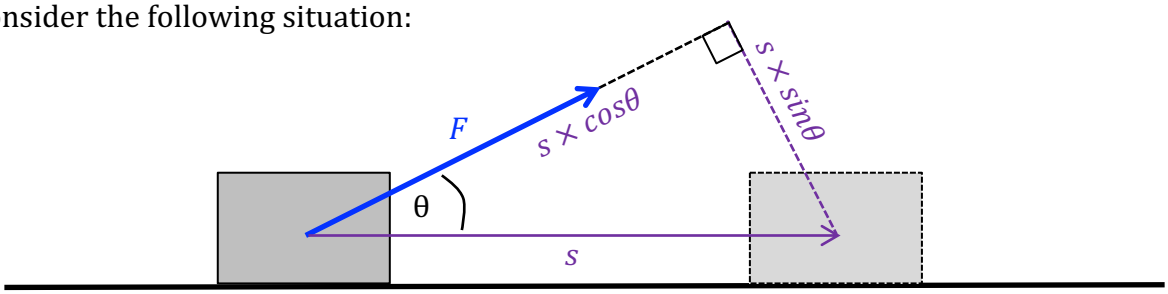
4.8.1 Work and energy

videos

Work done is done when a force displaces an object:

$$W = force \times distance\ moved\ in\ the\ direction\ of\ the\ force$$

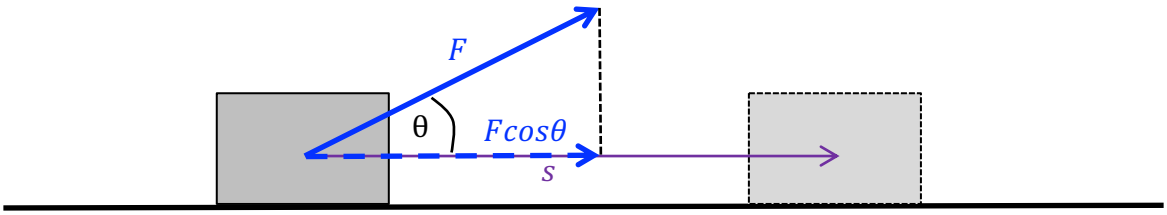
Consider the following situation:



A force F is applied to a block resting on a plane, horizontal surface. The block is moved sideways a distance s. The force is at an angle to the direction of movement. From the formula, above, we can find the work done by multiplying the force by the distance moved <u>in the direction of the force</u>. In this case we need to resolve the displacement vector into two components at right angles to each other. The displacement vector in the direction of the force is $s \times cos\theta$.
Therefore:

$$W = F \times scos\theta$$
$$= Fscos\theta$$

Alternatively, we can find the work done by multiplying the <u>force acting in the direction of movement</u>, by the distance:

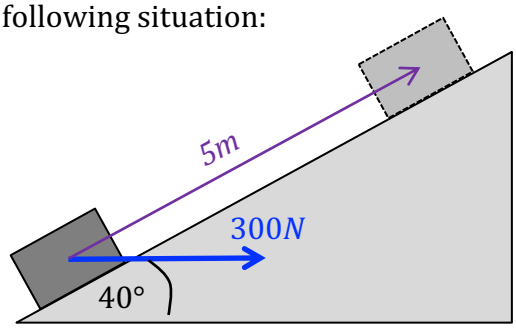


Therefore:

$$W = Fcos\theta \times s$$
$$= Fscos\theta$$

We get the same answer as previously!

Now consider the following situation:



A horizontal force of $300N$ is used to move a block $5m$ up a frictionless slope.

(1) Use one of the methods, above, to find the work done in displacing the block to the new position.

(2) Work is always done against a resisting force. What causes the resisting force in this situation?

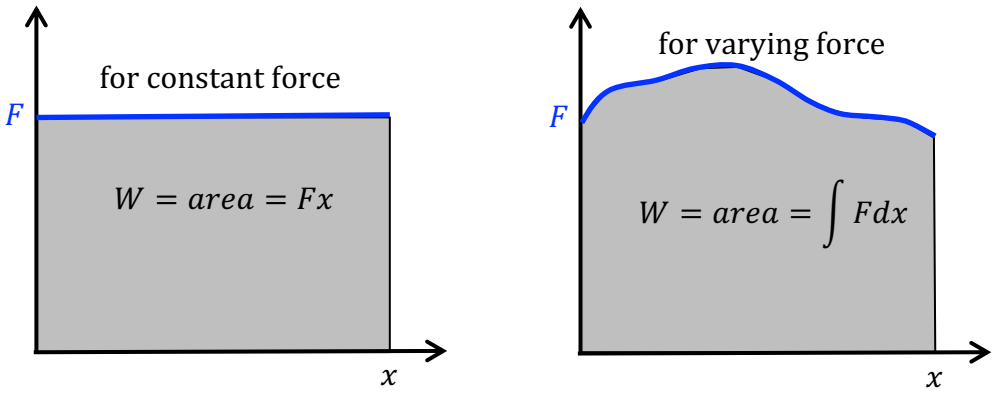
(3) Work out the height gain for this displacement.

(4) If we consider that the applied force is just enough to lift the block (at a constant speed), what is the weight of the block?

(5) Using the calculated weight and height gain, what is the increase in gravitational potential energy?

(6) Compare the gain in gravitational potential energy with the work done in moving the block. What do you notice?

Sometimes the force moving an object varies over time. In this case we can find the work done by taking the area under the force-distance graph:



(7) A varying force is applied in moving an object. Find the work done from the following graph: