Physics 208, Spring 2016 – Exam #1

A

Name (Last, First): ________________________________

ID #: __________________

Section #: _________________

- You have 75 minutes to complete the exam.
- Formulae are provided on a separate colored sheet. You may NOT use any other formula sheet.
- You may use only a simple calculator: one without memory, or with a memory demonstrated to be cleared.
- When calculating numerical values, be sure to keep track of units. Results must include proper units.
- Be alert to the number of significant figures in the information given. Results must have the correct number of significant figures.
- If you are unable to solve a problem whose solution is needed in another problem, then assign a symbol for the solution of the first problem and use that symbol in solving the second problem.
- If you need additional space to answer a problem, use the back of the sheet it is written on.
- Show your work. Without supporting work, the answer alone is worth nothing.
- Mark your answers clearly by drawing boxes around them.
- Please write clearly. You may gain marks for a partially correct calculation if your work can be deciphered.

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208 Mid-Term 1 POINTS TABLE	
Multiple Choice (out of 20)	
Problem 1 (out of 20)	
Problem 2 (out of 20)	
Problem 3 (out of 20)	
Problem 4 (out of 20)	
TOTAL SCORE (out of 100)	

MC1. (5 marks) X and Y are two uncharged metal spheres on insulating stands, and are in contact with each other. A positively charged rod R is brought close to X as shown in Figure (a).

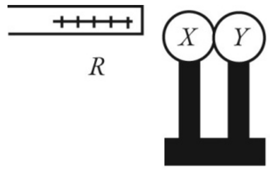


Figure (a)

Sphere Y is now moved away from X, as in Figure (b).

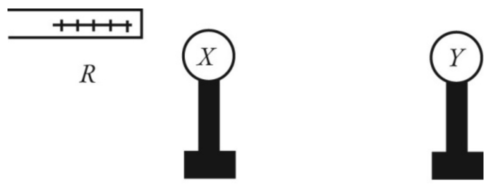


Figure (b)

What are the final charge states of X and Y?

A) Both X and Y are neutral.

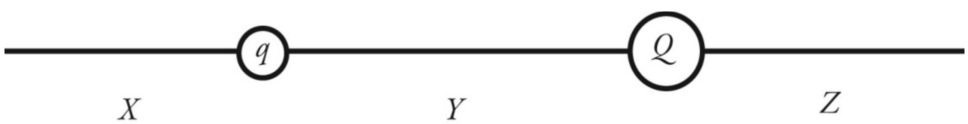
B) X is positive and Y is neutral.

C) X is neutral and Y is positive.

D) X is negative and Y is positive.

E) Both X and Y are negative.

MC2. (5 marks) The figure shows two unequal point charges, q and Q, of opposite sign. Charge Q has greater magnitude than charge q. In which of the regions X, Y, Z will there be a point at which the net electric field due to these two charges is zero?



A) only regions X and Z

B) only region X

C) only region Y

D) only region Z

E) all three regions

MC3. (5 marks) Which of the following statements about Gauss's law are necessarily correct? (There may be more than one correct choice.)

A) Gauss's law is valid only for symmetric charge distributions, such as spheres and cylinders.

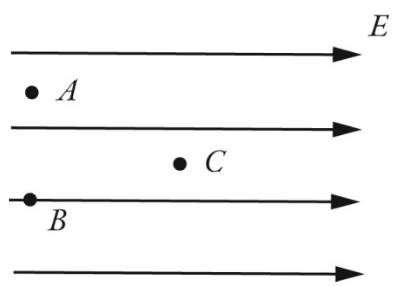
B) If there is no charge inside of a Gaussian surface, the electric field must be zero at points on that surface.

C) Only charge enclosed within a Gaussian surface can produce an electric field at points on that surface.

D) If a Gaussian surface is completely inside an electrostatic conductor, the net electric field must always be zero at all points on that surface.

E) The net electric flux passing through a Gaussian surface depends only on the amount of charge inside that surface, not on its size or shape.

MC4. (5 marks) Suppose a region of space has a uniform electric field, directed towards the right, as shown in the figure. Which statement about the electric potential is true?



A) The potential at all three locations (*A*, *B*, *C*) is the same because the field is uniform.

B) The potential at points *A* and *B* are equal, and the potential at point *C* is higher than the potential at point *A*.

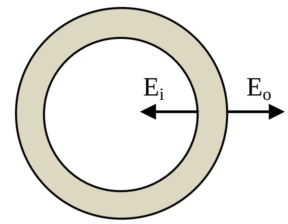
C) The potential at points *A* and *B* are equal, and the potential at point *C* is lower than the potential at point *A*.

D) The potential at point *C* is the highest, the potential at point *B* is the second highest, and the potential at point *A* is the lowest.

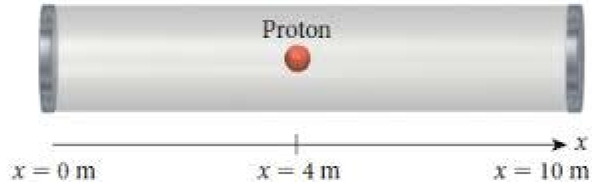
1. **(20 marks)** A point charge $q_1 = -80.0$ nC is located at $(x,y) = (2.00$ m, 1.00 m$)$, and a point charge $q_2 = -60.0$ nC is located at $(x,y) = (0.00, -2.00$ m$)$. Determine the net electric field, magnitude and direction, at the origin of the (x,y) coordinate system.

2. (20 marks) Charge +Q is distributed evenly throughout the volume of an insulating sphere that has radius R. Assume that the potential V=0, at r=∞. Calculate the potential at a radius of r=R/3.

3. (20 marks) A hollow (but not necessarily empty) conducting spherical shell has an inner radius of 8.00 cm and an outer radius of 10.0 cm. There is an electric field at the inner surface of the shell, E_i, which has a magnitude of 80.0 N/C and points toward the center of the sphere at all points on the inner surface. The electric field at the outer surface of the shell, E_o, has a magnitude of 80.0 N/C and points away from the center of the sphere (as shown) at all points on the outer surface. Determine the magnitude of the charge on: a) the inner surface and b) the outer surface of the spherical shell.



4. **(20 marks)** The electric potential inside a 10.0-m long linear particle accelerator is given by $\boldsymbol{V} = (3000 - 5\boldsymbol{x}^2/\mathrm{m}^2)$ V, where $\boldsymbol{x}$ is the distance from the left plate along the accelerator tube, as shown in the figure.



a) Determine an expression for the electric field along the accelerator tube.
b) A proton is released (from rest) at $\boldsymbol{x}$ = 4.00 m. Calculate the acceleration (magnitude and direction) of the proton just after it is released.
c) What is the impact speed of the proton when (and if) it collides with one of the end-plates.