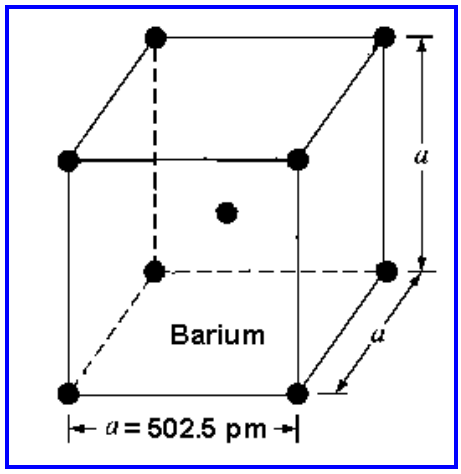
For room temperature barium in its crystal state, determine/calculate: a) Bravais lattice type, b) lattice constant(s), c) sketch primitive unit cell, d) atomic volume density, e) atomic surface density for top face, f) standard atomic weight, and g) mass density (How does your calculated value compare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

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

a) Barium has a Bravais lattice type of **body-centered cubic (bcc).**

b) Barium lattice constant is $\Rightarrow$ $\mathbf{a = 502.5\ pm = 5.025\ Å}$

c)



d) # atoms/unit cell = 8 corners (1/8 atoms/corner) + 1 atom in center = 1 + 1 = 2

avd = (# atoms/unit cell)/volume = $2/a^3 = 2/(502.5\times10^{-12}\ \text{m})^3 = 1.5762 \times 10^{28}\ \text{atoms/m}^3$

$\Rightarrow$ $\mathbf{avd_{Ba} = 1.576 \times 10^{22}\ atoms/cm^3}$

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

asd = (# atoms/unit cell)/area = $1/a^2 = 1/(502.5\times10^{-12}\ \text{m})^2 = 3.9603 \times 10^{18}\ \text{atoms/m}^2$

$\Rightarrow$ $\mathbf{asd_{Ba} = 3.960 \times 10^{14}\ atoms/cm^2}$

f) From https://en.wikipedia.org/wiki/Barium, the atomic mass A_r of barium is

$\Rightarrow$ $\mathbf{A_{r,Ba} = 137.327}$

g) The mass density md of barium is

$md_{Ba} = (avd_{Ba})\ (A_{r,Ba}) / N_A = 1.5762 \times 10^{22}\ \text{atoms/cm}^3\ (137.327)/\ 6.02214076 \times 10^{23}$

$\Rightarrow$ $\mathbf{md_{Ba} = 3.5944\ g/cm^3}$

From https://en.wikipedia.org/wiki/Barium, the mass density is 3.594 g/cm^3. Excellent agreement!