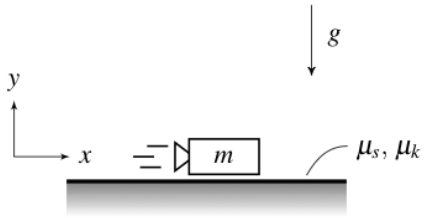
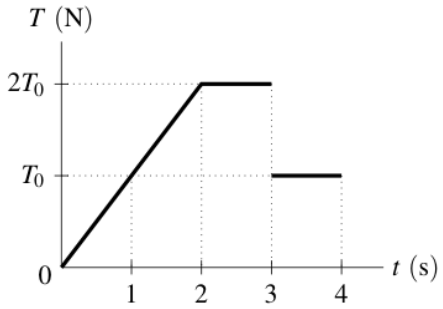
Department of Mechanical Engineering
University of California at Berkeley
ME 104 Engineering Mechanics II
Spring Semester 2010

Instructor: F. Ma
Midterm Examination No. 2 April 2, 2010

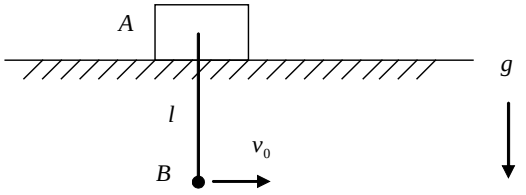
The examination has a duration of 50 minutes.
Answer all questions.
All questions carry the same weight.

1. A block with mass $m = 4\,\text{kg}$ is initially at rest at time $t = 0$ on a rough horizontal surface with coefficients of static and kinetic friction given by $\mu_s = 0.5$ and $\mu_k = 0.25$, respectively. A small booster attached to the block ignites at $t = 0$ and generates a variable thrust $T(t)$ for 4 s, as illustrated below. Let $T_0 = 20\,\text{N}$ and gravitational acceleration $g = 10\,\text{m/s}^2$.
   (a) Draw a free-body diagram for the block.
   (b) When does the block begin to move?
   (c) How fast is the block moving at $t = 4\,\text{s}$?




2. Ball *B*, of mass $m_B$, is suspended from a cord of length *l* attached to cart *A*, of mass $m_A$, which can roll freely on a frictionless horizontal track. If the ball is given an initial horizontal velocity $v_0$ while the cart is at rest, determine (a) the velocity of *B* as it reaches its maximum elevation, and (b) the maximum vertical distance *h* through which *B* will rise. It is assumed that $v_0^2 < 2gl$.




3. The slender rod rolls without slipping on a circular disk which has a constant angular velocity $\omega_0$. End *A* is constrained to move on a smooth horizontal surface as $\theta$ decreases. Determine the angular velocity $\omega$ of the rod in terms of $\omega_0$ when $\theta = 70°$.