ME31 Examination 1  
Wednesday, October 14, 2009  
Total Marks: 25; Time: 11.30-12.20 hrs

To get full credit for your answers, provide proper units.

Name:

Problem 1. (8 points)
A model rocket is launched from point A with an initial velocity $v_0 = 86 \text{ m/s}$. If the rocket's descent parachute does not deploy and the rocket lands 104 m from A, determine (a) the angle $\alpha$ that $v_0$ makes with the vertical, (b) the maximum height $h$ reached by the rocket, and (c) the duration of the flight.

Problem 2. (7 points)
The pin follows the path described by the equation $r = (0.2 + 0.15 \cos \theta) \text{ m}$. Determine the magnitudes of the pin’s velocity and acceleration at the instant $\theta = 30^\circ$, $\dot{\theta} = 0.7 \text{ rad/s}$ and $\ddot{\theta} = 0.5 \text{ rad/s}^2$. Given $\vec{\tau} = \dot{r}\hat{e}_r + r\dot{\theta}\hat{e}_\theta$ and $\vec{\tau} = (\ddot{r} - r\dot{\theta}^2)\hat{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{e}_\theta$.

Problem 3. (10 points)
A 40 kg package is at rest on an incline when a force $P$ is applied to it. Determine the magnitude of $P$ if 4 sec is required for the package to travel 10 m up the incline. The static and kinetic coefficients of friction between the package and the incline are 0.30 and 0.25, respectively.