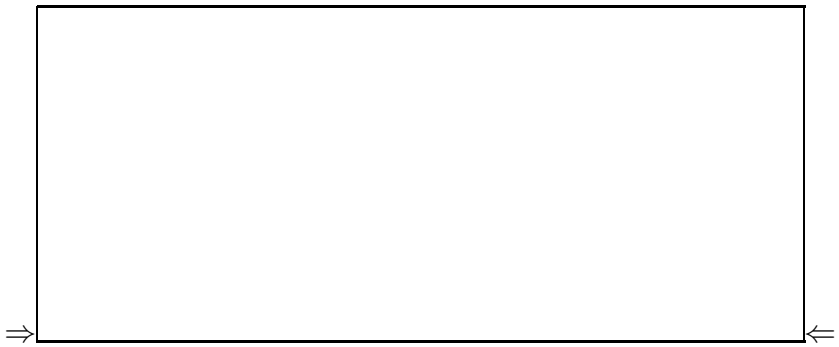
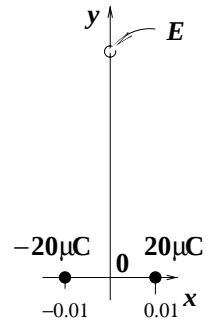
Physics 227 – FIRST COMMON HOUR EXAM
Thursday, October 4, 2001
Profs. Thomson and Glashausser



Your name sticker with **exam code**

1. The exam will last from 8:00 - 9:20 p.m. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts..
2. In the section labelled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first name, another blank, and finally your middle initial.
3. Under STUDENT # enter your 9-digit Social Security Number.
4. Enter 227 under COURSE, and your section number (see label above) under SEC.
5. Under CODE enter the exam code given above.
6. During the exam, you may use pencils, a calculator, and one 8.5 x 11 inch sheet with formulas and notes.
7. There are 15 multiple-choice questions on the exam. For each question, mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess. **At the end of the exam, hand in the answer sheet and the cover page.** Retain this question paper for future reference and study.
8. When you are asked to open the exam, make sure that your copy contains all 15 questions. Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.
9. Please SIGN the cover sheet under your name sticker and have your student ID ready to show to the proctor during the exam.

1. A charge of $+20\mu$C is placed on the x-axis at $x = 0.01$m, and a charge of -20μC is placed on the x-axis at $x = -0.01$m. On the y-axis at $y = 1$m, the electric field is



a) pointing in the $+x$ direction
b) pointing in the $-x$ direction
c) pointing in the $+y$ direction
d) pointing in the $-y$ direction
e) zero

2. Consider a region where there is a uniform electric field given by $\mathbf{E} = -3000\text{V/m}\,\hat{\imath}$. After a proton moving with an initial velocity of 5×10^6 m/s in the $+x$ direction enters this region,

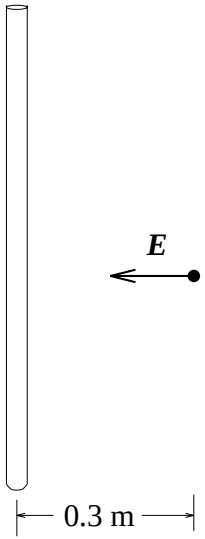
a) it decelerates and momentarily comes to rest after moving a distance 17.3 μm.
b) it decelerates and momentarily comes to rest after moving a distance 1.67 km.
c) it moves in a parabola with axis pointing downward.
d) it decelerates and momentarily comes to rest after moving a distance 43.4 m.
e) it immediately speeds up.

3. A point charge $+Q$ is located infinitesimally above the bottom surface of a pyramid with a base of area 5m^2. What is the sum of the flux through the four sides of the pyramid?

   a) less than zero.
   b) zero because the negative flux through two sides is cancelled by the positive flux through the other two.
   c) Q/ϵ_0 .
   d) $Q/2\epsilon_0$.
   e) $5Q/\epsilon_0$.

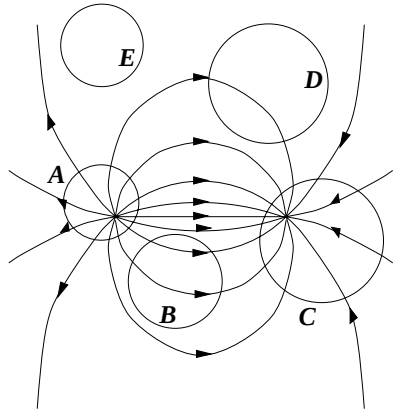
4. A very long glass rod of radius 0.005 m carries a uniform charge distribution with an unknown charge per unit length. At a distance of 0.30 m away from the axis of the rod, the electric field is measured to be 200 V/m, pointing towards the rod. The charge per unit length is

   a) -2.00 nC/m
   b) -7.43 nC/m
   c) -1.77 nC/m
   d) -0.60 nC/m
   e) -3.34 nC/m



5. This figure shows electric field lines in the plane through the centers of five spherical Gaussian surfaces, labelled A through E. Of these, the following have **zero** net flux through them:

   a) E only
   b) C and A only
   c) B, D, and E, only
   d) all of them
   e) none of them



6. Two large parallel conducting plates are 10 cm apart and carry equal but opposite charges on their facing surfaces. An electron placed midway between the two plates experiences a force of 1.6×10^{-15} N. The potential difference between the plates is

   a) 10,000 V
   b) 100 V
   c) 1000 V
   d) 100,000 V
   e) 1100 V

7. Consider a conductor in electrostatic equilibrium. Then,

   a) the electric potential must be zero inside the conductor.
   b) the electric field cannot have a component perpendicular to the surface.
   c) work is done by the electric field to move a charge on the surface.
   d) the electric field must be zero at the conductor's surface.
   e) any net charge on the conductor must reside on the surface.

8. A charge of +6.0 nC is at the origin, and another charge of +6.0 nC is on the x-axis at x = 1.0 m. If the potential is chosen to be zero at infinity, what is the value of the potential on the y-axis at y = 1.0 m?

a) 15.8 V
b) 108 V
c) 92.2 V
d) 85.4 V
e) 81 V

9. A charge of −3.0 nC lies on the x-axis at $x = +6$ cm, and another equal charge of −3.0 nC is at $x = -6$ cm. The magnitude of the electric field at the origin is

a) Zero
b) 7500 N/C
c) 15000 N/C
d) 450 N/C
e) 900 N/C

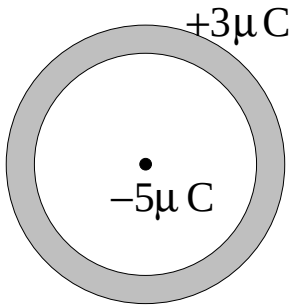
10. A charge of −3.0 nC lies on the x-axis at $x = +6$ cm, and another equal charge of −3.0 nC is at $x = -6$ cm. What is the electric potential at the origin, assuming that it is zero at infinity?

a) Zero
b) 450 V
c) −450 V
d) 900 V
e) −900 V

11. Two small identical metal balls hold charges of $-10\ \mu$C and $+6\ \mu$C respectively. When placed a certain distance apart, the magnitude of the force between them is F. They are then allowed to touch and brought back to their original position. The force between them is now

a) $F/15$, attractive
b) $4F/15$, attractive
c) $F/15$, repulsive
d) $4F/15$, repulsive
e) $4F$, repulsive

12. A charge of –5μC is at the center of a conducting spherical shell. The outer surface of the shell has a charge of +3μC. What is the charge on the inner surface of the shell ?



a) None of the other answers
b) +5μC
c) –2μC
d) –3μC
e) +2μC

13. The potential in a certain region between x=0 and x=5m is $V = ax + bx^2$ where a= 10V/m and b = 4V/m^2. What are the magnitude and direction of the electric field at x = 2 m?

a) 18 **i** V/m
b) 26 **-i** V/m
c) 18 **-i** V/m
d) 36 **i** V/m
e) none of the other answers is correct

14. The electric field at a point 0.3 m from the center of a uniformly charged solid sphere is found to be 10.0 N/C. The radius of the sphere is 0.01m. What is the volume charge density, ρ, in the sphere?

a) 1×10^{-10} C/m^3
b) 1×10^{-2} C/m^3
c) 2.4 C/m^3
d) 0.24 C/m^3
e) 2.4×10^{-5} C/m^3

15. A +2 μC charge is held fixed at (x, y) = (0.03m, 0.00m). How much work is required to bring a +5μC charge from infinity to the point (0.00m, 0.04m)?

a) 1.8 J b) 36 J c) 9 J d) 0.3 J
e) 0.225 J