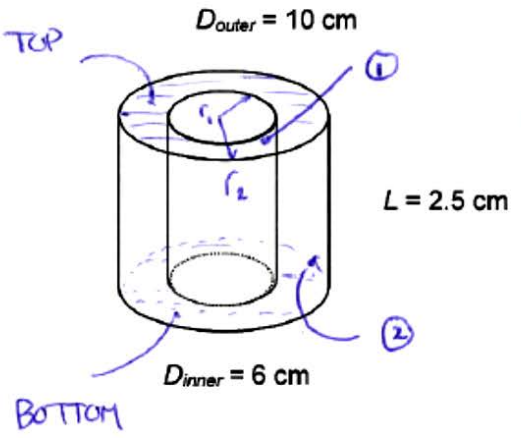
Example

Two concentric cylinders are nested together coaxially as shown in the figure. Assuming the surfaces are *diffuse,*

(a) calculate the fraction of radiation leaving the outer surface of the inner cylinder that goes through the top and bottom openings.
(b) Calculate the fraction of radiation leaving the outer surface of the inner cylinder that goes through just the top opening.
(c) Calculate the fraction of radiation leaving the inner surface of the outer cylinder that goes through the top and bottom openings.



③ = TOP + BOTTOM

(a) USING CHARTS/GRAPHS IN TEXT...

$F_{2\to1} = f(r_1/r_2, L/r_2)$

$r_1/r_2 = 0.6$
$L/r_2 = 0.5$
$\Big\} \quad F_{2\to1} = 0.330$

Reciprocity: $A_1 F_{12} = A_2 F_{21}$

$$F_{12} = \frac{A_2}{A_1} F_{21} = \frac{\pi D_{OUTER} \cancel{L}}{\pi D_{INNER} \cancel{L}} \cdot F_{21}$$

$$= \left(\frac{10\,cm}{6\,cm}\right)(0.330) = 0.55$$

Summation rule.

$F_{12} + F_{13} = 1 \qquad 1 - F_{12} = F_{13}$

$F_{13} = 1 - 0.55 =$ **0.45**

(b) Superposition:

$F_{13} = F_{1\text{-TOP}} + F_{1\text{-BOTTOM}}$

Symmetry:

$F_{1\text{-TOP}} = F_{1\text{-BOTTOM}}$

$\therefore \quad F_{13} = 2F_{1\text{-TOP}}$

$F_{1\text{-TOP}} = F_{13}/2 = 0.45/2 =$ **0.225**

(c) Summation rule

$$F_{2-1} + F_{2-2} + F_{2-3} = 1$$

↳ CAREFUL! ≠0!

From figure in text.

$$F_{22} \approx 0.125$$

$$\therefore F_{23} = 1 - F_{21} - F_{22} = 1 - 0.33 - 0.125$$

$$= \boxed{0.545}$$