Astro HW 3

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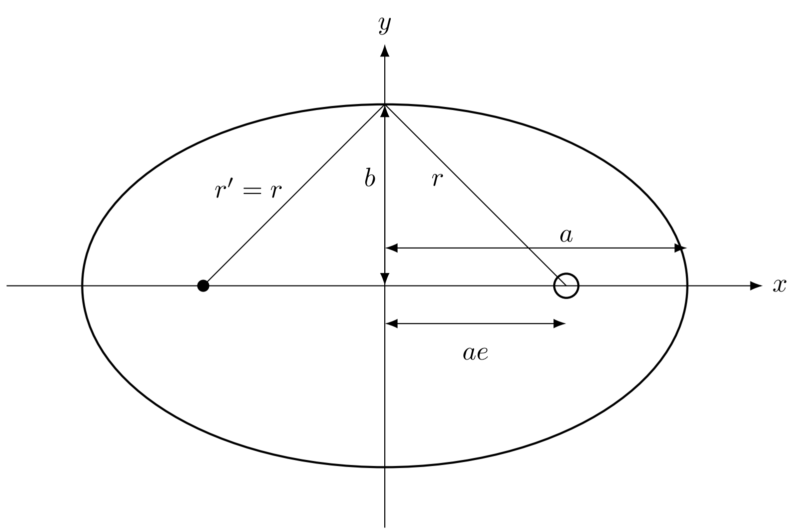
3.1

3.1.1

$$r_{pe} = ae - a$$

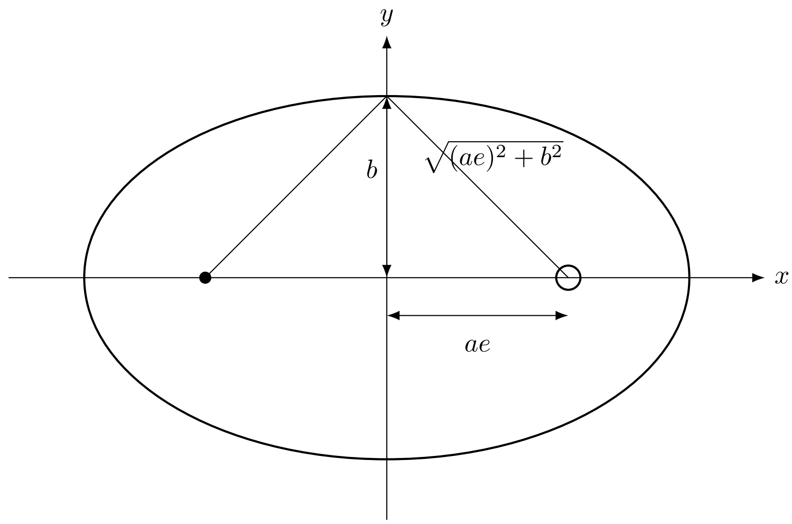
$$r_{pe} = a(e - 1)$$



$$r_{pa} = ae - a$$

$$r_{pa} = a(e + 1)$$

3.1.2



$$e^2 = b^2 + (ae)^2$$

$$\frac{a^2 - b^2}{a^2} = e^2$$

$$\sqrt{1 - \frac{b^2}{a^2}} = e$$

3.1.3

$$r_{pe} = a(1 - .4103) = .4276au$$

$$r_{pa} = a(1 + .4103) = 1.0206au$$

if p_{pe} is less than earths radius and r_{pa} is greater than earths radius, at some point it must cross earths orbit.

3.1.4

$$t = 2\pi \frac{a^3}{GM}$$

$$t = 2\pi \sqrt{\frac{4.33 \times 10^{13}}{6.67 \times 10^{-11} \times 1.988 \times 10^{30}}}$$

$$t \approx 1804385days \approx 4940.13years$$

3.2

3.2.1

$$E = k + u$$

$$k = \frac{1}{2}m(\frac{GMm}{L})^2(1 + e^2 + 2e\cos\theta)$$

$$u = -\frac{(GM)^2m^3}{L^2}(1 + e\cos\theta)$$

$$E = \frac{1}{2}m(\frac{GMm}{L})^2(1 + e^2 + 2e\cos\theta) - \frac{(GM)^2m^3}{L^2}(1 + e\cos\theta)$$

$$E = (\frac{G^2m^2m^3}{L^2})(\frac{1}{2} + \frac{e^2}{2} + e\cos\theta - 1 - e\cos\theta)$$

$$E = (\frac{G^2m^2m^3}{L^2})(\frac{1}{2} + \frac{e^2}{2} + \cancel{e\cos\theta} - 1\cancel{- e\cos\theta})$$

$$E = (\frac{G^2m^2m^2}{L^2})(\frac{m}{2})(e^2 - 1)$$

ran out of time to transcribe the rest into LaTeX, rest is photos