1. What is the Aufbau principle?
   The Aufbau principle is used to determine the electron configuration of an atom, molecule or ion. According to the principle, electrons fill orbitals starting at the lowest available energy states before filling higher energy states.

2. Which lies highest in energy a 3s or 4d subshell?
   4d subshell

3. What is Hund’s rule?
   Hund's rule says that if multiple orbitals of the same energy are available unoccupied orbitals will be filled before a second electron is placed in an occupied orbital.

4. State the Pauli exclusion principal.
   Electrons in the same orbital have opposing spin.

5. Which is more metallic in character Br or F?
   Br

6. How many valence electrons do the following atoms have?
   a. He
   b. Rb
   c. Ba
   d. Ge
   e. Rn
   (a) 2e⁻ (b) 1 e⁻ (c) 2e⁻ (d) 4e⁻ (e) 8e⁻
7. Write the abbreviated electron configuration for the elements in question 6.
   (a) [He] (b) [Kr]5s\(^1\) (c) [Xe]6s\(^2\) (d) [Ar]4s\(^2\)3d\(^{10}\)4p\(^2\) (e) [Rn]

8. Which of the elements in question 6 do you expect to have the highest first ionization energy?
   Ge

8. Which of the elements in question 6 do you expect to have the smallest atomic radii?
   barium or rubidium (its actually barium)

10. Give an example of an element that has:
   a. 1 electron in a s subshell
   b. A half filled p subshell
   c. Belongs to the f block
   d. A completely filled d subshell
   e. Has 5 valence electrons
   f. Has the fourth shell as its valence shell
   g. Is a nonmetal
   h. Is a metalloid
   (a) Na (b) N (c) U (d) Zn (e) N (f) K (g) F (h) Ga

11. Predict the number of electrons that would be gained or lost during ionic bond formation for each of the following elements. In each case give the name of the ion formed.
   a. Element number 35
   b. Rb
   c. P
   (a) 1e\(^-\) gained, bromide ion (b) 1e\(^-\) lost rubidium ion (c) 3e\(^-\) gained phosphide ion
12. Give the formula and name for the binary ionic compound that would form between each of the following pairs of atoms:
   a. Na and Cl
   b. Na and O
   c. Mg and P
   d. Ca and O
   (a) NaCl, sodium chloride  (b) NaO, sodium oxide  (c) Mg₃P₂, magnesium phosphide  (d) CaO, calcium oxide

13. Calculate the formula weight for the ionic compounds predicted to form between the following ions:
   a. Oxide ions and strontium ions
   b. Chloride ions and sodium ions
   c. Sodium ions and sulfide ions
   (a) SrO, FW = 87.62 + 15.9994 = 64.0648 gmol⁻¹
   (b) NaCl, FW = 22.98977 + 35.4527 =  58.44247 gmol⁻¹
   (c) Na₂S, FW = 22.98977 x 2 + 32.066 = 78.04554 gmol⁻¹

14. Give the Lewis structure and identify the molecular geometry (using the appropriate name of the shape) for the following:
   a. Sulfate ion
   b. NH₃
   c. N₂

   (a)
   \[
   \begin{aligned}
   \text{S} & \quad 6e^- \\
   30 & \quad 18e^- \\
   2- & \quad 2e^- \\
   26e^- & \\
   \end{aligned}
   \]

   4 e- regions 0 lone pairs ∴ tetrahedral
15. Name the following binary compounds:
   a. CO$_2$
   b. CO
   c. NO$_2$
   d. N$_2$O$_5$
   e. CS$_2$
   (a) carbon dioxide (b) carbon monoxide (c) nitrogen dioxide (d) dinitrogen pentoxide (e) carbon disulfide

16. Predict if the following will be polar or non-polar
   a. N$_2$
   b. CO
   c. H$_2$O
   (a) non-polar as only two atoms (linear) and both the same
   (b) polar as only two atoms (linear) and are different
   (c) more than two atoms so need to consider shape

   \[
   \begin{array}{cccc}
   & 6e^- & H & O \\
   2H & 2e^- & & H \\
   & 8e^- & & H \\
   \end{array}
   \]

   4e$^-$ regions so the angle between the two outer H atoms will be $109.5^\circ$.

   \[
   \begin{array}{c}
   \delta^+ \\
   H \\
   \delta^-
   \end{array}
   \begin{array}{c}
   \delta^+ \\
   O \\
   \delta^-
   \end{array}
   \begin{array}{c}
   \delta^+ \\
   H \\
   \delta^-
   \end{array}
   \]

   There is a non-symmetrical distribution of outer atoms so H$_2$O is a polar molecule
17. For which of the following covalent compounds will dispersion forces be present?
   a. N₂
   b. H₂
   c. CO₂
   d. NH₃
   e. H₂O

   Dispersion forces will be present for all of the compounds a-e.

18. Predict the charge on the simple ions formed by the following atoms:
   a. Li
   b. Ca
   c. Sr
   d. Rb
   e. Se
   f. Br
   g. O
   h. Ra
   i. I
   j. P

   (a) + (b) 2+ (c) 2+ (d) + (e) 2- (f) – (g) 2- (h) 2+ (i) - (j) 3-

19. Write the Lewis diagrams for the atoms above.
   (a) Li · (b) Ca: (c) Sr: (d) Rb · (e) :Se: (f) :Br: (g) :O: (h) Ra: (i) :I: (j) :P:

20. Write the reaction for the formation of a binary ionic compound formed between the following pairs of atoms.
   a. Li and Cl
   b. Mg and Br
   c. Na and S
   d. Ca and F
   e. Sr and P

   (a) 2Li + Cl₂ → 2LiCl  (b) Mg + Br₂ → MgBr₂  (c) 2Na + S → Na₂S
   (d) Ca + F₂ → CaF₂  (e) 3Sr + 2P → Sr₃P₂
21. What is the product of the reaction between the following pairs of atoms?
   a. Li and O
   b. Mg and S
   c. Mg and P
   d. Sr and I
   (a) Li₂O (b) MgS (c) Mg₃P₂ (d) SrI₂

22. Draw the Lewis structure for the following molecules:
   a. N₂
   b. H₂
   c. O₂
   d. Cl₂

   (a) :N≡N: (b) H-H (c) O=O (d) :Cl-Cl:

23. Determine the geometry of the following.
   a. NO₃⁻
   b. NH₄⁺
   c. CH₄
   d. H₂O
   e. OH⁻
   f. ClO₄⁻
   g. NH₃
   h. O₃
   i. CO₂
   j. SO₂
   (a) trigonal planar (b) tetrahedral (c) tetrahedral (d) bent (e) linear
   (f) tetrahedral (g) trigonal pyramidal (h) bent (i) linear (j) linear
24. Write the name for:
   a. CO₂
   b. NO
   c. NO₂
   d. OH⁻
   e. Cr₂O₇²⁻
   f. ZnCr₂O₇
   g. CuOH
   h. Fe(OH)₃
   i. MgSO₄

   (a) carbon dioxide (b) Nitrogen monoxide (c) carbon dioxide
   (d) hydroxide ion (e) dichromate ion (f) zinc(II) dichromate (g) copper(II)
   hydroxide (h) iron(III) hydroxide (i) magnesium sulfate