

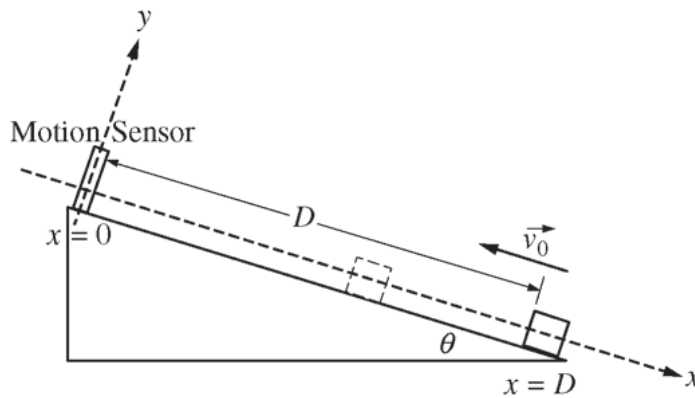
PHYSICS C: MECHANICS

SECTION II

Time—45 minutes

3 Questions

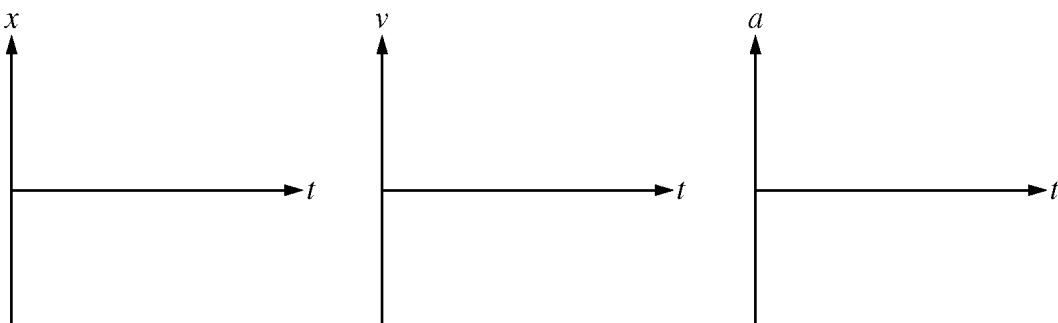
Directions: Answer all three questions. The suggested time is about 15 minutes for answering each of the questions, which are worth 15 points each. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part.



Mech.1.

A block of mass m is projected up from the bottom of an inclined ramp with an initial velocity of magnitude v_0 . The ramp has negligible friction and makes an angle θ with the horizontal. A motion sensor aimed down the ramp is mounted at the top of the incline so that the positive direction is down the ramp. The block starts a distance D from the motion sensor, as shown above. The block slides partway up the ramp, stops before reaching the sensor, and then slides back down.

- Consider the motion of the block at some time t after it has been projected up the ramp. Express your answers in terms of m , D , v_0 , t , θ and physical constants, as appropriate.
 - Determine the acceleration a of the block.
 - Determine an expression for the velocity v of the block.
 - Determine an expression for the position x of the block.
- Derive an expression for the position x_{min} of the block when it is closest to the motion sensor. Express your answer in terms of m , D , v_0 , θ , and physical constants, as appropriate.
- On the axes provided below, sketch graphs of position x , velocity v , and acceleration a as functions of time t for the motion of the block while it goes up and back down the ramp. Explicitly label any intercepts, asymptotes, maxima, or minima with numerical values or algebraic expressions, as appropriate.



- After the block slides back down and leaves the bottom of the ramp, it slides on a horizontal surface with a coefficient of friction given by μ_k . Derive an expression for the distance the block slides before stopping. Express your answer in terms of m , D , v_0 , θ , μ_k , and physical constants, as appropriate.
- Suppose the ramp now has friction. The same block is projected up with the same initial speed v_0 and comes back down the ramp. On the axes provided below, sketch a graph of the velocity v as a function of time t for the motion of the block while it goes up and back down the ramp, arriving at the bottom of the ramp at time t_f . Explicitly label any intercepts, asymptotes, maxima, or minima with numerical values or algebraic expressions, as appropriate.

