Points

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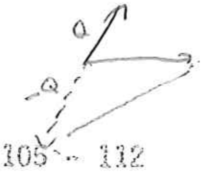
Josh E.

Samuel K.

Josh L.



Physics 105 - 112

Exam 1

1. A ship fires a shell which lands in the water 20 seconds later. The horizontal component of the initial velocity, $V_{ox}$ is 500 m/s. Neglect the height of the gun above the water and air resistance.

A) How far from the ship does the shell land? (5 pts.)

$\Delta x = V_{ox} t$

$= (500 m/s)(20 s)$

$\boxed{\Delta x = 10{,}000 m.}$

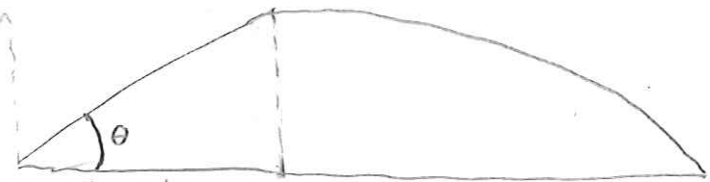
~~$\Delta x = \frac{1}{2}(V_o + V_f)t$~~

~~$\Delta x = \frac{1}{2}(500 m/s) 20s$~~

~~5000 m assuming $V_{final}$ is 0.~~

$V_{ox} = 500 m/s$

B) What was the vertical component of the initial velocity, $V_{oy}$? (5 pts.)



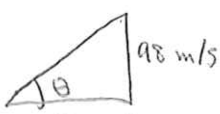

$R = \frac{2 V_{ox} \cdot V_{oy}}{g}$

$10{,}000 = \frac{2(500) V_{oy}}{9.8}$

$98{,}000 = 1000 V_{oy}$

$\boxed{V_{oy} = 98 m/s}$

C) At what angle, θ, was the gun inclined, relative to the horizontal? (5 pts.)


$\tan\theta = \frac{98 m/s}{500 m/s}$

$\theta = \tan^{-1}\left(\frac{98 m/s}{500 m/s}\right)$

$\boxed{\theta = 11.1°}$

D) Where was the shell 7 seconds after it was fired (x and y components)? (5 pts.)

$\Delta x = V_{ox} t$

$= 500 m/s (7)$

$\Delta x = 3500 m$

$\Delta y = V_{oy} t - \frac{1}{2} g t^2$

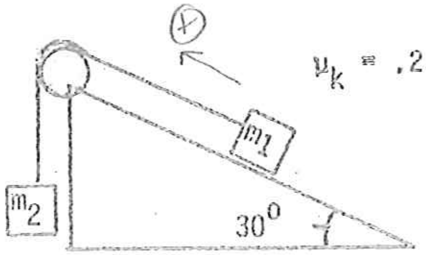
$= 98 m/s (7s) - 4.9 (7)^2$

$\Delta y = 446 m$

(3500, 446)

Amy Knutson
Brittney Jones
Nicole Pagel

4.




$m_1 = 5$ kg

$m_2 = 10$ kg

Mass $m_2$ pulls mass $m_1$ up a $30^0$ incline with coefficient of kinetic friction $\mu_k = .2$. Find the acceleration of $m_1$. (10 pts.)

$m_2 g - T_1 = m_2 a$

$T_1 = -m_2 a + m_2 g$

$n_1 - mg\cos 30 = 0$

$T_1 - m_1 g \sin 30 - f = m_1 a$

$f = \mu_k n$ ($n = m_1 g \cos 30$)

$n_1 = m_1 g \cos 30$

$T_1 = -m_2 a + m_2 g$

$-m_2 a + m_2 g - m_1 g \sin 30 - \mu_k m_1 g \cos 30 = m_1 a$

$+m_2 a \qquad\qquad +m_2 a$

$m_2 g - m_1 g \sin 30 - \mu_k m_1 g \cos 30 = (m_2 + m_1) a$

$\frac{98 - 24.5 - 8.49}{15} = \frac{(15) a}{15}$

$4.33 m/s^2 = a$

*Eye Quiz*

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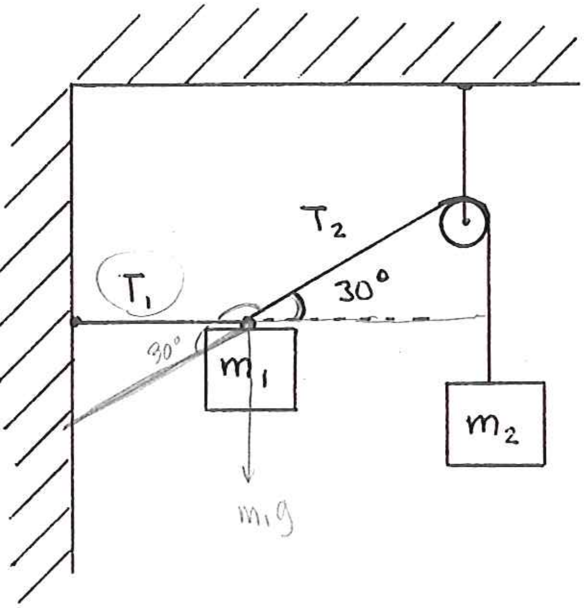
Autumn Flynn
Bobby Thomas
Jack Brixius

shared with

Ben Kuhr
William McCue
Gabe Amon

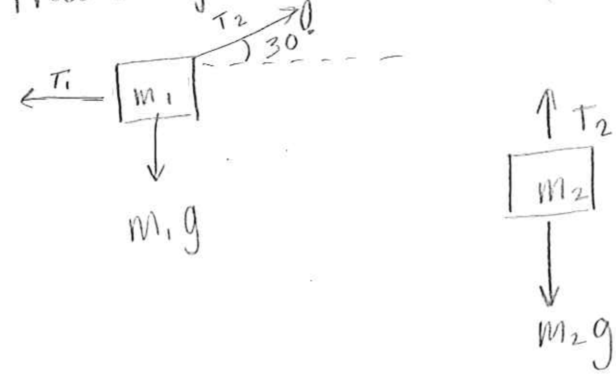
Abbie Moritko
Erin Wissler
John Dube

(1) In the diagram shown, <u>both masses are at rest</u>. The mass of $m_1$ is 5 kg, and the pulley is frictionless and massless.




a) What are the tensions $T_1$ and $T_2$ in the two ropes?

Free body diagrams:




$m_1 g = T_2 \sin 30$

$T_1 = T_2 \cos 30$

$\frac{m_1 g}{\sin 30} = \frac{T_2 \sin 30}{\sin 30}$

$T_2 = \frac{5.4 kg (9.80 m/s^2)}{\sin(30)}$

$\boxed{T_2 = 98 N}$

b) What value does $m_2$ have to be for the blocks to be at rest?

$T_1 = T_2 \cos 30$

$T_1 = 98 N (\cos(30))$

$\boxed{T_1 = 84.9 N}$

points

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$\frac{T_2}{g} = \frac{m_2 g}{g} = \frac{98 N}{9.80 m/s^2} = m_2$ $\boxed{m_2 = 10 kg}$

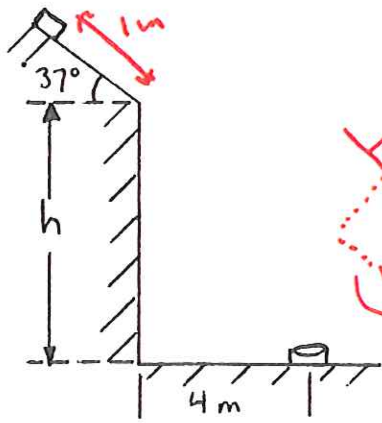
Julie
Sammi
Kaelyn
Shared with
Tayler Huston
Kaitlyn Rolands
Kirsten Montray
Rich Rohlik

Tom Kirkman

actually doesn't matter

(3) A block of mass 20 kg starts at rest at the top of the slope. The slope is 1 m long, and the coefficient of kinetic friction is $\mu_K = 0$. After sliding down the slope, the block flies off and lands in the cup.

frictionless





$mg \sin\theta = ma$

$g \sin\theta = a$

$v^2 = v_0^2 + 2a\,\Delta x$ ($v_0 = 0$, $\Delta x = 1\text{m}$)

a) What is the velocity of the block at the instant it leaves the slope?

(Hint: velocity is a vector!)

$v^2 = 0 + 2 \cdot 9.8 \cdot \sin 37° \cdot 1\text{m}$

$v = \sqrt{11.8} = 3.43 \text{ m/s}$

$\theta = -37°$

$V_{0x} = V \cos(-37°) = 2.74 \text{ m/s}$

$V_{0y} = V \sin(-37°) = -2.07 \text{ m/s}$

b) From the instant it leaves the slope, how long does it take for the block to drop into the cup?

$\Delta x = V_{0x}\, t$

$4\text{m} = 2.74\, t$

$1.46\text{s} = \frac{4\text{m}}{2.74} = t$

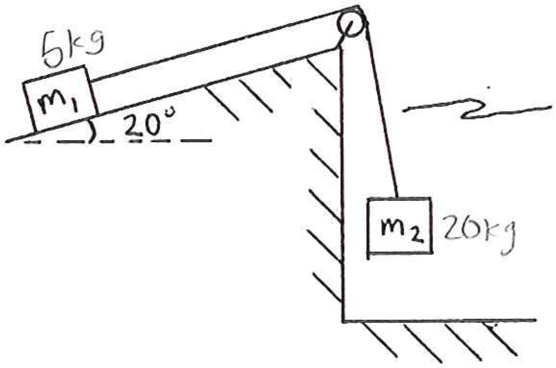
c) What must the height h be for the block to drop into the cup?

$\Delta y = -h = V_{0y}\, t - \frac{1}{2} g t^2$ ($V_{0y} = -2.07 \text{ m/s}$) $t = 1.46\text{ s}$

$(2.07)(1.46) + \frac{1}{2} 9.8 (1.46)^2 = h = 13.4 \text{ m}$

Kelly S.
Bailey D.
Sam H.

(4) Two blocks $m_1$ and $m_2$ are connected by a string over a massless, frictionless pulley. The coefficient of kinetic friction between $m_1$ and the slope is 0.2. Take $m_1$ = 5 kg and $m_2$ = 20 kg.




Note: $m_2$ is actually hanging straight down.

$f = \mu_k n$

$\mu_k = .2$

$n_1$

$f = \mu_k n_1$

$x: T - m_1 g \sin 20 - f = m_1 a$

$n_1 = m_1 g \cos 20$

$y: m_2 g - T = m_2 a$

a) What is the acceleration of $m_1$ for the situation shown?

$$a = \frac{(m_2 g - m_1 \sin 20 g - f)}{(m_1 + m_2)}$$

$$a = \frac{(20 \cdot 9.8) - (5 \sin 20 \cdot 9.8) - (.2 \cdot 5 \cdot \cos 20)}{(20+5)}$$

$a = 6.8\ m/s^2$

$T - m_1 g \sin 20 = m_1 a$

$m_2 g - T = m_2 a$

$(m_2 - m_1 \sin 20)g = (m_1 + m_2)a$

$$a = \frac{(m_2 - m_1 \sin 20)g}{m_1 + m_2}$$

b) At the moment when $m_1$ has a velocity of 5 m/s, $m_2$ hits the floor, and the tension in the rope drops instantly to zero. How much farther up the slope does $m_1$ travel before coming to a stop?

$ma = \mu_k mg \cos 20 + mg \sin 20$

$$a = \frac{\mu_k m g \cos 20 + m g \sin 20}{m_1}$$

$a = 5.19$ ← this acceleration should be negative

No iQuiz score reported 10 assumed.

$v^2 = v_0^2 + 2a\Delta x$

$\Delta x = 2.4$ meters