Celestial Mechanics – Exercises

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Unit 3

Problem 3.1

Consider Neptune and Pluto. The orbital periods and eccentricities of these objects are:
Neptune: $P_{\rm N} = 165$ years, $e_{\rm N} = 0.00$; Pluto: $P_{\rm P} = 248$ years, $e_{\rm P} = 0.25$.

(a) Compare the minimum and the maximum distances of Neptune and Pluto from the Sun. (**1 point**)
(b) Could Pluto collide with Neptune? Which other criteria must be fulfilled for such a collision to occur? (**1 point**)
(c) Determine the ratio of Pluto's orbital velocities at its pericenter and apocenter. (**1 point**)

Problem 3.2

Imagine you are standing on a non-rotating spherical asteroid – that would be cool, right? ;) – with a radius R and mean density ρ, and you are throwing a stone at an angle α and a velocity v away from the surface. If the stone enters an elliptic orbit (that will eventually lead to fallback), what will be the semi-major axis and the eccentricity of that orbit? (**2 points**)

Bonus: at which distance from the starting point will the stone fall back to the surface? (**+1 point**)

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