

$$I) d \ll r \quad \emptyset(r, \theta, t) = \frac{1}{4\pi\epsilon_0} \left\{ \frac{q_0 \cos(w\phi(t + \frac{r_+}{c}))}{r_+} - \frac{q_0 \cos(w\phi(t + \frac{r_-}{c}))}{r_-} \right\}$$

$$\begin{aligned} \cos\left(w\phi\left(t + \frac{r_+}{c}\right)\right) &= \cos\left(w\phi\left(t + \frac{r}{c}\left(1 - \frac{d\cos\theta}{2r}\right)\right)\right) = \cos\left(wt + \frac{wr}{c} - \cancel{rw} \frac{d\cos\theta}{\cancel{2r}}\right) = \\ &= \cos\left[wt + \frac{r}{c} + \left(\frac{w}{c} \frac{d}{2} \cos\theta\right)\right] \\ &\quad \left| \begin{array}{l} \text{use sum identities} \\ \cancel{\text{use sum identities}} \end{array} \right. \\ &= \cos\left[wt + \frac{r}{c}\right] \cos\left[\frac{w}{c} \frac{d}{2} \cos\theta\right] - \sin\left[wt + \frac{r}{c}\right] \sin\left[\frac{w}{c} \frac{d}{2} \cos\theta\right] \end{aligned}$$

$$\cancel{\text{use sum identities}} \quad \cos(a+b) = \cos a \cos b - \sin a \sin b$$

