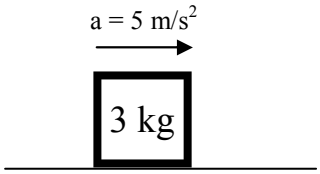
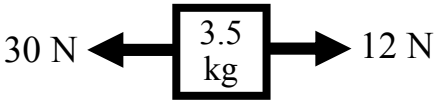
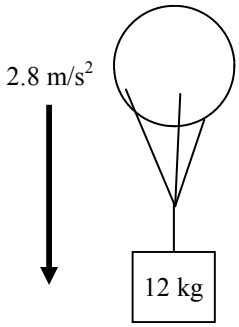
Forces in Equations



1. A 3 kg object is accelerating 5 m/s2 to the right. Calculate the net force acting on the object.

2. Calculate the acceleration of the object at the right.



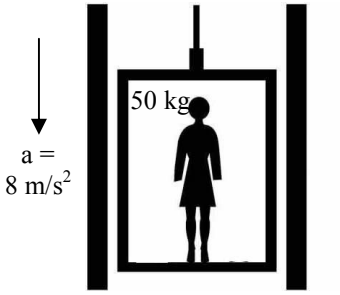


3. A. Draw a force diagram for the object at the left next to the object.

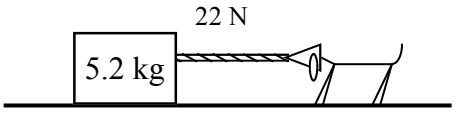
   B. Is the acceleration positive or negative?
   C. Calculate the tension in the rope.

4. A. Draw the force diagram for the lady in the elevator.
   B. Is the acceleration positive or negative?
   C. Figure out the normal force acting on the lady.

   C. Does she feel lighter or heavier?



$\mu_s = .35$
$\mu_k = .2$



5. Bim is pulling a 5.2 kg object with 22 N. The floor has friction.
   A. Which way does friction act?
   B. Draw a force diagram for the object.
   C. Write the equation for friction:

   D. Calculate both types of friction acting on the object.

   E. If the object started at rest, does it start to slide?
   F. Why?

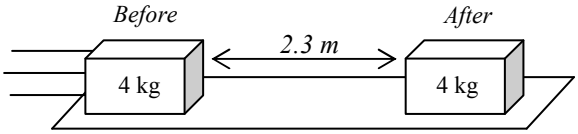
   G. If the object is already moving, calculate its acceleration.

6. What is the force pair for each of the following forces found in the diagram above.
   A. The force of gravity pulling down on Bim.
   B. The force of tension pulling on the mass.
   C. The normal force of the floor on Bim's feet.
   D. The force of friction of the floor on a block.

7. The normal force acting on the object above is equal to the force of the its weight. Why are these not a Third Law Action-Reaction pair?

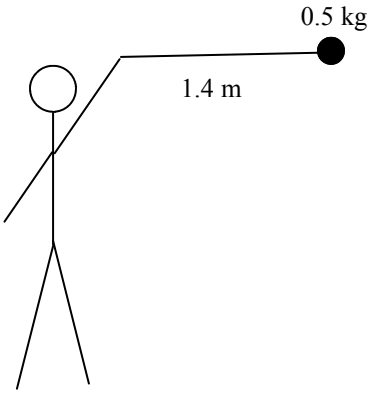
8. A 4 kg object slides to a stop due to friction in 4.8 seconds.
   A. Draw a force diagram of the object while it is moving.

   B. Use a kinematic equation to find the acceleration of the object.



   C. Find the force that slowed down the object.

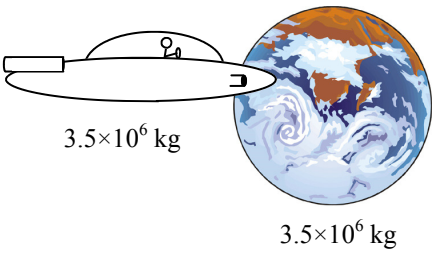
   D. Use the friction equation to find the coefficient of friction of the surface.

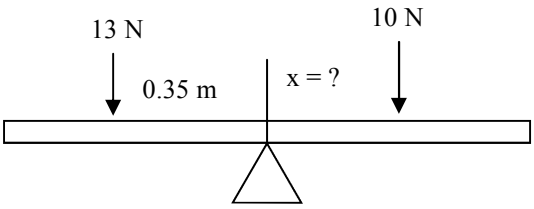


9. Slim Jim is spinning a ball around his head. The ball is moving 6.2 m/s.
   A. Draw a force diagram for the ball.
   B. Which direction does the acceleration of the ball point?
   C. If the rope is released, what path does the ball follow?
   B. Calculate the centripetal acceleration of the ball.

   D. Calculate the tension in the rope.

10. Slim Jim's spaceship the "Galactic Cruiser" is 1.8×10^8 m from the center of the earth. Calculate the force of gravity on the ship.

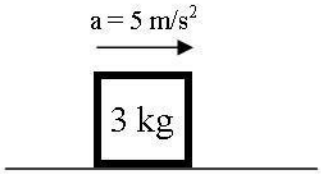




11. A 13N force pushes on a lever 0.35m from the pivot point.
   A. Calculate the torque of the force.

   B. Where must a 10N force be applied to balance out the 13N force?

Forces in Equations



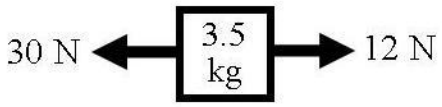
1. A 3 kg object is accelerating 5 m/s2 to the right. Calculate the net force acting on the object.

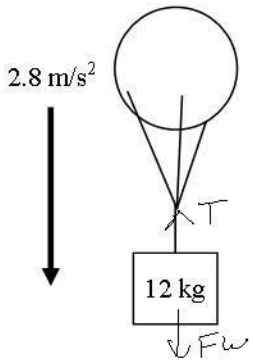
$F_{net} = ma$
$= 3(5) = 15\ N$

There could be multiple forces, but together they equal 15 N.

2. Calculate the acceleration of the object at the right.

$\Sigma F = ma$
$-30 + 12 = 3.5a$
$-18 = 3.5a$
$\frac{-18}{3.5} = a$
$a = -5.14\ m/s^2$





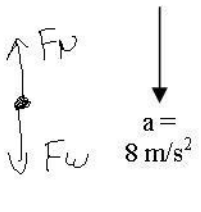
3. A. Draw a force diagram for the object at the left next to the object. here it is.
   B. Is the acceleration positive or negative?
   C. Calculate the tension in the rope.

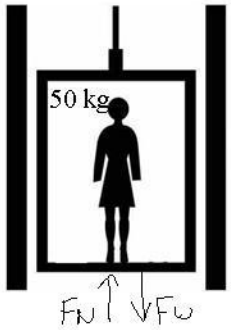
$\Sigma F = ma$
$T - F_w = ma$
$T - 120 = 12a$
$T = 120 + 12(-2.8)$
$T = 86.4\ N$

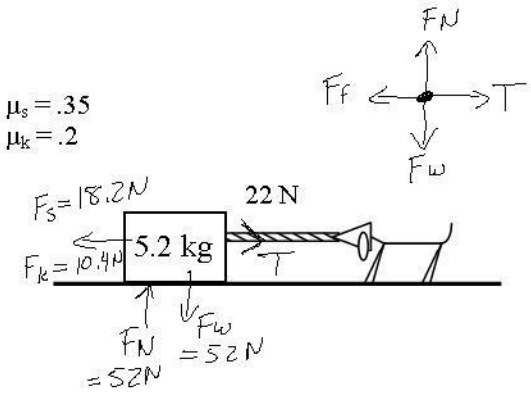
4. A. Draw the force diagram for the lady in the elevator.
   B. Is the acceleration positive or negative?
   C. Figure out the normal force acting on the lady.

$F_N - F_w = ma$
$F_N = F_w + ma = 500 + 50(-8) = 500 - 400$
$F_N = 100\ N$

   C. Does she feel lighter or heavier?
much lighter.







5. Bim is pulling a 5.2 kg object with ~~15 N~~. The floor has friction.
   A. Which way does friction act? left
   B. Draw a force diagram for the object. ✓
   C. Write the equation for friction:

$F_k = \mu_k F_N$ or $F_s = \mu_s F_N$

   D. Calculate both types of friction acting on the object.

$F_s = .35(52) = 18.2N$
$F_k = .2(52) = 10.4N$

   E. If the object started at rest, does it start to slide? yes
   F. Why? $22 > 18.2$

   G. If the object is already moving, calculate its acceleration.

$\Sigma F = ma$
$22 - 10.4 = 5.2a$
$11.6 = 5.2a$
$\frac{11.6}{5.2} = a = 2.23\ m/s^2$

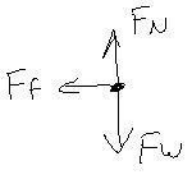
6. What is the force pair for each of the following forces found in the diagram above.
   A. The force of gravity pulling down on Bim. Bim pulling up on earth.
   B. The force of tension pulling on the mass. mass pulling on rope.
   C. The normal force of the floor on Bim's feet. Bim pushing on floor.
   D. The force of friction of the floor on a block. Block's friction on floor.

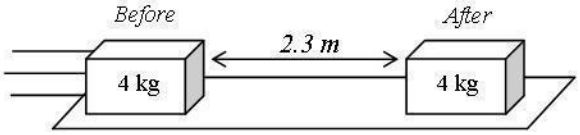
7. The normal force acting on the object above is equal to the force of the its weight. Why are these not a Third Law Action-Reaction pair?

They are both acting on the block. Force pairs have to be on two different objects. Fw of earth on Bim is equal to Bim's pulling up on the earth. Floor pushing on Bim is same and Bim pushing on floor.

8. A 4 kg object slides to a stop due to friction in 4.8 seconds.

A. Draw a force diagram of the object above the picture.





B. Use a kinematic equation to find the acceleration of the object.

$t = 4.8\,sec$ $\quad \Delta x = V_F t - \frac{1}{2} a t^2$

$\Delta x = 2.3\,m$ $\quad 2.3 = 0 - \frac{1}{2} a (4.8)^2$

$V_F = 0\,m/s$ $\quad 4.6 = -23.04\,a$ $\quad a = -.2\,m/s^2$

$a = \_\_\_$

C. Find the force that slowed down the object

$F = ma$ $\quad F = -.8\,N$

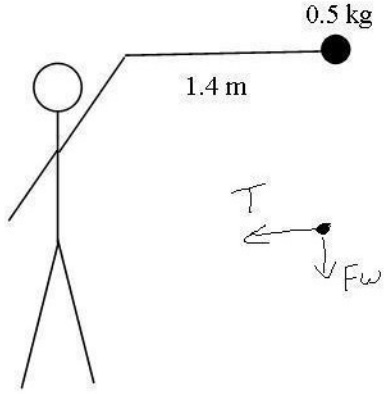
$F = 4(-.2)$

D. Use the friction equation to find the coefficient of friction of the surface.

magnitude only (so no negative)

$F_K = \mu F_N$

$\mu = \frac{F_K}{F_N} = \frac{.8}{40} = .02$



9. Slim Jim is spinning a ball around his head. The ball is moving 6.2 m/s.

A. Draw a force diagram for the ball.

B. Which direction does the acceleration of the ball point? inward

C. If the rope is released, what path does the ball follow? straight

B. Calculate the centripetal acceleration of the ball.

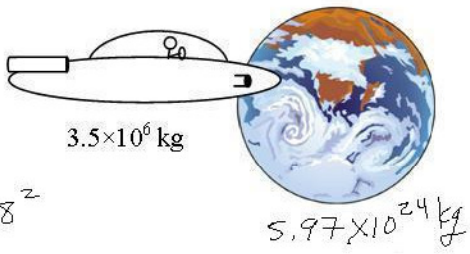
$a_c = \frac{V_t^2}{r} = \frac{6.2^2}{1.4} = 27.5\,m/s^2$

D. Calculate the tension in the rope.

$\Sigma F = ma$

$T = 0.5(27.5) = 13.75\,N$

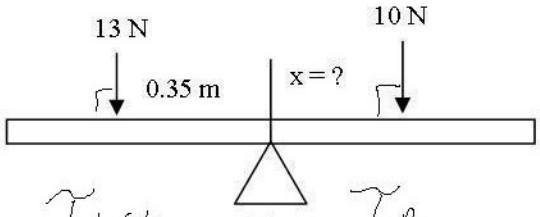
10. Slim Jim's spaceship the "Galactic Cruiser" is 1.8×10^8 m from the center of the earth. Calculate the force of gravity on the ship.



$F_g = G \frac{m_1 m_2}{r^2}$

$= 6.673E{-}11 * 3.5E6 * 5.97E24 / 1.8E8^2$

$= 4.3 \times 10^4\,N$



$\tau_{left} = \tau_R$

$Fd = Fd$

$13(.35) = 10(d)$

$d = .455\,m$

11. A 13N force pushes on a lever 0.35m from the pivot point.

A. Calculate the torque of the force.

$13(.35) = 4.55\,Nm$

B. Where must a 10N force be applied to balance out the 13N force?

$\tau_R = Fd$ $\quad d = .455\,m$

$4.55 = 10(d)$