1. How many protons, neutrons, and electrons are in $^{119}_{50}Sn^{2+}$?
2. The atomic weight of Ga is 69.72 amu. There are only two naturally occurring isotopes of gallium: 69Ga, with a mass of 69.0 amu, and 71Ga, with a mass of 71.0 amu. The natural abundance of the 69Ga isotope is approximately:
3. A student has determined the mass-to-charge ratio for an electron to be 5.64 × 10–12 kg/C. In another experiment, using Millikan's oil-drop apparatus, he found the charge on the electron to be 1.605×10^{-19} C. What would be the mass of the electron, according to these data?
4. The following table gives the number of protons and neutrons in the nuclei of various atoms. Which atom is the isotope of atom A? Which atom has the same mass number as atom A?

Atoms	***Neutrons***	***Protons***
Atom A	18	19
Atom B	16	19
Atom C	18	18
Atom D	17	20

5. Naturally occurring chlorine is a mixture of the isotopes Cl-35 and Cl-37. How many protons and how many neutrons are there in each isotope? How many electrons are there in the neutral atoms?
6. What is the nuclide symbol for the nucleus that contains 11 protons and 12 neutrons?
7. While traveling to a distant universe, you discover the hypothetical element "X." You obtain a representative sample of the element and discover that it is made up of two isotopes, X-23 and X-25. To help your science team calculate the atomic weight of the substance, you send the following drawing of your sample with your report.

8. A monatomic ion has a charge of +4. The nucleus of the ion has a mass number of 235. The number of neutrons in the nucleus is 1.55 times that of the number of protons. How many electrons are in the ion? What is the name of the element?
9. A monatomic ion has a charge of +1. The nucleus of the ion has a mass number of 85. The number of neutrons in the nucleus is 1.30 times that of the number of protons. How many electrons are in the ion? What is the name of the element?
10. What is the notation for the subshell in which $n = 4$ and $l = 3$? How many orbitals are in this subshell?
11. What is the general shape of an *s* orbital? of a *p* orbital?
12. An electron in the $n = 1$ level of the hydrogen atom is in its ground state.
13. On average, an electron in the $n = 3$ level is farther from the nucleus than an electron in the $n = 2$ state.
14. The wavelength of light emitted when the electron goes from the $n = 3$ level to the $n = 1$ level is the same as the wavelength of light absorbed when the electron goes from the $n = 1$ level to $n = 3$ level.
15. An electron in the $n = 1$ level is higher in energy than an electron in the $n = 4$ level.
16. Light of greater frequency is required for a transition from the $n = 1$ level to $n = 3$ level than is required for a transition from the $n = 2$ level to $n = 3$ level
17. Which of the following statements is (are) true?

    I. The product of wavelength and frequency of light is a constant.

    II. As the energy of electromagnetic radiation increases, its frequency decreases.

III. As the wavelength of light increases, its frequency increases.

I only II only III only I and III only II and III only

18. Of the following possible transitions of an electron in a hydrogen atom, which emits light of the highest energy?

n = 1 to the n = 3 level n = 1 to the n = 2 level

n = 3 to the n = 1 level n = 2 to the n = 1 level

n = 5 to the n = 4 level

19. What wavelength of electromagnetic radiation corresponds to a frequency of 3.46×10^{13}? 8.66 × 1026 m, 1.15 × 105 m, 7.65 × 10229 m, 9.10 × 1026 m , 8.99 × 1026 m

20. Which has the greater wavelength, blue light or red light?

21. How do the frequencies of blue light and red light compare?

22. How does the energy of blue light compare with that of red light?

23. Does blue light have a greater speed than red light?

24. How does the energy of three photons from a blue light source compare with the energy of one photon of blue light from the same source?

25. How does the energy of two photons corresponding to a wavelength of 451 nm(blue light) compare with the energy of three photons corresponding to a wavelength of 704 nm (red light)?

26. A hydrogen atom with an electron in its ground state interacts with a photon of light with a wavelength of 1.22 × 10-6 m. Could the electron make a transition from the ground state to a higher energy level? If it does make a transition, indicate which one. If no transition can occur, explain.

27. If you have one mole of hydrogen atoms with their electrons in the n = 1 level, what is the minimum number of photons you would need to interact with these atoms in order to have all of their electrons promoted to the n = 3 level? What wavelength of light would

28. A photon corresponding to a particular frequency of blue light produces a transition from the n = 2 to the n = 5 level of a hydrogen atom. Could this photon produce the same transition (n = 2 to n = 5) in an atom of X? Explain.

29. An electron in a hydrogen atom in the level n = 5 undergoes a transition to level n = 3. What is the frequency of the emitted radiation?

Calculate the frequency of electromagnetic radiation emitted by the hydrogen atom in the electron transition from $n = 6$ to $n = 3$

30. If the n quantum number of an atomic orbital is 4, what are the possible values of l? If the l quantum number is 3, what are the possible values of ml?

31. The n quantum number of an atomic orbital is 5. What are the possible values of l? What are the possible values of ml if the l quantum number is 4?

32. How many subshells are there in the M shell? How many orbitals are there in the d subshell?

33. How many subshells are there in the N shell? How many orbitals are there in the f subshell?

34. Give the notation (using letter designations for l) for the subshells denoted by the following quantum numbers.

$n = 6, l = 2$ $n = 5, l = 4$

$n = 4, l = 3$ $n = 6, l = 1$

35. Give the notation (using letter designations for l) for the subshells denoted by the following quantum numbers.

$n = 3, l = 1$ $n = 4, l = 0$

$n = 5, l = 3$ $n = 4, l = 2$

36. Explain why each of the following sets of quantum numbers would not be permissible for an electron, according to the rules for quantum numbers.

$n = 1, l = 0, ml = 0, ms = +1$

$n = 1, l = 3, ml = +3, ms = +1 /2$

$n = 3, l = 2, ml = +3, ms = -1/ 2$

$n = 0, l = 1, ml = 0, ms = +1 2$

$n = 2, l = 1, ml = -1, ms = +3/ 2$

37. State which of the following sets of quantum numbers would be possible and which impossible for an electron in an atom.

$n = 2, l = 0, ml = 0, ms = +1/ 2$

$n = 1, l = 1, ml = 0, ms = {}^{+}1/ 2$

$n = 0, l = 0, ml = 0, ms = {}^{-}1/ 2$

$n = 2, l = 1, ml = -1, ms = {}^{+}1 /2$

$n = 2, l = 1, ml = -2, ms = {}^{+}1/ 2$

1. The compound CuCl emits blue light having a wavelength of 450nm when heated at about 200°C. What is the increment in energy (quantum) that is emitted at 450nm?
   A. 2.25 x 10-19J C. 8.20 x 10-19J
   B. 4.41 x 10-19J D. 16.20 x 10-19J
2. What is the difference between chlorine – 35 and chlorine -37?
   A. Chlorine – 37 has two more protons than chlorine -35
   B. Chlorine – 37 has two more neutrons than chlorine -35
   C. Chlorine – 37 has two more electrons than chlorine -35
   D. Chlorine – 37 has two more protons and more neutron than chlorine -35
3. Which one of the following electromagnetic radiations has the shortest wavelength?
   A. X – rays B. UV rays C. gamma rays D. microwaves

4. Which of the following quantum number/s determine the energy of an electron in a hydrogen atom?
   A. n B. n and 1 C. n, 1 and m D. n,1,m and s
5. Which of the following electron transitions requires the smallest energy to be absorbed by the hydrogen atom?
   A. from n = 1 to n = 2 C. from n = 3 to n = 4
   B. from n = 2 to n = 3 D. from n = 4 to n = 5
6. For an electron that has quantum numbers n = 4 and m = 0, which of the following is true?
   A. It must have the quantum number n = 0
   B. It must have the quantum number = 0
   C. It must have the quantum number ms = +1/2
   D. It may have the quantum number = 0,1,2,3
7. Which group of elements is characterized with ns2np2 outer – electron configuration?
   A. Group 2A B. Group 4A C. Group 4B D. Group 3B
8. For elements in the left-most column of the periodic table, properties that have increasing values as the atomic number increases include which of the following?
   I. Ionization energy II. Atomic radius III. Atomic mass
   A. III only B. I,II, and III C. I and II only D. II and III only
9. Which of the following statements is TRUE?
   A. Ultraviolet light has longer wavelength than visible light
   B. The energy of radiation decreases as the wavelength decreases
   C. The frequency of radiation increases as the wavelength decreases
   D. Wave number of an electromagnetic radiation increases as wavelength increases
10. Which one of the following groups in the periodic table has paramagnetic atoms?
    A. Group zero B. Group IIA C. Group IIB D. Group IVA
11. Which of the following quantum number(s) is (are) related to the size and energy of an electron in a hydrogen atom? A. n B. n,l C. n,l,m D. n,l,m,s
12. Which of the following represents the genial configuration of the transition elements?
    A. ns2np6 B. ns(n-l)d C. ns(n-2)f D. ns2np6(n-1)d10
13. An electron has a spin quantum number, s = +1/2 and a magnetic quantum number , m1 = +1. In which of thefollowing orbital will it NOT be present?
    A. s-orbital B. p-orbital C. d-orbital D. f-orbital
14. What is the wavelength associated with an electron of mass, m= 9.11 x 10-28g, travelling at 40% of the velocity of light?
    A. 6.06 x 10-15m C. 6.06 x 10-12m
    B. 2.42 x 10-15m D. 2.42 x 10-11m
15. What sizes of particles and velocities can one consider quantum effect?
    A. Particles with very large mass and large velocities
    B. Particles with large mass and small velocities

C. Particles with very small mass and large velocities
D. Particles with small mass and small velocities

16. 1. Which electron transition in a hydrogen atom releases the largest energy?
A. n = 2 n = 1 B. n = 4 n = 2 C. n = 6 n = 3 D. n = 7 n = 6

17. What is the ration of the energy of a photon of 300nm wavelength radiation to that of 600nm radiation?
A. 1:2 B. 1:1 C. 2:1 D. 3:1

18. Which of the following particles contains more electrons than neutrons?
I $^{1}H_{1}$ *II* $^{35}Cl_{-17}$ *III* $^{39}K_{+19}$
A. I only B. II only C. I and II only D. II and III only

19. Which one of the following atoms in its ground state has the greatest number of unpaired electrons?
A. 13Al B. 14Si C. 15P D. 16S

20. What is the ionization energy of an iron atom if it requires a radiation of 276 nm to completely remove its outer most electron in the gaseous state? (plank's constant, h = 6.626 x 10-34Js, speed of light , c = 3 x 108 ms-1)
A. 7.21 x 10-19J B. 7.21 x 10-19kJ C. 7.21 x 1019J D. 7.21 x 1019kJ

21. Which of the electron configurations describes the ground state electron configuration of Cl1?
A. 1s22s22p63s23p6 C. 1s22s22p63p1
B. 1s22s22p63s1 D. 1s22s22p63s23px23py1

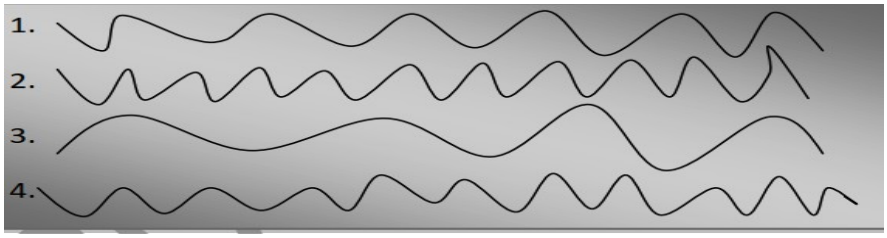
22. How many 3d electrons are present in the ground state of chromium atom?
A. 4 B. 5 C. 6 D. 1

23. 1. Of the three types of radioactivity characterized by Rutherford. Which of the following are particles?
A. - rays C. – rays and – rays B. - rays D. - rays, - rays, and – rays

24. Which one of the following represents an acceptable possible set of quantum numbers (in the order n, I, m1, ms) for an
electron in an atom?
A. 2, 1, 0, 0 C. 2, 1, -1, 1/2
B. 2, 0, 2, +1/2 D. 2, 0, 1, -1/2

25. How many orbitals are there in an atom with n = 4? A. 2 B. 8 C. 16 D. 25

26. Consider the electromagnetic waves shown below. Which of the electromagnetic waves has the highest frequency?



A. 1 B. 2 C. 3 D. 4

27. The wave number of an electromagnetic radiation is 1 x 105 cm-1. The frequency of the radiation would be
    A. 3 x 108 s-1 B. 3 x 106 s-1 C. 3 x 1010 s -1 D. 3 x 1015 s -1
28. The maximum number of electrons in p-orbital with n = 6, m = 0 is A. 2 B. 6 C. 16 D. 14
29. Which of the following transitions will emit maximum energy in the hydrogen atom?
    A. n = 4 n = 3 C. n = 2 n = 1
    B. n = 4 n = 2 D. n = 3 n = 2
30. Which of the following statements is true?
    A. All forms of electromagnetic radiation are visible.
    B. Radio waves have shorter wavelengths than visible light.
    C. Ultraviolet light has longer wavelengths than visible light.
    D. The frequency of radiation increases as the wavelength decreases
31. Which of the following are NOT electromagnetic waves?
    A. Infrared waves C. Radio waves
    B. Gamma waves D. sound waves
32. What is the distance that a radio wave will travel in 0.250s?
    A. 1.2 x 107m B. 12 x 107m C. 7.5 x 107m D. 5.6 x 107m
33. What values of are permitted for an electron with n = 4?
    A. 1, 2, 3 B. 1, 2, 3, 4 C. 0, 1, 2, 3, 4 D. 0, 1, 2, 3
34. Which of the following electrons, identified only by their n and quantum numbers have the highest energy? n = 3, 1 = 0 n = 3, 1 = 2 n = 4, 1 = 1 n = 4, 1 = 2
    A. n = 3, 1 = 2 B. n = 4, 1 = 1 C. n = 4, 1 = 2 D. n = 3, 1 = 0
35. What is the maximum number of unpaired electrons in a d sub shell?
    A. 2 B. 5 C. 3 D. 4
36. The following energy level diagram represents the outermost shell of what ground state element? A. B B. He C. Al D. Be
37. Which of the following types of rays combine to form atoms of helium?
    A. Gamma rays B. beta rays C. alpha rays D. X-rays
38. What is the relationship between frequency (v) , wavelength and the speed of light (c)?
    A. = c B. vc = h C. D. c = v
39. What is the magnitude of quantum energy and the frequency for an object whose wavelength is 0.6 x 10-6 m?

A. 3.31 x 10-19J, 5x 1014S-1 C. 1.99 x 10-25J, 3.98 x 10-40S-1

B. 3.98 x 10-40J, 2 x 10-15S-1 D. 9.94 x 10-12J, 1.99 x 10-25S-1

40. What new concept did Bohr adapt and use to formulate his model of the atom?

A. Electromagnetic theory developed by Maxwell.

B. The quantum concept developed by Planck.

C. Photoelectric theory developed by Thompsohn.

D. Neutron theory developed by Chadwick.