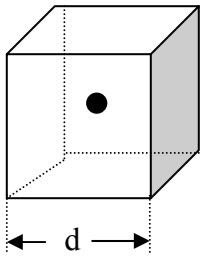
Problem 3 (Essay 10 points) You may use diagrams and equations but no calculations in your response for this problem.

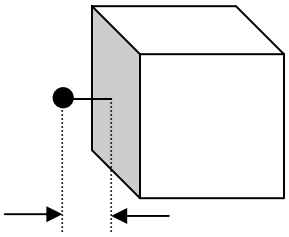
A. Which shaded face has the greater magnitude flux?

B. Which Gaussian cube has the larger Φ_{Total}?

Cube A



Cube B



Case A Definition of flux $\Phi \equiv \int \vec{E} \cdot d\vec{A}$

Since both charges have charge q_o, both the shaded areas have the magnitude area, and in both cases the relative positions of the charge and shaded area's are the same (including the distance between the charge and the area), the E-field and the flux are on the shaded Areas is the same magnitude.

Another way to look at flux through the shaded areas is to draw a 3rd cube just to the left of cube B (so the shaded area forms the right-hand side wall of the new cube. Then you can see that you have identical point charges at the center of identical cubes, so the flux through one side of each cube has to be the same magnitude

Case B Gauss Law say $\oint \vec{E} \cdot d\vec{A} = \frac{q_{enclosed}}{\epsilon_o}$

That is the net flux through a surface that completely encloses a volume = the charge enclosed by that surface divided by ϵ_o.

Cube A encloses a charge $q_1 = q_o$

for cube A $\Phi_A = \oint_A \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_o} = \frac{q_o}{\epsilon_o}$

$\Phi_A = \frac{q_o}{\epsilon_o}$

or the flux through cube A = $\frac{q_o}{\epsilon_o}$

Cube B does not enclose a charge so $\Phi_B = 0$

So if $q_o > 0$, then $\Phi_A > \Phi_B$

if $q_o < 0$, then $\Phi_A < \Phi_B$