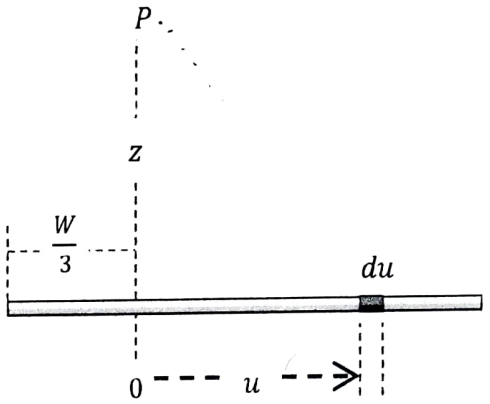
Section	Group	Name	Signature
	5	Ryan Kenney	RK
Grade		Justin Brown	JB
		Jacob Harkins	Jacob Harkins
		Sarah Cole	SC

After this activity you should know: • *Set up integrals for the voltages due to rods and rings of charge.*

1. A thin rod of length W has uniform charge per length λ. Find the electric potential (voltage) at the position P as shown. Assume $V = 0$ at $r = \infty$ for problems on this worksheet.

   Use the integration variable u as defined in the diagram to write the voltage at point P. Include the limits of integration but you do not need to evaluate the integral.

   Hint: break up the rod into small pieces of length du and use the point charge formula for the voltage due to the small piece $dV = Kdq/r$ with dq and r written in terms of the givens λ, L, z and integration variable u and du.



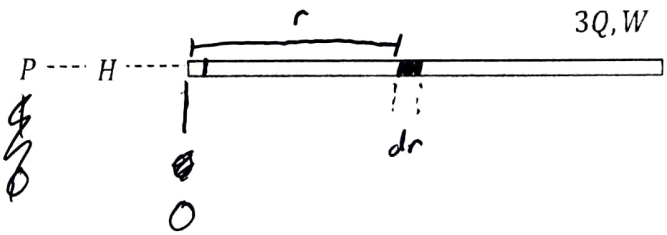
$$V = \int_{-\frac{W}{3}}^{\frac{2}{3}W} K\frac{dq}{r}$$

$$V = K\lambda \int_{-\frac{W}{3}}^{\frac{2}{3}W} \frac{du}{\sqrt{z^2+u^2}}$$

2. A thin rod has charge $3Q$ uniformly distributed along its length W. Find the voltage at a distance H from the end of the rod. Please evaluate the integral. *Hint: repeat the steps above. You will need to define your own integration variable.*

$$dq = \frac{3Q}{W}\cdot dr$$

$$\lambda = \frac{3Q}{W}$$



$$V = \int_0^W K\frac{dq}{r}$$

$$V = K\lambda \int_0^W \frac{dr}{H+r}$$

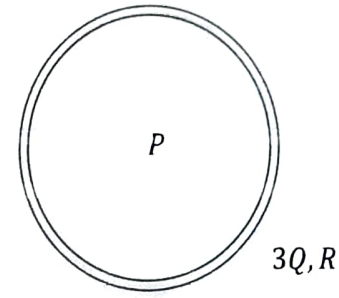
$$= K\lambda \left(\ln|H+r|\right)\Big|_0^W = K\lambda \ln\left|\frac{W+H}{H}\right|$$

$$= K\lambda \ln\left(\frac{2H+W}{H+W}\right)$$

3. A thin circular ring has a radius R and charge $3Q$ distributed uniformly over its length.

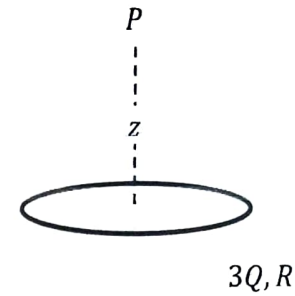
   a. What is the electric potential at the center of the ring? *Hint: this is very easy since every point on the ring is the same distance from the center. Therefore you don't need to integrate.*

$\frac{3kQ}{R}$



   b. What is the electric potential at a distance z along the axis of the thin ring? *Comment: each point on the ring is still the same distance from point P.*

$\frac{3kQ}{\sqrt{R^2+z^2}}$



4. Two thin half circular arcs form a circle of radius R. One semi-circle has charge $-6Q$ while the other semi-circle has charge $+2Q$. What is the voltage at the center of the circle?

$\frac{-6kQ}{R} + \frac{2kQ}{R} = \frac{-4kQ}{R}$