This print-out should have 10 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Note: Problem 1 is asking about a field point along the long axis of the rod, not along the axis perpendicular to rod.

**Charged Rod**

001 10.0 points

A rod 14.3 cm long is uniformly charged and has a total charge of $-25.6 \, \mu C$.

Find the magnitude of the electric field along the axis of the rod at a point 29.5137 cm from the center of the rod. The Coulomb constant is $8.98755 \times 10^9 \, N \cdot m^2/C^2$.

Correct answer: $2.80609 \times 10^6 \, N/C$.

**Floating Styrofoam**

002 10.0 points

A 15.1 g piece of Styrofoam carries a net charge of $-0.5 \, \mu C$ and floats above the center of a very large horizontal sheet of plastic that has a uniform charge density on its surface.

What is the charge per unit area on the plastic sheet? The acceleration of gravity is $9.8 \, m/s^2$ and the permittivity of free space is $8.85419 \times 10^{-12} \, C^2/N \cdot m^2$.

Correct answer: $-5.24097 \, \mu C/m^2$.

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003 (part 1 of 4) 10.0 points

A 2.25 $\mu C$ charge is uniformly distributed on a ring of radius 9 cm.

Find the electric field on the axis at 1.2 cm from the center of the ring. The value of the Coulomb constant is $8.99 \times 10^9 \, N \cdot m^2/C^2$.

Correct answer: $3.24277 \times 10^5 \, N/C$.

004 (part 2 of 4) 10.0 points

Find the electric field on the axis at 3.6 cm from the center of the ring.

Correct answer: $7.99522 \times 10^5 \, N/C$.

005 (part 3 of 4) 10.0 points

Find the electric field on the axis at 3.5 m from the center of the ring.

Correct answer: $1649.59 \, N/C$.

006 (part 4 of 4) 10.0 points

Find the electric field on the axis at 3.5 m assuming that the ring is a point charge at the origin.

Correct answer: $1651.22 \, N/C$.

**Charged Nonconducting Plate**

007 10.0 points

A nonconducting plate with infinite dimensions carries a uniform surface charge density of $10.92 \, \mu C/cm^2$.

What is the electric field 6.6 cm in front of the plate? The permittivity of free space is $8.85419 \times 10^{-12} \, C^2/N \cdot m^2$.

Correct answer: $N/C$.

**Charged Semicircle**

008 (part 1 of 3) 10.0 points

Consider a charged semicircular arc with radius $r$. The total charge $Q$ is negative and distributed uniformly on the semicircle. The charge on a small segment with angle $\Delta \theta$ is labeled $\Delta q$.

What is $\Delta q$?

1. $\Delta q = \frac{Q \Delta \theta}{2\pi}$
2. $\Delta q = \frac{2Q \Delta \theta}{\pi}$
3. $\Delta q = \frac{2Q}{\pi}$
4. $\Delta q = Q$
5. \( \Delta q = \frac{Q}{\pi} \)

6. \( \Delta q = 2\pi Q \)

7. \( \Delta q = \frac{Q}{2\pi} \)

8. \( \Delta q = \frac{Q\Delta \theta}{\pi} \) correct

9. None of these

10. \( \Delta q = \pi Q \)

009 (part 2 of 3) 10.0 points
What is the magnitude of the \( x \)-component of the electric field at the center due to \( \Delta q \)?

1. \( \Delta E_x = k |\Delta q| (\cos \theta) r \)

2. \( \Delta E_x = k |\Delta q| (\sin \theta) r^2 \)

3. \( \Delta E_x = \frac{k |\Delta q| \cos \theta}{r} \)

4. \( \Delta E_x = k |\Delta q| r^2 \)

5. \( \Delta E_x = \frac{k |\Delta q| \sin \theta}{r^2} \)

6. \( \Delta E_x = k |\Delta q| (\cos \theta) r^2 \)

7. \( \Delta E_x = \frac{k |\Delta q|}{r^2} \)

8. \( \Delta E_x = k |\Delta q| (\sin \theta) r \)

9. \( \Delta E_x = \frac{k |\Delta q| \sin \theta}{r} \)

10. \( \Delta E_x = \frac{k |\Delta q| \cos \theta}{r^2} \) correct

010 (part 3 of 3) 10.0 points
Determine the magnitude of the electric field at \( O \). The total charge is \(-37.7 \mu C\), the radius of the semicircle is 77 cm, and the Coulomb constant is \(8.98755 \times 10^9\) N \cdot m^2/C^2.

Correct answer: \[ \text{N/C} \]