Johannes Byle

9.6

$$U_{tid} = -GM_m m\Big(\frac{1}{d} + \frac{x}{d_0^2}\Big)$$

$$d = \sqrt{T^2 + d_0^2 - 2Td_0\cos\theta}$$

$$\frac{1}{d} = \Big(1 + \frac{d_0^2}{T^2} - \frac{2d_0\cos\theta}{T}\Big)^{-1/2}$$

$$\frac{1}{d} \approx 1 - \frac{1}{2}\Big(\frac{d_0^2}{T^2} - \frac{2d_0\cos\theta}{T}\Big)$$

$$U_{tid} = -GM_m m\Big[1 - \frac{1}{2}\Big(\frac{d_0^2}{T^2} - \frac{2d_0\cos\theta}{T}\Big) + \frac{x}{d_0^2}\Big]$$

Assuming $T \approx R_e$

$$U_{tid} = -GM_m m\Big[1 - \frac{d_0^2}{2R_e^2} - \frac{d_0\cos\theta}{R_e} + \frac{R_e\cos\theta}{d_0^2}\Big]$$

If $h_0 = \frac{3M_m R_e^4}{2M_e d_0^3}$

$$h(\theta) = h_0\cos^2\theta$$