14. ENERGY : THE DRIVING FORCE

"Work" in our daily life

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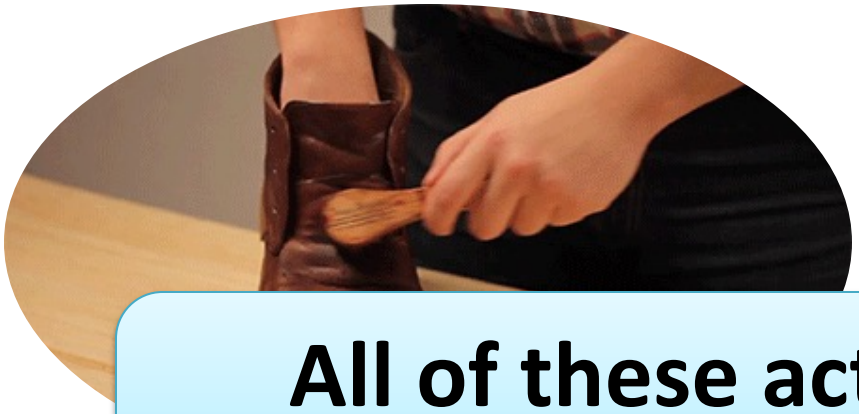

All of these activities can not be termed as "Work" in scientific terms.

(1) Kausar is doing her homework, completes assignments given in the school. She feels that she has done a lot of work.

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(2) Iqbal stands holding 10 kg of weight on his shoulder.

(3) Sameer is a computer operator and he spends the day operating the computer.

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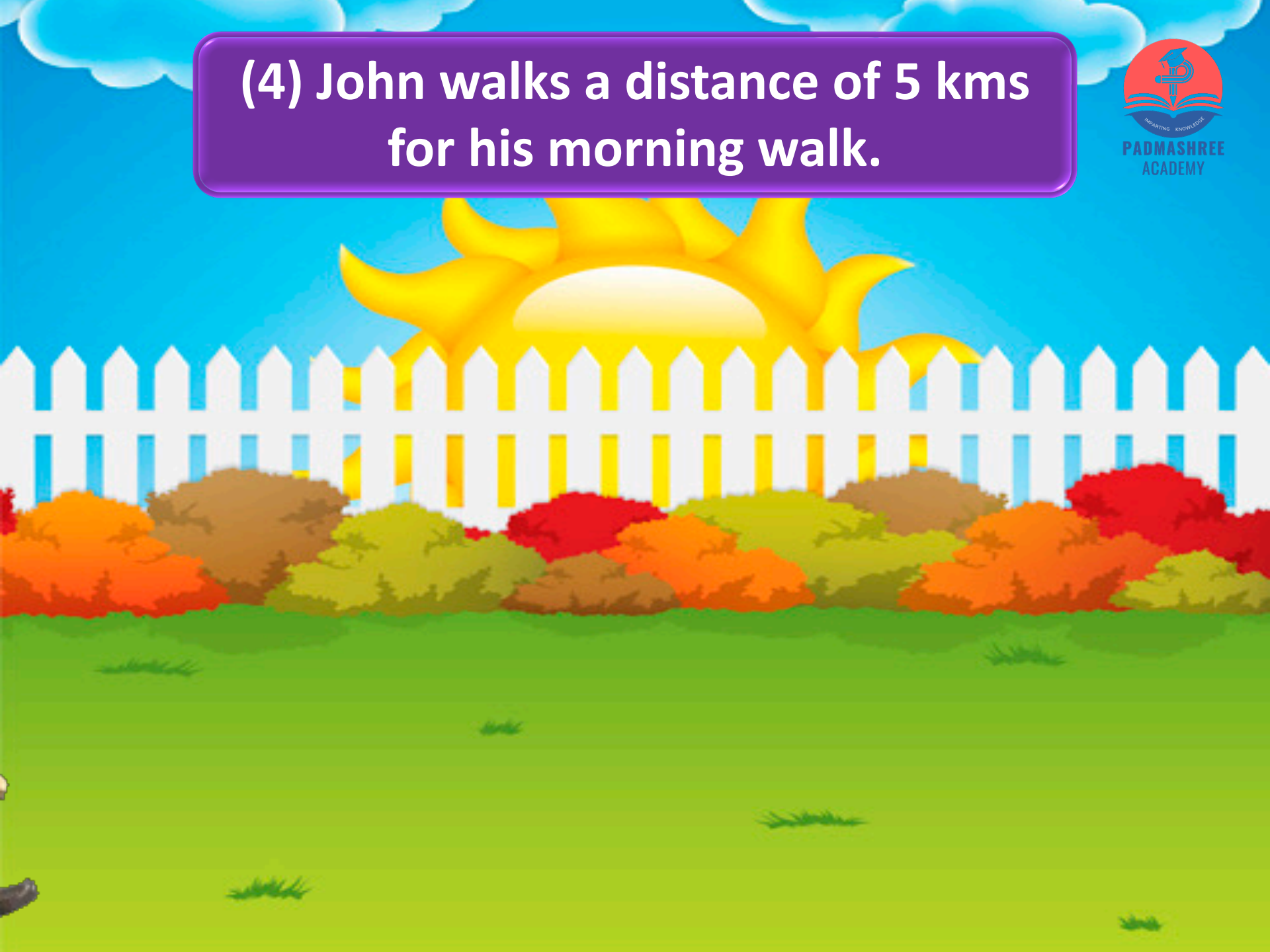
(4) John walks a distance of 5 kms for his morning walk.



(5) Sachin plays football on the ground.

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(6) A coolie carries a heavy suitcase from the rickshaw stand to the train.
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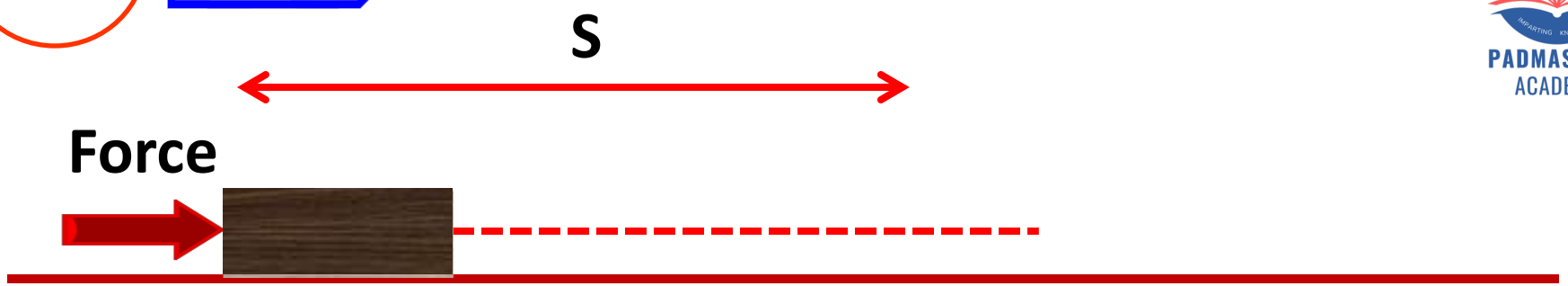
TRAIN STATION

In scientific terms, Kausar,Iqbal and Sameer have hardly done any work. This is because there is no displacement taking place in their activity.

John, Sachin and the coolie have done work.

WORK



Work is the product of force and displacement. In above figure
Let F be the constant force which acts on an object and
s be its displacement in the direction of the force.
Let W be the work done : then work is the product of force and displacement.
The work done W will be given by -

$$W = F.s$$

Work has only magnitude and no direction, hence it is a scalar quantity. SI unit of force is newton and that of displacement is meter, hence SI unt of work is newton –metre or joule.

Positive Work

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One day while going to school, the bus failed. The children got down to push the bus to get it started again.

FORCE → DISPLACEMENT → (Same Direction)

The work done in this case '**Positive Work**'.

Negative Work

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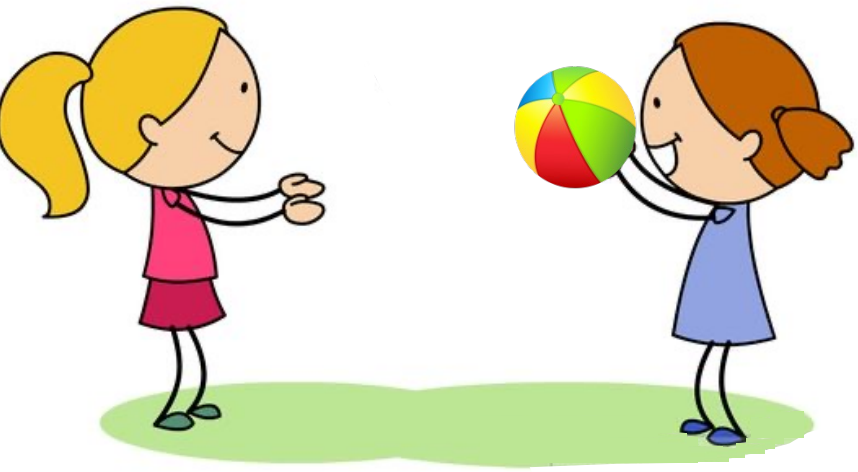
You and your your friend are playing with a ball and she throw a ball towards you. You take a catch.



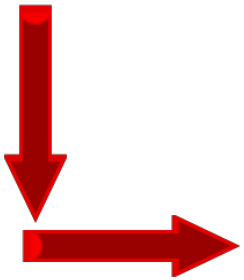
FORCE → DISPLACEMENT ← (Opposite Direction)

The work done in this case is ‘ Negative Work’.

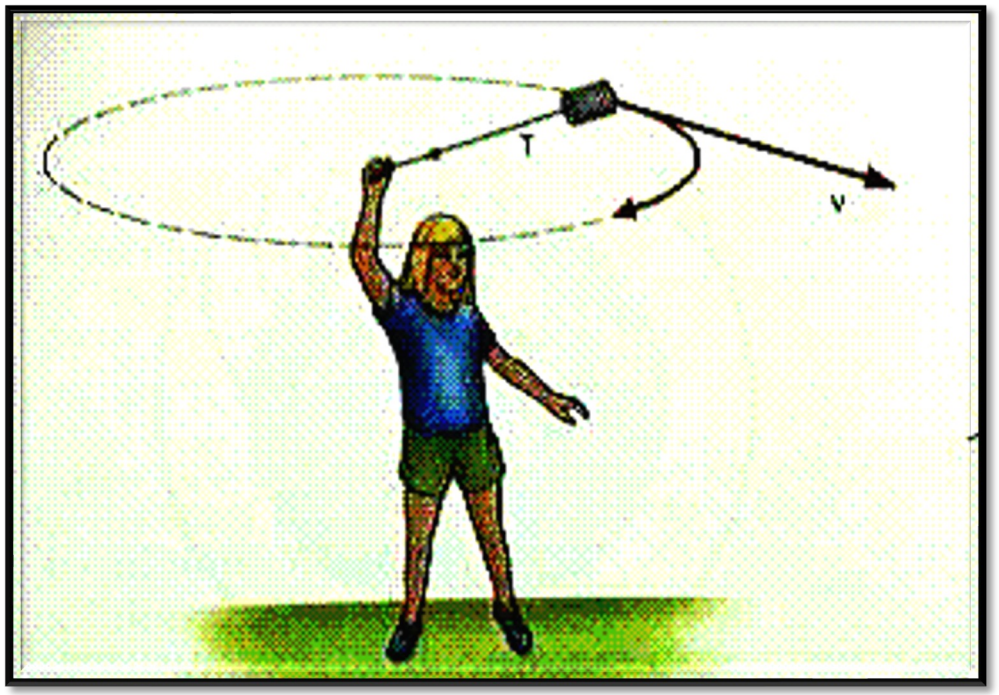
Zero Work

When a stone is tied to a string and whirled in a circular path, the string does zero work on the stone.

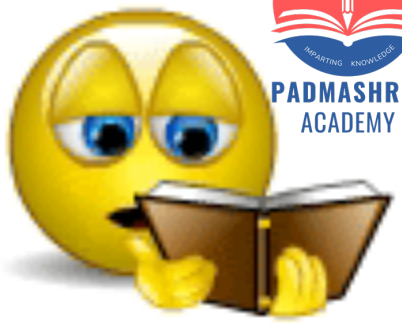
FORCE



DISPLACEMENT (Tangent)



The work done in this case ‘Zero Work’.



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The work done by the forces said to be :

(1) Positive when the displacement is in the direction of the force.

(2) Negative when the displacement is in the opposite direction of applied force.

(3) Zero when the displacement is perpendicular to the direction of the applied force or if the applied force does not produce any displacement.

Classify the following work done as Positive, Negative or

(1) A Bhel Puri vendor is pushing his cart.

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ACTIVITY

(2) Sameer is lifting a book from the table.

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(4) Work done by while lifting a bucket.

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More Examples

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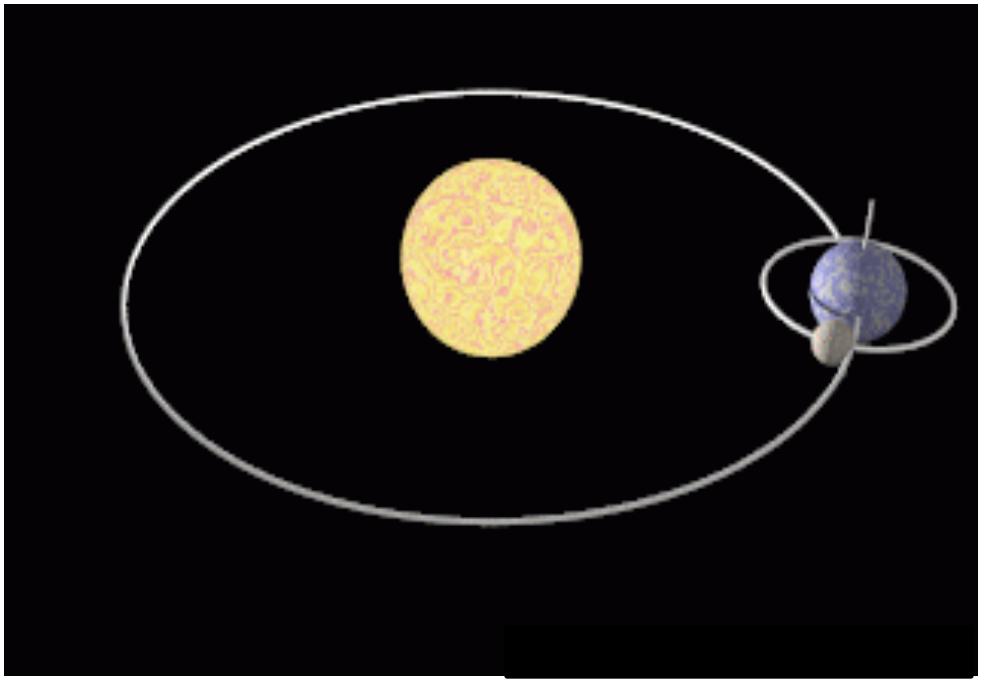
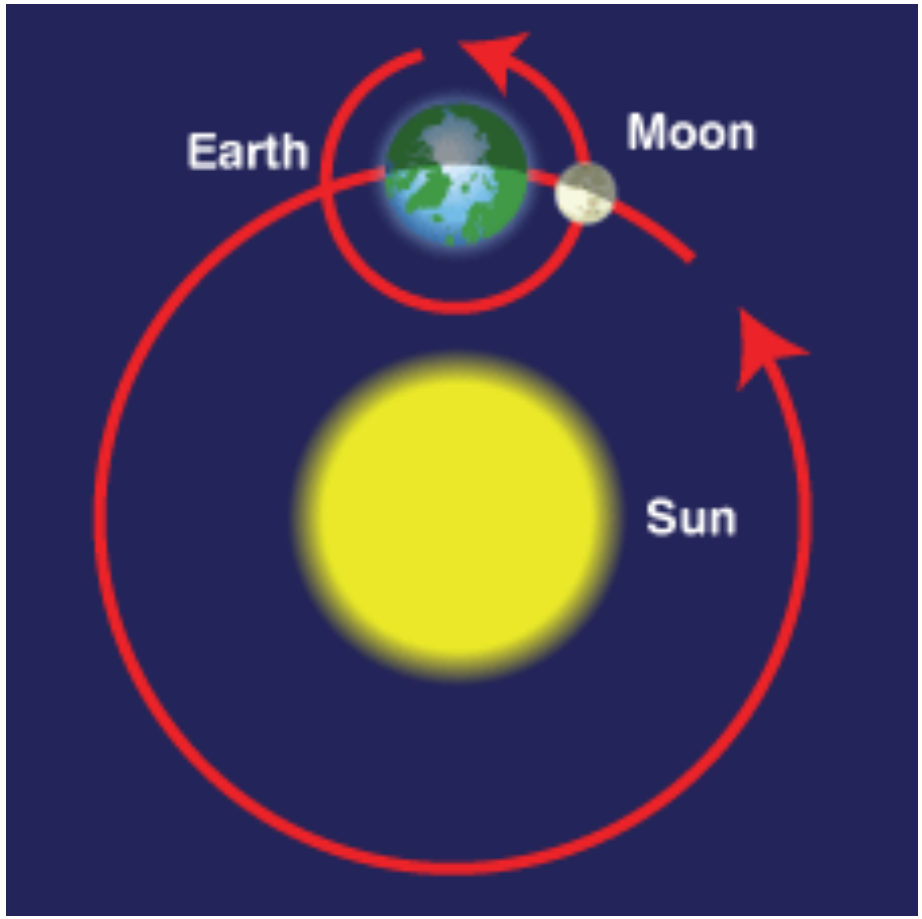
(1) Earth and other planets move around the sun and a satellite like moon or artificial satellite chandrayan-1 moves around the earth, the work done by the force acting towards the centre of the earth in all these cases is zero.





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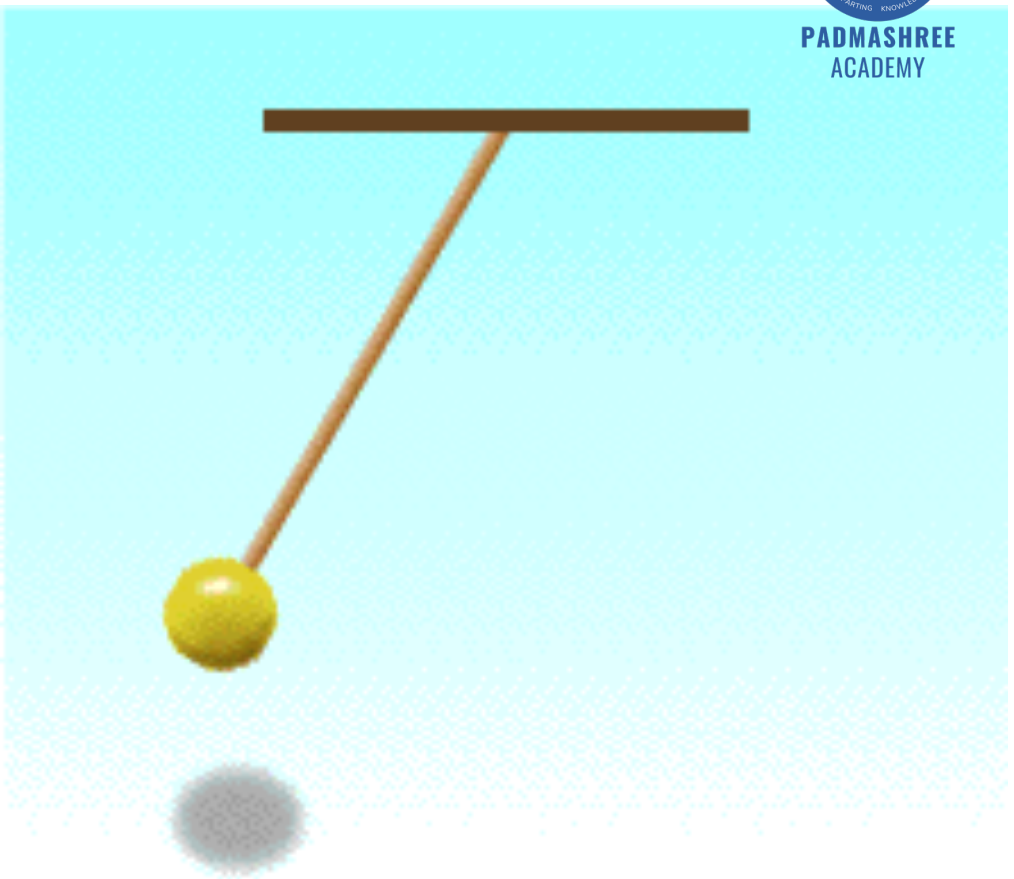
(2) When a simple pendulum is hung by a string in equilibrium, the weight acting downwards and the tension in the string acting upwards balances each other. In this case no work is done by any force since there is no displacement.



Energy

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Energy is the capacity to do work.

Energy

RGY

PO NERGY

Think over it

- A moving ball hits a stationary ball and displaces it.

Think over it

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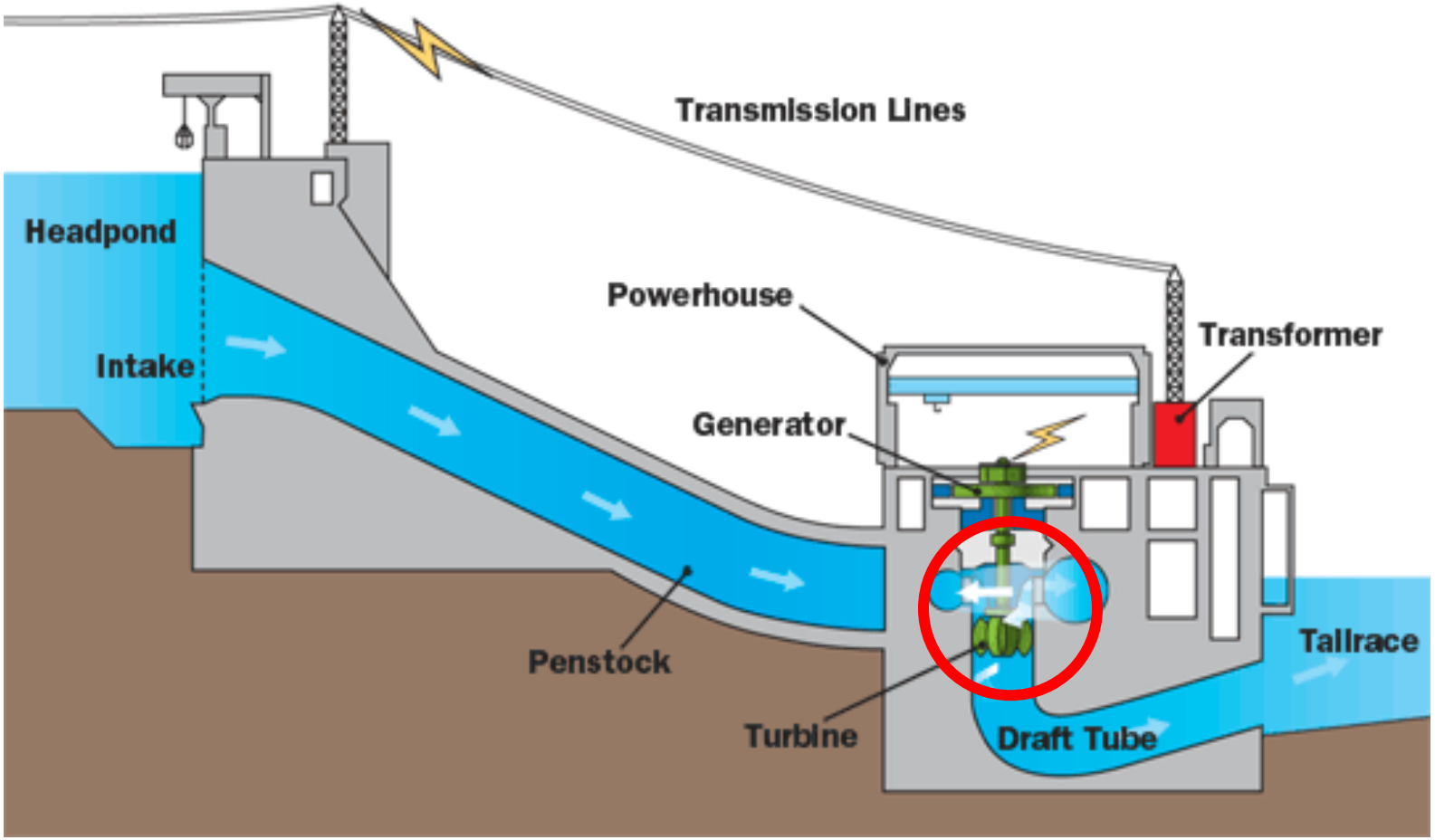
➢ Flowing water from some height can rotate a turbine.



Think over it

- A stretched rubber band when released regains its original length.

Think over it

- Wind can move the blades of a wind mill.

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Kinetic Energy

A body can have energy by virtue of its motion. This is **kinetic energy**.

Eg. (1) When a fast moving cricket ball hits stationary stumps, they are thrown away.

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Kinetic Energy

PADMASHREE ACADEMY

A body can have energy by virtue of its motion. This is kinetic energy.

Eg. (2) The bullet fired from the gun goes deep inside the target e whereas the same bullet if thrown by hand cannot penetrate the surface of the target.

Kinetic Energy

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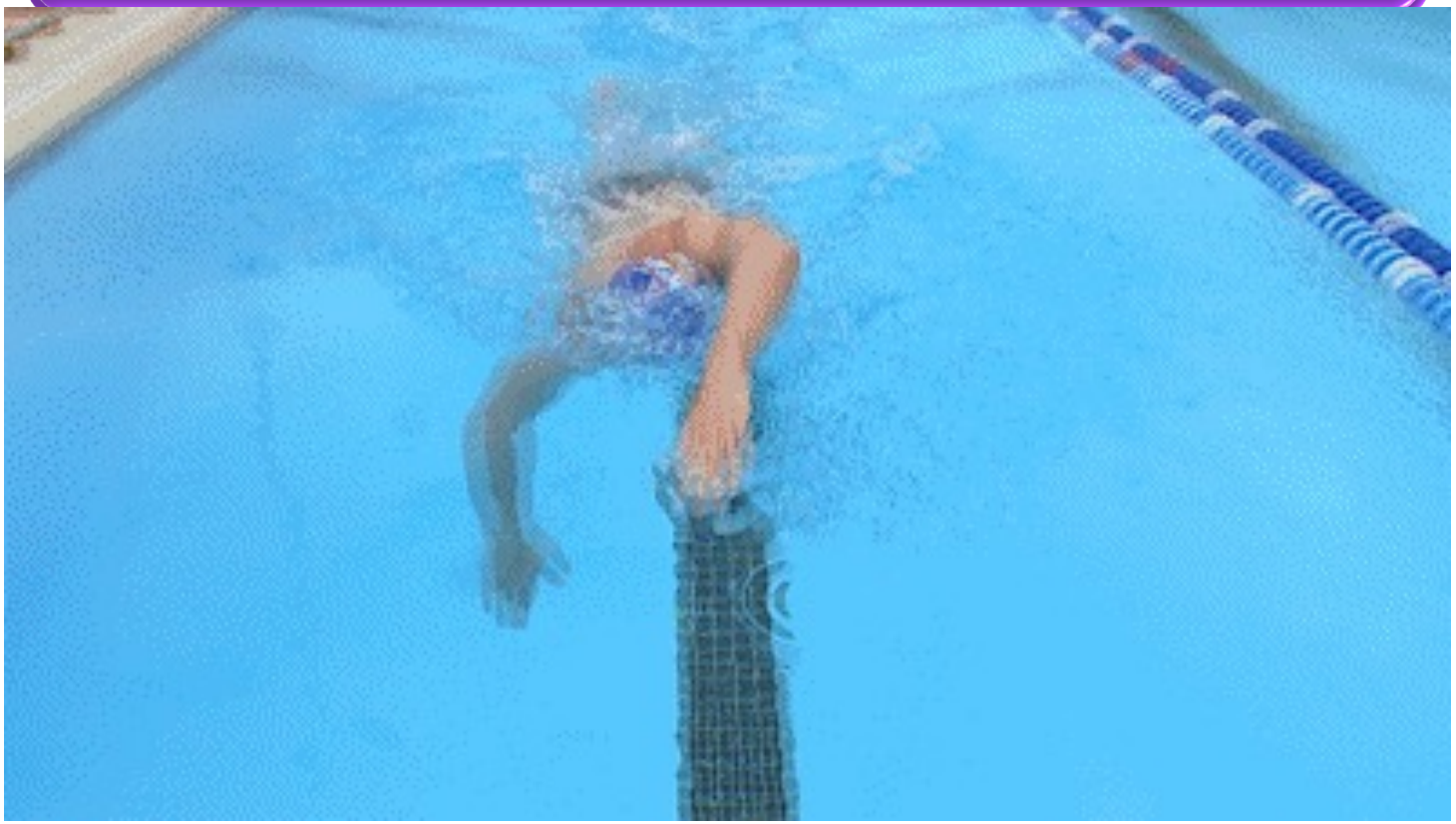
A body can have energy by virtue of its motion. This is kinetic energy.

Eg.

(3) You require less energy to swim in the river in the direction of the flow of water whereas you require more energy to swim against the direction of flow of water.



ACTIVITY

- Take a ball. Hit it on a target from the ground level.

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- Now take the same ball to some height and hit the same target and observe its impact.

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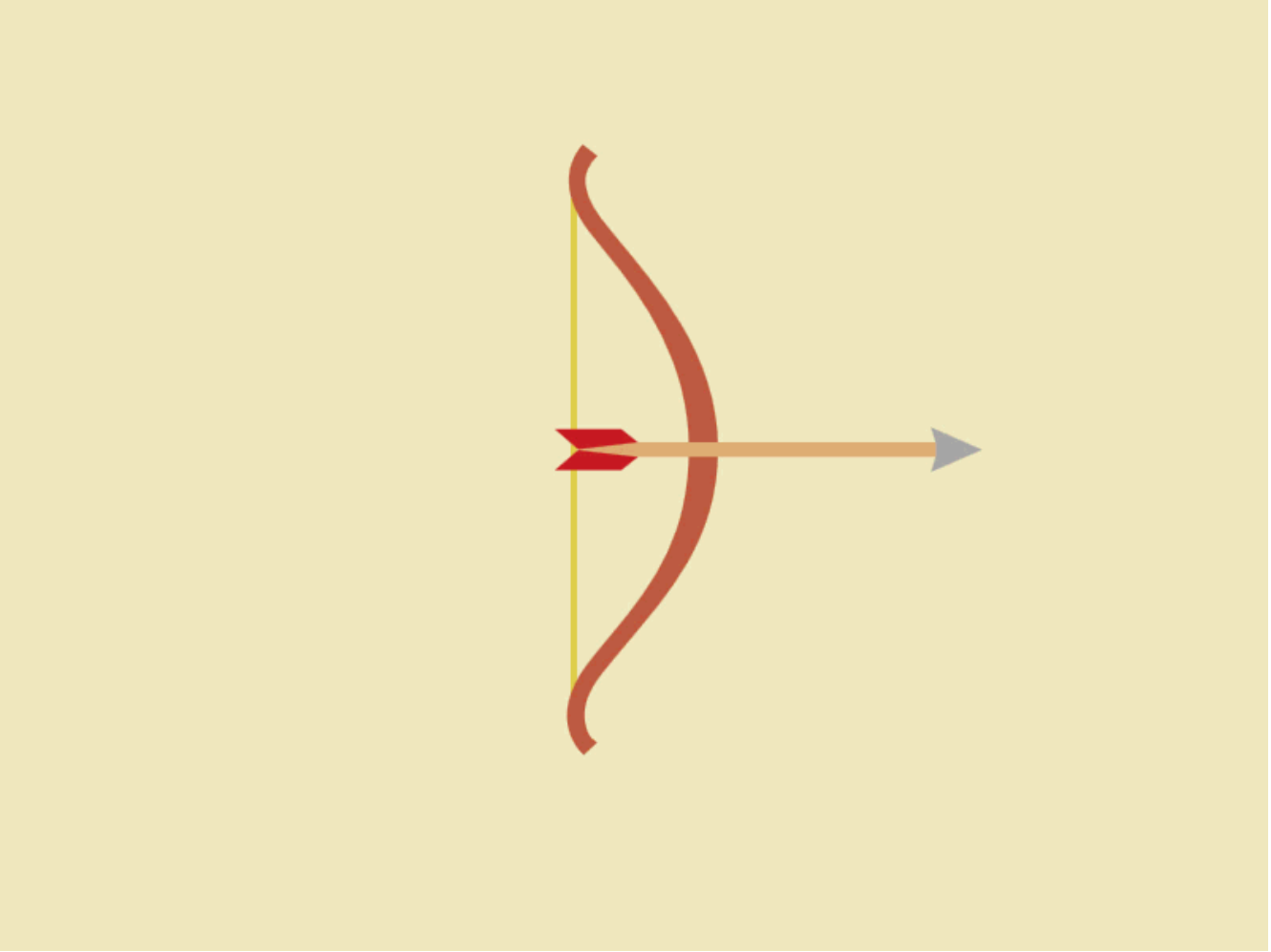
ACTIVITY

- Prepare a bow and an arrow using a bamboo stick and a string. Pull the string and release the arrow.



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Potential Energy

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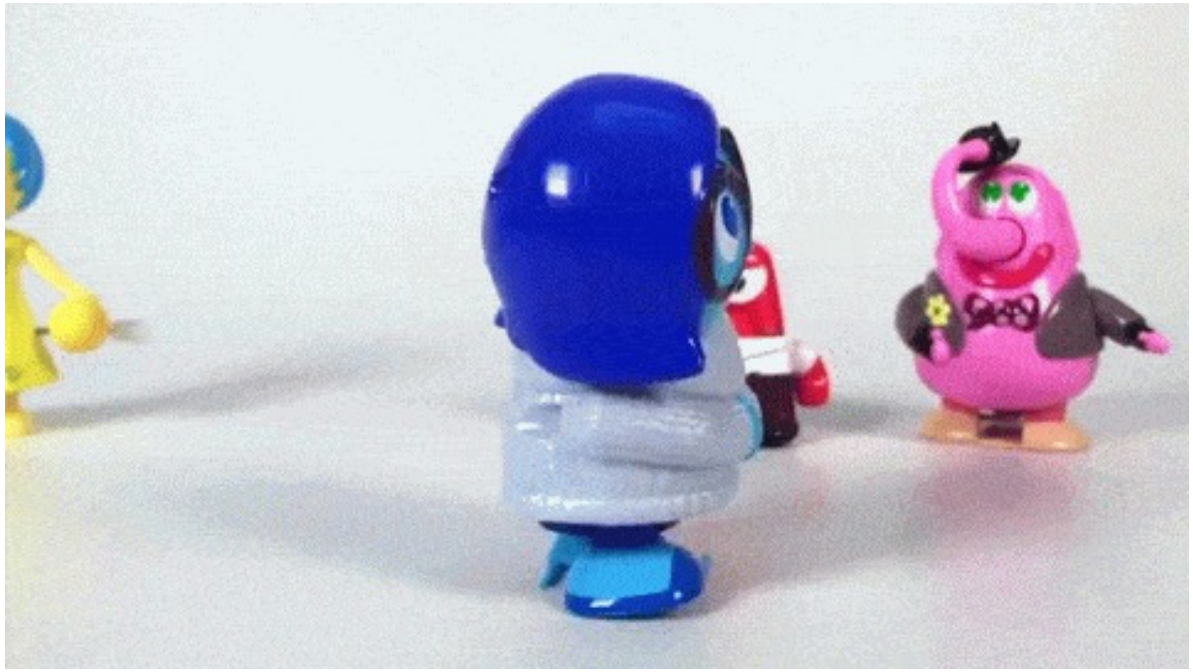
A body can have energy because of its shape or position or configuration . This is known as **potential energy**.

Eg.

(1) A toy moves some distance if we wind the key given for charging of the spiral spring connected to wheels of the toy.



Potential Energy

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A body can have energy because of its shape or position or configuration . This is known as **potential energy**.

Eg. (2) Water cannot flow from a well to a overhead tank on its own. You have to use a machine for it. But water can flow from the overhead tank to the ground level tap on its own.

Potential Energy

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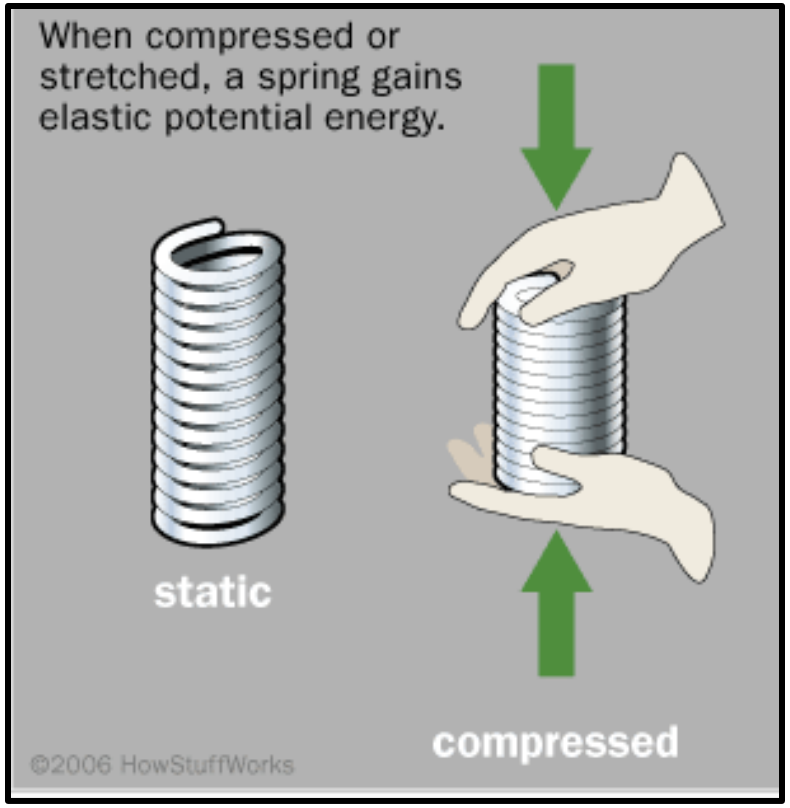
A body can have energy because of its shape or position or configuration . This is known as potential energy.

Eg. **(3) A compressed spring possess more energy than the spring in normal length.**



Law of Conservation of energy

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Some important form of energies are :

- **Heat Energy :**
- **Electrical Energy :**
- **Solar Energy :**
- **Chemical Energy :**
- **Nuclear Energy :**

Law of Conservation of energy

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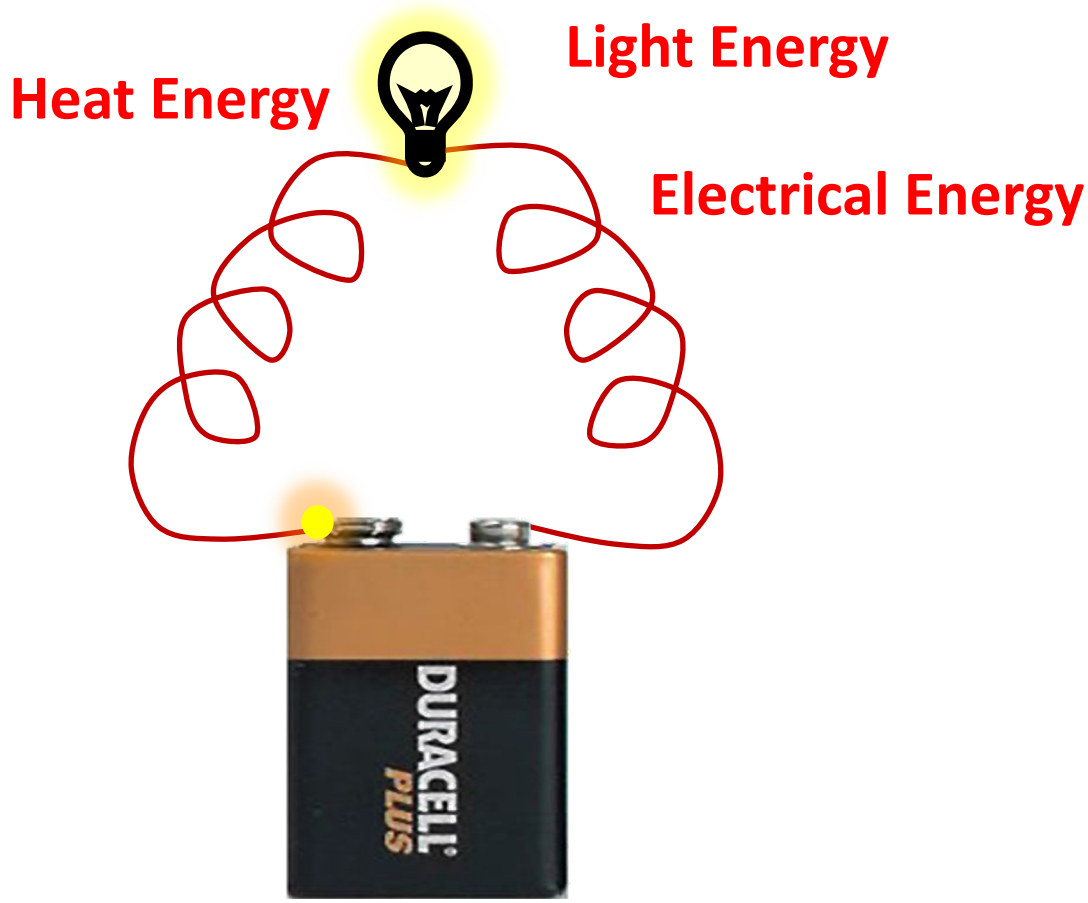
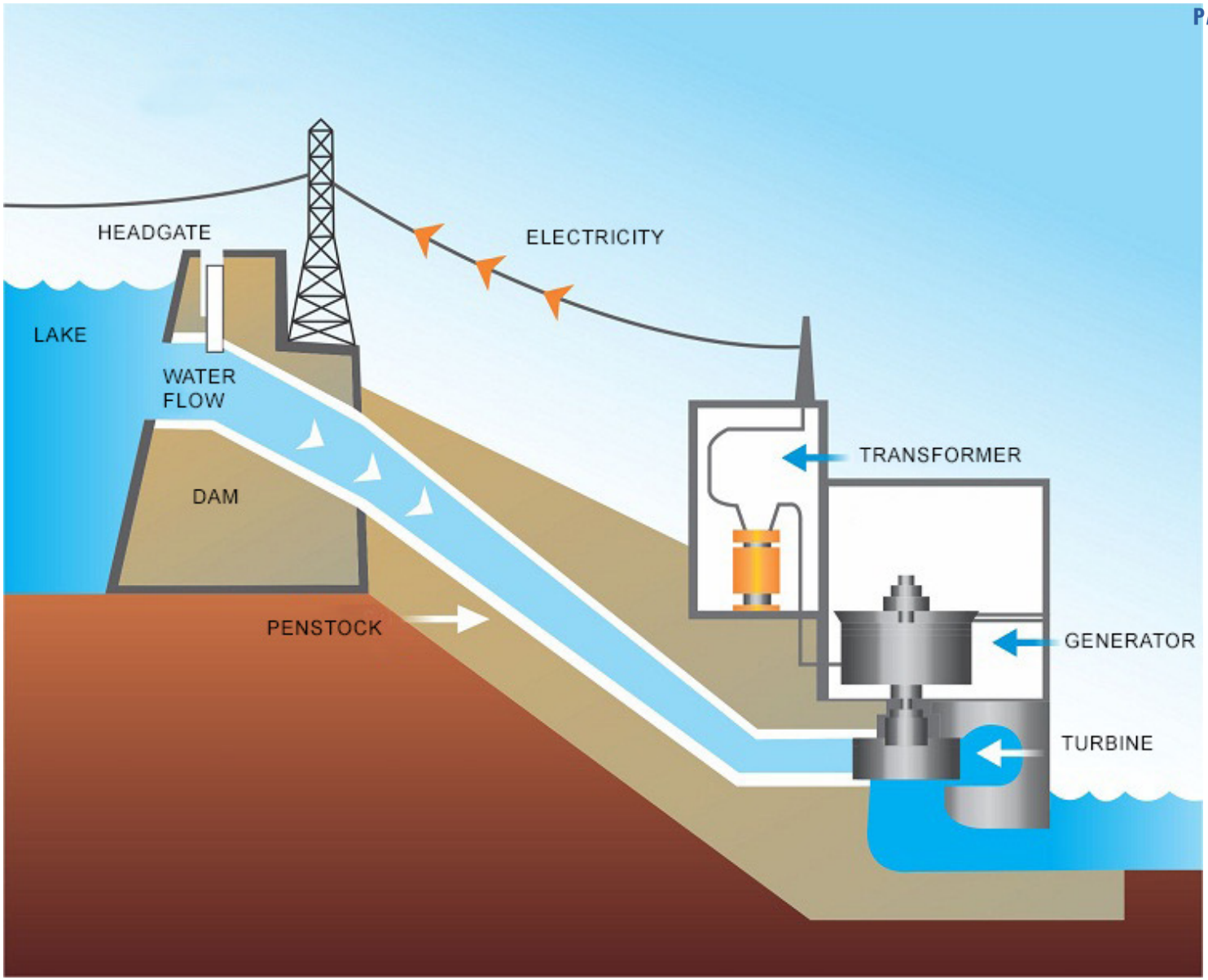
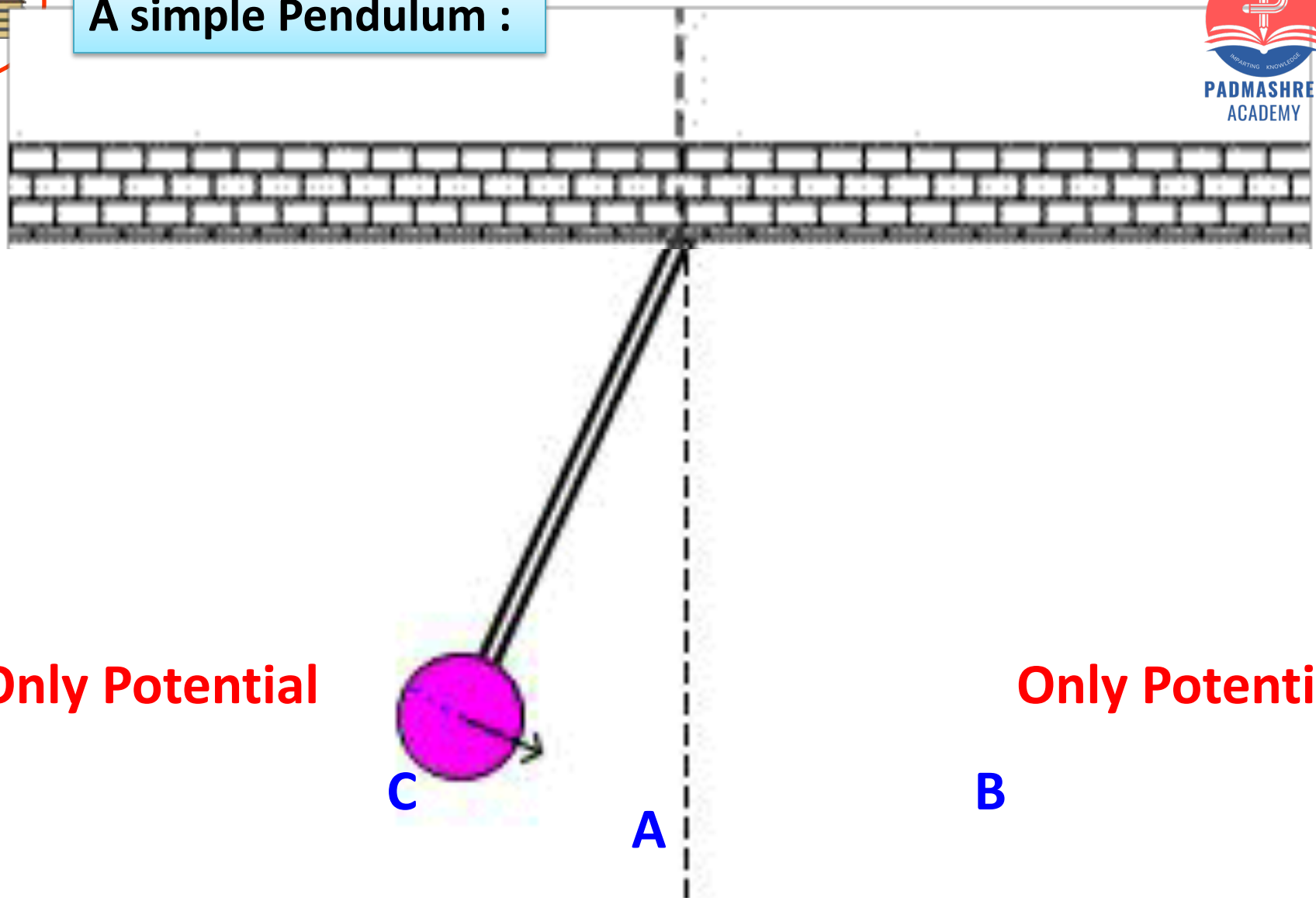
Energy can neither be created nor be destroyed. It can be converted from one form to another. The total amount of energy in the universe always remains constant.



Hydroelectric power station :



A simple Pendulum :



Fire cracker :

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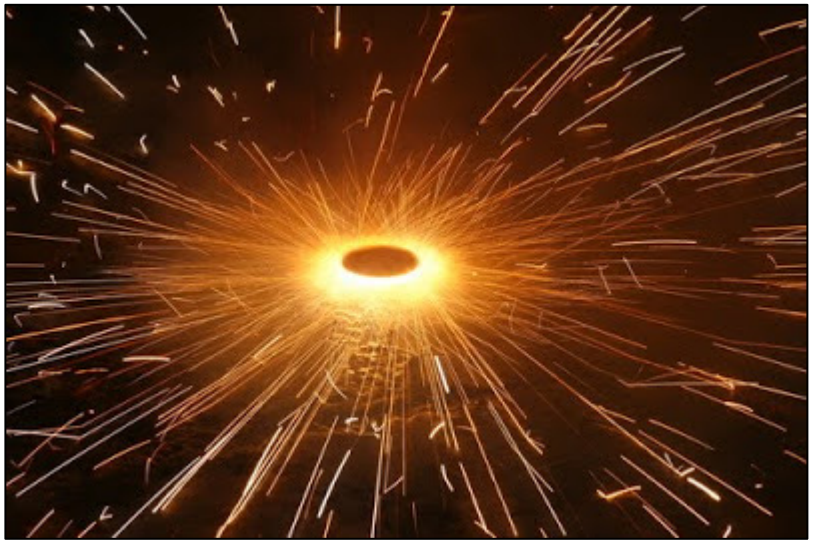

CHEMICAL ENERGY

- **HEAT ENERGY**
- **SOUND ENERGY**
- **LIGHT ENERGY**

Power

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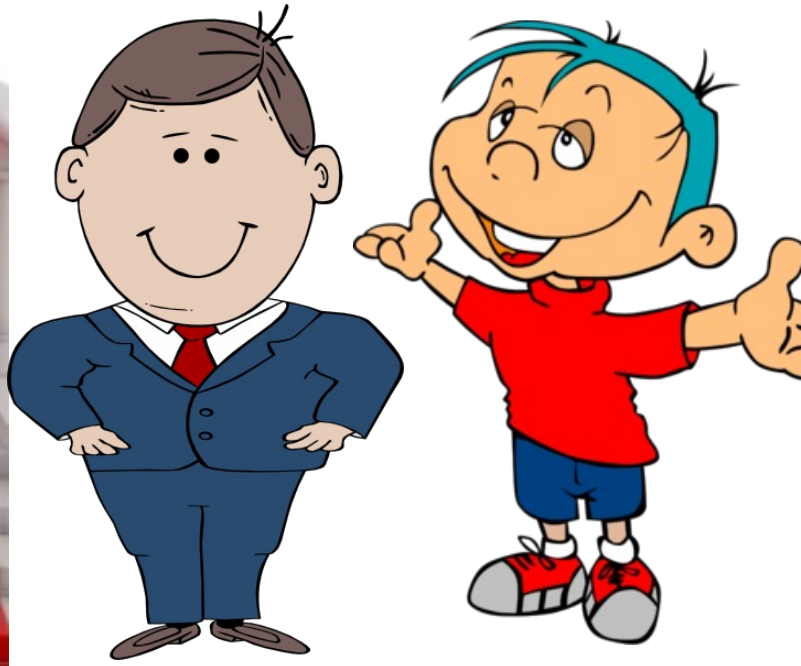
Suppose a 50 kg man takes 5 minutes to go up a staircase, but a 12 kg boy can go up the same staircase in 3 minutes.

Then, who is powerful and why?



Power

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We want to fill a tank with water which is on top of a building. If we try filling it with a bucket, it may require a day to fill it but a motor or a pump can do this job in just a few minutes.

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Deepak, Rahul and Ketan wanted to go to the top of hill.

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Power

Power is the measure of how fast or slow the work is done. If w is the work done in time t, then power P is defined as rat of doing work i.e.

$$\text{Power} = \frac{\text{Work done}}{\text{Time}}$$

The unit of power is 'watt'
(In honor of James Watt, 1736 - 1819)

1 Watt = 1 Joule/ sec

1kW = 1000 Watt

Power is also measured in a unit called as horse power.

This unit is used in industry.

1 hp = 746 Watts.