



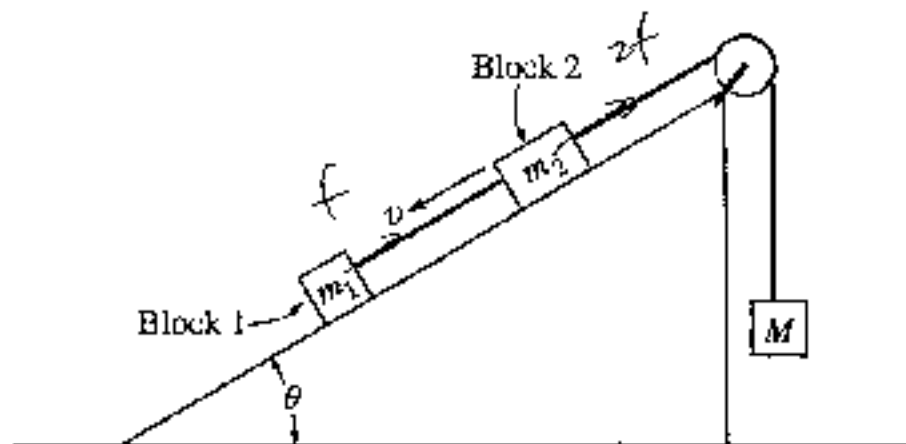
AP Physics B 2000 Student Samples

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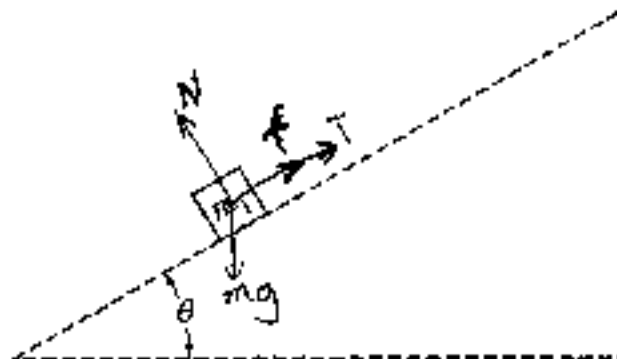


F1

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
 $\Sigma F = 0$

$$\begin{aligned} \mu N &= f \\ \mu mg \cos \theta &= f \\ \mu &= \frac{f}{mg \cos \theta} \end{aligned}$$

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

$$f = \mu N$$

GO ON TO THE NEXT PAGE.

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

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

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

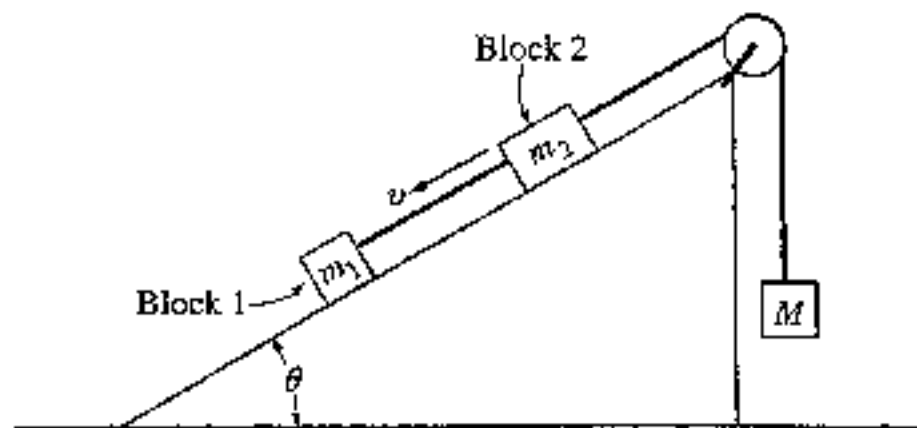
$$M = \frac{(m_1 + m_2) g \sin \theta - 3f}{g} \text{ (kg)}$$

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



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

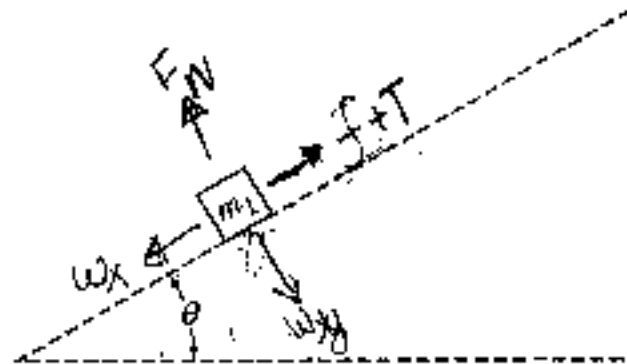
$$a = \frac{m_1 g \sin \theta - f}{m_1} \text{ (m/s}^2\text{)}$$



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 $2f$.

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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.

$$\begin{aligned}
 m_1 g &= W \\
 W_y &= F_N \\
 W_y &= W \cos \theta \\
 f &= \mu m_1 g \cos \theta
 \end{aligned}$$

GO ON TO THE NEXT PAGE.

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

$$\sum F = 0$$

$$T_m = T_1 + T_2$$

$$T_m = Mg$$

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

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

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

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

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

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

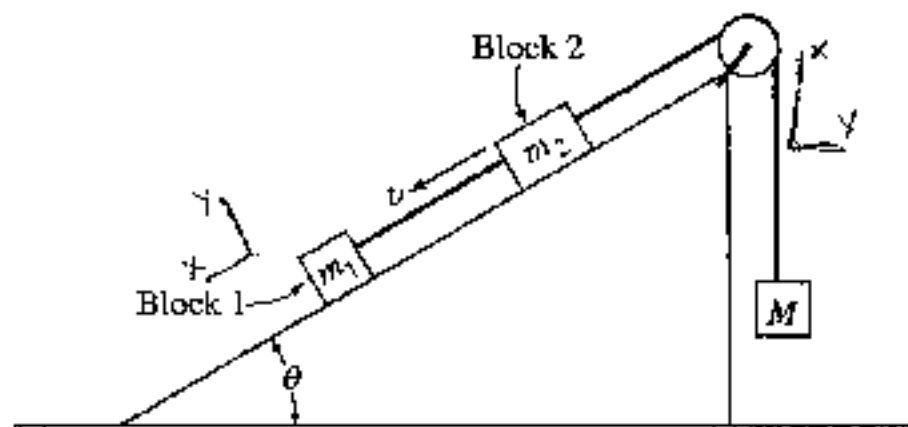
$$F = W_x - f$$

$$W_x = m_1 g \sin \theta$$

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

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

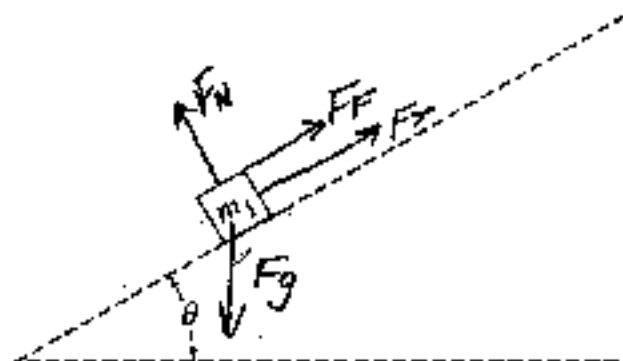
$$a = g \sin \theta - \mu g \cos \theta$$



2. (15 points)

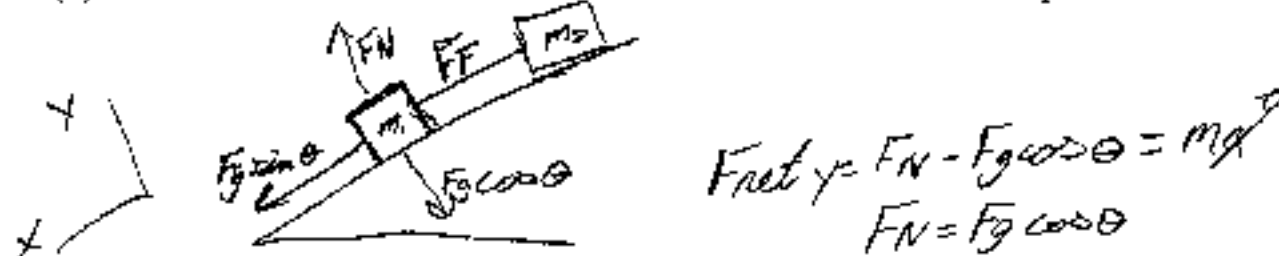
Blocks 1 and 2 of masses m_1 and m_2 , respectively, are connected by a light string, as shown above. These blocks are further connected to a block of mass M by another light string that passes over a pulley of negligible mass and friction. Blocks 1 and 2 move with a constant velocity v down the inclined 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.



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

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

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

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

GO ON TO THE NEXT PAGE.

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

$$F_{\text{Net}x} = F_g - F_T = ma^0$$

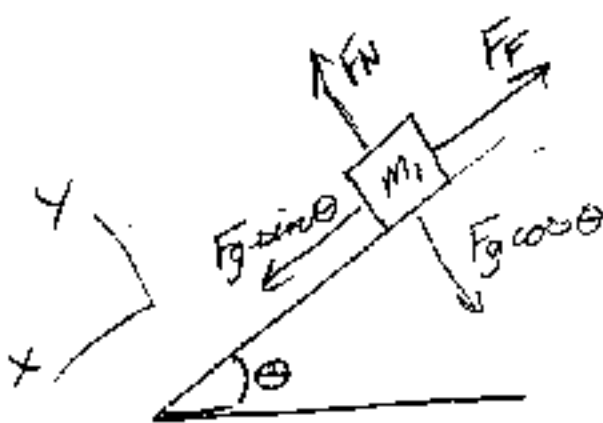
$$F_g = F_T$$

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

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

$$M = m_1 + m_2$$

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



$$F_{\text{Net}x} = F_g \sin \theta - F_F = ma$$

$$F_{\text{Net}y} = F_N - F_g \cos \theta = ma^0$$

$$F_N = F_g \cos \theta$$

$$F_F = \mu F_N$$

$$mg \sin \theta - \mu mg \cos \theta = ma$$

$$a = g \sin \theta - \mu g \cos \theta$$

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