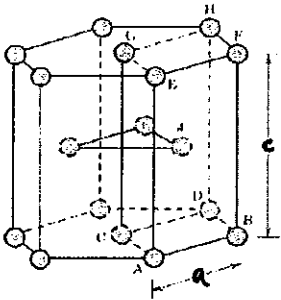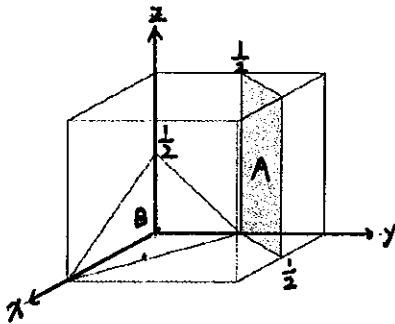1. This is a HCP crystal structure. Please calculate that the ideal c/a ratio. (10)


2. Please determine the miller index of A and B plane sin following figure. (10)

3. Consider a single crystal of BCC iron oriented such that a tensile stress (σ) is applied along a [010] direction.
   (a) Please identify the slip plane when the material is under such tensile stress. (5)
   (b) Please identify the slip direction (use miller index) when the material is under such tensile stress. (5)
   (c) If the angle between the slip direction and σ is λ, and the angle between the slip plane and σ is Φ, calculate λ and Φ. (10)
   (d) Calculate the resolved shear stress, τ, if σ is 52 MPa. (10)

4. This is an x-ray diffraction pattern (XRD) showing the diffracted peaks and their corresponding crystallographic planes in a cubic structure.
   (a) Explain why (200) plane's peak appears at a higher angle than (110) plane's peak? (10)
   (b) Similarly, why (211) plane's peak appears at a higher angle than (200) plane's peak? (10)
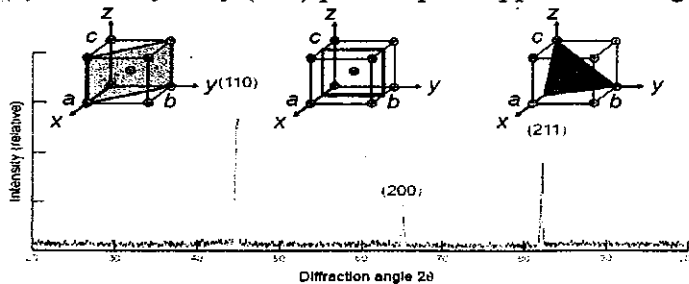
5. Please draw specific volume vs temperature for a glass material, by properly labeling T_g (glass transition temperature), T_m (melting temperature), and the regions of liquid, supercooled liquid, glass, crystalline. (10)

6. For a Fe-C system, assume the eutectoid temperature is 727°C, draw the isothermal transform diagram by properly labeling the regions of Austenite, Perlite, Bainite, and Martensite. Please draw the diagram using three lines with 0%, 50% and 100% transformation. (10)

7. Write down five types of magnetic materials (10)