Homework 2

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1. (a) We begin by calculating the inter-planar spacing as:

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$
$$d_{110} = \frac{.2866}{\sqrt{1 + 1 + 0}}$$
$$\boxed{d_{110} = .2027[\text{nm}]}$$

We may write Bragg's law as:

$$n\lambda = 2d\sin(\theta)$$

We take $n \to 1$ since we are interested in the first diffraction angle. This gives us:

$$(.154) = 2(.2027)\sin(\theta)$$
$$2\theta_{110} = 2\sin^{-1}\left(\frac{.154}{2(.2027)}\right)$$
$$\boxed{2\theta_{110} = 44.65^\circ}$$

We repeat this process for the other two planes:

$$d_{200} = \frac{.2866}{\sqrt{4 + 0 + 0}}$$
$$\boxed{d_{200} = .1433}$$

$$d_{211} = \frac{.2866}{\sqrt{4 + 1 + 1}}$$
$$\boxed{d_{211} = .117}$$

We then calculate the angles:

$$2\theta_{200} = 2\sin^{-1}\left(\frac{.154}{2(.1433)}\right)$$

$$\boxed{2\theta_{200} = 65^\circ}$$

$$2\theta_{211} = 2\sin^{-1}\left(\frac{.154}{2(.117)}\right)$$

$$\boxed{2\theta_{211} = 82.31^\circ}$$

(b)

(c)

2. (a) Given such intersections, we may find the Miller indices to be:

$$h = a\left(\frac{1}{a}\right) \quad k = a\left(\frac{2}{a}\right) \quad l = a(0)$$

This gives us Miller Indices of:

$$\boxed{(120)}$$

(b) Symmetry-equivalent planes have Miller Indices whose values create the same inter-planar spacing. This can be found by finding the scale factor for the Miller Indices from part (a):

$$\sqrt{1^2 + 2^2 + 0} = \sqrt{5}$$

We then find symmetry-equivalent planes to be those which have this same scale factor. Thus, we may find that the following are symmetry-equivalent:

$$\boxed{(210), (201), (102), (021), (012)}$$

(c)

3. (a)

(b)

(c)

4. (a)

(b)

(c)