Physics 208: Electricity and Magnetism.
Common Exam 1, 26 September 2016

Print your name **neatly**:

Last name: | | | | | | | | | | | | | | | | |

First name: | | | | | | | | | | | | | | | | |

Sign your name: ________________________________

Please fill in your Student ID number (UIN): __ __ __ –__ __ –__ __ __ __

Your classroom instructor: ____________________ Your section: __________

IMPORTANT

Read these directions carefully:

- You have 75 minutes to complete the exam.
- Formulas are provided on a separate colored sheet. You may NOT use any other formula sheet. Please take the formula sheet with you. Do not turn it in.
- You may use only an SAT approved calculator.
- 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 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.

For grading only:

Problem	Score
Conceptual 1	
Conceptual 2	
Conceptual 3	
Problem 1	
Problem 2	
Problem 3	
TOTAL	

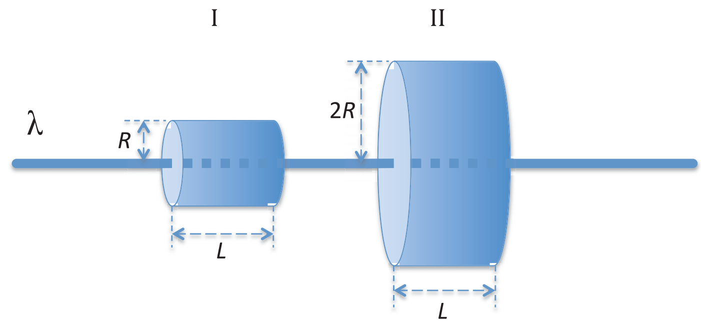
Print your name: ____

Physics 208: Electricity and Magnetism, Exam 1

Conceptual problems

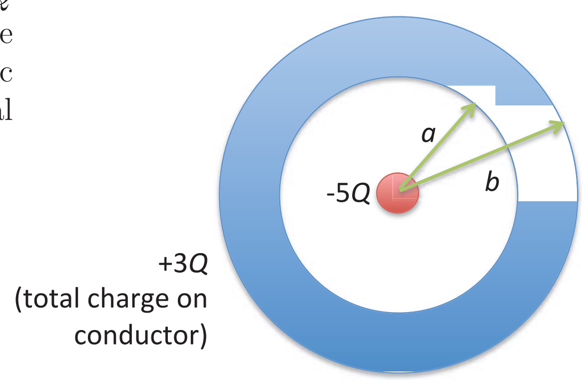
1. (5 points) An infinite line of charge has linear charge density λ. Consider two cylindrical surfaces I and II which are coaxial with the line of charge. Both cylindrical surfaces have the same length L, but the diameter of surface II is twice that of surface I. Compare the magnitude of the electric flux Φ through these two surfaces.

A. $\Phi_{\text{I}} > \Phi_{\text{II}}$
B. $\Phi_{\text{I}} = \Phi_{\text{II}}$
C. $\Phi_{\text{I}} < \Phi_{\text{II}}$
D. There is not enough information to decide



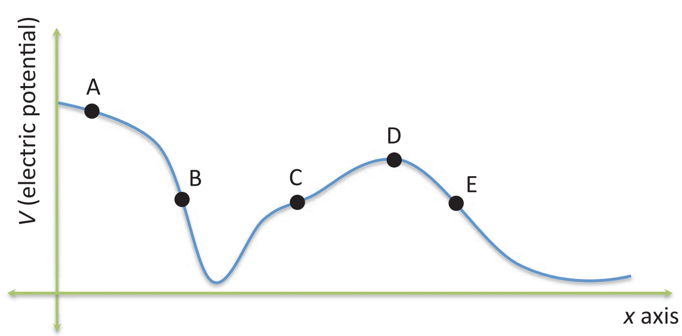
2. (5 points) The total charge on a conducting spherical shell with inner radius a and outer radius b is $3Q$ and it is positive. This spherical shell has a negative point charge -5Q located at its center. The electric potential is zero at the infinity. Inside the spherical shell:

A. the electric potential is $V(r) = -5kQ/a$
B. the electric potential is $V(r) = 5kQ/a$
C. the electric potential is $V(r) = 3kQ/b$
D. the electric potential is $V(r) = -2kQ/b$
E. the electric potential is $V(r) = -2kQ/a$



3. (5 points) The electric potential in a certain region is plotted below. At which point is the magnitude of the electric field the greatest?

A.
B.
C.
D.
E.

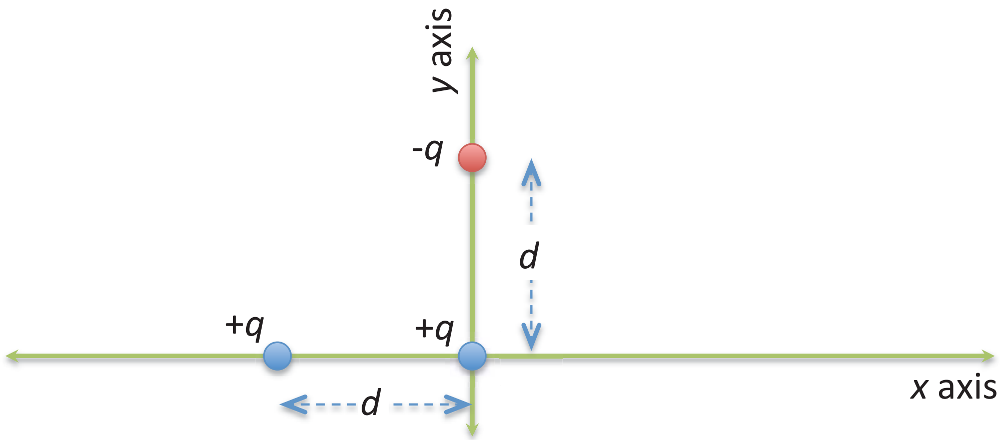


Print your name: ______________________________

Physics 208: Electricity and Magnetism, Exam 1

Problem 1. 30 points.

Two positive charges of magnitude q are placed on the x-axis as shown. One is placed at the origin and the other a distance d to the left of the first one. A third charge, with *negative* charge -q is placed a distance d up the y-axis.



(a) (6 points) Sketch the magnitude and direction of the electric field for points along the x-axis. You don't need to draw an infinite number of lines, just make sure you indicate what is happening for each of the three regions on the x-axis ($x < -d$, - $d < x < 0$, $x > 0$).

(b) (8 points) Calculate the x and y components of the electric field for points along the x-axis for $x > 0$. Express your answer in terms of the electric force constant k, the charge q, the distance d, and x.

(c) (8 points) Calculate the electric potential for points along the x-axis for $x > 0$. Express your answer in terms of the electric force constant k, the charge q, the distance d, and x.

(d) (8 points) Calculate the potential energy of this arrangment of charges. Express your answer in terms of the electric force constant k, the charge q, and the distance d.

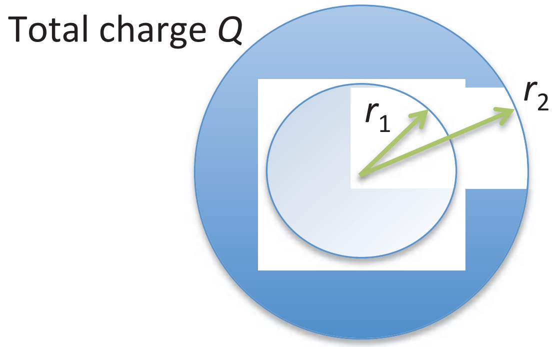
Be **neat.** Neatness helps. Work *neatly.*

Print your name: ____

Physics 208: Electricity and Magnetism, Exam 1

Problem 2. 25 points.

A hollow insulating sphere has total charge Q uniformly distributed throughout the material. The inner radius is r_1 and the outer radius is r_2.



(a) (6 points) Calculate the charge density ρ in terms of Q, r_1 , r_2 , and numerical factors.

(b) (4 points) Draw electric field lines on the given figure. Draw enough lines to make it clear what is happening.

(c) (15 points) Calculate the electric field a distance r from the center for three cases: $r < r_1$, $r_1 < r < r_2$, and $r > r_2$. Express your answer in terms of Q, r_1, r_2, and physical constants and numerical factors.

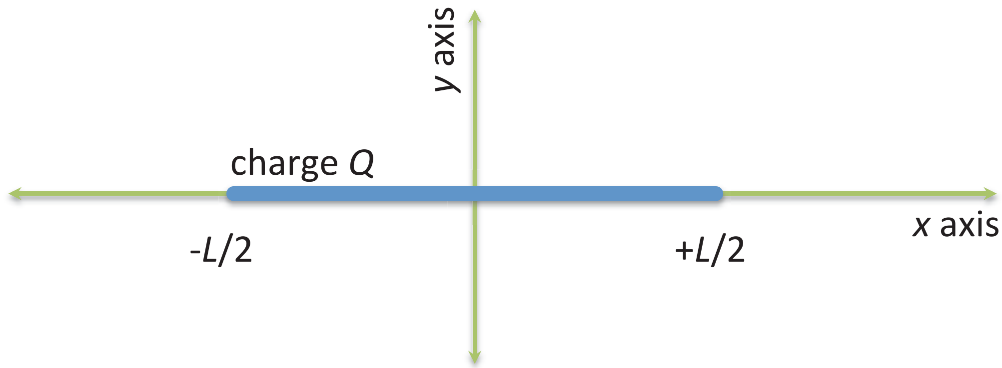
If you work **neatly** we may find more partial credit for you!

Print your name: ______________________________

Physics 208: Electricity and Magnetism, Exam 1

Problem 3. 30 points.

A thin rod of length L has charge Q uniformly distributed along its length. Choose a coordinate system where the rod is oriented along the x-axis and the origin is at the center.



(a) (20 points) Calculate the electric potential for points along the y-axis. Express your answer in terms of y and Q, L, physical constants, and numerical factors.

(b) (10 points) Suppose $L = 2$ cm and $Q = 3.79$ pC. Here p means "pico" and a pico-Coulomb is 10^{-12} Coulombs. Now suppose a proton (mass 1.672×10^{-27} kg and charge 1.602×10^{-19} C) is placed a distance of 1 cm up the y axis from the origin, and released from rest. It will be repelled and move away from the rod. What will be the velocity of the proton when it is far away? Make sure you explain your work for partial credit.

Make sure you are being neat. Working neatly will help you get it right.