PEU 416 Assignment 4

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1 Problem 1

$$\sin\theta \approx \theta - \frac{\theta^3}{6} + \frac{\theta^5}{120}$$

$$\theta - \sin\theta \approx \frac{\theta^3}{6} - \frac{\theta^5}{120}$$

$$9(\theta - \sin\theta)^2 \approx \frac{\theta^6}{4} - \frac{\theta^8}{40}$$

$$2(1 - \cos\theta)^3 \approx \frac{\theta^6}{4} - \frac{\theta^8}{16}$$

$$1 + \delta = \frac{\frac{\theta^6}{6} - \frac{\theta^8}{120}}{\frac{\theta^6}{4} - \frac{\theta^8}{16}}$$

For small θ

$$1 + \delta \approx \left(1 - \frac{\theta^2}{10}\right)\left(1 + \frac{\theta^2}{4}\right) \approx 1 + \frac{3}{20}\theta^2$$

$$\delta \approx \frac{3}{20}\theta^2$$

$$t = B(\theta - \sin\theta) \approx B\frac{\theta^3}{6}$$

$$\theta \approx \left(6\frac{t}{B}\right)^{\frac{1}{3}}$$

$$t_{i,\ \max} = B(\pi - \sin\pi) = B\pi$$

$$\theta^2 = (6\pi)^{\frac{2}{3}}\left(\frac{t_i}{t_{i,\ \max}}\right)^{\frac{2}{3}}$$

$$\delta_i = \frac{3}{20}(6\pi)^{\frac{2}{3}}\left(\frac{t_i}{t_{i,\ \max}}\right)^{\frac{2}{3}}$$

2 Problem 2

(a)
$$\sigma^2 = \langle M^2 \rangle - \langle M \rangle^2 = \frac{\langle M \rangle^2}{V^2} \int_V \xi(|\vec{x}_1 - \vec{x}_2|) d^3\vec{x}_1 d^3\vec{x}_2$$

(b)

3 Problem 3

(a)

(b)

(c)

4 Problem 4

(a)
$$M = \frac{4}{3}\pi r_i^3 \rho_i = \frac{4}{3}\pi r_i^3 \bar{\rho}_i(1 + \delta_i)$$

$$\ddot{r} = -\frac{G \cdot \frac{4}{3}\pi r_i^3 \bar{\rho}_i(1 + \delta_i)}{r^2}$$

$$\frac{\ddot{r}}{r} == -\frac{4\pi G\bar{\rho}_i}{3}(1 + \delta_i)\left(\frac{r_i}{r}\right)^3$$

(b)
$$\ddot{r} = -\frac{4\pi G\bar{\rho}_i}{3}(1 + \delta_i)\frac{(r_i)^3}{(r)^2}$$

$$\dot{r}\ddot{r} =$$

(c)

(d)

(e)

References

[1] M. El-Deeb, "PEU-405 Assignments." [Online]. Available: https://github.com/mhdeeb/peu-assignments/tree/main/peu-405