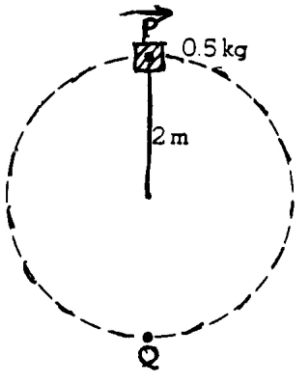
Summer Homework

2019 AP C Physics

Time—90 minutes

7 Questions



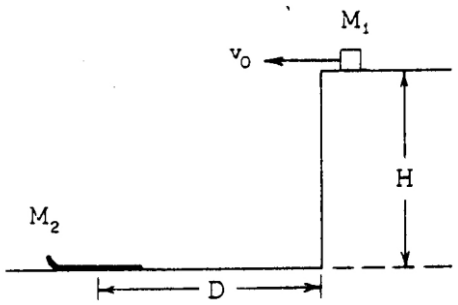
1. A 0.5-kilogram object rotates freely in a vertical circle at the end of a string of length 2 meters as shown above. As the object passes through point P at the top of the circular path, the tension in the string is 20 newtons. Assume g = 10 meters per second squared.

   (a) On the following diagram of the object, draw and clearly label all significant forces on the object when it is at the point P.

   (b) Calculate the speed of the object at point P.

   (c) Calculate the increase in kinetic energy of the object as it moves from point P to point Q.

   (d) Calculate the tension in the string as the object passes through point Q.



2. A block of mass M_1 travels horizontally with a constant speed v_0 on a plateau of height H until it comes to a cliff. A toboggan of mass M_2 is positioned on level ground below the cliff as shown above. The center of the toboggan is a distance D from the base of the cliff.

   (a) Determine D in terms of v_0, H, and g so that the block lands in the center of the toboggan.

   (b) The block sticks to the toboggan which is free to slide without friction. Determine the resulting velocity of the block and toboggan.

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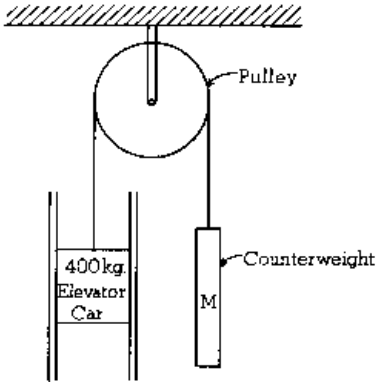


1976B1. The two guide rails for the elevator shown above each exert a constant friction force of 100 newtons on the elevator car when the elevator car is moving upward with an acceleration of 2 meters per second squared. The pulley has negligible friction and mass. Assume $g = 10$ m/sec^2.

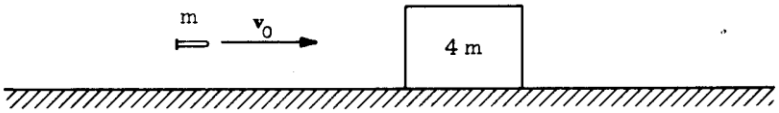
(a) On the diagram below, draw and label all forces acting on the elevator car. Identify the source of each force.

(b) Calculate the tension in the cable lifting the 400-kilogram elevator car during an upward acceleration of

2 m/sec^2. (Assume g 10 m/sec^2.)

(c) Calculate the mass M the counterweight must have to raise the elevator car with an acceleration of 2 m/sec^2.

1976B2.

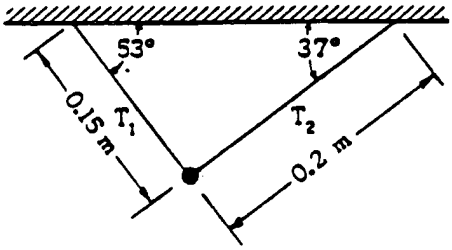


A bullet of mass m and velocity v_0 is fired toward a block of mass 4m. The block is initially at rest on a frictionless horizontal surface. The bullet penetrates the block and emerges with a velocity of $\frac{v_o}{3}$

(a) Determine the final speed of the block.

(b) Determine the loss in kinetic energy of the bullet.

(c) Determine the gain in the kinetic energy of the block.



1980B1. A ball of weight 5 newtons is suspended by two strings as shown above.

a. In the space below, draw and clearly label all the forces that act on the ball.

b. Determine the magnitude of each of the forces indicated in part (a).

Suppose that the ball swings as a pendulum perpendicular to the plane of the page, achieving a maximum speed of 0.6 meter per second during its motion.

c. Determine the magnitude and direction of the net force on the ball as it swings through the lowest point in its path.