

Sample Midterm 1

There are three problems, worth 33 points each. You must show your work to receive full credit.

1. A window is 1.5 m high. A rock thrown upward from somewhere below the window is observed to take 0.10 s to go from the bottom of the window to the top of the window.

(a) (8 points) Draw a motion diagram for the rock showing its motion from the bottom of the window to the top of its trajectory.

(b) (25 points) Find the top of the rock's trajectory as measured from the top of the window.

2. A block of mass 0.30 kg is on an inclined plane that makes an angle of 60° above the horizontal. The coefficients of friction between the block and the plane are $\mu_s = 0.60$ and $\mu_k = 0.20$. A *horizontal* force is applied to the block to keep it from sliding down the plane.

(a) (10 points) Draw a free-body diagram for the block showing all forces acting on the block. Clearly indicate the physical origin of each of the forces.

(b) (23 points) What is the minimum horizontal force that must be applied to the block to keep it from moving?

3. (33 points) An unknown car left skid marks 3.5 m long while coming to a stop. As an accident investigator, you know that car tires have coefficients of friction in the range $0.3 \leq \mu_k \leq 0.4$ and $0.5 \leq \mu_s \leq 0.7$. What is the minimum and maximum possible speed of the car before it hit the brakes?