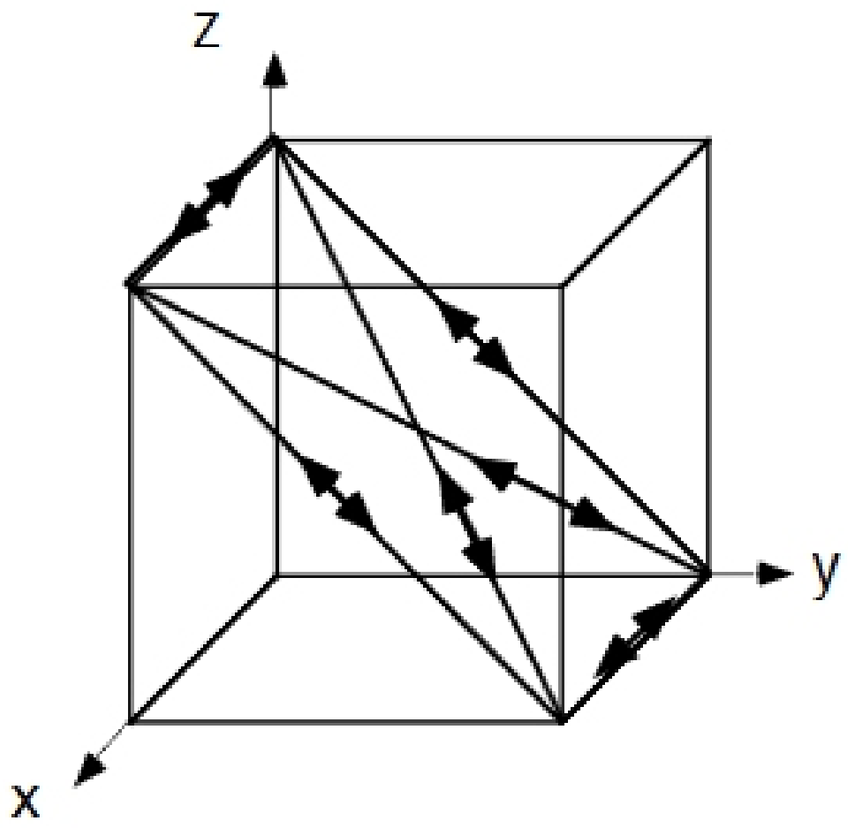
MSE 230 Assignment 3 Solutions Fall 2013

1)



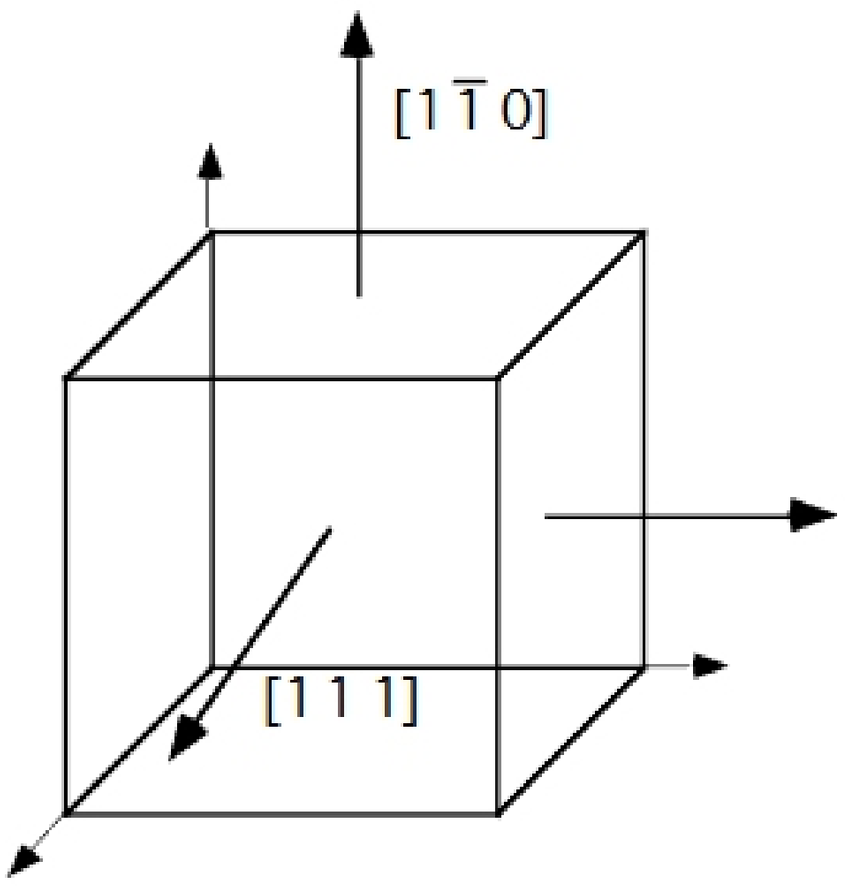
[1 0 0] [0 1 $\bar{1}$] [$\bar{1}$ $\bar{1}$ 1]

[$\bar{1}$ 0 0] [0 $\bar{1}$ 1] [1 1 $\bar{1}$]

[1 $\bar{1}$ 1]

[$\bar{1}$ 1 $\bar{1}$]

2)

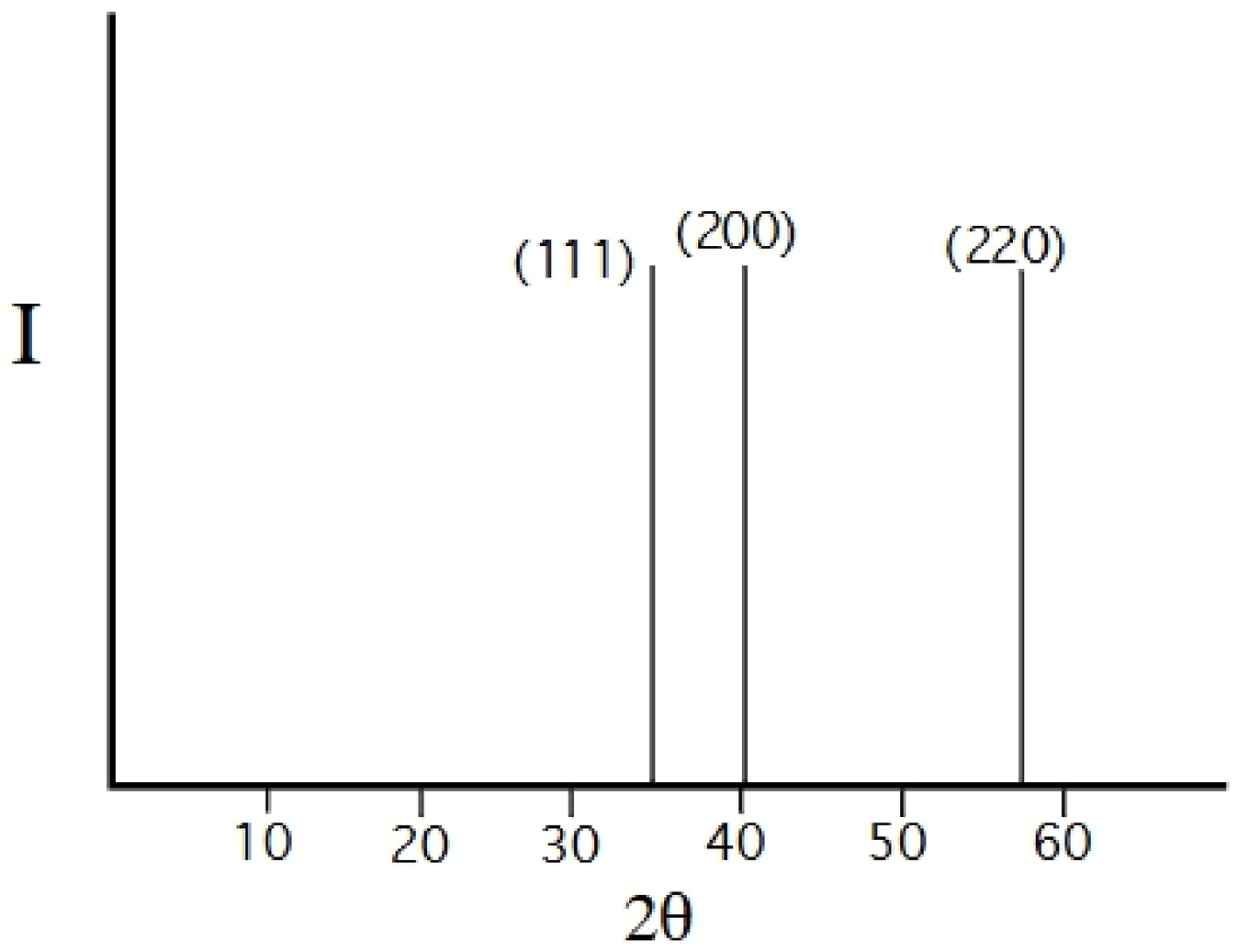


Cross product

[1 $\bar{1}$ 0] X [1 1 1] = [$\bar{1}$ $\bar{1}$ 2]

3) $d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$ $0.15\,\text{nm} < \frac{0.45\,\text{nm}}{\sqrt{h^2+k^2+l^2}} \rightarrow \sqrt{h^2+k^2+l^2} \leq 3$

Plane	$\sqrt{h^2+k^2+l^2}$	FCC/h,k,l = all odd, all even?	d(nm)	2θ from $n\lambda = 2d\sin\theta$
100	1	No		
110	$\sqrt{2}$	No		
111	$\sqrt{3}$	Yes	0.26	34.5
200	2	Yes	0.225	40.0
210	$\sqrt{5}$	No		
211	$\sqrt{6}$	No		
220	$\sqrt{8}$	Yes	0.16	57.9
300	$\sqrt{9}$	No		
221	too large, >3			



4. a) Thermal expansion during heating increases the d-spacing between planes of atoms. Referring to Bragg's law, $\lambda=2d\sin\theta$, increasing d decreases $\sin\theta$. This will cause the x-ray peaks to shift to slightly lower values of 2θ.

b) When $T>T_m$ iron melts to form a liquid (T_m(iron)=1538°C). Liquids are amorphous (no long range order), and long range ordering is required to form sharp peaks.