1) Electronic configurations.
   a. Write or otherwise describe the electronic structure of each of the following atoms or ions:
      \( \text{O}^{2-}, \text{F}^{-}, \text{Ne}^{0}, \text{Na}^{+}, \text{Mg}^{2+}, \text{Al}^{3+}, \text{Si}^{4+}, \text{P}^{5+}, \text{S}^{6+} \)
   b. The valences I have given above are the ones most commonly found at the earth’s surface. Why are
      they the favored ones? There is a very clear pattern that reflects some underlying principle of the way
      atoms are built. In your own words, explain why these ions are the common ones in nature instead of
      other valences.
   c. Nitrogen can be found as \( \text{NO}_{3}^{-}, \text{NO}_{2}^{-} \), and/or \( \text{NH}_{3} \) in groundwater. Explain why these forms are
      favored (assume oxygen is -2 valence and hydrogen is +1 valence for now).
   d. Write reasonable electronic configurations for the following and explain why these configurations are
      favorable: \( \text{Fe}^{3+}, \text{Mn}^{2+}, \text{Cu}^{+}, \text{Zn}^{2+} \)
   e. (optional) \( \text{Cr}^{3+} \) and \( \text{Mn}^{4+} \) are very common in nature, and thus must have “happy” e- configurations. I
      don’t know why. If you’re curious about this, try to find out what their electronic configurations are
      and why these configurations are “happy”.
   f. It turns out that the Rare Earth Elements (REE’s) all tend to be present in the 3+ valence. Look at the
      electronic configuration of these elements. What do they have in common? They are called
      “lanthanides” because of their chemical similarity to lanthanum. Do a little google research and some
      reasoning to explain why they tend to prefer the 3+ valence.

2) If an atom emits an x-ray, what causes this?

3) What is the relationship between the wavelength of a photon and the amount of energy it carries? Explain in
   words and give an equation.

4) What is wrong with the following statement? “If an atom is hit by an x-ray, the atom always absorbs the x-ray
   and the atom’s energy becomes greater.” Give a concise explanation of why this is not true, using what you
   have learned about electron orbitals.