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Problem B

Introduction

During the attempt to make contact with the small asteroid, Ryugu, The team that was handling the Japanese probe had to jump through many hoops to overcome technical challenges. As secondhand witnesses, We look for a way to efficiently traverse the asteroid. The mission of the space probe is to explore the surface of the asteroid, then collect the sample for return to Earth. The average asteroid is not spherical, this terrain is odd and rugged. For an efficient traverse, the probe would need modifications before the mission to attempt maximum productivity.

Asteroid

The asteroid we selected is Bennu, discovered on September 11, 1999, considered to be a “rubber pile”: smaller fragments of a large asteroid coming together. It is located 340 km away from Earth. Bennu is composed of carbon and has a radius of approximately 246 meters. Using our equations we concluded that a probe with a 50m search radius will theoretically complete its exploration in 97 jumps.

Idea [Probe]

The first idea was the anchor or harpoon which the probe will launch as a grappling hook to land on the probe. The problem with this idea is that the probe needs the wheels, and the process of exploration will take a very long time to finish. Another idea was the large magnet that will attract the probe into the asteroid. The problem with this idea is that the magnet field is too short to attract the probe.

Final Idea [Probe]

The probe will have four main legs with spring to bounce around the asteroid. The large spring on the center will be an optional part to operate in case if there are any bumps in the center. Additionally, each leg will have a rotational foot to maneuver the bounce.

Equation

$$4\pi R^2 = nr^2 \quad n = \frac{4R^2}{r^2} \quad R = \frac{r}{2}(\sqrt{n}) \quad r = \frac{2R\sqrt{n}}{n}$$

R = Asteroid Radius

r = Probe search radius

n = Theoretical minimum number of jumps