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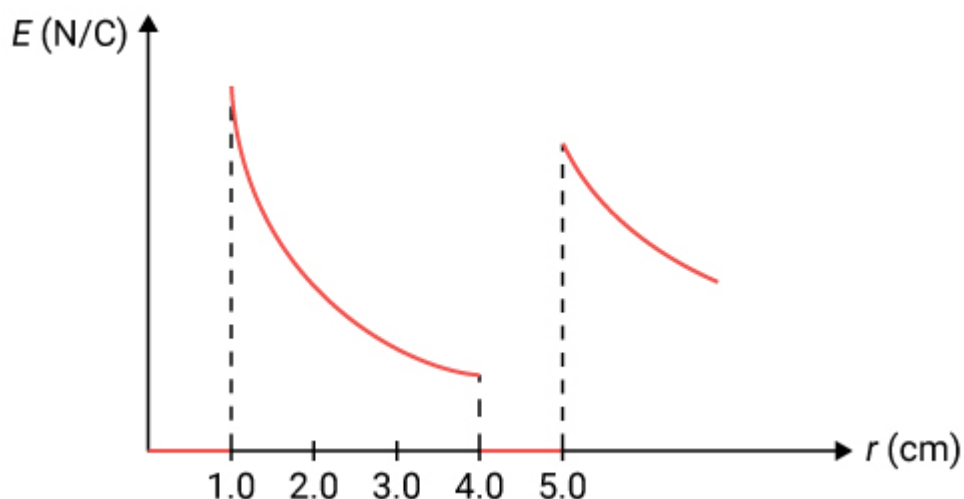
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QUESTION 1



Choose the correct answer.

The graph in the figure to the right shows the variation of the electric field in terms of the distance r from the center of a charged sphere of radius a . The sphere is placed at the center of a charged hollow sphere of thickness b . Use the graph to determine a , b , and the nature of the spheres.



☐ Both spheres are conducting, with
 $a = 1.0 \text{ cm}$
 and
 $b = 3.0 \text{ cm}$
 .

☒ Both spheres are conducting, with
 $a = 1.0 \text{ cm}$
 and
 $b = 1.0 \text{ cm}$
 .





Both spheres are non-conducting, with

$$a = 1.0 \text{ cm}$$

and

$$b = 3.0 \text{ cm}$$

.



Both spheres are non-conducting, with

$$a = 3.0 \text{ cm}$$

and

$$b = 1.0 \text{ cm}$$

.

QUESTION 2

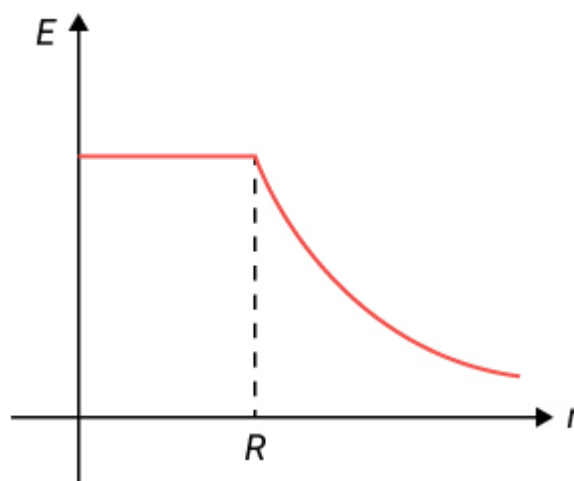


Choose the correct answer.

The figure to the right shows the variation of the electric field in terms of the distance r .

A student thinks that the graph corresponds to a charged conducting sphere of radius R .

Do you think the student is right? Choose one of the statements below that has the correct explanation.



No, the graph does not correspond to a charged conducting sphere because inside a conductor the electric field is equal to zero.



☐

No, the graph does not correspond to a charged conducting sphere because the electric field is constant inside and outside a conductor.

☐

No, the graph corresponds to a charged non-conducting sphere because inside a non-conducting object the electric field is constant.

☐

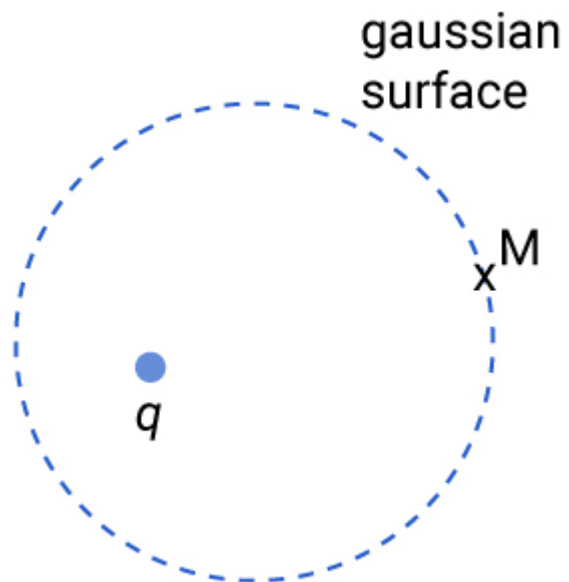
Yes, the graph corresponds to a charged conducting sphere because inside a conductor the electric field is constant.

QUESTION 3



Choose the correct answer.

A charged sphere is moved into a Gaussian surface, as shown in the figure to the right. What happens to the electric field at point M as the sphere moves inside the Gaussian surface?

☐

The electric field varies only if the charge is moved horizontally.

☐

The electric field remains constant but the electric flux varies.

The electric field at M varies.



The electric field at M remains constant as long as the charge remains inside the Gaussian surface.

QUESTION 4



Choose the correct answer.

Two concentric conducting spheres are shown in the figure to the right. The inner sphere has a radius

$$a = 2.0 \text{ cm}$$

and carries a charge

$$q_1 = 10.0 \times 10^{-6} \text{ C}$$

. The outer spherical shell has an inner radius

$$b = 3.0 \text{ cm}$$

and an outer radius

$$c = 5.0 \text{ cm}$$

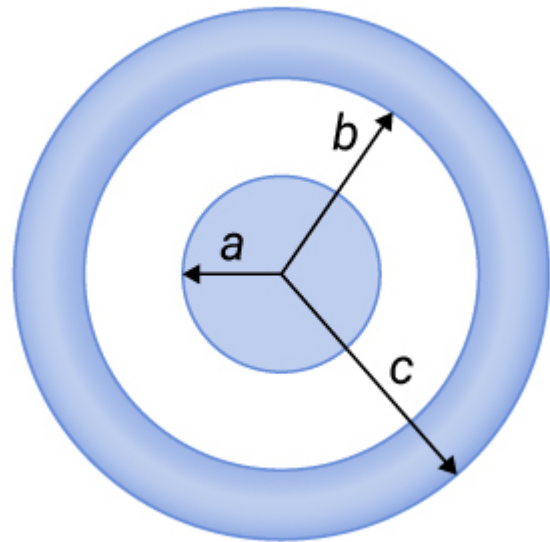
. The shell carries a charge

$$q_2 = -5.0 \times 10^{-6} \text{ C}$$

. Determine the charge enclosed by a spherical Gaussian sphere of radius

$$r = 4.0 \text{ cm}$$

.



The enclosed charge is

$$q = -5.0 \times 10^{-6} \text{ C}$$

☐ The enclosed charge is
 $q = 10.0 \times 10^{-6} \text{ C}$
.

☒ The enclosed charge is
 $q = 0 \text{ C}$
.

☐ The enclosed charge is
 $q = 5.0 \times 10^{-6} \text{ C}$
.

QUESTION 5



Choose the correct answer.

Consider a conducting spherical shell of inner radius

$$r = 5 \text{ cm}$$

and carrying a charge q . Compare the electric charges enclosed by two spherical Gaussian surfaces, one passing through a point M at

$$3 \text{ cm}$$

from the center of the shell while the other passes through a point N at

$$4 \text{ cm}$$

from its center. Which of the following statements are correct?



The electric charge enclosed by the Gaussian surface at M is greater than that enclosed by the Gaussian surface at N.



The electric charge enclosed by the Gaussian surface at M is smaller than that enclosed by the Gaussian surface at N.



Both Gaussian surfaces enclose the same charge because the electric charge is distributed equally inside a conductor.



Both Gaussian surfaces enclose a zero charge because the electric charge appears only at the surface of a conductor.



QUESTION 6



Choose the correct answer.

Consider a conducting hollow sphere of inner radius a and outer radius b carrying a charge q . The electric field for a chosen Gaussian sphere is

$$E = 0$$

. Where could the Gaussian surface be chosen?



Outside the hollow sphere.



Either inside the hollow sphere or between its inner and outer radii a and b .



Only inside the inner radius a of the hollow sphere.Only between the inner and outer radii a and b of the hollow sphere.

QUESTION 7

*Select the correct answer from the drop-down menu.*

Consider a solid non-conducting charged sphere of radius R . What is the expression of the charge density

 ρ

, in the case of spherical symmetry for this sphere?

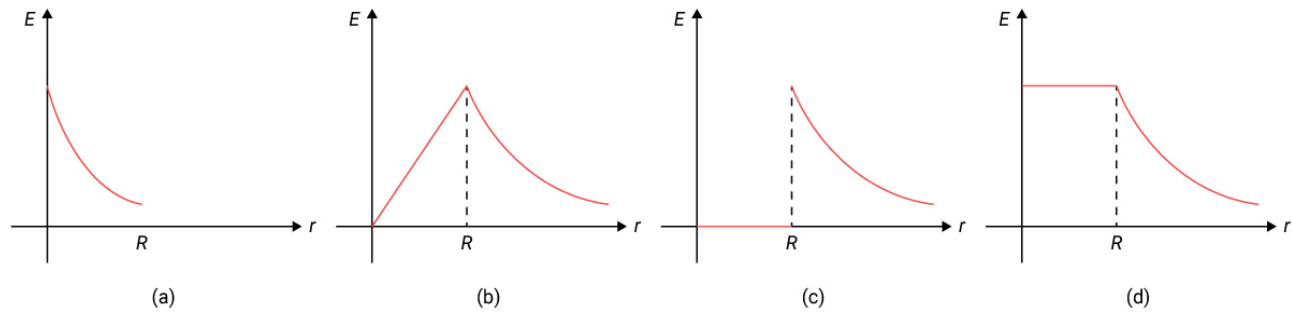
Charge density is

$$\rho = \frac{q_{\text{total}}}{\frac{4}{3} \pi R^3} \quad \checkmark \quad \vee$$

QUESTION 8

*Choose the correct answer.*

Consider a charged conducting sphere of radius R . One of the graphs in the figure below represents the variation of the magnitude of the electric field as a function of the distance r from the center of the sphere.



Which graph is the correct one?

☐ graph (d)

☐ graph (b)

☐ graph (a)

☒ graph (c)

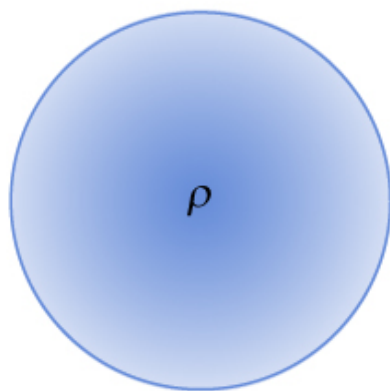


QUESTION 9

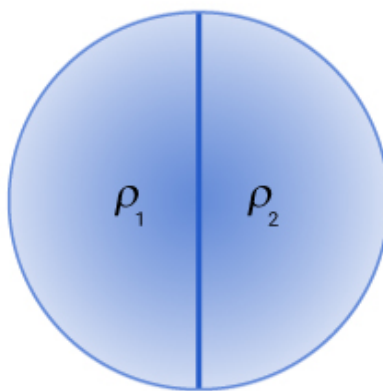


Choose the correct answer.

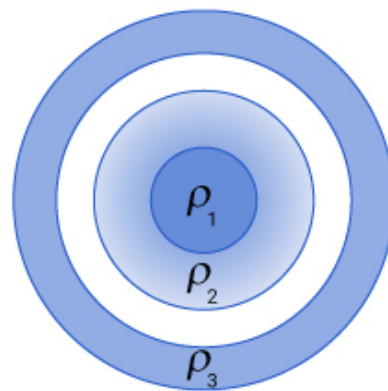
The figure to the right shows three spheres with their charge densities. Which image(s) show complete spherical symmetry?



(a)



(b)



(c)

☒ a and c

☐ Only (a)

☐ Only (b)

☐ (b) and (c)

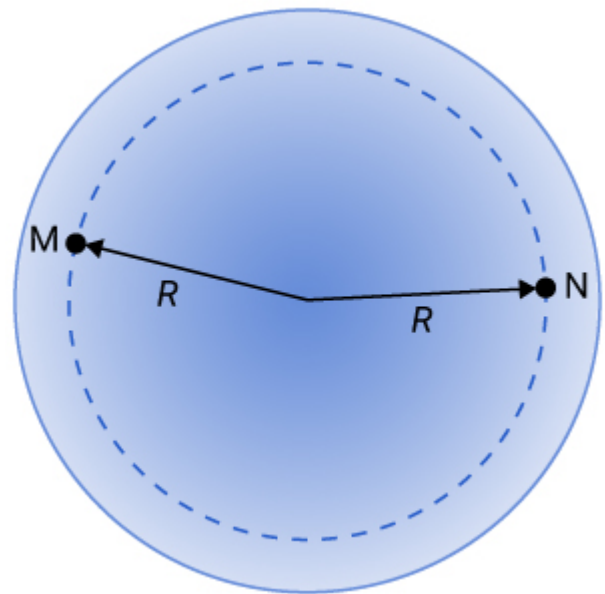
QUESTION 10



Choose the correct answer.

The figure to the right shows a solid sphere carrying a charge q distributed uniformly over its volume.

A Gaussian spherical sphere passes through M and N as shown in the figure. Choose a statement below that compares the electric fields at both points.



☒ $E_M = E_N$



☐ $E_M > E_N$

☐ $E_M < E_N$

☐ $E_M = E_N = 0$

QUESTION 11



Choose the correct answer.

A tiny sphere that carries a charge

q

is placed at the center of two concentric conducting shells A and B as shown in the figure to the right. The three Gaussian surfaces shown in the figure have radii

R

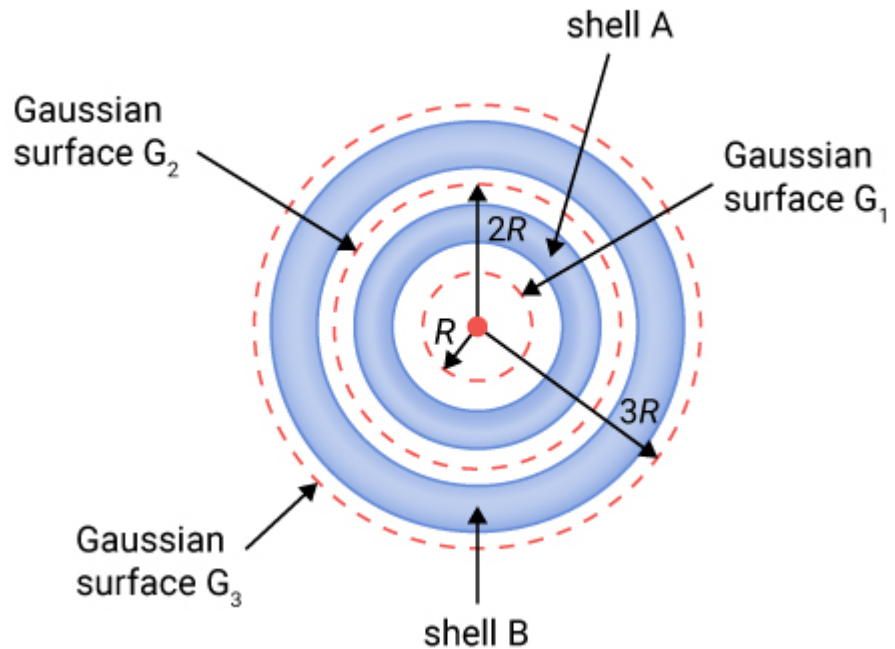
,

$2R$

, and

$3R$

.



Determine, as a function of

q

the charge carried by each shell so that the electric fields at the three Gaussian surfaces are equal.



The charge on shell B is

$3q$

and the charge on shell A is

$5q$

.



The charge on the shell B is

$5q$

and the charge on shell A is

$3q$

.



The charge on each shell is

$4q$

.



The charge on each shell is

$9q$

.

QUESTION 12



Choose the correct answer.

Two non-conducting spheres are shown in the figure to the right. The outer sphere is a hollow sphere of radius

r

and carries a charge

q

uniformly distributed over its volume. The inner sphere fills the hollow gap, has a radius, and carries a charge

$-\frac{q}{2}$

uniformly distributed over its volume. The electric field at a Gaussian surface of radius

R

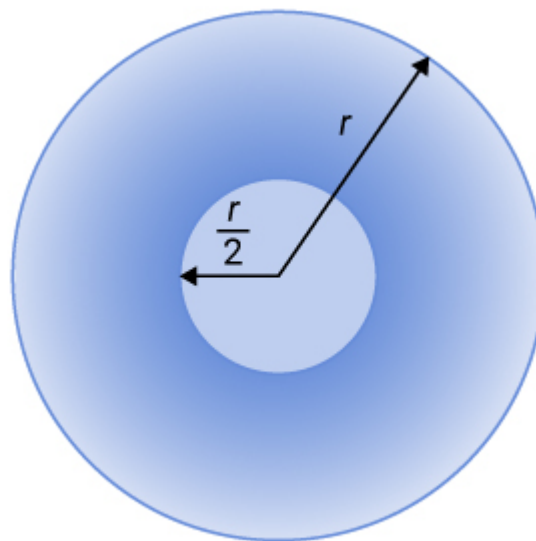
is found to be zero. Determine

R

in terms of

r

.



$R = 1.2r$



$R = r$



$R = 0.5 r$

$R = 0.825 r$

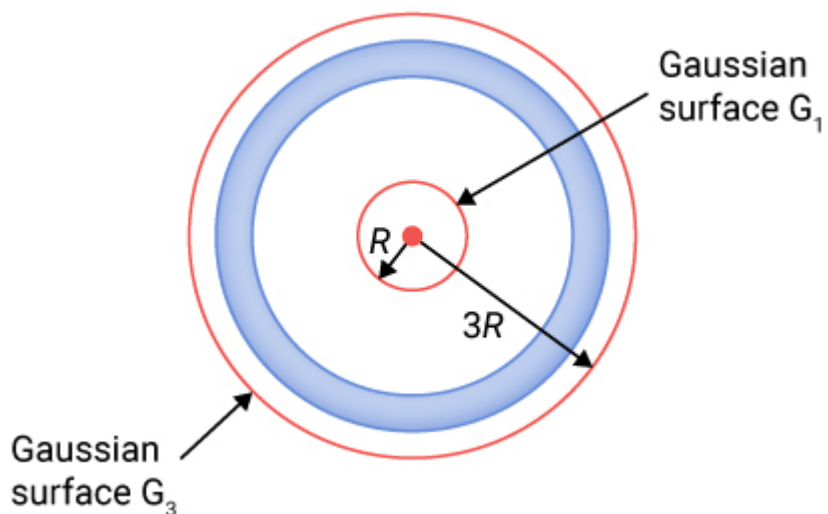


QUESTION 13



Choose the correct answer.

A tiny sphere that carries a charge q is placed at the center of a conducting shell as shown on the figure to the right. Determine, in terms of q , the charge carried by the shell so that the electric field at Gaussian surface G_2 is equal to that at Gaussian surface G_1 .



The charge on the shell is

$-2q$



The charge on the shell is

$2q$

The charge on the shell is

$$8q$$



The charge on the shell is



$$9q$$

QUESTION 14



Choose the correct answer.

Two Gaussian spherical surfaces are chosen inside a charged sphere as shown in the figure to the right.

The sphere is uniformly charged with a density

$$\rho_1$$

up to a distance

$$r_1$$

from its center. The remaining part is uniformly charged with a density

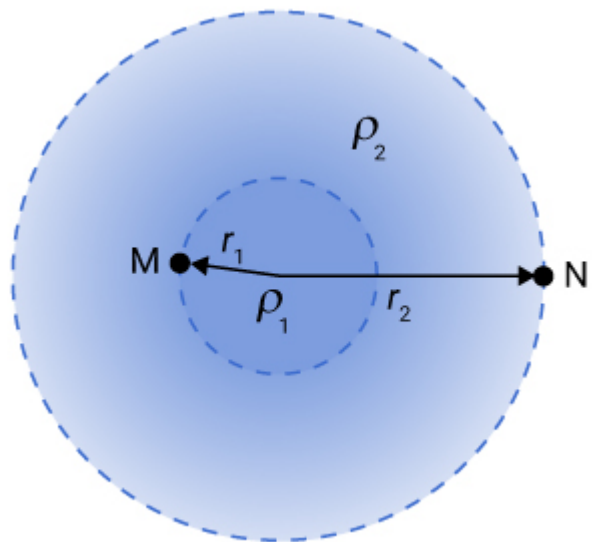
$$\rho_2 = -\rho_1$$

.

Compare the electric field at the points M and N such that N is at a distance

$$r_2 = 2r_1$$

from the center.



☐ $|E_N| = 2|E_M|$

☒ $|E_M| < |E_N|$

☐ $|E_M| = |E_N|$

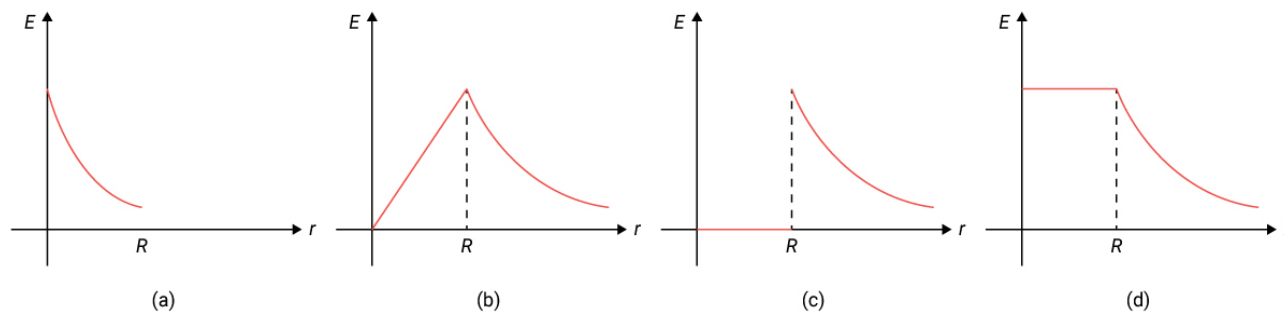
☐ $|E_M| > |E_N|$

QUESTION 15



Choose the correct answer.

Consider a uniformly charged non-conducting sphere of radius R . One of the graphs in the figure below represents the variation of the magnitude of the electric field as a function of the distance r from the center of the sphere.



Which graph is the correct one?



graph (c)



graph (b)



graph (d)



graph (a)