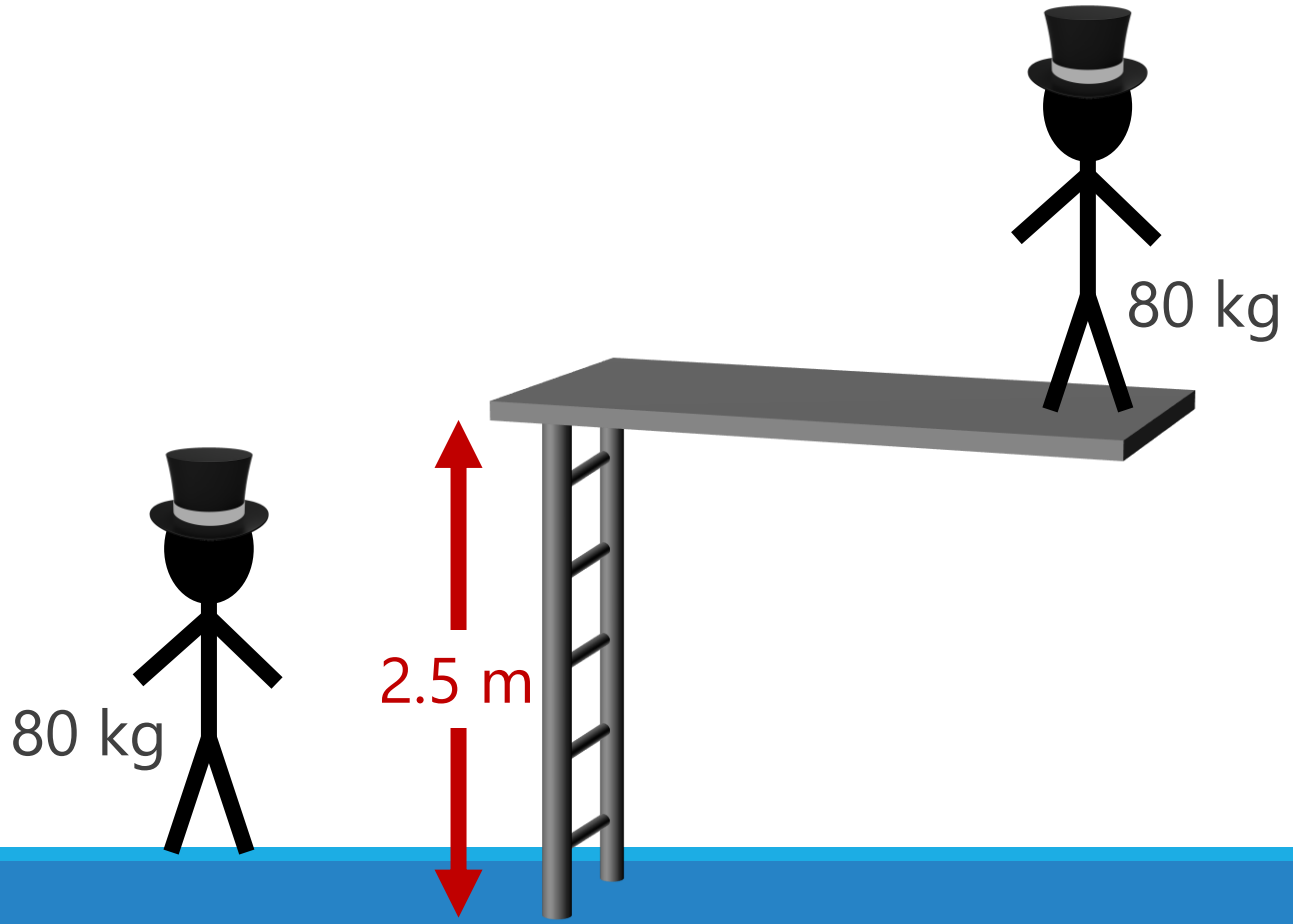
Work and Power

IB PHYSICS | ENERGY & MOMENTUM

Where did the energy come from?

Initial Energy | Final Energy



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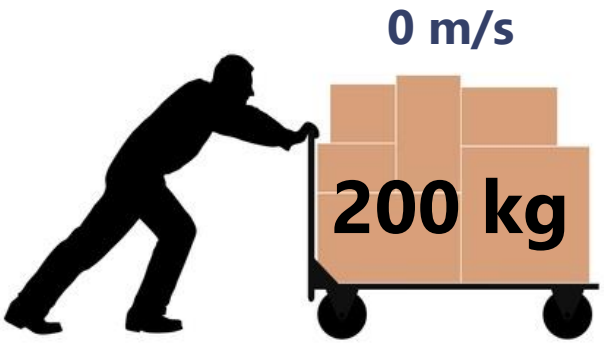


Let’s give it a name

When the energy is added to or removed from a system, we call it

How does Science Define Work?

Work is done when a **force** is applied to an object and the object moves in the **same direction** as the applied force.

How do you Calculate Work

Work* = Force × Displacement

*When force is constant and in the same direction as the movement

Symbols	=	×	
Units	=	×	

The things necessary for Work

- There must be a force
- There must be a displacement

What about direction?

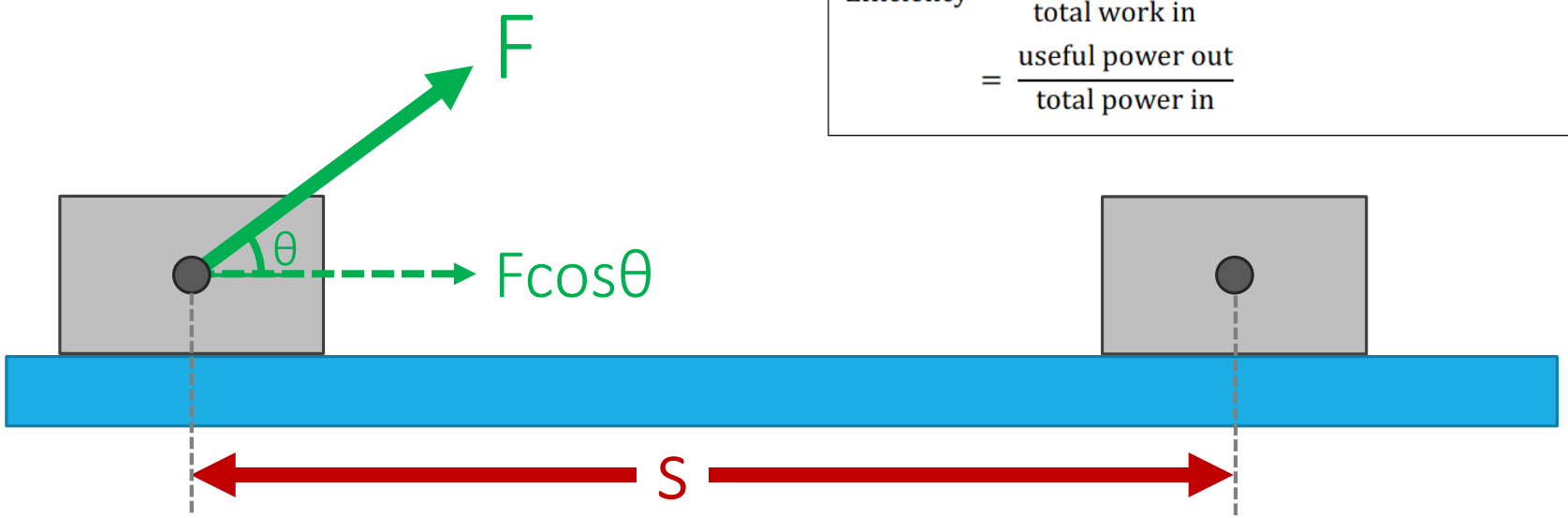
Work at an Angle

Must use the component of the force that is in the **same direction** as the motion

Work at an Angle

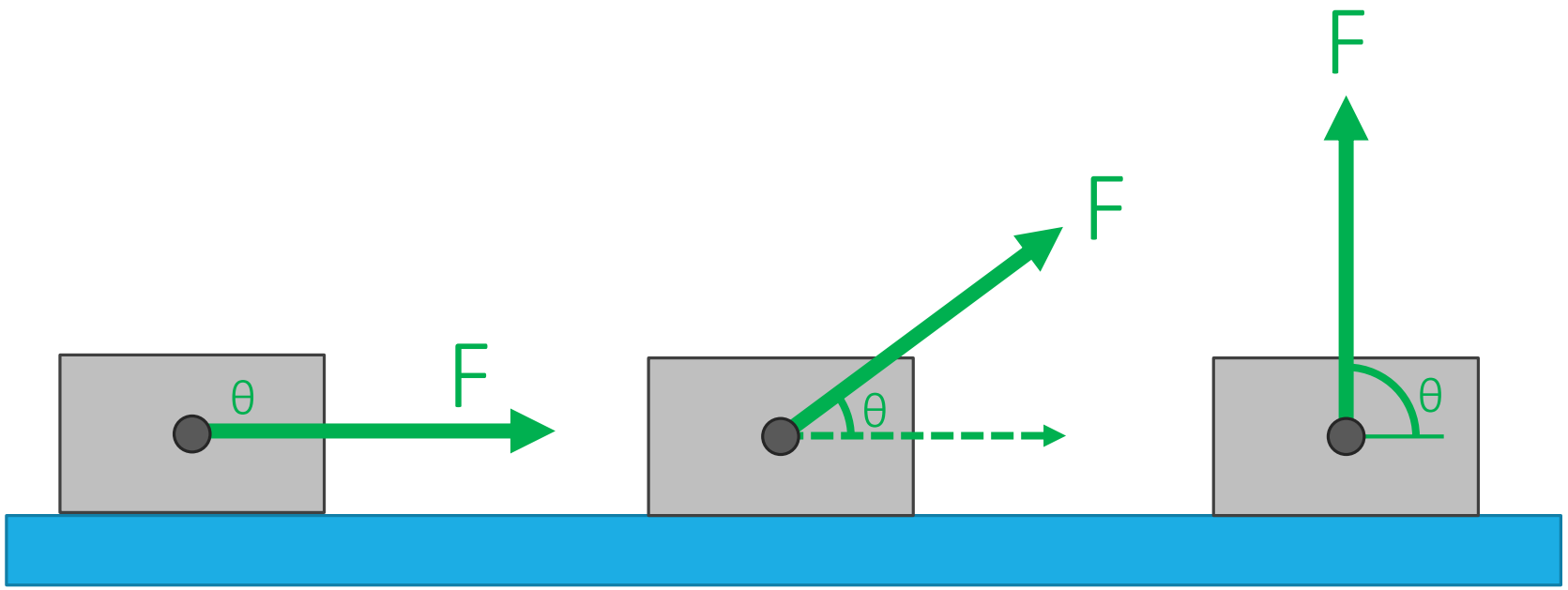
$W = Fs\cos\theta$

Sub-topic 2.3 – Work, energy and power
$W = Fs\cos\theta$
$E_K = \frac{1}{2}mv^2$
$E_P = \frac{1}{2}k\Delta x^2$
$\Delta E_P = mg\Delta h$
power $= Fv$
Efficiency $= \frac{\text{useful work out}}{\text{total work in}}$ $= \frac{\text{useful power out}}{\text{total power in}}$

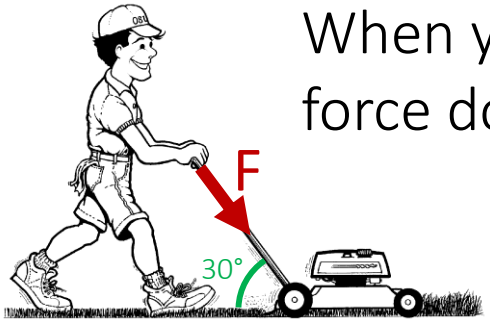


Does this always work?

$W = Fs\cos\theta$



Try This



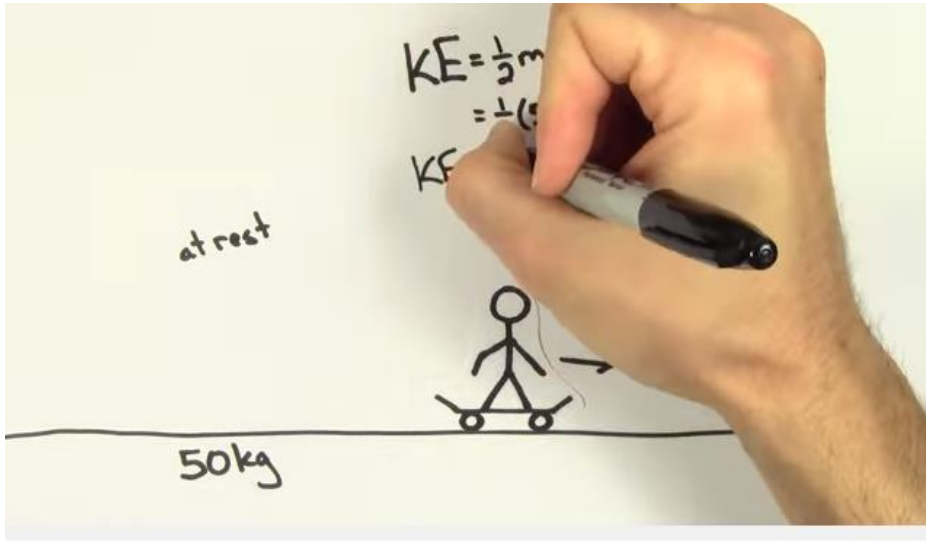
When you push a lawn mower, you are really applying a force down the angled handle bar as shown in this picture

How much **work** do you do when you push a lawn mower 20 m with a force of 200 N directed at an angle of 30° with the ground?

Work-Energy Theorem

If energy is truly conserved, how can things ever start or stop moving?

Energy is still conserved (not created or destroyed), it's just being transferred in or out of the system/object that we are studying (gained or lost)



Work as the transfer of energy | Work and energy | Physics | Khan Academy

Work-Energy Theorem

Your engine applies 1000 N of force over a distance of 50 m. If you started from rest and your car has a mass of 2000 kg, how fast are you moving after travelling that distance?

Try This

A 75 kg skateboarder kicks off with an initial velocity of 2 m s^{-1} and comes to a stop after 15 m. What is the force of friction?

Think about it…

Is a waiter carrying a heavy tray of food at a constant velocity across a room doing any work on the tray?

Think about it…

A particle of mass m is moving with constant speed v in uniform circular motion. What is the total work done by the centripetal force during one revolution?

A. Zero
B. $mv^2/2$
C. mv^2
D. $2\pi mv^2$

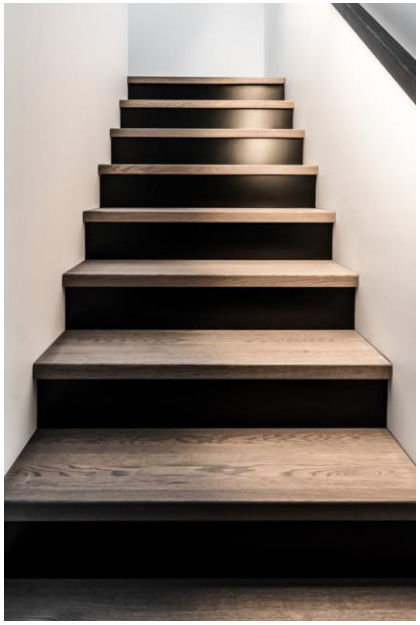
Is the earth's gravity doing any work on the moon?

Think about it…

Two physics students, Maria and Paige, are going from the first floor to the second floor on their way to their next class.

- Maria walks up the 3 meter tall staircase in 15 seconds
- Paige runs up the 3 meter tall staircase in 5 seconds

If they both have a mass of 60 kg, which student does the most work?



What is Power?

Power is the **rate** at which **work** is done.

(how much work is done in a given amount of time)

How do you Calculate Power

Power = Work / Time

Symbols		=	/
Units		=	/

Say Watt?!?

Common Appliances	Estimated Watts
Blender	300-1000
Microwave	1000-2000
Waffle Iron	600-1500
Toaster	800-1500
Hair Dryer	1000-1875
TV 32" LED/LCD	50
TV 42" Plasma	240
Blu-Ray or DVD Player	15
Video Game Console (Xbox / PS4 / Wii)	40-140

We will be looking at power again this year when we discuss electricity…

Lesson Takeaways

- ❑ I can define and calculate the property of work
- ❑ I can calculate work when the force is at an angle to the direction of the motion
- ❑ I can equate work done on a system to the change in energy of an open system
- ❑ I can use the work-energy theorem to solve for an unknown
- ❑ I can identify situations where there is motion but no work being done