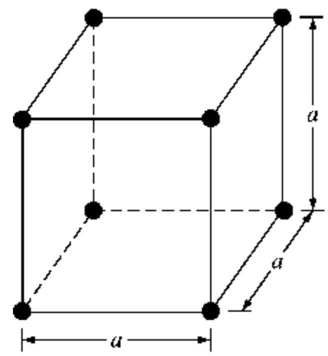
1.18 The lattice constant of a simple cubic primitive cell is 5.28 Å. Determine the distance between the nearest parallel (*a*) (100), (*b*) (110), and (*c*) (111) planes.



simple cubic lattice in 3D

a) (1 0 0) is the front face of the cube.

Method 1 By inspection, the nearest parallel plane is at a distance $\Rightarrow$ ***d = a = 5.28 Å***.

Method 2 Per https://en.wikipedia.org/wiki/Miller_index, the distance between planes defined by Miller indices (*h k l*) for **cubic lattices** w/ lattice constant *a* is

$$d_{(h\ k\ l)} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}. \text{ So, } d_{(1\ 0\ 0)} = \frac{a}{\sqrt{1^2 + 0^2 + 0^2}} = \frac{a}{\sqrt{1}} = \frac{5.28}{\sqrt{1}} \Rightarrow \mathbf{d_{(1\,0\,0)} = 3.87\ Å.}$$

b)

Method 1 (1 1 0) is a plane going from side diagonal (back left) to side (front right) diagonal on the cube. Therefore, the nearest parallel plane is half the diagonal distance *d* from corner to corner on a side of the cube

$$d = \sqrt{a^2 + a^2} = \sqrt{2}a = \sqrt{2}(5.28) = 7.467 \Rightarrow \mathbf{d/2 = 3.7335\ Å.}$$

Method 2 $$d_{(1\ 1\ 0)} = \frac{a}{\sqrt{1^2 + 1^2 + 0^2}} = \frac{a}{\sqrt{2}} = \frac{5.28}{\sqrt{2}} \Rightarrow \mathbf{d_{(1\,1\,0)} = 3.7335\ Å.}$$

c)

Method 1 (1 1 1) is a plane going through the back left top, front left bottom, & back right bottom corners on the cube. Therefore, the nearest parallel plane is a third of the diagonal distance *d* from corner to corner of the cube

$$d = \sqrt{a^2 + a^2 + a^2} = \sqrt{3}a = \sqrt{3}(5.28) = 9.1452 \Rightarrow \mathbf{d/3 = 3.0484\ Å.}$$

Method 2 $$d_{(1\ 1\ 1)} = \frac{a}{\sqrt{1^2 + 1^2 + 1^2}} = \frac{a}{\sqrt{3}} = \frac{5.28}{\sqrt{3}} \Rightarrow \mathbf{d_{(1\,1\,1)} = 3.048\ Å.}$$