I) $d << r$ $\quad \phi(r, \Theta, t) = \frac{1}{4\pi\varepsilon_0}\left\{\frac{q_0 \cos(w * (t + \frac{r_+}{c}))}{r_+} - \frac{q_0 \cos(w * (t + \frac{r_-}{c}))}{r_-}\right\}$ (

$$r_+ = \sqrt{r^2 - rd\cos\Theta + \frac{d^2}{4}} \simeq \sqrt{r^2\left(1 - \frac{d}{r}\cos\Theta\right)} = r\sqrt{1 - \underbrace{\frac{d}{r}\cos\Theta}_{\text{small}}} =$$

$$\boxed{\text{use Mc Lawrin expansion of } \sqrt{1+x} = 1 + \frac{x}{2} - \frac{x^2}{8} + \frac{x^3}{16} \cdots \; ; \; x = -\frac{d}{r}\cos\Theta}$$

$$= (\text{McLaurin expansion}) = r * \left(1 + \frac{1}{2}\left(-\frac{d}{r}\cos\Theta\right) - \frac{1}{8}\left(-\frac{d}{r}\cos\Theta\right)^2 + \right.$$

$$\left. + \frac{1}{16}\left(-\frac{d}{r}\cos\Theta\right)^3\right) \simeq r * \left(1 + \frac{1}{2}\left(-\frac{d}{r}\cos\Theta\right)\right) = r * \left(1 - \frac{d}{2r}\cos\Theta\right)$$

$$\frac{1}{r_+} = \frac{1}{r * \left(1 - \frac{d}{2r}\cos\Theta\right)} = (\text{Mc Lawrin expansion}) \simeq \frac{1}{r} * \left(1 + \frac{d\cos\Theta}{2r} + \left(\frac{d\cos\Theta}{2r}\right)^2 + \cdots\right)$$

$$\boxed{\text{Use Mc Lawrin expansion of } \frac{1}{1-x} = 1 + x + x^2 + x^3 \cdots \; ; \; x = \frac{d\cos\Theta}{2r}}$$

$$= \frac{1}{r} * \left(1 + \frac{d\cos\Theta}{2r}\right)$$