2 2p^6$
    B) $1s^2 2s^2 2p^8 3s^2 3p^4$
    C) $1s^2 2s^2 2p^8 3s^2 3p^2$
    D) $1s^2 2s^2 2p^6 3s^2 3p^4$
    E) $1s^2 2s^2 2p^6 3s^2 3d^4$

29. The electronic structure $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$ refers to the ground state of
    A) Kr.
    B) Ni.
    C) Fe.
    D) Pd.
    E) none of the above.

30. In the ground state of an atom of silver (Ag), how many electrons will there be with the quantum number $l = 1$? (The n, m_l, and m_s quantum numbers may have any appropriate values.)
    A) 9
    B) 12
    C) 18
    D) 24
    E) 36

31. An atom of element number 33 (As) is in its ground electronic state. Which one of the following sets quantum numbers could not apply to any of its electrons?
    A) $n = 2$ $l = 1$ $m_l = -1$ $m_s = +\frac{1}{2}$
    B) $n = 3$ $l = 0$ $m_l = 0$ $m_s = -\frac{1}{2}$
    C) $n = 3$ $l = 2$ $m_l = -2$ $m_s = -\frac{1}{2}$
    D) $n = 4$ $l = 0$ $m_l = 0$ $m_s = -\frac{1}{2}$
    E) $n = 4$ $l = 2$ $m_l = 1$ $m_s = +\frac{1}{2}$

32. How many valence electrons are there in an atom with the electron configuration [noble gas]$ns^2(n-1)d^{10}np^3$?
    A) 2
    B) 3
    C) 5
    D) 10
    E) 15

33. Which of the following electron configurations represents the ground state of an element?
    A) [Ne]$3s^1 3p^1$
    B) [He]$2s^1 2p^3$
    C) [Ne]$3s^2 3p^2 3d^1$
    D) [Ne]$3s^2 3p^3 3d^1$
    E) [Ne]$3s^2 3p^3$

34. Which of the following electron configurations is correct for the excited state of an element?
    A) [He]$2s^2 2p^5$
    B) [Ne]$3s^2 3p^1$
    C) [Ar]$4s^1 4p^1$
    D) [Kr]$5s^2 4d^7$
    E) [He]$1p^1$

35. Which of the following fourth-period elements has the smallest atomic radius?
    A) K
    B) Ti
    C) Cu
    D) Ge
    E) Kr

36. Which of the following elements has the largest atomic size?
    A) S
    B) Ca
    C) Ba
    D) Po
    E) Rn

37. Which of the following elements has the smallest atomic radius?
    A) Li
    B) Ne
    C) Rb
    D) Sr
    E) Xe

38. Which of the following elements has the largest first ionization energy?
    A) Na
    B) Cl
    C) Ca
    D) Te
    E) Br

39. When comparing the successive ionization energies of an element, an unusually big increase in ionization energy is seen when
    A) the first valence electron is removed.
    B) the second valence electron is removed.
    C) the eighth electron of is removed.
    D) the first core electron is removed.
    E) the last valence electron is removed.

40. Which of the following elements has the largest second ionization energy (IE_2)?
    A) Li
    B) B
    C) O
    D) F
    E) Na

41. Elements with the highest first ionization energies are found in the _____ region of the periodic table.
    A) lower left
    B) upper left
    C) center
    D) lower right
    E) upper right

42. Which of the following has the most negative electron affinity?
    A) H
    B) Li
    C) Na
    D) K
    E) Rb

43. Elements with _____ first ionization energies and _____ electron affinities generally form cations.
    A) low, very negative
    B) high, positive or slightly negative
    C) low, positive or slightly negative
    D) high, very negative
    E) None of the above is generally correct.

44. Select the element with the greatest metallic character.
    A) Li
    B) Ca
    C) Al
    D) Pb
    E) Cs

45. Select the element with the least metallic character.
    A) Sn
    B) Sr
    C) Tl
    D) Ge
    E) Ga

46. Select the paramagnetic ion.
    A) Cu^{+}
    B) Ag^{+}
    C) Fe^{3+}
    D) Cd^{2+}
    E) Ca^{2+}

47. Which of the following atoms will be diamagnetic?
    A) Cr
    B) Ru
    C) Fe
    D) Pt
    E) Cd

48. Consider the set of isoelectronic atoms and ions A^{2-}, B^{-}, C, D^{+}, and E^{2+}. Which arrangement of relative radii is correct?
    A) $A^{2-} > B^{-} > C > D^{+} > E^{2+}$
    B) $E^{2+} > D^{+} > C > B^{-} > A^{2-}$
    C) $A^{2-} > B^{-} > C < D^{+} < E^{2+}$
    D) $A^{2-} < B^{-} < C > D^{+} > E^{2+}$
    E) None of the above is correct.

49. What is the correct order of decreasing size of the following ions?
    A) $P^{3-} > Cl^{-} > K^{+} > Ca^{2+}$
    B) $Ca^{2+} > K^{+} > Cl^{-} > P^{3-}$
    C) $K^{+} > Cl^{-} > Ca^{2+} > P^{3-}$
    D) $K^{+} > Cl^{-} > P^{3-} > Ca^{2+}$
    E) None of the above is correct.

50. Which of the following elements has the smallest atomic size?
    A) Na
    B) Ar
    C) K
    D) Ca
    E) Kr