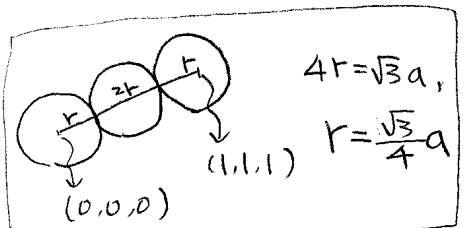
PHY 140 A HW 1

1. Packing Fraction

(a) bcc



Maximum radius of the sphere $= \frac{\sqrt{3}a}{4}$

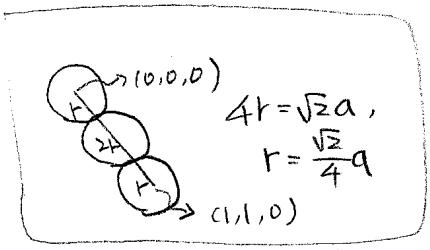
Volume of spheres $= \frac{4}{3}\pi r^3 \times \left(1 + \frac{1}{8}\times 8\right)$

(1 at center; 8 on corners)

$= \frac{4}{3}\pi \left(\frac{\sqrt{3}a}{4}\right)^3 \times 2 = \frac{\pi}{8}\sqrt{3}\,a^3$

Packing Fraction $= \frac{\pi}{8}\sqrt{3} \sim 0.680$

(b) fcc



Maximum radius of the sphere $= \frac{\sqrt{2}a}{4}$

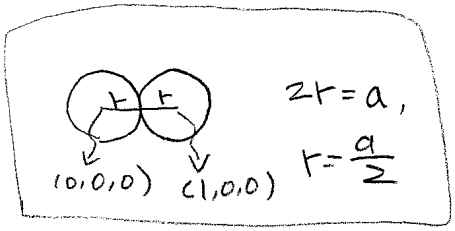
Volume of spheres $= \frac{4}{3}\pi r^3 \times \left(\frac{1}{8}\times 8 + \frac{1}{2}\times 6\right)$

(8 on corners; 6 on faces)

$= \frac{4}{3}\pi \left(\frac{\sqrt{2}}{4}a\right)^3 \times 4 = \frac{\pi}{6}\sqrt{2}\,a^3$

Packing Fraction $= \frac{\pi}{6}\sqrt{2} \sim 0.740$

(c) sc



Maximum radius of the sphere $= \frac{a}{2}$

Volume of spheres $= \frac{4}{3}\pi r^3 \times \left(\frac{1}{8}\times 8\right)$

(8 on corners)

$= \frac{4}{3}\pi \cdot \left(\frac{a}{2}\right)^3 = \frac{\pi}{6}a^3$

Packing Fraction $= \frac{\pi}{6} \sim 0.524$