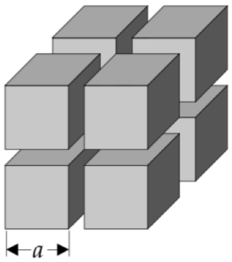
HW #4: Delocalization

Figure 6.17 Options A and B for accommodating eight electrons within a solid.

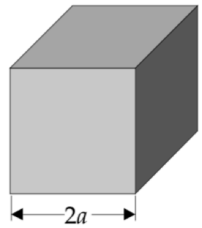
Option *A*



Each electron is confined to its own separate box (atom) with side $\approx a$. Each electron enters the ground state in its own box, and so the total energy will be:

$$E = 8 \times \frac{h^2}{8ma^2} \times [3]$$

Option *B*



Each electron is contained in the same box with side $\approx 2a$. The electrons enter the lowest quantum states available. Two electrons can occupy the ground state and so the total energy of these two electrons will be:

$$2 \times \frac{1}{4} \times \frac{h^2}{8ma^2} \times [3]$$

1. Figure 6.17 is *one of the most important figures in the entire course!* So, it is worth asking you to explicitly repeat the "Option A/Option B" exercise, considering:
   a) Metals with $3^3 = 27$ electrons, and
   b) Metals with $4^3 = 64$ electrons.
   c) Compare the (*energy per electron*) with the value calculated for:
      i) the $2^3 = 8$ electron metal given in the text, and for
      ii) "real" metals given in Tables 6.4 and 6.5