Step 4

$$V(r) - V(\infty) = -\int_{\infty}^{r} \frac{Q}{4\pi\varepsilon_0 r'^2}\,dr' \quad \leftarrow \text{plug in } \vec{E}$$

$$V(r) = \frac{-Q}{4\pi\varepsilon_0}\left[-\frac{1}{r'}\right]_{\infty}^{r}$$

$$= \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r} - \cancelto{0}{\frac{1}{\infty}}\right]$$

Step 5

Solve:

$$V(r) = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r}\right]$$

At P, $r = 2R$ ↙ plug in

$$V_P = \frac{Q}{4\pi\varepsilon_0(2R)} = \underline{\underline{1.35\,V}}$$

b) $q_1 = 4\mu C$, $m_1 = 2 \times 10^{-6}$ kg

Does the charge "fall" with constant acceleration?

<u>No</u>, the force is changing

⇒ use energy considerations

$$\Delta U_{S\to P} = U_P - U_S = qV_P - qV_S$$

$$= q\left(\frac{Q}{4\pi\varepsilon_0 R} - \frac{Q}{4\pi\varepsilon_0(2R)}\right)$$

$$= \frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{R} - \frac{1}{2R}\right)$$