

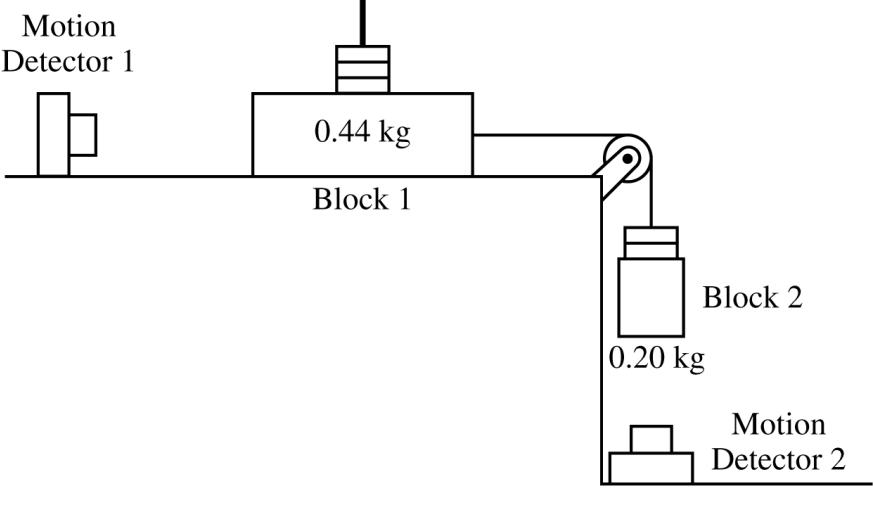
PHYSICS C: MECHANICS

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.



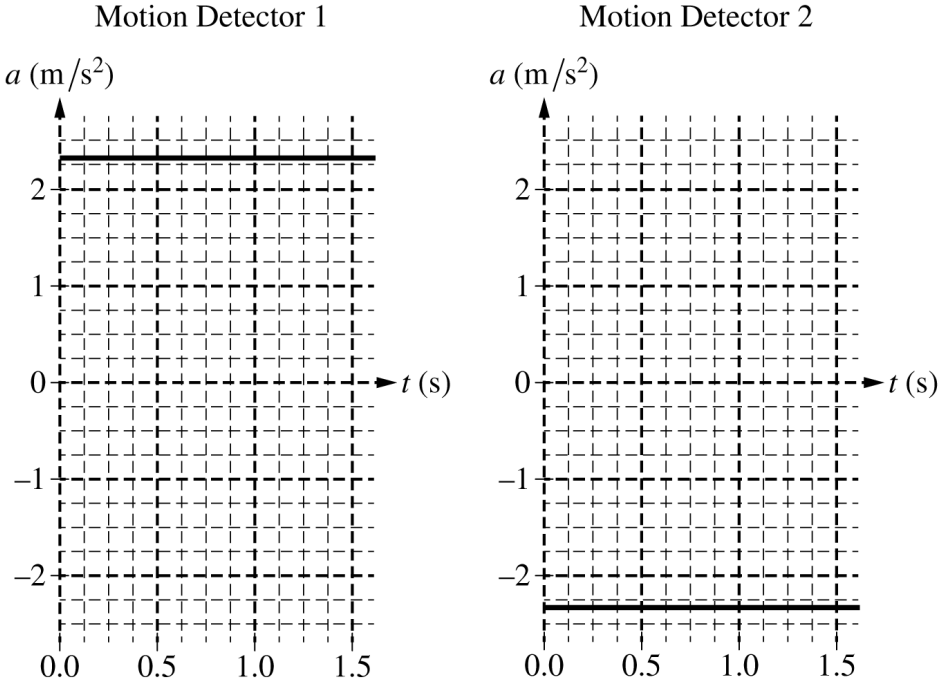
Students design an experiment using blocks of adjustable mass to investigate friction using the setup shown. Block 1 of initial mass 0.44 kg is placed on a rough horizontal surface and connected by a string to block 2 of initial mass 0.20 kg. The string extends over a pulley that has negligible mass and friction.

(a) Calculate the minimum value of the coefficient of static friction μ_s that would keep the two-block system at rest.

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The coefficient of friction is such that when block 2 is released from rest, block 1 travels across the surface. The acceleration a of each block is recorded with motion detectors 1 and 2, as shown in the figure. The data for the motion detectors as functions of time t are shown on the graphs. For each motion detector, the positive direction is away from the detector.



(b) On the dots below, which represent the blocks, draw and label the forces (not components) that act on each block. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot.



(c) Calculate the coefficient of kinetic friction μ_k between block 1 and the table.

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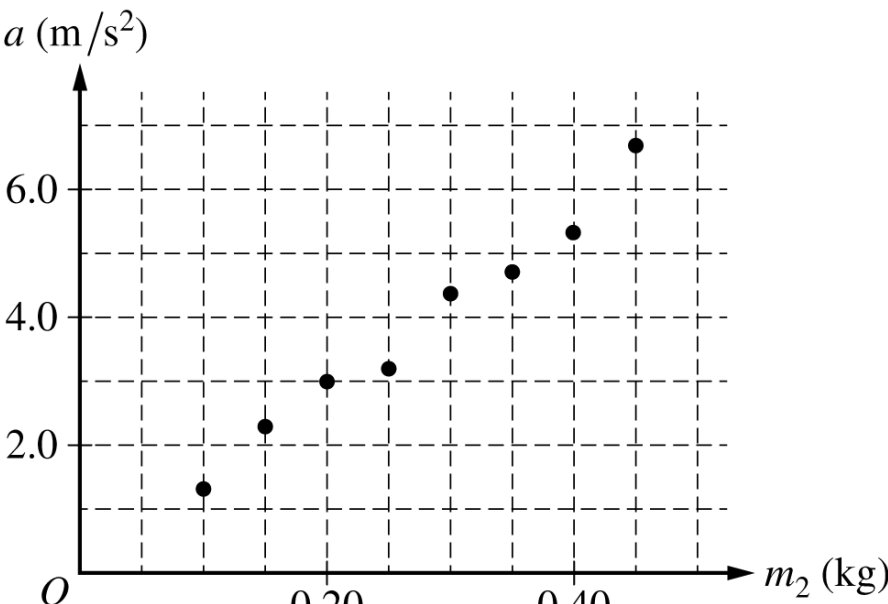
(d) Careful measurements determine that the coefficient of kinetic friction is larger than the value calculated in part (c). Does the following explanation sufficiently account for the observed discrepancy?

“The horizontal table was not perfectly level before the experiment was conducted. The observed difference in the angle accounts for the difference in the expected and calculated values of μ_k .”

____ Yes ____ No

Justify your answer.

The experiment is moved to a surface with negligible friction and run for eight trials. In each trial, the students vary the masses m_1 and m_2 of blocks 1 and 2, respectively, while keeping the total mass $(m_1 + m_2) = 0.64 \text{ kg}$ constant. The data for the acceleration a of block 1 as a function of m_2 are shown on the graph below.



- (e)
- Draw a best-fit line for the data points.
 - Using the straight line, calculate an experimental value for the acceleration due to gravity g .

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(f) The students lift the left end of the surface so that the surface is inclined at an angle to the horizontal, and the experiment for $m_2 = 0.20 \text{ kg}$ is repeated. Would the acceleration of the system be greater than, less than, or equal to the acceleration of the system in the original experiment?

____ Greater than ____ Less than ____ Equal to

Justify your claim.

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