

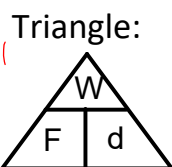
# Work

**Def:** Is accomplished when a force is applied to an object/person and the object/person moves in the direction of the force.

Holding is not an example of work because directional movement must be involved.



Formula:  $W = F // d$   
*work* ↑  
*parallel to line of travel* ↓  
 Effective force ↓  
 distance ↓

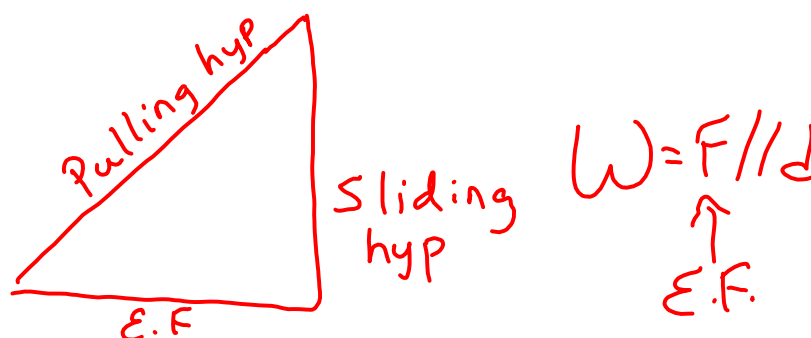


Units:  
 $W = J$      $F = N$   
 $d = m$

$F = \frac{W}{d}$      $d = \frac{W}{F}$   
 $W = F \times d$

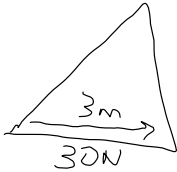
- Conversions:
- cm - m ÷ 100
  - km - m x 1000

- In a sliding or pulling question if they give you the force (hypotenuse), you need to find the effective force (direction) because the force (F) must be parallel to the direction travelling. Sometimes in word problem they don't use the term 'effective force', they just use the word 'force'.



Practice questions

1. What is the work done if a boy pulls a box with an effective force of 30 N over a distance of 3 m?



$$W = F \cdot d$$

$$30\text{N} \times 3\text{M}$$

$$W = 90\text{J}$$

2. What work is accomplished when a man pulls a carriage up a hill with an effective force of 50.0 N over a distance of 1.0 km?

$$1.0 \times 1000$$

$$= 1000\text{m}$$

$$W = F \cdot d$$

$$50.0\text{N} \times 1000\text{M} = 50\,000\text{J}$$

$$5.0 \times 10^4\text{J}$$

3. What is the force applied if a boy does 7 000.0 J of work while walking up a hill for 2.00 km?

$$W = 7000.0\text{J}$$

$$d = 2.00\text{km} \times 1000 = 2000\text{m}$$

$$F = \frac{W}{d} = \frac{7000.0}{2000}$$

$$F = 3.5\text{N}$$

4. What is the distance travelled if a girl pulls a wagon for 20 minutes and uses 1 500 J of energy and exerts 20 N of force?

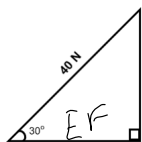
$$W = 1500\text{J}$$

$$F = 20\text{N}$$

$$d = \frac{W}{F} = \frac{1500}{20} = 75 = 80\text{m}$$

5. What is the work done when a girl drags her school bag across the pavement for 70 m with a force of 40 N at a 30° angle?

CAH

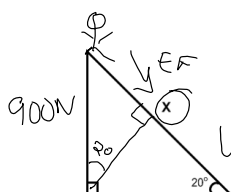


$$W = F \cdot d$$

$$(\cos 30(40)) \times (70\text{m}) = 2424\text{J}$$

$$2000\text{J}$$

6. What is the work done if a skier weighing 90 kg goes down a hill at a 20° angle for 30 km?



$$\sin 20 = \frac{x}{900}$$

$$90\text{kg} \times 9.8\text{N/kg}$$

$$= 882$$

$$= 900\text{N}$$

$$W = (\sin 20(900)) \times (30000\text{m})$$

$$9\,234\,543\text{J}$$

$$30\text{km} \times 1000$$

$$9\,000\,000\text{J}$$

$$= 30000\text{m}$$

$$W = 9 \times 10^6\text{J}$$

Past Exam Question

1. Brad is pulling his daughter Ashley on a sleigh. The rope is at an angle of  $47^\circ$  with the horizontal. Brad has a mass of 87 kg and exerts a force equal to his weight and pulls his daughter for 1.0 km. How much work is done by Brad?



$$W = (F \cos 47^\circ) \times d$$

$$W = (850 \cos 47^\circ) \times (1000 \text{ m})$$

$$W = 579690 \text{ J} \approx 5.8 \times 10^5 \text{ J}$$

