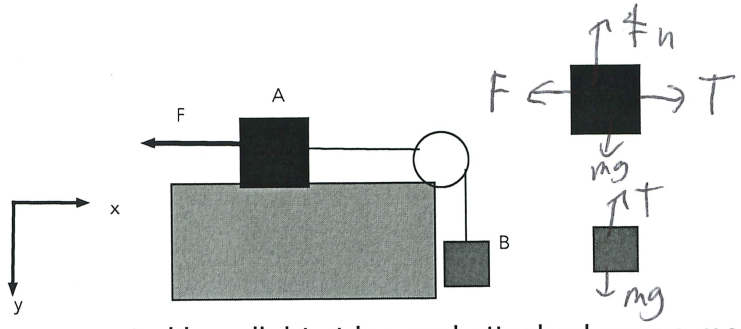
Your Name: _____

PHY203
Exam #2
Chapters 5-8
~~2021202~~
Fri, March 21, 2025

Solutions

S25

Exam2F24Makeup



1. Blocks A and B are connected by a light string and attached over a massless pulley and are initially at rest. Assume masses m_A and m_B. A force, F, is applied to block A, parallel to the upper surface, as shown. The surface under block A is frictionless.

a. Draw free body diagrams of the blocks on the figures above and to the right. **5**

b. Write out Newton's 2nd Law for both blocks in x- and y-directions using the coordinate system given above. **15**

A: x: $T - F = m_A a$

y: $m_A g - F_n = 0$

B: y: $m_B g - T = m_B a$

Assume that m_A =6.50 kg, m_B = 8.00 kg, ~~$\theta = 40.0^\circ$~~, and F = 47.5 N.

c. Find the magnitude of the acceleration of the blocks and the tension in the string. **10**

Combine A: x and B: y:

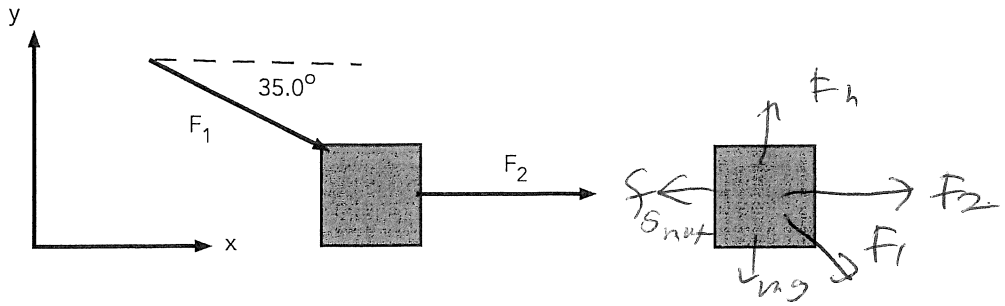
$$m_B g - F = (m_A + m_B) a$$

$$a = \frac{8.00 g - 47.5}{14.5} = 2.14 \text{ m/s}^2$$

From A: x $T = m_A a + F$

$= (6.50)(2.14) + 47.5$

$= 61.4$ N



2. A block of mass m is on a rough surface. Two forces are applied to the block, as shown above, and the block is <u>just about to slide</u>.

a. Above and to the right draw a free body diagram of the block. **5**

b. Write out Newton's 2nd Law for the block in both directions. **20**

x: $F_2 - \mu_s F_n + F_1 \cos 35^\circ = ma = 0$

y: $F_n - mg - F_1 \sin 35^\circ = 0$

Assume m=6.50 kg, F_1=45.0 N and F_2=28.0 N.

c. Find the magnitude of the normal force of the block. **5**

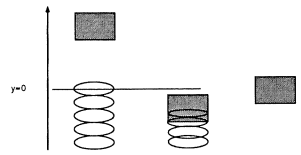
$F_n = 6.50g + 45 \sin 35^\circ = 89.6\ N$

d. Find the coefficient of static friction. **5**

$\mu_s F_n = F_2 + F_1 \cos 35^\circ$

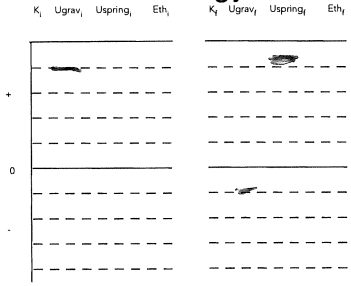
$\mu_s = \frac{1}{89.6}\left[28.0 + 45.0 \cos 35^\circ\right]$

$= \frac{64.9}{89.6} = 0.724$



3. An 8.50 kg block is dropped onto a massless spring from a height of 4.50 m. The spring has a spring constant of 1500 N/m. Choose y=0 as the top of the uncompressed spring, as shown above. Ignore the size of the block. Take the final position as the maximum compression of the spring.

a. Create energy bar charts: **5**



b. Find the maximum compression of the spring. **15**

$$mgh = \frac{1}{2}kd^2 - mgd$$

$$8.5g(4.50) = 750d^2 - 8.5gd$$

$$750d^2 - 83.4d - 375 = 0$$

$$d = \frac{83.4 \pm \sqrt{83.4^2 + 4(750)375}}{1500} = 0.765$$

c. The block will then rebound. Find the speed of the block when it is at a height of 2.50 m (it is no longer in contact with the spring at this point). **15**

$$mgh = \frac{1}{2}mv^2 + mgh'$$

$$g(4.50) = \frac{1}{2}v^2 + g(2.50)$$

$$v^2 = 2g(4.5 - 2.5) = 4g$$

$$v = 6.26 \text{ m/s}$$