1. The wavelength of light emitted from a traffic light having a frequency of 5.75 x 10^8 MHz is:
   a. 315 nm
   b. 522 nm
   c. 702 nm
   d. 917 nm

2. A student wishes to determine the thickness of a rectangular piece of aluminum foil but cannot measure it directly. She can measure its density (d), length (l), mass (m) and width (w). Which relationship will give the thickness?
   a. \( \frac{m}{dlw} \)
   b. \( \frac{mlw}{d} \)
   c. \( \frac{dlw}{m} \)
   d. \( \frac{dxm}{lxw} \)

3. What value should be reported for the buret shown:
   a. 22.3 mL
   b. 22.30 mL
   c. 22.36 mL
   d. 22.40 mL
4. Which element has the largest first ionization energy?
   a. Li  
   b. B  
   c. N  
   d. Na  

5. Which one of the following is the formula of iodic acid?
   a. HI(g)  
   b. HI(aq)  
   c. HIO\(_2\)(aq)  
   d. HIO\(_3\)(aq)  

6. The deBroglie wavelength of a ______ will have the shortest wavelength when traveling at 100 m/s.
   a. Electron  
   b. Proton  
   c. Helium atom  
   d. Cesium atom  

7. Under ordinary conditions (25°C, 1 atm), the second most common physical state of the elements is:
   a. Solid  
   b. Liquid  
   c. Gas  
   d. Plasma
8. Five pellets of a metal have a total mass of 1.25g and a total volume of 0.278 mL. What is the density of one pellet?
   a. 0.348 g·mL⁻¹
   b. 0.900 g·mL⁻¹
   c. 4.50 g·mL⁻¹
   d. 22.5 g·mL⁻¹

9. Of the following, the most metallic nonmetal is:
   a. Helium
   b. Neon
   c. Xenon
   d. Radon

10. How many significant figures should be reported in the answer to the calculation (assume all numbers are experimentally determined).
    \[
    \frac{12.501 \times 3.52}{0.0042} + 6.044
    \]
    a. 2
    b. 3
    c. 4
    d. 5

11. Silver has two naturally occurring isotopes, \(^{107}\text{Ag}\) and \(^{109}\text{Ag}\) and an average atomic mass of 107.8682 amu. If \(^{107}\text{Ag}\) has an atomic mass of 106.90509 amu and \(^{109}\text{Ag}\) has an atomic mass of 108.8682 amu, what is the fractional (relative) abundance of the lighter isotope?
    a. 0.2422
    b. 0.5184
    c. 0.7578
    d. 0.9047
12. A result of Schrödinger’s wave equation is that______ may be determined at a given instant:
   a. the exact position of an electron
   b. the exact momentum of an electron
   c. the product of the position and momentum of an electron
   d. the probability that an electron will be in a certain region of space

13. The correct formula for chromium(III) oxide is:
   a. CrO₃
   b. Cr₃O
   c. Cr₂O₃
   d. Cr₃O₂

14. Under ordinary conditions (25°C, 1 atm), how many elements are found as diatomic molecules in nature?
   a. 5
   b. 7
   c. 9
   d. 11

15. The element that looks like a metal, is a poor thermal conductor, and acts an electrical semiconductor is:
   a. Aluminum
   b. Carbon
   c. Phosphorous
   d. Silicon

16. There are four spectral lines (l = 410.2 nm, 434.0 nm, 486.1 nm, 656.3 nm) in the emission spectra for the hydrogen atom. The emission at 656.3 nm corresponds to which of the following transitions?
   a. n = 3 → n = 2
   b. n = 4 → n = 2
   c. n = 5 → n = 2
   d. n = 6 → n = 2
17. How many orbitals in a ground state oxygen atom are completely filled?
   a. 1
   b. 2
   c. 3
   d. 4

18. Which element has the smallest atomic radius?
   a. Br
   b. K
   c. Mg
   d. Na

19. For an isoelectronic series, the size of the ions depends on:
   a. Number of electrons
   b. Number of neutrons
   c. Number of protons
   d. If the subshells are full or half-full

20. In the hydrogen atom, the transition that will absorb the photon of longest wavelength is:

   a. $n = 1 \rightarrow n = 3$
   b. $n = 3 \rightarrow n = 5$
   c. $n = 1 \rightarrow n = 5$
   d. $n = 5 \rightarrow n = 1$
   e. $n = 5 \rightarrow n = 3$
   f. $n = 3 \rightarrow n = 1$

21. Suppose a thermometer has marks at every one degree increment and the mercury level on the thermometer is halfway between the 25 and 26 degree Celsius marks. We should properly report the temperature measurement as

   a. 25.50°C
   b. 25.55°C
   c. 25°C
   d. 25.5°C
22. Which reacts most vigorously with water?
   a. Na  
   b. Mg  
   c. K  
   d. Ca

23. What is the common name for HBrO2 dissolved in water?
   a. hydrogen bromate  
   b. hydrogen dioxybromide  
   c. bromous acid  
   d. bromic acid

24. In the solid phase, which of the following elements is expected to be the dullest (not shiny)?
   a. Ag  
   b. Al  
   c. Ar  
   d. Au

25. A photon of blue light _____ sufficient energy to eject an electron from an atom of at least one element
   a. Will have  
   b. Will never have  
   c. Depends on the intensity of the light  
   d. Depends on the source of the light

26. What is the common name for HBrO2 dissolved in water?
   a. Number of electrons  
   b. Number of neutrons  
   c. Number of protons  
   d. If the subshells are full or half-full

27. The lowest temperature possible on the Fahrenheit scale, Celsius scale, and Kelvin scale are
   a. Negative on all three temperature scales.  
   b. Negative on two of the scales, zero on the third scale.  
   c. Zero on two of the scales, negative on the third scale.  
   d. Negative on one scale, zero on one scale, and positive on one scale.
28. Which one of the following rays is unaffected by external magnetic fields?
   a. Alpha
   b. Beta
   c. Gamma
   d. Cathode

29. Which of the following elements is expected to be the best insulator at room temperature?
   a. Al
   b. Ar
   c. At
   d. Au

30. The second most common number of valence electron(s) in the periodic table is:
   a. 0
   b. 1
   c. 2
   d. 4
   e. 6
   f. 8
   g. none of the above

31. Which of the following is NOT true for the atoms 13N, 14N, 15N?
   a. They all have 7 electrons
   b. They all have 7 protons
   c. The all have 7 neutrons
   d. They all have the same atomic number

32. The three most common phases of matter are present in group:
   a. 5A
   b. 6A
   c. 7A
   d. 8A
33. What is the maximum number of electrons in an atom that can have the following set of quantum numbers? \( n = 4; l = 2; ms = -1/2 \)

   a. 1
   b. 2
   c. 5
   d. 10
   e. 18
   f. 32
   g. None of these

34. Using a high grade volumetric device, the volume of a liquid sample is determined to be 6.321 L. Three students are asked to determine the volume of the same liquid using a lower-grade measuring device. The data obtained are:

<table>
<thead>
<tr>
<th>Trials</th>
<th>Student A</th>
<th>Student B</th>
<th>Student C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.36 L</td>
<td>6.31 L</td>
<td>6.15 L</td>
</tr>
<tr>
<td>2</td>
<td>6.36 L</td>
<td>6.32 L</td>
<td>6.21 L</td>
</tr>
<tr>
<td>3</td>
<td>6.35 L</td>
<td>6.33 L</td>
<td>6.58 L</td>
</tr>
<tr>
<td>4</td>
<td>6.36 L</td>
<td>6.32 L</td>
<td>6.32 L</td>
</tr>
<tr>
<td>5</td>
<td>6.36 L</td>
<td>6.32 L</td>
<td>6.45 L</td>
</tr>
</tbody>
</table>

Which statement is correct?

   a. Student A was accurate and precise, Student B was precise, Student C was accurate.
   b. Student A was accurate, Student B was accurate and precise, Student C was neither accurate nor precise.
   c. Student A was precise, Student B was accurate and precise, Student C was accurate.
   d. More than one student was accurate and precise.

35. How many unpaired electrons does a ground-state aluminum ion have?

   a. 0
   b. 1
   c. 2
   d. More than 2