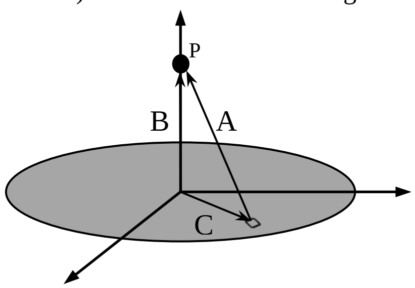
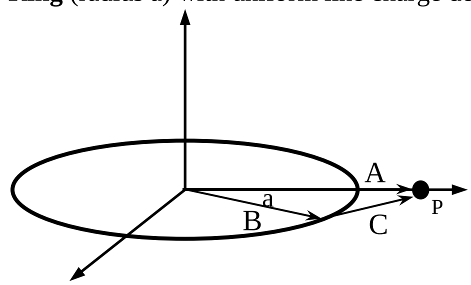
Warmup 2: Coulomb's Law and Gauss' Law

Using the (standard) notation of Griffiths (see his Fig 2.3 in section 2.1.3): On each of the diagrams below, identify the labeled vectors (A, B, and C) with either $\vec{r}$, $\vec{r}'$ and $\vec{\mathscr{r}}$.
NOTE that you may choose more than one of these for any given vector!

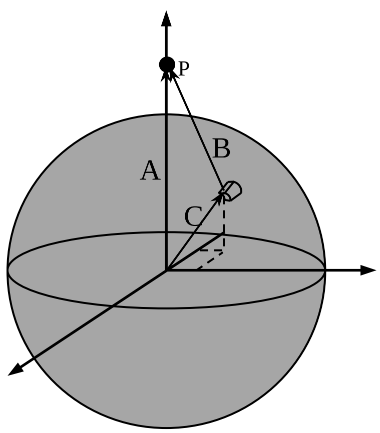
A. **Disk** (radius a) of uniform surface charge density



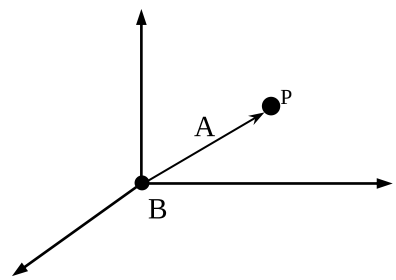
B. **Ring** (radius a) with uniform line charge density



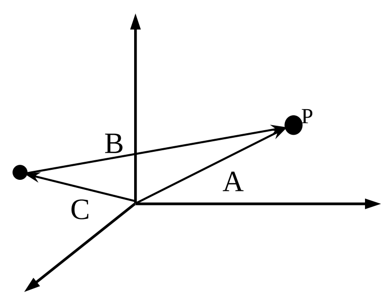
C. **Solid** (radius a) sphere with uniform volume charge density



D. Point charge at the origin



E. Point charge at an arbitrary location



Match each of the diagrams above (A-E) with the correct formula for the magnitude of $\vec{\mathscr{r}}$. Note that there may be more than one correct form, select ALL that are appropriate for a given diagram. (Here, θ' is measured from the z-axis)

$\mathscr{r}_1 = \sqrt{x^2 + y^2 + z^2} = r$

$\mathscr{r}_2 = \sqrt{(x - x')^2 + (y - y')^2 + (z - z')^2}$

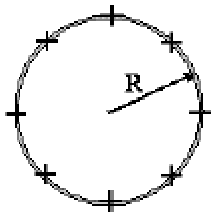
$\mathscr{r}_3 = \sqrt{r^2 + r'^2 - 2rr'\cos(\theta')}$

$\mathscr{r}_4 = \sqrt{r^2 + a^2 - 2ra\cos(\theta')}$

$\mathscr{r}_5 = \sqrt{r^2 + r'^2}$

$\mathscr{r}_6 = \sqrt{r^2 + a^2}$

turn over…



You have a thin spherical shell of uniform positive charge +Q centered at the origin with no other charge anywhere (i.e. all the charge is concentrated in a hollow shell at r=R).

Where in space (if anywhere) is the divergence of E NON-zero? Select all that you think are correct.

a) At the origin

b) Throughout the region $r<R$

c) On the surface $r=R$

d) Throughout the region $r>R$

e) At infinity

f) None of these

Please explain your reasoning:

Where in space (if anywhere) does the curl of E vanish? Select all that you think are correct.

a) At the origin

b) Throughout the region $r<R$

c) On the surface $r=R$

d) Throughout the region $r>R$

e) At infinity

f) None of these

Please explain your reasoning: