

Lecture 12 Discussion on a sample problem

Uniformly Charged Sphere

Given: ϕ, R

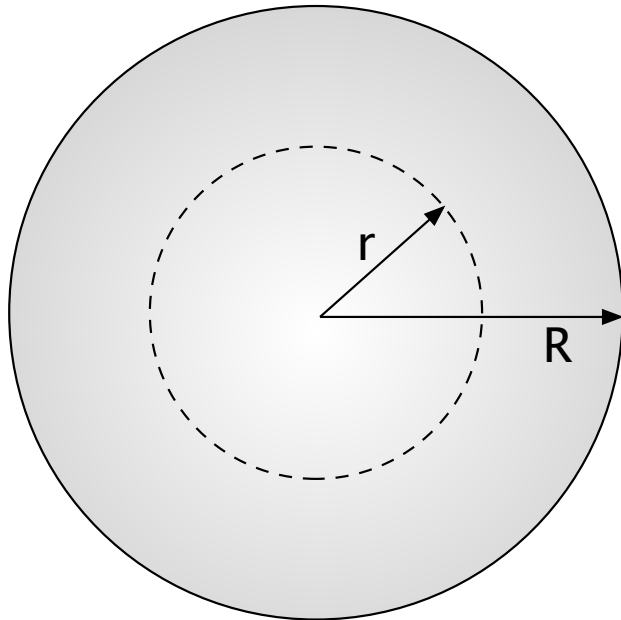
Find: ϕ through S with r

What is E at R? - Plot E vs. r

G-L: $\phi_s = \frac{Q_S}{\epsilon_0}$

Once Q_S is found $\Rightarrow \phi, E$

$$Q_S = Q \times \left[\frac{\text{vol. of } r}{\text{vol. of } R} \right]$$



IQ Choices

	Q_S
1	$Q \left(\frac{r}{R} \right)$
2	$Q \left(\frac{r}{R} \right)^2$
3	$Q \left(\frac{r}{R} \right)^3$

Uniformly Charged Sphere sample problem

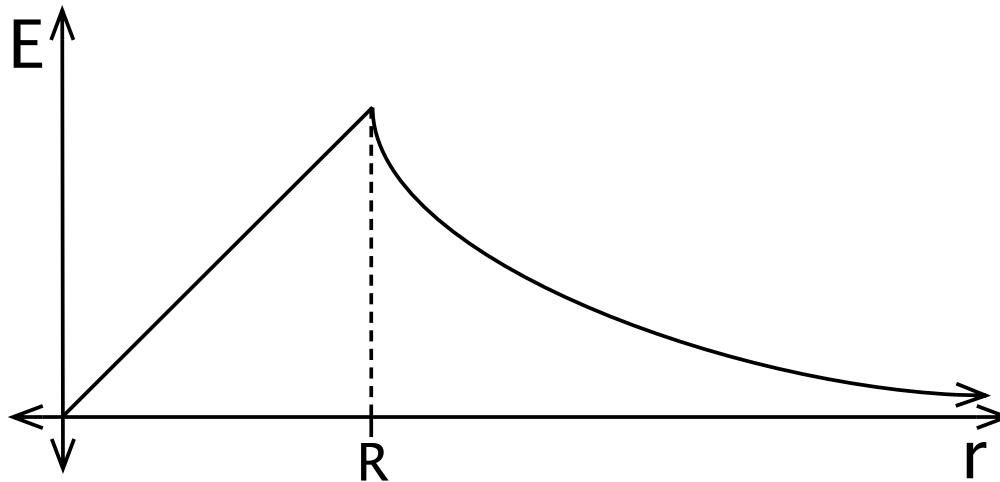
Given: ϕ, R

Find: ϕ through S with r

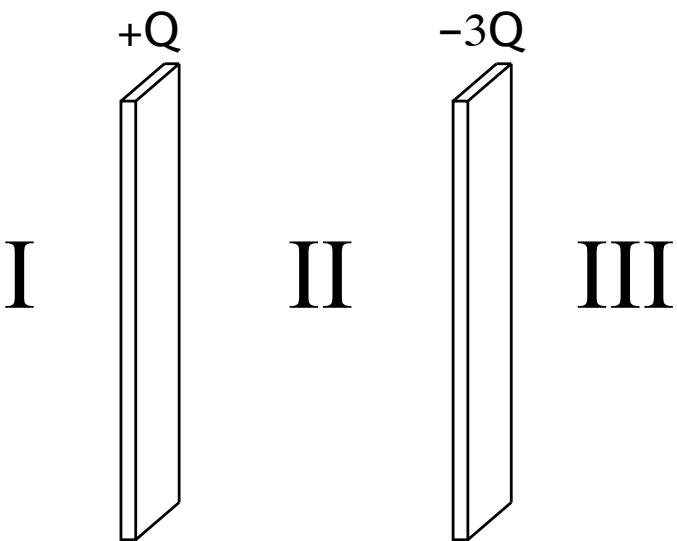
What is E at R? - Plot E vs. r

$$E_{\text{?}} 4\pi r^2 = \frac{Q \left(\frac{r}{R}\right)^3}{\epsilon_0}$$

$$E_{\text{?}} = \frac{Q \left(\frac{r}{R}\right)^3}{4\pi r^2 \epsilon_0}$$



Field due to two charged plates

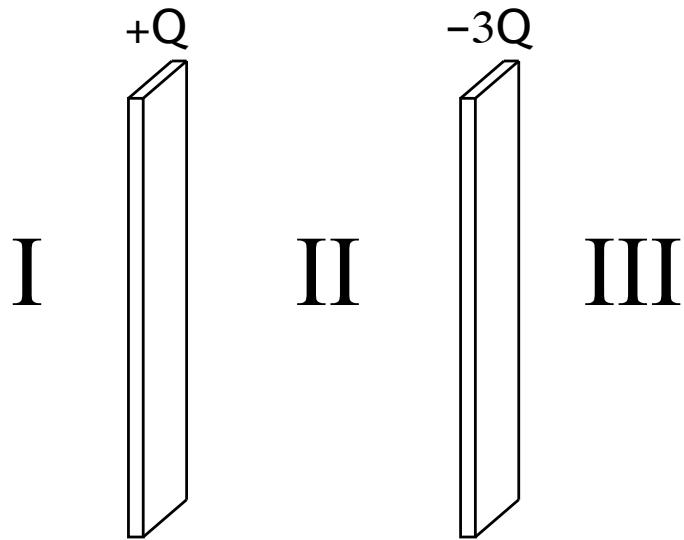


Given: $+Q, -3Q$

Find: E_{III}

Superposition of fields due to left plate and superposition of fields due to right plate:

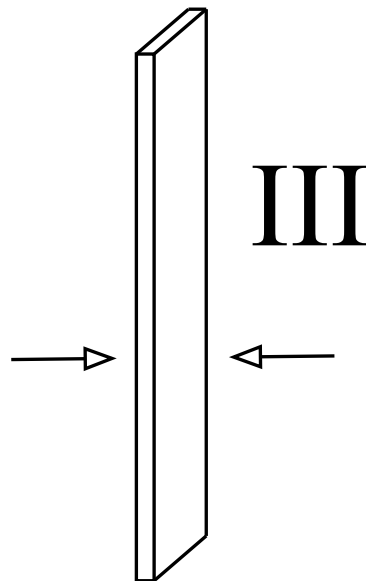
	I	II	III
Left plate $ E^{left} = \frac{Q/A}{2\epsilon_0}$	←	→	→
Right plate $ E^{right} = \frac{3Q/A}{2\epsilon_0}$	→	→	←



$$\begin{aligned}
 III : E_{III} &= E_{III}^{left} + E_{III}^{right} \\
 &= \frac{Q/A}{2\epsilon_0} - \frac{3Q/A}{2\epsilon_0} \\
 &= -\frac{Q/A}{\epsilon_0}
 \end{aligned}$$

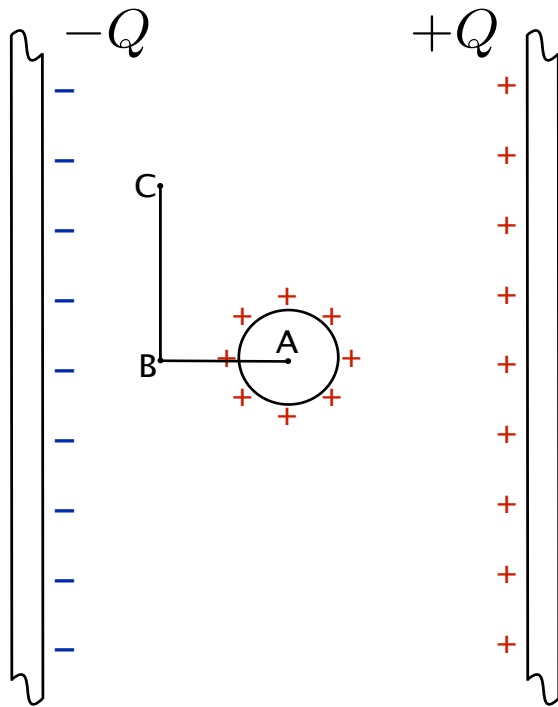
Collapsing charges into “1 resultant plate”

$$-3Q + Q = -2Q$$



$$-\frac{2Q/A}{2\epsilon_0} = -\frac{Q/A}{\epsilon_0}$$

Comments on sample problem similar to text(16.P.59)

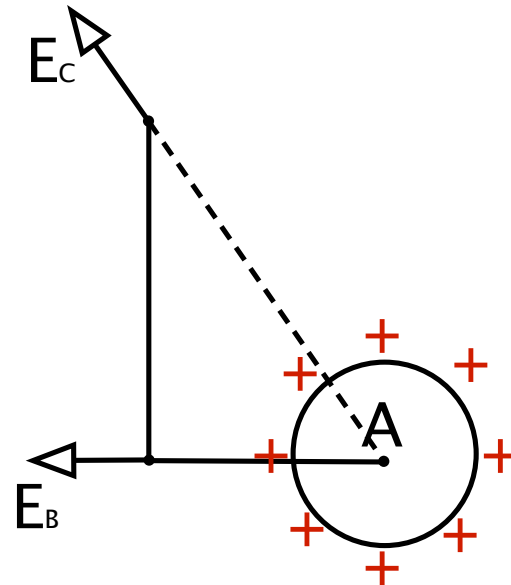


Rank Order: $|E_A|, |E_B|, |E_C|$

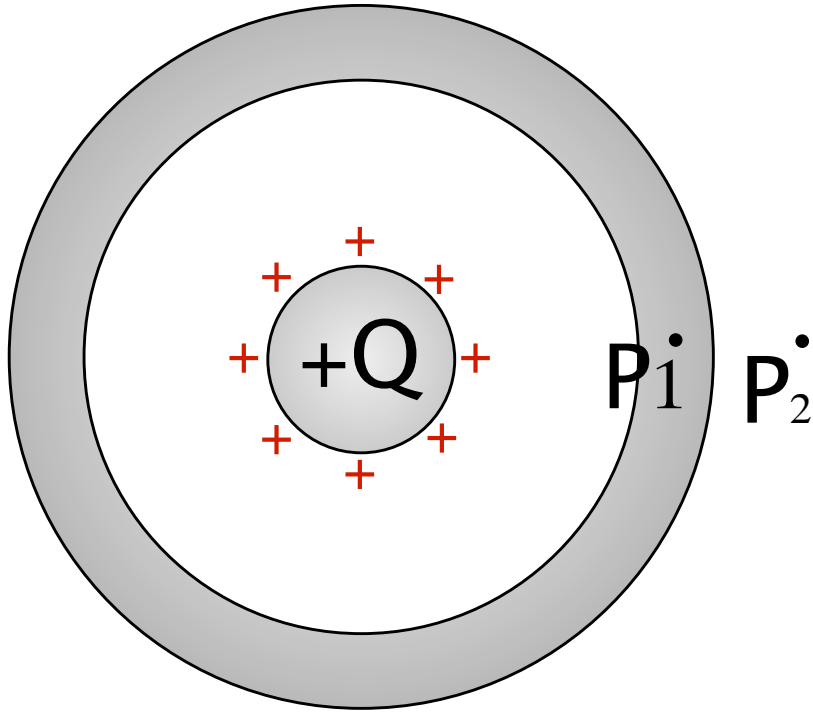
Hint: $\vec{E}_A = \vec{E}_A^{ball} + \vec{E}_A^{plates}$

Compare

$E_A^{ball}, E_B^{ball}, E_C^{ball}$



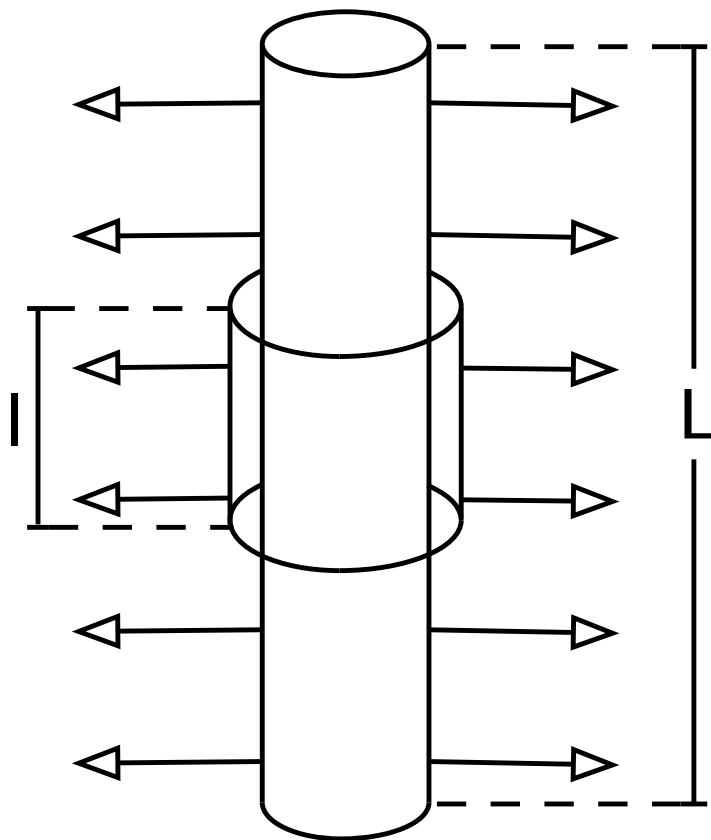
Problem 008



Hint: What is $E_{P\perp}$, m ?

When comparing $E_{p2,m}$ and $E_{p2,p}$ use Gauss' Law

Problem 009: Cylindrical Symmetry Impulse

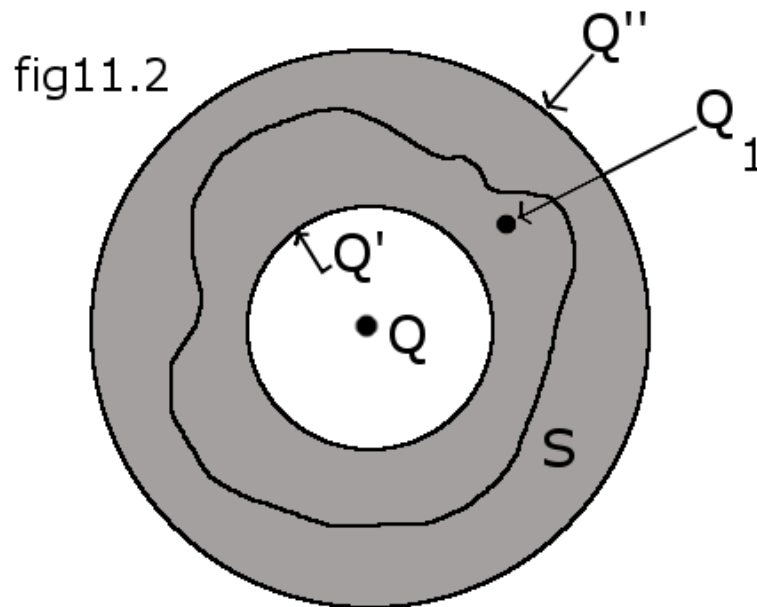


$$\frac{\Phi_L}{\Phi_l} = \frac{E2\pi rL}{E2\pi rl} = \frac{L}{l}$$

Given: q_1 at 0, q_2 in the shell

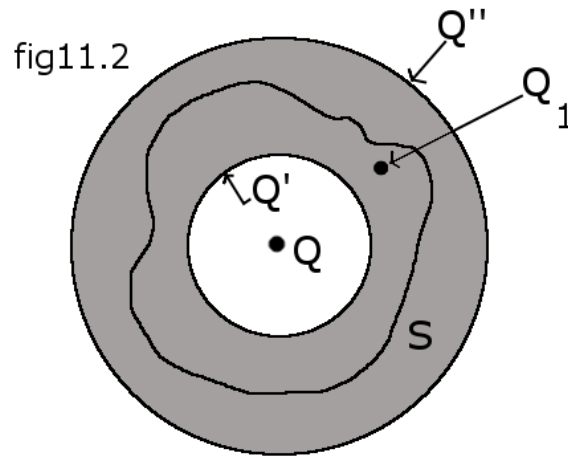
Find: q' and q''

Consider a charge Q enclosed within a thick spherical, conducting shell carrying total charge Q_1 . See Fig11-2



A Gaussian surface S of arbitrary shape is drawn entirely within the conducting medium.

Clicker 12-1



a. What is the total flux through S ?

Choice	1	2	3
ϕ_s	Q/ϵ_0	0	$-Q/\epsilon_0$

b. Determine Q' , the charge at the inner surface of the shell, and Q'' , the charge on the outer surface of the shell.

Choice	1	2	3
Q'	$-Q$	Q	0
Q''	$Q + Q_1$	$-Q + Q_1$	Q_1

Clicker 12-2

Negative-charged metal ball near uniformly charged plastic shell.

Use 16.X.53. A solid metal ball of radius 1.5 cm bearing a charge of -17 nC is located near a solid plastic ball of radius 2 cm bearing a uniformly distributed charge of 7 nC (Fig16.62, p. 659).

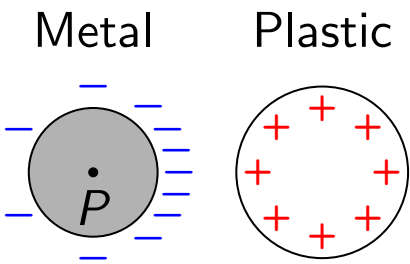


fig. 12.1

For each case, determine the field at P due to the charge distribution on the sphere indicated by the superscript.

Case a.

Choice	1	2	3
E^{metal} at P	> 0	0	< 0

Case b.

Choice	1	2	3
$E^{plastic}$ at P	> 0	0	< 0

Case c. Replace the metal ball with a spherical metal shell of the same radius and total charge.

Choice	1	2	3
$E^{metal\ shell}$ at P	> 0	0	< 0

Clicker 12-3

Lec12-2 r-dependence of fields due to sources with 1D-infinite extent as well as 2D-infinite extent.

Find the r-dependence of the electric field for each of the sources of infinite extent below. (The first case is an infinitely long rod, while the second case is an infinitely large plate)

Choice	1	2	3	4
Long Rod (1D Infinity)	$1/r^0$	$1/r^1$	$1/r^2$	$1/r^3$
Large Plate (2D Infinity)	$1/r^0$	$1/r^1$	$1/r^2$	$1/r^3$