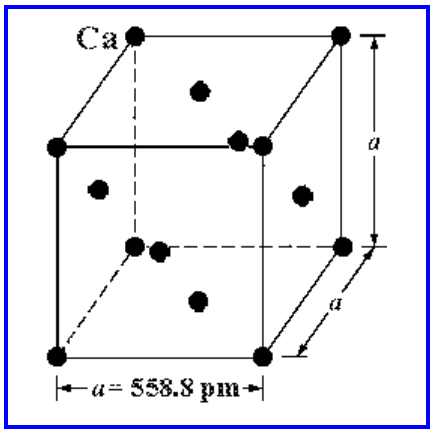
For room temperature calcium in its crystal state, determine/calculate: a) Bravais lattice type, b) lattice constant(s), c) sketch primitive unit cell, d) atomic volume density, e) atomic surface density for top face, f) standard atomic weight, and g) mass density (How does your calculated value compare with accepted measured value?). Hint: Use Wikipedia as a resource.

From https://en.wikipedia.org/wiki/Calcium-

a) Calcium has a Bravais lattice type of **face-centered cubic (fcc).**

b) Calcium lattice constant is $\Rightarrow$ $\mathbf{a = 558.8\ pm = 5.588\ Å}$

c)



d) # atoms/unit cell = 8 corners (1/8 atoms/corner) + 6 faces (1/2 atoms/face) = 1 + 3 = 4

avd = (# atoms/unit cell)/volume = $4/a^3 = 4/(558.8\times10^{-12}\ \text{m})^3 = 2.2924\times10^{28}\ \text{atoms/m}^3$

$\Rightarrow$ $\mathbf{avd_{Ca} = 2.292\times10^{22}\ atoms/cm^3}$

e) # atoms/top = 4 corners (1/4 atom/corner) + 1 face (1 atom/face) = 1 + 1 = 2

asd = (# atoms/unit cell)/area = $2/a^2 = 2/(558.8\times10^{-12}\ \text{m})^2 = 6.40497\times10^{18}\ \text{atoms/m}^2$

$\Rightarrow$ $\mathbf{asd_{Ca} = 6.405\times10^{14}\ atoms/cm^2}$

f) From https://en.wikipedia.org/wiki/Calcium, the atomic weight A_r of calcium is

$\Rightarrow$ $\mathbf{A_{r,Ca} = 40.078}$

g) The mass density md of calcium is

$md_{Ca} = (avd_{Ca})\ (A_{r,Ca})\ /\ N_A = 2.2924\times10^{22}\ \text{atoms/cm}^3\ (40.078)/\ 6.02214076\times10^{23}$

$\Rightarrow$ $\mathbf{md_{Ca} = 1.5256\ g/cm^3}$

From https://en.wikipedia.org/wiki/Calcium, the mass density is 1.526 g/cm^3. Excellent agreement.