ADVANCED PHYSICS CLUB

FEBRUARY 5, 2023

USEFUL RESOURCES

TODAY'S MEETING

Today we finished the assignment on harmonic motion. The next topics are the universal law of gravity and Kepler's laws.

HOMEWORK

1. What is the value of free fall acceleration 400 km above the surface of the Earth (corresponding to the orbit of the International Space Station, ISS)? Radius of the Earth is 6400 km. Why do astronauts on board the ISS experience weightlessness?

2. Find the mass of the Sun knowing that Earth's orbit is circular with the radius $R = 1.5 \cdot 10^8$ km and period of Earth's rotation around the Sun is one year.

3. The two stars in a binary system have mass m_1 and m_2. The distance between the stars is constant and is equal to R. Find the period of the system's revolution around its center of mass.

4. A rocket at the surface of a planet is provided with the speed exceeding the escape velocity v_e of this planet by 0.5%. When the rocket gets very far away from the planet it has speed v_f. What is the ratio $\dfrac{v_f}{v_e}$?

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.

*6. Some sci-fi book describes a cosmic ship doomed to fall on the Sun due to a small error in its' initial velocity. What is the minimal possible velocity of the spaceship at the surface of the Earth for which such scenario is possible? Assume that the engines only fire for a very short period of time at the start to provide the spaceship with that initial velocity.

*7. A space probe approaches a planet of mass M and radius R from far away having speed v relative to the planet. At what impact parameter ρ (which is defined on the figure) the space probe will fly as close as possible to the planet's surface without crashing?
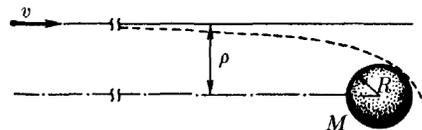
FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **February 12**.