This print-out should have 8 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points
Two insulating spheres having radii 0.43 cm and 0.63 cm, masses 0.13 kg and 0.77 kg, and charges $-4 \mu C$ and $4 \mu C$ are released from rest when their centers are separated by 1.6 m.

How fast is the smaller sphere moving when they collide? Answer in units of m/s.

002 10.0 points
Note: The force of gravity does not enter into this problem.
A charged particle is connected to a string that is tied to the pivot point $P$. The particle, string, and pivot point all lie on a horizontal table (consequently the figure below is viewed from above the table). The particle is initially released from rest when the string makes an angle $85^\circ$ with a uniform electric field in the horizontal plane (shown in the figure).

Determine the speed of the particle when the string is parallel to the electric field. Answer in units of m/s.

003 (part 1 of 2) 10.0 points
A deuteron (a nucleus that consists of one proton and one neutron) is accelerated through a 3.03 kV potential difference.

How much kinetic energy does it gain? Answer in units of J.

004 (part 2 of 2) 10.0 points
How fast is it going if it starts from rest?

005 10.0 points
Consider an equilateral triangle with sides of lengths 2.7 $\mu m$ and charge $-0.2 \mu C$, 1.9 $\mu C$ and 1.4 $\mu C$ located at the corners of the triangle.

Find the minimum work required to move the first point charge to infinity. Answer in units of J.

006 10.0 points
Particles A (of mass $m$ and charge $Q$) and B (of $m$ and charge 5 $Q$) are released from rest with the distance between them equal to 0.9401 m.

If $Q = 27 \mu C$, what is the kinetic energy of particle B at the instant when the particles are 2.9401 m apart? Answer in units of J.

007 10.0 points
A charge of 5 $\mu C$ is distributed uniformly along the circumference of a circle with a radius of 27 cm.

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

How much external energy is required to bring a charge of 53 $\mu C$ from infinity to the center of the circle? Answer in units of J.

008 10.0 points
A charge of 7.209 nC is uniformly distributed along the $x$-axis from $-4 \text{ m}$ to $4 \text{ m}$.

What is the electric potential (relative to zero at infinity) of the point at 5 m on the $x$-axis? Answer in units of V.