AP Physics B
2000 Student Samples

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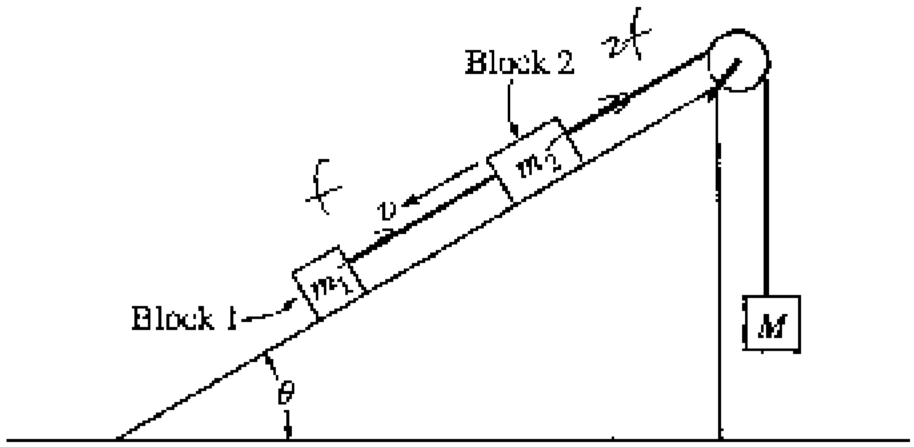
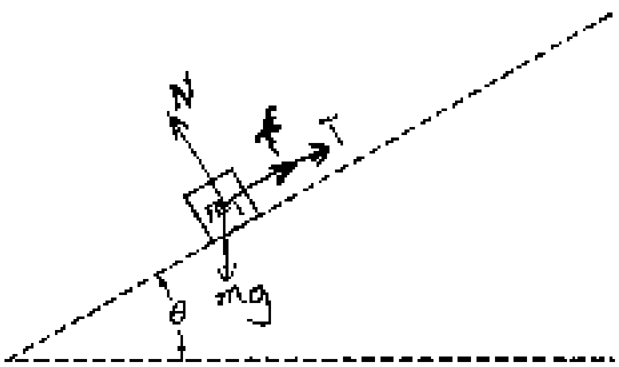


F1

2. (15 points)

Blocks 1 and 2 of masses m_1 and m_2, respectively, are connected by a light string, as shown above. These blocks are further connected to a block of mass M by another light string that passes over a pulley of negligible mass and friction. Blocks 1 and 2 move with a constant velocity v down the inclined plane, which makes an angle θ with the horizontal. The kinetic frictional force on block 1 is f and that on block 2 is $2f$.

(a) On the figure below, draw and label all the forces on block m_1.



Express your answers to each of the following in terms of m_1, m_2, g, θ, and f.

(b) Determine the coefficient of kinetic friction between the inclined plane and block 1.

since a = 0, V is constant
T = 0

$f = \mu N$

$\mu N = f$

$\mu mg\cos\theta = f$

$\mu = \frac{f}{mg\cos\theta}$

μ is equal to $\mu = \frac{f}{mg\cos\theta}$

GO ON TO THE NEXT PAGE.

F2

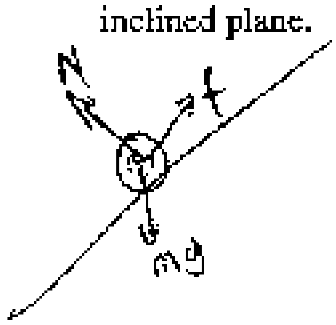
(c) Determine the value of the suspended mass M that allows blocks 1 and 2 to move with constant velocity down the plane.

$$m_1 g \sin\theta + m_2 g \sin\theta - 3f = Mg$$

$$\frac{g(m_1+m_2)\sin\theta - 3f}{g} = M$$

$$M = \frac{(m_1+m_2)g\sin\theta - 3f}{g} \quad (kg)$$

(d) The string between blocks 1 and 2 is now cut. Determine the acceleration of block 1 while it is on the inclined plane.



$$m_1 g \sin\theta - f = ma$$

$$a = \frac{m_1 g \sin\theta - f}{m_1} \quad (m/s^2)$$

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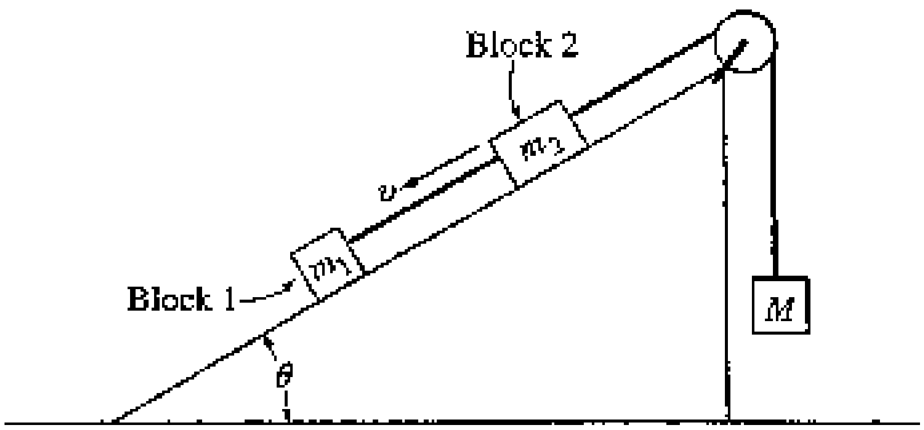

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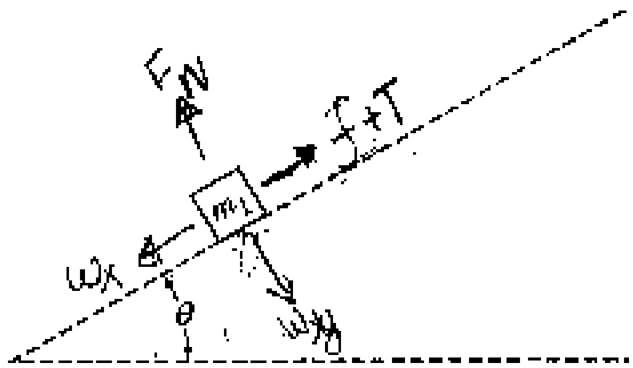

Express your answers to each of the following in terms of m_1, m_2, g, θ, and f.

(b) Determine the coefficient of kinetic friction between the inclined plane and block 1.

$m_1 \cdot g = W$

$W_y = F_N$

$W_y = W\cos\theta$

$f = \mu m_1 g \cos\theta$

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(c) Determine the value of the suspended mass M that allows blocks 1 and 2 to move with constant velocity down the plane.

$\Sigma F = 0$

$T_m = T_1 + T_2$

$T_m = Mg$

$T_1 = m_1 g \sin\theta - f$

$T_2 = m_2 g \sin\theta - 2f$

$Mg = m_1 g \sin\theta + m_2 g \sin\theta - 3f$

$\boxed{M = (m_1 + m_2)\sin\theta - 3f}$

(d) The string between blocks 1 and 2 is now cut. Determine the acceleration of block 1 while it is on the inclined plane.

$a = \frac{F}{m}$

$F = W_x - f$

$W_x = m_1 g \sin\theta$

$f = \mu m_1 g \cos\theta$

$F = m_1 g \sin\theta - \mu m_1 g \cos\theta$

$\boxed{a = g\sin\theta - g\cos\theta}$

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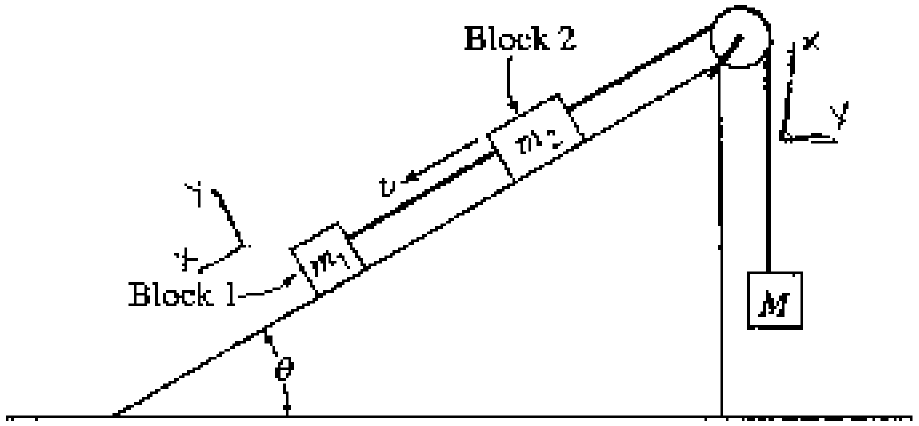
H1



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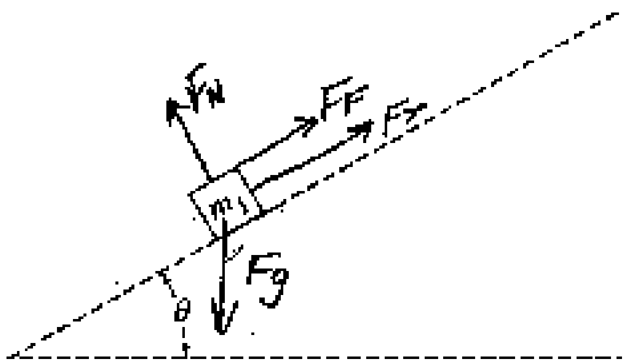

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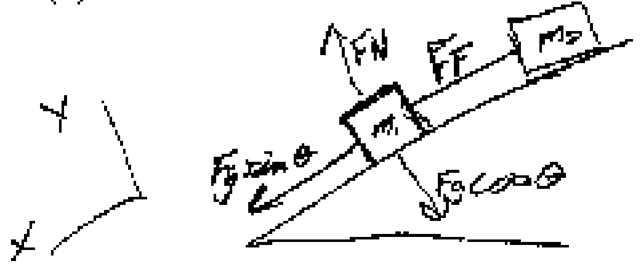

$F_{net\,y} = F_N - F_g\cos\theta = ma$

$F_N = F_g\cos\theta$

$K = \frac{1}{2}mv^2$

$F_F = \mu F_N = \mu F_g\cos\theta$

$\mu = \frac{mg\cos\theta}{Ma}$

$\mu = \frac{g\cos\theta}{a}$

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H2

(c) Determine the value of the suspended mass M that allows blocks 1 and 2 to move with constant velocity down the plane.

$$F_{Net\,x} = F_g - F_T = m\cancel{a}^{0}$$

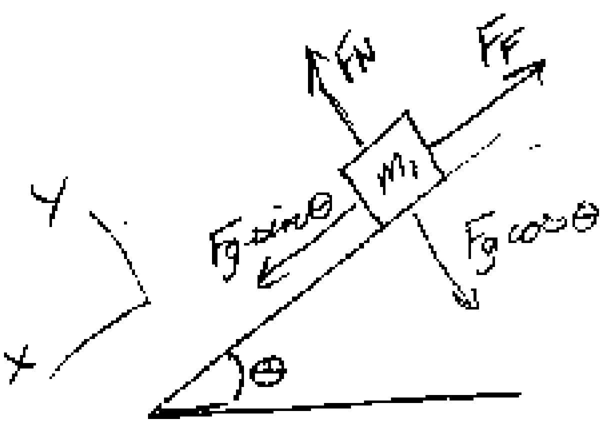
$$F_g = F_T$$

$$(m_1+m_2)g = Mg$$

$$\frac{M\cancel{g}}{\cancel{g}} = \frac{(m_1+m_2)\cancel{g}}{\cancel{g}}$$

$$\boxed{M = m_1 + m_2}$$

(d) The string between blocks 1 and 2 is now cut. Determine the acceleration of block 1 while it is on the inclined plane.



$$F_{net\,x} = F_g \sin\theta - F_F = ma$$

$$F_{net\,y} = F_N - F_g\cos\theta = m\cancel{a}^{0}$$

$$F_N = F_g\cos\theta$$

$$F_F = \mu F_N$$

$$\cancel{m}g\sin\theta - \mu\cancel{m}g\cos\theta = \cancel{m}a$$

$$\boxed{a = g\sin\theta - \mu g\cos\theta}$$

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