1. Atoms that have eight valence electrons would tend to
   A) be very reactive.
   B) be inert.
   C) form positive ions.
   D) form negative ions.

3. Photons of which of the following colors of light possess the greatest amount of energy?
   A) blue
   B) green
   C) yellow
   D) red

4. When atoms of non-metallic elements react with one another, they tend to seek stability by
   A) acquiring a noble gas electron arrangement
   B) losing electrons
   C) forming ionic bonds
   D) none of these

5. Identify the number of protons, neutrons and electrons in an atom of $^{19}_{9}$F.
   A) 9 protons, 10 neutrons and 9 electrons
   B) 9 protons, 10 neutrons and 10 electrons
   C) 9 protons, 19 neutrons and 9 electrons
   D) 10 protons, 9 neutrons and 10 electrons

6. Because of our belief in the law of conservation of mass, it seems reasonable that
   A) in combustion reactions, part of the mass of the reactants must be converted into fire.
   B) the mass of a newly formed compound cannot be changed.
   C) molecules cannot be broken down for the mass would be reduced.
   D) the number of atoms of reactants must equal the number of atoms of products.

8. In an ionic compound, the metal
   A) usually forms a negative ion.
   B) combines with another metal atom
   C) gains electrons
   D) is written first.

9. Evidence of a chemical reaction includes
   A) a color change
   B) a change in temperature
   C) the production of a gas
   D) all of these

11. An oxidizing agent is a substance that
    A) reacts with oxygen.
    B) removes electrons from another substance.
    C) supplies electrons to another substance.
    D) frees a metal from its ore.

12. The reaction: potassium chlorate $\xrightarrow{\Delta} \xrightarrow{\Delta}$ potassium chloride and oxygen gas is an example of
    A) decomposition
    B) combination
    C) replacement
    D) ion exchange
13. Using the laws governing moving particles and the forces of electrical attraction, Bohr reasoned that electrons could 
   A) move in orbits whose radii depended on their velocity. 
   B) move, as the planets, in orbits at any distance from the nucleus. 
   C) move in orbits whose radii matched the distances between the lines in the hydrogen spectrum. 
   D) move only in specific orbits

14. Neutral atoms of a given element all have the same 
   A) number of protons. 
   B) atomic number. 
   C) number of electrons. 
   D) all of these.

15. The formation of an ionic bond 
   A) involves a transfer of one or more electrons. 
   B) results in a release of energy. 
   C) helps atoms achieve a noble gas electron arrangement. 
   D) all of these.

16. A solution with a pH of 2 
   A) is twice as acidic as one with a pH of 1. 
   B) is half as acidic as a solution with a pH of 1. 
   C) is ten times as acidic as a solution with a pH of 1. 
   D) is one tenth as acidic as a solution with a pH of 1.

17. A hydrogen bond is 
   A) what holds the atoms of a water molecule together. 
   B) a force between hydrogen atoms in adjacent water molecules. 
   C) a force between a hydrogen atom of one polar molecule and another polar molecule. 
   D) a force between a hydrogen atom and a metal.

19. When Rutherford found that some of the alpha particles fired at the gold foil were widely deflected, he concluded that 
   A) gold was an element, not a compound as previously believed. 
   B) atoms are solid, with spaces between them. 
   C) atoms are electrically neutral. 
   D) the positive charge in an atom is concentrated in a tiny nucleus.

20. The atomic number of an element is the number of 
   A) protons 
   B) protons and neutrons 
   C) protons and electrons 
   D) all the particles in the atom.

21. In liquid solutions, the solute is 
   A) a solid. 
   B) a liquid. 
   C) a gas. 
   D) all of these could be true.

23. Rutherford concluded from his calculations that the volume of an atom 
   A) is filled with protons, neutrons and electrons. 
   B) is mostly protons, with electrons revolving around the outside. 
   C) is filled with electrons. 
   D) is mostly empty space.
25. The fact that wavelengths of the four lines in the Balmer series fit a regular pattern was evidence supporting the idea that
A) electrons could exist in only four energy states in a hydrogen atom.
B) there must be four electrons in each hydrogen atom.
C) electrons could only gain or lose specific amounts of energy in hydrogen atoms.
D) electrons were continuously losing energy.

26. Ionic compounds are generally
A) white, crystalline solids
B) gaseous substances
C) syrupy liquids
D) shapeless solids.

27. The smallest unit of a covalent compound that still retains the properties of the compound is called a (an)
A) electron
B) atom
C) molecule
D) dipole

28. The amount of energy released when wood is burned is
A) greater than the amount of solar energy absorbed during its formation.
B) equal to the amount of solar energy absorbed during its formation.
C) less than the amount of solar energy absorbed during its formation.
D) greater or less than the amount of solar energy absorbed during its formation, depending on how it is burned.

29. Which of the following is a sign of an ion exchange reaction?
A) a precipitate is formed.
B) a compound is broken down into simpler substances.
C) a reactant is oxidized.
D) a metal ion is reduced.

30. Polar compounds such as alcohol would be expected to be
A) more soluble in water than in non-polar solvents.
B) more soluble in non-polar solvents than in water.
C) equally soluble in water and non-polar solvents.
D) none of these are true.

31. J. J. Thomson reasoned that cathode rays were really charged particles because
A) a magnet deflected cathode rays.
B) cathode rays formed only when the air was pumped out of a discharge tube.
C) the properties of the cathode rays depended on the cathode material.
D) the cathode rays were attracted to the anode.

32. Which one of the following is a property of basic solutions?
A) They turn the dye litmus red.
B) They taste sour.
C) They feel slippery.
D) They react with active metals to produce hydrogen gas.

33. What is the most likely temperature of the water at the bottom of Lake Superior in the winter?
A) 0°C
B) 4°C
C) 10°C
D) The temperature is pretty variable.
34. Isotopes of an element are atoms that have
   A) the same number of protons, but a different number of electron.
   B) the same number of neutrons, but a different number of protons.
   C) the same number of protons, but a different number of neutrons.
   D) equal numbers of protons and neutrons.

35. Which of the following solutions is likely to have a pH less than 7?
   A) sodium chloride
   B) ammonia
   C) citric acid
   D) pure water

37. The reaction between water solutions of sodium chloride and silver nitrate produces a precipitate: \[ \text{NaCl}_{(aq)} + \text{AgNO}_3_{(aq)} \rightarrow \text{NaNO}_3_{(aq)} + \text{AgCl}_{(s)} \]. This is an example of
   A) decomposition
   B) combination
   C) replacement
   D) ion exchange

38. Which combination of elements results in the formation of a white crystalline solid that dissolves to form a solution that conducts electricity?
   A) metal and metal
   B) non-metal and non-metal
   C) metal and non-metal
   D) metal and metalloid

39. Water solutions of ionic substances that conduct electricity are called
   A) electrical solutions
   B) polar solutions
   C) electrolytes
   D) indicators

43. The reaction \(2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}\) is an example of
   A) oxidation
   B) combination
   C) combustion
   D) all of these

44. Which of the following are properties of acidic solutions?
   A) They turn the dye litmus red.
   B) They taste sour.
   C) They react with active metals to produce hydrogen gas.
   D) All of these are true.

45. Hydrogen bonding in water accounts for
   A) water’s higher than expected boiling temperature.
   B) the fact that ice floats in liquid water.
   C) the fact that snowflakes are 6-sided.
   D) all of these are true.

46. What type of chemical bond does the sharing of a pair of electrons form?
   A) covalent
   B) ionic
   C) metallic
   D) double
47. What do solutions of acids, bases and salts have in common?
A) They are proton donors.
B) They are proton acceptors
C) They all have a pH of less than 7
D) They are electrolytes.

48. The energy of a photon of light emitted by an electron equals
A) the energy of the level it currently occupies.
B) the energy of the level it just left.
C) the energy of the ground state of the atom.
D) the difference in energy between two levels.

49. A chemical bond that involves somewhat unequal sharing of electrons is called
A) ionic
B) covalent
C) polar
D) coordinate covalent

50. Atoms from an element in group II A are allowed to react with atoms from an element in group VII A. What type of compound is likely to form?
A) ionic
B) covalent
C) polar
D) none at all

51. The reaction: \( 2 \text{NaI} + \text{Cl}_2 \rightarrow 2 \text{NaCl} + \text{I}_2 \) is an example of
A) decomposition
B) combination
C) replacement
D) ion exchange

52. The formation of a positive ion
A) occurs when an atom gains a proton.
B) involves a release of energy.
C) occurs when an electron is removed from an atom.
D) occurs in covalent bonding.

53. Air is considered to be a homogeneous mixture that is 79 percent nitrogen gas, 20 percent oxygen gas and 1 percent all the other gases. In this mixture, nitrogen can be considered
A) a solvent
B) a solute
C) a solution
D) saturated
Answer Key (Answers to omitted questions above not included)

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