Review: Atomic Theory, Bonding and Structure

1. Draw an energy level (box and arrow) diagram for:

   ∴ a) $^{51}_{23}V$ b) $^{32}_{16}S$ c) $^{91}_{40}Zr$

   a) $^{75}_{33}As$ b) $^{59}_{28}Ni$ c) $^{65}_{29}Cu$

2. Write the electronic configuration for: Fe, Fe(2+), Cr, Cu(1+), V(3+)

3. In **chart form**, generate a complete set of quantum numbers for the **last four electrons** in an atom having the electronic configuration: $[Kr]\ 5s^2 4d_1^1 4d_2^1$

4. What are the quantum numbers **n, l and m_l** for each of the orbitals of:
   a) the 5p sublevel   b) the 6d sublevel

5. If one electron has the quantum number n = 4, l = 3, m = +2, s = -1/2 and another electron has the quantum numbers n = 4, l = 3, m = -2, s = +1/2, what are the similarities and differences between the orbitals in which the electrons are found?

6. Consider the following properties of three substances...

Substance	Boiling Point (K)	Electrical Conductivity of solid	Electrical Conductivity of liquid
I	1770	poor	good
II	2220	good	good
III	2630	poor	poor
IV	386	poor	poor

   Identify each substance as a molecular solid, network solid, metal or ionic compound. Briefly justify your choice in terms of structure and bonding for these substances.

7. Neon boils at -245°C while argon boils at -186°C. Explain why these boiling points are both **very low** and why the boiling point of argon is **higher** than that of neon.

8. Examine the following data...

Formula	Molar Mass	Melting Point (°C)
ZnO	81.4	1975
ZnS	97.5	1700
ZnSe	144.4	1100

   Why does the melting point of these compounds **decrease** despite an increase in molar mass?

9. Solid A is a molecular solid and solid B is an ionic solid. Both substances appear as white crystalline solids. Outline **three** methods that you would use to distinguish each solid.

10. Examine the following data for three **hypothetical** elements:

Formula	Molecular Mass (u)	Boiling Point (°C)	Density (g/L) at STP
X_2	30.0	-219.9	1.34
Y_2	92.0	-178.4	4.11
Z_2	138.0	-96.7	6.16

   a) **Describe** and **explain** the relationships between molecular mass and boiling point.
   b) Why does the density increase as you go down the chart **despite** the increase in molecular **size**?