Name, Surname: «First_Name» «Last»	**P102_Index: «MT1_Index»**
Student ID Number: «ID»	**Exam Room: «Exam_Room»**

PHYS 102 General Physics II – MT I Exam

October 19, 2017 Thursday 19:00-20:30

Please read!

- Count to make sure that there are 5 pages in the question booklet
- Check your name and surname on front page, and student ID number on each page, and sign each page.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct!).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are not allowed to use calculators during this exam.
- Only the answers in the boxes will be graded and NO partial credit will be given. No points will be given to unjustified answers. Incomplete calculations will not be graded.

Integrals:

$$\int \frac{dy}{\sqrt{y^2+a^2}} = \ln\left(y+\sqrt{y^2+a^2}\right)+const$$

$$\int \frac{ydy}{\left(y^2+a^2\right)^{3/2}} = -\frac{1}{\sqrt{y^2+a^2}}+const$$

$$\int \frac{dy}{\left(y^2+a^2\right)^{3/2}} = \frac{y}{a^2\sqrt{y^2+a^2}}+const$$

$$\int \frac{dy}{y+a} = \ln(y+a)+const$$

$$\int \frac{dy}{(y+a)^2} = -\frac{1}{y+a}+const$$

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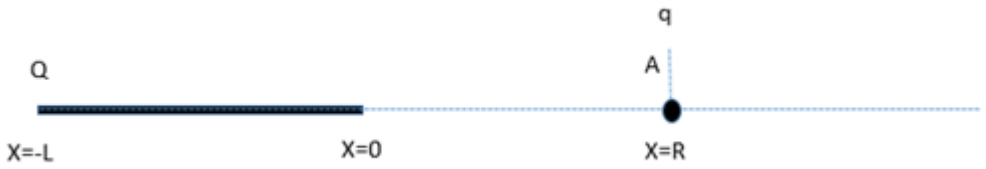
1-(25 Points) Positive charge Q is distributed **uniformly** along the x-axis between x=0 and x= -L. A positive point charge q is located on the x-axis at point A, x = R.



a) Calculate x and y components of the electric-field produced by the charge Q at x= R

Ex=

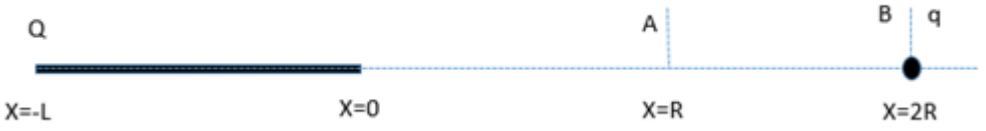
Ey=

b) Calculate the total electrostatic force applied on the point charge q.

Fx=

Fy=

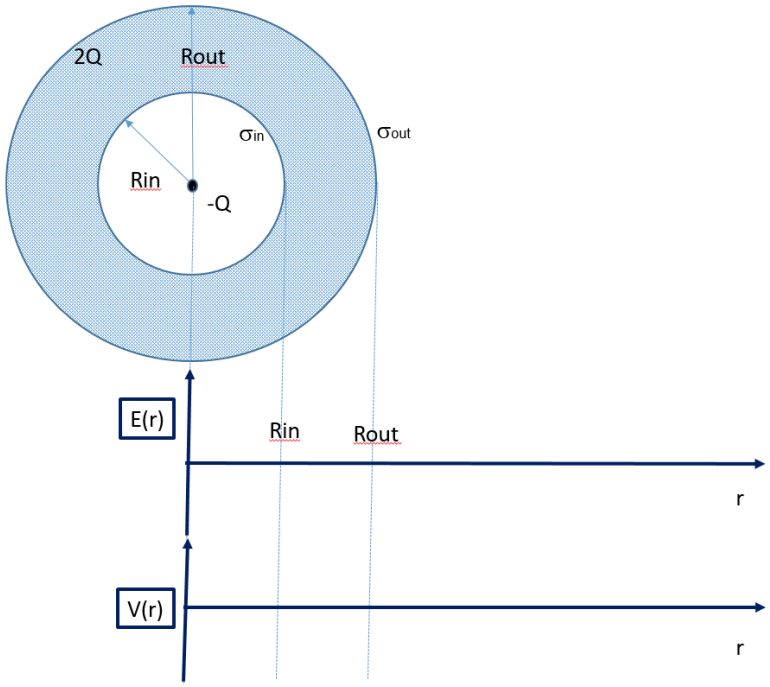
c) Calculate the total work required to move the point charge from point A to point B, x = 2R.



W=

Name, Surname: «First_Name» «Last»	P102_Index: «MT1_Index»
Student ID Number: «ID»	Exam Room: «Exam_Room»

2- (25 pts) A conducting spherical shell with inner radius R_{in} and outer radius R_{out} has a negative point charge -Q located at its center. The total charge on the shell is +2Q.



a) Claculate the surface charge densities on inner and outer surfaces of the metal spherical shell.

σ_{in} =

σ_{out} =

a) Using Gauss's theorem determine and plot the electric-field E (magnitude and direction) for the regions given below as a function of distance (r) from the center. Show all your calculations.

$r > R_{out}$ E(r) =

$R_{in} < r < R_{out}$ E(r) =

$r < R_{in}$ E(r) =

b) Determine and plot the electrical potential V for the regions given below as a function of distance (r) from the center. Show all your calculations.

$r > R_{out}$ V(r) =

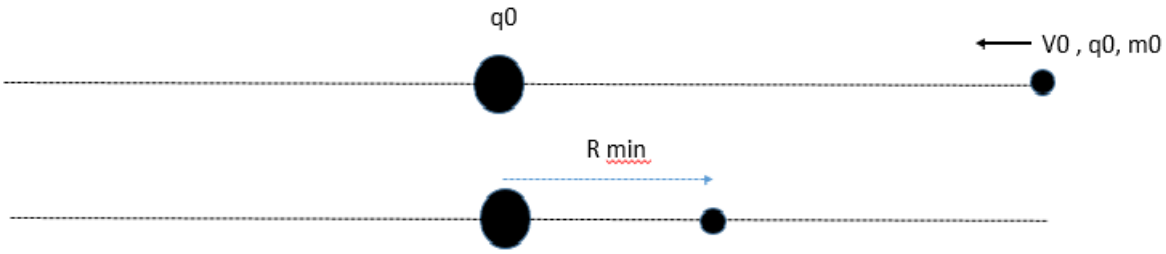
$R_{in} < r < R_{out}$ V(r) =

$r < R_{in}$ V(r) =

Name, Surname: «First_Name» «Last»	P102_Index: «MT1_Index»
Student ID Number: «ID»	Exam Room: «Exam_Room»

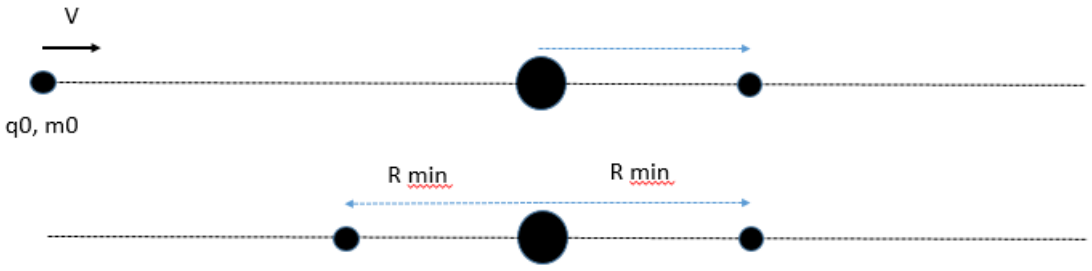
3-(25 pts) A small metal sphere, carrying a net charge of q0 is held in a stationary position. As shown in the figure, a second point charge with the same charge of q0 and mass m0 is projected toward the sphere with the initial speed of V_0. Initially they are infinitely far apart. (Ignore all gravitational interactions.)

a) Find the minimum distance (Rmin) between the sphere and the point charge.



Rmin=

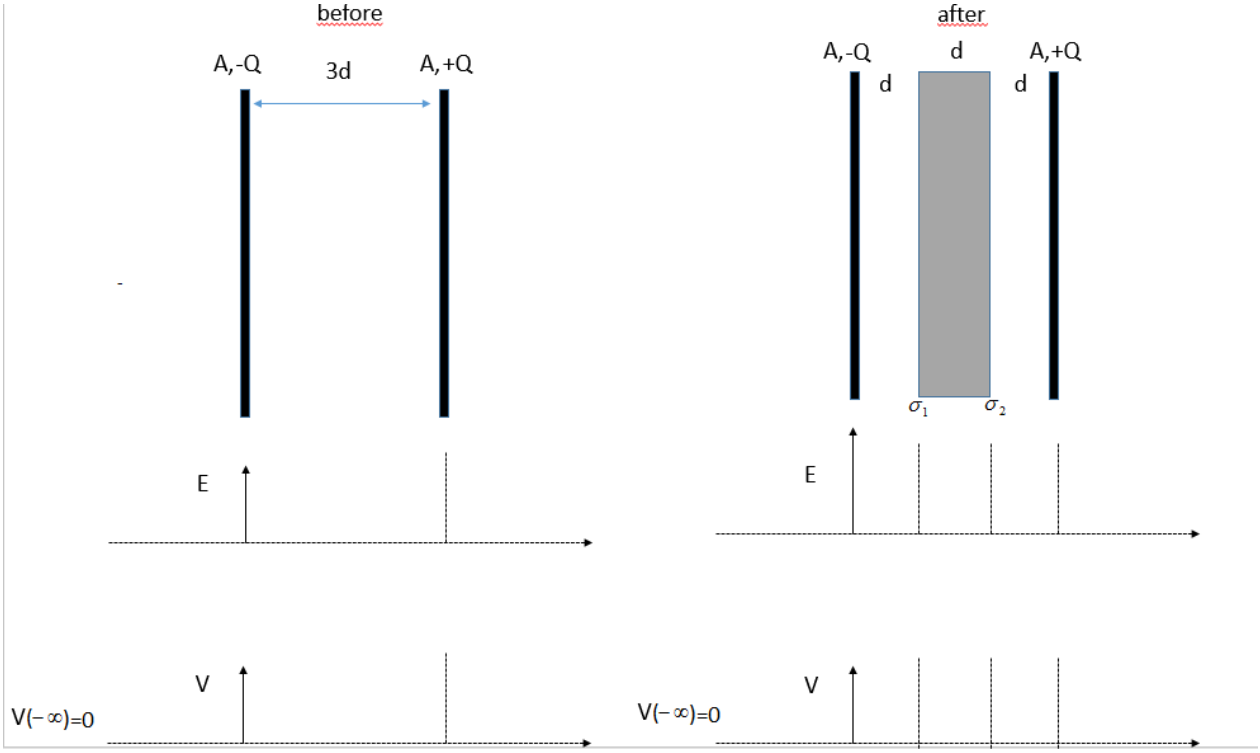
b) Then the third charged particle (q0, m0) is projected toward the sphere from the opposite direction. Assume that the positions of the sphere and the second point charge are fixed as shown in the figure. In order to place the third charge at the same minimum distance (**Rmin**) away from the sphere what should be the initial speed **V** (in terms of $\mathbf{V_0}$) of the third particle?



V=

Name, Surname: «First_Name» «Last»	P102_Index: «MT1_Index»
Student ID Number: «ID»	Exam Room: «Exam_Room»

4- (25 pts) As shown in the figure, two very large **parallel plates** are oppositely charged. Two plates with area A are separated by a distance **3d**. Then a metal slap having thickness d is inserted between them.



a) Calculate and plot on the graph given above the electric field for each region before and after inserting the metal slap. Show your calculations.

b) Calculate and plot on the graph given above the potential difference between two plates before and after inserting the metal slap. Show your calculations.

c) Calculate the surface charge densities (σ_1, σ_2) on the surface of metal slab. (Use Gauss's theorem.)

$\sigma_1 =$

$\sigma_2 =$