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 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.

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001 (part 1 of 1) 7 points
A rod 14.8 cm long is uniformly charged and has a total charge of $-10.6 \ \mu C$.

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 38.3454 cm from the center of the rod. Answer in units of N/C.

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002 (part 1 of 3) 2 points
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.
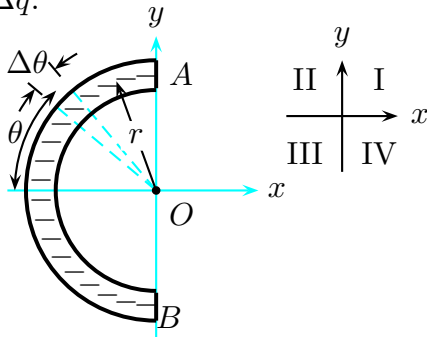
Δq is given by

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

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

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

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

5. None of these

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

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

8. $\Delta q = Q$

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

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

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003 (part 2 of 3) 2 points
The magnitude of the x-component of the electric field at the center, due to Δq, is given by

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

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

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

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

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

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

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

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

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

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

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004 (part 3 of 3) 5 points
Determine the magnitude of the electric field at O. The total charge is $-12.6 \ \mu C$, the radius of the semicircle is 61 cm, and the Coulomb constant is $8.98755 \times 10^9 \ \mathrm{N \cdot m^2/C^2}$. Answer in units of N/C.

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005 (part 1 of 1) 2 points

A 15.1 g piece of Styrofoam carries a net charge of -0.5 μC 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 m/s^2 and the permittivity of free space is 8.85419×10^{-12} C^2/N/m^2.

What is the charge per unit area on the plastic sheet? Answer in units of μC/m^2.

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006 (part 1 of 4) 6 points
A uniformly charged ring of radius 14 cm has a total charge of 103 μC.

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

Find the magnitude of the electric field on the axis of the ring at 0.62 cm from the center of the ring. Answer in units of N/C.

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007 (part 2 of 4) 6 points
Find the magnitude of the electric field on the axis of the ring at 7.16 cm from the center of the ring. Answer in units of N/C.

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008 (part 3 of 4) 6 points
Find the magnitude of the electric field on the axis of the ring at 45 cm from the center of the ring. Answer in units of N/C.

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009 (part 4 of 4) 2 points
Find the magnitude of the electric field on the axis of the ring at 65.1815 cm from the center of the ring. Answer in units of N/C.

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010 (part 1 of 2) 6 points
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 m/s^2.

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011 (part 2 of 2) 6 points
If the electron starts from rest, in what distance will it acquire a speed equal to 5% of the speed of light, 3×10^8 m/s? Answer in units of mm.