Note 1: You will need to do a little research (*web*, library, or other) to answer some of these questions. If you use a search engine, this will also give you experience in assessing the credibility of different sources. Note 2. The marks shown are a guide to valuation on an exam. Some study set questions may reappear in an exam.

1. **(5 points)** What raw materials are used to produce metallic sodium and potassium? Given that these elements belong to the same family, one might expect them to be produced by a common pathway. As they are not, explain how and why they differ.

2. **(5 points)** Copper metal is produced via smelting, but highly pure copper is obtained via an additional electro-refining step. Outline the electro-refining step and explain why it is only used to produce the purest of materials.

3. **(5 points)** Outline a straightforward experiment you could perform to probe the theory that the electronic structure of atoms is quantized.

4. **(5 points)** How do the 1s orbitals of He atoms differ from those of Ti? How are they similar?

5. **(10 points)** Using a consistent relative scale, sketch the radial probability distribution function (as a function of r, distance from the nuclear center) for all atomic orbitals with the principal quantum number = 4. Label the figures. Explain how they are relevant to the concept of shielding.

6. **(10 points)** Use Slater’s rules to determine the effective charge on the outermost electron for Ru, Pd, and Sn. What general trend in effective nuclear charge does this illustrate? What might this suggest about metal reactivity?