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0 a) $N_{corners} = 8$

$N_{edges} = 12(n-2)$

$N_{faces} = 6(n-2)^2$

2/2 $N_{bulk} = (n-2)^3$

$N_{tot} = N_{bulk} + N_{faces} + N_{edges} + N_{corners}$

$= (n-2)^3 + 6(n-2)^2 + 12(n-2) + 8$ ✓

$= n^3$

b) $\ell_{bulk} = -6b/2 = -3b$

$\ell_{faces} = -5b/2$

$\ell_{edges} = -4b/2 = -2b$ ✓

$\ell_{corners} = -3b/2$

c) $E_{bulkonly} = N_{bulk}\ell_{bulk}$

$= -3b(n-2)^3$

$E_{total} = N_{bulk}\ell_{bulk} + N_{faces}\ell_{faces} + N_{edges}\ell_{edges} + N_{corners}\ell_{corners}$

$= -3b(n-2)^3 - 15b(n-2)^2 - 24b(n-2) - 12b$

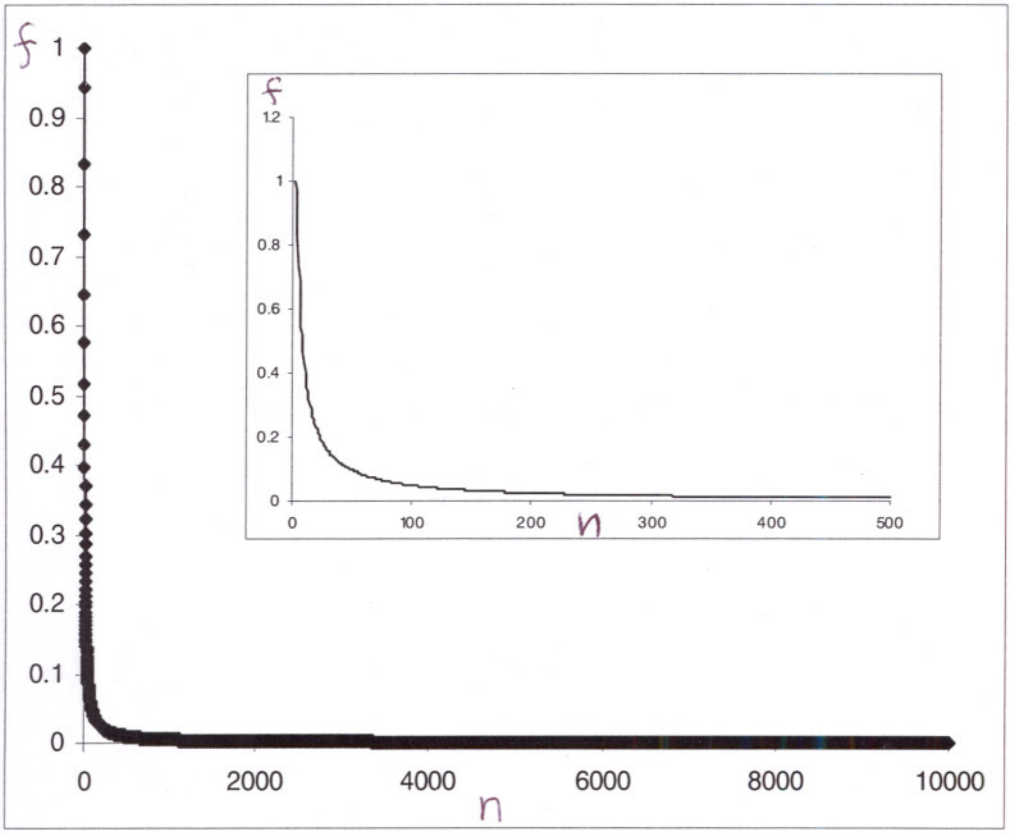
$= -3b[(n-2)^3 + 5(n-2)^2 + 8(n-2) + 4]$ ✓

$= -3bn^2(n-1)$

$f \equiv (E_{total} - E_{bulkonly})/E_{total}$

$= \dfrac{n^2(n-1) - (n-2)^3}{n^2(n-1)}$

$f = 1 - \dfrac{(n-2)^3}{n^2(n-1)}$ #



~~For large crystals~~ For large crystals, the energy of surface atoms is completely negligible. The percentage of energy due to bulk atoms increases dramatically as the crystal size increases. But the rate of increase slows down at some point.

$$\frac{E_{bulkonly}}{E_{total}} = 1 - f = \frac{(n-2)^3}{n^2(n-1)} = \frac{(1-2/n)^3}{(1-1/n)}$$

$$= 0.999$$

$$\approx (1-6/n)(1+1/n) \approx 1 - 5/n$$

$$\Rightarrow n \simeq \frac{5}{0.001}$$

$$n \approx 5000 \quad \text{for} \quad \frac{E_{Bulkonly}}{E_{total}} = 99.9\%$$

#