263(5) : Checking Calculation

$$v^2 = \omega^2 r^2 \left(1 + \left(\frac{dr}{d\theta}\right)^2\right)$$

$$= \omega^2 r^2 \left(1 + \frac{\epsilon^2 r^4}{\alpha^2} \sin^2\theta\right)$$

where $\sin^2\theta = 1 - \cos^2\theta$

and $\cos^2\theta = \frac{1}{\epsilon^2}\left(\frac{\alpha}{r} - 1\right)^2$.

So $v^2 = \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{\epsilon^2}{\alpha^2} - \frac{1}{\alpha^2}\left(\frac{\alpha}{r} - 1\right)^2\right)$

$= \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{\epsilon^2}{\alpha^2} - \frac{1}{\alpha^2 r^2}(\alpha - r)^2\right)$

$= \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{\epsilon^2}{\alpha^2} - \frac{1}{\alpha^2 r^2}(\alpha^2 - 2r\alpha + r^2)\right)$

$= \frac{L^2}{m^2}\left(\frac{\epsilon^2}{\alpha^2} + \frac{2}{\alpha r} - \frac{1}{\alpha^2}\right)$

$= \frac{L^2}{m^2\alpha}\left(\left(\frac{\epsilon^2 - 1}{\alpha}\right) + \frac{2}{r}\right)$

$= \frac{L^2}{m^2\alpha}\left(\frac{2}{r} - \frac{1}{a}\right) = mG\left(\frac{2}{r} - \frac{1}{a}\right)$

Here $L = mr^2\omega$

so $v^2 = \frac{r^4\omega^2}{\alpha^2}\left(\frac{2}{r} - \frac{1}{a}\right)$

this is the corrected eq. (34)