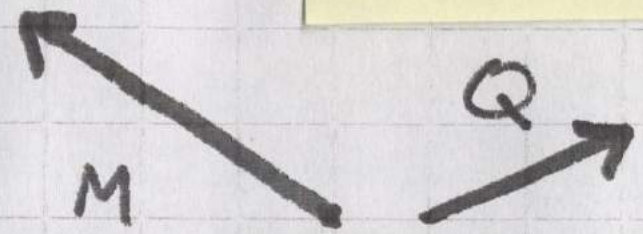
Packet H3



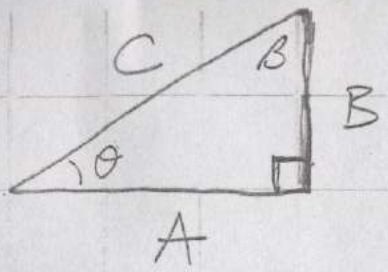
1. Add M and Q graphically and by adding coordinates.

2.) Draw the negative vector of M and Q.

3.) Subtract M and Q with coordinates.

4.) IF Q represents the net force required to accelerate a mass of 4 kg at $3\ m/s^2$, draw the vector required to accelerate the same mass at $6\ m/s^2$.

5.) Draw AT THE TOP OF THE PAGE... a potential pair of component vectors for Q.



The following questions refer to the triangle on the left. Each question is independent of prior questions.

6.) If side length of A is 15 meters and B is 20 meters, what is C's length?

7.) If $\theta = 45°$ and A has length 5 meters, what is B's length? What is angle β?

8.) Using variables and trig. identity sine write the equation for the length of B.

9.) Using variables and trig identity cosine write an equation for A.

10.) If C is 3 times as long as side A, angle θ must be what?

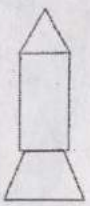
11.) If C is 4 times as long as B, angle θ must be what?

(Newton's 2nd law)

1. A rocket accelerating upward from the surface of the Earth has a mass of 8000 kg.

It has an upward acceleration of 30 m/sec^2.

a) What is the net force on the rocket?



b) Draw a force diagram (at right).
Include the weight and the thrust force.

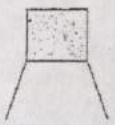
c) What is the thrust force on the rocket in newtons?

d) If the rocket leaves the ground initially at rest, what will the velocity of the rocket be 20 seconds after leaving the ground?

2. Someday in the future a 2000-kg craft will land on the surface of Mars where g = 4 m/sec^2. The craft is currently descending to the surface at a speed of 50 m/sec. The craft will use a thrust force to slow down and come to a stop (and safe landing). The thrust force is 24,000 N.

a) What is the weight of the rocket?
(Remember, this is not Earth.)

b) Draw a force diagram (at right).
Include the weight and the thrust force.



c) Draw a motion diagram.

d) What is the acceleration of the craft?

e) How many seconds does it take for the craft to come to a stop?

A 60-kg crate attached to a rope is initially moving upward with a speed of 8 m/sec. The tension in the rope is 480 N.

a) Draw a force diagram for the crate.

b) What is the acceleration of the crate?
Draw a motion diagram.

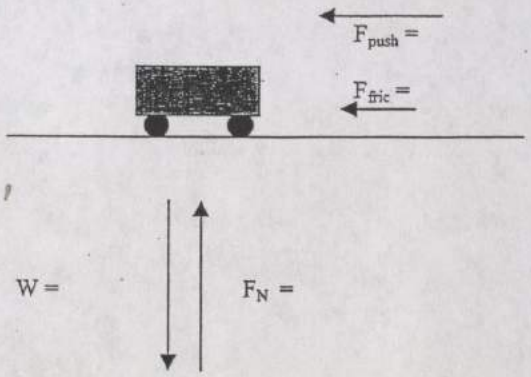
c) How high does the crate travel before coming to a stop?

d) Suppose the tension in the rope is 600 N. Describe the motion of the crate.

e) Suppose the tension in the rope is 800 N. Describe the motion of the crate.

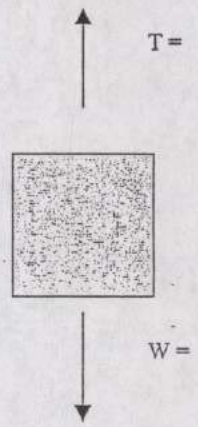
1. A 60-kg cart is initially moving to the right. A person steps out in front of the cart and pushes to the left to slow it down at a rate of 2.5 m/sec^2. The force of friction on the cart is 40 N.

a) Draw a motion diagram (including the acceleration vector).
b) Use $F_{net} = ma$ to find the net force and show its direction on the force diagram.
c) Find the values for F_{push}, W and F_N.



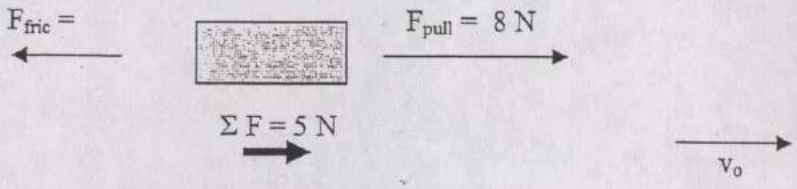
2. An 1800-kg elevator at the top of a building is initially at rest and begins to accelerate downward toward the ground, increasing downward speed at a rate of 2.5 m/sec^2.

a) Draw a motion diagram (including the acceleration vector).
b) Find the net force and show its direction on the force diagram.
c) Find the value of T.



a) From the given information, find the unknown force(s).
b) Given the direction of v_o, finish the motion diagram.

1)



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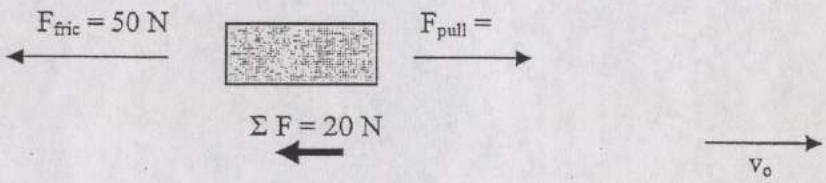
1)



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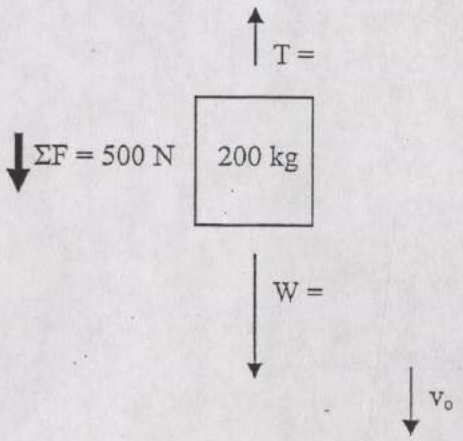
3)



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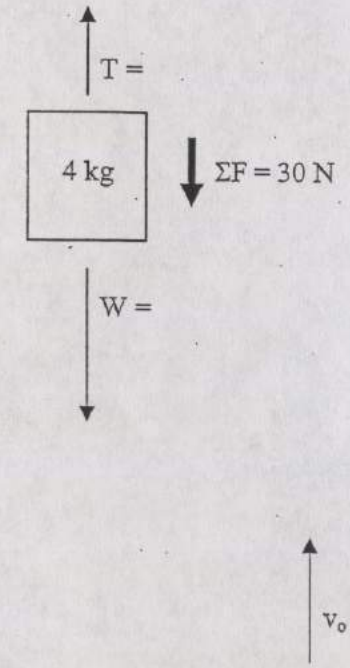


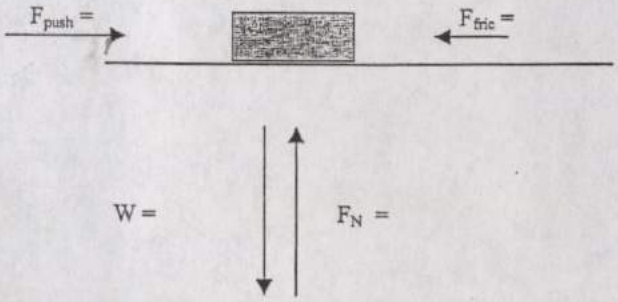
A person pushes on a 40-kg box. The coefficient of static friction between the box and the floor is $\mu_s = .6$. The coefficient of kinetic friction is $\mu_k = .35$.

a) What is the minimum force needed to start the box moving from rest?

Once the box has started to move, the person pushes with a force of 200 N.

b) Fill in the values for the force diagram below.

c) Use the values in the force diagram to find the net force and acceleration.

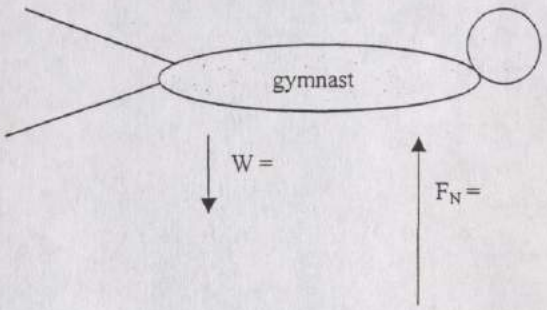


d) What is the direction of the acceleration? Draw a motion diagram for the box.

A 55-kg gymnast hits a mat on the floor while falling. The gymnast hits the mat with a high speed and then comes to a stop. The deceleration of the gymnast while falling is 30 m/sec^2.

a) Draw a motion diagram for the gymnast while she is moving downward and decelerating, in contact with the mat. Show the direction of the acceleration vector.
b) Find the net force and show its direction on the motion diagram.

The weight of the gymnast pulls downward while the normal force of the mat pushes upward on her body.
c) Write in the value of the weight W. The use the magnitude and direction of F_{net} to determine F_N.



d.) If initial velocity was 6 m/s when the gymnast hits the mat, what is the distance required to come to a stop?

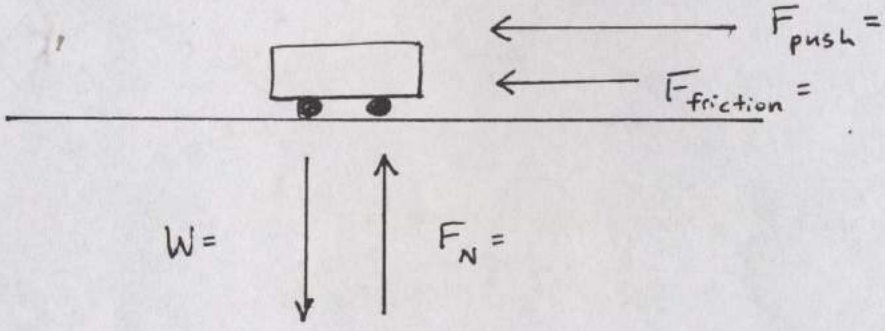
e.) What is the time required to stop?

1.) A 50 kg cart is moving right. A person steps in front of the cart and pushes it left at a rate of $3\ m/s^2$. The force of friction on the cart is 10 N.

a.) Draw a motion diagram. Include acceleration.

b.) Use $\Sigma F = m \cdot a$ to find net force and show its direction on the force diagram.

c.) Find F_{push}, W, and F_N

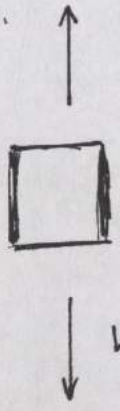


2.) An 500 kg elevator at the top of a building is initially at rest and begins to move downward (accelerate) toward the ground, increasing speed at $4\ m/s^2$.

a.) Draw the force diagram. Include acceleration.

b.) Find net force and show its direction.

c.) Find the valve of T.



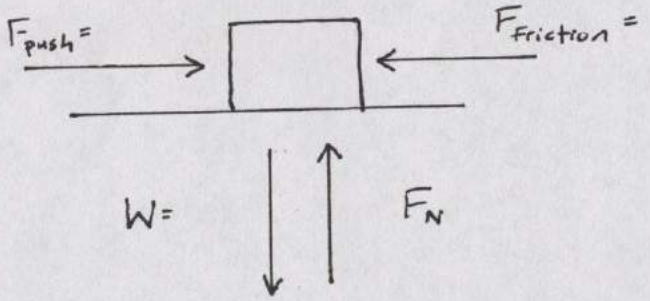
3.) A person pushes on a 60 kg box. The coefficient of static friction between the box and floor is $\mu_s = .6$ The coefficient of kinetic friction is $\mu_K = .4$

a.) What is the minimum force needed to start the box moving?

Once the box starts to move, the person pushes with a force of 300 N.

b.) Fill in the values for the force diagram below.

c.) Use these values to find net force and acceleration.

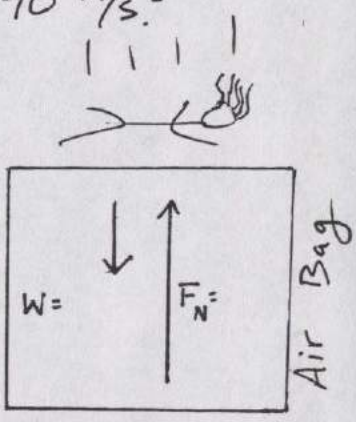


$\Sigma F =$ _____

$a =$ _____

4.) A 50 kg daredevil / stuntwoman hits a large air bag while falling. The stuntwoman hits the mat then comes to a stop. The deceleration of the woman is 40 m/s^2

a.) Find the net force and show its direction.

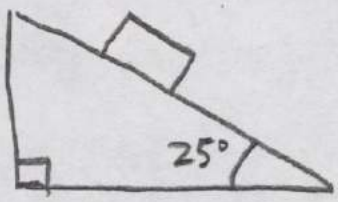


b.) Write the values of W and F_N.

c.) If the woman initially hits the mat going 15 m/s, what is the stopping distance required to come to a stop?

NAME:

Block on an Incline



block mass = 250 kg

1.

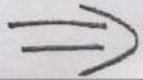
a.) Draw the components of the weight. Determine the component values.

$W_{\parallel}$ = _____ $W_{\perp}$ = _____

b.) Assume no friction, what is the acceleration of the block?

c.) What is the force of friction if $\mu_k = .25$ between the block & incline?

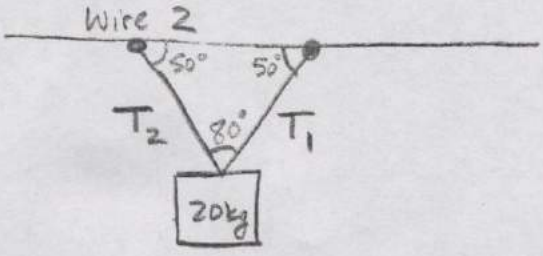
d.) Calculate the acceleration if $\mu_k = .25$ between the block and incline?



e.) Draw the force diagram. Label each force.

f.) Draw the motion diagram assuming the block starts at rest. Include $\vec{a}$.

(2.)



A 20 kg block is supported by two wires. The wires are at the same angle to the ceiling.

a.) Which wire has more tension: $T_2 \square T_1$

b.) Draw the components of wires 1 and 2.

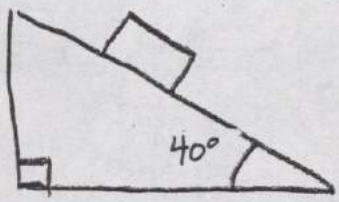
Wire 1 $\begin{cases} T_x = \\ T_y = \end{cases}$ Wire 2 $\begin{cases} T_x = \\ T_y = \end{cases}$

c.) What is the tension is wire 1?

NAME:

Block on an Incline

block mass = 50 kg



1

a.) Draw the components of the weight. Determine the component values.

$W_{\parallel}$ = _____ $W_{\perp}$ = _____

b.) Assume no friction, what is the acceleration of the block?

c.) What is the force of friction if $\mu_k = .3$ between the block & incline?

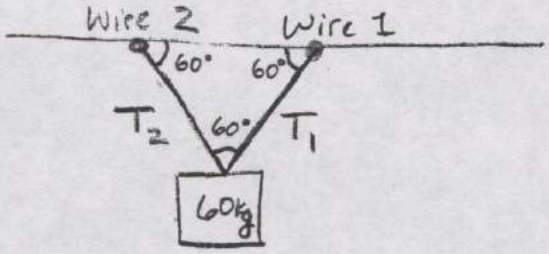
d.) Calculate the acceleration if $\mu_k = .3$ between the block and incline?

⇒

e.) Draw the force diagram. Label each force.
Include normal force, force of gravity and friction.

f.) Draw the motion diagram assuming the block starts at rest. Include $\vec{a}$.

(2.)



A 60 kg block is supported by two wires. The wires are at the same angle to the ceiling.

a.) Which wire has more tension: T_2 ☐ T_1

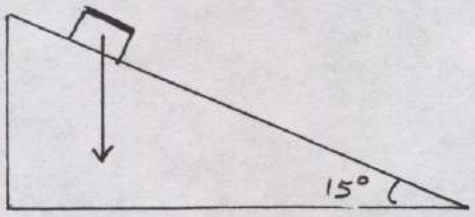
b.) Draw the components of wires 1 and 2.

Wire 1 { T_x = , T_y = } Wire 2 { T_x = , T_y = }

Fill in the above values for T_x and T_y of each wire.

c.) What is the tension is wire 1?
Show your work!

Name: _____ 15



1.) A block is on a frictionless incline. The mass of the block is 500 kg. The angle of incline is 15°.

a.) Break the weight vector into components. Draw those components on the above picture. Label the components.

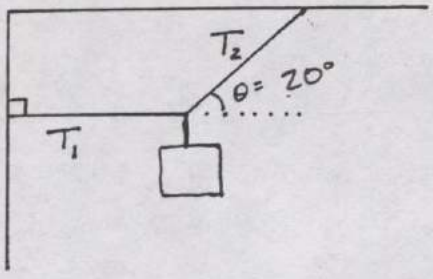
b.) Give the numeric values of the components.

$W_{\perp}$ =

W_{11} =

c.) What is the acceleration of the block? Assume no friction.

2.) A 15 kg mass is supported by two wires as shown.

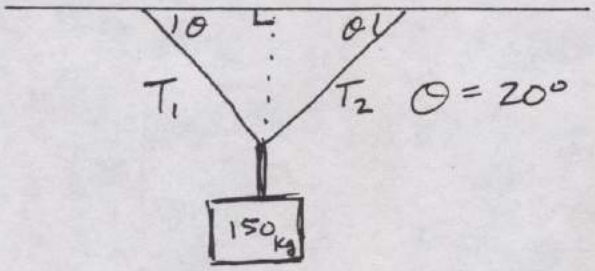


a.) Show how T_2 can be broken into T_x and T_y.

b.) Find the tension in T_2. Show your work.

c.) Find the tension in T_1. Show your work.

A 150 kg mass is supported by two wires as shown:

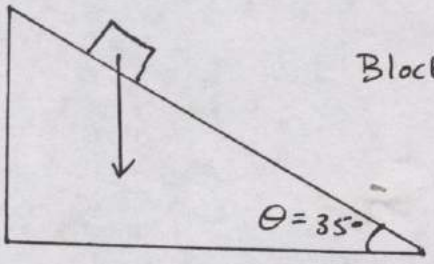


1.) Show how T_1 can be broken into T_x and T_y. Use sine and cosine in your answer. Give numeric values.

T_x:

T_y:

2.) Find the Tension in T_2. Show your work.



Block mass = 50 kg

3.) A block is on a frictionless incline. The mass of the block is 50 kg. The angle of incline is 35°.

a.) Break the weight into components. Draw the components on the above picture, label the components, and give the numeric values below:

$W_\perp$:

$W_{||}$:

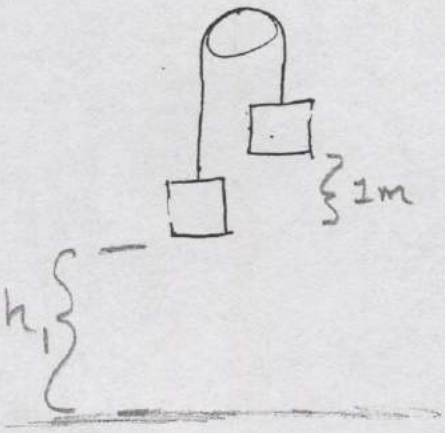
b.) What is the acceleration of the block? (no friction).

c.) If Force Friction = 100 N, what would acceleration become?

Individual Activity

1) An atwood machine has a ___ kg block hanging right on one side and a ___ kg block on the left side.

right ___
left ___
h_1 ___
$g = 10\ m/s/s$



A.) Find the magnitude of the acceleration of the blocks. a: ____

B.) What is the tension in the string?

C.) Which direction does the system move?

d.) How much time passes before the system touches the floor?

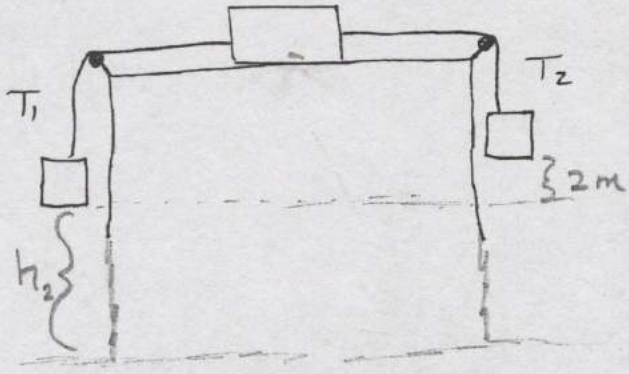
e.) What is the impact velocity?

2.) Find the tension in each string for the 3 box system:

μ_k = ____

right ___
middle ___
left ___
h_2 ___

$g = 10\ m/s/s$



a.) if there is no friction

b.) if μ_k = ____ between the middle block and table.

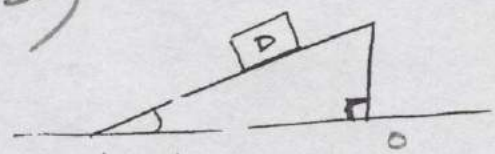
c.) Which direction does the system move?

d.) How much time passes until the system touches the floor?

e.) What is the impact velocity of the system?

All systems begin at rest.

3.)



Angle: ____ °

Block D is on an incline.
It has mass of ____ kg.
Assume $g = 9.8\ m/s^2$

a.) Draw a free body diagram.

b.) What is the normal force or $F_{\perp}$?

c.) What is the parallel force or $F_{\parallel}$?

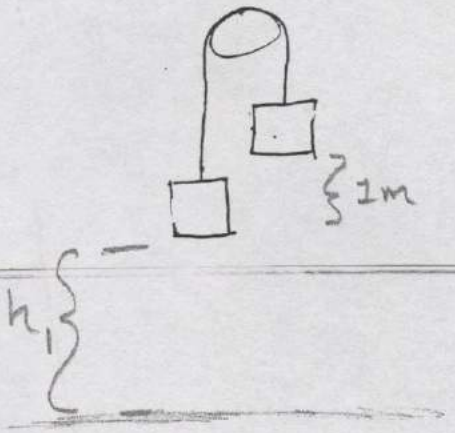
d.) What is the acceleration of the block?

e.) What would μ_s need to be in order for the block <u>not</u> to accelerate?

Individual Activity

1) An atwood machine has a ___ kg block hanging right on one side and a ___ kg block on the left side.

right ___
left ___
h_1 ___
$g = 10\ m/s/s$



A.) Find the magnitude of the acceleration of the blocks. a: ____

B.) What is the tension in the string?

C.) Which direction does the system move?

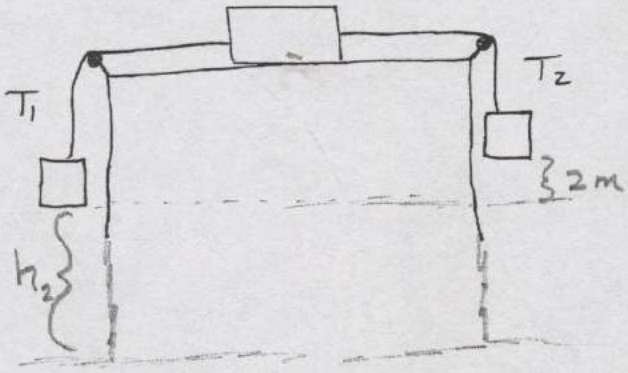
d.) How much time passes before the system touches the floor?

e.) What is the impact velocity?

2.) Find the tension in each string for the 3 box system:

μ_k = ____

right ___
middle ___
left ___
h_2 ___
$g = 10\ m/s/s$



a.) if there is no friction

b.) if μ_k = ____ between the middle block and table.

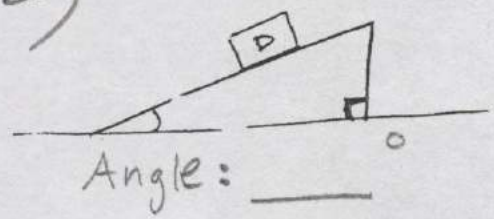
c.) Which direction does the system move?

d.) How much time passes until the system touches the floor?

e.) What is the impact velocity of the system?

All systems begin at rest.

3.)



Block D is on an incline.
It has mass of ____ kg.
Assume $g = 9.8\ m/s^2$

a.) Draw a free body diagram.

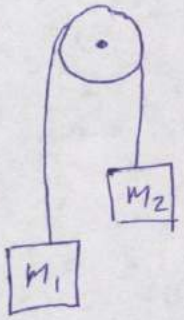
b.) What is the normal force or $F_\perp$?

c.) What is the parallel force or $F_{||}$?

d.) What is the acceleration of the block?

e.) What would μ_s need to be in order for the block <u>not</u> to accelerate?

An atwood machine is a simple pulley



$m_1 = 8\ kg$
$m_2 = 5\ kg$

What is the acceleration of the system?

① Start with $F = ma$ or $a = \frac{F_{net}}{m_T}$

② Calculate net force
$F_{net} = m_1 g - m_2 g$ Why?

③ Next divide by the sum of the masses.

$$\frac{F_{net}}{m_1 + m_2} = \frac{m_1 g - m_2 g}{m_1 + m_2} = a$$

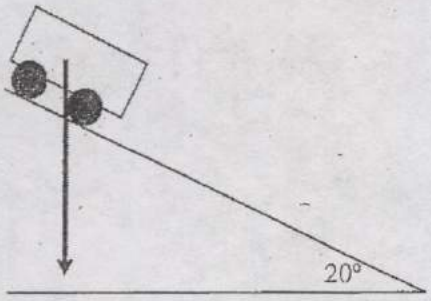
④ Complete the problem by substituting values.

⑤ What is the tension in the string?
$T_{1 or 2} = mg \pm m_1 a$ Should we add or subtract?

⑥ Does T_1 equal T_2? Yes, No or Impossible to know

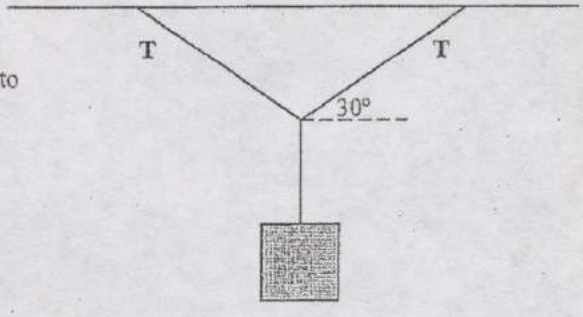
1. A cart is on an incline. The mass of the cart is 50 kg. The angle of the incline is 20°.

a) Break the weight vector into components. **Carefully draw the components.** Give the numerical value of each component.



b) What is the acceleration of the cart down the incline?

2. A 20 kg mass is supported by two wires as shown. Each wire is hanging at the same angle.



a) Show how each force **T** can be broken into T_x and T_y.

b) Find T_y of each wire.

c) Find T_x of each wire. Show your work.

d) Find the tension T of each wire.

Newton's 2nd law

1. A 2000-kg rocket (initially at rest) is lifted upward with an upward thrust of 30,000 N.
a) Draw a motion diagram and a force diagram for the rocket.

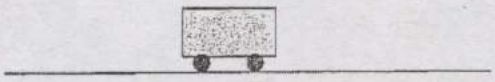
b) Determine the acceleration using Newton's second law.

c) What will the velocity of the rocket be after 40 seconds of thrust?

2. A 1600-kg car has an initial speed of 24 m/sec to the right. It brakes to a stop without skidding. The coefficients of friction are $\mu_s = .8$ and $\mu_k = .6$.

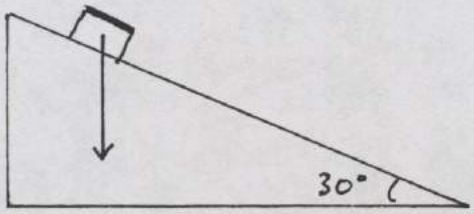
a) Draw the motion diagram including the acceleration arrow.

b) Draw the force diagram on the car including the direction of the net force. Give a name to each force. (Is there a forward force on the car?)



c) Find the (1) net force, (2) deceleration and (3) forward distance traveled by the car.

Name: _____ 24



1.) A block is on a frictionless incline. The mass of the block is 40 kg. The angle of incline is 30°.

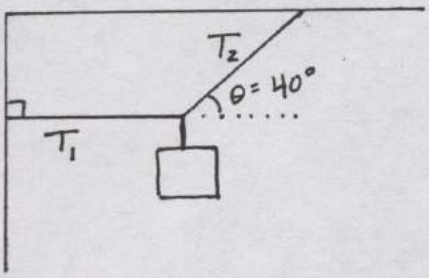
a.) Break the weight vector into components. Draw those components on the above picture. Label the components.

b.) Give the numeric values of the components.

$W_{\perp}$ =

$W_{\parallel}$ =

2.) A 30 kg mass is supported by two wires as shown.



a.) Show how T_2 can be broken into T_x and T_y.

b.) Find the tension in T_2. Show your work.

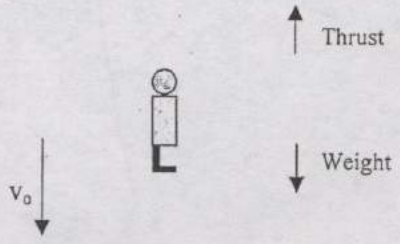
c.) Find the tension in T_1. Show your work.

Descending in a jet pack

An 80-kg person wearing a jet pack is descending toward the ground. He plans to land safely on the ground with a velocity of zero. At the moment he has a downward velocity of 10 m/sec.

1. Suppose the person can choose a thrust force of 600 N, 800 N or 1000N.

Describe the subsequent motion of the person in each of these 3 cases. Show your reasoning.



a) Thrust = 600 N

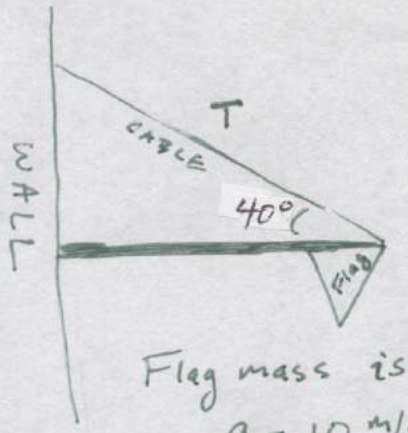
b) Thrust = 800 N

c) Thrust = 1000 N

2. Using the appropriate thrust value above,

a) Draw a force diagram.
b) Draw a motion diagram.
c) Find the acceleration.
d) Find the distance it will take the person to come to a stop.

#1



Flag mass is 25kg

$g = 10\ m/s/s$

a.) Draw a quantitative force diagram for the flag.

b.) Determine T_y, begin with $\Sigma F_y = 0$

c.) Solve for T_x, begin with $\Sigma F_x = 0$

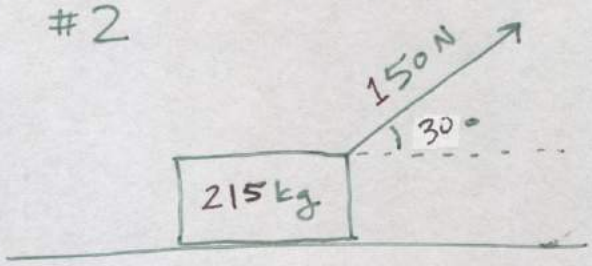
d.) Solve for total Tension in the cable.

(A)

#2

$g = 10\ m/s/s$

$\mu_k = .12$



a.) Draw a quantitative force diagram for the box.

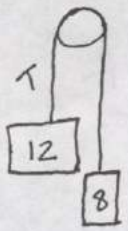
b.) Determine F_N, begin with $\Sigma F_y = 0$

c.) Calculate force friction.

d.) Calculate net force.

e.) Calculate acceleration.

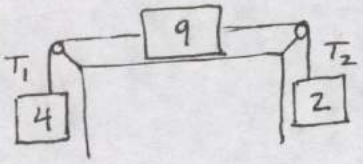
1. An atwood machine has an 8kg block hanging on one side and a 12 kg block hanging on the other side.



A.) Find the magnitude of the acceleration of the blocks.

B.) What is the tension in the string? (ignore the mass of the string)

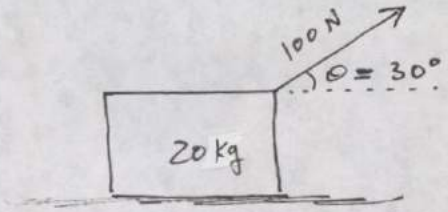
2. Find the tension in each string for the 3-box system:



a.) if there is no friction

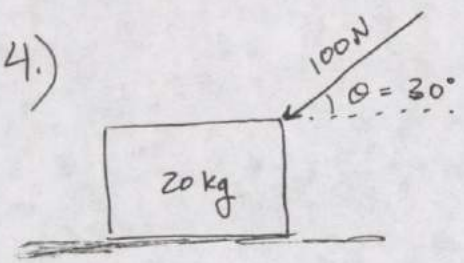
b.) if $\mu_K = .2$ for the surfaces of the table and 9kg block.

3.)



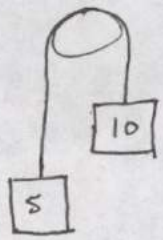
A box is being pulled along the ground with a slanted force as shown. The coefficient of kinetic friction between the box and the ground is $\mu_k = .3$ a.) Find the acceleration of the box. b.) Find force normal.

4.)



A box is being pushed along the ground with a slanted force as shown. The coefficient of kinetic friction between the box and the ground is $\mu_k = .3$ a.) Find the acceleration of the box. b.) Find force normal.

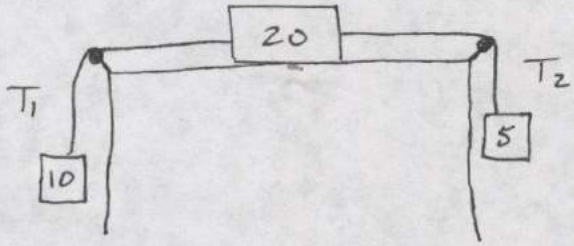
5.) An atwood machine has a 10 kg block hanging on one side and a 5 kg block on the other side.



A.) Find the magnitude of the acceleration of the blocks.

B.) What is the tension in the string?

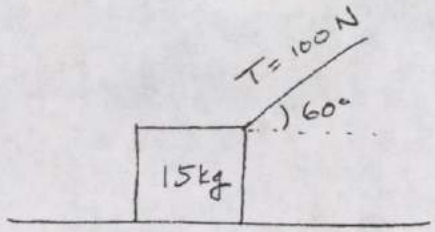
6.) Find the tension in each string for the 3 box system:



a.) if there is no friction

b.) if $\mu_k = .15$ between the 20 kg block and table.

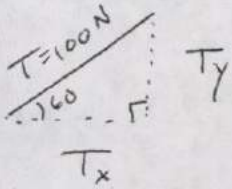
7.) Stationary Block



Label the Free body diagram

a.) What is the normal force exerted by the table? $\vec{F}_N$ = normal force

b.) In what direction is the normal force?



c.) In what direction is the tension?

d.) In what direction is the gravitational force?

$$\Sigma \vec{F}_y = m a_y$$

Solve for $\vec{F}_N$

$$\vec{F}_N + T_y - mg = m(0)$$

Homework – Elevator Problems

1.) Elevator moving up at a constant velocity of 2.5 m/s. The passenger has mass 85 kg. $g = 10\ m/s/s$

a.) Draw the force diagram for the passenger.

b.) Calculate the force of the floor on the passenger.

2.) Now the passenger is accelerating up at 2 m/s/s.

a.) Draw the force diagram for the passenger.

b.) Write an equation for the vertical forces on the passenger.

c.) Calculate the forces on the passenger.

3.) Now the passenger accelerates downward at 3 m/s/s.

a.) Draw the force diagram for the passenger.

b.) Write an equation for the vertical forces on the passenger.

c.) Calculate the force of the floor on the passenger.