Team Homework 5
Due: 11/23/2005

Names:

1. Use vectors to prove that the line segment joining the midpoints of two sides of a triangle is parallel to the third side and half as long.

2. Derive the polar coordinate curvature formula

$$\kappa = \frac{|r^2 + 2(r')^2 - rr''|}{(r^2 + (r')^2)^{\frac{3}{2}}}$$

where the derivative of r is with respect to θ.

3. A ball rolls off a table 4 ft high while moving at a constant speed of 5 ft/sec.

(a) How long does it take for the ball to hit the floor after it leaves the table?

(b) At what speed does the ball hit the floor?

(c) If a ball were dropped from table height (initial speed 0) at the same time the rolling ball leaves the table, which ball would hit the ground first?

4. The nuclear accelerator at the Enrico Fermi Laboratory is circular with a radius of 1 km. Find the scalar normal component of acceleration of a proton moving around the accelerator with a constant speed of 3×10^5 km/sec.

5. A clothesline is tied between two poles, 8 m apart. The line is quite taut and has negligible sag. When a wet shirt with a mass of 0.8 kg is hung at the middle of the line, the midpoint is pulled down 8 cm. Find the tension in each half of the clothesline.

6. Two thieves decide to steal a safe. In order to get the safe into their truck they need to slide it (along a frictionless floor) 10 meters. The first thief stands behind the safe and pushes on it at a downward angle of 30 degrees while the second thief stands in front of the safe and pulls on it at an upward angle of 40 degrees. The force of the first thief is 320 N and the force of the second thief is 250 N.

(a) What is the total work done on the safe by the thieves?

(b) What is the work done on the safe by the force of gravity as the safe is slid along the floor?