



ADVANCED PHYSICS CLUB

FEBRUARY 9, 2020

TODAY'S MEETING

Today we discussed some problems from PhysicsBowl 2017 exam. We solved the homework problem on oscillations from the last meeting. Then we discussed the force of gravity. We've also discussed Kepler's laws.

We solved the following problems in class.

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

HOMEWORK PROBLEMS

1. (This problem was partially discussed, but finish it!)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)?
2. 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.
- *3. If the Earth suddenly stopped its' orbital motion, how long would it take it to fall on the Sun? Express your answer in years.
- *4. Imagine there is a straight narrow tunnel dug through the Earth from one pole to the other. What time would it take a stone to fly from one end to the other? Neglect air resistance, assume the Earth density to be constant. Earth's radius is 6400 km. (Hint: to solve this problem you need to know the gravitational field inside the Earth. The correct way to find it is to ignore the "outside layers" completely - only take into account what's closer to the center than the point where you calculate the gravity).

IMPORTANT

The next club meeting is on February 23, 2020. We will continue discussing the PhysicsBowl exam.