PHY101, Problem solving session
Instructor: Goutam Sheet

Time Limit: None, Maximum points: 00

The first two problems were discussed in the class.

1. A rocket based observer (uniform speed) and her ground (Earth) based twin set their respective clocks to zero at the instant they crossed each other. Sometime later, the ground based twin observes the rocket's clock through a powerful telescope. She finds that the rocket's clock is 4 O'clock while her own clock (with her) is showing 5 O'clock. What is the speed of the rocket with respect to the Earth?

2. Alice has two clocks - one at her origin and another 8 light-hours away. She synchronized the clocks. Bob rushes past her (in the direction of the second clock) on a rocket ship at a speed of 0.8c at the moment her clock is showing 0, and sets his clock to 0 at that instant. What do Bob's and Alice's clocks show when he is just beside the second clock? From these clock readings, calculate the speed of Alice's clocks as observed by Bob.

3. A train of proper length L_0 is approaching a station at a speed $\beta c/$. Light signals emitted by the front and the back-ends of the train reach an observer on the station simultaneously. Calculate the distance between the points of emission of the light signals, as measured by a stationary observer.

4. Find the moment of inertia and products of inertia of a uniform right angled triangle bounded by the x-axis, y-axis and the line $x+y=a$ about the coordinate axes. Calculate the principal moments of inertia and the principal axes.

5. Observer A, standing on Earth, sends out pulsed signals using a laser pointer every six minutes. Observer B is on a space station that is stationary with respect to Earth at a distance of 60 light-minutes. C is in a rocket travelling from A to B with a velocity $v = 0.6c$ relative to A. At what time intervals will B and C receive the pulsed laser signals?

6. In continuation of the problem above, if C sends light pulses back to A at six minute intervals, at what intervals will A receive the pulses?

7. A uniform cylinder of radius R is made to rotate with an angular velocity $omega_0$ about its axis and then gently placed on the floor such that it also touches a vertical wall. The coefficient of friction between the cylinder and the surfaces of the wall and the floor is μ. How many turns will the cylinder complete before it stops?

8. Find the torque needed to rotate a rectangular plate of mass M and of sides a and b about a diagonal with a constant angular velocity ω.