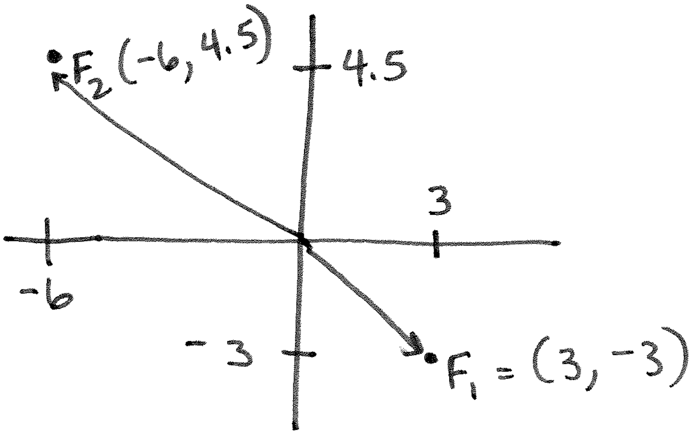
AP Physics Review

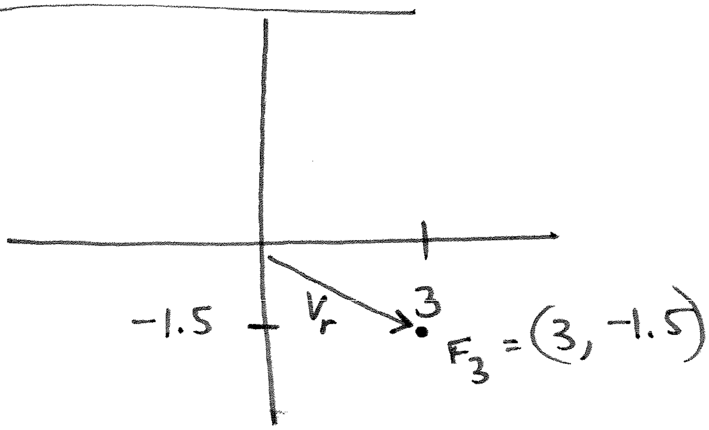
Vectors

P. 93 #38



	$\hat{x}$	$\hat{y}$
F_1	3	-3
F_2	-6	4.5
F_3	+3	-1.5
$\Sigma F =$	0	0

Vector resultant:



$$V_r = \sqrt{(3)^2 + (-1.5)^2}$$

$$V_r = 3.35\,N$$

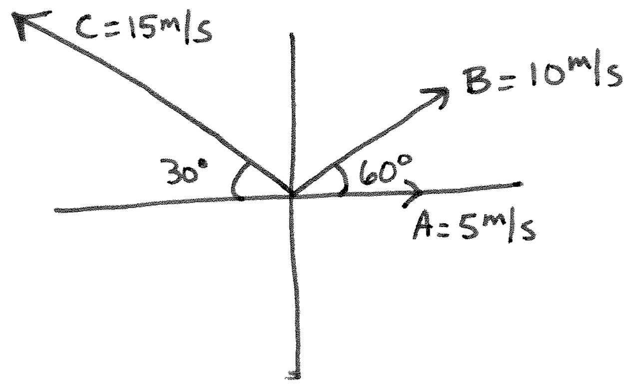
$$\tan\theta = \left|\frac{y}{x}\right| = \left|\frac{-1.5}{3}\right|$$

$\theta = 26.6°$ below x axis

AP Physics Review

Vectors

P. 93 #36



First: Find component vectors

A: $x = +5\hat{x}$ $\quad y = 0\hat{y}$

B: $x = 10\cos 60 = +5\hat{x}$

$y = 10\sin 60 = +8.66\hat{y}$

C: $x = -(15\cos 30) = -13\hat{x}$

$y = 15\sin 30 = +7.5\hat{y}$

Second: Add ém up (A − B − C)

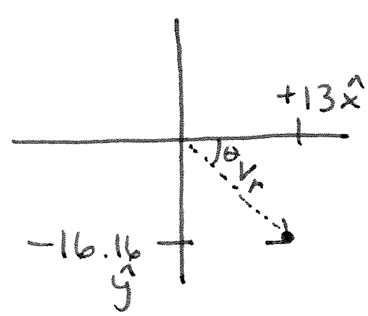
x: $+5\hat{x} - (+5\hat{x}) - (-13\hat{x}) = +13\hat{x}$

y: $0\hat{y} - (+8.66\hat{y}) - (+7.5\hat{y}) = -16.16\hat{y}$

Third: find resultant Vector and θ

$$V_r = \sqrt{(13\hat{x})^2 + (-16.16\hat{y})^2}$$

$$V_r = 20.7\,m/s$$



$$\tan\theta = \left|\frac{y}{x}\right| = \left|\frac{-16.16}{13}\right|$$

θ = 51° below X axis

AP Physics Review Problems

Atwood's Machine

P. 133 #58

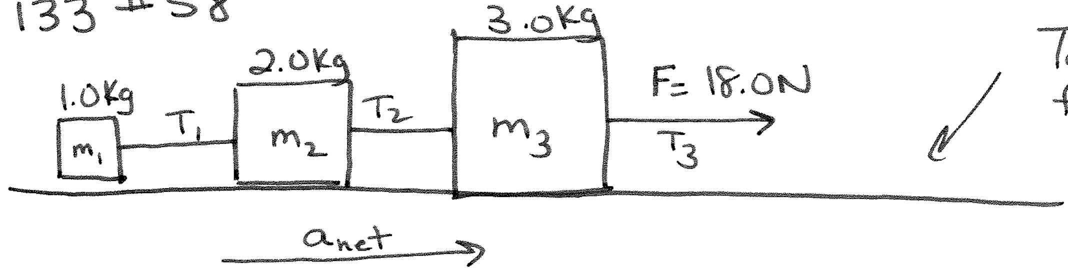


Table is frictionless (Thank Goodness! ☺)

T_1 must be enough to pull block m_1
T_2 must be enough to pull block m_1 and m_2
T_3 must be enough to pull block m_1, m_2 and m_3

Since T_3 is given as 18.0N, we know the total force of the System

$$F_{system} = m_{system}\, a_{net\,system}$$

$$18.0N = (m_1 + m_2 + m_3)\, a_{net}$$

$$a_{net} = 3\,m/s^2 \quad \text{(because all Masses are known)}$$

$$F_{m_1} = m_1 a_{net} = (1.0kg)(3\,m/s^2) = 3N$$

$$F_{m_2} = m_2 a_{net} = (2.0kg)(3\,m/s^2) = 6N$$

$$F_{m_3} = m_3 a_{net} = (3.0kg)(3\,m/s^2) = 9N$$

$$\Sigma = 18N$$

T_3 must $= 3N + 6N + 9N = 18N$

T_2 must $= 6N + 3N = 9N$

T_1 must $= 3N$

Keys To remember:

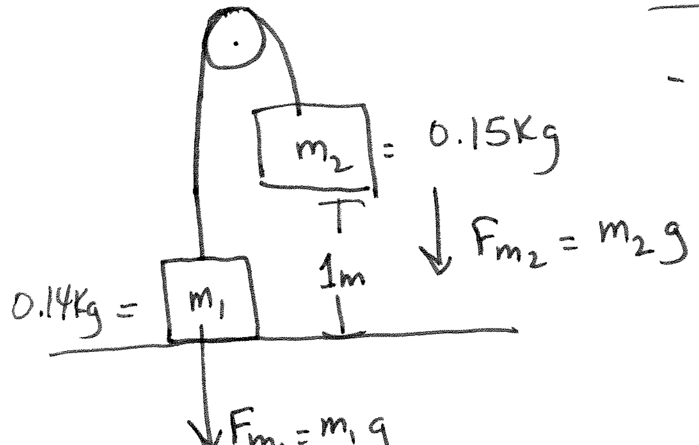
* Tension is a Force (ma)

* Find a_{net} for whole system. Determine if it is positive or negative (is The whole system moving left (-) or right (+)?)

AP Physics Review Problems

Atwoods Machine:

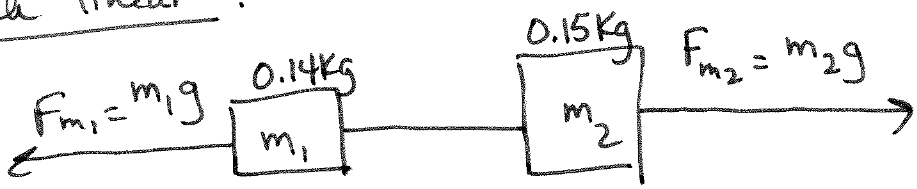
P. 134 # 61



What we Know:

- $V_0 = 0 \, m/s$
- Both m_1 and m_2 have g acting on Them
- it takes 2.4 sec for m_2 to hit The floor

Think linear:



1. Find net acceleration

$$F_{net} = F_{m_1} + F_{m_2} = -(m_1 g) + m_2 g = g(m_2 - m_1)$$

(going in -x direction)

$$F_{net} = g(0.15\,Kg - 0.14\,Kg) = g(0.01\,Kg)$$

2. Find a_{net} of system:

$$X = V_0 t + \tfrac{1}{2} a_{net} t^2$$

$$1m = 0 + \tfrac{1}{2} a_{net} (2.4\,sec)^2$$

$$a_{net} = 0.347 \, m/s^2$$

3. $F_{net} = m_{net} a_{net}$

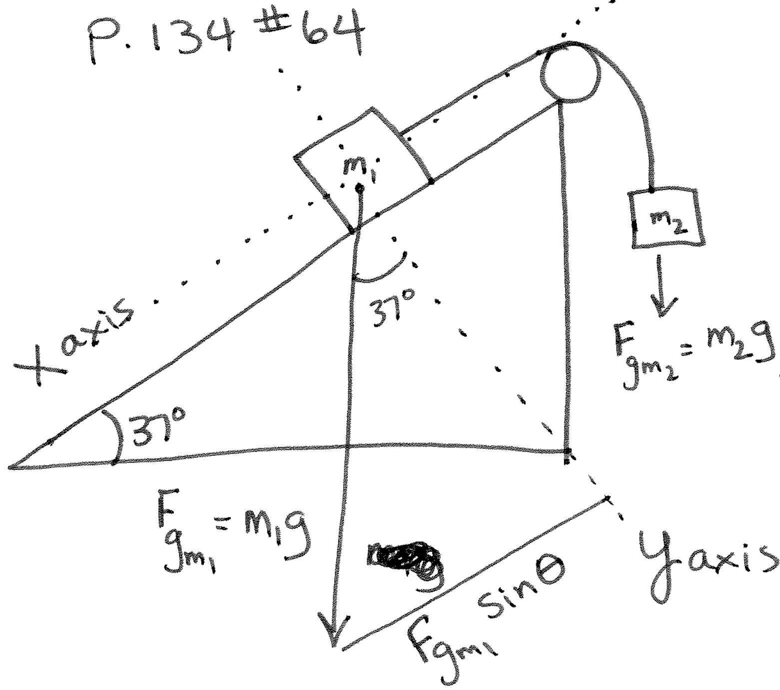
$$g(0.01\,Kg) = (0.14\,Kg + 0.15\,Kg)(0.347\,m/s^2)$$

$$\boxed{g = 10.063 \, m/s^2}$$

AP Physics Review Problems

Atwoods Machine

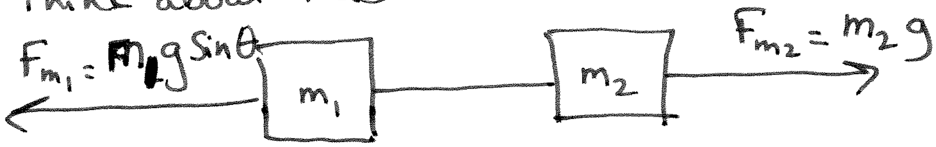
P. 134 #64



What We Know:

- Both objects are @ rest ($a_{net} = 0\,m/s^2$) ($V = 0\,m/s$)
- $m_1 = 2.0\,Kg$
- ramp is frictionless (Thank goodness!)
- m_1 wants to slide in ($-x$) direction @ $F_{gm_1} \sin\theta$
- m_2 wants to slide in ($+x$) direction w/ an acceleration of g

Key: Think about This as 2 blocks on a horizontal:



F_{m_1} must $= F_{m_2}$ for acceleration to be zero

So.... $m_1 \cancel{g} \sin\theta = m_2 \cancel{g}$ (g's Cancel! Whoopee!)

$$m_1 \sin\theta = m_2$$

$$(2.0\,Kg) \sin 37 = m_2$$

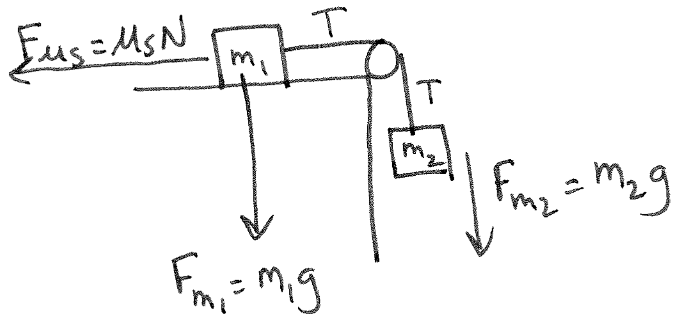
$$m_2 = 1.2\,Kg$$

Part b If you want Them to move @ a constant velocity, just tug on one of Them to get it moving. Once it is moving, since There is no acceleration (because equal force on m_1 and m_2) There will be nothing to stop them (until one block hits The pulley)

AP Physics Review Problems

Atwoods Machine/Tension:

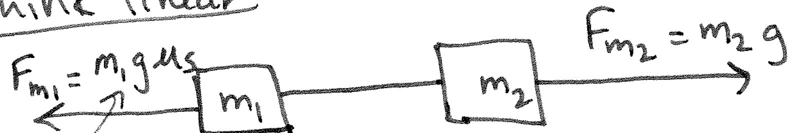
P. 136 #88



What We Know:

- Table has friction (darn it!)
  - $\mu_k = 0.40$ (in motion)
  - $\mu_s = 0.60$ (standing still)
- $m_1 = 10\,Kg$
- what m_2 will just overcome μ_s?

Think linear!



HINT BOX:
- Since its a Flat Surface, $m_1 g = N$
- if it were on a slope, ~~$m_1 g$ = N~~ $m_1 g \cos\theta = N$ (as θ approaches 0°, N approaches $m_1 g$)

$F_{m_1} = m_1 g \mu_s = (10Kg)(9.8m/s^2)(0.60)$

$F_{m_1} = 58.8N$

So, m_2 must be just a little bit over 58.8N to get it moving

$F_{m_2} = 58.8N = m_2 g = m_2 (9.8m/s^2)$

$m_2 = 6Kg$

(b) $F_{net} = F_{m_1} + F_{m_2}$ (realize m_1 moves (−x)) (realize m_2 moves (+x))

$F_{net} = m_1 g \mu_k + m_2 g$ — μ_k because its Now in motion

$F_{net} = -(10Kg)(9.8m/s^2)(0.40) + (6Kg)(9.8m/s^2)$ — Negative

$F_{net} = 19.6N$ ← Positive, so blocks are moving +x direction

$F_{net} = m_{net}\, a_{net}$

$19.6N = (10Kg + 6Kg)\, a_{net}$

$a_{net} = 1.23\, m/s$

What if....... The table were frictionless? Then $F_{net} = m_2 g$ because m_1 provides no force.

$F_{net} = m_{net}\, a_{net}$

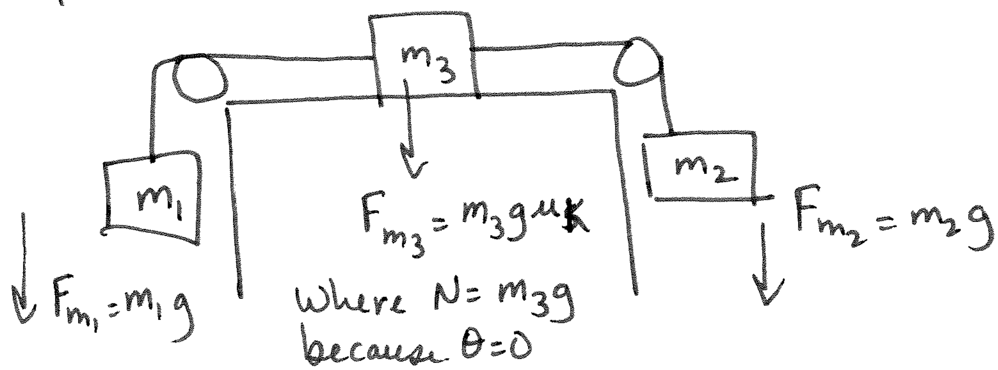
$m_2 g = (m_1 + m_2)\, a_{net}$

$a_{net} = 3.675\, m/s^2$

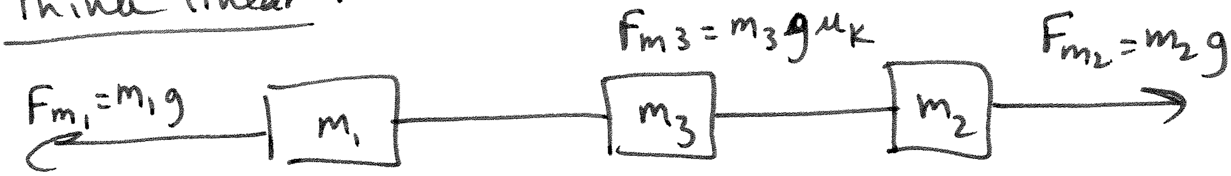
AP Physics Review Problems

Sliding blocks on Tables w/ pulleys

p. 136 #90



Think linear:



F_{m_3} acts in The <u>opposite</u> direction to The more massive block ← Which is m_2

F_{m_1} acts in $(-x)$ direction

F_{m_2} acts in $(+x)$ direction

$$F_{net} = F_{m_1} + F_{m_3} + F_{m_2}$$

$$F_{net} = {}^{-}(m_1 g) + {}^{-}(m_3 g \mu_K) + m_2 g$$

$$F_{net} = g\,(0.25\,\text{Kg} - 0.15\,\text{Kg} - m_3 \mu_K)$$

$$F_{net} = 0.98 - 9.8 m_3 \mu_K = 0.98 - 5.488\, m_3$$

← $\mu_K = 0.560$

$$F_{net} = m_{net}\, a_{net}$$

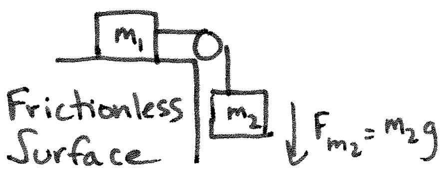
← $a_{net} = 0$ m/s because it isn't acc. it is moving @ constant speed

$$0.98 - 5.488 m_3 = m_{net}\,(0\ \text{m/s}^2)$$

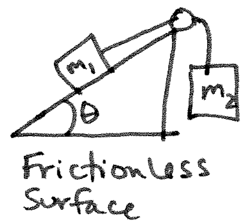
$$\boxed{m_3 = 0.179\ \text{Kg}}$$

AP Physics Review

Scenario #1



Scenario #2



Scenario #3

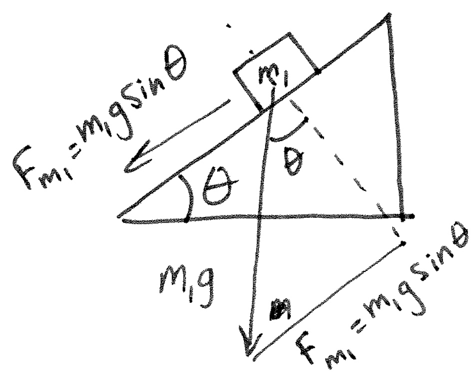
Scenario #1 : $F_{net} = F_{m_1} + F_{m_2} = 0N + m_2 g$

Scenario #2 $F_{net} = F_{m_1} + F_{m_2} = m_1 g \sin\theta + m_2 g$

Scenario #3 $F_{net} = F_{m_1} + F_{m_2} = m_1 g + m_2 g$

- Notice in Scenario #1, $\theta = 0$ and $\sin 0 = 0$ so $m_1 g \sin\theta = 0$
Why? Since There is no friction on m_1, and it isn't moving in $(-x)$ direction, There is no force on it.

- Notice in Scenario #2, m_1 Tries to Slide in $(-x)$ direction



This counteracts m_2 Trying to fall in $(+x)$ direction
(again, as θ approaches zero, $\sin\theta$ approaches zero so F_{m_1} approaches zero in $-x$ direction)

- Notice in Scenario #3, $\theta = 90°$ so $\sin\theta = max = 1$

$$m_1 g \sin 90 + m_2 g = m_1 g + m_2 g = F_{net}$$

What about Friction? Friction Force $= N \mu_s$

$N = m_1 g \cos\theta$ So Friction Force $= m_1 g \cos\theta (\mu_s)$

Notice, as θ approaches Zero, Friction Force is <u>max</u> because $\cos 0 = 1$

PHYSICS B

SECTION II

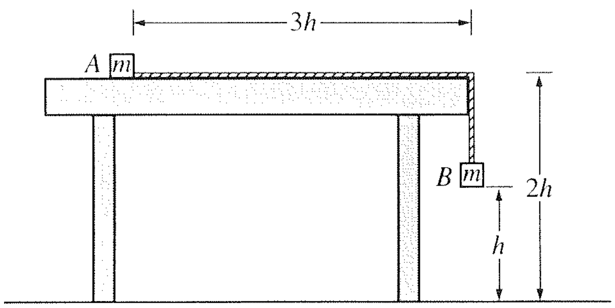
Time — 90 minutes

8 Questions

1998

#1

Directions: Answer all eight questions, which are weighted according to the points indicated. The suggested time is about 15 minutes for answering each of questions 1 and 2, which are worth 15 points each, and about 10 minutes for answering each of questions 3-8, which are worth 10 points each. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part, NOT in the green insert.



1. (15 points)
Two small blocks, each of mass m, are connected by a string of constant length $4h$ and negligible mass. Block A is placed on a smooth tabletop as shown above, and block B hangs over the edge of the table. The tabletop is a distance $2h$ above the floor. Block B is then released from rest at a distance h above the floor at time $t = 0$. Express all algebraic answers in terms of h, m, and g.

(a) Determine the acceleration of block B as it descends.

(b) Block B strikes the floor and does not bounce. Determine the time t_1 at which block B strikes the floor.

GO ON TO THE NEXT PAGE

(c) Describe the motion of block A from time $t = 0$ to the time when block B strikes the floor.

(d) Describe the motion of block A from the time block B strikes the floor to the time block A leaves the table.

(e) Determine the distance between the landing points of the two blocks.

GO ON TO THE NEXT PAGE