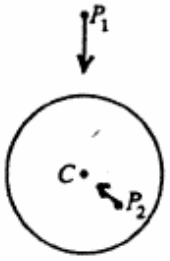
(a) 2 points



1 point for each correct vector — 2 points

(If both vectors are reversed from correct directions, then partial credit of 1 point awarded)

(b) i. 4 points

Gauss's Law:

$\oint \mathbf{E} \cdot d\mathbf{A} = Q_{encl}/\epsilon_0$ (or $4\pi k Q_{encl}$) — 1 point

For $r > R$, using a Gaussian surface that is a cylinder of radius r and length ℓ:

$\oint \mathbf{E} \cdot d\mathbf{A} = E(2\pi r\ell)$ — 1 point

$Q_{encl} = \rho(\pi R^2 \ell)$ — 1 point

$E(2\pi r\ell) = \rho(\pi R^2 \ell)/\epsilon_0$

$E = \frac{\rho R^2}{2\epsilon_0 r}$ $\left(\text{or } \frac{2\pi k \rho R^2}{r}\right)$ — 1 point

(b) ii. 2 points

For $r < R$, using a similar Gaussian surface as above:

$E(2\pi r\ell) = \rho(\pi r^2 \ell)/\epsilon_0$ — 1 point

$E = \frac{\rho r}{2\epsilon_0}$ (or $2\pi k \rho r$) — 1 point