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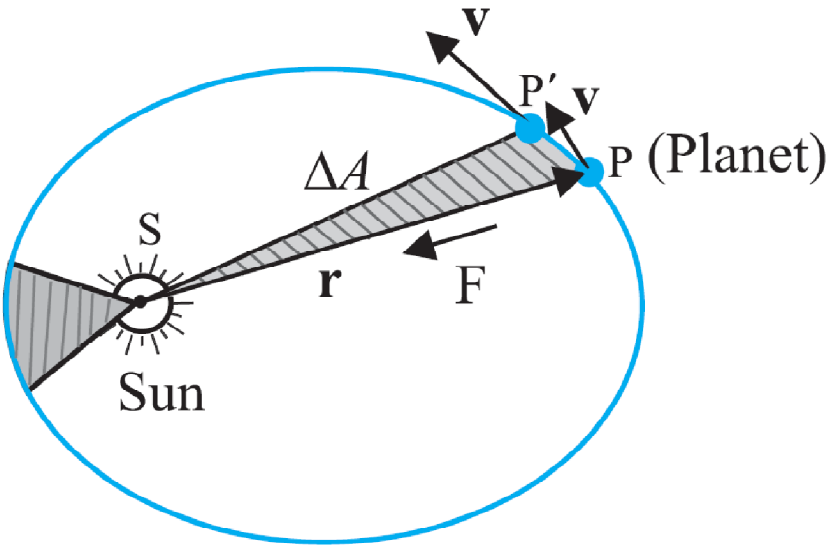

Class-8th

PHYSICS

STUDY NOTES & WORKSHEET

STARS AND THE SOLAR SYSTEM

Contact

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Stars and the Solar System

1. INTRODUCTION

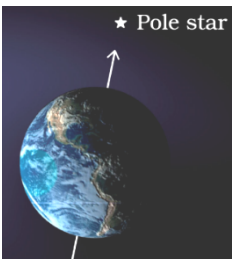
The objects which exist in the sky (or in the outer space) are called celestial objects. The stars (including the Sun), the planets (including the Earth), satellites (like the Moon), asteroids, comets and meteoroids are all celestial objects. Celestial objects are also known as heavenly objects (or heavenly bodies).

1.1 The Night Sky

The various celestial objects which we can see easily in the night sky are stars, planets, moon and meteors (or shooting stars). An important characteristic of stars is that they appear to twinkle in the sky. The twinkling of stars is an illusion (false show) caused by the disturbance of star's light by Earth's atmosphere. Planets do not twinkle because they are much more nearer to the Earth than the stars. Moon is the most prominent object which we can see in the night sky.

2. STARS

Stars are the celestial objects (like the Sun) that are extremely hot and have light of their own. Stars emit heat and light continuously. Stars consist mostly of hydrogen gas. The heat and light of stars is produced by the nuclear fusion reactions taking place inside them all the time. In these fusion reactions, hydrogen present inside the stars is converted into helium, with the release of a tremendous amount of heat and light. The stars appear to be small because they are very, very far away from us. The Sun is the star which is nearest to the Earth. The Sun looks much bigger and brighter because it is much nearer to us than any other star. Though the stars are present in the sky even during the daytime, but we cannot see them during the daytime because of the bright light of the Sun. The stars appear to move in the sky from east to west direction. This apparent motion of the stars in the sky from east to west is due to the rotation of Earth from west to east on its axis. When the Earth moves on its axis from west to east, then the stars in the sky appear to move in the opposite direction: from east to west. There is one star which does not appear to move in the sky. It is called Pole Star. Thus, the star which appears stationary from the Earth is Pole star. **The Pole Star appears to be stationary and does not change its position with time because it lies on the axis of rotation of Earth** (which is fixed in space and does not change with time).



2.1 The Unit of Measuring Distances in the Universe: Light Year

The distances between the various celestial objects (like the stars and planets) are expressed in the unit of 'light year'. **One 'light year' is the distance travelled by light in one year.**

$$1 \text{ light year} = 9.46 \times 10^{12} \text{ kilometres}$$

Light year is a unit of distance. In addition to light year, light minute is also used as a unit of distance in some cases. One light minute is the distance travelled by light in one minute. The distance of Sun from the Earth is 8 light minutes. In other words, we can say that the Sun is about 8 light minutes away from the Earth. **After the Sun, the next nearest star to the Earth is 'Proxima Centauri'.**

3. CONSTELLATIONS

The group of stars which appears to form some recognizable shape or pattern is known as a constellation. All the stars of a constellation always remain together. Due to this the shape of a constellation always remains the same. Our ancestors named these 'star groups' or 'constellations' after the objects which they seemed to resemble. About 88 constellations are known at present. Each constellation has been given a name signifying an animal, a human being or some other object which it appears to resemble. Some of the important constellations are:

(i) Ursa Major *(ii)* Cassiopeia *(iii)* Orion *(iv)* Leo Major

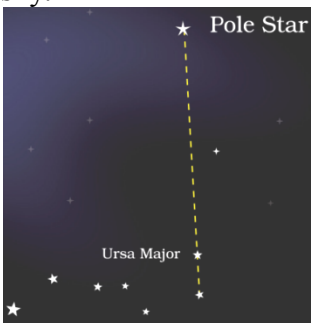
(a) Great Bear *(b) Orion* *(c) Cassiopeia* *(d) Leo Major*

Some constellations in the night sky

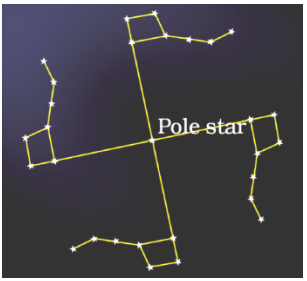
3.1 Ursa Major Constellation

Ursa Major constellation is one of the most famous constellation which we can see in the night sky. **Ursa Major constellation is also known as 'Great Bear'**, 'Big Bear', 'Big Dipper' or 'Plough'. The Indian name of Ursa Major constellation is 'Saptarishi'. The Ursa Major constellation consists of seven bright stars which are arranged in a pattern resembling somewhat a big bear.

The Ursa Major constellation is visible during the summer season in the early part of the night. The Ursa Major constellation appears to revolve around the Pole star in the night sky.



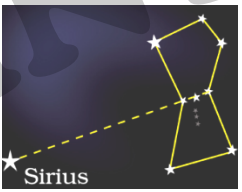
Locating the pole star



Ursa Major moves around the Pole Star

3.2 Orion Constellation

Orion is one of the well known and most impressive constellations in the night sky. Orion is also known as 'Hunter'. **The Indian name of Orion is 'Mriga'**. The Orion constellation consists of seven or eight bright stars (and several faint stars.) The Orion constellation is visible in the sky during the winter season in the late evenings. The brightest star in the night sky is 'Sirius'. The brightest star called 'Sirius' is located close to the Orion constellation.



Locating - Sirius

3.3 Cassiopeia Constellation

Cassiopeia constellation consists of 5 main stars. The 5 main stars of Cassiopeia constellation are arranged to form the shape of distorted letter W or M. Cassiopeia constellation is visible during winter in the early part of the night.

3.4 Leo Major Constellation

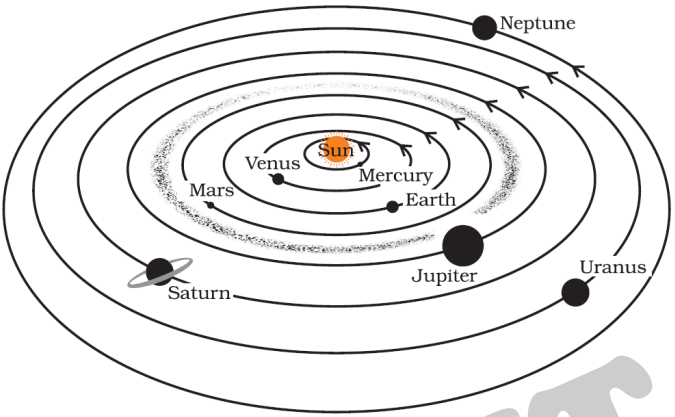
Leo Major constellation usually consists of 9 main stars. Leo means lion. So, the arrangement of stars in Leo Major constellation is thought to form the outline of a big lion. Leo Major constellation is visible during summer in the early part of the night. Leo Major constellation is sometimes called just Leo constellation.

4. The Solar System

Solar system consists of the Sun, the eight Planets and their Satellites (or Moons) and millions of smaller celestial objects such as Asteroids, Comets and Meteoroids. The Sun is at the centre of the Solar System and all other objects are revolving around it in fixed elliptical paths called orbits.

The eight planets of the Solar System (in order of their increasing distances from the Sun) are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. All the planets (except Mercury and Venus) have natural satellites (or moons) around them. Just as planets revolve around the Sun, in the same way, the satellites revolve around the planets.

The gravitational pull of the Sun keeps all the planets and other objects revolving around it.



5. SUN

The Sun is a star. It is the star around which the Earth and other planets revolve. Compared with the millions of other stars, the Sun is a medium-sized star and of average brightness. The Sun appears to be bigger and brighter because it is much more nearer to the Earth than any other star. The Sun is a star having a system of planets around it with life on one of its planets called Earth. The diameter of the Sun is about 100 times the diameter of the Earth, and mass of the Sun is more than a million times the mass of the Earth.

The Sun is an extremely hot object. The temperature at the surface of the Sun is about 6000^0 C . The Sun is not a solid object. It is a sphere of hot gases. The Sun consists mostly of hydrogen gas. The nuclear fusion reactions taking place in the centre of the Sun produce a tremendous amount of energy in the form of heat and light. It is this nuclear energy which makes the Sun shine. The Sun is the main source of heat and light energy for all the planets of the solar system and their satellites, etc.

6. PLANETS

Planets are the large celestial objects which revolve around the Sun in closed elliptical paths called orbits. There are 8 major planets (including the Earth). The planets of the Solar system are:

1. Mercury **2.** Venus **3.** Earth **4.** Mars
5. Jupiter **6.** Saturn **7.** Uranus **8.** Neptune

The planets have no light of their own. The planets shine because they reflect the light of the Sun which falls on them. Since the planets are much nearer to us than the stars, they appear to be big and do not twinkle at night. In fact, the easiest way to distinguish planets from the stars in the night sky is that the stars appear to twinkle at night but the planets do not twinkle at all. The planets keep changing their positions with respect to stars in the night sky.

A planet may be made of rock and metal, or gas. The first four planets, Mercury, Venus, Earth and Mars are much nearer to the Sun. The first four planets are called **inner planets**. The four inner planets (Mercury, Venus, Earth and Mars) are made of rocks and have metallic cores. The four inner planets are comparatively small and dense bodies having solid surfaces like Earth. Earth is the biggest of the four inner planets. The inner planets have very few natural satellites.

The planets outside the orbit of Mars are called **outer planets**. Thus, Jupiter, Saturn, Uranus and Neptune are called outer planets. The outer planets are much farther off from the Sun than the inner planets. The four outer planets are giant planets. The four outer planets (Jupiter, Saturn, Uranus and Neptune) are made mainly of hydrogen and helium gases, and not of rock and metal.

All the planets revolve around the Sun and also rotate on their axis. The time taken by a planet to complete one revolution around the Sun is called its period of revolution. The time taken by different planets to make one revolution around the Sun is, however, different. Actually, as the distance of a planet from the Sun increases, its period of revolution also increases. The time taken by a planet to complete one rotation on its axis is called its period of rotation.

A Planet rotates on its own axis like a top

6.1 Mercury

Mercury is the first planet from the Sun. Mercury is the planet which is nearest to the Sun. Since the planet Mercury is closest to the Sun, therefore, it is very hot during the day. Mercury is the smallest planet of the Solar System. The planet Mercury has a rocky surface which is covered with craters. Mercury is always close to the Sun and usually hidden by the Sun's glare.

The planet Mercury can be seen either as a Morning Star in the eastern sky just before sun-rise or as an Evening Star in the western sky just after sun-set. Planet Mercury shows phases like the Moon. This is due to the fact that Mercury lies

inside the Earth's orbit. So, as Mercury revolves around the Sun, its sun-lit surface is visible in varying amounts from the Earth. This produces phases of Mercury. **No life can exist on the planet Mercury** because it is extremely hot and has no water on it. Mercury has no satellite.

6.2 Venus

Venus is the second planet from the Sun. **Venus is the closest planet to the Earth**. The rotation of Venus on its axis is somewhat unusual. This is because Venus rotates on its axis from east to west. Venus is a rocky planet. The planet Venus has a dense atmosphere which consists almost entirely of carbon dioxide gas. Venus is the brightest planet in the night sky. In fact, the planet Venus is the brightest object in the night sky. The hottest planet is Venus. The Planet Venus is also called a 'Morning Star' or an 'Evening Star'. The Planet Venus also shows phases like the Moon. Venus has no satellite. Mercury and Venus are the only two planets of the Solar System which have no satellites revolving around them.

6.3 Earth

Earth is the third planet from the Sun. The two planets which lie between the Sun and the Earth are Mercury and Venus. The Earth is spherical in shape. When viewed from the outer space, the Earth appears to be a blue and green ball due to the reflection of sunlight from water and land on its surface. Earth is the only planet in the Solar System on which life is known to exist.

The various environmental conditions available on Earth which are responsible for the existence and continuation of life on Earth are as follows:

(a) **The Earth has an atmosphere** (which contains many gases including oxygen and carbon dioxide). The Earth's atmosphere plays an important role in maintaining life on the Earth. For example, the Earth's atmosphere has sufficient oxygen, the gas we need in order to live. The Earth's atmosphere also supplies carbon dioxide needed for the preparation of food by photosynthesis by the plants.

(b) **The Earth has large quantities of water**. In fact, Earth is the only planet to have lots of water. This water helps in the evolution and maintenance of life on Earth. There can be no life without water.

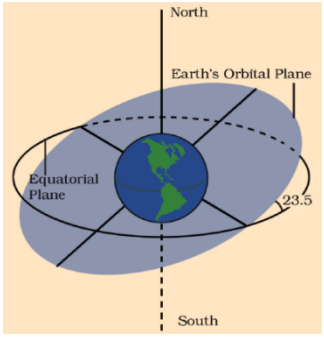
(c) **The Earth has a suitable temperature range for the existence of life**. The Earth is neither too hot nor too cold.

(d) **The Earth has a protective blanket of ozone layer high up in the atmosphere.** This ozone layer absorbs most of the extremely harmful ultraviolet radiations coming from the Sun and prevents them from reaching the Earth and hence protects the living things on the Earth.

The Earth has two types of motion:

- the Earth rotates on its axis, and
- the Earth revolves around the Sun.

The Earth rotates on an imaginary axis which passes through its North and South Poles. The Earth completes one rotation on its axis in 24 hours which we call one day. The axis of rotation of the Earth is slightly tilted with respect to the plane of its orbit around the Sun.



Earth rotates on a tilted axis

An important consequence of the rotation of Earth on its axis is that it causes day and night on the Earth. The Earth rotates on its axis and also revolves around the Sun in an elliptical orbit. The Earth takes 1 year to complete one revolution around the Sun. An important consequence of the motion of tilted Earth around the Sun is that it causes different seasons on the Earth. The Earth has one natural satellite called Moon.

6.4 Mars

Mars is the fourth planet from the Sun. It is the first planet beyond Earth. Mars is also called the red planet because its surface appears red. The red colour of Mars is used to distinguish it from other planets of the Solar System. Mars is visible from the Earth for most part of the year. **Of all the planets, Mars is most like the Earth**. Mars is a rocky planet. Mars has a thin atmosphere as compared to the Earth. The thin atmosphere of Mars contains mainly carbon dioxide with small amounts of nitrogen, oxygen, noble gases and water vapour. Mars has two natural satellites.

6.5 Jupiter

Jupiter is the fifth planet from the Sun. **Jupiter is the biggest planet of the Solar System**. It is almost twice as large as rest of the planets put together. Jupiter appears to be a very bright object in the night sky. Jupiter's bright appearance is due to the fact that it has a thick, cloudy atmosphere which reflects most of the sunlight falling on it. Jupiter is made of hydrogen and helium. Life cannot exist on the planet Jupiter because it has poisonous gases in its atmosphere. Moreover, Jupiter is a very cold planet. Jupiter has 67 satellites.

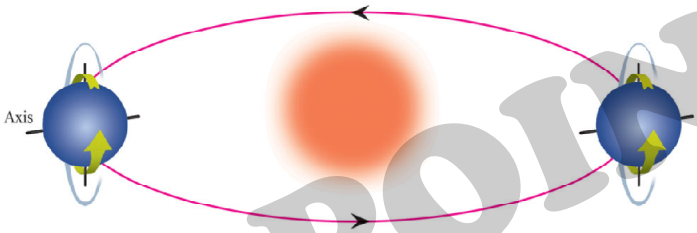
6.6 Saturn

Saturn is the sixth planet from the Sun. Saturn is somewhat smaller in size and mass than Jupiter. Saturn is the second biggest planet of the Solar System. Saturn is also made up mainly of hydrogen and helium. One interesting thing about Saturn

is that it is the least dense among all the planets of the Solar System. The density of Saturn is even less than that of water. The most distinguishing feature of Saturn is the system of colourful rings which surround it. Three distinct sets of rings around Saturn are visible from the Earth. Saturn is the only planet with a system of well-developed rings encircling it. Saturn has 62 satellites.

6.7 Uranus

Uranus was the first planet to have been discovered with the help of a telescope. Though the diameter of Uranus is almost four times that of the Earth, it appears as a small disc through a telescope. This is because Uranus is very, very far off from the Earth. After Jupiter and Saturn, Uranus is the third biggest planet of the Solar System. Like Venus, Uranus also rotates on its axis from east to west. The most remarkable feature of Uranus is that it has highly tilted axis of rotation.



Uranus in its orbital path

Uranus appears to roll on its side while orbiting around the Sun. Uranus is made up mainly of hydrogen and helium. Uranus is an extremely cold planet. It is also surrounded by an atmosphere of poisonous gases.

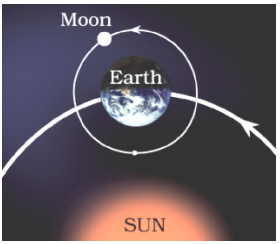
6.8 Neptune

Neptune is the eighth planet from the Sun. It lies beyond Uranus. Neptune is the outermost planet of the Solar System. The planet Neptune is farthest from the Sun. Neptune is the second planet which was discovered with the help of a telescope. Neptune is made up mainly of liquid and frozen hydrogen and helium gases. Neptune is an extremely cold planet. So, no life can exist on the planet Neptune. Neptune has 14 satellites (or moons).

7. SATELLITES

A satellite is a celestial body that revolves around a planet. Earth is a planet. Since the Moon revolves around the Earth, therefore, Moon is a satellite of the Earth. Out of the eight planets of the solar system, the first two planets, Mercury and Venus, do not have satellites. All the remaining six planets have one or more satellites.

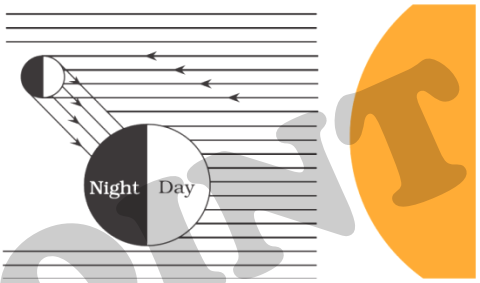
The satellites revolve around the planets due to the gravitational pull of the planets. The satellites have no light of their own. The satellites shine and become visible to us because they reflect the light of the Sun falling on them.



Earth accompanied by Moon revolving round the Sun

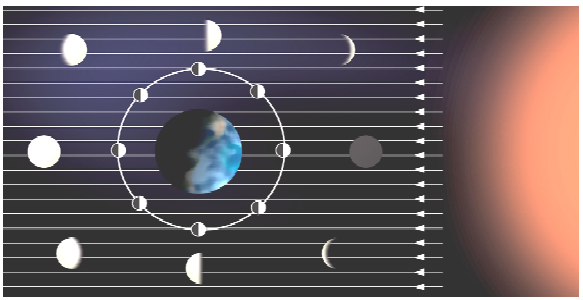
7.1 Moon

The moon is a natural satellite of the Earth. The Moon revolves around the Earth on a definite regular path-the Moon's orbit. The gravitational attraction of the Earth holds the Moon in its orbit. Moon is the closest celestial object to the Earth. Moon appears to be much bigger than the stars because it is much more nearer to the Earth than the stars. The surface of Moon is covered with hard and loose dirt, craters and mountains. The Moon has no air. The Moon has no water. Since there is no air or water on the Moon, therefore, there is no life on the Moon.



Moon is visible due to reflected sunlight

We are able to see the Moon because the sunlight falling on the Moon gets reflected towards the Earth. There is one day in the month when the Moon cannot be seen in the night (even when the sky is clear and there are no clouds, etc.). The day on which the Moon is not visible at all is called the **new Moon day**. There is also one day in a month when the Moon is visible as perfectly round ball of light in the sky. The day on which the whole bright disc of Moon is visible to us on the Earth is called the **full Moon day**. The different shapes (or appearances) of the bright, visible part of the Moon as seen from the Earth are called phases of the Moon. As Moon revolves around the Earth once every month and moves around the Sun along with Earth, different amounts of its sun-lit surface are turned towards the Earth leading to a change in the appearance of Moon and formation of phases of the Moon.



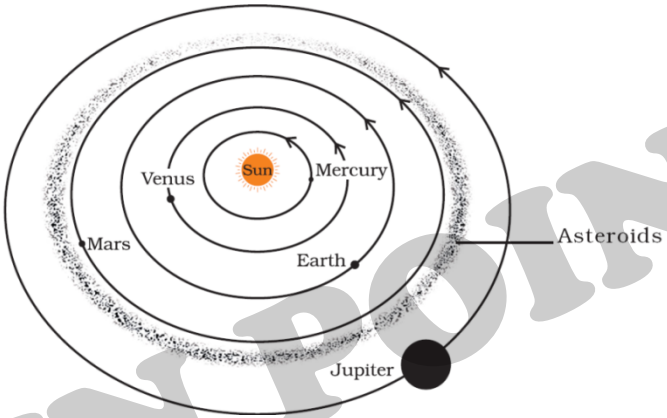
Positions of the moon in its orbit and its corresponding phases

7.2 Some Other Members of the Solar System

In addition to the Sun, planets and satellites, the Solar System also includes asteroids, comets and meteoroids. Asteroids, Comets and Meteoroids revolve around the Sun just like the planets but they are much smaller than the planets.

8. ASTEROIDS

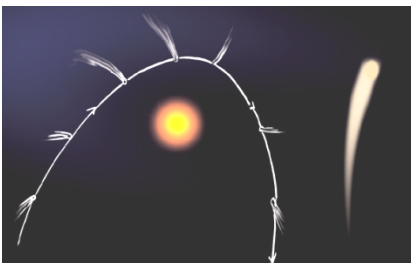
Asteroids are small celestial objects which revolve around the Sun between the orbits of Mars and Jupiter. Asteroids are smaller than the planets. Asteroids are also called minor planets. The asteroids are rocks of various sizes. Asteroids are the members of the Solar System.



Asteroid belt

9. COMETS

Comets are very small celestial objects made of gas and dust which revolve around the Sun in highly elliptical orbits and become visible only when they come close to the Sun. The tail of a comet always points away from the Sun. The tail of a comet grows longer as it comes nearer the Sun but it disappears when the comet moves far away from the Sun. Comets are smaller than asteroids. Comets are also the members of our Solar System. Comets revolve around the Sun just like planets. The period of revolution of a comet around the Sun is very, very large. For example, Halley's comet has a period of revolution of about 76 years. That is, Halley's comet is seen after every 76 years.



Different position of a Comet

10. METEOROIDS

Meteoroids are celestial objects which range in size from tiny sand grains to big boulders of several hundred tonnes and revolve around the Sun in their orbits. Meteoroids are much smaller than asteroids and comets. Meteoroids are present throughout the Solar System. Meteoroids are members of the Solar System because they revolve around the Sun. Meteoroid is a small body in the Solar System that would become a meteor if it entered Earth's atmosphere. **Meteors** are the celestial bodies from the sky which we see as a bright streak of light that flashes for a moment across the sky. The meteors are commonly called shooting stars. When a meteor enters into the atmosphere of Earth with high speed, a lot of heat is produced due to the resistance of air. This heat burns the meteor and the burning meteor is seen in the form of a streak of light shooting down the sky, and it falls on the Earth in the form of dust. A meteor lasts for a very short time because the tiny rocky pieces burn and vaporise completely in a few seconds due to the excessive heat produced by atmospheric friction. When the Earth crosses the tail of comet, swarms of meteors are seen. These are known as meteor showers.

A meteor is commonly known as a shooting star though it is not really a star. **A meteor is called a shooting star** because, viewed from the Earth, it looks like a streak of starlight shooting across the night sky. The main difference between a star and a shooting star is that a star has its own light but a shooting star has no light of its own. The light of shooting star is produced when its particles burn on entering the Earth's atmosphere. A meteor which does not burn up completely on entering the Earth's atmosphere and lands on Earth is known as a meteorite.

11. ARTIFICIAL SATELLITES

A man-made space-craft placed in orbit around the Earth is called an artificial satellite. The artificial satellites are also known as man-made satellites. The motion of artificial satellite around the Earth is maintained by the gravitational pull of the Earth. The main differences between the artificial satellites of the Earth and its natural satellite Moon are as follows:

(a) The artificial satellites are much nearer to the Earth than its natural satellite Moon.

(b) The height of the artificial satellites from the Earth can be adjusted according to our needs. This is, however, not possible with the natural satellite of Earth called Moon.

The artificial satellites carry a large variety of equipment and instruments inside them. For example, they may carry sound and picture relaying machines, cameras, infra-red sensors, telescopes and many other type of instruments required for doing different jobs. The electricity required for running the equipment in an artificial satellite is provided by solar cells. The technique of collecting information about an object from a distance is called **remote sensing**. Remote sensing satellites can scan the Earth's surface very closely with their cameras and infra-red sensors, even while orbiting high above the Earth.

India has built and launched many artificial satellites. The first artificial satellite launched by India was 'Aryabhatta'. It was launched in 1975. Some other Indian satellites are: Bhaskara, INSAT, IRS, Rohini, Kalpana-1 and EDUSAT. The Agency responsible for the development of space science programmes in our country is 'Indian Space Research Organisation (ISRO).

The important applications of artificial satellites are given below:

- Artificial satellites are used for communications such as long distance transmission of television programmes, radio programmes, telephone calls and internet. The artificial satellites used for communications purposes are called Communication Satellites.
- Artificial satellites are used for weather forecasting and for giving advance warning of floods and cyclones, etc. Weather forecasting is done by using artificial satellites called weather satellites which are a kind of remote sensing satellites.
- Artificial satellites are used for surveying the natural resources of the Earth like minerals, agricultural crops and potential fishing zones in the sea etc. This is done by using the artificial satellites called remote sensing satellites.
- Artificial satellites are used for spying for military purposes (like observing the movement of enemy troops and military equipment, taking pictures of enemy air-fields and harbours, etc.) Remote sensing satellites are used for spying for military purposes.
- Artificial satellites are used to collect information about other planets, stars and galaxies, etc. The artificial satellites used for studying celestial objects are called 'Astronomy Satellites'.

12. GRAVITATIONAL FORCE

A force is necessary to produce motion in a body. A stone dropped from a height falls towards the earth because the earth exerts a force of attraction (called gravity) on the stone and pulls it down. ***The force with which the earth pulls the objects towards it is called the gravitational force of earth or gravity (of earth)***.The

gravitational force of earth (or gravity of earth) is responsible for holding the atmosphere above the earth; for the rain falling to the earth; and for the flow of water in the rivers. It is also the gravitational force of earth (or gravity of earth) which keeps us firmly on the ground.

12.1 Universal Law of Gravitation

Everybody in the universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. The direction of force is along the line joining the centres of the two bodies.

According to the universal law of gravitation:

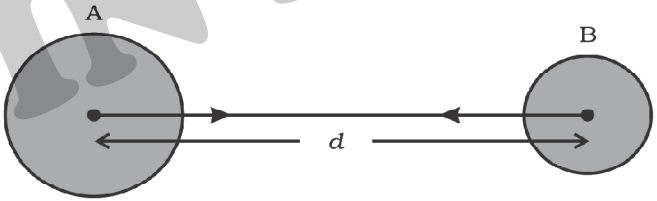
(i) The force between two bodies is directly proportional to the product of their masses. That is, $F \propto m_1 \times m_2$

(ii) The force between two bodies is inversely proportional to the square of the distances between them. That is, $F \propto \frac{1}{r^2}$

From above two statements, we get: $F \propto \frac{m_1 \times m_2}{r^2}$

$$\Rightarrow Gravitational\ Force\ (F) = G \times \left(\frac{m_1 \times m_2}{r^2} \right)$$

In formulation, ***G*** is a constant known as "***universal gravitational constant***".



The gravitational force between two uniform objects is directed along the line joining their centres.

- If we double the distance between two bodies, the gravitational force becomes one-fourth and if we halve the distance between two bodies, then the gravitational force becomes four times.

12.2 Units of gravitational constant (G)

$$F = G\left(\frac{m_1 m_2}{r^2} \right)$$

This can be rearranged to get an expression for the gravitational constant G as follows:

$$G = F\left(\frac{r^2}{m_1 m_2}\right)$$

So, the SI unit of gravitational constant G becomes $\mathbf{Nm^2/kg^2}$ .The value of universal gravitational constant G has been found to be $\boldsymbol{6.67 \times 10^{-11}\ Nm^2/kg^2}$. The force of gravitation is a vector quantity and it acts along the line joining the centres of mass of the two bodies.

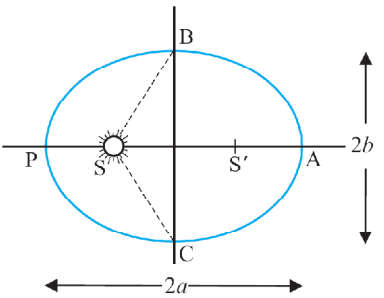
12.3 Gravitational Force Holds the Solar System Together

It is the gravitational force between the sun and the earth which keeps the earth in uniform circular motion around the sun. Similarly, the gravitational force between the earth and the moon makes the moon revolve at uniform speed around the earth. The tides in the sea formed by the rising and falling of water level in the sea are due to the gravitational force of attraction which the moon and the sun exert on the water surface in the sea.

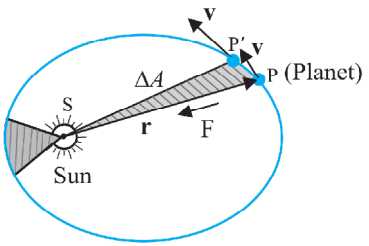
13. KEPLER'S LAWS OF PLANETARY MOTION

1. ***Kepler's first law*** states that: The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit.

An ellipse traced out by a planet around the sun. The closest point is P and the farthest point is A, P is called the perihelion and A the aphelion The semi-major axis is half the distance AP.



2. ***Kepler's second law*** states that: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time. A planet moves faster when it is closer to the sun, and moves slowly when it is farther from the sun. A planet does not move with constant speed around the sun. The speed is greater when the planet is nearer the sun, and less when the planet is farther away from the sun.



The planet P moves around the sun in an elliptical orbit. The shaded area is the area ΔA swept out in a small interval of time Δt .

3. ***Kepler's third law*** states that: The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun. The law can be expressed as:

$$r^3 \propto T^2 \;\Rightarrow\; r^3 = (\text{constant}) \times T^2 \qquad \Rightarrow \frac{r^3}{T^2} = \text{constant}$$

where r = mean distance of planet from the sun

and T = time period of the planet (around the sun)

It was Newton who showed that **the cause of the motion of planets is the gravitational force which the sun exerts on them.**

14. MASS

The mass of a body is the quantity of matter (or material) contained in it. Mass is a scalar quantity which has only magnitude but no direction. The SI unit of mass is kilogram which is written in short form as kg. The mass of a body (or object) is constant and does not change from place to place. Mass of a body is a measure of inertia of the body and it is also known as inertial mass. **The mass of a body cannot be zero**.

15. WEIGHT

The weight of a body is the force with which it is attracted towards the centre of the earth. **Weight is a vector quantity** having magnitude as well as direction. The weight of a body acts in vertically downward direction. The weight of a body also changes from place to place. The weight of a body is not constant. The weight of a body can be zero. Whatever be the weight of a body on the surface of the earth, its weight becomes zero when it is taken to the centre of the earth (because the value of g is zero at the centre of the earth). The weight of an object is measured with a spring balance. It is the gravitational force acting on an object which operates a spring balance, and not its mass.

Weight, $W = m \times g$

where m = mass of the body

and g = acceleration due to gravity

15.1 Weight of an Object on the Moon

The gravitational force of the moon is about one-sixth that of the earth, therefore, **the weight of an object on the moon will be about one-sixth of what it is on the earth.**

$$\frac{Weight\ on\ moon}{Weight\ on\ earth} = \frac{1}{6} \;\Rightarrow\; Weight\ on\ moon = \frac{1}{6}(Weight\ on\ earth)$$

15.2 Differences Between Mass and Weight

Mass	*Weight*
The mass of an object is the quantity of matter contained in it.	The weight of an object is the force with which it is attracted towards the centre of the earth.
The S.I. unit of mass is kilograms (***kg***).	The S.I. unit of weight is Newton (***N***).
The mass of an object is constant.	The weight of an object is not constant. It changes with the change in acceleration due to gravity (***g***).
The mass of an object can never be zero.	The weight of an object can be zero. For example, in the interplanetary space, where $g = 0$, the weight of an object becomes zero.

16. SATELLITE

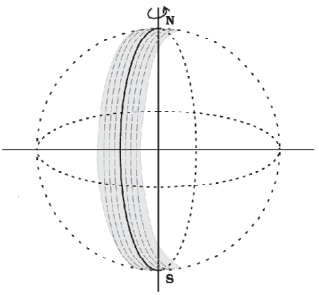
A satellite is a body which continuously revolves on its own around a much larger body in a stable orbit.

16.1 Geostationary Satellites

A satellite which revolves around the earth in its equatorial plane with the same angular speed and in the same direction as the earth rotates about its own axis is called a geostationary or synchronous satellite.
These satellites are used in communicating radio, T.V. and the telephone signals across the world. Geostationary satellites act as reflectors of such signals.

16.2 Polar Satellites

A satellite that revolves in a polar orbit is called a polar satellite. Its orbit passes over north and south poles of the earth and has a smaller radius of 500-800 km. These satellites are used in weather and environment monitoring. They provide more reliable information than geostationary satellites because their orbits are closed to the earth.



A Polar Satellite. A strip on earth's surface (shown shaded) is visible from the satellite during one cycle. For the next revolution of the satellite, the earth has rotated a little on its axis so that an adjacent strip becomes visible.

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Class-8th (SCIENCE)

Topic: STARS AND THE SOLAR SYSTEM

Worksheet-1

1. Name any two celestial objects which we can see easily in the night sky.

2. Name the star (after the Sun) which is closest to the Earth.

3. Name the unit which is used to express distances between the various celestial bodies (like stars and planets).

4. Give two other names of Ursa Major constellation.

5. In which season of the year are the following constellations visible in night sky ?

(a) Cassiopeia ***(b)*** Leo Major

6. Name the planet having a well-developed system of rings around it.

7. Which planet is known as the red planet ?

8. Name two objects other than planets which are members of the Solar System?

9. Name the member of the Solar System which appears in the sky like a bright ball of light with a long, glowing tail.

10. Write the full name of INSAT.

11. Write the full name of IRS.

12. What is meant by 'celestial objects' ? Name any three celestial objects.

13. What is a constellation? Name any two constellations.

14. Name all the planets of the Solar System in the order of their increasing distances from the Sun.

15. State one important consequence of each of the following:

(a) Rotation of Earth on its axis.

(b) Motion of tilted Earth around the Sun.

16. ***(a)*** In which direction do stars appear to move in the sky ?

(b) Why do they appear to move in this direction ?

17. Match items in column A with one or more items in column B:

Column A	*Column B*
	(a) Saturn
(i) Inner planets	(b) Pole Star
(ii) Outer planets	(c) Great Bear
(iii) Constellation	(d) Moon
(iv) Satellite of the Earth	(e) Earth
	(f) Orion
	(g) Mars

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Class-8th (SCIENCE)

Topic: STARS AND THE SOLAR SYSTEM

Worksheet-2

1. Which characteristics of Mars distinguishes it from other planets ?

2. ***Fill in the blanks:***

(a) The stars appear to _____ in the sky.

(b) The Sun is a _____ whereas Orion is a _____.

(c) The group of stars that appears to form a recognisable pattern in the sky is known as _____.

(d) The brightest star in the night sky is _____.

(e) Ursa Major constellation appears to revolve around the _____ star in the night sky.

(f) Orion constellation can be used to locate the position of _____ star whereas Ursa Major constellation can be used to locate the position of _____ star in the night sky.

(g) The planet which is farthest from the Sun is _____.

(h) The planet which appears reddish in colour is _____.

(i) The small heavenly bodies revolving around the Sun between the orbits of Mars and Jupiter are called _____.

(j) Asteroids are found between the orbits of _____ and _____.

(k) Shooting stars are actually not _____.

(l) A celestial body that revolves around a planet is known as _____.

(m) A meteoroid becomes a _____ on entering Earth's atmosphere.

(n) The long distance transmission of television programmes has been made possible with the help of _____satellites.

3. Name the constellation which appears to have the shape of:

(a) A big bear (b) A distorted W or M

(c) A hunter (d) A big lion.

4. State two differences between the artificial satellites of the Earth and its natural satellite Moon.

5. What is a comet ? Name the comet which was last seen in 1986 after a period of 76 years.

6. When does a comet become visible to us ?

7. What is a meteor ? What is the other name of a meteor ?

8. What is the difference between a star and a shooting star ?

9. What is the difference between a meteor and a meteorite ?

10. What are meteoroids? Which of two is really a member of the Solar System: Meteoroid or Meteor ?

11. ***(a)*** What is the number of prominent stars in the Ursa Major?

(b) Draw a diagram of Ursa Major constellation to show the position of main stars in it.

12. ***(a)*** What is the difference between a full Moon and a new Moon? After how many days a full Moon changes into a new Moon?

(b) What is meant by the phases of the Moon? What causes the phases of the Moon ?

13. X is a group of stars which is visible during the summer season in the early part of the night. It can be seen clearly in the month of April in the northern part of the sky. It resembles a bowl with a handle. It also resembles a big kite with a tail.

(a) What is the general name of groups of stars like X ?

(b) Write any two names of X.

(c) Is it a part of our Solar System?

(d) How many bright stars are usually observed in X?

(e) Which famous star can be located in the sky with the help of X?

14. The number of main stars in constellation A is 5, in constellation B is 7, in constellation C can be 7 or 8, whereas in constellation D is usually 9. Name the constellations A, B, C and D.

15. Which star in the night sky can be located with the help of :

(a) Orion constellation ?

(b) Ursa Major constellation ?

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Class-8th (SCIENCE)

Topic: STARS AND THE SOLAR SYSTEM

Worksheet- 3

1. Why is the distance between stars expressed in light years ? What do you understand by the statement that a star is eight light years away from the Earth ?

2. The radius of Jupiter is 11 times the radius of the Earth. Calculate the ratio of the volumes of Jupiter and the Earth. How many Earths can Jupiter accomodate ?

3. What are the various environmental conditions available on Earth which are responsible for the existence and continuation of life on Earth ?

4. Draw the sketches to show the relative positions of prominent stars in

(a) Ursa Major ***(b)*** Orion

5. ***(a)*** Explain how you can locate the Pole Star with the help of Ursa Major constellation.

(b) Explain how the position of Sirius Star can be located in the night sky with the help of Orion constellation.

6. State the universal law of gravitation. What is the importance of this law ?

7. What happens to the force between two objects, if :

(a) The mass of one object is doubled.

(b) The distance between the objects is doubled and tripled.

(c) The masses of both objects are doubled ?

8. What is the magnitude of the gravitational force between the Earth and a 1 kg object on its surface ? (Mass of the Earth is 6×10^{24} kg and Radius of the Earth is 6.4×10^{6} m).

9. What is the S.I. unit of G ? Write the relation between g and G.

10. State three points of difference between the following:

(i) g and G ***(ii)*** mass and weight

11. Gravitational force on the surface of the moon is only $\left(\frac{1}{6}\right)^{th}$ as strong as gravitational force on the earth. What is the weight in Newton of a 10 kg object on the moon and on the earth ?

12. Two lead spheres of masses 2 kg and 1 kg are placed with their centres 1 m apart. Calculate the force of attraction between the spheres.
(Given the value of G is $6.67 \times 10^{-11}\ Nm^2/kg^2$).

13. Mass of an object is 10 kg. What is its weight ?

14. A man weighs 600 N on the earth. What is his mass ? ($g = 10\ m/s^2$)

15. How much would a 70 kg man weigh on the moon? What should be his mass on the earth and on the moon ?

(Acceleration due to gravity on the moon is 1.63 m/s^2)

16. The time period of the satellite of the earth is 5 hours. If the separation between the earth and the satellite is increased to 4 times the previous value, then what will be the new time period of the satellite?

17. State and explain Kepler's laws of planetary motion. Draw diagrams to illustrate these laws.

18. Suppose a planet exists whose mass and radius both are half of the earth. Calculate the acceleration due to gravity on the surface of this planet.

19. The values of 'g' at six distances A, B, C, D, E and F from the surface of the earth are found to be 3.08 m/s^2, 9.23 m/s^2, 0.57 m/s^2, 7.34 m/s^2, 0.30 m/s^2 and 1.49 m/s^2, respectively.

(a) Arrange these values of g according to the increasing distances from the surface of the earth (keeping the value of g nearest to the surface of the earth first) ?

(b) If the value of distance F be 10000 km from the surface of the earth, state whether this distance is deep inside the earth or high up in the sky. Give reason for your answer.

20. The mass of the earth is 6×10^{24} kg and that of the moon is 7.4×10^{22} kg. If distance between the earth and the moon be 3.84×10^5 km, calculate the force exerted by the earth and the moon.

21. A Saturn year is 29.5 times the Earth year. How far is the Saturn from the Sun if the Earth is 1.50×10^8 km away from the Sun ?

22. The acceleration due to gravity at the moon's surface is 1.67 m/s^2. If the radius of the moon is 1.74×10^6 m, calculate the mass of the moon. Use the known value of G.

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