Chapters 4 & 7 XtraWrk – Forces

MC 1: If a block were to slide down a frictional incline, what would be true?

a.) Its speed and acceleration would both increase.
b.) Its speed and acceleration would remain the same.
c.) Its speed would become greater while its acceleration stayed the same.
d.) Its speed and acceleration would both decrease.
e.) Its speed would become greater while its acceleration would become less.

MC 2: Over a given time interval, a constant, net external force (non-zero) is applied to an object. What would be true in that case (there can be more than one)?

a.) The object must move.
b.) The object's velocity magnitude must increase.
c.) The object's acceleration must increase.
d.) The object accelerates.
e.) The object speed does not change.

MC 3: If the earth's radius and mass doubled, the acceleration of gravity at the earth's surface would be:

a.) 9.8 m/s^2.
b.) 4.9 m/s^2.
c.) 2.45 m/s^2.
d.) 19.6 m/s^2.
e.) 12.6 m/s^2.

MC 4: Two very fat squirrels of equal weight are on a single vine that is hanging in the vertical. One is a meter above the other. What is the ratio of the tension in the line above the upper squirrel to the tension in the line between the squirrels?

a.) 1:2.
b.) 1;1.
c.) 3:2.
d.) 2:1
e.) more information is required

MC 5: A crate sits stationary on an incline. The magnitude of the frictional force between the crate and the incline is:

a.) greater than mg.
b.) at least equal to mg.
c.) equal to the component of the gravitational force on the crate perpendicular to the incline.
d.) equal to the component of the gravitational force on the crate parallel to the incline.

MC 6: A truck runs into a wall, breaking through.

a.) The truck exerts a greater force on the wall than the wall exerts on the truck.
b.) The truck exerts the same force on the wall as the wall exerts on the truck.
c.) The truck exerts a lesser force on the wall than the wall exerts on the truck.
d.) You can't relate the force by the wall on the truck and the force by the truck on the wall, as the wall is broken through.

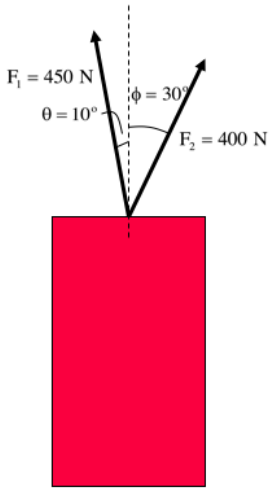
MC 7: An object of mass *m* moving with constant velocity *v* has a net force on it equal to:

a.) mg.
b.) mv.
c.) mv/t.
d.) 0.
e.) None of the above.

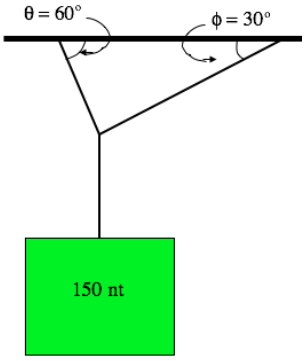
4.2) A soccer goalie accelerates a ball from rest to 10. m/s over a time period of about 0.20 seconds (that's how long her foot touches the ball). If the soccer ball's mass is 0.50 kg, what is the average force exerted by the goalie on the ball?

4.12) Two forces are applied to a crate as shown to make it move.

a) What is the resultant force applied?
b) If the crate's mass is 3000 kg, what's the acceleration? Ignore friction.



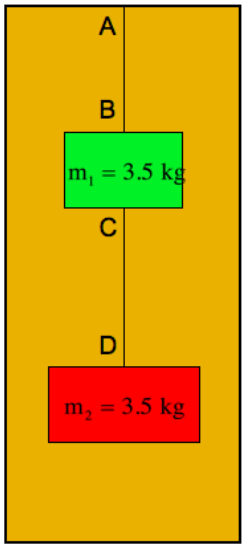
4.19) A 150-N potted plant is suspended by three cables as shown. What's the tension in each cable?



4.21) Two small crates hang from the end of a crane, as shown. Each crate has a mass of 3.50 kg.

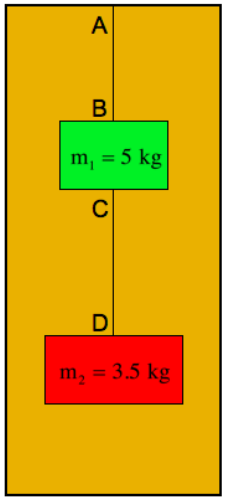
a) If the crane is lifting the crates at a constant acceleration of 1.60 m/s^2, what are the tensions in each string? Call the upper string T_1 and the lower string T_2.

b) If the maximum strength of the strings is 85.0 N, what's the maximum acceleration of the crates before the top string breaks?



4.21 hybrid) Two masses are attached to one another by rope as shown in the sketch.

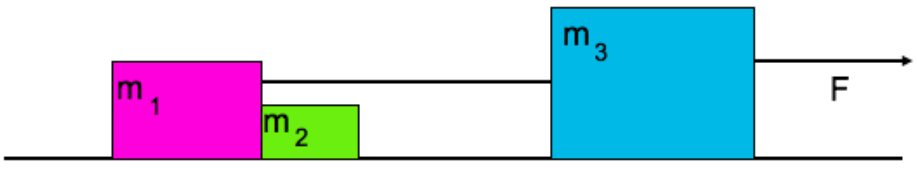
a) What is the difference in tension between Point A and Point B?
b) What is the difference in tension between Point B and Point C?
c) What is the difference in tension between Point C and Point D?
d) Which line has the greater tension, the upper or the lower?



4.29) The three blocks below are moving on a frictionless surface. Given the values and set up in the image below, determine:

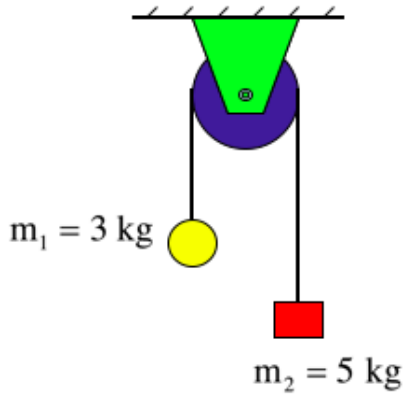
a) The acceleration of the system
b) The tension in the line between the blocks
c) The force exerted by the left mass (m_1) on the central mass (m_2)

$m_1 = 1$ kg
$m_2 = 2$ kg
$m_3 = 3$ kg
$F = 42$ N

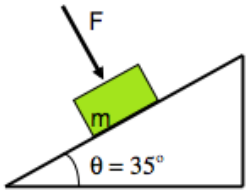


4.38) A simple Atwood machine is shown to the right. It consists of two masses, m_1 = 3 kg and m_2 = 5 kg, suspended on either side of a massless, frictionless pulley by a light string. Find:

a) The tension in the strings
b) The acceleration of the system
c) The distance each initially stationary mass will travel in 1 second after being released.



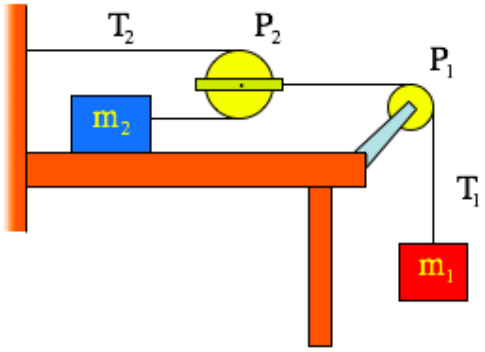
4.47) What is the minimum force F needed to hold the block motionless as shown?



m = 3 kg
$\mu_s = .3$

4.68) Masses m_1 and m_2 are connected to one another as shown in the sketch. Assume no friction and ideal pulleys and strings.

a) How are the accelerations of the masses related? That is, give a ratio (1:1, 2:1, 3:1, 2:3, etc.) (Hint: track the motion of each mass as the bodies move in unison).
b) Derive expressions for the tensions denoted, in terms of known values and constants.
c) Derive expressions for the masses' accelerations.



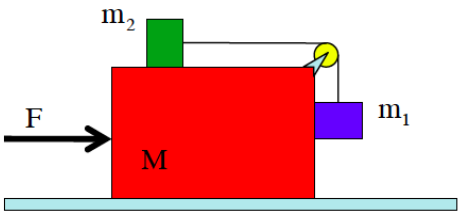
4.78) A 70.0 N child is sitting on a 60.0 N sled, being pulled across snow by a horizontal force F. The coefficient of kinetic friction between the snow and sled is 0.10. The coefficient of static friction between the child and the sled is 0.70, and the coefficient of kinetic friction between the child and the sled is 0.40.

a) How large does F have to be before the child breaks loose and slides over the sled? (This is the same as asking what the maximum F could be and NOT have the child break loose).
b) Once the child has broken loose, what will her acceleration be?

4.81) A kid pulls on a rope that has passed over a pulley as shown. If the scale attached to the rope reads 250 N, and if the kid's weight is 320 N and the swing's weight is 160 N:

a) What's the system's acceleration?
b) What's the force exerted on the kid by the chair?

4.85) Derive an expression for what force F will keep m_2 stationary with respect to M? Assume no friction anywhere.



7.21) A girl on roller skates is skating at 4.0 m/s when she grabs a 0.80 m long ribbon tied at one end to a maypole and begins skating in a circle around the maypole. If the girl has a mass of 55 kg:

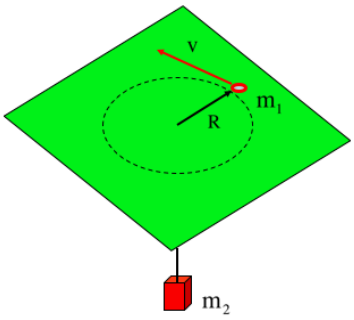
a) What's the horizontal tension force exerted by the ribbon on her arms?
b) How big is that force compared to her weight?

7.23) A car is able to drive around a flat curve of radius 150 m with a top speed of 32.0 m/s. How fast can that same car go around a 75 m radius curve?

7.25) A 50.0 kg box sits at the edge of a giant turntable of radius 2.00 m, rotating at 2.0 rad/s (this means the box is moving with velocity magnitude 4.0 m/s).

a) Determine the centripetal acceleration of the box.
b) Determine the minimum force needed to keep the box in its circular path without sliding.
c) Determine the minimum coefficient of static friction to accomplish (b). Evaluate whether this answer is reasonable/realistic.

7.27) A 0.25 kg mass is tied to a string and allowed to revolve in a circle of r = 1.0 m. A 1.0-kg mass hangs from the other end of the string.



a) What is the tension in the string?
b) What horizontal force acts on the puck?
c) What's the puck's speed?

Non-book problems:

1. Hanging mass in railroad car problem

A 3 kg object hangs at 4º from the vertical of a railroad car when the car accelerates to the right. What is the car's acceleration?