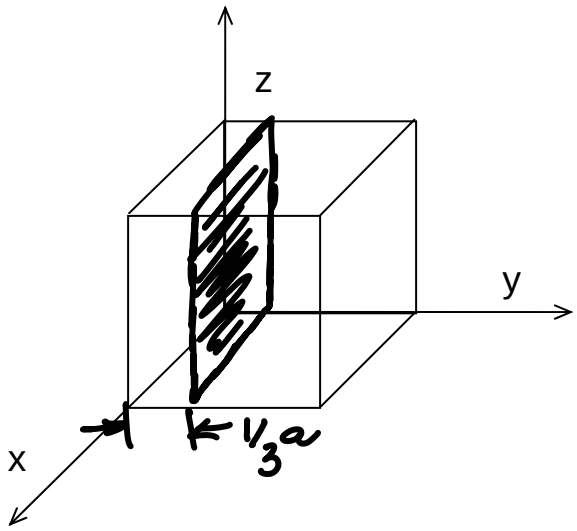
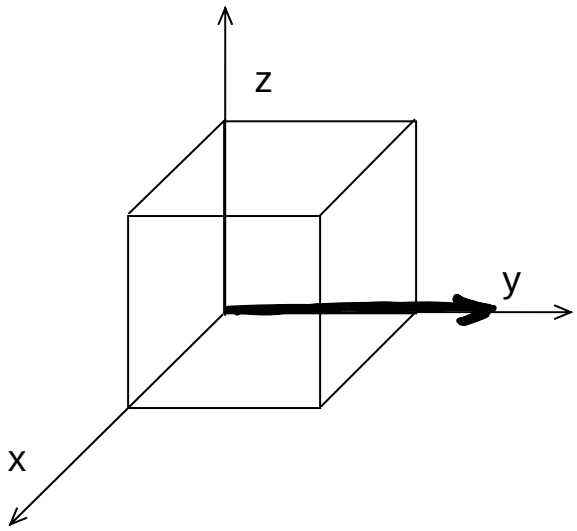
3.091 Fall Term 2004

Homework Quiz #6A

solution outline

(a) (i) In the cubic unit cell below sketch (030). (ii) In the cubic unit cell below sketch [030].





(b) Calculate the density of atoms in (011) in iridium (Ir). Express your answer in units of *atoms/cm*^{2}.

Ir is FCC. (011) is the cube diagonal, a rectangular area of $a \times 2^{½}a$. There are atoms at the four corners of the rectangle which are shared with adjacent unit cells; only ¼ of the area of each corner atom lies within the rectangle. In addition, there are atoms along each of the long sides of the rectangle (these are the atoms at the center of the upper and lower faces); only ½ of the area of each side atom lies within the rectangle. So the total number of atoms per rectangle can be expressed as $(4 \times ¼) + (2 \times ½) = 2$.

To get the value of the lattice constant *a*, we use the relationship between the number of atoms in the unit cell and the number of atoms in a molar volume:

$$\frac{4\ atoms}{a^3} = \frac{N_{Av}}{V_{molar}}, \quad \therefore \quad a = \left(\frac{4\,V_{molar}}{N_{Av}}\right)^{1/3}$$

So now the atom area density is $2/(2^{½}a^2) =$

$$\frac{2}{2^{1/2}\left\{\left(\frac{4\,V_{molar}}{N_{Av}}\right)^{1/3}\right\}^2} = \frac{2}{2^{1/2}\left(\frac{4\times 8.49}{6.02\times 10^{23}}\right)^{2/3}} = 9.61\times 10^{14}\ atoms/cm^2$$