ADVANCED PHYSICS CLUB

FEBRUARY 28, 2021

Useful resources

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2020`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

Today's homework concludes our discussion of mechanics with gravity and Kepler laws. Once again, it consists of two parts: problems we discussed last year and problems which we did not discuss last year.

Homework part I

1. a) Find the mass of the Earth knowing the free fall acceleration on its' surface g =9.8 m/s^2 and its' radius $R = 6370$ km . b) Find the escape velocity for the Earth.

2. A satellite is orbiting the Earth with velocity v. Which additional velocity should be given to the satellite so that it could escape the Earth gravity completely?

3. The largest distance from the Sun to the Halley comet is $35.4R_E$, and the smallest distance is $0.6R_E$ where R_E is the radius of Earth's orbit. Last time it was observed near the Sun in 1986. Which year would it be observed near the Sun next time? What is the ratio of velocities of the comet in these two points (the farthest from and the closest to the Sun).

4. A rocket is approaching the Moon. When it was far from the Moon (and all other celestial bodies), it had zero velocity relative to the Moon. At what height above the Moon's surface should it turn on the braking engine creating acceleration $5g$ so that the landing is smooth? Neglect mass change of the rocket. Moon's radius is around 1700 km, free fall acceleration on its' surface is 6 times smaller than on the Earth.

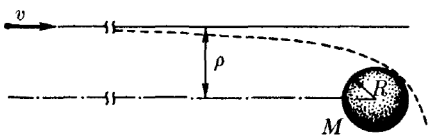
***5.** If the Earth suddenly stopped its' orbital motion, how long would it take it to fall on the Sun? Express your answer in years.

Homework part II

6. How long would an Earth's year be if mass of the Earth was equal to mass of the Sun and the distance between them stayed the same?

***7.** A small object is at the center of an asteroid in a straight tunnel going all the way to the surface of the asteroid. Mass of the asteroid is m, its' radius is R. What speed should be given to the object so it could escape the asteroid completely?

***8.** A space probe approaches a planet of mass M and radius R from far away with a relative speed v. At what impact parameter ρ (see the figure) the space probe will fly the closest to the planet without crashing?



For the next meeting

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **March 7**.