WORK.

Introduction.

You have always done work in our daily routine. But can you measure the amount of work you do on a given day? When you write your notes, lift a jerrycan or walk to the canteen, are you doing work?

In physics, work is said to be done when a force is applied on something and moves it through a distance that follows its direction..

Definition:

Work is defined as the product of force and the perpendicular distance moved to the direction of force.

I.e Work done = force × displacement

$= f \times d$

S.I units of work is **joules (J)**

Note: The distance moved has to be in the direction of the applied force. It is common that a force may be applied to move an object to the right, but instead the object moves to the left. The force in this case has not done any work.

Definition:

A joule is the work done when a force of one newton moves a body through a distance of one metre in the direction of the force.

Other units of work include:

1 kilo joule= 1000 joules $= 10^3$ J

1megajoule =1000000 joules $= 10^6$ J

Examples.

1. A constant force of 10N acts on a body and moves it through 200cm. find the work done.

Given:	From
force = 10N distance = 200 cm = $\frac{200}{100} = 2.0m$	workdone $= f \times d$ = 10 x 2 = 20J

2. Calculate the work done when a force of 30N moves through a distance of 9cm.

Solution:

Given; force , f = 30N, distance d = 9 cm = $\frac{9}{100} = 0.09m$. (We have to change *cm to m)*	workdone = force × distance $= 30 \times 0.09$ $= 2.7$ J

Note:
If an object is raised vertically to a height, h or falls freely from a height, h, then the force causing work to be done is its weight.

In such cases, we get the force from the formular below.

Force = Weight = mass × acceleration due to gravity,

Force = Weight = m × g

Force = m g

Thus, the work done against gravity is given by;

Work done = Weight × height

Work done = mgh

The value of acceleration due to gravity, g = 10 N/kg

(where m is mass in kg, h is distance in metres and some times, it is height)

Examples below demostrate the content above.

3. A body of mass 5 kg is lifted through a distance of 6m. Calculate the work done.

Solution.
Given; mass, m = 5kg, distance, d = 6m
From; Work done = force × distance
We have been given mass but the formular has force. So to get force from mass, we use the formular shown below.
Force = mg
= 5 x 10
= 50N.
At this point, we can now find the work done;
workdone = force × distance
= 50X6
= 300J.

4. Sandra climbs a hill 300m high. If her weight is 50kg.

Find the work she does to lift his body to the top of the hill.

Solution:

Given; distance, d = 300 m mass = 50 kg. (*We use this quantity to determine force as shown below).* Force =mg = 50x 10 = 500N	Work done = $f \times d$ = 500 x 300 = 150000 J

5. Mr. Okello of mass 80 kg runs up a staircase of 10 stairs, each of vertical height 25cm. Find the work done against gravity.

Solution:

Given, mass m = 80Kg, distance, h = 25cm = $\frac{25}{100} = 0.25m$ total distance, *h*= 0.25 m × 10stairs = 2.5m	From; work done = force(weight) × height work done = $m \times g \times h$ = $80 \times 10 \times 2.5$ = 2000 J

Assesment exercise:

1. Calculate the work done when a force of 9000N acts on a body and makes it move through a distance of 6m. (Ans = 54000 J)

2. A jack fruit of mass 3kg held at a height of 5m above the ground is allowed to fall freely to the ground. Calculate the workdone. (Ans = 150 J)

3. Calculate the work done when the force of 500N moves an object through a distance of 25m.
(Ans = 12500 J)

4. Calculate the work done by Salma of mass 40kg when she climbs a stair case of 20 steps each of height10cm. (Ans = 800 J)

ENERGY

Introduction:

Have you ever tried to lift a heavy object such as a 20 litre jerrycan but eventually failed. However, after eating food, suprinsingly, you were able to lift it. Why do you think you were able to lift it after food. At first, you didn't have energy to lift but after eating, you got the energy to lift. Theefore energy describes the ability to do work

But where did the energy come from?

Food stores chemical energy and it is this chemical energy that is converted to other forms like kinetic energy and others.
Work is the transfer of energy that happens when an external force moves an object. Ebergy can be found in many forms.

Definition:.

Energy is the ability or capacityto do work.
S1units of energy are joules (J)
Work and energy are convertible and therefore they have the same S1units of joules.

Sources of energy.

The raw material for the production of energy is called the energy source.
There are two types of energy sources.

(a) Non-renewable sources of energy;

These are energy sources, which cannot be replaced when they get used up.
Examples of non- renewable sources of energy include;

(i) **Fossil fuels**; these are formed from plant remains that died million years ago.
They include;
- ✓ coal,
- ✓ petroleum oil,
- ✓ natural gas,
- ✓ Parafin , e.t.c.

(ii) Nuclear fuels; these are fuels found in radioactive elements which may be occurring naturally such as Uranium. These fuels can be used in nuclear reactions to produce electricity.

Advantages of non-renewable source of energy.

- ✓ They have high energy density. I.e a lot of energy can be produced from a small quantity.
- ✓ They are readily available

Disadvantages of non-renewable source of energy.

- ✓ They are highly polluting.

(b) Renewable sources of energy

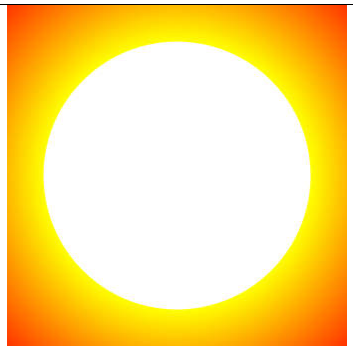
These are energy sources which can be replaced when they get used up.
They can never get exhausted i.e they can never get used up. If I may ask: Do you think the sun can ever get used up, or the running water from rivers can ever stop runnig or the wind will ever stop blowing? So, these and many others form the kind of renewable sources of energy.

Advantage:

- ✓ They are non-polluting.

Examples of renewable sources of energy.

(i) The Sun:

This is the form of energy which reaches the earth in form of heat and light from the sun. It can be harvested using solar panels and transformed into electrical energy, which is used for many purposes. It is also used in direct low temperature heating.	

(ii) Wind:

Wind can be harvested using giant windmills, which can turn electrical generators to produce electrical energy, which is a more useful form.	

(iii) Running water:

Running water is used in hydro - electricity plants to turn giant turbines, which produce electrical energy. The water will always flow hence a renewable source. Tides can also be used to generate electricity in this way.	

Forms of energy

Energy can exist in the following forms;

(a) Chemical energy:

This is energy stored in food and fuel. This energy is stored in the atoms and molecules of a compound. Its always released whenever the compound is changing to a new compound. For example, if sugars in the human body are burnt, a lot of chemical energy is released.	

(b) Nuclear energy:

This is the energy created by nuclear reactions. This energy is released when atomic nuclei disintegrate during nuclear reactions of fussion and fission.	

(c) Electrical energy (Electricity):

This is the form of energy which is due to electric charges moving from one point of a conductor to another. Electrical energy can be obtained from running water ,dynames, generators e.t.c	

(d) Light energy:

This is the form of energy which enables us to see. Light energy can be obtained from conversion of other forms of energy.	

(e) Radiant energy:

This is the energy from the sun.	

(f) Heat energy:

Heat is a form of energy, which results from random movement of the molecules in the body. It is responsible for changes in temperature. When a body is heated or when heat energy of the body increases; Heat energy can also be taken as the energy from fire sources. Heat energy is obtained from fuel , electric heaters and radiationfrom the sun.	 *burning fire wood produces heat energy*

(g) Sound energy:

This is the energy which enables us to hear. Like light, sound is also a form of wave motion, which makes particles to vibrate. Our ears are able to detect sound because it produces vibrations in the ear.	 *playing a guitar produces sound*	 *fire works produce sound*

(h) Geothermal energy

Water is pumped from under ground rocks where it's heated and then forced out through another shaft where it can turbines.	

(h) Mechanical energy:

This is the energy of motion.

Mechanical energy can be obtained from conversion of other forms of energy

There are two forms of mechanical energy.

(i) Kinetic energy

(ii) Potential energy

Note: Mechanical energy = kinetic energy + Potential energy

 *springs posses elastic potential energy*	 *Ugandan Bombadier has both kinetic and potential energy*	 *electric train*	 *simple pendulum*

Kinetic energy

This is the energy possessed by a body due to its motion. Examples of such bodies include running water, moving bullet etc.

SI unit; joules (J)

Kinetic energy is given by;

Kinetic energy = $\frac{1}{2} \times m \times v^2$, *where m is the mass of the body, and v is the speed or velocity.*

Example;

1. Find the kinetic energy of a body mass 2kg moving with a speed of 4m/s

Solution:

Given; mass, m = 2 kg, velocity, v = 4 m/s

From; $KE = \frac{1}{2}mv^2$

$KE = \frac{1}{2} \times 2 \times 4^2$

$KE = 4^2$

$KE = 16$ J

2. Mansoor of mass 60 kg is running at a speed of 10m/s.Find his kinetic energy.

Solution:

Given; mass, m = 2 kg, velocity, v = 10 m/s

From; $KE = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 60 \times 10^2$

$= 30 \times 10^2$

$= 30 \times 100$

$= 3000$J

Assesment exercise:

1. A girl of mass 50kg is running at a velocity of $10ms^{-1}$. Calculate her kinetic energy.
   (Ans = 2500 joules)

2. Calculate the kinetic energy of a car of mass 1000kg moving at $40ms^{-1}$
   (Ans = 800000 joules)

3. Evra has a mass of 50kg moving with kinetic energy of 3125J.
   Calculate the speed with which he runs.(Ans = 11.2 m/s)

Potential energy

This is the energy possessed by a body due to its position.
Forexample a body raised above the ground has *gravitational potential energy*while a stretched spring has *elastic potential energy.*

It is equal to the work done in putting the body in that position or condition.

A body above the earth's surface has an amount of gravitational potential energy equal to the work done against gravity.

Weight = mg.

If a body has mass (m) and its at a height (h) above the ground, its potential energy is given by;

Potential energy = workdone against gravity

P.E = force(weight) × height

= mass × acceleration due to gravity × height

P.e = $m \times g \times h$

P.e =mgh.

Worked out examples

Where necessary use acceleration due to gravity g =10N/kg

1. Nambassa of mass 80kg moves up from the ground floor to the third floor. If the third
   floor is 30m above the ground floor, find the gain in potential energy.

Solution

Given m = 80kg g =10Nkg^{-1} h= 30m	*From;* *P.E* = mgh =80 × 10 × 30 = 800 × 30 = 24000 joules

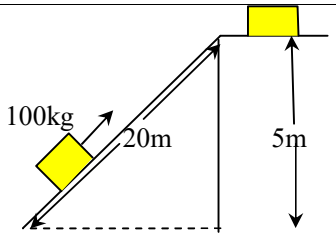
2. A box of physics textbooks of 500kg is raised from the ground to a height of 10m above the ground. Find the gain in potential energy by the box.

Solution

Given $m = 500kg$ $g = 10Nkg^{-1}$ $h = 10m$	From; P.E $= m \times g \times h$ $= 500 \times 10 \times 10$ $= 50000\ J$

3. A piece of mass 100kg is moved along an inclined plane to a platform of height 5m. Calculate the gain in potential energy of the piece.

Solution

Given $m = 100kg$ $g = 10Nkg^{-1}$ $h = 5\ m$		*P.E* $= m \times g \times h$ $= 100 \times 10 \times 5$ $= 5000J$

Assesment exercise:

1. A stone of mass 8kg is lifted through a height of 2metres.Find the potential energy the stone develops. (Take g = $10m/s^2$)(Ans = 160 J)

2. Shamim of mass 40kg is 15 metres above the ground. Find the potential energy she possesses.(Ans = 6000 J)

Energy Transformations

An energy transformation is the change of energy from one form to another. Energy transformations occur everywhere every second of the day. There are many different forms of energy such as electrical, thermal, nuclear, mechanical, electromagnetic, sound, and chemical. Because the law of conservation of energy states that energy is always conserved in the universe and simply changes from one form to another, many energy transformations are taking place constantly.

The principle of conservation of energy:

It states that 'energy is neither created nor destroyed' but can be changed from one form to another.

For example;

When electrical energy is changed to light energy in the bulb. However, the bulb also feels hot because some of the energy is changed to heat. Therefore;

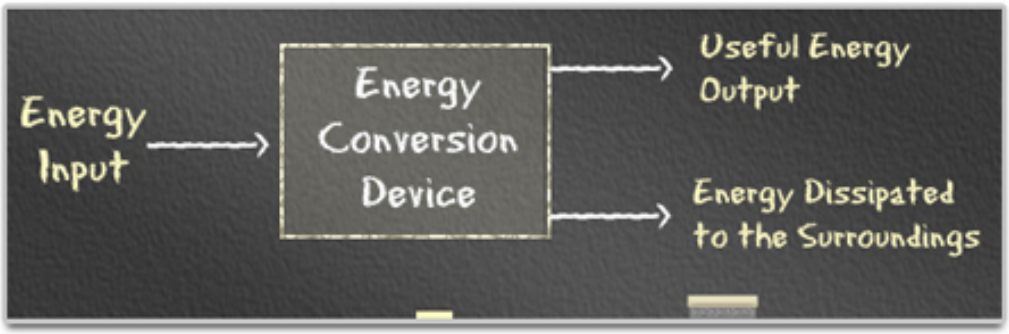
light energy + heat energy = electrical energy supplied.

Thus from this principle, we conclude that;

- ✓ *No new energy is created*
- ✓ *Total existing energy is not destroyed*
- ✓ *Energy is only changed from one form to another.*

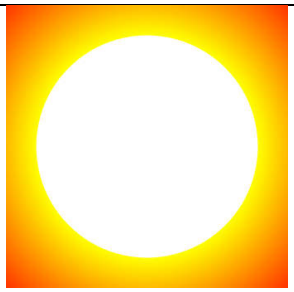
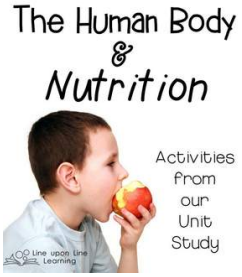
Devices used in Energy Conversion.

As energy is changed from one form or state to another, an energy converter (device) is required to ease the conversion.



Examples of such devices are shown in the table below.

 Torch Chemical to light	 Batteries Chemical to electrical	 Solar panels Light to Electrical

 lamps e.g bulbs Electrical to light and heat	 flat iron Electrical to heat	 Electric cooker Electrical to heat
 Loud speakers Electrical to sound	 Thermocouple (digital thermometer) Heat to Electrical	 Microphones Sound to Electrical
 Electric motors Electrical to Kinetic	 Electric generators Kinetic to Electrical	 toaster electrical to thermal
 Blender electrical to mechanical	 The sun Nuclear to electromagnetic energy.	 Our bodies chemical from food into mechanical

 A natural gas stove chemical to thermal used to cook food.	 Wind mill Mechanical to electrical	 Lawn Mower Mechanical to electrical

Some other example is the energy conversion at the hydro electric power station.
Conversion at the Hydro electric power generation

Potential energy of water in the waterfall

↓

Kinetic energy of water falling

↓

Kinetic energy of the turbine

↓

Electrical energy

Body at rest K.E = 0 X P.E = maximum. h Y P.E + K.E Z K.E = max, P.E = 0 ground	**At X,** the body has maximum potential energy, but has no K.E. ie K.E = 0 J As the begins to fall. The velocity of the body increases as the height, h decreases. The body therefore gains kinetic energy as it loses P.E At Y. The body has both K.E and P.E At Z The body is just reaching the ground, the height, h is zero (h = 0 m) but its velocity is maximum. Thus, its kinetic energy as it reaches the ground is maximum. At this point, all the initial P.E has finally converted to K.E. (P.E = 0 J)

As the stone just hits the ground, at Z,

Gain in K.E = loss in P.E

$\frac{1}{2}mv^2 = mgh$

$v^2 = 2gh$

$\therefore v = \sqrt{2gh}$, where v is the speed which the stone lands on the ground with.

Example:

1. A stone of mass 1kg is released from rest at height of 120m above the ground.

(a) Find its potential ground energy before it begins to fall.

(b)

Given; mass, m = 1 kg height, h = 120 m g = 10 N/kg	From; P.E = mgh = 1 x 10 x120 = 1200J

(b) If the stone falls with a velocity of 2m/s.Find its Kinetic energy.

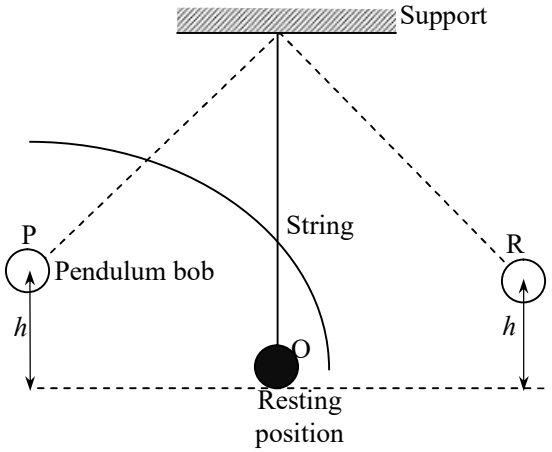
Given; mass, m = 1 kg v = 2 m/s	From; KE = $\frac{1}{2}$ mv^2 =$\frac{1}{2}$x 1 x 2^2 = 2J

(c) Find the velocity with which it hits the ground.

Gain In K.E = Loss in P.E $\frac{1}{2}$ mv^2= mgh $\frac{1}{2}$ x 1 x v^2= 1 x 10 x 120 v^2 = 10 x 120 x 2 V^2 = 2400 V = $\sqrt{2400}$ V = 48.99m/s	Alternatively, Just simply use the formular, V = $\sqrt{2gh}$ V = $\sqrt{2\ x\ 10\ x\ 120}$ V = $\sqrt{2400}$ V = 48.99m/s

SWINGING PENDULUM:

The transformation of energy between kinetic and potential energy can also be seen in a swinging pendulum.The swinging pendulum demonstrates inter conversion of energy.



For an oscillating pendulum, the following are noted:

i). At the extreme ends P and R of the string, all the energy is potential and maximum since the height *h* is also maximum; K.E = 0

ii). When passing through the rest position O, all the energy is kinetic and maximum because at O, velocity is maximum and *h* = 0 , P.E = 0

iii). While at intermediate points PO and OR, the energy is partly kinetic and potential.

NOTE:

As the bob falls from the left towards the central position, it gains K.E at the expense of P.E.

Similarly, as it rises from the central position towards the left end, it gains P.E at the expense of K.E.

Assesement Exercise:

1. A ball of mass 200g falls freely from a height of 20m above the ground and hits a concrete floor and rebounds to a height of 5m. Given that g = 10ms^{-2} , find the;

   (i) P.E of the ball before it fell. (Ans = 40 J)

   (ii) Its K.E. as it hits the concrete. (Ans = 40 J)

   (iii) Velocity with which it hits the concrete. (Ans = 20 m/s)

   (iv) K.E as it rebounds. (Ans = 10 J)

   (v) Velocity with which it rebounds. (Ans = 10 m/s)

   (vi) Velocity when it has fallen through a height of 15m. (Ans = 17.32 m/s)

2. Calculate the kinetic energy of a 2Kg mass trolly traveling at 400m per second. (Ans = 160,000 J)
3. A 5Kg mass falls from a height of 20m. calculate the potential energy lost.

   (Ans = 1000 J)

4. A 200g ball falls from a height of 0.5m. Calculate its kinetic energy just before hiting the ground.

   (Ans = 1 J)

5. A block of mass 2 kg falls freely from rest through a distance of 3m.

   (i) Find the K.E of the block. (Ans: =60J)

   (ii) Potential energy (Ans: =60J)

   (iii) The velocity with which the body hits the ground.

   (Hint : K.E gained = P.E lost).

6. A body falls freely through 3m. Calculate the velocity with which it hits the ground. (Ans: = 7.75 ms^{-1})

7. 100g steel ball falls from a height of 1.9m on a plate and rebounds to a height of 1.25m. Find the;

   (i) P.E of the ball before the fall. (Ans: =1.8 J)

   (ii) Its K.E. as it hits the plate. (Ans: =1.8 J)

   (iii) Its velocity on the plate. (Ans: =6ms-1)

   (iv) Its K.E as it leaves the plate on rebound. (Ans: =1.25J)

   (v) Its velocity of rebound. (Ans: =5ms^{-1})

NOTE:

If a body is not falling freely and experiences air resistance as it falls, the kinetic energy gained bysuch a body just before it hits the ground is calculated from:

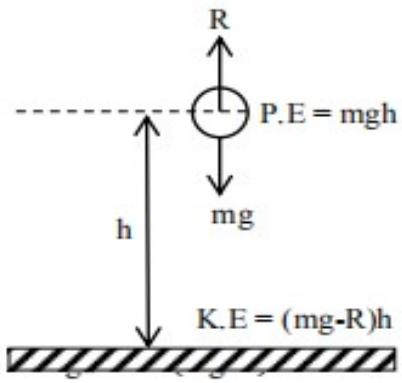
K. E gained $(mg - R)h$, where mg is the weight of the body, R is the air resistance and h is the height above the ground.

Example :

A 20kg body falls from 1.8m above the ground. If the air resistance is 0.9N.

(i) Calculate the kinetic energy just before hitting the ground.

Solution;
Given; m = 20 kg, Resistance, R = 0.9N, h = 1.8 m, K.E = ?

	K.E gained $= (\text{mg} - \text{R})h$ $= (20 \times 10 - 0.9) \times 1.8$ $= (200 - 0.9) \times 1.8$ $= 199.1 \times 1.8$ $= 358.38\ \text{J}$

(ii) Calculate energy lost due to air resistance.

Total energy = mgh

$= 20 \times 10 \times 18 = 360J$

Energy lost due to air resistance = 360 J - 358.38 J

Energy lost due to air resistance = 1.62 J

POWER:

Introduction:

If you and your friend are to carry a 10 litre jerrycan from the water tank to class and that you are to start at the same time.

If you take 5 minutes and your friend takes 3 minutes to carry the jerry, then who is more powerful?

Ofcourse your friend is more powerful. But why?

This is because he has taken less time compared to you to carry the same capacity of a jerrycan.

Definition.

Power is defined as the rate of doing work.

Or;

Power is the rate of transfer of energy.

Note: Work done is the same as energy transferred.

$$\text{Power} = \frac{\text{work done}}{\text{time taken}} = \frac{energy\ transfered}{time\ \ taken}$$

$$\text{Power} = \frac{\text{force} \times \text{distance}}{\text{time taken}} = \frac{mgh}{t}$$

$$\text{Power} = F \times V$$

S1 unit of power is a watt (W)

Note:
1 watt = 1 Js^{-1}
$1Js^{-1}$ is called a **watt (w).**

Definition:

A watt is defined as the rate of doing work at one joule per second.

Other units of power include:
Kilo watt (KW) = 1000 W = 10^3 W

Mega watt (MW) = 1000000 W = 10^6 W

Worked out examples.

1. A machine does 1 jouleof work in 7 seconds, find the power it develops.

Solution;

Given;	From;
Work done = 1 joule Time taken = 7 s	Power = $\frac{\text{work done}}{\text{time taken}} = \frac{1}{7} = 0.143\ J$

2. An engine raises 20kg of water through a height of 50m in 10 seconds. Calculate the power of the engine.

Solution:

Given;	From;
Mass, m = 20 kg Height , h = 50 m Time taken, t = 10 s g = 10 N/kg Power = ?	Power = $\frac{\text{work done}}{\text{time taken}}$ = $\frac{mgh}{t} = \frac{20 \times 10 \times 50}{10}$ = 1000 W

3. An electric bulb is rated 100W. How much electrical energy does the bulb consume in 2 hours.

Solution:

Given; (1hr = 3600s)	From:
Power = 100 W Time taken = 2 × 60 × 60 = 7200 s Energy used = ?	Power = $\frac{\text{energy used}}{\text{time}}$ $100 = \frac{\text{energy used}}{7200}$ energy used $= 100 \times 7200 = 720000$ J

4. A bulb is rated 30W. What is meant in this statement?

Solution

The statement means the bulb converts 30 joules of electrical energy to light energy every second.

5. Sendawulahas a mass of 50kg. If climbs a stair case of 10 stairs .each of height 20cm.

Solution.

(a) How much work does he do in the climbing the stairs?

Solution:

Work done = force × distance

= mg × h

$= 50 \times 10 \times \left(10 \times \frac{20}{100}\right)$, (cm changed to m)

= 1000 J

(b) Calculate the power developed in climbing the stairs for 10 seconds.

$\text{Power} = \frac{\text{work done}}{\text{time taken}}$

$= \frac{1000}{10}$

= 100 W

Assesment exercise:

1. A machine lifts a loads of 2500N through a vertical height of 3m in 1.5s

Find;

(i)the power developed by a machine. (Ans = 5000W.)

(ii) Using the same power how long would it take to lift of 6000N through a vertical height of 5m.(Ans = 6 seconds.)

2. A ball of 1 kg bounces off the ground to a height of 5m . find the energy lost . (Ans = 30J)

3. State the principle of conservation of energy ?

4. A pump is rated 400W . How many kilograms of water can it raise in one hour through a height of 72m? (Ans = 20,000kg.)

5. A girl of mass 50kg climbs a flight of a stair having 40steps each of 30m high in 10 s. Calculate the power developed by the girl.(Ans =600 W)

6. A force of 600N pulls a load through distance of 20m in 2 minutes. Calculate the
7. powerexpanded.(Ans =100watts)

8. A car moving at $30ms^{-1}$ pulls another with a force of 500N. Calculate the power of the pulling car.(Ans = 15000watts)

9. A 200g ball falls from a height of 0.2m. Calculate the kinetic energy just before it hits the ground.(Ans = 0.4J)

10. A block of mass 2kg falls freely from rest through a distance of 3m. Find the kineticenergy of the block(Ans = 60J)

11. Cathy of mass 40kg runs up a stair case in 16 seconds. If each stair case is 20 cm high and she uses 100 Js−1 . Find the number of stairs. [Ans: 20]

We recomend that you also try out questions from the UNEB question bank. Some of them are listed below.

UNEB 1994 QUESTION 17
A force of 50N moves an object through a distance of 200m in 40s. Find the work done.
(Ans = 10,000 J)

UNEB 1989 QUESTION 2
A stone of mass 20g falls through a distance of 10m. Calculate the kinetic energy it loses.
(Ans = 2J)

UNEB 2007 QUESTION 33
When a force F acts on a body, the body's kinetic energy increases by 800 joules over a distance of 2metres. (Ans= 400N)

UNEB 1993 QUESTION 19
A car of mass 1.5×10^3kg climbs a hill in 900s. If the top f the hill is 50m above the starting point, find the average power output of the engine. (Ans = 833.33 W)

UNEB 2006 QUESTION 7
A crane lifts 4 bricks per minute through a height of 1.5m. Find the power that is expanded if each brick weighs 100N. (Ans = 10 W)

UNEB 1997 QUESTION 5

A man whose mass is 75kg climbs up a ladder of 6.5m high in 5s. Calculate:

(i) work done (Ans = 4875 J)

(ii) power expended(Ans = 975 W)

UNEB 1993 QUESTION 4

(a) Distinguish between potential energy and kinetic energy

(b) A block of mass 2kg falls freely from rest through a distance of 3m. find the kinetic energy of the block

(Ans = 60J)

UNEB 1994 QUESTION 4

An object of mass 2kg is dropped from the top of a building, hits the ground with kinetic energy of 900J. Calculate the height of the building.

(Ans = 45 m)

UNEB 1995 QUESTION 9

A bullet of mass 5g is fired at a speed of $400ms^{-1}$. How much energy does it have?

(Ans = 400 J)

UNEB 2002 Q. 1 a

The diagram in the figure shows large smooth bowl. Explain the energy changes that take place as the ball is released from P.

See more UNEB

1987 (Qtn 3 and 24)	1997 (Qn.5 and 10)	2001 (Qn.26)	2007 (Qn.6)
1989 (Qtn 29)	1994 (Qtn 17)	2003 (Qn.15)	2000 (Qn.23)
1991 (Qn.11)	1999 (Qn.2 and 8)	2005 (Qn.45)	2007 (Qn.33)
1992 (Qtn 11)	1993 (Qtn 3 and 24)	1993 (Qn.4 and 18)	2006 (Qn.7)

By the end of chapter, you must be in position to clearly explain the terms work, energy and power and also give their applications in daily life. You should also be in position to solve numerical problems related to them.