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1) A projectile is launched straight up from the equator with an initial velocity (radial) of 6 km/sec. Will it come down in the same place or not? Substantiate your answer with a numerical calculation. Neglect the effect of atmospheric drag but include the effect of the earth's rotation.

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2) Show that for a parabolic trajectory, the time after pericenter passage is

$$t = \frac{1}{2\sqrt{\mu}}\left[pD + \frac{1}{3}D^3\right]$$

where $D = \sqrt{p}\, tan\frac{\theta}{2}$.

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3) Starting with the relation

$$\bar{\boldsymbol{r}} \cdot \frac{d\bar{\boldsymbol{r}}}{dt} = r\frac{dr}{dt}$$

show that for a parabolic trajectory

$$\bar{\boldsymbol{r}} \cdot \bar{\boldsymbol{V}} = \sqrt{\mu p}\,\frac{sin\theta}{1 + cos\theta} = \sqrt{\mu p}\,\tan\frac{\theta}{2}$$

and that the parabolic eccentric anomaly

$$D = \frac{\bar{\boldsymbol{r}} \cdot \bar{V}}{\sqrt{\mu}}$$

The above equation is a convenient expression to calculate D if $\bar{\boldsymbol{r}}$ and $\bar{\boldsymbol{V}}$ are known.

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4) Curtis (4.22)
