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

001 10.0 points
A sphere is charged with electrons to $-8 \times 10^{-6}$ C. The charge of an electron is $-1.6 \times 10^{-19}$ C.

How many electrons are there on the sphere?

002 10.0 points
Two identical small charged spheres hang in equilibrium with equal masses as shown in the figure. The length of the strings are equal and the angle (shown in the figure) with the vertical is identical.

The acceleration of gravity is 9.8 m/s$^2$ and the value of Coulomb’s constant is $8.98755 \times 10^9$ N m$^2$/C$^2$.

Find the magnitude of the charge on each sphere. Answer in units of C.

003 10.0 points
Four point charges, each of magnitude $8.82 \mu$C, are placed at the corners of a square 16.6 cm on a side.

The value of Coulomb’s constant is $8.98755 \times 10^9$ N m$^2$/C$^2$.

If three of the charges are positive and one is negative, find the magnitude of the force experienced by the negative charge. Answer in units of N.

004 (part 1 of 3) 10.0 points
Coulomb constant is $8.98755 \times 10^9$ N m$^2$/C$^2$.

The $1.91 \mu$C charge is at the origin and a $-5.99 \mu$C charge is 10 cm to the right, as shown in the figure.

Identify the direction of $\vec{E}$ in the region II ($0 < x < 10$ cm, along the x-axis).

1. up
2. right
3. all possibilities: right, left, or zero
4. None of these
5. down
6. left

005 (part 2 of 3) 10.0 points
Identify the direction of $\vec{E}$ in region III ($x > 10$ cm, along the x-axis).

1. None of these
2. all possibilities: right, left, or zero
3. left
4. right
5. up
6. down

006 (part 3 of 3) 10.0 points
Locate the x coordinate such that $\vec{E} = 0$.

Note: $q_1$ is at the origin $O$. Answer in units of cm.

007 (part 1 of 3) 10.0 points
An electron traveling at $5 \times 10^6$ m/s enters a 0.08 m region with a uniform electric field of 184 N/C, as in the figure.

The mass of an electron is $9.10939 \times 10^{-31}$ kg and the charge on an
Find the magnitude of the acceleration of the electron while in the electric field. Answer in units of m/s².

008 (part 2 of 3) 10.0 points
Find the time it takes the electron to travel through the region of the electric field, assuming it doesn’t hit the side walls. Answer in units of s.

009 (part 3 of 3) 10.0 points
What is the magnitude of the vertical displacement ∆y of the electron while it is in the electric field? Answer in units of m.

010 10.0 points
The electron gun in a television tube is used to accelerate electrons (mass of 9.10939 × 10⁻³¹ kg and charge of −1.60218 × 10⁻¹⁹ C) from rest to 3 × 10⁷ m/s within a distance of 1.2 cm.

What electric field is required? Answer in units of N/C.