
at $: \theta=0, v=v_{\rho}=v_{0}$
$v=r \dot{\theta}=r_{p} \dot{\theta}, \dot{r}=0$
$r=r_{p}, \dot{\theta} \neq 0$
$-r^{-2} \dot{r}=-C \dot{\theta} \sin \theta+D \dot{\theta} \cos \theta$

$$
0=O+D \dot{\theta}=D \dot{\theta}
$$

$$
\frac{1}{r}=C \cos \theta+\frac{G M}{\hbar^{2}}
$$

$$
\therefore D=0
$$

at Q: $\theta=\pi, v=v_{Q}=r_{Q} \dot{\theta}, \dot{\theta} \neq 0, r=r_{a}$

$$
\frac{1}{r}=\frac{G M}{h^{2}}+c \cos \theta \quad \frac{1}{r}=\frac{G M}{h^{2}}\left(1+\frac{c h^{2}}{G M} \operatorname{coc} \theta\right)
$$

Let $\varepsilon=\frac{c h^{2}}{G M} \quad \frac{1}{r}=\frac{G M}{h^{2}}(1+\varepsilon \cos \theta)$

$$
\frac{1}{r_{Q}}=\frac{G M}{h^{2}}(1+\varepsilon \cos \pi)=\frac{G M}{h^{2}}(1-\varepsilon) \quad V_{1} \cdot \cdots I .
$$

at P: $\theta=0, r=r_{p}$

$$
\begin{gathered}
\frac{1}{r_{p}}=\frac{G M}{h^{2}}(1+\varepsilon \cos 0)=\frac{G M}{h^{2}}(1+\varepsilon) \\
\frac{1}{r_{p}}+\frac{1}{r_{Q}}=\frac{G M}{h^{2}}(1-\varepsilon+1-\varepsilon)=\frac{2 G M}{h^{2}} \\
\frac{1}{r_{p}}+\frac{1}{r_{Q}}=\frac{2 G M}{h^{2}} \quad \text { V.V...I. }
\end{gathered}
$$

$\Sigma=0$ : circular orbit
$0<\varepsilon<1$ : elliptic orbit.
$\left.\begin{array}{l}\varepsilon>1: \text { hyperbolic trajectory } \\ \Sigma=1: \text { parabolic trajectory }\end{array}\right\} \begin{aligned} & \text { P. } 541 \\ & \text { of } \\ & \text { text, }\end{aligned}$

$$
\varepsilon=\frac{c}{a}=\frac{\frac{1}{2}\left(r_{Q}-r_{p}\right)}{\frac{1}{2}\left(r_{Q}+r_{p}\right)} \quad \Sigma=\frac{r_{Q}-r_{p}}{r_{Q}+r_{p}}
$$

A epacirsapt is in a circular orbit of altitude 100 mi above the surface of the earth. Determine its period of orbit $\tau$

$$
\begin{aligned}
& r_{p}=r_{Q}=r \quad \frac{1}{r}+\frac{1}{r}=\frac{2 G+1}{h^{2}} \quad \frac{2}{r}=\frac{2 G M}{h^{2}} \\
& h^{2}=G M r \quad \text { On enifece of the earth: } W=m g=\frac{G^{\text {Nim }}}{R^{2}} \\
& G M=g R^{2} \quad g=32.2 \mathrm{t} / \mathrm{R}^{2}, \quad R=3960 \mathrm{mi} \\
& \tau=\frac{\pi\left(r_{p}+r_{2}\right) \sqrt{r_{p} r_{\alpha}}}{h}=\frac{\pi(r+r) r}{h}=\frac{2 \pi r^{2}}{h} \\
& \tau^{2}=\frac{4 \pi^{2} r^{4}}{\hbar^{2}}=\frac{4 \pi^{2} r^{4}}{4 M r}=\frac{4 \pi^{2} r^{3}}{g R^{2}}, \begin{array}{l}
r=R+100 \mathrm{mi} \\
\\
=4060 \mathrm{mi}
\end{array} \\
& \left.\begin{array}{rl}
\tau^{2}=\frac{4 \pi^{2}(4060)^{3}}{\frac{32.2}{5280}(3960)^{2}} & \tau
\end{array}\right)=5250 \mathrm{~A}, \\
& \tau=1.46 \text { hours }
\end{aligned}
$$

