Resource material for Kangaroo Contest Preparation 2016.

Ms.Seema Adil

Combustion and Flame

1) Combustible substances:-
Substances which burn in air to produce heat and light are called combustible substances.
Eg :- wood, coal, charcoal, kerosene, petrol, diesel, liquefied petroleum gas (LPG),compressed natural gas (CNG) etc.

2) Combustion:-
The chemical process in which a substance reacts with oxygen to produce heat is called combustion.
The substance which undergoes combustion is called a combustible substance. It is also called a fuel.

Air is necessary for combustion.
Sometimes light is also produced during combustion either as a flame or as a glow.

3. Ignition temperature:-
The minimum temperature at which a substance catches fire and burns is called its ignition temperature.
A substance will not catch fire and burn if its temperature is lower than its ignition temperature.

Different substances have different ignition temperatures.
Eg:- The ignition temperature of kerosene is less than the ignition temperature of wood.

Inflammable substances: Substances which have very low ignition temperature and can easily catch fire with a flame are called inflammable substances. Eg:- petrol, alcohol, LPG, CNG etc.
4) Conditions necessary for combustion :-
The conditions necessary for combustion are :-
i) Fuel.
ii) Air (to supply oxygen).
iii) Heat (to raise the temperature beyond the ignition temperature.
Note: A substance will not burn without one or more of these conditions.

5) How do we control fire?
The conditions necessary for producing fire are :-
i) Fuel ii) Air (to supply oxygen)
iii) Heat (to raise the temperature of the fuel beyond its ignition temperature).
Fire can be controlled by removing any one or more of these conditions.
A fire extinguisher cuts off the supply of air or brings down the temperature of the fuel or both and controls the fire.
6) Methods of controlling fire :-
i) By using water:-
Water is the most common fire extinguisher. It can be used only when materials like wood, paper etc. are on fire.

Water cannot be used if electrical equipments are on fire because water conducts electricity and can harm those trying to put out the fire.
Water cannot be used to put out oil and petrol fires because they float on water and continue to burn.

ii) By using carbon dioxide:-
Carbon dioxide is the best fire extinguisher to put out fire caused by inflammable materials like oil and petrol and electrical equipments. Carbon dioxide is heavier than air and it covers the fire and cuts off the supply of oxygen and puts out the fire.
Carbon dioxide is stored at high pressure as liquid in cylinders. Chemicals like sodium bicarbonate (baking soda), potassium bicarbonate produce carbon dioxide near the fire.

7) Types of combustion :-
There are three main types of combustion. They are :-
i) Rapid combustion ii) Spontaneous combustion iii) Explosion

Rapid combustion:- is combustion in which a substance burns rapidly and produces heat and light with the help of external heat. Eg:- burning of LPG
Spontaneous combustion:- A combustion in which a substance burns spontaneously and produces heat and light without the help of external heat. Eg:- phosphorus burns spontaneously at room temperature

Explosion:- A combustion in which a substance burns suddenly and produces heat, light and sound with the help of heat or pressure. Eg:- explosion of crackers on applying heat or pressure.
9) Flame :-
Flame :- is the zone of combustion of a combustible substance. Substances which vapourise during burning produce flames. Eg:- kerosene, wax etc.
Substances which do not vapourise during burning do not produce flames. Eg:- coal, charcoal etc.
10) Structure of a candle flame :-
A candle flame has three main zones. They are:-
i) Outer zone ii) Middle zone iii) Inner zone

In the outer zone complete combustion of the fuel takes place and the colour of the flame is blue and is the hottest part of the flame. It is the non luminous part of the flame.

In the middle zone partial combustion of the fuel takes place and the colour of the flame is yellow and is moderately hot part of the flame. It is the luminous part of the flame.

In the inner zone there are unburnt vapours of the fuel and the colour is black and is least hot part.
11) Types of fuels :-
Fuels are of three main types. They are :-
i) Solid fuels :- Eg:- wood, coal, charcoal etc.
ii) Liquid fuels :- Eg:- kerosene, petrol, diesel etc.
iii) Gaseous fuels :- Eg:- CNG, LPG, biogas, hydrogen etc.

12) Characteristics of a good fuel :-

The main characteristics of a good fuel are :-

i) Is readily available. ii) Is cheap.

iii) Is easy to store and transport. iv) Burns at a moderate rate.

v) Produces a large amount of heat. vi) Does not leave behind any undesirable substances.

vii) Does not cause pollution.

13) Calorific value of a fuel :-

The calorific value of a fuel :- is the amount of heat energy produced on complete combustion of 1 kg of a fuel.

The calorific valve of a fuel is expressed in kilojoule per kg.

Calorific values of some fuels in kilojule per kg

Cowdung cake	6000 - 8000	Wood	17000 - 22000
Coal	25000 - 33000	Petrol	45000
Kerosene	45000	Diesel	45000
Methane	50000	CNG	50000
LPG	55000	Biogas	35000 - 40000
Hydrogen	150000		

Hydrogen has the highest calorific value among all fuels.

14) Harmful effects on the environment due to burning of fuels :-

i) Fuels like wood, coal, petroleum release unburnt carbon particles which cause respiratory diseases like asthma.

ii) Incomplete combustion of fuels release carbon monoxide gas which is a very poisonous gas which can cause death.

iii) Burning of most fuels release carbon dioxide gas which causes rise in the temperature of the atmosphere. This is called global warming. It causes melting of polar ice, rise in sea level and flooding of coastal areas.

iv) Burning of coal and petroleum release oxides of sulphur and nitrogen which dissolve in rain water and forms acid rain. It is harmful for crops, soil and damages buildings.

Conservation of plants and animals

Red Data Book is the source book which keeps a record of all the endangered animals and plants.
Species is a group of populations which are capable -of interbreeding.

Migratory animals face extinction because many of the places they used to migrate to have been altered by human actions. As a result, these animals do not have anywhere to go when weather conditions become harsh or food in their habitat becomes scarce.

Endemic plants and animals are those which live or grow in just one geographical area, often in small numbers. Such plants and animals are at a greater risk of becoming extinct. They are very vulnerable to local habitat disturbance.

The World Conservation Union or International Union for the Conservation of Nature and Natural Resources (IUCN) is an international organization dedicated to natural resource conservation.IUCN was responsible for the idea of compiling lists of threatened plants and animals as a means of drawing attention to those faces with extinction. These lists became known as Red Data Books (RDBs), 'red' stands for 'danger'.

(a) A place where animals are protected in their natural habitat is called a sanctuary.

(b) Species found only in a particular area are known as endemic.

(c) Migratory birds fly to far away places because of climatic changes.

2. Differentiate between the following.

(a) Wildlife sanctuary and biosphere reserve

Wildlife sanctuary	Biosphere reserve
It is an area within which animals are protected from possible dangers such as hunting. Their habitat is also conserved in this area.	It is a large protected area constructed for the conservation of biodiversity.
It provides protection and suitable living conditions to wild animals.	It helps in the conservation of various life forms such as plants, animals, and micro-organisms.

(b) Zoo and wildlife sanctuary

Zoo	Wild life sanctuary
Zoos are smaller places having some animals protected for the public view.	Wildlife Sanctuary are larger places having wild animals in their natural habitat
It is an artificial habitat.	It conserves the natural habitat of animals.
It provides protection only.	It provides protection and suitable living condition to wild animals.

(c) Endangered and extinct species

Endangered species	Extinct species
It is a population of species that is on the verge of becoming extinct.	It is a population of species that no longer exists. Hence, it is extinct.
Blue whale, tiger, leopard, etc. are examples of endangered species.	Dodo, passenger pigeon, etc. are examples of extinct species.

(d) Flora and fauna

Flora	Fauna
It refers to all living plants in a particular area.	It refers to all animals living in a particular area.
Sal, teak, mango, etc. form the flora of Pachmarhi biosphere reserve.	Leopard, wolf, wild dog, etc. form the fauna of Pachmarhi biosphere reserve.

3. Discuss the effects of deforestation on the following.

(a) Wild animals: When forests are cut, the natural habitat of the animals is destroyed. Without the natural habitat the animals are left with no place to live and breed. As a result of this many animals are at the verge of extinction.

(b) Environment: Environment is adversely affected by deforestation as ecological balance is disturbed. Carbon

dioxide is not absorbed by plants and it gets accumulated in the atmosphere to cause global warming which increases the temprature of earth and disturb water cycle.

(c) Villages (Ruaral Areas): Deforestation leads to soil erosion and results in flash floods. This hampers agricultural activities and thus disturbs the people in rural areas.

(d) Cities (Urban Areas): Deforestation in cities can increase the risk of many natural calamities such as floods and droughts in that area.

(e) Earth: The whole earth is full of various ecosystems which together make the biosphere. Deforestation disturbs the balance in the biosphere. It disturbs climatic patterns.

(f) The next generation: They will not be able to see wide variety of flora and fauna also not get clean and cool environment. They will have to breathe poisonous gas. Life would be very difficult for the next generation.

4. What will happen if:
(a) we go on cutting trees.
(b) the habitat of an animal is disturbed.
(c) the top layer of soil is exposed.

Answer

(a) If we go on cutting trees then:
→ Earth will loose its top fertile soil layer and get conevrted into desert.
→ The ecological balance will get disturbed and and floods and drought will become more frequent.
→ Wildlife will also be affected.

(b) The habitat of an animal provides it with necessities such as shelter, food, and protection. If the habitat of an animal is disturbed, then it will be forced to go to other places in search of food and shelter. The animal could get killed by other animals in this process.

(c) If the top layer of soil is exposed, then it will gradually expose the lower layer of soil, which is hard and rocky in nature. This type of soil is less fertile as it contains less humus. Continued soil erosion will make the land barren or infertile.

5. Answer in brief:

(a) Why should we conserve biodiversity?

Answer

We should conserve biodiversity because it is very important for all living organisms and for the environment. We should conserve biodiversity to save it from becoming extinct.

(b) Protected forests are also not completely safe for wild animals. Why?

Answer

Protected forests are not completely safe for wild animals because people who live near or adjacent to forests use resources from forests to fulfil their own requirements. In this process, wild animals are killed and sold for lucrative amounts of money.

(c) Some tribals depend on the jungle. How?
Answer
Tribals gather food, fodder, and fallen branches of trees from forests. Hence, they depend on forests for their daily requirements.

(d) What are the causes and consequences of deforestation?

Answer

The main cause of deforestation is growing urbanization and industrialization. Need for more land and resources have lead to the cutting down of forests.
Consequences of deforestation are as follows:
→ Soil erosion
→ Depletion of groundwater
→ Flash flood
→ Global warming

(e) What is Red Data Book?

Answer

Red Data Book is a source book that maintains an international list of all endangered animal and plant species.

(f) What do you understand by the term migration?

Answer

Migration refers to the movement of an organism or a group of organisms from its natural habitat to another place at a particular time every year.

6. In order to meet the ever-increasing demand in factories and for shelter, trees are being continually cut. Is it justified to cut trees for such projects? Discuss and prepare a brief report.

Answer

No. It is not at all justified to cut trees to meet the ever increasing demands of human population. Forests are the habitat of several organisms including wild animals. They provide us with good quality air as they give out O_2 and absorb the harmful CO_2 gas from the atmosphere. In the process, they prevent the excessive heating of the atmosphere. They prevent soil erosion and natural calamities such as floods and droughts. They increase the fertility of the soil and help conserve biodiversity. The cutting of forests to meet the demands of growing human population will lead to global warming, soil erosion, greenhouse effect, droughts, floods, and many more problems. The destruction of forests will disturb the balance of nature. Hence, forests must be conserved.

7. How can you contribute to the maintenance of green wealth of your locality? Make a list of actions to be taken by you.

Answer

We can contribute to the maintenance of green wealth by taking following actions:
→ We can grow new plants in our locality.
→ Water them regularly and care of them.
→ The existing plants should be properly nourished.
→ Encouraging awareness among the people in the locality about the importance of growing trees.

8. Explain how deforestation leads to reduced rainfall.

Answer

Plants absorb water from the soil and evaporates it to form clouds. Deforestation leads to cutting down of trees. As a result less water is absorbed from the soil and it disturbs the water cycle. The formation of clouds become difficult which leads to reduced rainfall.

10. Why should paper be saved? Prepare a list of ways by which you can save paper.

Answer

Paper should be saved because it takes around seventeen full grown trees to make one tonne of paper. Trees, as we know, are important to maintain a balance of nature. Therefore, in order to save trees and prevent the impact of their loss on living organisms, we need to save paper.
Ways by which paper can be saved:
→ Collect used paper and recycle it.
→ Use both sides of a paper for writing.
→ Spread awareness about the importance of paper.
→ Use paper intelligently.

CELL

Organelle	Main function	Structure	Organisms	Notes
chloroplast(plastid)	photosynthesis, traps energy from sunlight	double-membrane compartment	plants, protists(rare kleptoplastic organisms)	has own DNA; theorized to be engulfed by the ancestral eukaryotic cell (endosymbiosis)
endoplasmic reticulum	translation and folding of new proteins (rough endoplasmic reticulum), expression of lipids (smooth endoplasmic reticulum)	single-membrane compartment	all eukaryotes	rough endoplasmic reticulum is covered with ribosomes, has folds that are flat sacs; smooth endoplasmic reticulum has folds that are tubular
Flagellum	locomotion, sensory		some eukaryotes	
Golgi apparatus	sorting, packaging, processing and modification of proteins	single-membrane compartment	all eukaryotes	cis-face (convex) nearest to rough endoplasmic reticulum; trans-face (concave) farthest from rough endoplasmic reticulum
mitochondria	energy production from the oxidation of glucose substances and the release of adenosine triphosphate	double-membrane compartment	most eukaryotes	has own DNA; theorized to be engulfed by an ancestral eukaryotic cell (endosymbiosis)
vacuole	storage, transportation, helps maintain homeostasis	single-membrane compartment	eukaryotes	
nucleus	DNA maintenance, controls all activities of the cell, RNAtranscription	double-membrane compartment	all eukaryotes	contains bulk of genome

Mitochondria and chloroplasts, which have double-membranes and their own DNA, are believed to have originated from incompletely consumed or invading prokaryotic organisms, which were adopted as a part of the invaded cell. This idea is supported in the Endosymbiotic theory.

Reproduction in animals

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- binary fission

the process whereby a cell divides asexually to produce two daughter cells

- hermaphroditism
  having sexual organs of both sexes
- parthenogenesis
  a form of asexual reproduction where growth and development of embryos occur without fertilization

Methods of Reproduction

Asexual Reproduction

Asexual reproduction produces offspring that are genetically identical to the parent because the offspring are all clones of the original parent. This type of reproduction occurs in prokaryotic microorganisms (bacteria) and in some eukaryotic single-celled and multi-celled organisms. Animals may reproduce asexually through fission, budding, fragmentation, or parthenogenesis.

Fission

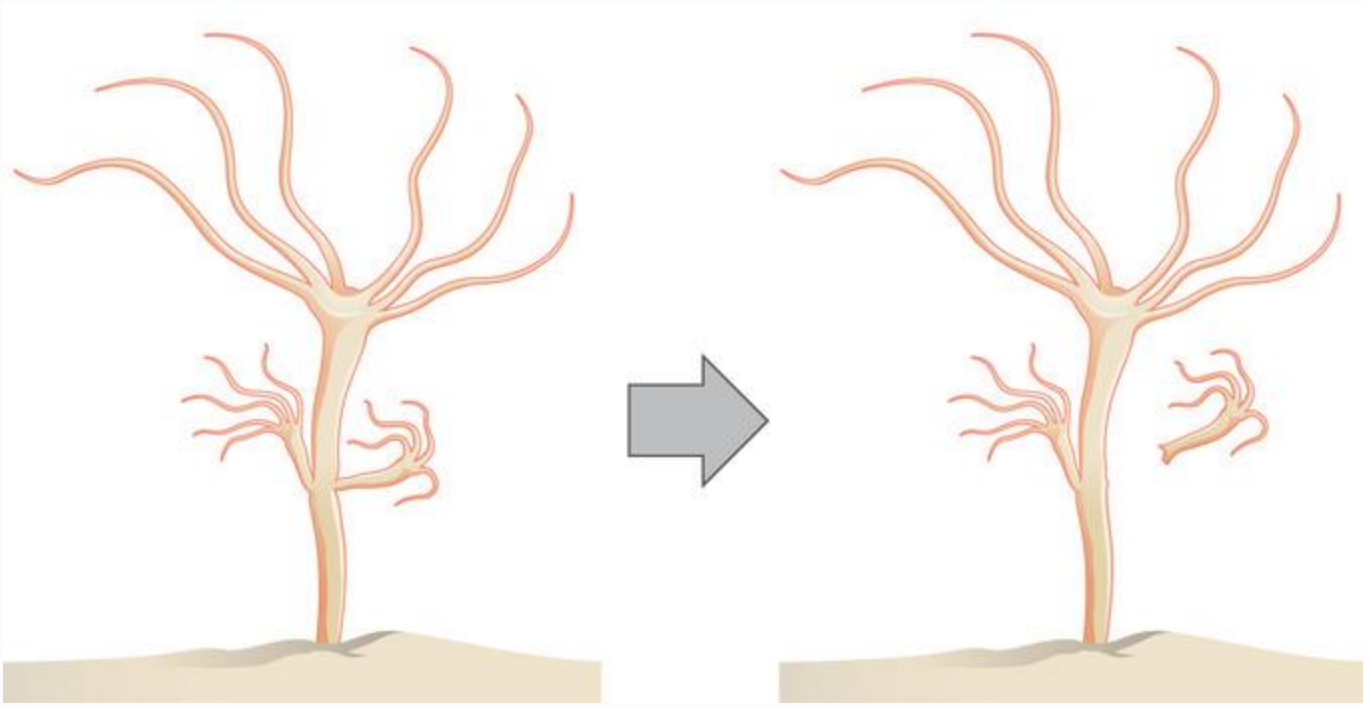
Fission, also called binary fission, occurs in prokaryotic microorganisms and in some invertebrate, multi-celled organisms. After a period of growth, an organism splits into two separate organisms. Some unicellular eukaryotic organisms undergo binary fission by mitosis. In other organisms, part of the individual separates, forming a second individual. This process occurs, for example, in many asteroid echinoderms through splitting of the central disk. Some sea anemones and some coral polyps also reproduce through fission .

Fission

Coral polyps reproduce asexually by fission, where an organism splits into two separate organisms.

Budding

Budding is a form of asexual reproduction that results from the outgrowth of a part of a cell or body region leading to a separation from the original organism into two individuals. Budding occurs commonly in some invertebrate animals such as corals and hydras . In hydras, a bud forms that develops into an adult, which breaks away from the main body; whereas in coral budding, the bud does not detach and multiplies as part of a new colony.



Budding

Hydra reproduce asexually through budding, where a bud forms that develops into an adult and breaks away from the main body.

Fragmentation

Fragmentation is the breaking of the body into two parts with subsequent regeneration. If the animal is capable of fragmentation, and the part is big enough, a separate individual will regrow.

Many sea stars reproduce asexually by fragmentation. For example, if the arm of an individual sea star is broken off it will regenerate a new sea star . Fishery workers have been known to try to kill the sea stars that eat their clam or oyster beds by cutting them in half and throwing them back into the ocean. Unfortunately for the workers, the two parts can each regenerate a new half, resulting in

twice as many sea stars to prey upon the oysters and clams. Fragmentation also occurs in annelid worms, turbellarians, and poriferans.

Fragmentation

Sea stars can reproduce through fragmentation. The large arm, a fragment from another sea star, is developing into a new individual.

Note that in fragmentation, there is generally a noticeable difference in the size of the individuals, whereas in fission, two individuals of approximately the same size are formed.

Parthenogenesis

Parthenogenesis is a form of asexual reproduction where an egg develops into a complete individual without being fertilized. The resulting offspring can be either haploid or diploid, depending on the process and the species. Parthenogenesis occurs in invertebrates such as water fleas, rotifers, aphids, stick insects, some ants, wasps, and bees. Bees use parthenogenesis to produce haploid males (drones) and diploid females (workers). If an egg is fertilized, a queen is produced. The queen bee controls the reproduction of the hive bees to regulate the type of bee produced.

Some vertebrate animals, such as certain reptiles, amphibians, and fish, also reproduce through parthenogenesis. Although more common in plants, parthenogenesis has been observed in animal species that were segregated by sex in terrestrial or marine zoos. Two Komodo dragons, a bonnethead shark, and a blacktip shark have produced parthenogenic young when the females have been isolated from males.

Sexual Reproduction

Sexual reproduction is the combination of (usually haploid, or having a single set of unpaired chromosomes) reproductive cells from two individuals to form a third (usually diploid, or having a pair of each type of chromosome) unique offspring. Sexual reproduction produces offspring with novel combinations of genes. This can be an adaptive advantage in unstable or unpredictable environments. As humans, we are used to thinking of animals as having two separate sexes, male and female, determined at conception. However, in the animal kingdom, there are many variations on this theme.

Hermaphroditism

Hermaphroditism occurs in animals where one individual has both male and female reproductive parts. Invertebrates, such as earthworms, slugs, tapeworms and snails, are often hermaphroditic. Hermaphrodites may self-fertilize or may mate with another of their species, fertilizing each other and both producing offspring. Self fertilization is common in animals that have limited mobility or are not motile, such as barnacles and clams.

Chemicals, enzymes[edit]

Microorganisms are used for many commercial and industrial production of chemicals, enzymes and other bioactive molecules. Examples of organic acid produced include

- **Acetic acid**: Produced by the bacterium *Acetobacter aceti* and other acetic acid bacteria (AAB)
- **Butyric acid** (butanoic acid): Produced by the bacterium *Clostridium butyricum*
- **Lactic acid**: *Lactobacillus* and others commonly called as lactic acid bacteria (LAB)
- **Citric acid**: Produced by the fungus *Aspergillus niger*

Microorganisms are used for preparation of bioactive molecules and enzymes.

- Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarctions leading to heart attack.
- Cyclosporin A is a bioactive molecule used as an immunosuppressive agent in organ transplantation
- Statins produced by the yeast *Monascus purpureus* are commercialised as blood cholesterol lowering agents which act by competitively inhibiting the enzyme responsible for synthesis of cholesterol

Diseases caused by Microorganisms

VIRAL DISEASES • AIDS • Mononucleosis • Chicken Pox & Shingles • Polio • Common Cold • Rabies • Dengue Fever • Rubella (new) • Ebola Hemorrhagic Fever • Small pox • Hepatitis (new) • West Nile Fever • Influenza • Yellow Fever • Measles • Mumps

BACTERIAL DISEASES • Anthrax • Pertussis (whooping cough) • Botulism • Rocky Mountain Spotted Fever • Cholera • Strep throat • Chlamydiasis (new) • Syphilis • Dental Caries (tooth decay) • Tetanus • Legionnaire's Disease • Tuberculosis • Lyme Disease • MRSA (new) • Peptic Ulcer Disease

FUNGAL DISEASES • Athlete's foot • Dutch Elm Disease • Ergotism • Histoplasmosis • Potato Blight • Ringworm • Thrush PROTOZOAN/ALGAL DISEASES • Malaria • Paralytic Shellfish Poisoning • Estuary Associated Syndrome • Giardiasis (new) • Cryptosporidiosis (new) PRION DISEASE – Scrapie and Kuru (both new) PARASITIC WORMS • Hookworm • Pinworm • Schistosomiasis • Tapeworm • Trichinosis • NATIONAL TOURNAMENT – ADDED DISEASES IMPORTANT GENERA • Wolbachia • Batrachochytrium

Force

A force is an agent which can change or try to change the state of an object. Force is theproduct of mass and acceleration
F = ma
Force has both magnitude and direction, making it a vector quantity. The SI unit used to measure force is the Newton (symbol N), which is equivalent to kg•m•s-2

Actions like picking, opening, shutting, kicking, hitting, lifting, flicking, pushing, pulling are often used to describe certain tasks. Each of these actions usually results in some kind of change in the motion of an object.
A force is a push or pull upon an object resulting from the object's interaction with another object.

Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force. Forces only exist as a result of an interaction.

All forces (interactions) between objects can be placed into two broad categories:

• Contact forces, and
• Non Contact forces

Contact Forces: Contact forces are those types of forces which result when the two interacting objects are perceived to be physically contacting each other. Examples of contact forces include frictional forces, tensional forces, normal forces, air resistance forces, and applied forces.

Non-contact Forces: Non Contact forces are those types of forces which result even when the two interacting objects are not in physical contact with each other, yet are able to exert a push or pull despite their physical separation. Examples of Non Contact forces include gravitational forces.

Types of Contact Forces

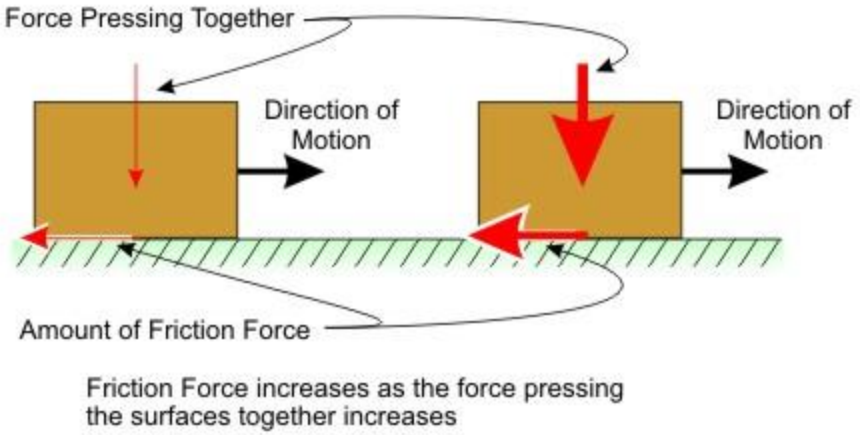
Applied Force: - An applied force is a force, which is applied to an object by a person or another object. For example, If a person is pushing a desk across the room, then there is applied force acting upon the object. The applied force is the force exerted on the desk by the person.

Normal Force: - The normal force is the support force exerted upon an object which is in contact with another stable object. For example, if a book is resting upon a surface, then the surface is exerting an upward force upon the book in order to support the weight of the book. On occasions, a normal force is exerted horizontally between two objects which are in contact with each

other. For instance, if a person leans against a wall, the wall pushes horizontally on the person.

Frictional Force: - The friction force is the force exerted by a surface as an object moves across it or makes an effort to move across it. There are at least two types of friction force - sliding and static friction. For example, if a book slides across the surface of a desk, then the desk exerts a friction force in the opposite direction of its motion. Friction results from the two surfaces being pressed together closely, causing intermolecular attractive forces between molecules of different surfaces. As such, friction depends upon the nature of the two surfaces and upon the degree to which they are pressed together.

Friction is necessary for every movement in life. Suppose you spill some oil on the floor then it will be difficult for you to walk because of negligible friction.



Air Resistance Force: - The air resistance is a special type of frictional force which acts upon objects as they travel through the air. The force of air resistance is often observed to oppose the motion of an object. This force will frequently be neglected due to its negligible magnitude (and due to the fact that it is mathematically difficult to predict its value). It is most noticeable for objects which travel at high speeds (e.g., a skydiver or a downhill skier) or for objects with large surface areas. When you ride your bike then your hair flip backwards because of air resistance.

Tension Force: - The tension force is the force which is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends. The tension force is directed along the length of the wire and pulls equally on the objects on the opposite ends of the wire.

Spring Force: - The spring force is the force exerted by a compressed or stretched spring upon any object which is attached to it. An object which compresses or stretches a spring is always acted upon by a force which restores the object to its rest or equilibrium position.

For most springs (specifically, for those which are said to obey "Hooke's Law"), the magnitude of the force is directly proportional to the amount of stretch or compression of the spring.

Types of Non-contact Forces

Gravitational Force: - The force of gravity is the force with which the earth, moon, or other massively large object attracts another object towards itself. By definition, this is the weight of the object. All objects upon earth experience a force of gravity which is directed "downward" towards the center of the earth. The force of gravity on earth is always equal to the weight of the object as found by the equation:
F grav = m x g
where g = 9.8 m/s2 (on Earth) and m = mass (in kg)

Magnetic Force:- Attraction or repulsion that arises between electrically charged particles because of their motion; the basic force responsible for the action of electric motors and the attraction of magnets for iron. Electric forces exist among stationary electric charges; both electric and magnetic forces exist among moving electric charges. The magnetic force between two moving charges may be described as the effect exerted upon either charge by a magnetic field created by the other.

The magnetic force on a moving charge is exerted in a direction at a right angle to the plane formed by the direction of its velocity and the direction of the surrounding magnetic field.

Electrostatic Force: - The force exerted by stationary objects bearing electric charge on other stationary objects bearing electric charge. If the charges are of the same sign, then the force is repulsive; if they are of opposite signs, the force is attractive. The strength of the force is described by Coulomb's law. Also called electrostatic force.

The force exerted by a charged body on another charged or uncharged body is known as electrostatic force.

Pressure

Pressure (symbol: p or sometimes P) is the force per unit area applied to an object in a direction perpendicular to the surface.

Mathematically:

P = F/A

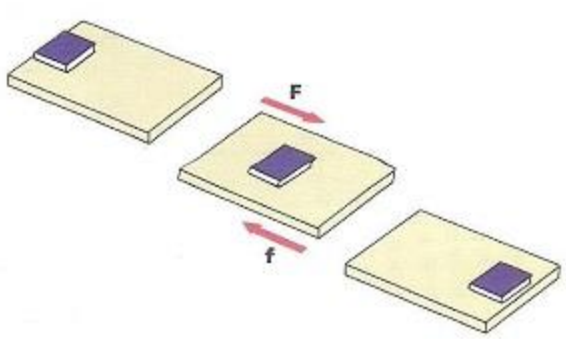
Where: p is the pressure, F is the normal force, A is the area

The SI unit for pressure is the pascal (Pa), equal to one newton per square meter (N•m-2 or kg•m-1•s-2).

What Is Friction?

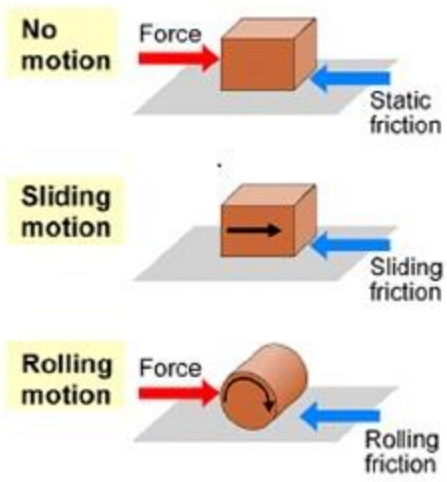
To stop a moving object, a force must act in the opposite direction to the direction of motion. For instance, if you push your book across your desk, the book will move. The force of the push moves the book. As the book slides across the desk, it slows down and stops moving. The force that opposes the motion of an object is called **friction**.

Forces and Motion



Look at this diagram. At first, the book is at rest. A push causes the book to slide across the desk. The force of the push (big F) keeps the book moving. As the book slides cross the desk, a **force of friction (f)**acts in the opposite direction. The friction slows down the motion of the book. Finally, the book is once again at rest.

Types of Friction



There are different types of friction. A book moving across the desk is an example of **sliding friction**. As the book slides cross the desk, the bottom of the book is touching the desk. The source of the friction is the contact between the surface and the book and the desk. The weight of the object and the type of surface it moves over determine the amount of sliding friction present between the two objects. A heavy object exerts more pressure on the surface is slides over, so the sliding friction will be greater.

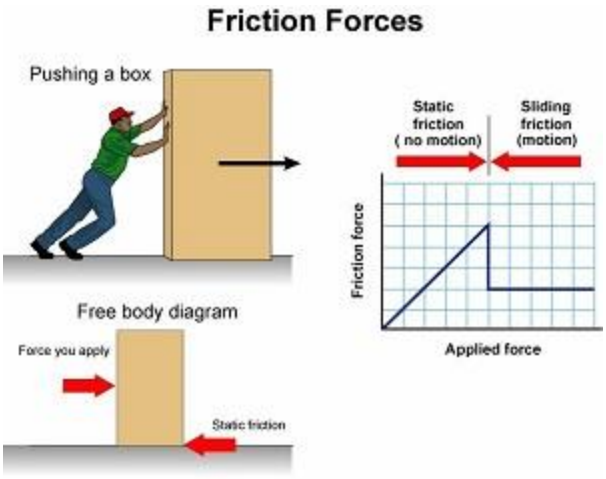
Air, water and oil are all fluids. Air resistance is a type of **fluid friction**. As an object falls, air resistance pushes it up on the object.

When you ride a bicycle, the contact between the wheel and the road is an example of **rolling friction**. When an object rolls over a surface, the force needed to overcome rolling friction is much less than that needed to overcome sliding friction.

Kinetic Friction

When you moved your book across the desk, the book experienced a type of friction that acts on moving objects. This force is known as a **kinetic friction force**. It is exerted on one surface by another when the two surfaces rub against each other because one or both surfaces are moving. If you stack additional books on top of the first book to increase the normal force, the kinetic friction force will increase. Let's look at the **formula for kinetic friction force**.

There is a linear relationship between the kinetic friction force and the normal force. The **coefficient of kinetic friction** relates the friction force to the normal force. The kinetic friction force (F(f, kinetic)) equals the product of the coefficient of kinetic friction (μ(k)) and the normal force (F(N)). F(f, kinetic) = μ(k) * F(N)



Static Friction

Imagine trying to push a couch across the floor. You push on it with a small force, but it does not move. This is because it is not accelerating. Newton's laws tell you that the net force on the couch must be zero. There must be a second horizontal force acting on the couch, one that opposes your force and is equal in size. This force is **static friction force**, which is the force exerted on the surface by another when there is no motion between the two surfaces.

Static friction force acts in response to a force trying to cause a stationary object to start moving. If there is no such force acting on an object, the static friction force is zero. If there is a force trying to cause motion, the static friction force will increase up to a maximum value before it is overcome and motion starts.

Now let's look at the **formula for static friction force**. The static friction force (F(f, static)) is less than or equal to the product of the coefficient of static friction (μ(s)) and the normal force (F(N)).

$$F(f, static) \leq \mu(s) \times F(N)$$

The maximum static friction force relates to the normal force in a similar way as the kinetic friction force. In the **equation for maximum static friction force**, μ(s) is the **coefficient of static friction** between two surfaces. The maximum static friction force that must be overcome before motion can begin is μ(s) * F(N). In the example of pushing the couch, the maximum static friction force balances the force of the person pushing on the couch the instant before the couch begins to move.

Measuring Coefficients of Friction

On what does a friction force depend? The materials that the surfaces are made of play a role. For example, imagine trying to play basketball while wearing socks instead of athletic shoes. You would slip and slide all over the basketball court. Shoes help provide the forces necessary to quickly change directions while running up and down the court. There is more reaction between your shoes and concrete than there is between your socks and a polished wood floor.

This table shows coefficients of static friction (μ(s)) and coefficients of kinetic friction (μ(k)) between various surfaces. The coefficients of friction show how easily one object can slide against another. These coefficients are estimates for each combination of surfaces. Exact measurements of coefficients of friction are quite sensitive to the conditions of the surfaces and are determined experimentally.

Surfaces	Coefficient of static friction μ(s)	Coefficient of kinetic friction μ(k)
Cast iron on cast iron	1.1	0.15
Glass on glass	0.94	0.4
Leather on oak	0.61	0.52
Nonstick coating on steel	0.04	0.04
Oak on oak	0.62	0.48
Steel on steel	0.78	0.42
Steel on steel (with castor oil)	0.15	0.08

Another important fact regarding the table is that all the measurements were made on dry surfaces (with exception of the oiled steel). Wet surfaces behave quite differently than dry surfaces.

Causes of Friction

All surfaces, even those that appear to be smooth, are rough at a microscopic level. If you look at a photograph of a graphite crystal magnified by a scanning tunneling microscope, the atomic level surface irregularities of the crystal are revealed. When two surfaces touch, the high points on each are in contact and temporarily bond. This is the origin of friction. The details of this process are still unknown and are the subject of research in both physics and engineering.

Agriculture

The science that deals with the growth of plants and animals for human use is called *agriculture*.
Agriculture includes-

- Soil management- the cultivation of soil
- Crop farming- growing and harvesting of crops.
- Horticulture- growing and harvesting of fruits, vegetables, flowers and decorative plants
- Animal husbandry- the breeding and raising of livestock including poultry

The land where plants are cultivated is known as *fields*.
Plants grown in large quantities in field are known as *crop plants or crops*.
Based upon the seasons, the crops are divided into two types- summer crops called *kharif crops* and winter crops called *rabi crops*.
Kharif crops are grown during summer between june/july and harvested by september/october. Rice, groundnut, maize, cotton , pulses are some common kharif crps.
Rabi crops are grown in the winter between october/november and harvestedv by march or april. Wheat, barley, mustard, potato and peas are some common rabi crops.
The recent progress in agriculture has taught farmers to cultivate crops in a systematic way. The tasks that a farmer follows are called agricultural practices. The major steps involved in this process are-

- Preparation of soil
- Selection and sowing of seeds
- Addition of manure and fertilizers
- Irrigation
- Protection from weeds and pests
- Harvesting
- Storage

Preparation of soil:

Ploughing or tilling involves loosening and turning of soil using a tool or an implement called the plough. Then the soil is leveled.
Loosening of the soil-

1. Allows the roots to breath easily
2. Helps the roots to penetrate deeper into the soil.
3. Enables fertilizers to mix uniformly with the soil.
4. Aids the growth of organisms such as earthworms, millipedes, bacteria and fungi.

Sowing of seeds:

Seeds used for sowing should be of good quality, healthy, viable and free of infections. Seeds are sown manually by broadcasting or by seed drills. *Broadcasting* is the scattering of seeds over the soil surface by hand.

Addition of manure and fertilizers:

Plants require nutrients for growth. They get these nutrients from the soil. This can be done either by natural methods or by adding manures and fertilizers to the soil.

Natural methods:

Field fallow: The method of leaving the field without cultivating any crops to replenish nutrients in the soil.
Crop rotation: It involves growing two or more crops alternatively on the same land in the same growing season so that the soil is not depleted of any particular nutrients.

Differences between manures and fertilizers:

Differences between manures and fertilizers:	
Manures	**Fertilizers**
These are natural organic substances that are derived from animal wastes and plant residues.	These are inorganic salts made by humans.
These are rich in humus but not in inorganic nutrients.	These are rich in inorganic nutrients but do not contain humus.
They are quite bulky and difficult to transfer.	They are less bulky and easy to handle.

Irrigation:

Irrigation is the artificial supply of water to farms when needed.
Some of the modern irrigation methods are as follows:

- Sprinkler system
- Drip irrigation

Protection from weed and pests:

Weeding:

- Weeds are unwanted plants that grow along with the crops. They compete with the crops for water, minerals and sunlight and, therefore reduce crop yield.
- Amaranthus is very common weed which grow with almost every crop.
- Weeding can be done manully using a trowel or a harrow or by using a seed drill using certain chemicals called weedicides for example- 2,4-D. some common weedicides are Dalapon, Siniazine and Picloram.

Pests:

- Insects that attack crops and damage them are called pests.
- Pests can be controlled by pesticides which are poisonous chemicals. Pesticides kill pests as well as their eggs and larvae but do not affect the plants.

Harvesting:

- *Harvesting* is the cutting and gathering of the mature crop from the fields.
- *Threshing* is the process of removal of the edible part of grain from the scaly, inedible chaff that surrounds it.

- *Combine harvester* is a farm machine which does both harvesting as well as threshing.
- *Wind winnowing* is a method of separating grain from chaff by throwing the mixture into the air with a winnowing fan.

Storage:

Large scale storage of grains is done in granaries or silos to protect them from pests like rodents, microbes or insects.

Increasing crop produce:

Crop produce can be increased by increasing the land under cultivation, by improvement in the methods of agriculture, and by developing better varieties of crops by plant breeding.
Hybridization is a technique used for plant breeding in which new varieties with desired characteristics of high yield and resistance to disease, are developed.

Nitrogen cycle:

Air contains about 78% nitrogen. Nitrogen is used by life forms for the formation of protein, amino acidsand nucleic acids.

The cyclic process of nitrogen being fixed, used by plants and animals and later returned to the atmosphere is referred to as the nitrogen cycle.

Nitrogen cycle involves the following steps:

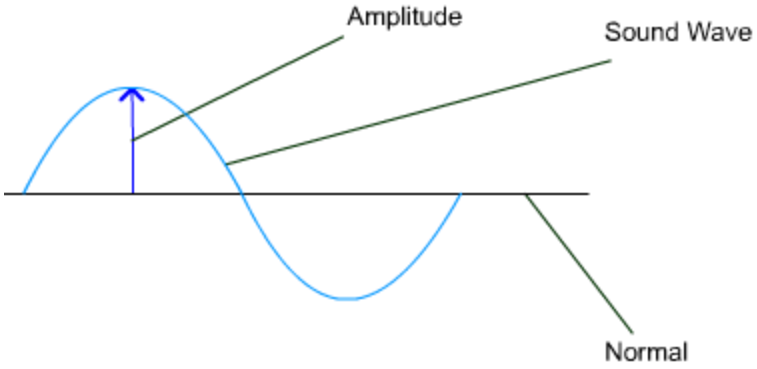
- *Nitrogen fixation:* fixing free nitrogen gas of the atmosphere into inorganic compounds by organism such as Rhizobium.
- *Nitrogen assimilation:* converting inorganic nitrogen into usable organic compounds in organisms.
- *Ammonification:* Conversion of organic nitrogen into ammonia.
- *Nitrification:* Ammonia is converted into nitrates in the soil with the help of bacteria.
- *Denitrification:* Conversion of nitrates into nitrogen gas by denitrifying bacteria.

Animal husbandry:

- The breeding, feeding and caring of domestic animals for food and other purposes is called animal husbandry.
- Meat or egg yielding animals such as goat, poultry animals (e.g. chicken, duck and trkey), fish, sheep.
- Milch or (milk yielding) animals such as cow, buffalo, goat and camel.
- Large scale rearing of fish for food is known as *pisciculture.*
- Large scale rearing of honeybee is known as *apiculture.*

Sound is a form of energy produced by a vibrating bodies. Sound requires a material medium for its propagation. Sound does not propagate in vacuum as there is no material in the vacuum. **Amplitude, Time Period and Frequency of a Sound**
Sound travels in the form of wave. When a pebble is dropped in pond water, it produces ripples in water. The ripple is called wave. Sound travels producing similar waves.

Amplitude and frequency are two important characters of sound. Sounds produced by different object are differentiated by amplitude and frequency of sound.



Amplitude – The distance from normal to peak is called amplitude. Since, sound travels in the form of wave, so sound has amplitude.

Frequency: The number of vibrations or oscillations per second is called frequency.

$$Frequency = \frac{Numer\ of\ oscillation\ or\ vibration}{Time}$$

Frequency is expressed in hertz.

If an object oscillates or vibrates 40 times in 1 second, then its frequency will be equal to 40 hertz.

Time period - Time required to produce one complete oscillation is called time period.

$$Time\ period = \frac{Time}{Number\ of\ oscillation\ or\ vibration}$$

Loudness and Pitch

Loudness of sound depends on the amplitude of the sound wave. Greater amplitude produces louder sound and smaller amplitude produces feeble sound.

Loudness of sound is measured in decibel (dB). Loudness of some types of sound is given here in decibel.

Loudness of sound	
Normal breathing	10 dB
Soft whisper	30 dB
Normal Conversation	60 dB
Busy traffic (Inside car)	70 dB
Telephone dial tone	80 dB
Train whistle	90 dB
Hand drill	98 dB
Jet Engine	140 dB

Shrillness or pitch

Frequency of a sound determines the shrillness or pitch of the sound. Shrillness or pitch increases with increase in frequency of sound. Sound with greater frequency is shriller and has higher pitch. Sound with lower frequency is less shrill and of lower pitch.

Examples:

Children and women produce sound of high frequency and their sound is shriller and of higher pitch. On the other hand, an adult male produces sound of lower frequency and his sound is less shrill and has lower pitch.

A drum produces sound of lower frequency which is less shrill and has lower pitch, while a whistle produces sound of higher frequency which is shriller and is of higher pitch.

A lion produces a sound of lower frequency which is less shrill and has lower pitch, while a bird produces sound of high frequency which is shriller and has higher pitch. However, sound of lion is louder than the sound of a bird.

Audible and Inaudible Sound

Sounds with frequency between 20 Hz to 20,000 Hz are called audible sound. The hearing range of human beings is between 20 hertz to 20,000 hertz.

Sound with frequency below 20 hertz and above 20,000 hertz is called sound of inaudible range. Humans cannot hear the sound of inaudible range.

Many animals, such as dogs, cats, etc. can hear the sound with frequency above 20,000 hertz.

Noise and Music

Sound that appears unpleasant to us is called noise, such as sound of horn, sound near the site of construction work, sound of aeroplane, etc.

Sound that appears pleasant to our ear is called musical sound, such as sound of musical instrument, song of a good singer, etc.

Noise Pollution

Loud and excessive sound is unbearable to our ears, and is called noise. Unwanted and excessive sound in our environment creates noise pollution. Sounds of crackers, factories, vehicles, desert coolers, air conditioners, aeroplane, transistors or television with high volume, loudspeakers, etc. create sound pollution.

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Amplitude

The maximum displacement of a vibrating particle from its mean or equilibrium position is called its amplitude.

Time period

The time taken by the vibrating particle for one full vibration or oscillation is called the time period of vibration.

Frequency

The number of vibrations per second is called the frequency. Frequency is measured hertz (Hz).

Characteristics of Sound

Sound produced by any means has the following characteristics, namely, loudness, pitch or shrillness, and quality or timbre.

Loudness

The loudness of sound depends on its amplitude. The loudness of sound is proportional to the square of the amplitude. A roar of a lion is louder than a woman's voice. The loudness of sound is measured in Decibel (db). If loudness exceeds 80 db, then the sound becomes physically painful.

Pitch

The pitch of sound depends on its frequency. If frequency is more, then the pitch or shrillness is more. The pitch of a woman's voice is more and it is shriller then a man's voice.

Audible sound

Not all sound produced by vibrating bodies is audible. The human ear can recognise the sounds of frequencies in the range of 20 Hz to 20,000 Hz. This range of frequency of sound is called audible sound.

Some animals like dogs and snakes can hear sounds of frequencies greater than 20,000 Hz.

Infrasonic sounds

Sounds of frequencies less than 20 Hz are called infrasonic sounds.

Ultrasonic sounds

The sounds of frequencies greater than 20,000 Hz are called ultrasonic sounds

Stars and The Solar System

Celestial Objects:

Any naturally occurring object in the observable universe is called a celestial body. Stars, planets, satellites, comets, etc. are examples of celestial objects.

THE MOON

The moon is the only natural satellite of the earth. This is our nearest neighbour in the universe. The moon is at a distance of about 400,000 km from the earth. In terms of size; the earth is 81 times bigger than the moon.

There is no atmosphere on the moon. It is full of craters and mountains. Some of the mountains on the moon are as high as the highest mountains on the earth.

Phases of Moon

The moon does not appear similar on different days rather its shape changes every day. The different shapes of the moon are called the phases of moon.

New Moon: On the new moon day, no moon is visible in the sky.

Waxing Crescent: Within a few days of the new moon day; the moon appears like a crescent. This is called the waxing crescent.

1st Quarter: Within about a week from the new moon day; the moon appears as a semicircle. This is called the 1st quarter moon.

Waxing Gibbous: Within about 10 days from the new moon day; the moon appears as a circle with some portion cut off. This is called the waxing gibbous moon.

Full Moon: Within about 15 days from the new moon day; the moon appears as a complete circle. This is called the full moon.

Waning Phase: The waxing phase of the moon is followed by the waning phase. During this phase; the full moon reduces in size and goes through the waning gibbous, 2nd quarter and waning crescent phases. Within about 29 days from the new moon day; the next lunar month begins with the next new moon.

Reason for Phases of Moon: The periods of rotation and revolution are same in case of the moon. This means that the moon takes the same time in completing one rotation and one revolution. Due to this, only one surface of the moon is visible from the earth.

We also know that the moon does not have its own light rather it reflects the sunlight. So, the sunlit portion of the moon is visible to us. When the moon, the earth and the sun are in a straight line and the earth is between the other two; we are able to see the full moon. On the other hand, when the moon is in between the earth and the sun; we are able to see the new moon, i.e. the whole surface of the moon appears in dark.

THE STAR

A star is a huge celestial body. Stars produce heat and light because they are full of very hot gases. The sun is the nearest star from us. It is at a distance of about 150,000,000 (one hundred fifty million) kilometer from us. The next nearest star from us is Alpha Centauri. This is about 40,000,000,000,000 (forty trillion) km from us.

Light Year: The interstellar distances or intergalactic distances are too big to be easily expressed in terms of kilometers. Hence, we need a more convenient unit to express them. A light year is the distance travelled by light in one year. Distances of stars are usually expressed in terms of light years.

The sunlight takes about 8 minutes to travel from the sun to the earth. This implies that the sun is at a distance of 8 light minute from us. Alpha Centauri is 4.3 light years away from us.

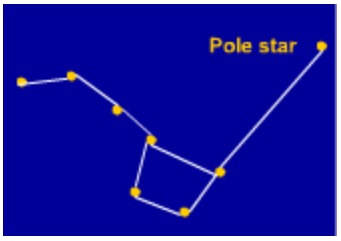
Astronomical Unit: The distance between the sun and the earth is called one astronomical unit (AU). This unit of distance makes it easy to express the distance of different planets from the sun.

Do you know why the stars are not visible during the day? In fact, the sunlight is so bright during the day that we are unable to see the stars. This is similar to the blinding effect of the headlights of a car. When the headlights of a car fall on your eyes, you are unable to see anything else.

Apparent Movement of Stars, Sun and the Moon

All the celestial bodies appear to move from east to west. This happens because the earth rotates from west to east. When you are sitting in a moving train; the objects on the platform appear to be moving in the opposite direction. The same illusion happens to show the apparent movement of the celestial bodies.

Pole Star

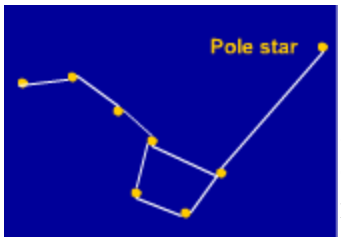


While other stars appear to move with gradual progress of night, the pole star remains fixed at its position. This happens because the pole star is in line with the axis of the earth. The pole star appears in the northern sky. It is only visible from the northern hemisphere. However, the fixed position of the pole star has helped humans since ages. Sailors and travelers used the pole star to find way when they had to travel during night.

Stars and The Solar System

Constellation

A group of stars which resembles certain shape is called a constellation. Human beings have an innate ability to recognize shapes and faces even in formless things; like clouds, smoke, etc. This ability of human beings has given rise to various constellations. Different constellations may have different names in various cultures. There are twelve signs of zodiac, viz. Aries, Taurus, Gemini, Cancer, Virgo, Leo, Libra, Scorpio, Capricorn, Sagittarius, Aquarius and Pisces. There are numerous other constellations, e.g. Great Bear, Cassiopeia, Ursa Minor, Orion, etc.



Great Bear: This is also known as Ursa Major and Big Dipper. It resembles the shape of a ladle. The four stars which appear as four vertices of a quadrilateral make the bowl of the ladle and the remaining three stars make the handle of the ladle. Ursa Major appears in the northern sky. The pole star is in line with last two stars of the quadrilateral. Since this constellation appears quite close to the pole star, it looks as if revolving around the pole star.

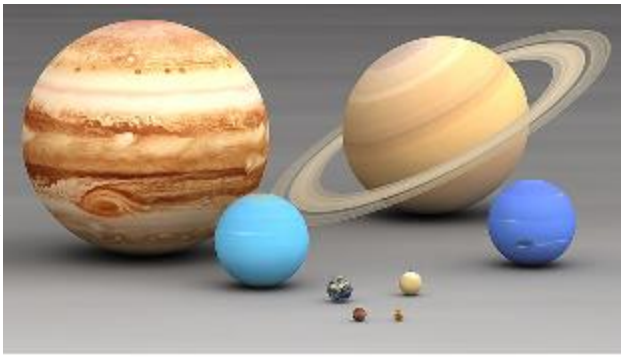
Orion: Orion is also called the Hunter. The three prominent stars in this constellation mark the belt of the hunter. An elaborate structure shows a man with a club and a shield. This constellation is visible in the southern sky and this can be easily seen during summer months in India.

THE SOLAR SYSTEM

The solar system is made up of the sun, its planets, satellites, asteroids, comets, dwarf planets, etc. All other members of the solar system keep on revolving around the sun. This is possible because of the gravitational attraction between the sun and these bodies. The solar system is 4.6 billion years old. Different members of the solar system are as follows.

The Sun: The sun is the centre of the solar system. The sun is a huge store of heat and light energy. The sun is mainly composed of hydrogen gas. The hydrogen gas in the sun keeps on changing to helium gas and this process releases huge amount of energy. This is like thousands of atom bombs working together.

Planet: A celestial body which revolves around a star is called a planet. There are eight planets in the solar system, viz. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.



Jupiter & Saturn (top row)
Uranus & Neptune (middle)
Earth & Venus (3rd row)
Mars & Mercury (bottom row)

Image Ref: Wikicommons

Satellite: A celestial body which revolves around a planet is called a satellite. Mercury and Venus do not have known satellites. Jupiter has the largest number of known satellites.

Mercury: This is the smallest planet in the solar system and is nearest to the sun. It is at a distance of 0.4 AU from the sun. This is so close to the sun that it cannot be seen without a powerful telescope.

Venus: Venus is at a distance of 0.7 AU from the sun. This planet is almost of the same size as the earth. Venus is the hottest planet on the earth. After moon; this is the brightest object in the night sky. Venus is visible in early evening during the summer months and in early morning during winters. Due to this, Venus is also called the morning and evening star.

Earth: Earth is the only planet where life is known to exist. According to scientists; earth is at a perfect distance from the sun and hence it has the right combination of gases, materials and temperature to support life. A major portion of the earth's surface is covered with water and hence it appears blue from the space. Due to this; earth is also called the BLUE PLANET.

Mars: Mars is at a distance of 1.5AU from the sun. Mars appears red because of the presence of iron oxide on its surface. Hence, it is also known as the RED PLANET. Deimos and Phobos are the two natural satellites of mars.

The four planets before the asteroid belt are called rocky planets or TERRESTRIAL PLANETS because they are made of rocks. The four remaining planets which are after the asteroid belt are called GASEOUS GIANTS because they are mainly composed of gases.

Jupiter: Jupiter is at a distance of 5.2 AU from the sun. This is the largest planet in the solar system. Jupiter is 1300 times the size of the earth. But because of its lower density; it is just 388 times the mass of the earth. There are 67 known satellites of Jupiter.

Saturn: Saturn is at a distance of 9.5 AU from the sun. Saturn is famous for its rings. The rings around this planet are composed of rocks, gases and vapours. These rings can be seen through a telescope. There are 62 known satellites of Saturn. The density of Saturn is so low that it can float on water.

Uranus: Uranus is at a distance of 19.2 AU from the sun. Uranus rotates from east to west; like Venus. The axis of Uranus is slightly tilted on its orbit. Due to this, Uranus appears to be rolling on its sides. There are 27 known satellites of Uranus.

Neptune: Neptune is at a distance of 30 AU from the sun. There are 14 known satellites of Neptune. This is the farthest planet from the sun.

Asteroid Belt: The asteroid belt is present between the orbits of Mars and Jupiter. This belt extends between 2.3 and 3.3 AU from the sun. Asteroids are made up of rocks, metallic minerals and some ice. They are remnants of formation of the solar system.

Comet: A comet is a celestial body which revolves around the sun in a highly elliptical path. When a comet passes from near the earth, it becomes visible to us. Halley's Comet and Hale Bopp are some of the famous comets. Halley's Comet appears after every 76 years. It appeared last time in 1986 and is expected to appear again in 2062.

Meteor: When a small object from the space reaches the atmosphere of the earth; it enters at a very high speed. The high speed creates so much friction that the object burns off before reaching the earth. Such objects are called meteors. They are visible as shooting stars in the night sky. Sometimes, an object can be too big to be completely destroyed by burning. Such objects reach the surface of the earth and are called meteorites. A meteorite can cause huge damage to the earth; like destroying a huge population of living beings.

Artificial Satellites: The man-made satellites are called artificial satellites. These satellites are made for various purposes; like remote sensing, telecommunication, defence, etc. Data from the satellites is utilised by meteorologists to make predictions about weather. Communication satellites help in working of mobile phones, television, etc. Global Positioning System (GPS) works because of these satellites.

Magnetism

Magnets and Their Types

Substances that possess the property of attracting iron are called magnets. The two ends of a magnet are called its poles. All magnets have two poles, namely, the north pole and the south pole. In order to identify the poles, the north pole is usually painted in red colour. The other end of the magnet will, therefore, be the south pole. In laboratories, magnets are painted completely red in colour with a white dot to indicate the north pole.

Magnets can be classified into natural and artificial magnets. A material which occurs naturally and possesses magnetic properties is called a natural magnet, e.g. magnetite (lodestone). A material which is made into a magnet by artificial means is called an artificial magnet. Artificial magnets are made by magnetising different shapes of magnetic materials. A rectangular iron bar, an iron needle, a blade or an iron nail can be turned into a magnet by rubbing a bar magnet over it. Hence artificial magnets can be of diffrent shapes, e.g., bar magnets, cylindrical magnets, dumb-bell shaped magnets, horseshoe magnets, etc. Also, artificial magnets are more powerful than natural magnets.

Magnets can also be made using electricity. An electromagnet is made by passing an electric current around an iron piece. Magnets which lose their magnetic property when the cause producing the magnetism is removed are called temporary magnets. Electromagnets and magnets made of soft iron are temporary magnets. Magnets which do not lose their magnetic property even when the cause producing the magnetism is removed are called permanent magnets. Magnets made of steel are permanent magnets. The strongest magnets are made of an alloy containing aluminium, nickel, iron and cobalt (ALNICO). Even small magnets of ALNICO are strong enough to lift hundreds of times their own weight.

Magnetic Compass

A magnetic compass is an instrument which is used by sailors and navigators to find the direction in which their ship is going. It has a thin magnetic needle supported from a pivot so that it can rotate freely. The needle is placed over a dial with the directions marked. The entire assembly is placed inside an airtight box. The north pole of the magnetic needle is painted red. The magnetic needle in the compass points in the north-south direction. By aligning the dial properly, the directions can be found. In the ancient days, an old pointing device called the south-pointing fish was used to know the directions, in which the head of the fish pointed towards the south.

Properties of Magnets

- Attractive property: A magnet attracts magnetic materials towards itself.
- Directive property: A freely suspended bar magnet always aligns in the north-south direction.
- Unlike poles attract each other and like poles repel each other.
- A magnet with a single pole does not exist. If a magnet is cut into two pieces each piece will behave like an independent magnet, with a north pole and a south pole.
- When a bar magnet is rubbed over an iron bar, it changes the iron bar into a magnet.
- If a magnet is heated, hammered or dropped from a height, it loses its magnetism.
- Repulsion is the surest test of magnetism.
- Magnets can damage objects like CDs, DVDs, debit cards, credit cards, audio and video cassettes, and mobile phones which contain magnetic material.

Storing Magnets

If a magnet is left to itself over a long period of time it gets demagnetised, i.e. it loses its magnetic property. To avoid this, when not in use, magnets are stored between soft iron pieces called keepers. To protect magnets from demagnetisation, bar magnets are arranged in pairs with their opposite poles facing each other and two soft iron pieces are placed at the two ends of the pair of magnets.

Uses of Magnets

- Magnets are used in making magnetic compasses which help sailors and navigators to know the directions.
- Magnets are used in magnetic toys, stickers, refrigerator doors, etc.
- Magnets are used for separating iron from ores containing other non-magnetic substances.
- Electromagnets are used in generators, motors, loud speakers, telephones, TV sts, fans, mixers, electric bells, etc.
- Electromagnets are used in cranes to lift heavy iron bars and to separate iron objects from scrap.
- Eye doctors use magnets to remove tiny iron pieces that have accidentally fallen into the patient's eye.

Magnetic Field and Magnetic Lines of Force

The space around the magnet where its influence can be experienced is called the magnetic field. The magnetic field is filled with magnetic lines of force. A magnetic line of force is a closed continuous curve in a magnetic field along which the north pole will move if free to do so, and its direction is given by the direction in which the north pole will point.

Properties of Magnetic Lines of Force

- Magnetic lines of force are closed continuous curves.
- They travel from north to south outside the magnet and from south to north inside the magnet.
- They never intersect each other. If two field lines intersect, there would be two directions of the magnetic field at that point, which is not possible.
- they are crowded near the poles of the magnet where the magnetic field is strong and are separated near the middle of the magnet and far from the magnet, where the magnetic field is weak.
- They behave like the stretched elastic rubber strings. They contract laterally, i.e., they bend along the length of the magnet.

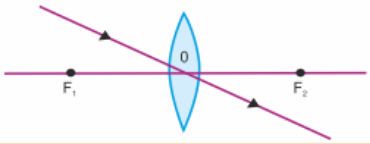
Light

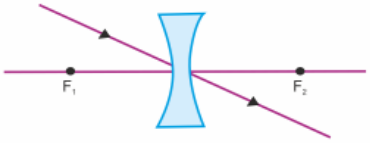
The branch of physics dealing with the properties and behaviour of light is called **optics**. **Light** is a form of energy which helps us to see the objects.

- Have you ever wondered why we are able to see the different objects around us, their images in a mirror , in a pond? This is simply due to **reflection of light** .
- When light travels obliquely from one transparent medium into another it gets bent. e.g. This bending of light is called **refraction of light**. The straw appears to break at the surface of the water due to refraction of light. As light passes from air to water, its speed slows down and the light rays are bent.
- **Speed of light** is different in different optical mediums.
- **Refractive Index** is a characteristic property of a medium. The refracting ability of a medium is measured by its refractive index. Those with higher values of refractive index are optically denser than those with lower values of refractive index. e.g. water is optically denser than air but optically rarer than glass.
- Learn about **lenses - concave and convex** and their image formation. Solve the problems related to lens, their image formation and refraction.
- Learn the **dispersion of white light** through a prism and how a spectrum is formed. The phenomenon of splitting of white light by a prism into its constituent colours is known as dispersion.
- The band of colours obtained on a screen on passing white light through a prism, is called **spectrum**. Do you know why we cannot see the whole spectrum ?
- Learn about different optical instruments- **simple microscope, astronomical telescope.**

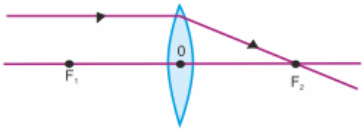
LC7074 Rules for the Formation of Image by the Lenses.

1) In both the lenses a ray of light passing through the optical center goes without any deviation.

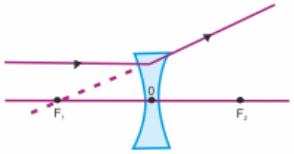




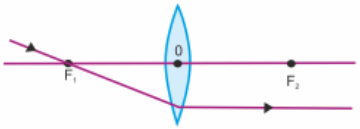
A ray of light parallel to the principal axis after refraction passes through the focus on the other side of the lens.



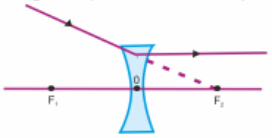
A ray of light appears to diverge from the focus on the same side of the lens.



A ray of light passing through the focus after refraction goes parallel to the principal axis.



A ray of light directed towards the focus after refraction goes parallel to the principal axis.



LC7068 Refractive Index

Refractive Index is a characteristic property of a medium. The refracting ability of a medium is measured by its refractive index.

$$\text{Refractive index} = \frac{\textit{Speed of light in the medium from which light travels}}{\textit{Speed of light in the medium into which light travels}}$$

$$\text{Refractive index of a medium} = \frac{\textit{Speed of light in air or vaccum}}{\textit{Speed of light in medium}}$$

Refractive Indices

Medium	Refractive Index
Air	1.003
Water	1.33
Alcohol	1.36
Kerosene	1.42
Types of glasses	1.5-1.7
Diamond	2.42

Mediums with higher values of refractive index are optically denser than mediums with lower values of refractive index. e.g. water is optically denser than air but optically rarer than glass.

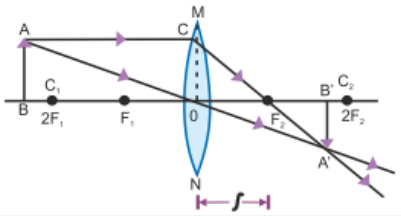
LC7075

Images formed by Convex Lens

1) When object is placed beyond 2F.

The image is :

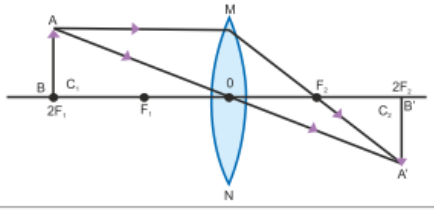
- formed between F_2 and $2F_2$
- real and Inverted
- diminished



2) When the Object is Placed at $2F_1$

The image is :

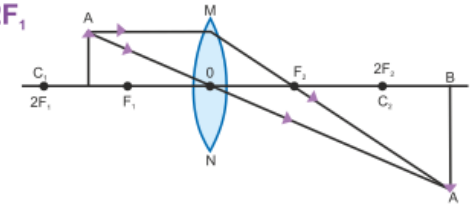
- formed at $2F_2$
- real and Inverted
- same size as the object



3) When the Object is Placed between F_1 and $2F_1$

The image is :

- formed beyond $2F_2$
- real and Inverted
- magnified



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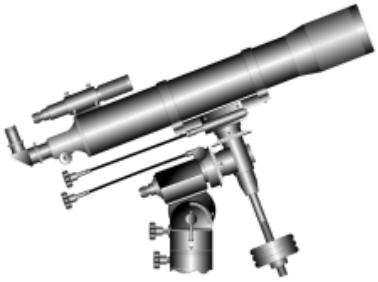
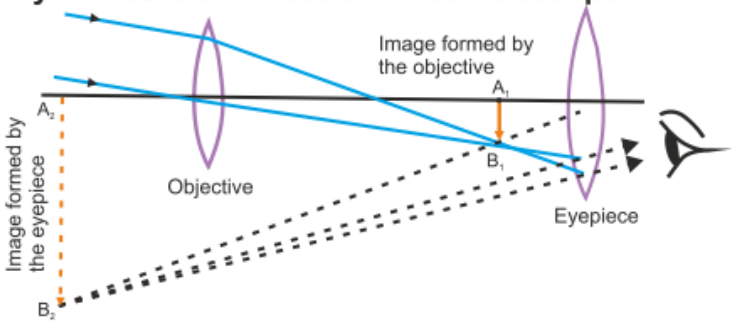
Applications of Lenses

3) Astronomical Telescope

The telescope used to **see heavenly bodies** is called **astronomical telescope**.





It has two convex lenses fitted at the ends of a long tube. The length of the tube is equal to the sum of the focal lengths of the two lenses. The lens facing the object is called objective and the lens near which the eye is placed is called **eyepiece**. The **objective** has a large focal length.

Working

Light from objects that are far away (infinity) reaches it as parallel beam and forms an image at the focus of the objective. This image acts as the object for the eyepiece, which creates a magnified, inverted and virtual image.

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LI16

- India CBSE
- Marashtr

- **FORCE**
- a**1. Joule It is the work done by a force of one Newton when the body is displaced one meter. 2. Erg It is the work done by a force of one Dyne when the body is displaced one centimeter. 3. Foot Pound (ft-lb) It is the work done by a force of one pound when the body is displaced one foot. 4. Force It is an agent that moves or tends to move or stops or tends to stop a body. 5. Watt Watt is the unit of power that is equal to the quantity of 1 Joule work done in 1 second. Work When a force produces displacement in a body, it is said to do work. Units of Work S.I System - Joule C.G.S**

- 4. Sometimes, a crackling sound is heard while taking off a sweater during winters. Explain.

Answer

Sweater is made of wool and generally shirt we wear is made of cotton blended with some synthetic fibers. Constant friction between the shirt and sweeter lets transfer of electrons from one material to the other. This results in building of electric potential. When enough potential has been accumulated, while taking of the sweater it discharges and transfer of electrons take place. Passage of electrons through air in the forms of spark let out heat and sound energy. Thus we hear the crackling sound and in dark rooms we may see the spark lights as well.

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5. Explain why a charged body loses its charge if we touch it with our hand.

Answer

When we touch a charged body, with our hand, the excess of accumulated charge or static charges on it, gets transfer to ground through our body. Thus the charged body loses its charge, and becomes neutral.

6. Name the scale on which the destructive energy of an earthquake is measured. An earthquake measures 3 on this scale. Would it be recorded by a seismograph? Is it likely to cause much damage?

Answer

The destructive energy of an earthquake is measured on Richter Scale.
The reading of magnitude 3 on the Richter scale would be recorded by a seismograph.
If the Richter scale gives a reading of magnitude 3, then the earthquake is not likely to cause much damage.
Generally, earthquake of magnitudes higher than 5 is considered destructive in nature.

7. Suggest three measures to protect ourselves from lightning.

Answer

Protective measures against lightning are:→ Stay indoor or under covered area.
→ Do not take bath during lightning.
→ Do not use any electrical appliances during lightning.

8. Explain why a charged balloon is repelled by another charged balloon whereas an uncharged balloon is attracted by another charged balloon?

Answer

A charged balloon is repelled by another charged balloon because both carry same charges and we know same charges repel each other whereas an uncharged balloon is attracted by charged balloon because unlike charges attract each other.

9. Describe with the help of a diagram an instrument which can be used to detect a charged body.

Answer

An electroscope can be used to detect whether a body is charged or not. The following figure shows a simple electroscope.

Thermodynamics

- Thermodynamics is that branch of physics which is concerned with transformation of heat into mechanical work.
- It deals with the concepts of heat, temperature and interconversion of heat into other forms of energy i.e., electrical, mechnical, chemical magnetic etc.
- Thermodynamics does not take any account of atomic or molecular constitution of matter and it deals with the bulk systems.
- State of any thermodynamic system can be described in terms of certain know macroscopic variables known as thermodynamic variables.
- Thermodynamic variables determine the thermodynamic behaviour of a system . Quantities like pressure(P), volume(V), and temperature(T) are thermodynamic variables. Some other thermodynamic variables are entropy, internal energy etc. described in terms of P, V and T
- A thermodynamic system is said to be in thermal equilibrium if all parts of it are at same temperature.
- Thus two systems are said to be in thermal equilibrium if they are at same temperature.