Multiple Choice (3 points each)

1) The atomic mass number of an element is the same as the number of its
   a. protons    b. neutrons
   **c. protons and neutrons**    d. protons, neutrons, and electrons

2) The half-life of an isotope is one day. At the end of two days the amount that remains is
   a. one-half   b. **one-quarter**
   c. one-eight    d. none of these

3) When thorium (symbol = Th, atomic number = 90) emits a beta particle, the resulting nucleus has an atomic number of
   a. 89    b. 90    c. **91**    d. none of these

4) Control is exercised in a nuclear reactor by
   **a. absorbing excess neutrons with control rods.**
   b. emitting fast neutrons with a moderator
   c. both of these
   d. none of these

5) When Uranium-238 absorbs a neutron, it
   **a. fissions**    b. becomes a beta emitter
   c. emits a neutrino    d. becomes an alpha emitter

6) Gases are so much easier to squeeze into smaller volumes than liquids or solids because
   a. they are so much lighter.
   b. their atoms or molecules are already moving at high speeds.
   **c. there is so much space in between the submicroscopic particles.**
   d. they are always warmer than liquids or solids.

7) One element is distinguished from a different element by the number of
   a. neutrons    b. electrons    **c. protons**    d. quarks

8) How is a physical change different from a chemical change?
   a. The physical properties of a substance are not altered during a chemical change.
   b. A physical change involves changes in chemical properties.
   c. The chemical identity of a substance is altered during a physical change.
   **d. The chemical identity of a substance is not altered during a physical change.**
9) Elements of the periodic table are listed in order of
   a. atomic mass     b. atomic size
   c. **atomic number**  d. none of these

10) How many electrons are in the outermost (valence) shell of strontium (Sr)?
    a. 2   b. 38   c. 8   d. 4

11) Although the nucleus of a carbon atom has a charge of +6, the charge experienced by
    carbon’s valence electrons is different because
    a. the valence electrons are far away so that the nuclear charge is diminished.
    b. inner shell electrons shield the valence electron from the nucleus.
    c. both “a” and “b”
    d. neither “a” nor “b”

12) The alkali metals (group 1) tend to form +1 ions while the alkali-earth metals (group
    2) tend to form +2 ions because
    a. alkali metals are less massive.
    b. this is a random occurrence.
    c. **the charges of these ions corresponds to the number of valence electrons that may be lose**
    d. the ion on atom forms is always equal to the group number.

13. What elements tend to form ionic compounds?
    a. any two elements of the same phase can form an ionic compound
    b. those found in the upper right hand side of the periodic table
    c. metallic elements
    d. **elements found on opposite sides of the periodic table.**

14. What type of chemical bond would you expect between two chlorine atoms (Cl)?
    a. ionic     b. **nonpolar covalent**
    c. metallic     d. polar covalent

15. The atoms of materials that conduct electricity best tend to be held together by
    a. **metallic bonds**
    b. ionic bonds
    c. covalent bonds
    d. soluble in water

16. If gallium ions have a +3 charge and a sulfur ion has a −2 charge, the compound
    gallium sulfide is
    a. Ga₃S₂   b. Ga₆S₆   c. **Ga₂S₃**   d. Ga₄S₃

17. Covalent and ionic bonds differ in that
    a. covalent bonds are more permanent
    b. covalent bonds are much less common
    c. **ionic bonds don’t involve the sharing of electrons**
    d. ionic bonds are electrical by nature
18. Which of these covalent bonds in most polar
   a. P-Cl  
   b. P-S  
   c. Si-S  
   d. Al-Cl

19. An individual carbon-oxygen bond is polar. Yet carbon dioxide, CO₂, which has two carbon-oxygen bonds, is nonpolar because
   a. the two carbon-oxygen bonds in CO₂ are oriented 180° from each other.  
   b. any molecule containing two polar bonds is always nonpolar.  
   c. at low temperatures carbon dioxide solidifies into dry ice.  
   d. none of the above

20. The boiling temperature of water is much higher than that of methane because water molecules are
   a. more massive  
   b. polar  
   c. composed of fewer atoms  
   d. smaller

21. Water molecules are attracted to sodium chloride because
   a. water molecules are small enough to fit within the crystal lattice.  
   b. the dipoles of water are attracted to the ionic charges.  
   c. of the hydrogen bonding between water molecules.  
   d. of the great attraction between sodium and chlorine ions.

22. What exactly is a hydrogen bond?
   a. the bond that holds two hydrogen atoms together in the hydrogen molecule  
   b. a strong dipole-dipole interaction between two hydrogen atoms  
   c. a nuclear explosive  
   d. a strong dipole-dipole interaction involving a hydrogen atom and an adjacent electronegative element.

23. Ion-dipole interactions are stronger than dipole-dipole interactions because
   a. ions and molecular dipoles can get a lot closer than molecular dipoles can get to molecular dipoles.  
   b. the charge of an ion is much greater than then charge of a molecular dipole.  
   c. the electrons in a molecular dipole only congregate to one side.  
   d. They are not stronger.

24. Uranium-235, Uranium-238, and Uranium-239 are different
   a. elements  
   b. ions  
   c. isotopes  
   d. none of these

25. A certain radioactive isotope placed near a Geiger counter registers 120 counts per minute. If the half-life of the isotope is 1 day, what will the count rate be at the end of 4 days?
   a. 30 counts/min  
   b. 15 counts/min  
   c. 10 counts/min  
   d. 7.5 count/min
Problems (SHOW ALL WORK ON THE ANSWER SHEET):

(5 points) The following materials are probably in daily use in your home; classify these materials as elements, compounds, or mixtures:

- Milk: **Mixture**
- Water: **Compound**
- Aluminum: **Element**
- Butter: **Mixture**
- Sugar: **Compound**

(5 points) Complete the following nuclear equations:

\[
\begin{align*}
\frac{14}{6} C & \rightarrow \_\_\_\_\_\_ + \frac{0}{-1} e \\
\frac{14}{6} C & \rightarrow \frac{14}{7} N + \frac{0}{-1} e \\
\frac{1}{1} n + \frac{14}{7} N & \rightarrow \_\_\_\_\_\_ + \frac{1}{1} H \\
\frac{1}{1} n + \frac{14}{7} N & \rightarrow \frac{14}{6} C + \frac{1}{1} H
\end{align*}
\]

(5 points) Give the chemical formula for compounds formed from the following elements:

- Aluminum(Al) and Oxygen(O)
  \[Al^{+3} \quad O^{2-} \quad \rightarrow \quad Al_2O_3\]
- Magnesium (Mg) and Fluorine(F)
  \[Mg^{+2} \quad F^{-1} \quad \rightarrow \quad MgF_2\]
Complete the following table

<table>
<thead>
<tr>
<th>Substance</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Electrons</th>
</tr>
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<tbody>
<tr>
<td>$^{238}_{92}U$</td>
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<td>146</td>
<td>92</td>
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<tr>
<td>$^{56}_{26}Fe$</td>
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<td>30</td>
<td>26</td>
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<tr>
<td>$^{35}_{17}Cl^{-1}$</td>
<td>17</td>
<td>18</td>
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