(3) $r = a(1+\cos\theta)$.

$$\frac{dr}{d\theta} = a(-\sin\theta)$$

Wehare $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left[\frac{dr}{d\theta}\right]^2$

$= \frac{1}{r^2} + \frac{1}{r^4}(-a\sin\theta)^2$

$--=+$
$(-a)^2 a^2$

$= \frac{1}{r^2} + \frac{a^2}{r^4}(\sin^2\theta)$

$$\boxed{\frac{1}{p^2} = \frac{1}{r^2} + \frac{a^2}{r^4}(1-\cos^2\theta)} - (1)$$

Given $r = a(1+\cos\theta)$

$\frac{r}{a} = (1+\cos\theta)$

$\cos\theta = \frac{1 \mp r}{a} = \boxed{\frac{a \mp r}{a}}$ - (2)

Substituting eq (2) in (1) we get.

$\frac{1}{p^2} = \frac{1}{r^2} + \frac{a^2}{r^4}\left[1 - \left[\frac{a \mp r}{a}\right]^2\right]$

$= \frac{1}{r^2} + \frac{a^2}{r^4}\left[1 - \frac{(a \mp r)^2}{a^2}\right]$

$= \frac{1}{r^2} + \frac{a^2}{r^4}\left[\frac{a^2 - [a^2 + r^2 \mp 2ar]}{a^2}\right]$

$= \frac{1}{r^2} + \frac{a^2}{r^4}\left[-a^2 - r^2 + 2ar\right]$

$= \frac{1}{r^2} + \frac{2ar}{r^4} - \frac{r^2}{r^4} = \frac{1}{r^2} + \frac{2a}{r^3} - \frac{1}{r^2}$

$\frac{1}{p^2} = \frac{2a}{r^3}$

$$\boxed{2ap^2 = r^3}$$ //