

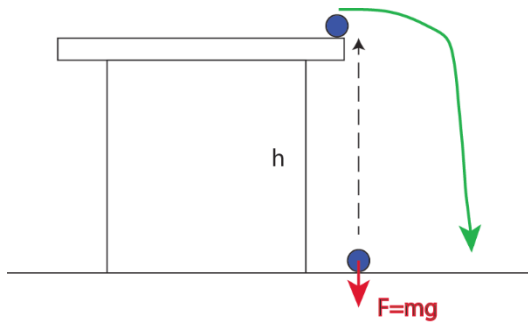
Energy and Work

*You keep both Rule and Energy in view,
Much power in each, most in the balanced two:
Ferocity existing in the fence
Built by an exercised intelligence.....*

Thorn Gunn (An early poem written to his mentor Jay Parini)

To complete the use of Newton's law we need something new. It takes something to create a force that makes a car move and out it into a state of motion, furthermore that state of motion can be used to lift an object to a height against the force of gravity. Today we know this as an energy. To lift a mass m against the force of gravity, $F=mg$, we must expend energy by doing work.

The work done = Force * displacement in direction of force, $W = mgh$.



$$\text{Work} = F \cdot h = mgh = (1/2)mV^2 = \text{KE}$$

Use dynamics (from above) $V = gt$, $h = \frac{1}{2}gt^2 = \frac{V^2}{2g}$

If we kick the ball off the shelf it acquires velocity (kinetic energy) before it hits the floor.

Work converted to kinetic energy.

Conservation of Energy (if we can account for all forms of energy in a problem).





We can use this principle to solve more complicate problems.

Energy cannot be created or destroyed. It can be converted from one form of energy to another or transferred from one object to another.


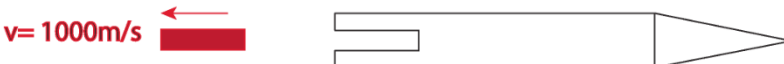
Conservation of Momentum (Newton)

Must be careful about sign

Collisions

10 kg	20 kg
	
Before collision $P = 100 \text{ kg m/s}$	$E = 500 \text{ J}$
After collision	
	
$P = 100 = 10 V_B + 20 V_R$	$E = 500 = 5(V_B)^2 + 10 (V_R)^2$
Solve: $V_B = 20/3 \text{ m/s}$	$V_A = -10/3 \text{ m/s}$ (goes backward)

Rockets

Before burn Fuel $m = 100 \text{ kg}$	$M = 900 \text{ kg}$ $V = 100 \text{ m/s}$
	
$P = 100,000 \text{ kg m/s}$	
After burn $v = 1000 \text{ m/s}$	$M = 800$ $V = ?$
	
$P(\text{fuel}) = -100,000$ $P(\text{after}) = -100,000 + P(\text{Rocket after burn}) = P(\text{Before}) = 100,000$	
$P(\text{Rocket after burn}) = 200,000$. Thus $V(\text{after}) = 250 \text{ m/s}$.	

Emily Dickison

Hope is a strange invention --

A Patent of the Heart --

In unremitting action

Yet never wearing out --

Of this electric Adjunct

Not anything is known

But its unique momentum

Embellish all we own --