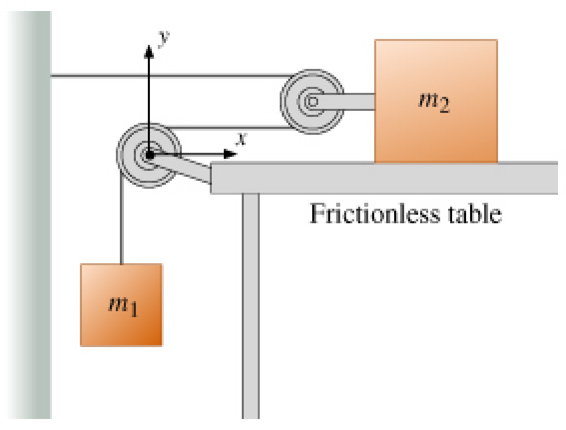
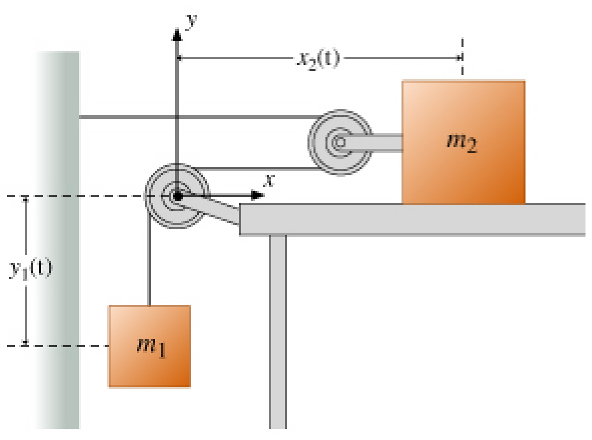
Two Blocks and Two Pulleys



Note that in general for a puley system with only one pulley the acceleration will be the same for all the objects.

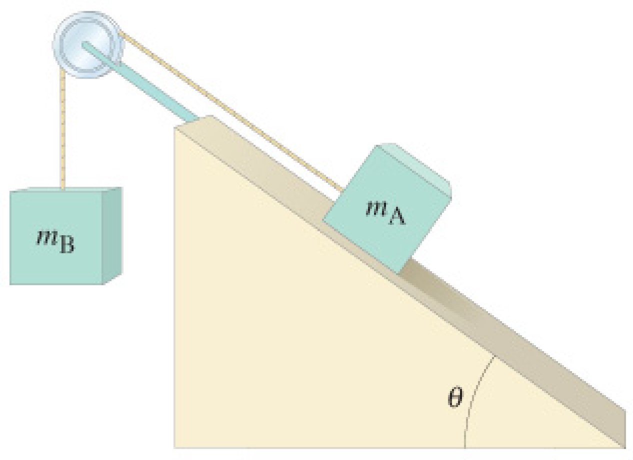
In this case it is not the case! This is because when **m1** drops a distance $y = l$ **m2** will move to the left only a distance $x = l/2$ because of the double pulley. Hence, at each instant, $v_1 = 2v_2$, where **v1** and **v2** are the speeds of the blocks of masses m1 and m2, respectively. The formula for a2 versus a1 should follow the same scaling because $a_2 = \frac{dv_2}{dt} = \frac{d(2v_1)}{dt} = 2a_1$

This is also easy to obtain using calculus:



The total rope length is: $L = 2x_2(t) + y_1(t) + C$, where C is a constant for the lenght of the rope around the pulleys, which does not change with time. $\frac{dL}{dt} = 0 = 2v_2 + v_1$ $v_2 = -v_1/2$, of course the minus sign because they are effectively in opposite directions, if y_1 increases x_2 decreases.

4.77



For object **b**

$m_b g - T = m_b a$

For object **a**

$T - m_a sin(\theta) = -m_a a$

$a = \frac{-g(m_a sin(\theta) - m_b)}{m_a + m_b}$

4.78 Two objects in two inclines with different angles

Make an asumption of the direction of motion and then apply signs accordingly: Lets assume object **a** (on the left) drops.

For object **a**

$g m_a sin(\theta_a) - T = m_a a$

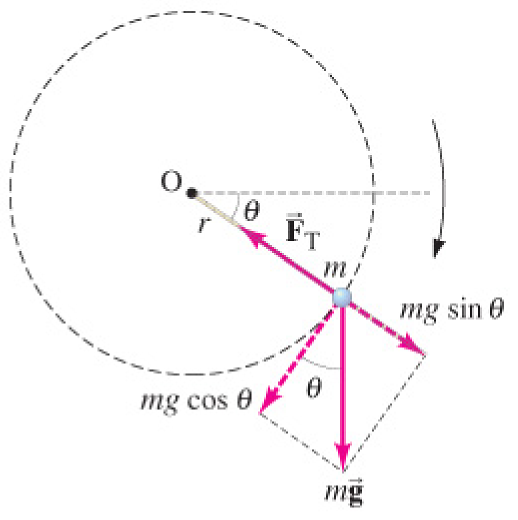
For object **b**

$T - m_b sin(\theta_b) = -m_b a$

$a = \frac{m_a sin(\theta_a) - m_b sin(\theta_b))}{m_a + m_b}$

5.105

A ball of mass m = 1.7 kg at the end of a thin cord of length r = 0.60 m revolves in a vertical circle about point O, as shown in the figureA ball of mass m is attached by a cord to point O and revolves in a vertical loop about it. The cord has length r, and the revolution is clockwise. The ball is below and to the right of point O. The cord makes an angle theta with the horizontal. The tension force F subscript T acts on the ball and is directed along the cord toward point O. The gravitational force m vector g acts on the ball vertically downward. One component of this force is m g times the sine of theta and it acts along the cord away from point O. The second component is m g times the cosine of theta and it acts perpendicular to the cord, downward and to the left. The angle between this component and the gravitational force is theta.. During the time we observe it, the only forces acting on the ball are gravity and the tension in the cord. The motion is circular but not uniform because of the force of gravity. The ball increases in speed as it descends and decelerates as it rises on the other side of the circle. At the moment the cord makes an angle θ = 35 ∘ below the horizontal, the ball's speed is 6.0 m/s . At this point, determine the (a)tangential acceleration, (b)the radial acceleration, and (c)the tension in the cord, FT Take θ increasing downward as shown.



5.98

A banked curve of radius R in a new highway is designed so that a car traveling at speed v0 can negotiate the turn safely on glare ice (zero friction). If a car travels too slowly, then it will slip toward the center of the circle. If it travels too fast, it will slip away from the center of the circle. If the coefficient of static friction increases, it becomes possible for a car to stay on the road while traveling at a speed within a range from vmin to vmax.

We know that $tg(\theta) = \frac{v_0^2}{Rg}$

- Derive formula for vmin as a function of μs, v0, and R.

  In this case we know that at this point the car will slide down and hence $_{fr}$ will be pointing up the bank slope.

  $v_{min} = v_0\sqrt{(1 - \frac{\mu Rg}{v_0^2})(1 + \frac{\mu v_0^2}{Rg})^{-1}}$

- Derive formula for vmax as a function of μs, v0, and R.

  In this case we know that at this point the car will slide up and hence $_{fr}$ will be pointing down the bank slope.

  $v_{max} = v_0\sqrt{(1 + \frac{\mu Rg}{v_0^2})(1 - \frac{\mu v_0^2}{Rg})^{-1}}$

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