


Work



Physics Clicker Quizzes

*Is it possible to do work on an object that remains at rest?*

YES

NO

**No**

$W = Fd$

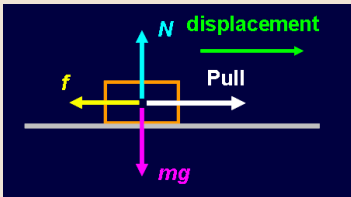
Work requires that a **force acts over a distance**. If an object does not move at all, there is **no displacement**, and therefore **no work done**.

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

A friction does no work at all  
 B friction does negative work  
 C friction does positive work

**B** friction does negative work

Friction acts in the **opposite** direction to the displacement, so the work is **negative**. Or using the definition of work:  
 $W = Fd \cos \theta$  since  $\theta = 180^\circ$ , then  $W < 0$ .



*Can friction ever do positive work?*

YES

NO

**YES**

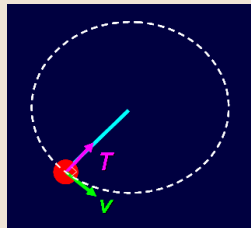
Consider the case of a box on the back of a pickup truck. If the box **moves along with the truck**, then it is actually the **force of friction that is making the box move**.

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

- A tension does no work at all
- B tension does negative work
- C tension does positive work

**A** tension does no work at all

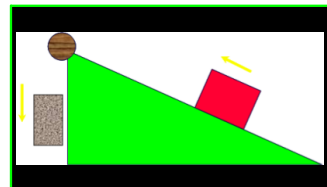
No work is done because the force acts in a **perpendicular** direction to the displacement. Or using the definition of work:



$W = F d \cos \theta$  since  $\theta = 90^\circ$ , then  $W = 0$ .

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

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

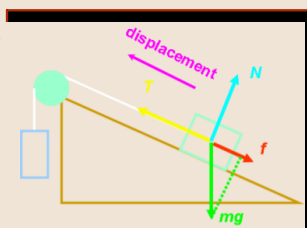


- A one force
- B two forces
- C three forces
- D four forces
- E no forces are doing work

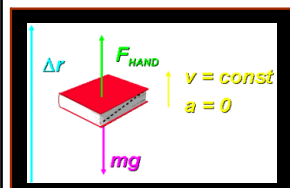
**C** three forces

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**



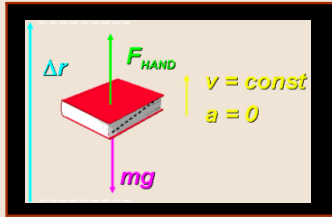
*You lift a book with your hand in such a way that it moves up at constant speed. While it is moving, what is the total work done on the book?*



- A  $mg \times \Delta r$
- B  $F_{HAND} \times \Delta r$
- C  $(F_{HAND} + mg) \times \Delta r$
- D **zero**
- E none of the above

**D zero**

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!



**Follow-up:**

What would happen if  $F_{HAND}$  was greater than  $mg$ ?

*A child on a skateboard is moving at a speed of 2 m/s. After a force acts on the child, her speed is 3 m/s. What can you say about the work done by the external force on the child?*

- A positive work was done
- B negative work was done
- C zero work was done

**A positive work was done**

The **kinetic energy of the child increased** because her speed increased. This **increase in KE** was the result of **positive work being done**. Or, from the definition of work, since  $W = \Delta KE = KE_f - KE_i$  and we know that  $KE_f > KE_i$  in this case, then the **work  $W$  must be positive**.

**Follow-up:**

What does it mean for negative work to be done on the child?