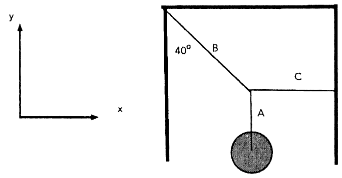
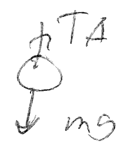
F24

Exam2~~S24Makeup~~

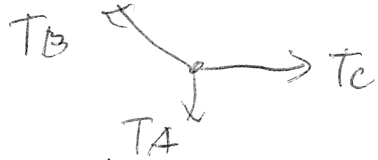


1. Assume the ball with mass 7.50 kg in the picture above is not moving. Find the magnitude of the tensions in the strings A, B, and C.

a. Below, draw a free body diagram of the ball. **5**



b. Below, draw a free body diagram of the junction point of the 3 strings. **5**



c. Write out Newton's 2nd Law for the ball in the y-direction and find the tension in the A string. **10**

y: $T_A - mg = ma = 0$

$T_A = 7.50g = 73.6\,N$

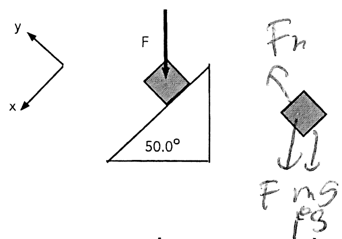
d. Write out Newton's 2nd Law for the junction in the x- and y-directions and find the tensions in the B and C strings. **10**

x: $T_B \sin 40^\circ - T_C = 0$

y: $T_B \cos 40^\circ - T_A = 0$

$T_B = \frac{T_A}{\cos 40^\circ} = \frac{73.6}{\cos 40^\circ} = 96.0\,N$

$T_C = T_B \sin 40^\circ = 61.7\,N$



2. ~~A rope is attached to a~~ A block on a smooth ramp ~~and~~ pushed with a force, F, perpendicular to the floor.

a. Above and to the right draw a free body diagram of the block while it is sliding down the ramp. **5**

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

x: $(F + mg)\sin 50^\circ = ma$

y: $F_n - (F + mg)\cos 50^\circ = 0$

Assume m=4.00 kg and F = 15.0 N.

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

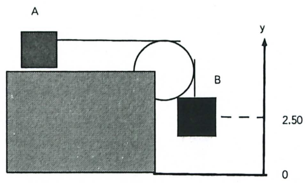
$F_n = (15.0 + 4g)\cos 50^\circ = 34.9\ N$

d. Find the magnitude of the acceleration of the block. **5**

$a = \frac{1}{m}(F + mg)\sin 50^\circ$

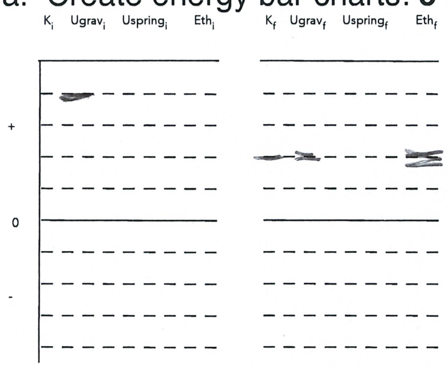
$= \frac{1}{4}(15 + 4g)\sin 50^\circ$

$= 10.4\ m/s^2$



3. Blocks A and B are connected by a light string and attached over a massless pulley and are initially at rest (as shown above). Assume a rough surface under block A and masses m_A and m_B. The blocks are released and start moving. Take the final position as after the blocks have moved 1.75 m

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



Assume that m_A = 6.50 kg, m_B = 8.00 kg, μ_{kA}= 0.300, and that the initial heights of the blocks are 2.50 m and 5.00 m.

b. Find the initial energy of block B before the blocks start moving. **5**

$$U_B = (8.00)g(2.50) = 196\ J$$

c. Using Conservation of Energy, find the speed of the blocks after they have moved 1.75 m. **25**

$$196 = \frac{1}{2}(m_A + m_B)v^2 + m_B g(0.75) + \mu_k m_A g(1.75)$$

(we've ignored U_A since the height doesn't change)

$$= \frac{1}{2}(6.5 + 8)v^2 + 8g(.75) + (0.300)\,6.50g\,(1.75)$$

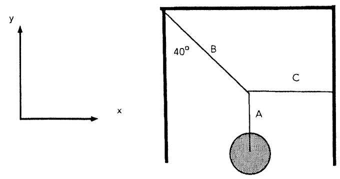
$$= 7.25v^2 + 58.86 + 33.48$$

$$v = 3.78\ m/s$$

Your Name: ___________________________

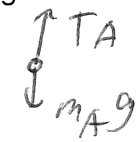
PHY203
Exam #3
Chapters 9-11,15
Wed., Dec. 11, 2024

PHY203Exam2F24Alt

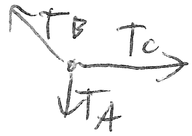


1. Assume the ball with mass 9.50 kg in the picture above is not moving. Find the magnitude of the tensions in the strings A, B, and C.

a. Below, draw a free body diagram of the ball. **5**



b. Below, draw a free body diagram of the junction point of the 3 strings. **5**



c. Write out Newton's 2nd Law for the ball in the y-direction and find the tension in the A string. **10**

y: $T_A - m_A g = m_A a = 0$

$T_A = 9.50g = 93.2\,N$

d. Write out Newton's 2nd Law for the junction in the x- and y-directions and find the tensions in the B and C strings. **10**

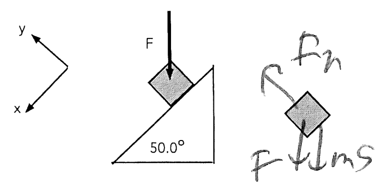
x: $T_C - T_B \sin 40° = 0$

y: $T_B \cos 40° - T_A = 0$

$T_B = \frac{T_A}{\cos 40°} = \frac{93.2}{\cos 40°} = 122\,N$

$T_C = T_B \sin 40° = 122 \sin 40°$

$= 78.2\,N$



2. A block on a smooth ramp is pushed with a force, F, perpendicular to the floor.

a. Above and to the right draw a free body diagram of the block while it is sliding down the ramp. **5**

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

$x: \quad mg \sin 50.0^\circ + F \sin 50.0^\circ = ma$

$y: \quad F_n - mg\cos 50^\circ - F\cos 50^\circ = 0$

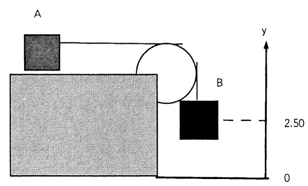
Assume m=5.00 kg and F = 12.0 N.

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

$$F_n = \cos 50^\circ (mg + F)$$
$$= \cos 50^\circ (5.00g + 12.0)$$
$$= 39.2 \text{ N}$$

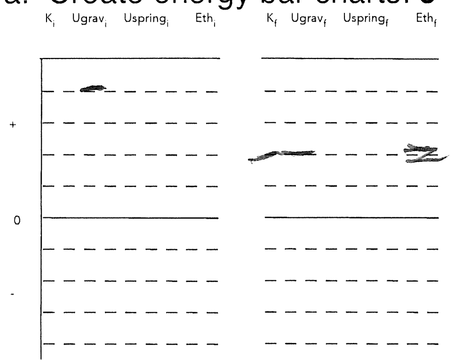
d. Find the magnitude of the acceleration of the block. **5**

$$a = \frac{1}{m} \sin 50^\circ (mg + F)$$
$$= \frac{1}{5.00} \sin 50^\circ (5.00g + 12.0)$$
$$= 9.35 \text{ m/s}^2$$



3. Blocks A and B are connected by a light string and attached over a massless pulley and are initially at rest. Assume a rough surface under block A and masses m_A and m_B. The blocks are released and start moving. Take the final position as after the blocks have moved 1.25 m

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



Assume that m_A = 5.50 kg, m_B = 8.50 kg, μ_{kA}= 0.300, and that the initial heights of the blocks are 2.50 m and 5.00 m.

b. Find the initial energy of block B before the blocks start moving. **5**

$U_B = mgh = (8.50)g(2.50) = 208\ J$

c. Using Conservation of Energy, find the speed of the blocks after they have moved 1.25 m. **25**

$208\ J = \frac{1}{2}(m_A + m_B)v^2 + m_B g h' + \mu_k m_A g \Delta s$

$= 7v^2 + (8.50)g(1.25) + (0.300)(5.50)g(1.25)$

$= 7v^2 + 104 + 20.2$

$7v^2 = 83.8$

$v = 3.46\ m/s$