Astronomy Club,IIT K
SnT Summer Project
Blast Off
Assignment 1

Submission Deadline: 23:59:59, 12/06/2022

Try to attempt all the questions

1. Chirag possibly discovered a new asteroid in the asteroid belt. He found that it was lying in the elliptic plane.He made a few observations of that body and found it's coordinates in heliocentric elliptic coordinate system with X axis aligned parallel to axis passing through sun's center and vernal equinox.

Table 1: Table with observed coordinates of the object in AU.

S.no	**X**	**Y**
1	-0.30738	-0.62208
2	3.69262	3.37792
3	4.69262	0.37792
4	3.69262	-0.62208
5	5.69262	3.37792
6	0.69262	2.37792

   (a) Find the possible equation of the trajectory of the body(assuming it to be a ellipse) in the orthogonal coordinate frame used in the problem.Mention the eccentricity and the length of the semi-major axis of the orbit.

   (b) Also find the minimum distance between the object and earth assuming it is at it's apogee on the day of vernal equinox.(Assume the orbit of earth to be circular orbit of radius 1 AU)

2. A suborbital low altitude sounding rocket is launched from the the surface of earth to take atmospheric measurements.It remains vertical throughout the flight,neglecting drag and assuming constant exhaust velocity w.r.t to rocket u_e , specific impulse I_{sp} , fuel burnout time t_b find :

   (a) Speed of rocket u as function of time assuming constant fuel rate $\dot{m}$ accounting for earths constant gravitational pull g_o.

   (b) Altitude of rocket at burnout time t_b and it's maximum altitude

3. Yondu and his friends are held captives in a spaceship (of mass m, moving with velocity v, w.r.t. some inertial frame). They somehow break free and decide to escape, on a quadrant of the of the spaceship (of mass $m/5$). He has planted a bomb on the main ship, that'll explode exactly t_0 secs after the quadrant is detached, resulting in debris flying everywhere with speed $v/2$ w.r.t. the CoM of the remaining ship. Since the more the thrusters are used, the more they wear down, calculate the minimum fuel rate $\dot{m}$ that can result in them escaping the sphere of destruction.

   Additional information, if required:

   - I_{sp} = Specific impulse of the boosters
   - u_e = Exhaust speed (w.r.t. the spaceship quadrant)