1

In Callister's book two polymorphs of tin are described. Look up the lattice parameters for each polymorph. Also, determine the number atoms in the unit cell of each polymorph.

✓ **Answer**

α-tin

- Diamond Cube
- $a = 6.489 \mathring{A}$
- Density: $5.77 \frac{g}{cm^3}$

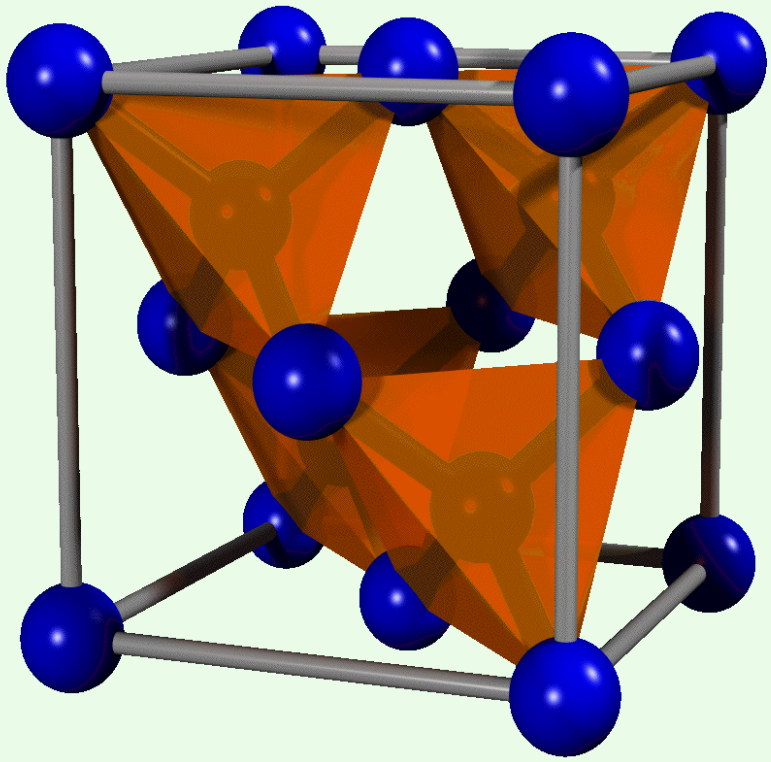
β-tin

- Body Centered Tetragonal
- $a = 5.831 \mathring{A}$
- $c = 3.181 \mathring{A}$
- Density: $7.29 \frac{g}{cm^3}$

2

Determine if an atom is located at the 1⁄4 1⁄4 1⁄4 position in the unit cell of diamond.

✓ **Answer**



If you look at the atom located at the bottom right of the image, moving 1/4 left, 1/4 back and 1/4 up would get you an atom which is directly adjacent to it. Therefore there is an atom at that position.

3

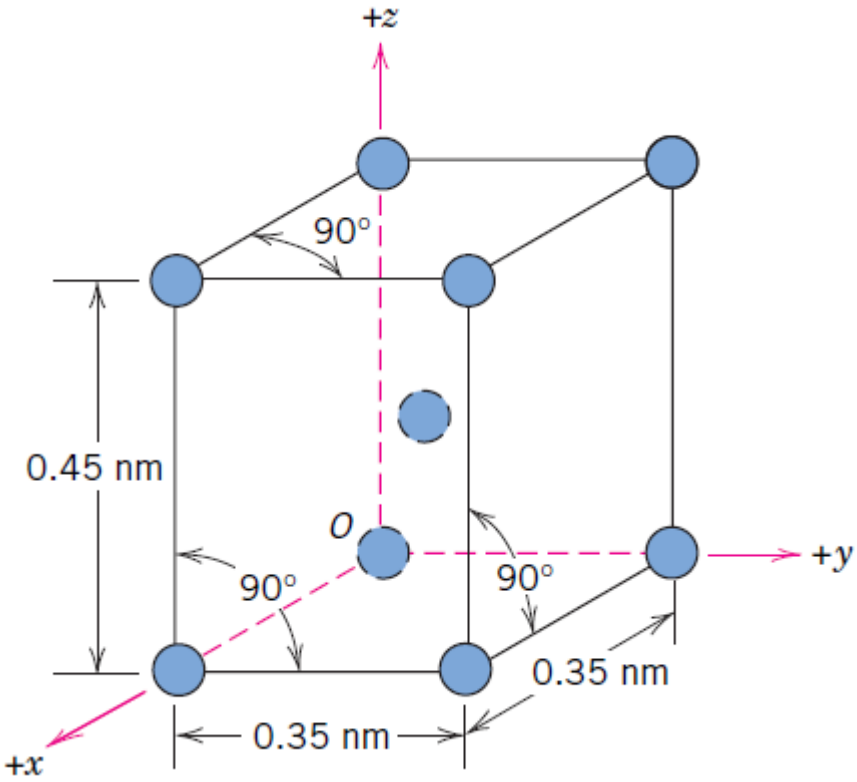
Summarize a web article a National Renewable Energy Laboratory (NREL) project that involves studying a material with the perovskite crystal structure.

✓ **Answer**

The structure of the perovskite crystal allows more light to enter the photovoltaic elements, which increases the efficiency of the panels. This is because the structure itself is thinner.

4

The accompanying figure shows a unit cell for a hypothetical metal.



a

To which crystal system does this unit cell belong?

✓ **Answer**

$a = b \neq c$
$\alpha = \beta = \gamma$
Tetragonal crystal system

b

What would this crystal structure be called?

✓ **Answer**

Body centered Tetragonal

c

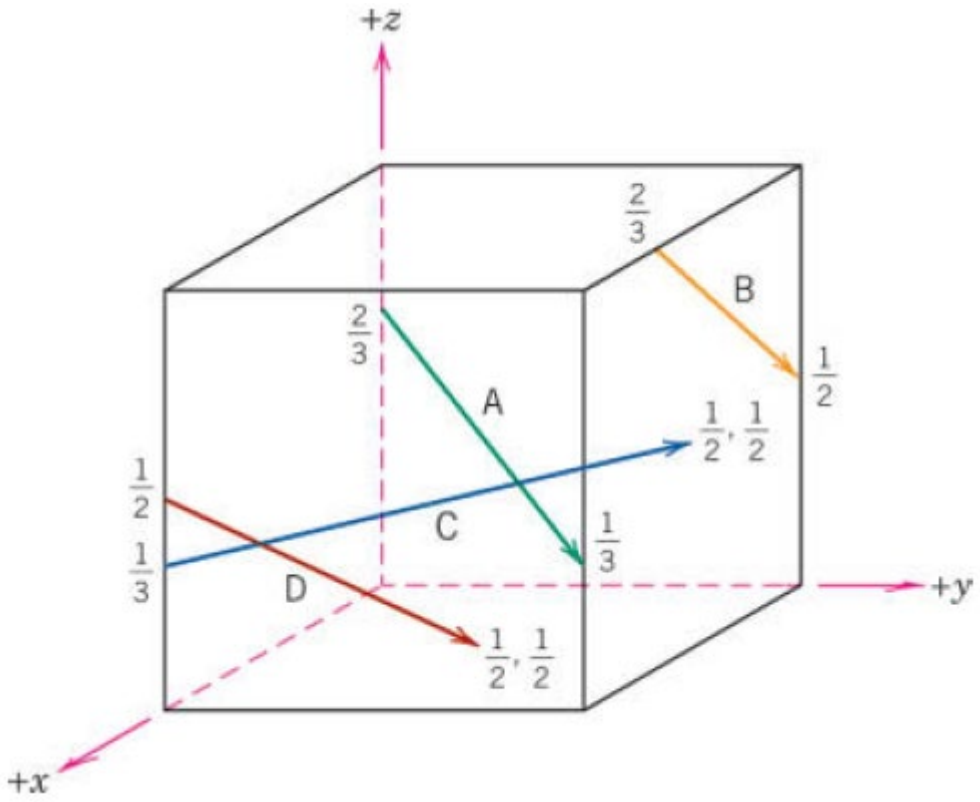
Calculate the density of the material, given that its atomic weight is 141 g/mol.

✓ **Answer**

$$\rho = \frac{nA}{V_c N_A}$$
$$\rho = \frac{2\left(141 \frac{g}{mol}\right)}{(3.5\times10^{-8})^2(4.5\times10^{-8})6.022\times10^{-23}}$$
$$\rho = 8.49 \frac{g}{cm^3}$$

5

Determine the indices for the directions shown in the cubic unit cell shown



✓ **Answer**

$$A: \left[1\ 1\ \frac{-1}{3}\right] = \left[3\ 3\ \bar{1}\right]$$
$$B: \left[\frac{-2}{3}\ 0\ \frac{-1}{2}\right] = \left[\bar{4}\ 0\ \bar{3}\right]$$
$$C: \left[\frac{-1}{2}\ 1\ \frac{1}{6}\right] = \left[\bar{3}\ 6\ 1\right]$$
$$D: \left[\frac{-1}{2}\ \frac{1}{2}\ \frac{-1}{2}\right] = \left[\bar{1}\ 1\ \bar{1}\right]$$