This print-out should have 11 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Please notice that for your homework to be considered towards your grade, it needs to be submitted one hour before the corresponding recitation starts. Work submitted after this time, but before the DUE DATE on top of this page, will be accepted but not graded.

PLEASE REMEMBER THAT YOU MUST CARRY OUT YOUR CALCULATIONS TO AT LEAST THREE SIGNIFICANT FIGURES. YOUR ANSWER MUST BE WITHIN ONE PERCENT OF THE CORRECT RESULT TO BE MARKED AS CORRECT BY THE SERVER.

Charged Rod

23:10, calculus, numeric, > 1 min, normal.

001

A rod 14 cm long is uniformly charged and has a total charge of $-22\ \mu$C.

The Coulomb constant is $8.98755 \times 10^9\ \mathrm{N \cdot m^2/C^2}$.

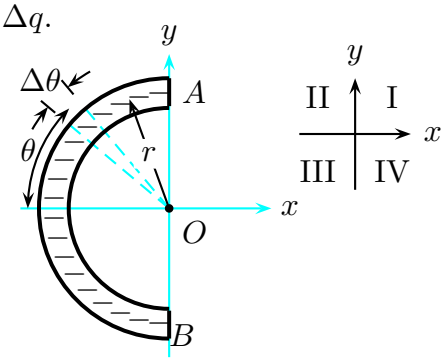
Determine the magnitude of the electric field along the axis of the rod at a point 36 cm from the center of the rod. Answer in units of N/C.

Charged Semicircle

23:10, calculus, numeric, > 1 min, normal.

002

Consider the setup shown in the figure below, where the arc is a semicircle 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 Δq.



Δq is given by

1. None of these

2. $\Delta q = Q$

3. $\Delta q = \dfrac{Q\,\Delta\theta}{2\pi}$

4. $\Delta q = \dfrac{2\,Q\,\Delta\theta}{\pi}$

5. $\Delta q = \dfrac{Q\,\Delta\theta}{\pi}$

6. $\Delta q = \dfrac{Q}{2\,\pi}$

7. $\Delta q = \dfrac{2\,Q}{\pi}$

8. $\Delta q = \dfrac{Q}{\pi}$

9. $\Delta q = 2\,\pi\,Q$

10. $\Delta q = \pi\,Q$

003

The magnitude of the x-component of the electric field at the center, due to Δq, is given by

1. $\Delta E_x = \dfrac{k\,|\Delta q|}{r^2}$

2. $\Delta E_x = \dfrac{k\,|\Delta q|\,\sin\theta}{r^2}$

3. $\Delta E_x = \dfrac{k\,|\Delta q|\,\cos\theta}{r^2}$

4. $\Delta E_x = \dfrac{k\,|\Delta q|\,\cos\theta}{r}$

5. $\Delta E_x = \dfrac{k\,|\Delta q|\,\sin\theta}{r}$

6. $\Delta E_x = k\,|\Delta q|\,r^2$

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

8. $\Delta E_x = k\,|\Delta q|\,(\cos\theta)\,r^2$

9. $\Delta E_x = k\,|\Delta q|\,(\cos\theta)\,r$

10. $\Delta E_x = k\,|\Delta q|\,(\sin\theta)\,r$

004

Determine the magnitude of the electric field at O. The total charge is $-7.5\ \mu$C, the radius of the semicircle is 14 cm, and the Coulomb constant is $8.98755 \times 10^9\ \mathrm{N \cdot m^2/C^2}$. Answer in units of N/C.

Floating Styrofoam

23:11, trigonometry, numeric, > 1 min, normal.

005

A 10 g piece of Styrofoam carries a net charge of $-0.7\ \mu$C and floats above the center of a very large horizontal sheet of plastic that has a uniform charge density on its surface.

The acceleration of gravity is 9.8 $\mathrm{m/s^2}$ and the permittivity of free space is $8.85419 \times 10^{-12}\ \mathrm{C^2/N/m^2}$.

What is the charge per unit area on the plastic sheet? Answer in units of $\mu\mathrm{C/m^2}$.

Uniformly Charged Ring

23:12, trigonometry, numeric, > 1 min, normal.

006

A uniformly charged ring of radius 10 cm has a total charge of 75 μC.

The value of the Coulomb constant is $8.98755 \times 10^9\ \mathrm{N \cdot m^2/C^2}$.

Find the magnitude of the electric field on the axis of the ring at 1 cm from the center of the ring. Answer in units of N/C.

007

Find the magnitude of the electric field on the axis of the ring at 5 cm from the center of the ring. Answer in units of N/C.

008

Find the magnitude of the electric field on the axis of the ring at 30 cm from the center of the ring. Answer in units of N/C.

009

Find the magnitude of the electric field on the axis of the ring at 100 cm from the center of the ring. Answer in units of N/C.

Sparking in the Air

23:17, trigonometry, numeric, > 1 min, normal.

010

Air will break down (lose its insulating quality) and sparking will result if the field strength is increased to about 3×10^6 N/C.

The mass of the electron is 9.11×10^{-31} kg and its charge is -1.602×10^{-19} C. Let the electric field be along the positive x-axis.

What acceleration will an electron experience in such a field? Answer in units of $\mathrm{m/s^2}$.

011

If the electron starts from rest, in what distance will it acquire a speed equal to 10% of the speed of light, 3×10^8 m/s? Answer in units of mm.