1 a) Why is “helium” called helium? When and where was it first detected?
1 b) Why is “titanium” called titanium? When and where was it first detected?

2) Show for the body-centered cubic crystal structure that the unit cell edge length $a$ and the atomic radius $R$ are related through $a = \frac{4R}{(3)^{1/2}}$.

3) Show that the atomic packing factor for HCP is 0.74.

4) Iron has a BCC crystal structure, an atomic radius of 0.124 nm, and an atomic weight of 55.85 g/mol. Determine the theoretical density. How does it compare with the experimentally determined value of 7.87 g/cm$^3$? The theoretical density is close to experimental, but measurably different. What conclusion do you reach from this?

5) What are the point coordinates for all atoms in the following crystal structures’ unit cells (don’t forget to include appropriate sketches):
   a) FCC
   b) BCC

6) Within a cubic unit cell, sketch the following directions:
   (a) $[1 -1 0]$, (b) $[1 2 1]$, (c) $[0 2 1]$, (d) $[0 1 0]$

7) Determine the indices for the following directions in the cubic unit cell (for 3D visualization, assume both ends of the arrows are on the edge of the unit cell shown):

   (a) ![Diagram](image1)
   (b) ![Diagram](image2)
   (c) ![Diagram](image3)
   (d) ![Diagram](image4)