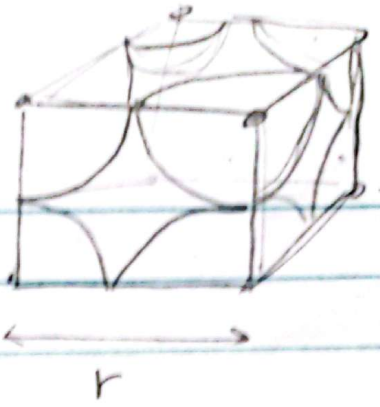
(4) (a)



$V_{cube} = r^3$

$V_{full\ sphere} = \frac{4}{3}\pi\left(\frac{r}{2}\right)^3 = \frac{1}{6}\pi r^3$

Each corner has 1/8 of a sphere. There are 8 corners:

$V_{solid} = 8 \times \frac{1}{8} \times V_{full\ sphere} = \frac{1}{6}\pi r^3$

$\phi = 1 - \frac{V_{solid}}{V_{cube}} \Rightarrow \phi = 1 - \frac{1}{6}\pi \Rightarrow \boxed{\phi \simeq 47.6\ \%}$