Physics 203 Lecture 1

Jun 24, 2013

1. An earthbound sibling observers her twin to depart from earth at a speed 60% the speed of light. After 10.0 years, the travelling twin returns having travelled 3.0 light-years and back. (a) Calculate the proper time the travelling twin was aboard the spaceship. (b) From the traveler's vantage point, the earth-bound twin's clocks tick slow. How much time does she observe to pass on earth? (c) During the moment of acceleration 3.0 light-years out, the clocks aboard ship go out of synch with those on earth. Calculate how far ahead the desynchronization put the clocks on the ship.

(a) 8.0 yr
(b) 6.4 yr
(c) 3.6 yr

2. We are used to ignoring the effect of the centrifugal force from the earth's rotation in most of our problems. What is the ratio of this centrifugal force to an object's weight?

0.34%

3. Halley's comet has a highly elongated orbit. The eccentricity of its orbit is 0.967 with a distance of closest approach equal to 0.586 AU. (a) What is the maximum distance Halley's comet reaches before it turns around toward the sun? Express your answer in units of AU. (For reference, Neptune's average distance from the sun is 30 AU.) (b) When distances are measured in astronomical units (AU) and time is measured in years, Kepler's Third Law simplifies to $T^2 = a^3$ for orbits around the sun. Determine the period of Halley's comet in years. (Hint: Halley's original estimate was 76 years).

(a) 34.9 AU
(b) 74.8 yr

4. A compass with a magnetic moment of 1.0 A-m^2 is oriented at NNE relative to the Earth's 50 micro-tesla magnetic field. Calculate the torque applied to this compass.

1.9×10^{-5} N-m

5. An evil genius wants to shrink the Moon in order to steal it. He accidentally shrinks its below it Schwarzschild radius and the Moon is lost forever in a mini-black hole. What is this radius?

0.109 millimeters

6. A certain mass spectrometer is designed with a radius of 0.50 meters using a magnetic field of 2.0 tesla. What electric voltage is required to accelerate a doubly ionized ozone molecule to travel through the spectrometer?

4.0 MV

7. An electron is travelling east at a speed of 100 m/s. It encounters a magnetic field pointing north. What magnitude of magnetic field is required to overcome the acceleration due to gravity effectively levitating the electron?

5.57×10^{-13} tesla