# PYTHAGORAS SERIES

## SOLID FOUNDATION INTEGRATED SCIENCE FOR JUNIOR HIGH SCHOOL

Question and Answers

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# CHAPTER ONE

(Q1) Within an atom, there are 5 electrons and 2 neutrons. Find its mass number.

Soln:

Number of electons = 5.

Number of neutrons = 2.

Mass number = 5 + 2 = 7.

(Q2) There are 2 neutrons and 6 protons within an atom. Determine its mass number.

Soln:

Number of neutrons = 2.
Number of proton = 6.
Mass number = 2 + 6 = 8.

(Q3) An atom has a mass number of 10. If it contains 2 electrons, how many neutrons does it contain?

Soln:

Mass number = 10.

Number of electrons = 2.

Number of neutrons =?

Since mass number = number of neutrons + number of electrons,

=>10 = number of neutrons + 2,

=> 10 – 2 = number of neutrons,

=>number of neutrons = 8.

(Q4) An atom which contains 3 electrons has a mass number of 8. Determine the number of neutrons that it contains.

Soln:

Number of electrons = 3.

Mass number = 8.

Number of neutrons =?

Since mass number = number of electrons + number of neutrons,

=>8 = 3 + number of neutrons,

=>number of neutrons = 8 – 3 = 5.

(Q5) An atom has 4 protons and a mass number of 12. How many neutrons does it contain?

Soln:

Mass number = number of protons + the number of neutrons.

=>Mass number = 4 + number of neutrons,

=>12 = 4 + number of neutrons,

=>number of neutrons = 12 – 4 = 8.

(Q6) An atom whose mass number is 10 contains 8 neutrons. Determine the number of protons that it contains.

Soln:

Number of neutrons = 8.

Mass number = 10.

Since mass number = number of neutrons + number ofprotons,

=>10 = 8 + number of protons,

=>Number of protons = 10 – 8 = 2.

Atomic symbol:

- If X = the element, A = its mass number and Z = its atomic number, then the atomic symbol of the element X is written as $\frac{A}{Z}X$.
- For example, the atomic symbol $^{23}_{11}\mathrm{Na}$represents theelement sodium, whose mass number is 23 and whose atomic number is 11.
- Also the symbol $^{24}_{12}\mathrm{Mg}$ represents the element magnesium, whose mass number is 24 and whose atomic number is 12.

(Q1) The atomic symbol of an element is $\boldsymbol{^{10}_{7}P}$.

(a) What is the mass number?
(b) Write down its atomic number.
(c) Find the number of neutrons.

Soln:

(a) The mass number = 10.
(b) The atomic number = 7,

=>it contains 7 electrons.

(c) From Mass number = number of neutrons + number of electrons,

=>10 = number of neutrons + 7,

=>10 – 7 = Number of neutrons,

=> it contains 3 neutrons.

(Q2) An element has an atomic symbol$\boldsymbol{^{12}_{8}X}$. Determine

(a) its atomic number.

(b) the number of protons it contains.

(c) its mass number

(d) the number of neutrons it contains.

Soln:

(a) The atomic number = 8.
(b) The number of protons = the atomic number = 8.
(c) The mass number = 12.
(d) Number of neutrons = mass number – number of electrons = 12 – 8 = 4.

(Q3) Write the atomic symbol of an element Y, which contains 8 electrons and 5 neutrons.

Soln:

Since there are 8 electrons=>the atomic number = 9.

The mass number = number of electrons + number of neutrons,

=> the mass number = 8 + 5 = 13.

The atomic symbol$is$ $^{13}_{8}\mathrm{Y}$.

(Q4)An element B has 10 protons and 8 neutrons. Write down its atomic symbol.

Soln:

Since the number of protons = 10, then the atomic number = 10.

Number of neutrons = 8.

Mass number = number of neutrons + the number of protons.

Mass number = 10 + 8 = 18

The atomic symbol is $^{18}_{10}\mathrm{B}$.

## Isotopes:

- These are two or more atoms which have the same atomic number, but different mass numbers.

- Within an atom, the number of protons is always fixed or constant but the number of neutrons may vary.
- If the number of neutrons vary, then the mass number of the atom will also vary.
- For this reason it is therefore possible to have two atoms of the same element, which have the same atomic number but different mass numbers, and such two atoms are called isotopes.
- Examples of isotopes are

(a) $^{37}_{17}\text{Cl}$ and $^{35}_{17}\text{Cl}$

(b) $^{10}_{8}\text{X}$ and $^{12}_{8}\text{X}$

Electronic configuration:

- This shows the number of electrons within each orbital of an atom.

(Q1) Write the electronic configuration of an element X whose atomic number is 7.

Soln:

N/B: The first orbital can take a maximum of 2 out of the 7 electrons found in the element X, the rest must be found in the second orbital.

Soln:

The required electronic configuration is 2 : 5.

(Q2)Write down the electronic configuration of an atom, whose atomic number is 12.

Soln:

Since the first orbital can contain a maximum of 2 electrons, and the second one a maximum of 8, the required electronicconfiguration is 2 : 8 : 2, since the given atom contains 12 electrons.

(Q3)The atomic symbol of sodium is given as $^{23}_{11}\mathbf{Na}$. Write down its electronic configuration.

Soln:

Since the atomic number of sodium = 11, then its electronic configuration is 2 : 8 : 1.

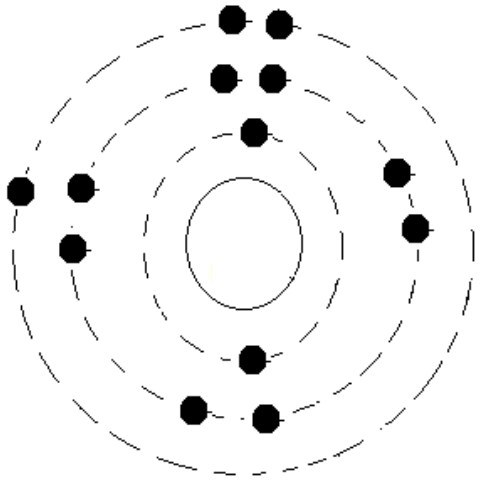
.

## The atomic structure:

- This refers to a diagram of an atom, which shows the number of electrons within each orbital.

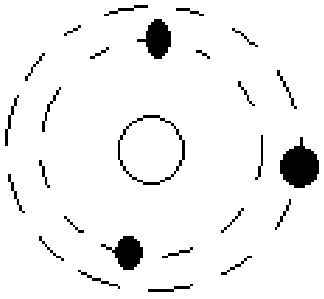
(Q1) The atomic number of an element is 13. Write down its atomic structure.

Soln



(Q2)The atomic number of an element is 3. Write down its atomic structure.

Soln:



(Q3)Write down the atomic structure of an element, which contains only two protons.

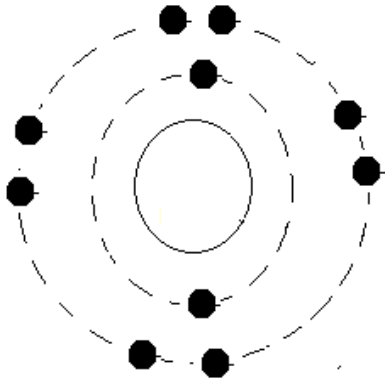
Hint:

Since the number of protons and electrons are the same, then the number of electrons = 2.

(Q4) An element has $\mathbf{^{17}_{10}P}$ as its atomic symbol. Write down its atomic structure.

Soln:

Since the atomic number of the element is 10, then it contains 10 electrons.



QUESTIONS

(Q1) (a) What is matter and why is a stone said to be matter.

Ans:

- Matter is any thing which has weight and occupies space.
- A stone is said to be matter since it has weight and occupies space.

(b) List the three states of matter.

Ans:

- These are the liquid, the solid, and the vapour states.

(c) Explain why the molecules within a solid are not free to move about.

Ans

- Because the attractive forces acting between them are very strong.

(d) Why does a liquid take the shape of its container.

Ans:

- Because a liquid does not have a definite shape.

(e) Why does gas always spreads out to fill its container.

Ans:

- Because the attractive forces acting between it molecules are the weakest.

(Q2) (a) Differentiate between melting and evaporation.

Ans:

- In melting a solid changes into the liquid state, but in evaporation a liquid change into the vapour state .

(b) When is a gas said to have undergone condensation.

Ans:

- When it changes into the liquid state.

c) Explain what happens if solid iodine or camphor is heated.

.

Ans:

- Each of them will change directly from the solid into the vapour state.

(d) Why is water not considered as an element?

- Because it contains two different kinds of atoms.

(e) What are chemical symbols?

Ans

- They are letters used to represent elements.

(Q3) (a) Write down the chemical symbols for the following elements:

(i) Iron (ii) zinc (iii) silver (iv) chlorine (v) potassium.

Ans:

- (i) iron.....Fe
  (ii)Zinc.....Zn
  (iii) Silver.....Ag
  (iv)Chlorine .....Cl
  (V) Potassium.....K

(b) What is the difference between an atom and a molecule?

Ans:

- An atom is the smallest particle which can exist, but a molecule is the combination of two or more atoms.

(c) Make a labeled diagram of the atom.

(d) Name the items found within the nucleus.

Ans:

- These are the protons and the neutrons.

(e) What do we mean if we say that an atom is neutral?

Ans:

- It means that it contains the same number of positive and negative charges.

(Q4) (a) What is the difference between atomic number and mass number?

- While the atomic number refers to the either the number of electrons or protons, the mass number refers to the total number of protons and neutrons.

(b) What will be the atomic number of an atom, which contain 8 electrons?

Ans:

- 8

(c) Write down the mass number of an atom, which contains 4 electrons and 2 neutrons.

Ans:

- 6

(d) What is an ion?

- An ion is either a positively or a negatively charged atom.

(e) Briefly explain how negative ions are formed.

Ans:

- When an atom gains an electron or electrons, its number of negative charges become more than that of the positive charges, making it a negative ion.

# CHAPTER TWO

## PHYSICAL AND CHEMICAL CHANGES,

## MIXTURES AND COMPOUNDS.

(Q1) State whether the following are physical or chemical changes:

(a) The boiling of egg for five minutes.

(b) Chewing a piece of bread.

(c) Chewing of piece of meat for two minutes in the mouth.

(d) Dissolving common salt in water.

(e) The burning of charcoal.

Soln:

(a) This is a physical change since the egg only changes from the liquid into the solid state, without any change in its food nutrients.

(b) It is a chemical change because a substance called ptyalin found in saliva, will break the starch within the bread into simple sugar.

(c) This is a physical change since the meat only breaks down into pieces, but the protein it contains does not change since ptyalin has no effect on protein.

(d) This is a physical change, since the salt does not change but only breaks down into smaller particles.

(e) It is a chemical change because the charcoal changes into a new material.

(Q2) Determine whether the following are physical or chemical changes:

(a) The melting of ice.

(b) Putting HCl into NaoH.

Soln:

(a) This is physical change since the ice only changes from the solid into the liquid state, and still remains as water.

(b) In other words, no new substance is formed.

(c) This is a chemical change because the HCl will combine with the NaoH to form NaCl and $H_2O$, which are new substances.

(Q3) Explain how you will demonstrate that

(a) a liquid has no fixed shape.

(b) a gas has no fixed volume.

Soln:

a). Containers of different shapes are taken, and liquid such as water is poured into each of them one after the other.

- It will be noticed that in each case, the liquid will take the particular shape of the container into which it is placed.

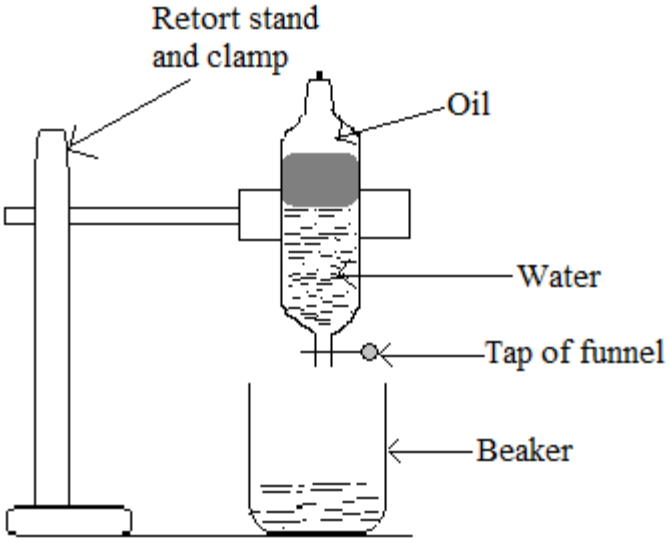
- When smoke is created at one corner of a room, it spreads to fill the whole room, which shows that a gas has no fixed volume..

Industrial application:

(1) It is used to separate crude oil into its various components or parts.

(2) It is used to separate liquefied air into oxygen and nitrogen.

The separation funnel:




- This is used to separate two or more immiscible liquids found within a mixture, according to their densities.
- The mixture is poured into the separating funnel.
- The set-up is allowed to stand for some time for the liquid to settle.
- The tap is opened to allow the bottom layer of liquid which has the greatest density to flow out.
- Among the liquids left within the mixture, the one with the greatest density then forms the bottom layer, which can also be made to follow out.
- By so doing, the mixture can be separated into its constituents.

- Within the round bottle flask will be left the water constituent of the mixture.

(Q1) Explain how you will separate a mixture of grinded salt and sand,

Soln:

- Add water to the mixture in order to dissolve the salt in the water.
- Filter the mixture of the salt water and the sand, for the sand to be deposited on the filter paper or the cotton wool.
- Evaporate the filtrate to get the salt.

(Q2) Given a mixture of sand, iron fillings and camphor, briefly explain how you will separate such a mixture.

Soln:

- Heat the mixture for the camphor to sublime, and condense the camphor in its gaseous state into solid camphor by means of a cold surface.
- The mixture remaining which consists of iron fillings ad sand is then separated by using a magnet to remove the iron fillings.

(Q3) Briefly explain you will obtain kerosene from a mixture of petrol and kerosene.

Soln:

- This is by means of distillation.
- Heat the mixture in a round bottom flask, for the petrol to be changed into the vapour state, since it has the lower boiling point.
- Condense the petrol vapour into liquid by allowing it to move into the condenser.
- Collect this liquid petrol in a beaker.
- The kerosene will be left in the round bottom flask.

(Q4) Classify the following as mixture or compound:

i.e. toothpaste, smoke, petrol, kerosene, common salt, salt solution, dye, water, sugar or sucrose, soup.

Soln:

- The mixtures are toothpaste, paint, smoke, salt water or salt solution, dye and soup.
- The compounds are water, sugar or sucrose, common salt, petrol and kerosene.

# CHAPTER THREE

## FORCE, WEIGTH AND MASS

Questions:

(Q1)(a) Define force.

(b) List three effectsof force.

(c) Explain why when a stone is thrown into the air, it returns to the ground.

Ans: Because the force of gravity pulls it back to the surface of the earth.

(Q2) A boy is running round a circular path. Determine the forces which are acting on him.

Ans: The forces acting on him are the force of gravity which is pulling him towards the surface of the earth, and the centripetal force which enables him to ran in the circular path.

(Q3)(a) Differentiate between cohesive and adhesive forces.

(b)Explain why a body has weight

Ans: Because the force of gravity which is pulling it towards the centre of the earth, enables it to exert a force (weight) on its support.

(c)Explain what the following mean:

(i) Friction.

(ii) The weight of an object.

(iii) The mass of an object.Ans: (i) Friction refers to the force, which tries to prevent objects from moving when they are being pulled across a surface. (ii) The weight of a body refers to the force which it exerts on its support, or on any thing that freely supports it. (iii) The mass of a body refers to the amount of matter or material that it contains.

(Q4)(a) List three differences between weight and mass.

(b) Explain why or what causes a body or have weight.

Ans: A body has weight because the force of gravity is pulling it towards the centre of the earth, which enables it to exert a force (weight) on its support.

(Q5)Briefly explain the main difference between a scalar and a vector quantity.

Ans: While a scalar quantity has only magnitudebut no direction, a vector quantity has both magnitude and direction.

(Q6)Briefly explain with the aid of diagrams, how each of the following can be used to determine the mass or the weight of a body:

(a) The spring balance.
(b) The beam (lever) balance.

(Q7)(a) State two advantages or importance of friction.
Ans: i) It enables us to walk. ii) It enables a car to come to a stop, when the brakes are applied.

(Q8) You are given two different liquids.Briefly explain how you will determine which one is more viscous, or has the greater viscosity. .
Ans: Place the the two liquids into two different identical cylinders, and drop two small identical metal balls, one into each liquid at the same time. The liquid in which the ball falls slowly has the greater viscosity.

(Q9)List two differences between weight and mass.

Ans: i) While weight is a vector quantity, mass is a scalar quantity. ii) While the weight of a body changes from one place to another, the mass of the same body always remains constant from one place to another.

(Q10)Explain why an object thrown into the air, always returns or falls to the surface of the earth.

Ans: It is the force of gravity which always pulls it to the surface of the earth.

# CHAPTER FOUR

## Water, Solutions and Solubility

Q.1. Explain how you will prepare a solution of sodium chloride using the method of neutralization.

Solution

I. Put sodium chloride into water and stir for it to dissolve.
II. The salty water had is a solution of sodium chloride

Q.2. List three solvents and give one use of each.

Solution

I. Water: which is used to dissolve sugar.
II. Alcohol: which is used to extract pigment from plant.
III. Thinner: which is used to dissolve paints.

Q.3. Explain why certain mixtures are shaken before their use.

.

Solution

— Because some of the solute tends to settle at the bottom of the container.
— Shaking or stirring will give rise to a homogenous mixture, which is a mixture in which the solid particles of the solute are evenly spread.

Q.4. Give three methods used in water purification and explain each one of them.

Solution

Three of the methods used in water purification are:

i. Boiling: In this method, the water is boiled for about 20 minutes to kill almost all the germs it contains.
ii. Filtration: In this the water is made to pass through a filter paper, or a filter bed made of sand and stones or a white cloth.
iii. Chemical treatment: In this method, chemicals such as chlorine and alum are added to the water. While the chlorine kills the germs in the water, the alum causes all the suspended particles within the water to settle to the bottom.

Q.5. By arranging them in their order of purity, name four sources of natural water.

Solution

(a) Rain water:

— This is the purest form of natural water, and it contains the least amount of dissolved material.

(b) Well water:

— This comes next in term of purity after rain water.

—Water from deep wells are clean because it has been filtered by different layers of soil.

(c) River/stream water:

— In terms of purify, this comes third.

(d) Sea/lake water:

— This contains the highest level of dissolved material which makes it the least pure.

Q.6. You have travelled to a village where the only source of drinking water available is a stream. Briefly explain how you will make a gallon of the stream water good for drinking.

Solution

i. I will first boil the water for about 20minutes, to kill the germs in it.
ii. I will then filter the boiled water, before drinking it.

Q.7. For each of the following, give a suitable solvent which can be used to dissolve each: Common salt, paint, sucrose, coal tar and chlorophyll.

Solution

| Substance | Solvent |
|---|---|
| Common salt…… | water. |
| Paint…… | kerosene/tinner/petrol. |
| Coal tar …… | …..turpentine/kerosene/petrol. |
| Sucrose …… | water. |
| Chlorophyll…… | alcohol. |

(Q1) Explain why it necessary for water from certain natural sources, must to be purified before being used.

Ans:

— To kill the germs in the water and remove harmful chemicals from it.
— To remove the solid particles from it.

(Q2) You are given a small amount of a liquid suspected to be water. List three tests you will carry out to determine whether it is pure or good water or not.

Ans:

— I will first determine the boiling point and the freezing point of the liquid. If they are respectively 100C and 0C, then it is likely the liquid is good water.
— Finally I will add a few drop of the liquid to anhydrous copper II sulphate, and if the colour changes from white to blue, then the liquid is water.

(Q3)(a) What do you understand by water conservation?

(b) Explain why it is important for water to be conserved.

(c) List three methods of water conservation.

(Q4)(a) What is the cause of hardness in water?

Ans:

— Due to the presence of calcium and magnesium ions in the water.

(b) Differentiate between temporary and permanent hardness of water.

Ans:

— Temporary hardness is due to the presence of calcium hydrogen carbonate in the water, while permanent hardness is due to presence of magnesium or calcium sulphate.

(c) Explain why hard water does not easily form lather with soap, or why hard water wastes soap.

Ans:

— When soap is used for washing using hard water, the soap starts combining with the calcium and the magnesium ions within the water to form a solid called scum.
— It is only after all these ions have combined with the soap to form scum, that the water will begin to form lather with the soap, for washing to take place.
— In this way part of the soap is wasted.

(5)(a) Write a short note to explain what the water cycle is.

(b) Differentiate between a dilute solution and an aqueous solution.

(c) When is a solution said to be concentrated.

Ans:

— When the amount of solute dissolved in the solvent to form the solution is great.

(d) What is it that it is impossible to dissolve more solute, in a saturated solution?

Ans:

— Because the solution contains the maximum amount of solute, that it can contain or be dissolved in it.

(Q6)(a) What is solubility?

(b) List three factors which affect solubility, and explain the effect of each.

.

Ans:

(a)Temperature;

— Solubility increase as the temperature increases.
— Stirring; Solubility increases as stirring increases.
— Nature of the solute:
— The smaller the particles of the solute, the greater its solubility within a given solvent.

(Q7)(a) What is the main difference between a suspension and a colloid?

Ans: The particles of a suspension settle on standing, but those of colloid do no settle on standing.

(Q8) List three differences between a true solution and a suspension.

(Q9)(a) Explain the role played by the alum and the chlorine, during water purification.

(b) Why is water from wells regarded to be good and clean?

Ans:

— Because the water has been well filtered by the different layers of soil or rocks, found deep down the earth.

(Q10)(a) List three differences between hard water and soft water.

(b) Give two ways of making hard water soft.

Ans:

— By boiling.
— By distillation.

(c) Describe an experiment to show that water from different sources, have different lathering abilities.

(Q11) the treatment of water for town supply, the water is first passed through gravel and sand bed. Potash (alum) is then added followed by the addition of chlorine. State the reason for each of these steps.

Soln:

- The sand and gravel bed serves as filter, and as such removes the undissolved particles or debris from the water.
- The potash or the alum added, causes the small particles in the water to stick together and drop to the bottom.
- The chlorine kills the germs within the water.

(Q12) Name three sources of natural water, and two cations which cause hardness in water.

Soln:

- These sources are rivers and rainwater.
- Two cations which causes hardness in water are calcium ions($ca^{2+}$) and magnesium ions($mg^{2+}$).

(Q13)(a)Give two examples of detergents.

(b)Explain why it is better to use detergent for washing, when using hard water rather than using soap.

Soln:

- Soap when used for washing in hard water is affected by the $ca^{2+}$ ions and the $mg^{2+}$ ions found in the water.
- For this reason, part of the soap becomes wasted.
- By since these ions have no effect on detergents, no portion of the detergent becomes wasted.

# Chapter Five

## The Solar System, Satellites And Measurement

- The sun, the planets and all the heavenly bodies which move around it from the solar system.
- Heavenly bodies are structures that are high up in the atmosphere, but have no specific names.
- The solar system is circular in shape and forms part of the Milky Way galaxy.
- A galaxy is the name given to a large number of stars.
- The centre of the solar system is occupied by the sun, whose great mass creates the gravitational force which enables other objects to travel round it in an orderly manner.
- The universe is made up of space and everything that exists in it, and is indeed very large.
- It is composed of a number of galaxies.
- Each star is a source of heat and light, which means that each produces heat and light.
- The stars which include our sun are giant shining balls of hot gases.
- The main difference between a star and a planet is that, while a star produces its own light, a planet does not do so but reflects the sun`s light.
- For this reason, a planet can be seen since it reflects light from the sun.
- At night, planets and stars look like, but while the planet produces steady light, that produced by the sun is twinkling.

### The planets:

- These are heavenly bodies that move around the sun.
- Each planet moves in a circular path called its orbit.
- The planet in the course of movement do not clash or meet, due to the sun`s gravitational force and each is at a particular distance away from the sun.

- The shape of the orbital path used by the planet around the sun is called ellipse.
- There are nine planets and naming them with respect to their closeness or nearest to the sun, we have: Mercury, Venus, Earth, Mars, Saturn, Uranus, Neptune and Pluto.
- All the planets with the exception of Pluto are surrounded by different kinds and amount of gases called atmosphere.
- For this reason, an atmosphere is the name given to the layer of gases which surrounds a planet.
- Among all the planets, the earth is the only one with enough oxygen and water on its surface to support life.
- While some of these planets have one or more moons moving around them, others have none.
- Each planet moves round the sun, and one complete movement of a planet round the sun is called a revolution.
- The earth takes a year or $365\frac{1}{4}$ days to revolve once round the sun.
- Apart from that, each planet spins on its axis which is an imaginary line through its centre, and this movement is called rotation.
- The earth takes 24hours to perform this rotation and it is this earth`s rotation which cause day and night.

The temperature, atmosphere, length of days and nights as well as other conditions vary from planet to planet and depend on the following factors:

(I) The distance of the planet from the sun.
(II) The planet`s atmosphere.
(III)The planet`s rotation.

## Facts about some planets:

### Mercury:

- Since this is the planet nearest to the sun, it is the hottest planet.

### Venus:

- When viewed from the earth, this is the brightest of all the planets.

## Earth:

- This is the only planet known to have life on it, since it has conditions which favour life.
- These conditions include the presence of oxygen and water, as well as a good or moderate temperature.

## Mars:

- This is referred to as the red planet.

## Jupiter:

- This is the largest of all the planets and it has a very big red spot on its surface.

## Saturn:

- This I the second largest planet and it has three colourful rings around it.

## Pluto:

- This is the farthest planet from the sun.
- It is also the darkest and coldest planetsince the rays of the sun does not get to it.

## Space Travel:

- The spaceship or the rocket is the only vehicle that can be used to travel to space.
- People who travel to space are called astronauts.

## The MOON:

- A moon is a natural satellite which orbits or moves round a planet.
- Our earth has one moon which is a solid heavenly body which moves round the earth.

- The moon has no air or water and its surface is covered with plains, mountains and large holes called craters.
- It is also the nearest heavenly body to the earth.

## The Sun:

- This is the star around which all the planets move.
- The importance or the uses of the sun`s energy are for the evaporation of liquid, in the drying of clothes and food, and in the salt making industries.
- It also used in keeping the atmosphere warm and provides light for sight or seeing.
- It also provides the light energy needed for photosynthesis.

## Asteroids:

- They are also referred to as planetoids, and are irregularly shaped objects found within space.

## Meteoroids:

- They are small heavenly bodies made up of iron and rock which sometimes fall from space to earth.
- Even though many meteoroids fall from space into the earth`s atmosphere, most of them burn up as a result of friction between them and the gases within the atmosphere.
- While they are falling through the atmosphere they are called meteors, but if they reach the earth`s surface they are referred to as meteoroids.

## Rotation of the earth:

- The rotation or the spinning of the earth refers to its turning on its axis.
- A complete rotation of the earth which takes 24hours to occur, causes it to turn through an angle of $360^0$.
- The rotation of the earth causes day and night.
- Since the earth moves round the sun, the part of the earth which faces the sun will have light i.e. day, while the part which does not face the sun will have darkness.

## The revolution of the earth:

- This refers to the movement of the earthround the sun.
- When the earth moves round the sun once, it is said to have made one revolution.
- The earth takes $365^{1}/_{4}$ days to make a complete revolution round the sun.
- It must be noted that the rotation and the revolution of the earth occurs at the same time.
- Therefore at any instant as the earth is rotating on its axis, it is also revolving round the sun.

## Earthquake:

- This refers to the violent shaking movement of a portion of the earth as a result of the sudden movement of rocks, which are found deep down the earth.

## Effects of earthquake:

- It leads to the destruction of infrastructures such as roads, buildingsand bridges.
- It can lead to the loss of lives and property.
- The lowering and rising of parts of the seamay occur, leading to the creation of tidal wave.

## Volcano:

- This is an opening in the earth`s surface through which hot melted rock is ejected up into the sky, and onto the earth`s surface.
- This melted rock is called magna and before this magna appears, there will be the ejection of steam, gases, ashes and rocks.

## Effects of Volcano:

- It can lead to the loss of life and property.
- It can lead to the formation of precious stones and minerals.
- The ashes and the gas released pollute the atmosphere.
- The rocks had as a result of volcanic action, break down to form fertile soil.

## Satellites:

- A satellite is an heavenly body, which moves round a planet.
- There are two types and these are the natural and the artificial satellites.
- While natural satellite is naturally made, artificial satellite is man made.

## The uses of satellites:

- The uses or importance of satellites are for the following purposes:
  (1) For communication purposes.
  (2) To study and forecast the weather.
  (3) To carry instruments into space and for scientific research purposes.
  (4) For military purposes.

## Measurement:

- There are different types of measuring instruments and each is used for a specific measurement.
- One of the main importance of accurate measurement or measurement being accurate is to avoid cheating.
- Apart from that, inaccurate measurement can lead to dangerous situations or disasters.
- For example, in the manufacturing of drugs, the chemicals used must be measured accurately.

## Some measuring instruments:

- There are different types of measuring instruments and some of them are:

(1) What is the metre rule?

- This is used to measure the lengths of objects which are greater than 50cm.

(2) What is Calipers/ vernier calipers?

- This is used to measure the lengths of small objects where ordinary ruler cannot be used.

(3) What is the tape measure?

- This is used to measure long lengths, such as that of a football field.

(4) What is the micrometer screw gauge?

- This is used to measure small lengths or distances such as the diameter of a piece of wire.

(5) What is the lever or beam balance?

- This is used to determine the weight or the mass of an object.

(6) What is the measuring cylinder?

- This is used to pour out various volumes of a liquid.
- For example, it can be used to pour out 25$cm^3$ of water into a container.

(7) What is measuring flask and the pipette?

- This is used to determine a fixed pre-determined volume of a liquid, into a container.
- For example, if we want to get 50$cm^3$ of water into a container, then we have to use the 50$cm^3$ capacity measuring flasks or the 50$cm^3$ capacity pipette.

(8) What is the burette?

- This can be used to run off any volume of liquid, to any required volume.
- It consists of a tap which when opened causes the liquid in the burette to run out, until the required volume of liquid within the burette is had.

## Some quantities and their units of measurement:

- The units used for certain quantities are as follows:

(1) Length ..... Metres (m).
(2) Mass ..... Kilogram (kg).
(3) Temperature ..... degree celcius ($^0$C) or degrees kelvin ($^0$k).
(4) Current .....Amperes (A).
(5) Area ..... Metre squared ($m^2$).
(6) Volume ..... Metre cubed ($m^3$).
(7) Speed ..... Kilometre per hour (km/h), or metre per second (m/s).

(8) Density ..... Kilogram per metre cubed ($kg/m^3$) or gram per centimetre cubed ($g/cm^3$).
(9) Velocity/ speed ..... metres per second (m/s) or kilometer per hour (km/h).
(10) Acceleration .....Metres per second squared ($m/s^2$).
(11) Force ..... Newtons (N).
(12) Mass ..... kilogram (kg).
(13) Weight ..... Newtons (N).

# Chapter six

## Pressure:

### Calculating Pressure:

(Q1) Calculate the pressure exerted by a block of area 100$m^2$, if it has a weight of 40kg. Take 'g' or acceleration due to gravity = 10$m/s^2$.

Soln:

Pressure = $\frac{Force}{Area}$

N/B: To get the force, we must multiply the weight or mass in kg by 'g' or the acceleration due to gravity, i.e 10$m/s^2$.

Since weight = 40kg,

=>force = 40 x 10 = 400N.

Area = 100$m^2$

But Pressure = $\frac{Force}{Area}$

∴Pressure = $\frac{400}{100} = 4.$

=>P = 4$NM^{-2}$.

(Q2)The area of a bottle is 50$m^2$. If it has a mass of 20kg, calculate the pressure that it will exert on top of a table.

Soln:

Since mass = 20kg,

=>force = 20 x 10 = 200N.

Area = 50$m^2$.

But Pressure = $\frac{Force}{Area} = \frac{200}{50} = 4,$

=> pressure = 4pascal.

N/B: If the mass or weight is given in grams, it must be converted into kg (kilogram).

(Q3)A rectangular block of length 18m and breadth 10m, lies on the surface of the floor. Calculate the pressure that will exert on the surface of the floor, if it has a mass of 4000g.

Soln:

Mass = 4000g = $\frac{4000}{1000} = 4kg,$

i.e divide the mass in grams by 1000 to convert it into kg.

Since mass = 4kg, then force = 4 x 10 = 40N.

Area of rectangle = Length x Breadth.

∴ Area of the rectangle = 180 x 10 = 180$m^2$.

Pressure = $\frac{Force}{Area} = \frac{40}{180} = 0.2,$

=>pressure = 0.2p

(Q4)A rectangular box of length 20m and breadth 10m, lies on a table. If it has a weight of 8000g, calculate the pressure which it will exert on the table.

(Take 'g' = 10$ms^{-2}$).

Soln:

Since area of rectangular block = length x breadth,

=>area = 20 x 10 = 200$m.^2$

Weight = 8000g = $\frac{8000}{1000} = 8kg.$

Force = 8 x 10 = 80N.

Pressure = $\frac{Force}{Area} = \frac{80}{200} = 0.4$.

∴ Pressure = $0.4NM^{-2}$.

(Q4)A square box of side or length 5m, lies on a table. If it has a mass of 25kg, find the pressure it will exert on the table.

Soln:

Length or side of box = 5m.

Area of square box = length squared = $5^2 = 25m^2$.

Mass = 25kg.

Force = 25 x 10 = 250N.

Pressure = $\frac{Force}{Area}$

= $\frac{250}{25} = 10NM^{-2}$.

N/B: Area of a square is also given by breadth squared i.e. $B^2$.

(Q5)A block which is in the shape of a square of breadth or length 2m has a mass of 8000g. Find the force it exerts on the ground as it lies there.

Soln:

Breadth of the block = 2m.

Area of square block = Breadth squared or length square = $2^2 = 4m^2$.

Mass = 800g = $\frac{8000}{1000} = 8kg$.

Force = 8 x 10 = 80N.

Pressure = $\frac{Force}{Area} = \frac{80}{4} = 2p.$

N/B: If the mass or weight is given in Newtons (N), then it is force and as such we must not convert it.

(Q6) The weight of a box is 40N. If it has an area of $20m^2$, calculate the pressure it will exert if it lies on a table.

Soln:

Weight = 40N. (i.e Force).

Area = $20m^2$.

Pressure = $\frac{Force}{Area} = \frac{40}{20} = 2N/M^2$.

(Q7) A rectangular box has a length of 5m and a breadth of 4m. If it has a mass of 80N, calculate the pressure it will exert on a table that it is placed.

Soln:

Area of rectangular block

= L x B = 5 x 4 = $20m^2$

Weight = force = 80N. (Since it is in newtons).

Pressure = $\frac{force}{Area} = \frac{80}{20} = 4p.$

(Q8) The mass of a pen is 20N. If it has an area of $4m^2$, calculate the pressure it will exert on its support.

Soln:

Mass = 20N => force = 20N.

Area = $4m^2$.

Pressure = $\frac{force}{Area} = \frac{20}{4} = 5p.$

(Q9) A chalk box of dimension 5m by 4m exerts a force of 200N. Calculate the pressure it will exert.

Soln:

L = 5m, B = 4m.

Area = L x B = 5 x 4 = $20m^2$

Force = 200N.

Pressure = $\frac{Force}{Area} = \frac{200}{20} = 10N/m^{-2}$.

(Q10)The pressure exerted by an object is $4N/m^2$. If the force exerted is 80N, calculate the area of this object.

Soln:

P = $4N/m^2$

F = 80N

A = ?

But since A = $\frac{F}{A} => 4 = \frac{80}{A}$

=>4A = 80 => A = $\frac{80}{4} = 20.$

Area = $20m^2$.

(Q11) The pressure exerted by an object is $5Nm^{—2}$. If its surface area is $20m^2$, calculate the force exerted by this object.

Soln:

P = 5N, A = $20m^2$, F = ?

But F = P x A = 5(20) = 100N.

(Q12) The pressure exerted by a block of length 10m and breadth 8m is 10p. Calculate the force.

Soln:

P = 10p.

A = L x B = 10 x 8 = $80m^2$

F = ?

But since P = $\frac{F}{A} => 10 = \frac{F}{8}$,

=>F = 8 x 10 = 80,

=>force = 80N.

$\frac{N}{B}$: $Weight$ (in kg) = $\frac{Force}{'g'}$, where 'g' = acceleration due to gravity.

(Q13) An object exerts a pressure of $40N/m^2$. If it has an area of $10m^2$, calculate

(i) the force.

(ii) the weight.

Soln:

P = $40N/m^2$, A = $10m^2$, F = ?

But since P = $\frac{F}{A} => 40 = \frac{F}{10}$,

=>F = 40 x 10 = 400,

=>F = 400N.

(ii)Weight = $\frac{Force}{'g'} = \frac{400}{10} = 40$, => weight = 40kg.

(Q1)(a) Define pressure.

(b)Two cements blocks each of weight 5kg, and of surface areas $8m^2$ and $2m^2$ respectively lie on the ground. Which of them will exert a greater pressure on the ground.

Ans: The one with the smaller surface, because the smaller the surface area, the greater becomes the pressure.

(Q2)A block of weight 30kg and whose surface area is $80m^2$ lies on the ground. Determine the pressure it exerts on the ground. [Take 'g' = $10m/s^2$].

Ans: $3.8Nm^{-2}$.

(Q3)A wooden box of mass 3000g and whose surface area is $50m^2$, is placed on a table. By taking g = $10m/s^2$, calculate the pressure that it will exert on the table.

Ans: $0.6Nm^{-2}$.

(Q4) A rectangular wooden block of length 12m and breadth 10m lies on a box. Calculate the pressure it exerts on the box if

a) it has a mass of 0.7kg.

Ans: 0.06p

(b) it has a mass of 2000g.

Ans: 0.17p.

(Q4) A rectangular shaped object has a length of 20m and a breadth of 10m. If it exerts a pressure of $0.4Nm^{-2}$ on a table on which it rests, determine

(a) the force.

Ans: 80N.

(b) the weight of the object.

Ans: 8kg.

[Take 'g' = $10ms^{-2}$].

(Q5) A square box of length 6m rests on the ground. If it has a mass of 72kg, how much pressure will it exert on the ground?

[Take g = $10ms^{-2}$].

Ans: $20Nm^{-2}$.

(Q6) A square metallic money save has a mass of 9kg, and exerts a pressure of $10Nm^{-2}$. By taking 'g' =$10m/s^2$,

(a) Calculate the force.

Ans: 90N.

(B) the length of the save.

Ans: 3m.

(Q7) A box has a weight of 80N and a surface area of $20m^2$. Calculate the pressurethat will exert on the ground. [Take g = $10m/s^2$].

Ans: $4Nm^{-2}$.

(Q8) A rectangular wooden constructed box, has a length of 10m and a width of 80m. If it has a mass of 100N, calculate the pressure that it exerts on the ground. [Tae g = $10m/s^2$].

Ans: $1.3Nm^{-2}$.

(Q9) A metallic box of dimension 20m by 16m exerts a force of 400N. (a) calculate the pressure that it exerts.

Ans: $1.3Nm^{-2}$.

(b) Determine the weight of the box. Ans: 40kg.[Take g = $10ms^{-2}$].

(Q10)The pressure exerted by an object is 40N/$m^2$. If it exerts a force of 1200N, calculate the area of this object.

Ans: 30$m^2$.

(Q11) The pressure exerted by a square block of length 10m is 8p. By taking 'g' = 10$ms^{-2}$, calculate

(a)the force. Ans: 800N.

(b)the weight. Ans: 80kg.

(Q12)With the aid of a diagram, briefly explain how you will show that the pressure within a liquid increases with depth.

(Q13) Describe an experiment to show that within a liquid, the pressure acts in all direction.

# Chapter Seven

## Density:

(Q1) A lump of metal has a weight of 72g and a volume of $20cm^3$. Find its density.

Soln:

Density = $\frac{Mass}{Volume}$

= $\frac{72}{20}$ = $3.6gcm^{-3}$.

(Q2) A piece of gold has a density of $5g/cm^3$ and a volume of $15cm^3$. Calculate its mass.

Soln:

Since density = $\frac{Mass}{Volume}$, =>

mass = density x volume,

=>mass = 5 x 15 = 75g.

(Q3) A piece of stone weighs 60g. When it was put into a measuring cylinder containing water, the water level rose from the $55cm^3$ mark to the $75cm^3$ mark. Find the density of the stone.

Soln:

Initial volume of water = $55cm^3$.

Volume of water after the immersion of the stone = $75cm^3$.

Volume of stone = 75 – 55 = $20cm^3$.

Mass of stone = 60g.

Density o stone = $\frac{Mass}{Volume}$, = $\frac{60}{20}$ = $3gcm^{-3}$.

(Q4) A cuboid made of silver has a weight of 200g. It has a length of 8cm, breadth of 4cm and a height of 2cm. determine its density.

Soln:

Volume of cuboid = L x B x H

= 8 x 4 x 2 = $64cm^2$.

Mass of cuboid = 200g.

Density = $\frac{Mass}{Vollume} = \frac{200}{64}$

= 3.1g/cm$^3$.

(Q5) An aluminum cube of side 5cm has a mass of 0.05kg. Find its density.

N/B: Since the length or the side of the cube is given in centimetres, then the mass in kilogram must be converted into grams.

Soln:

Mass = 0.05kg

= 0.05 x 1000 = 50g.

Volume of cube = side cubed

= $5^3$ = 125cm$^3$.

Density = $\frac{Mass}{Volume=} = \frac{50}{125}$

= 0.4gcm$^{-3}$.

(Q1)(a) Define density.

Ans: The density of a body is its mass divided by its volume.

(c) Explain why a piece of wood, when pushed to the bottom of a bucket containing water and then released, rose to rest on the surface of the water.

Ans: Because the density of the wood is less than that of water.

(d) A piece of metal when dropped in a liquid sank to the bottom of the liquid. Explain why this is so.

Ans: Because the density of the metal is greater than that of the liquid.

(Q2)Briefly explain how you will determine the density of cylindrically shaped metal.

Ans;

- Determine its mass using the weighing machine.
- Measure its dimensions so as to be able to determine its volume.
- Divide the mass by the volume to get the density.

(Q3) How will you determine the density of a piece of rock?

Ans:

- Find the mass of the rock using a weighing machine.
- Put water into a measuring cylinder and note the volume of the water within the cylinder.
- By means of a thread, immerse the rock into the water and note the new volume.
- Determine the difference between these two volumes, which is the volume of the rock.
- Divide the mass by this volume to get the density.

(Q4) A piece of metal of density 3g/$cm^3$ was placed into a measuring cylinder. If the level of the water rose from the 80$cm^3$ mark to the 100$cm^3$ mark, find the mass of the metal.

Ans: 60g.

(Q5) cuboid of mass 200g has a length of 8cm and a height of 2cm. If it has a density of 3.1g/$cm^3$, calculate its breadth.

Ans: 4cm.

(Q6) A man who weighs 60kg entered into a swimming pool, and noticed that his weight has decreased by 10kg. Why is this so?

Ans: Because the water exerted, an upward force called up-thrust on his body.

(Q7)Explain how a submarine can be made to sink deep down into the sea.

Ans:

- This can be done by drawing water into its ballast tanks, which causes an increase in its mass as well as an increase in its density.
- The density of the submarine therefore becomes greater than that of the sea water, causing it to sink into the sea.

# CHAPTER EIGHT

## QUESTIONS:

(1)(a) List two properties of metals

Ans:

- They have high melting points.
- They are lustrous.

(b) List three properties of non metals.

Ans:

- They are not malleable.
- They are poor conductors of heat and electricity.
- They have low densities.

(c) When is a metal said to be reactive?

Ans:

When it can easily react with oxygen, water or acid.

(d) Give one use of copper.

Ans:

Used in making electrical wire.

(2)(a) What are semi conductors?

Ans:

- They are a group or materials which are neither good conductors nor good insulators.
- Give one use of semi conductors.

Ans: They are used in making transistors.

( b) Explain what an alloy is .

Ans: It is what we get when two metals are combined together.

(c) Explain why pure metals are sometimes converted into alloys, before they are used.

Ans:

- Because these pure metals have certain bad properties or disadvantages.- These disadvantages are removed when these pure metals are converted into alloys.- (d) Give the main disadvantages associated with pure iron, and explain how this can be removed.Ans:The main disadvantage is that it rusts easily, and this can be removed by converting the iron into steel.

(Q3)(a) Explain why aluminum is not used for the making or construction of aircraft .

Ans: Because it is not strong enough for safety reasons.

(b) Why is it that duralumin is used for the construction of aircraft.

Ans: Because it is strong enough for safety reasons, but very light to make the aircraft move very fast.

(c) Give the composition of the following alloys:

(i) Solder. (ii) Brass. (iii) Bronze.

Ans :

- (i) Solder……tin and lead.
- (ii) Brass……copper and zinc.
- (iii) Bronze ……copper and tin.

(d) Give two conditions which are needed to enable iron to rust.

- Ans: These conditions are the presence of water and oxygen.

(e) List three methods used to prevent rusting.

Ans:

- These methods are:

(i) Painting.
(ii) Greasing.
(iii) Plating.

(f) Explain why painting or greasing prevents the rusting of metals.

Ans: Before rusting occurs, the surface of the metal must come into contact with water and air. - But by painting or greasing the metal's surface, water or air cannot come into contact with it.- For example when a metal such as iron is painted or covered with grease, corrosion or rusting does not occur, since the paint or the grease will prevent air, moisture or water from coming into contact with the iron (metal).

<u>PLATING:</u>

- This is the process in which a light coat of one metal is used to cover another metal.- Plating a metal which corrodes with another metal can also prevent corrosion or rusting.

# CHAPTER NINE

## WORK, ENERGY AND MACHINES:

- Work is done when an applied force moves through a distance, in the direction of the force.
- In science work is only done if there is movement of the applied force.
- For this reason, a man pulling a track does work, but a man who carries a load and stands at a place does no work.
- Work = Force x distance orwork = mgh,

Where m = mass of the object.

g =acceleration due to gravity.

h =height of the object above the ground.

(Q1) Find the work done when a force of 20N, pulls a block through a distance of 5m.

Soln

Force =20N.

Distance =5m.

Work done=Force xdistance.

Work done= 20 x 5 = 100J.

(Q2) Calculate the work done when a force of 2.5N moves through a distance of 4m.

Soln

Force = 2.5N.

Distance = 4m.

Work done = Force x distance = 2.5 x 4 = 10J.

NB: If the weight or mass is given in kg, it must be changed into force by multiplying by 'g' or the acceleration due to gravity i.e 10m/$s^2$.

(Q3) Calculate the work done when a body of mass 5kg moves through a distance of 10m.

Soln

Mass = 5kg.

Force = 5 x 10 = 50N.

Distance = 10m.

Work = Force x distance

= 50 x 10 = 500J.

(Q4) Calculate the work done when a body of weight 0.5kg, moves through a distance of 20m.

Soln

Weight = 0.5kg.

Force = 0.5 x 10 = 5N.

Distance = 20m.

Work done = Force x distance = 5 x 20 = 100J.

NB: If weight is given in grams, it must first be converted to kg by dividing by 1000.

(Q5) A body of mass 400g moves through a distance of 20m. Find the work done.

Mass =400g = 400/1000 = 0.4kg.

Force = 0.4 x 10 = 4N.

Work done = Force x distance

= 4 x 20 = 80J.

(Q6) A table of mass 6000g is moved through a distance of 4m. Calculate the work done.

Soln:

Mass = 6000g = 6000/1000 = 6kg.

Since force = mass x 'g,'

then force = 6 x 10 = 60N.

Distance = 4m.

Work done = Force x distance

= 60 x 4 = 240J.

NB: If the distance is given in cm, we must change it into metres by dividing by 100.

(Q7) A block of mass 5kg moves through a distance of 300cm. Calculate the work done.

Soln:

Mass = 5kg.

Force = 5 x 10 = 50N.

Distance = 300cm = 300/100 = 3m.

Work done = force x distance

= 50 x 3 = 150J.

(Q8) The distance moved by a force of 50N is 800cm. Find the work done.

Soln:

Distance = 800cm = 800/100 = 8m.

Force = 50N.

Work done = Force x distance

= 50 x 8 = 400J.

(Q9) A body of mass 600g moved through a distance of 200cm. Find the work done.

Soln:

Mass = 600g = 600/1000= 0.6kg.

Force = 0.6 x 10 = 6N.

Distance = 200cm = 200/100 = 2m.

Work done = Force x distance = 6 x 2 = 12J.

(Q10) Find the distance travelled by a force of 50N, if it does a work of 200J.

Soln:

Force = 50N.

Work done = 200J.

Distance = ?

Since work done = force x distance,

Then 200 = 50 x distance, and dividing through using 50 =>

200/50 = 50 x distance/50, =>

Distance = 4m.

(Q11) Find the distance moved by a force of 10N, if it did work of 50J.

Force = 10N.

Work done = 50J.

Distance =?

Since work done = force x distance, then

50 = 10 x distance, and dividing through using 10 =>

50/10 = 10 x distance/10,

=>5 = distance, =>

Distance = 5m.

(Q12) Find the distance travelled by a body of weight 5kg, if the work done = 200J.

Soln:

Weight = 5kg.

Force = 5 x 10 = 50N.

Work done = 200J.

Distance =?

Since work = force x distance,

then 200 = 50x distance.

200/50 = 50 x distance/50.

Distance = 4m.

(Q13) Calculate the distance moved by a body of mass 7000g, if the work done is 3500J.

Soln:

Mass = 7000g = 7000/1000 = 7kg.

Force = 7 x 10 = 70N.

Since work done = force x distance,

then 3500 = 70 x distance,

=>3500/70 = 70 x distance/70,

=> distance = 50m.

NB: When force is divided by acceleration due to gravity i.e. 'g' or $10m/s^2$, we get weight.

(Q14) A body moved a distance of 10m and did a work of value 4000J. Calculate

(a) the force.
(b) the weight.

Soln:

(a) Distance = 10m.

Work done = 4000J.

Since work done = force x distance, then

4000 = force x 10, =>

4000/10 = force x 10/10,

=> force = 400N.

(b)Weight = force/'g' = 400/10 = 40,

=> weight = 40kg.

(Q15) Calculate the work done by man of mass 70kg, if he climbs a tree 5m high.

[Take g = 10m/$s^2$]

.

Soln:

Mass = 70kg.

Force = 70 x 10 = 700N.

Distance = 5m.

Since work done = force x distance,

then work done = 700 x 5 = 3500J.

(Q16) A man of weight 500g climbs a mountain, which is 20m high. Calculate the work done.

Soln:

Weight= 500g = 500/1000 = 0.5kg.

Force = 0.5 x 10 = 5N.

Distance = 20m.

Work done = force x distance

= 5 x 20 = 100J.

(Q17) A man of 500g is moved up a pole which is 700cm long. Find the work done

Soln:

Weight = 500g = 500/1000 = 0.5kg.

Force = 0.5 x10= 5N.

Distance = 700cm = 700/100 = 7m.

Work done = force x distance = 5 x 7 = 35J.

(Q18) A simple machine is used to lift a load through a height of 5.0m. If the force exerted by the machine is 200N, calculate the work done by the machine.

Soln:

Distance = 5.0m = 5m.

Force= 200N.

Work done = Force x Distance

= 200 x 5 = 1000J.

(Q19) Calculate the work done by a man of mass 65kg, if he climbs a ladder which is 4m high

Soln:

Force = 65 x 10 = 650N.

Distance moved = 4m.

Work done= 650 x 4 =2600J.

NB: If the weight or the mass is given in Newtons, then it is force.

We must therefore not multiply it by 'g' or acceleration due to gravity.

(Q20) The weight of a bag of cement is 40g. If it moved through a distance of 2m, calculate the work done.

Soln:

Weight = 40g.

Distance moved= 2m.

Work done = 40 x 2 = 80J.

(Q21) If the work done in moving a bag of rice of weight 500N is 1000J, calculate the horizontal distance moved.

Soln:

Since weight = 500N, =>

force = 500N.
Since work done = force x distance,

then 1000 = 500 x distance,

=>1000/500 = 500 x distance/500,

=> distance = 2m.

(Q22) An object of mass 2kg was lifted vertically upwards through a distance of 5m. Calculate the work done. [Take 'g' = 10m/$s^2$].

Soln:

Mass = 2kg.

Height above the ground, h = 5m.

g= 10m/$s^2$.

Work done = mgh = 2 x 10 x 5 = 100J.

(Q23) A man of mass 1kg was lifted 4m above the ground. Calculate the work done. [Take 'g' = 9.8m/$s^2$]

Soln:

m = 1kg.

h= 4m.

g= 9.8m/$s^2$.

Work done = mgh

= 1 x 4 x 9.8 = 39.2J.

(Q24) Calculate the work done when a body of mass 500g, is lifted through a distance of 2m above the ground. [Take 'g' = 10m/$s^2$]

Soln:

Mass = 500g = 500/1000 = 0.5kg.

h = 2m and g = 10m/$s^2$.

Work done = mgh = 0.5 x 10 x 2 = 10J.

(Q25) The work done by lifting a stone to a height of 1m above the ground is 50J. Taking 'g' = 10m/$s^2$, find the mass of the stone.

Soln:

Since work done = mgh,

then 50 = m x 10 x 1, =>

50 = 10m, =>m = 50/10 = 5.

Mass = 5kg.

(Q26) Calculate the work done when a stone of weight 2kg is lifted 300cm above the surface of the earth, and allowed to fall to the ground. [Take g = $10m/s^2$]

Soln:

m = 2kg, h=300cm = 300/100 = 3m.

g= $10m/s^2$.

Work done =mgh = 2 x 10 x 3 = 60J.

POWER:

- This is define as the rate of doing work.

- Power = $\frac{\text{work done.}}{\text{Time taken.}}$

-The unit of power is J/s {i.e joules per second} or watt {w}.

(Q1) The work done by a body by moving up a staircase is 2,400J. If the time taken to move up the staircase is 10 seconds, calculate the power.

Soln:

Work done = 2,400J.

Time = 10 seconds.

Power = work done= 2,400

Time taken 10

= 240J/s or 240w

(Q2) It takes a man 9 seconds to move an object of weight 30N through a distance of 3m. Calculate the power.

Soln:

Weight = 30N, andsince weight is given in Newtons, then it is force.

Force= 30N.

Distance = 3m. Time = 9 seconds.

Work done = force x distance

= 30 x 3 = 90J.

Power = Work done = 90

Time 9

= 10, => Power = 10w.

(Q3) A body of weight 40kg is pushed through a distance of 5m, within a time interval of 2 minutes. Calculate the power.

Soln:

Weight = 40kg.

Force = 40 x 10 = 400N.

Distance = 5m.

Work done = force x distance = 400 x 5 = 2000J.

Time = 2 minutes = 2 x 60 = 120 seconds.

Power = $\frac{work\ done}{Time}$

= $\frac{2000}{120} = 16.6\ \mathrm{W}$.

N/B: If the time is in minutes, convert it first into seconds by multiplying by 60.

(Q1) A mango on top of a tree falls to the ground. Give the energy transformation which occurs.

Soln:

- The mango on the tree possesses potential energy, which is converted into kinetic energy as it falls to the ground.
- When the mango hits the ground, this kinetic energy is changed into sound energy.
- The energy transformation is P.e -> K.e -> Sound energy.

(Q2) A car battery is used to light the bulb of a car. Give the energy transformation which occurs.

Soln:

- The chemical energy within the battery will first be converted into electrical energy, which will be later on converted into the heat energy needed to heat the bulb in order to produce light.

- The energy transformation is chemical energy -> electrical energy -> heat energy -> light energy.

(Q3) A man kicks a football. Give the energy transformation which occurs.

Soln:

- Initially the energy within the man which is chemical energy had from the food eaten, will be changed into kinetic energy as the man kicks the ball.
- This kinetic energy will be converted into the sound heard as the ball is kicked.
- The energy transformation therefore is chemical energy -> kinetic energy -> sound energy.

(Q4) Give the energy transformation which occurs when water behind a dam is used to produce electricity.

Soln:

- Water behind the top part of the dam, which has been raised above the ground and as such possesses potential energy, is made to rotate the turbines of the generator which is associated with kinetic energy.
- As the turbine rotates, electricity is produced since the kinetic energy will be converted into electrical energy.
- This electrical energy will be converted into the heat energy, needed to heat the filament of the bulb in order to produce to the light.
- The energy transformation therefore is P.e -> K.e -> electrical energy -> heat energy -> light energy.

(Q5) A boy throws a ball to hit a wall. Give the energy transformation which occurs.

Soln:

- As the boy throws the ball, the chemical energy within his body had from the food eaten, will be converted into kinetic energy.
- As the ball hits the wall, sound is produced and as such the kinetic energy has been converted into sound energy.
- The energy transformation is chemical energy -> kinetic energy -> sound energy.

(Q6) A torch light is switched on. Give the energy transformation which occurs.

Soln:

- First the chemical energy within the cells or battery within the torch light, will be converted into the electrical energy used to heat the filament of the bulb of the torch light to produce light.
- The energy transformation is chemical energy -> electrical energy -> heat energy -> light energy.

(Q7) List five uses of solar energy.

Ans: - Needed for photosynthesis.

- Production of light.
- Production of electricity.
- For drying purposes, e.g. to dry food.
- Used by animals for seeing during the body.

ENERGY SOURCE AND INTER-CONVERSION:

- Even though there are different forms of energy, they can be classified into two main forms and these are kinetic energy and potential energy.

## Kinetic Energy (K.E):

Is the energy possessed by a moving body?

K.E = ½ $mv^2$, where K.E= kinetic energy of a moving body,

m =the mass of the object or body in kg and v=the velocity or speed of the body.

(Q1) A body of mass 2kg moves with a velocity of 10m/s.Find its kinetic energy.

Soln:

m = 2kg.

v= 10m/s.

K.E = ½ $mv^2$= ½ x 2 x $10^2$= 100J.

(Q2) The kinetic energy possessed by a moving ball is 20J. If the mass of the ball is 10kg, calculate its speed.

Soln:

K.E = 20J.

m = 10kg and v=?

Since k.e= ½ $mv^2$,

then 20 = ½ x10 x $v^2$,

=>20 = 5$v^2$, =>$v^2$=20/5 = 4,

$=>v^2=4$, $=>v = 2$ (i.e find the square

root of 4).

(Q3) A block of mass 2000g moves with a speed of 5m/s. Find its kinetic energy.

Soln:

m = 2000g = 2000/1000 = 2kg.

v= 5m/s.

K.E = ½ $mv^2$= ½ x 2 x $5^2$= ½ x 2 x 25J = 25J.

POTENTIAL ENERGY (P.E):

Is the energy possessed by a body by virtue of its position above the earth's surface?

- Therefore every body or object which is raised above the surface of the earth, possesses potential energy.- P.E = mgh, where m= mass of object in kg, h= height of object above the ground and 'g'=10m/$s^2$.

(Q1) Find the potential energy possessed by a block of mass 2kg, when it is raised 30m above the surface of the earth. [Take g= 10m/$s^2$].

Soln:

m = 2kg, g= 10m/$s^2$ and h= 30m.

P.E = mgh = 2 x 10 x 30 = 600J.

(Q2) A mango of mass 500g hangs on the top of a tree, and it is 20m above the surface of the ground. Find the energy it has.

NB: Because the mango is above the surface of the earth, it possesses potential energy.

Soln:

m = 500g = 500/1000 = 0.5kg.

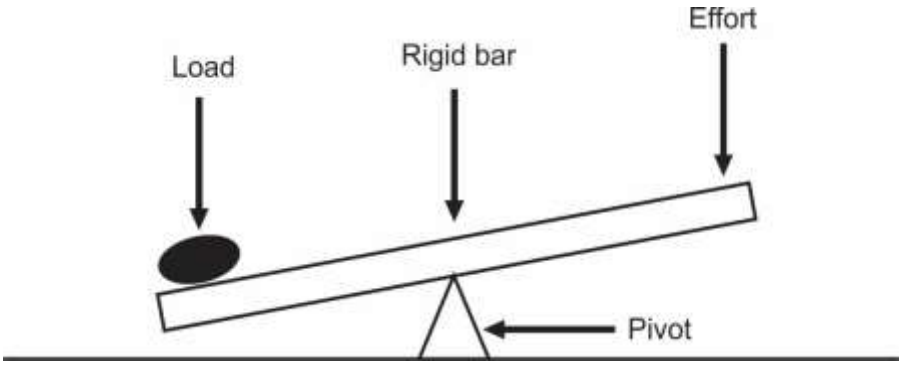
h= 20m and g = 10m/$s^2$.

P.e= mgh = 0.5 x 10 x 20 = 100J.

## MACHINES:

A machine is a device which enables work to be done easily. By means of a machine, a small force (effort), which is applied at one end can be used to overcome a large force (load) at another end. A machine does work by taking in energy at one end, and feeding it out at another end, possibly in another form. The work done by the machine is the amount of energy transferred or converted.

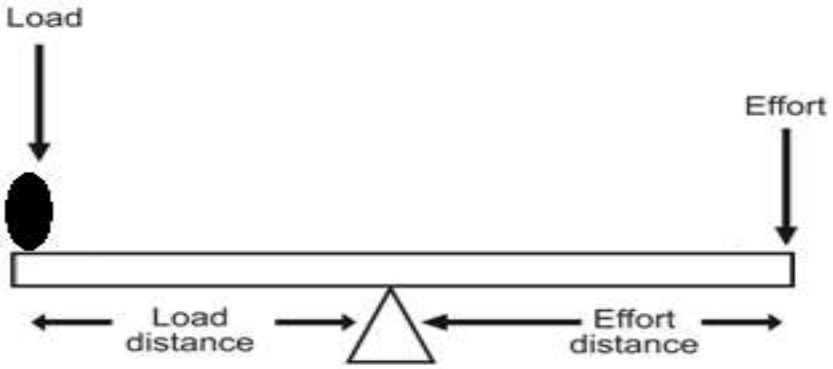
### SIMPLE MACHINE (THE LEVER):




- The lever is a rigid straight bar, which an immovable point has called the pivot or the fulcrum.
- The force which is applied to the lever (machine) is called the effort, and the work or the force it overcomes is known as the load.

— In the lever, a small force applied at one point (effort) is used to overcome a great force or load at another point.

LOAD AND EFFORT DISTANCE:




— The effort distance is the distance between the effort and the pivot.
— The load distance is the distance between the load and the pivot.
— Examples of levers are crowbar, wheelbarrow, nut cracker, pincers and hammer.

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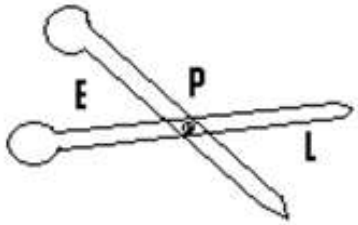
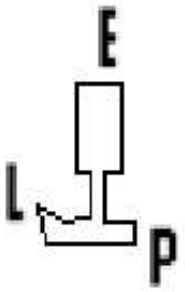
TYPES OF LEVERS:

— Levers are classified into three types and these are:

(i) First class levers.
(ii) Second class levers.
(iii) Third class levers.

FIRST CLASS LEVERS:



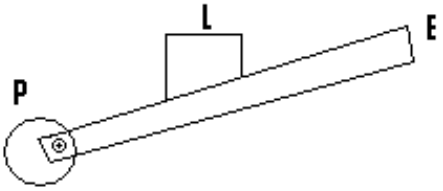




— In this type the pivot is between the load and the effort.
— Examples are the see-saw, scissors and the screw driver.
— The velocity ratio of the first class lever is greater than 1.

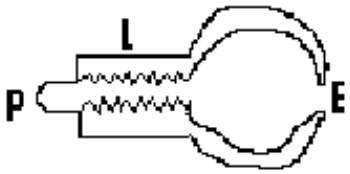
THE SECOND CLASS LEVER:

- In this type, the load is between the effort and the pivot.

- The velocity ratio of this type of lever is also greater than 1, and examples are the wheelbarrow, the nut cracker and the bottle opener.



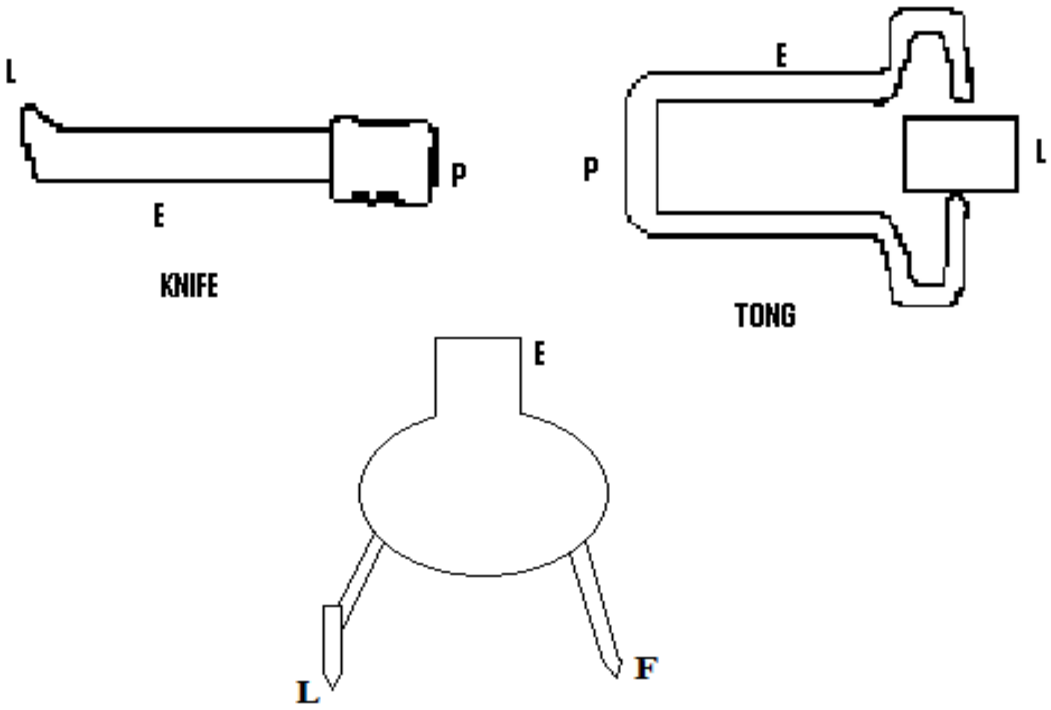

Wheel barrow




Nut cracker

THE THIRD CLASS LEVER:

- In this type, the effort is between the load and the pivot. .
- Examples are the knife, a pair of tong and a pair of compass.




THE VELOCITY RATIO (V.R):

— This is the distance moved by the effort to the distance moved by the load.

— V.R = Distance moved by effort
Distance moved by load

OR V.R= Effort distance

Load distance

(Q1) In using a simple machine, the effort moved through a distance of 150cm, and the load moved through a distance of 30cm.Find the velocity ratio.

Soln:

Effort distance = 150cm.

Load distance = 30cm.

V.R = Effort distance = 150 = 5

Load distance 30

NB: V.R has no units

(Q2) An effort applied at the end of a stick travelled through a distance of 6m, while the load moved through a distance of 2m. Calculate the V.R.

Soln:

Distance travelled by effort = 6m.

Distance travelled by load = 2m.

V.R = Dist. travelled by effort

Dist. travelled by load

V.R = 6/3 = 2.

(Q3) An effort which was applied at a distance of 10m away from the pivot of a machine, moved through a distance of 20m while the load moved a distance of 5m. Find the V.R.

Soln:

V.R = Dist. moved by effort = 20 = 4.

Dist. moved by load 5

(Q4) The velocity ratio of a simple machine is 10. If the effort travels through a distance of 20m, calculate the distance travelled by the load.

Soln:

V.R = 10.

Dist. travelled by effort = 20m.

Dist. travelled by load =?

Since V.R = Dist. travelled by effort

Dist. travelled by load

=>10 = 20

Dist. travelled by load

=>10 x Dist. travelled by load = 20,

=>Dist. travelled by load = 20 = 2m.

10

(Q5) The velocity ratio of a machine is 20. What distance does the effort travels, if the load moves through a distance of 5m.

Soln:

V.R =

Dist. travelled by load = 5m.

Dist. travelled by effort = ?

Since V.R = Dist. travelled by effort

Dist. travelled by load

then 20 = Dist. travelled by effort

5

=>20 x 5 = Dist. travelled by effort.

Dist. travelled by effort = 100m.

MECHANICAL ADVANTAGE (M.A):

This is given by the ratio of the load to the effort.

i.e M.A = $\frac{\text{Load}}{\text{Effort}}$

(Q1) An effort of 10N was applied to raise a stone of mass 20N. Calculate the mechanical advantage.

Soln:

Effort = 10N.

Load = 20N.

M.A = $\frac{\text{load}}{\text{Effort}} = \frac{20}{10} = 2.$

(Q2) A force of 20N was applied at one end of a crowbar to over come a force of 80N. Find the mechanical advantage.

Soln:

Effort = 20 and Load = 80N.

M.A = $\frac{\text{Load}}{\text{Effort}} = \frac{80}{20} = 4.$

(Q3) A simple machine has a mechanical advantage of 10. What effort will be needed in order to raise a load of 20N?

Soln:

M.A = 10.

Load = 20N.

Effort =?

Since M.A = Load , then 10 = 20

Effort Effort

=>10 x effort = 20,

=>Effort = 20 = 2N.

10

(Q4) The M.A of a lever is 5. If the effort applied is 20N, calculate the load.

Soln:

M.A = 5.

Effort = 20.

Load =?

Since M.A = Load,

Effort

then 5 = Load,

20

=> Load = 5 x 20 = 100N.

NB: If the load is given in kg, then it must be changed into Newton.

(Q5) Find the mechanical advantage of a machine, if a force of 20N applied at one end was used to overcome a load of 9kg.

Soln:

M.A =?

Effort = 20N.

Load = 9kg = 9 x 10 = 90N.

M.A = Load = 90 = 4.5.

Effort 20

EFFICIENCY OF A MACHINE:

— The efficiency of a machine is the ratio of its work output to its work input.
— Efficiency = work output x 100
Work input

or Efficiency = useful energy output x 100%

Energy input

- Efficiency is usually expressed as a percentage.The efficiency of a machine can never be 100%, because part of the work input is used to overcome friction between the moving parts of the machine, and becomes wasted as heat. Part of the energy input is also wasted in the raising of the moving parts of the machine. By reducing friction in a machine, its efficiency improves and this saves energy.

(Q1) A machine needs 100J of energy to produce an output of 80J. Calculate the efficiency.

Soln:

Work output = 80J.

Work input = 100J.

Efficiency = work output x 100

Work input

= 80 x 100 = 80%.

100

(Q2) A man operating a machine puts in 60J of energy and gets an output of 50J of energy. Calculate the efficiency.

Soln:

Work output = 50J.

Work input = 60J.

Efficiency = work output x 100

work input

= 50 x 100 = 83.3%.

60

(Q3) The efficiency of a machine is 40%. If the output is 12J, find the work input.

Soln:

Efficiency = 40% = 0.4.

Output = 12J, input=?

Efficiency = Output

Input

=> 0.4 = 12

Input

=> 0.4 x input = 12,

=> Input = 12 = 30J.

0.4

NB: If we convert the efficiency from percentages into decimals, then we can use the formula:

Efficiency = Output

Input

(Q4) The efficiency of a machine is 60%. Calculate

(a) the work done by the machine, if the energy input is 540J.
(b) the amount of energy needed by the machine to do 90J of work.

Soln:

a).Efficiency = 60% = 0.6.

Input = 540J.

Output =?

Since efficiency = output, then 0.6 = output => output = 0.6 x 540 = 324J.

Input 540

b. NB: The amount of energy needed by the machine is equal to the work input.

The work done or to be done is the work output.

Efficiency = 0.6.

Output = 90J, input =?

Since efficiency = output

input

then 0.6 = 90 => 0.6 x input = 90,

input

=> input = 90 =150J.

0.6

(Q5) In a machine, 200J of energy was obtained or wasted as heat. If the input energy is 600J, calculate the efficiency of the machine.

Soln:

Input = 600J.

Output = 600 — 200 = 400J.

Efficiency = work output x 100

Work input

= 400 x 100 = 66.7%.

600

NB: In a machine the energy lost or wasted = input — output,

=> energy lost + output = input.

(Q6) In a machine 20J of energy appears as heat. If the machine was used to overcome or do a work of 60J, calculate the efficiency.

Soln:

Energy wasted = 20J.

Output energy = 60.

Input energy = energy lost + output energy = 20 + 60 = 80J.

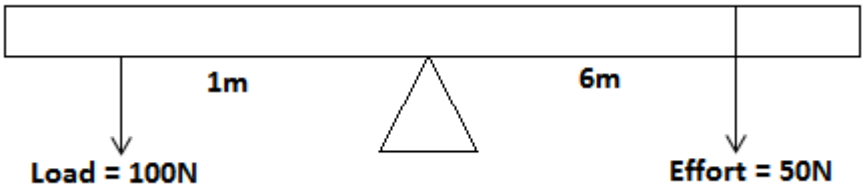
Efficiency = Output x 100

Input

= 60 x 100 = 75%.

80

(Q7)




Calculate the efficiency of the given lever.

Soln:

Work output = Load x Load distance

= 100 x 1 = 100J.

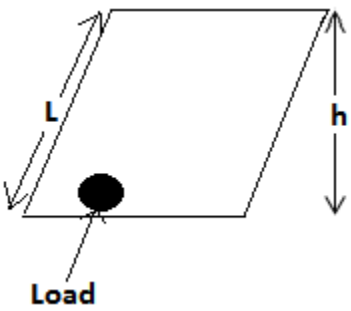
Work input = effort x effort distance

50 x 6 = 300J.

Efficiency = $\frac{Work\ output}{Work\ input}\ x\ 100$

= $\frac{100}{300}$ x $100 = 33.3\%$.

THE INCLINED PLANE:




— A heavy object can be raised more easily by pulling it along a sloping surface, than by lifting it vertically.
— Such a sloping surface is called an inclined plane.
— In order to raise the object to a height habove the ground, we must move it through a distance Lalong the inclined plane.
— It must be noted that the distance covered by the load is h and not Lin this case
— Work done on the load = work done by the effort i.e load x distance moved by the effort.
— The inclined plane can be used to raise a load from the ground into a truck.
— For an incline plane, V.R = distance moved by the effort = L
Distance moved by the load h

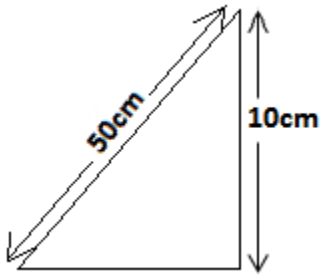
.

— Also for incline plane, M.A = distance moved by effort= L
Distance moved by load h

(Q1) A load was moved 50cm along an inclined plane. If it was raised from the ground by a distance of 10cm, calculate

(a) the velocity ratio.
(b) the mechanical advantage.

Soln:




L = 50cm and h = 10cm.

(a)V.R = $\frac{L}{h} = \frac{50}{10} = 5$.

(b)M.A = $\frac{L}{h} = \frac{50}{10} = 5$.

(Q2) An inclined plane has a mechanical advantage of 20. If the effort moves through a distance of 80m, calculate the distance moved by the load.

Soln:

M.A = 20, L= 80m and h= ?

From M.A = L/h =>20 = 80/h,

=>20h = 80,=>h = 80/20 = 4.

Distance moved through by the load = 4m.

(b) An inclined plane is classified as a machine because,

(I) it enables work to be done easier or faster.

(II) a heavy load can be overcome with a smaller effort by pushing it up the plane, than by lifting it directly upward.

(Q3) Calculate the velocity ratio of an inclined plane of length 16m, if it is 4m above the ground.

Soln:

L = 16m and h = 4m.

V.R = $\frac{L}{h} = \frac{16}{4} = 4.$

(Q4) Find the velocity ratio of an inclined plane of length 16m, if the height of the ground is 4m and the efficiency of the machine is 80%. Find also its mechanical advantage.

N/B: For an inclined plane,

V.R = $\frac{effort\ distance}{load\ distance} = \frac{L}{h}$.

Soln:

V.R = $\frac{L}{h} = \frac{16}{4} = 4.$

Efficiency = $\frac{M.A}{V.R}\ x\ 100\%$(N/B: when this formula is used, the efficiency must be in percentage but not in decimal).

Since efficiency = 80%, then 80% = $\frac{M.A}{V.R}\ \mathrm{x}\ 100$,

=> 80 = $\frac{M.A}{V.R}\mathrm{x}\ 100$, =>80 = $\frac{M.A}{4}\ \mathrm{x}\ 100$ => 80 = 25M.A,

=>M.A = $\frac{80}{25} = 3.2$ .

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## QUESTIONS

(1) (a) Define work.

(b)A man applied a force against a table which did not move. Explain why no work was done.

Ans: Because the point of application of the force did not move.

(Q2) A man pulled a bag with a force of 30N, through a distance of 20m. Calculate the work done.

Ans: 600J.

(Q3) A block of mass 15kg was moved through a distance of 2m. Calculate the work done.

Ans: 300J.

(Q4) A 5kg was moved through acertain distance. If the work done was 500J, determine this distance.

Ans: 10m.

(Q5) A body of mass 600g moved through a distance of 15m. Determine the work done.

Ans: 900J.

(Q6) A boy pulled a 12kg table through a distance of 400cm.Find the work done.

Ans: 480J.

(Q7) A bag of rice has a weight of 800g. A boy pulled a half bag rice through a distance of 700cm. Calculate the work done.

Ans: 56J.

(Q8) Find the work done by a force of 40N, which moved through a distance of 50m.

Ans: 2000J.

(Q9) Calculate the distance moved by a 20N force, if the work done was 800J.

Ans: 40cm.

(Q10) By moving through a distance of 5000cm, the work done by a force was 2000J. Calculate this force.

Ans: 40N.

(Q11) By pushing a box of nails through a distance of 20m, the amount of work done was 8000J. Determine

(a) the force.

Ans: 400N.

(b) the weight.

Ans: 40kg.

(Q12) A boy of weight 40kg climbed a 10m high pole to its top. By taking 'g' = 10m/$s^2$, calculate

(a) the work done.

Ans: 4000J.

(b) The potential energy possessed by the body.

Ans: 4000J.

(Q13) Determine the work done if a body of mass 200g is lifted through a distance of 3m. [Take 'g' = $10m/s^2$]

Ans: 6J.

(Q14) The work done by lifting a box to a height of 3m above the ground is 80J. Taking 'g' = $10m/s^2$, find the weight of the box.

Ans: 2.7kg

(Q15) The work done by a boy by climbing a staircase is 8000J. If he took 20 seconds to dose, determine the power.

Ans: 400J/s or 400w.

(Q16) A block of weight 30kg was pulled through a distance of 8m, within a time interval of 4 minutes. Calculate the power.

Ans: 10w or $10J/s^2$

(Q17) A block of mass 4kg moves with a speed of $20ms^{-1}$. Find its kinetic energy

Ans: 800J.

(Q18) A piece of metal has a mass of 5000g. If it moves with a speed of 6m/s, calculate its kinetic energy.

Ans: 90J.

(Q19) The energy possessed by a moving ball of mass 2kg is 64J. Determine its speed.

Ans: 8m/s.

(Q20) In a machine, an effort applied moved through a distance of 12m. If the load moved through a distance of 10m, determine the velocity ratio.

Ans: 1.2.

(Q21) The velocity ratio of a machine is 20. If the effort travels through a distance of 30m, find the distance moved by the load.

Ans: 1.5m.

(Q22) In a machine an effort of 20N was applied to raise an object of mass 50N. Find the mechanical advantage.

Ans: 2.5.

(Q23) The mechanical advantage of a machine is 5, and the effort needed to raise a load is 3N. Find the load.

Ans: 15N.

(Q24) In a machine an input of 140J of energy gave rise to an output of 70J of energy. Determine it efficiency.

Ans: 50%.

(Q25) The efficiency of a machine is 30%. If the work input is 60J, determine the output work.

Ans: 18J

(Q26) The output energy of a machine is 50J. If 10J of the input energy was wasted as heat, determine the efficiency of the machine.

Ans: 83%

(Q27) In a machine 60J of energy was wasted or used to overcome friction. If the machine was used to do a work of 80J, determine its efficiency.

Ans: 57% .

(Q28) Explain how machines save time and labour.

Ans:

- Machines make work easier and done faster.

Fewer people can do work in a shorter time when using a machine, than when doing the same work manually.

(Q29) State five uses of machines.

Ans:

- For cutting objects.
- For grinding vegetables.
- For lifting objects.
- For cracking nuts.
- For mixing ingredients.

(Q30)Give three reasons why the output energy of a machine is always less than the input energy.

Ans:

- This is because

(a) part of the input energy is used to overcome friction.
(b) part of the input energy is usedto overcome inertia.
(c) part of the input energy is used to overcome gravitational force.

(Q31)List three reasons why the efficiency of a machine is always less than 100%.

Ans:

- Because

(a) the input energy of a machine is always greater than the output energy.
(b) part of the input energy is used in overcoming friction.
(c) part of the input energy is used to overcome gravitational force.

# CHAPTER TEN

## Heat and temperature:

### What is heat?

- Is the type of energy which flows from the hot part to the cool part of a body.

### What is temperature?

- Is a number which tells us how hot or cold a body is.

### What are the sources of heat?

- The main sources of heat include some natural and sometimes artificial sources. These include:
- Solar energy.
- Fossil fuel.
- Hydroelectric power.
- Nuclear energy.
- Geothermal energy.
- Friction.

### What is a thermometer?

- This is a device used to measure temperature.

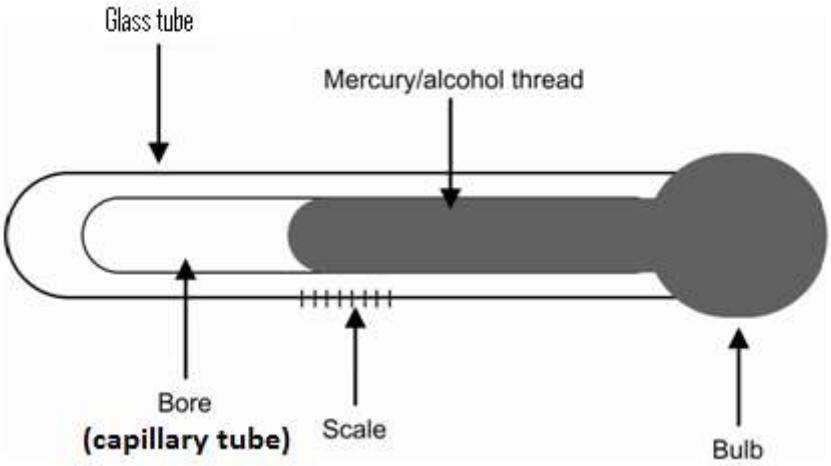
### Name the types of thermometers?

(1) Liquid in glass thermometer.
(2) Thermoelectric thermometer.
(3) Platinum resistance thermometer.

(4) Gas thermometer.
(5) Pyrometer.
(6) Digital thermometer.

## What is a Liquid in glass thermometer?

- These thermometers contain a liquid and there are two types. These are:
  (a) Mercury thermometer.
  (b) Alcohol thermometer.



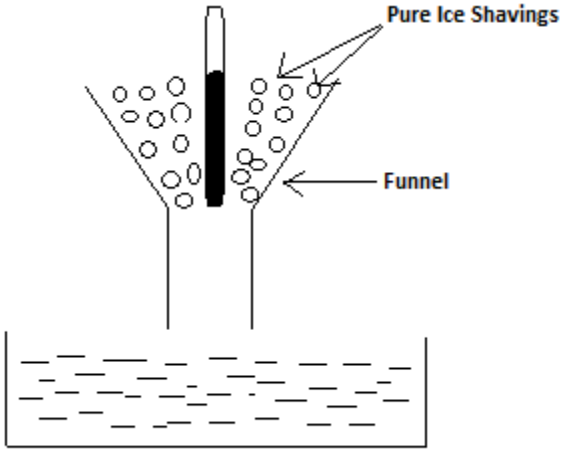

- The liquid in glass thermometer consists of a glass bulb, which contains a liquid, which is capable of rising or falling within a bore due to its expansion and contraction.
- It also has a temperature scale.

## How does a liquid in glass thermometer works?

- It works on the principle that matter expands when heated and contracts when cooled.
- When the thermometer is brought into contact with a hot body (or when the surrounding is hot), heat moves into the liquid in the thermometer from the hot body or the hot surrounding.
- This causes the liquid to expand and rise in the bore, to indicate a high temperature.

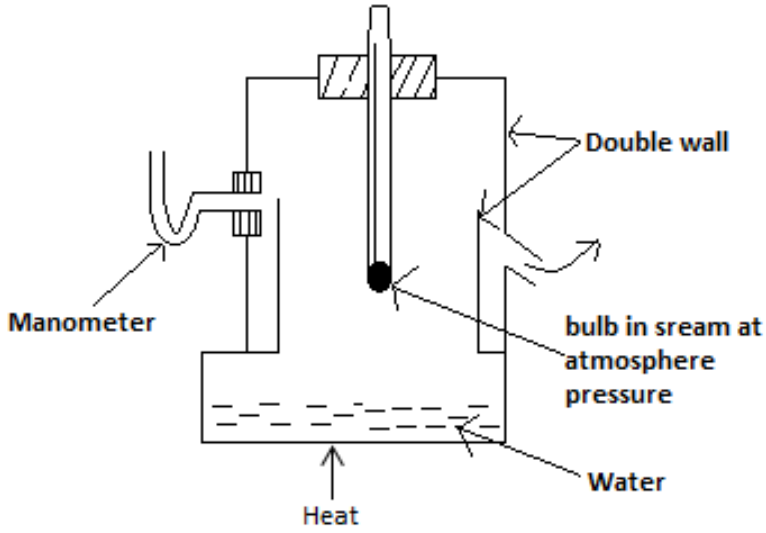
- If the thermometer is brought into contact with a cold body (or brought into a cold environment), heat will move from the liquid within the bulb into the cold body or surrounding.
- The liquid in the bulb becomes cool and contracts, causing the level of mercury or alcohol (alcohol or mercury thread) to fall indicating a low temperature.

## Describe how to determe the lower fixed point (ice point) of a thermometer ?




- To determine the lower fixed point of an un-graduated thermometer, the thermometer is pushed into pure ice shavings.
- The alcohol or mercury thread in the bore or stem starts to fall.
- At a particular point, the thread stops falling and remains steady.
- This point is marked as the lower fixed point.

## Describe how to determe the upper fixed point of a thermometer: The hypsometer:




- The thermometer is pushed through a hole in a cork and placed inside the hypsometer.
- Water is boiled at the lower part of the hypsometer, and the steam produced is made to surround the bulb.
- The mercurythread begins to rise and stops rising at a particular level.
- This point is marked as the upper fixed point.
- The double wall reduces the loss of heat and the consequent cooling of the vapour, surrounding the bulb.
- The manometer gives a warning, if the pressure inside the hypsometer becomes different from that of the atmosphere.

## What are thermometric liquids?

- These are liquids used as threads in thermometers.
- For a liquid to be a good thermometric liquid, it must possess the following features:
  (1) It must have a wide temperature within which it boils and freezes.

(2) It must have a regular volume expansitivity.
(3) It must not wet glass.
(4) It must be a very good conductor of heat.
(5) It must be coloured and opaque.
(6) It must not vapourize easily.

## State reasons why water is not used as a thermometric liquid?

(a) The volume expansion of water is not regular.
(b) It wets glass.
(c) It vapourizes and condenses in tubings.

## Choice of liquid for thermometers:

### State reasons why mercury is preferred to alcohol (advantages of mercury over alcohol)?

(1) It does not wet glass as alcoholdoes.
(2) It does not like alcohol vaporize to occupy the upper part of the bore.
(3) Unlike alcohol, it is coloured or opaque and can easily be seen and read when used in thermometers.
(4) It is a better conductor of heat than alcohol, and therefore responds more rapidly to temperature changes.

### State advantages of alcohol thermometer over that of mercury?

(1) Alcohol thermometers can be used in extremely cold area, where mercury thermometers cannot be used.
(2) Alcohol possesses a coefficient of expansion about six times that of mercury.

### State disadvantages of alcohol thermometer over that of mercury?

(1) It is colourless and as such its reading is difficult.

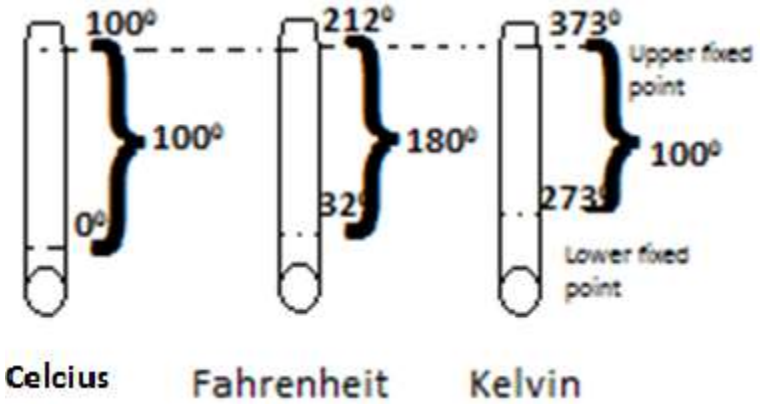
(2) It wets glass.
(3) It vapourizes to occupy the upper part of the bore.
(4) It is not too good a conductor of heat and responds slowly to temperature changes.

State disadvantages of mercury thermometer over that of alcohol?

- Mercury thermometers cannot be used in very cold areas.
- It has a low coefficient of expansion.

## State the temperature Scales?

There are three types and these are:
(1) The Celsius scale.
(2) The Fahrenhit scale.
(3) The Kelvin scale.




## What is the Celsius scale?

- A thermometer using the celcius scale has a lower fixed point of $0^0$.
- It has an upper fixed point of $100^0$ and a fundamental interval of $100^0$.

## What is the Fahrenheit scale?

(1) A thermometer using the Fahrenheit scale has a lower fixed point of $32^0$ and an upper fixed point of $212^0$.

(2) It has a fundamental interval of $180^0$.

## What is the Kelvin scale?

- A thermometer using the Kelvin scale has a lower fixed point of $273^0$, and an upper fixed point of 373.
- It has a fundamental interval of $100^0$.

## Expansion of solids and liquids:

- Matteexpands when heated and contracts when it cools.

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## What are the effects of expansion?

(1)

- Bridges built of metal expand when heated by the sun.
- Large forces are produced due to this expansion, which can cause damage to the bridge.
- In order to prevent this damage, room is made for its expansion by leaving gaps between the metal parts, and making both or one end of the bridge to rest on rollers.

(2)

- Metal roofing sheets expand on hot days.
- To make room for this expansion, roofing sheets have their edges placed on top of each other.
- It must also be noted that the cracking noise heard from the roofs during hot weather, is due to the occurrence of expansion in the roofing sheets.

(3)

- Railway lines have expansion gaps or overlapping tapered joints, so as to make room for expansion.

## State some applications or useful applications of expansion?

(1) It can be used to remove tight metal lids of bottles.

(2) Used to fit the metal wheel on axles of trains.
(3) Expansion is needed in order for thermostats to function.
(4) Used to rivet steel plates together in ship building and in the construction of boilers.

## State some uses of bimetallic strip?

(a) It is used in the thermostat.
(b) Thermostats are devices used to control the temperature of items such as electric iron, room heaters, refrigerators, electric cookers and water heaters.
(c) The thermostats within these items are set to the required temperatures.
(d) The bimetallic strip within these thermostats forms part of the electric circuit.
(e) As the temperature of the equipment such as the electric iron increases to the required temperature, the strip becomes heated and bends in a direction so as to open the circuit.
(f) When the equipment cools, the bimetallic strip also cools and straightens up at a particular temperature for the circuit to be closed.
(g) Current then restarts to flow through the circuit and the item continues to work.
(h) This process keeps on repeating itself.

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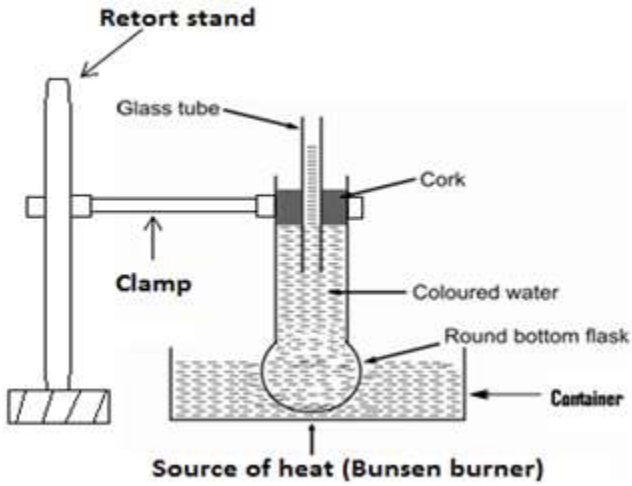
## Describe the experiment to demonstrate that solids expand when heated and contract when cooled?

(1) A hole is created in the middle of a piece of flat metal, in such a way that an egg cannot pass through it.
(2) Place an egg in this hole and heat the metal.
(3) After a time, the hole expands and the egg falls through the ground.
(4) Allows the metal to cool and this time, it will be noted that the egg cannot pass through the hole.
(5) Metals therefore expand when heated and contract when cooled.

## Describe the experiment to demonstrate the expansion and the contraction of liquid when heated and cooled:




(a) A round bottom flask is filled with coloured water.
(b) A glass tube is fitted with cork and fitted in the flask. so that one end of the glass tube enters the coloured water.
(c) The other end must project out at the top of the flask.
(d) Mark the initial level of the liquid within the glass tube.
(e) Heat the round bottom flask in a water bath.
(f) The level of coloured water in the glass tube first falls, due to the expansion of the glass.
(g) The level of water then rises in the tube.
(h) The round bottom flask is then removed from the water bath.
(i) The coloured water cools, contracts and the level of water in the tube falls.
(j) Liquids therefore expand when heated and contract when cooled.

## What is transmission or transfer of heat?

- This is the process by which heat travels from one part of a medium to another.
- The transmission of heat can occur in three ways and these are by:
  (a) Conduction.
  (b) Convection.
  (c) Radiation.

## What is conduction?

Is the type of heat transfer, in which the heat is passed from one section of a body or a material to another.

- In conduction, the particles of the medium or the material do not move, but only transfer the heat they gain to their neighbors.
- These neighbors in turn pass the heat unto other neighbors and by so doing, the heat is transmitted across the material.
- For conduction to occur, there must be a material medium such as a metal.
- Conduction can be demonstrated by holding one end of a spoon, whilst the other end is placed in a fire.
- After a time, the portion we are holding becomes hot due to conduction.

## State two characteristics of conduction?

- It occurs in solids.
- The molecules of the medium do not move.