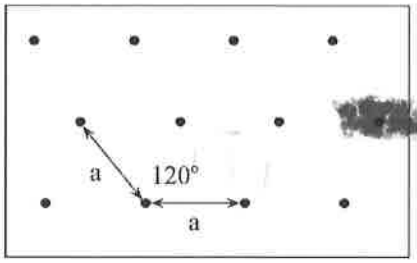
Week 2 - Crystal Structure
Comprehension Check
Total points = 25 (scaled by a factor of 1/10 in the system)

Question 1 (5 points)



Describe the hexagonal structure shown here by choice of lattice vectors and basis. Use Cartesian coordinates.

$a_1 = a\,(1, 0)$

$a_2 = a\,(-1/2, \sqrt{3}/2)$

atom (a) $(0, 0)$

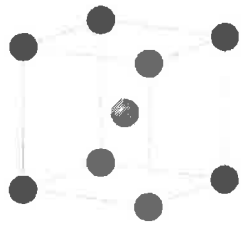
Question 2 (5 points)

Calculate the packing fraction for the simple cubic lattice.

1 atom / cube

$$P.F. = \frac{\frac{4}{3}\pi r^3}{a^3} \quad \text{and} \quad a = 2r \Rightarrow P.F. = \pi/6$$

Question 3 (6 points)



The cubic structure shown here has an edge length a; The spheres at the cube corners are dark in color; The sphere at cube center is light in color.

(a) Describe the structure by choice of lattice vectors and basis. Use Cartesian coordinates.

(b) What lattice sub-system within the cubic lattice does this structure belong to?

(a) $a_1 = a\,(1, 0, 0)$

$a_2 = a\,(0, 1, 0)$

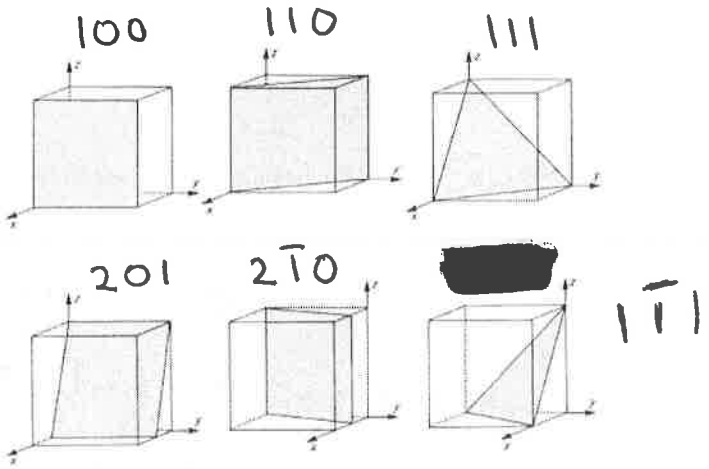
$a_3 = a\,(0, 0, 1)$

atom #1 a) $(0, 0, 0)$

atom #2 a) $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

(b) simple cubic

Question 4 (9 points)



The cube edge is 1. Identify the Miller indices for each of the 6 plane highlighted here.