Metallurgy Assignment

SAURABH KUMAR
SC22B146
Batch - II

① Why should HCP metals have lower ductility compared to FCC?

Ans: HCP metals generally exhibit lower ductility compared to FCC metals due to their inherent crystal structure and the nature of dislocation movement within the lattice.

Crystal Structure: The HCP structure has a close-packed arrangement of atoms along two of its crystallographic directions, while the third direction has a looser packing. This anisotropic arrangement makes it more difficult for dislocations to move uniformly throughout the lattice, limiting the ductility of HCP metals.

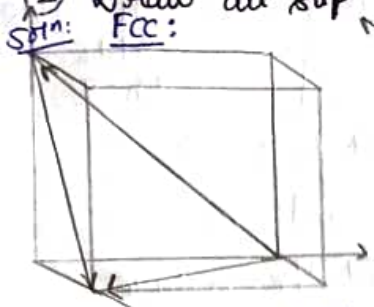
Slip Systems: FCC metals have multiple slip systems due to their cubic symmetry, which enables dislocations to propagate and glide more easily along different crystallographic planes and directions. This greater ~~ability~~ availability of slip systems allow FCC metals to deform more readily and exhibit ductility. In contrast, HCP metals have fewer slip systems, restricting the movement of dislocations and reducing their ductility.

Stacking Faults: HCP metals have stacking faults due to their crystal structure having alternating close-~~plo~~packed layers. This can hinder dislocation motion and lead to the formation of deformation twins, which are planar defects within the crystal lattice. These twins can act as barriers to dislocation movement, further limiting the ductility of HCP metals.

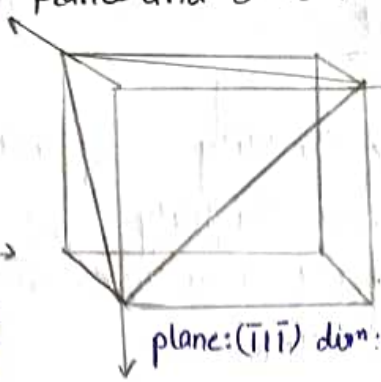
Shear Deformation: HCP metals primarily deform through shear mechanisms, whereas FCC metals can undergo both shear and deformation through multiple slip systems. Shear deformation in HCP metals is less homogeneous and more localised, making it more susceptible to localised strain concentration and fracture, thereby reducing their ovall ductility.

② Draw all slip planes and directions of Fcc and Bcc.

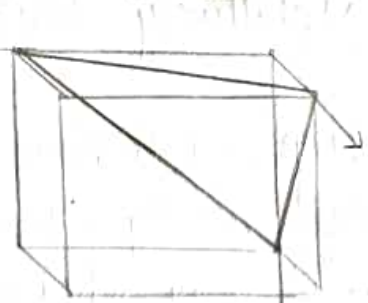
Soln: Fcc:



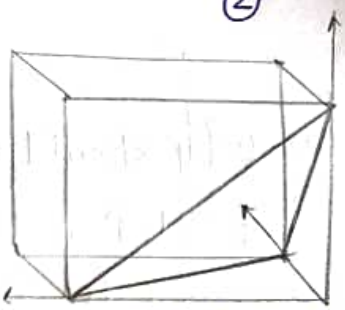
plane: (111) → dirn: $[10\bar{1}]$ $[0\bar{1}1]$ $[1\bar{1}0]$



plane: $(\bar{1}1\bar{1})$ dirn: $[110]$ $[10\bar{1}]$ $[01\bar{1}]$

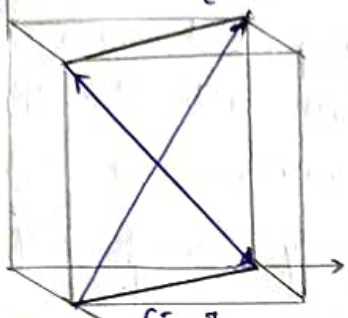


plane: $(1\bar{1}\bar{1})$ dirn: $[110]$ $[10\bar{1}]$ $[01\bar{1}]$

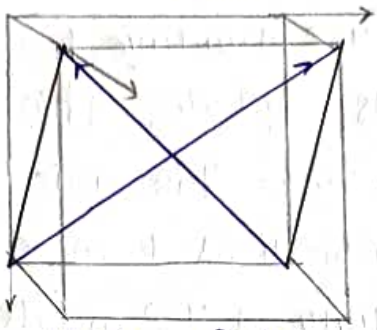


plane: $(\bar{1}\bar{1}1)$ dirn: $[011]$ $[01\bar{1}]$ $[1\bar{1}0]$

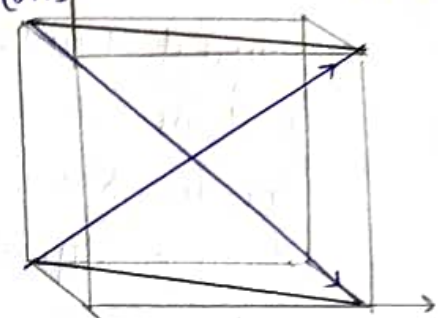
Bcc:



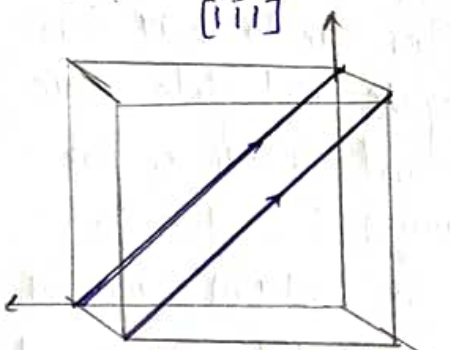
(110) → $[\bar{1}11]$ $[1\bar{1}1]$



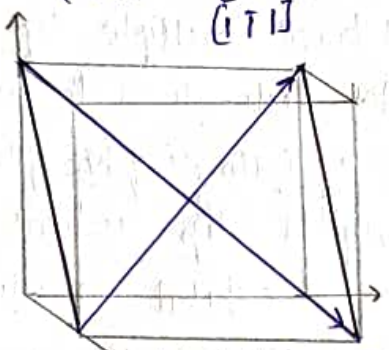
$(10\bar{1})$ $[111]$ $[1\bar{1}1]$



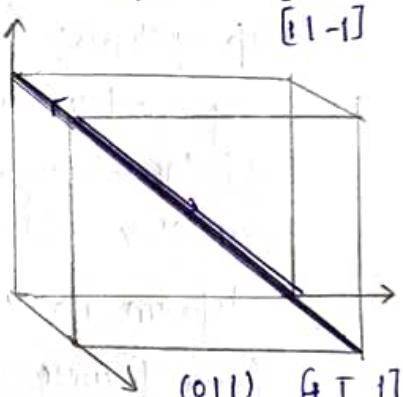
$(\bar{1}10)$ $[111]$ $[1\bar{1}\bar{1}]$



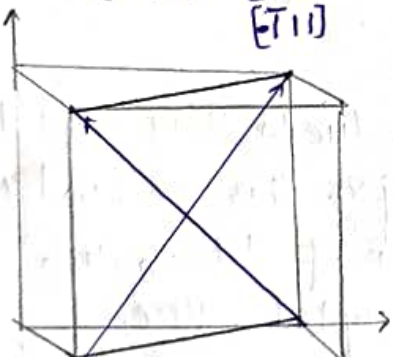
$(0\bar{1}1)$ $[111]$ $[\bar{1}11]$



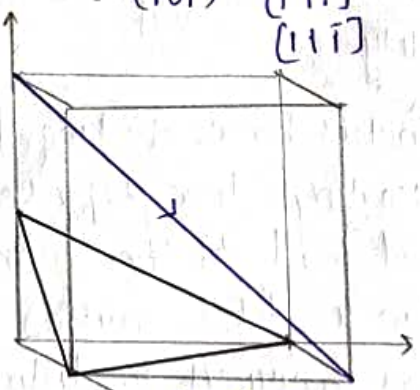
(101) $[\bar{1}11]$ $[11\bar{1}]$



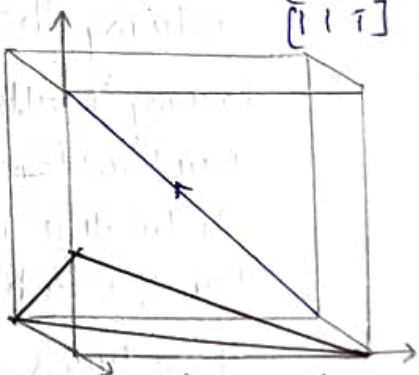
(011) $[\bar{1}\bar{1}1]$ $[1\bar{1}1]$



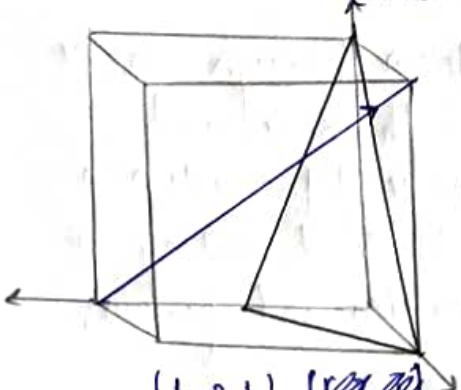
(110) $[\bar{1}11]$ $[1\bar{1}1]$



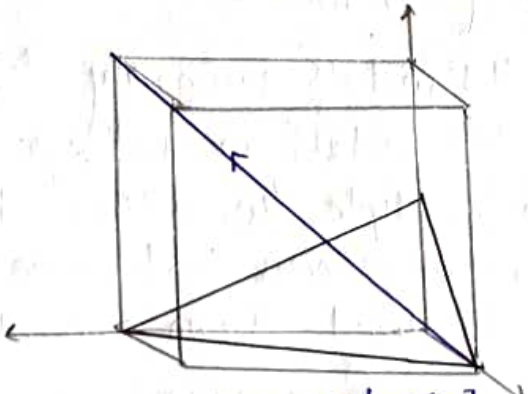
(112) $[1\bar{1}1]$



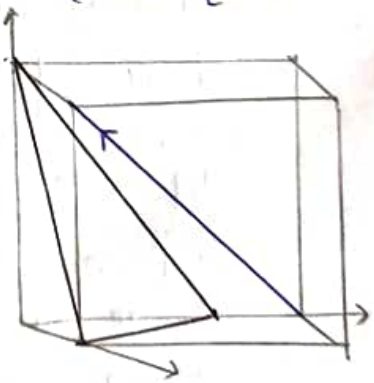
$(\bar{1}12)$ $[1\bar{1}1]$



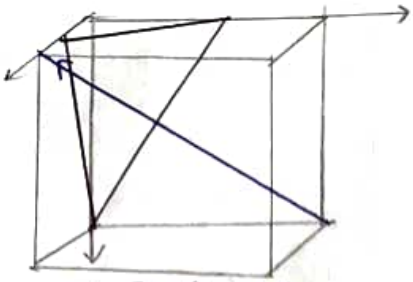
$(1\bar{2}1)$ $[111]$



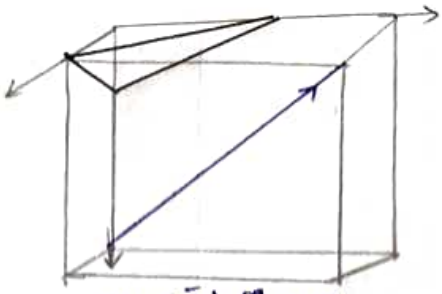
$(1\bar{1}2)$ $[\bar{1}11]$



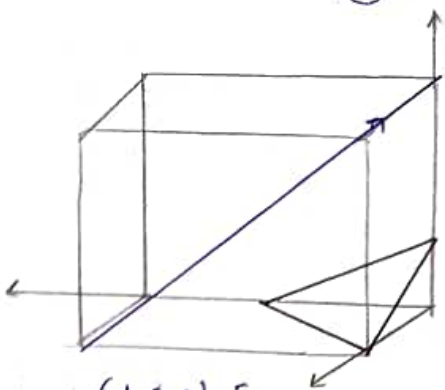
(121) $[1\bar{1}1]$



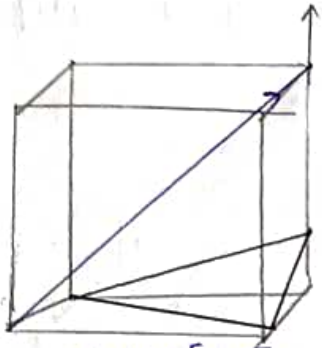
[11 $\bar{1}$] (3-21)



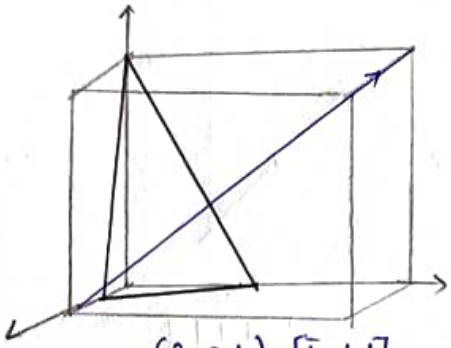
(1 • 2 $\bar{3}$) [$\bar{1}$ 11]



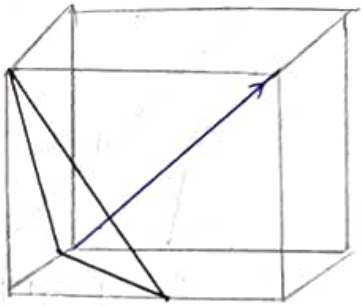
(1-23) [$\bar{1}$ 11]



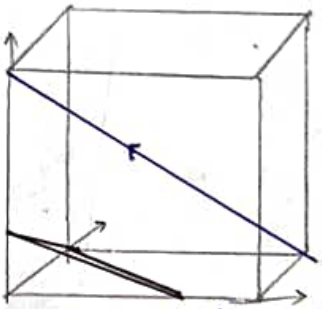
(2-13) [$\bar{1}$ 1$\bar{1}$]



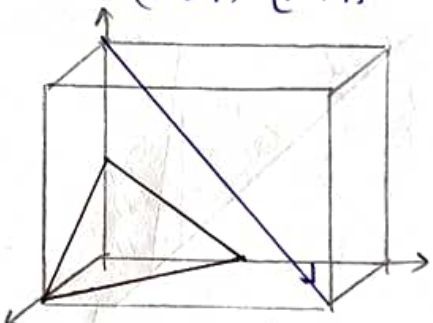
(3 21) [$\bar{1}$ 11]



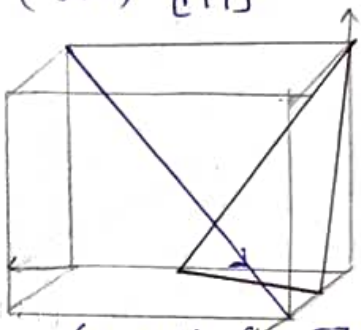
(-321) [111]



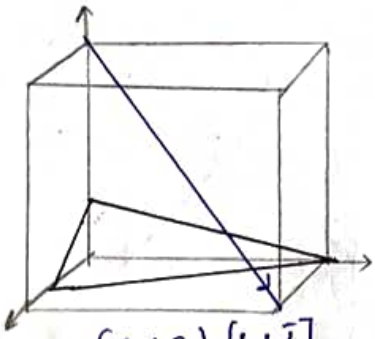
(-1 23) [1 $\bar{1}$ 1]



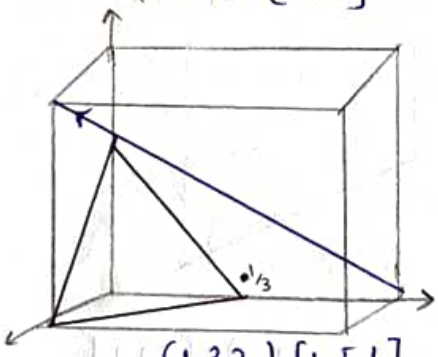
(123) [11 $\bar{1}$]



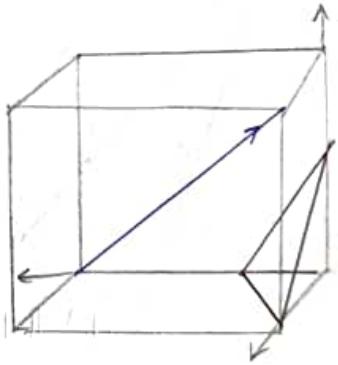
(3 -21) [1 1 $\bar{1}$]

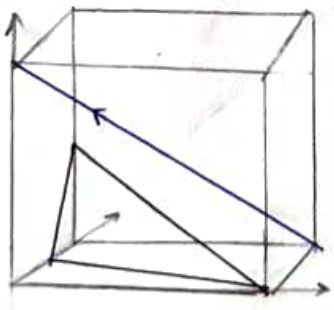


(213) [11 $\bar{1}$]

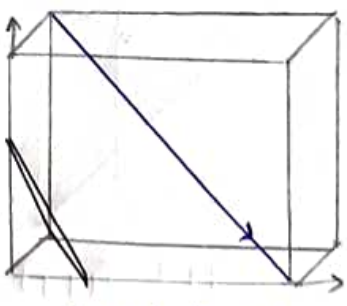


(132) [1 $\bar{1}$ 1]

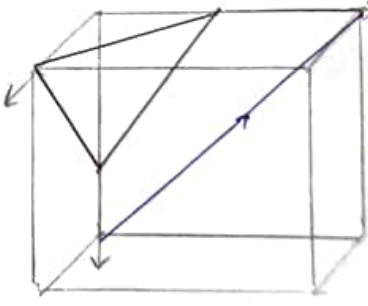




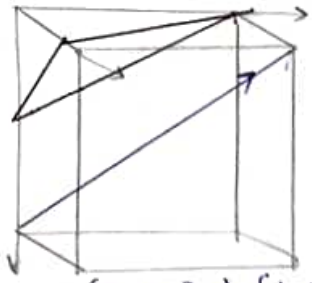
(-2 13) [1 $\bar{1}$ 1]



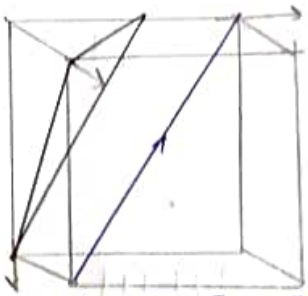
(-132) [11 $\bar{1}$]



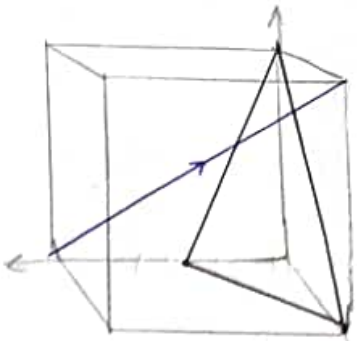
(13-2) [$\bar{1}$ 11]



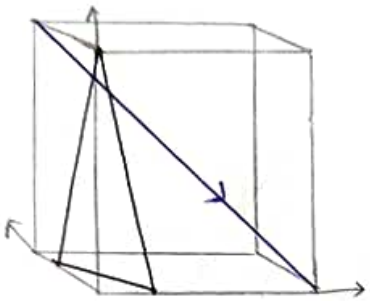
(2 1 -3) [1 1 2]



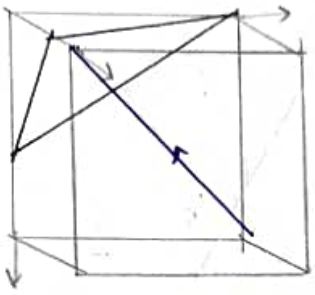
(1 2 -1) [$\bar{1}$ 1 1]



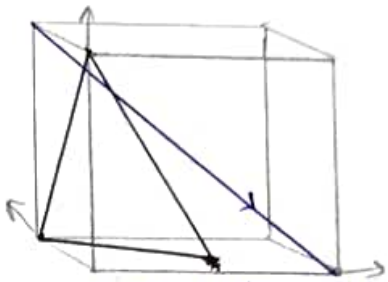
(1 -2 1) [1 1 1]



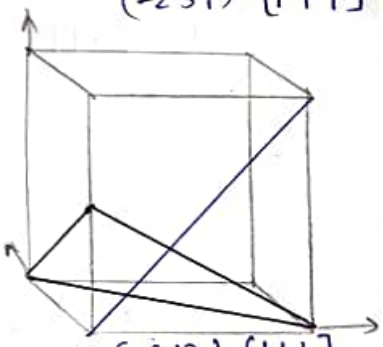
(-2 3 1) [1 $\bar{1}$ $\bar{1}$]



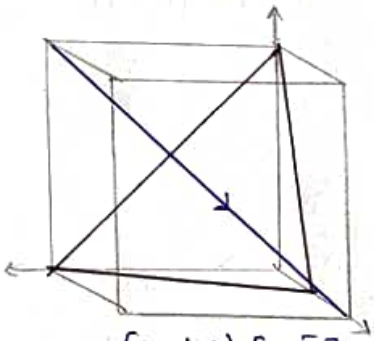
(3 1 2) [1 $\bar{1}$ 1]



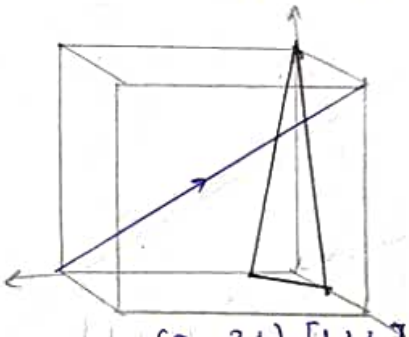
(-1 2 1) [1 1 $\bar{1}$]



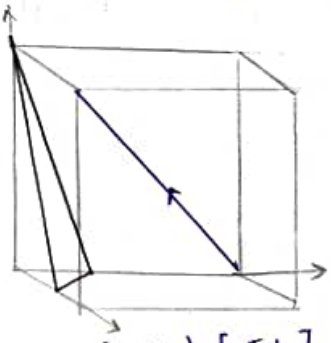
(-3 1 2) [1 1 1]



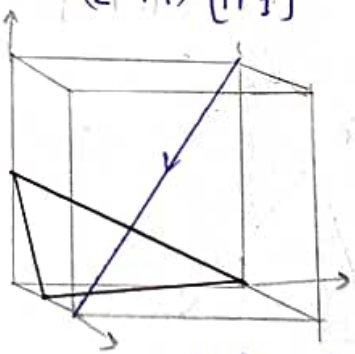
(2 -1 1) [1 1 $\bar{1}$]



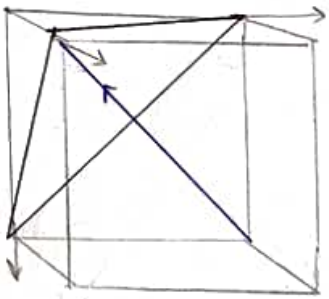
(2 -3 1) [1 1 1]



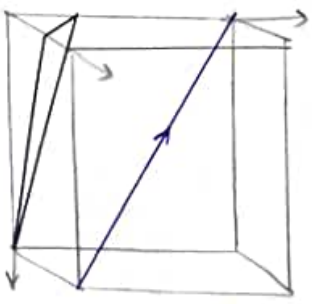
(2 3 1) [1 $\bar{1}$ 1]



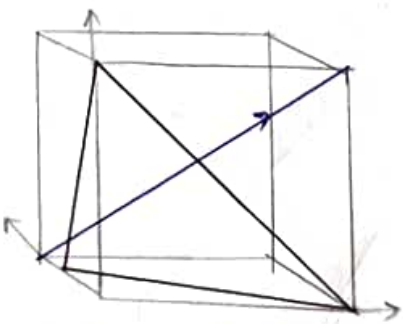
(3 1 2) [-1 1 1]



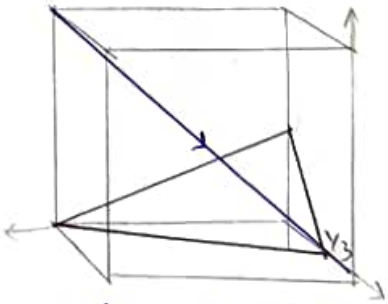
(2 1 -1) [1 $\bar{1}$ 1]



(2 3 -1) [$\bar{1}$ 1 1]



(-2 1 1) [1 1 1]



(3 -1 2) [1 1 1]