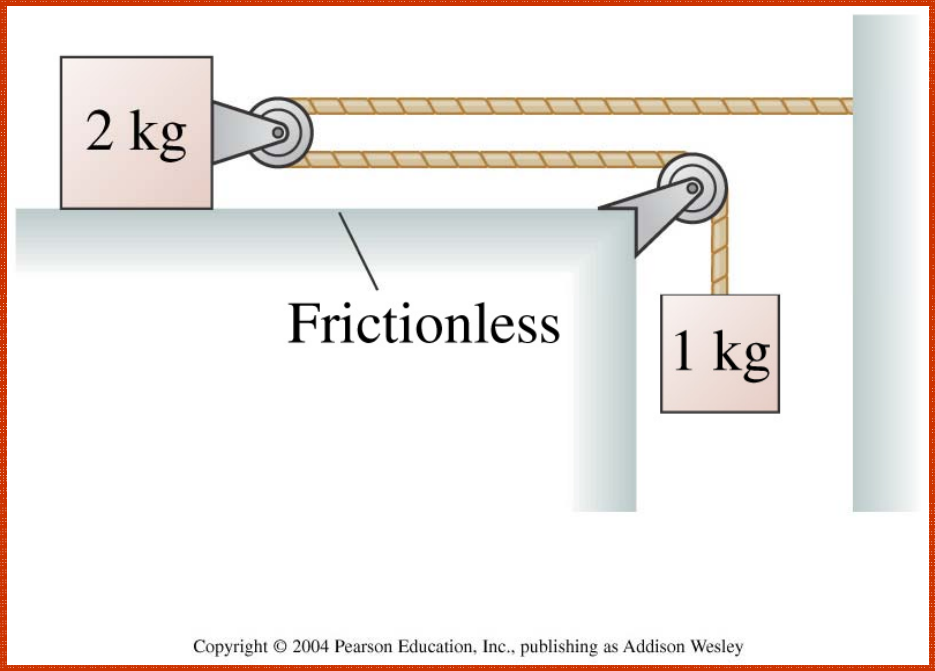
ConcepTest Pulley

Two masses are connected by a light rope as shown below. What is the relationship between the magnitude of the acceleration of m_1 to that of m_2 ? Mass m_1 represents the 1 kg mass.

1) $a_1 = 1/3\ a_2$
2) $a_1 = ½\ a_2$
3) $a_1 = a_2$
4) $a_1 = 3\ a_2$
5) $a_1 = 2\ a_2$



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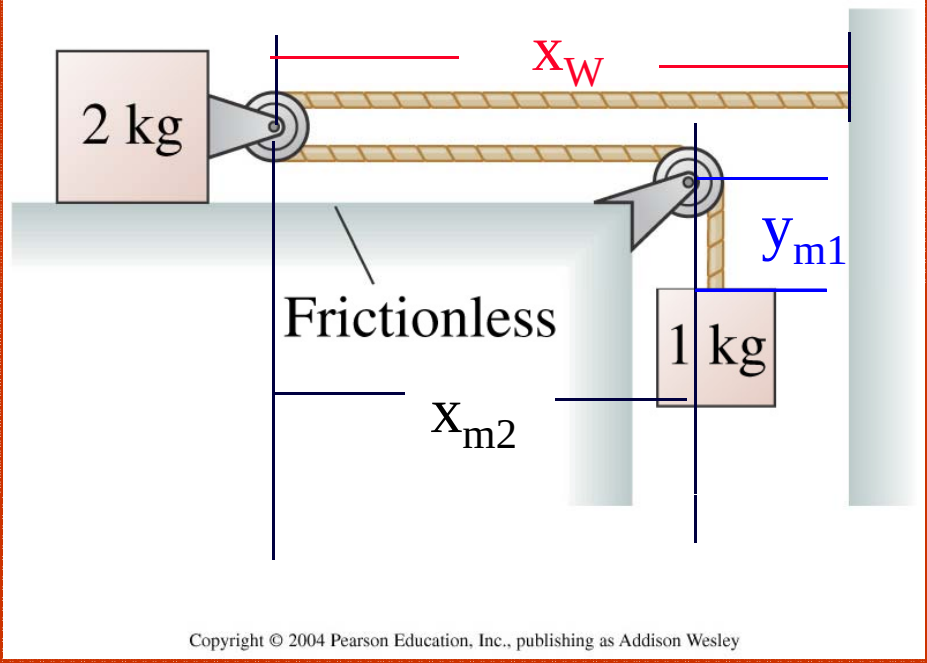


$L = x_W + x_{m2} + y_{m1}$

The length of the string must remain constant and

$x_W = x_{m2}$

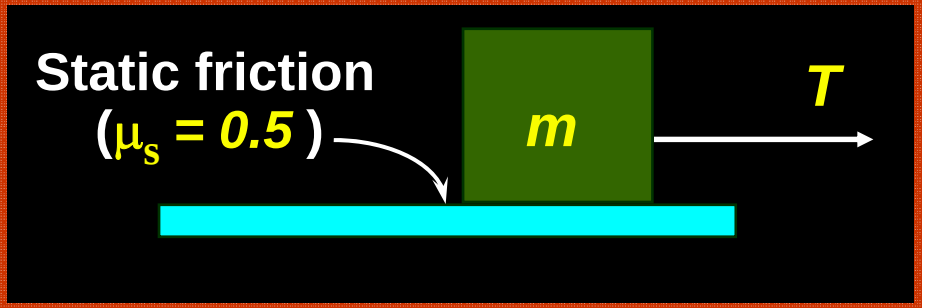
$L = x_{m2} + x_{m2} + y_{m1}$

$a_1 = 2\ a_2$ (magnitude)

ConcepTest 6.1 Will it Budge?

A box of weight 100 N is at rest on a floor where $\mu_s = 0.5$. A rope is attached to the box and pulled horizontally with tension $T = 30$ N. Which way does the box move?

1) moves to the left
2) moves to the right
3) the box does not move



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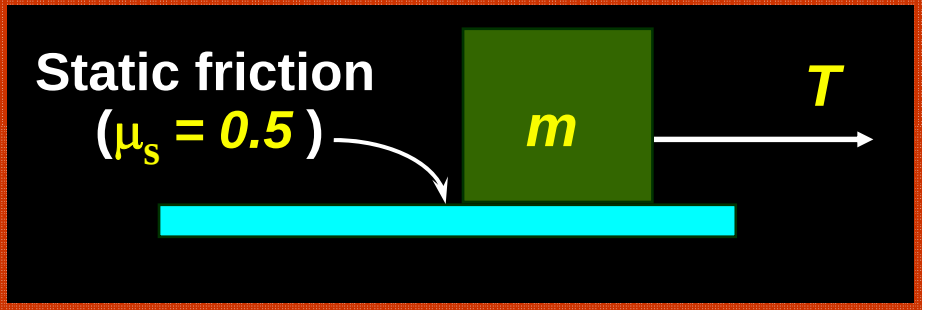
The static friction force has a maximum of $\mu_s N = 50$ N. The tension in the rope is only 30 N. So the pulling force is not big enough to overcome friction.



Follow-up: What happens if the tension is 35 N? What about 45 N?

ConcepTest 6.2 Tension and Work

A ball tied to a string is being whirled around in a circle. What can you say about the work done by tension?

1) **tension does no work at all**
2) **tension does negative work**
3) **tension does positive work**

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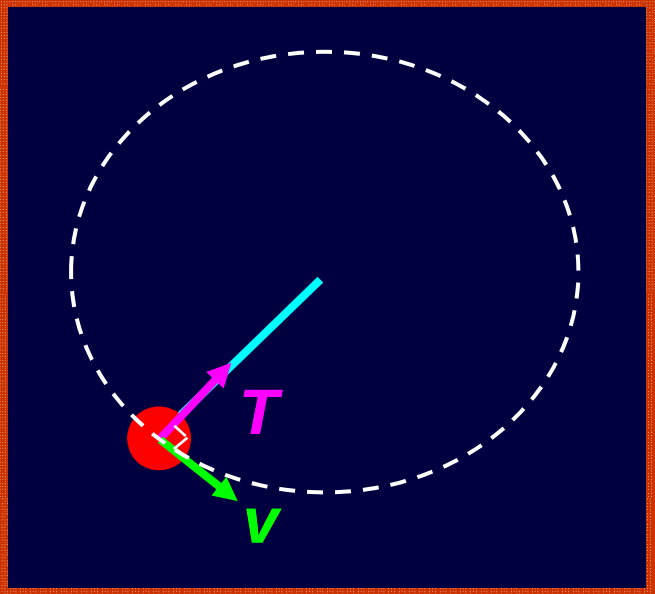
No work is done because the force acts in a perpendicular direction to the displacement. Or using the definition of work: $W = F\,d\cos\theta$

since $\theta = 90^o$, then $W = 0$

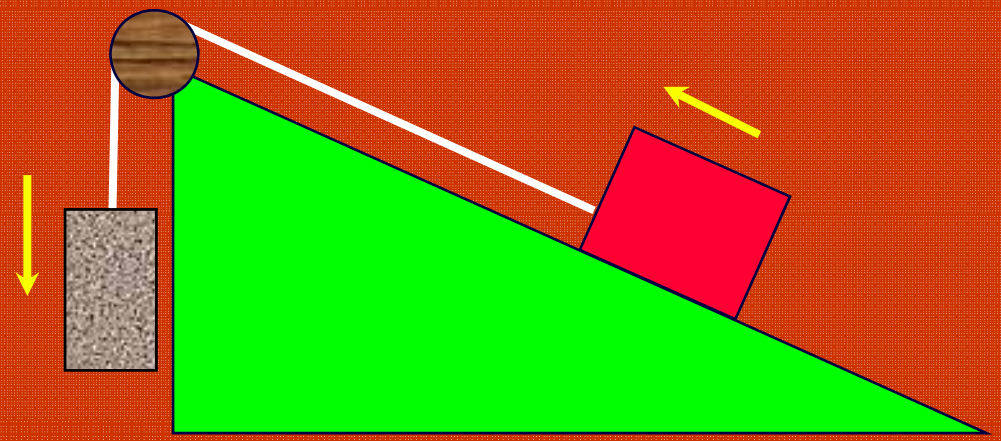


Follow-up: Is there a force in the direction of the velocity?

ConcepTest 6.2 Force and Work

A box is being pulled up a rough incline by a rope connected to a pulley. How many forces are doing work on the box?

1) one force
2) two forces
3) three forces
4) four forces
5) no forces are doing work



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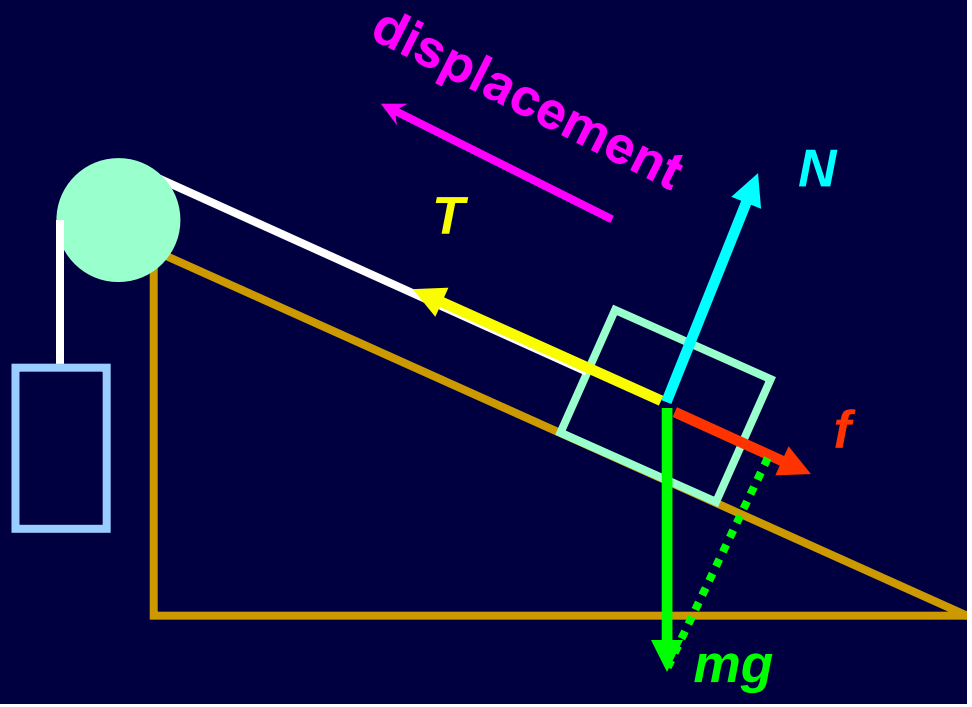
Any force not perpendicular to the motion will do work:

N does *no work*

T does positive work

f does negative work

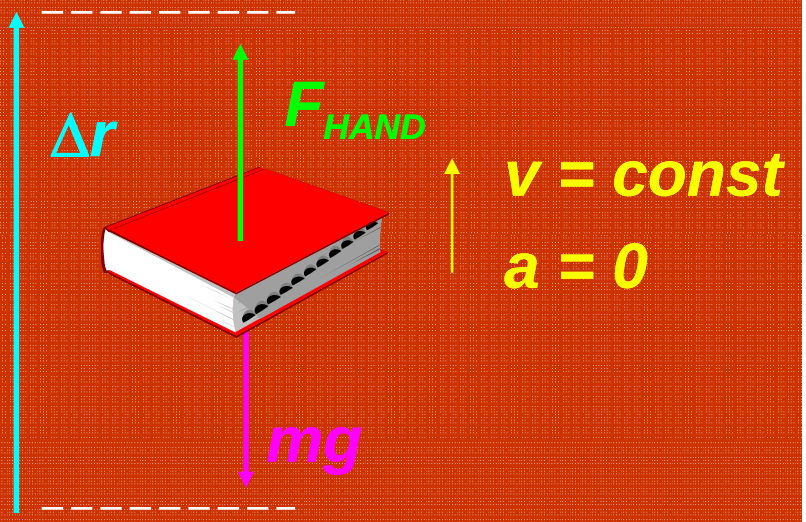
mg does negative work



ConcepTest 6.3 Lifting a Book

You lift a book with your hand in such a way that it moves up at constant speed. While it is moving, what is the total work done on the book?

1) $mg \times \Delta r$
2) $F_{HAND} \times \Delta r$
3) $(F_{HAND} + mg) \times \Delta r$
4) zero
5) none of the above



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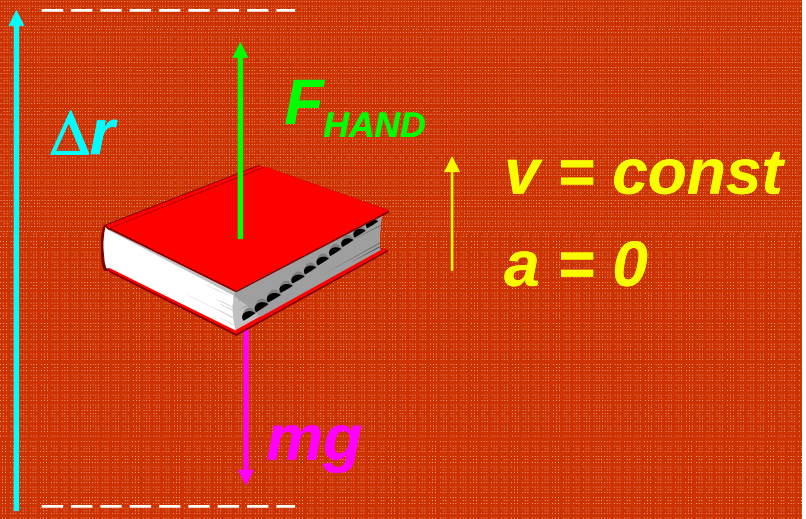
4) zero
5) none of the above

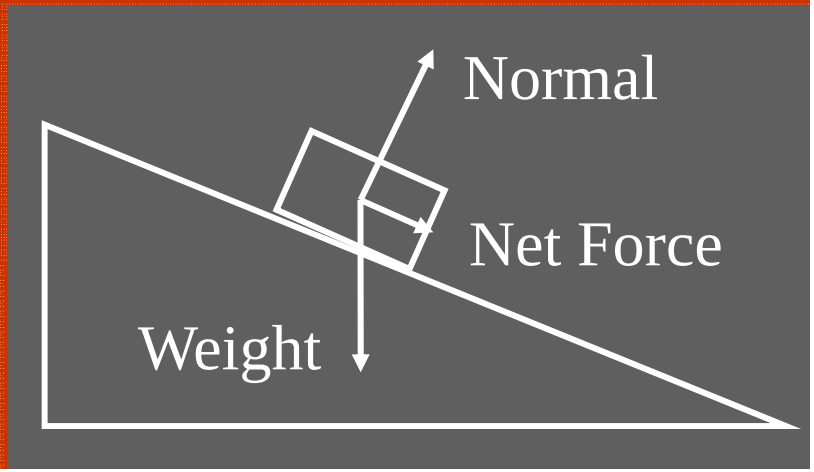
The total work is zero since the net force acting on the book is zero. The work done by the hand is positive, while the work done by gravity is negative. The sum of the two is zero. Note that the kinetic energy of the book does not change, either!



ConcepTest 6.4 Sliding Down I

A box sits on a flat board. You lift one end of the board, making an angle with the floor. As you increase the angle, the box will eventually begin to slide down. Why?

1) component of the gravity force parallel to the plane increased
2) coeff. of static friction decreased
3) normal force exerted by the board decreased
4) both #1 and #3
5) all of #1, #2 and #3



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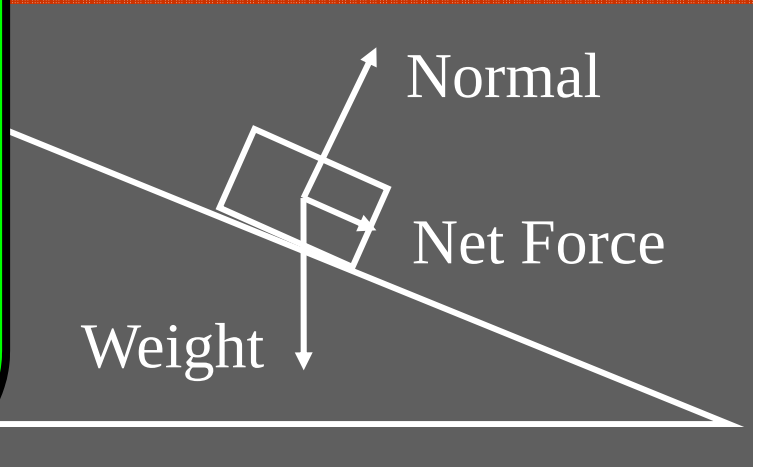
As the angle increases, the component of weight parallel to the plane increases and the component perpendicular to the plane decreases (and so does the Normal force). Since friction depends on Normal force, we see that the friction force gets smaller and the force pulling the box down the plane gets bigger.



ConcepTest 6.5 Friction and Work I

A box is being pulled across a rough floor at a constant speed. What can you say about the work done by friction?

1) friction does no work at all
2) friction does negative work
3) friction does positive work

ConcepTest 6.5 Friction and Work I

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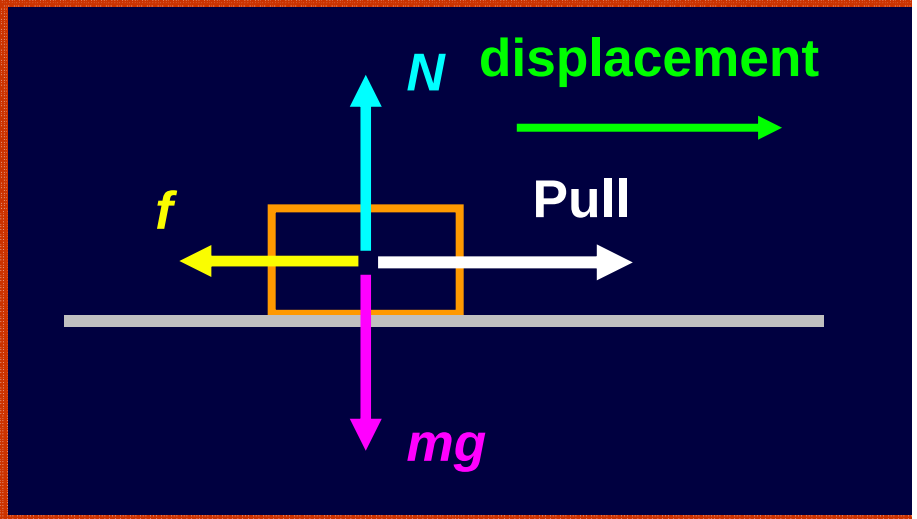
1) friction does no work at all
2) friction does negative work
3) friction does positive work

Friction acts in the **opposite** direction to the displacement, so the work is **negative**. Or using the definition of work: $W = F d \cos\theta$

since $\theta = 180^o$, then $W < 0$



ConcepTest 6.6 Play Ball!

In an Astros baseball game, the catcher (Ausmus) stops a 90-mph pitch. What can you say about the work done by the catcher on the ball?

1) **catcher has done positive work**
2) **catcher has done negative work**
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3) catcher has done zero work

The force exerted by the catcher is opposite in direction to the displacement of the ball, so the work is negative. Or using the definition of work ($W = F\,d\cos\theta$), since $\theta = 180^{o}$, then $W < 0$. Note that because the work done on the ball is negative, its speed decreases.

Follow-up: What about the work done by the ball on the catcher?