Friday Mar 3, 2017

Last time:

- TopHat questions
- Potential of line of charge (finite and infinite) on the board

Today:

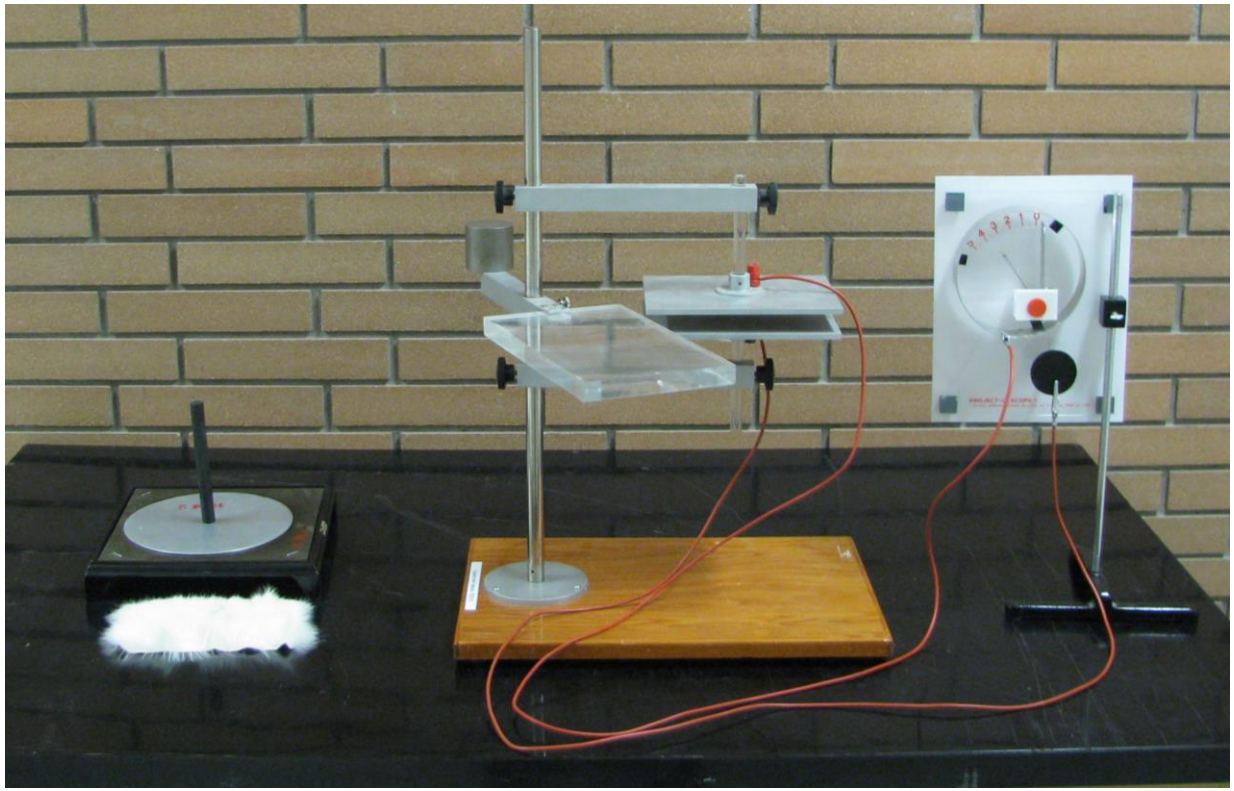
- Capacitors – demonstrations
- Group activity- electric potential

Demonstrations

- Capacitor (charge storage)

Demonstrations

- Capacitor with Dielectric



Group activity

(10 marks) The figure below shows a ring of charge with total charge dQ (Figure.1) and a solid disk of constant charge density σ (Figure.2). The points P are located a distance z above the center of both the ring and disk. Find the electrical potential at a point P above the center of the disk.

Useful formulas: $\int \frac{xdx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2}$ $\quad E_z^{disk} = \frac{\sigma}{2\varepsilon_0}\left[1 - \frac{z}{\sqrt{z^2+R^2}}\right]$

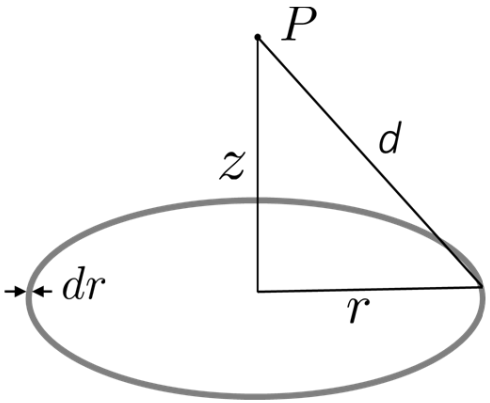


Figure 1. Ring

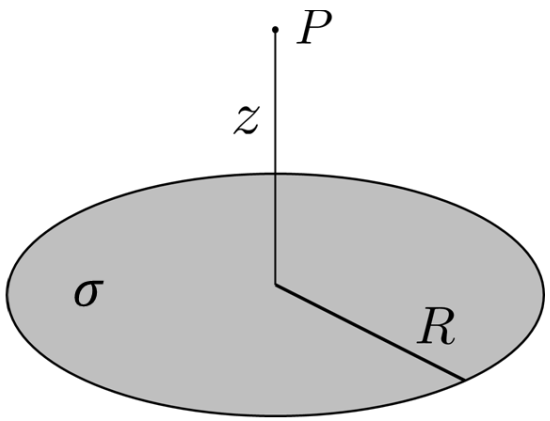


Figure 2. Disk

1. **(1 mark)** What is the distance d from some point on the ring of radius r to point P a distance z above the ring?
2. **(2 marks)** If you knew the potential at point P for a ring of thickness dr and charge dQ, how would go about calculating the potential at point P for a disk?
3. **(1 mark)** Considering the fact that all points on the ring are at the same distance from point P, write the expression for the small contribution to the potential at point P due to the ring of radius r and thickness dr shown in Figure 1?
4. **(2 marks)** What is the total potential at point P due to the disk (Figure.2). State explicitly what the limits of integration are and evaluate the integral.
5. **(1 mark)** Is there a direction associated with the electric potential in question 4? Why or why not?
6. **(2 marks)** Verify your expression for the potential of the disk (question 4) by calculating $E_z = -\frac{\partial V}{\partial z}$. Does this correspond with the electric field produced by a disk that you would expect?