CAREER POINT

Study Material for Pre foundation Class 7

Prepared by Career Point Kota Experts

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Note to the Students

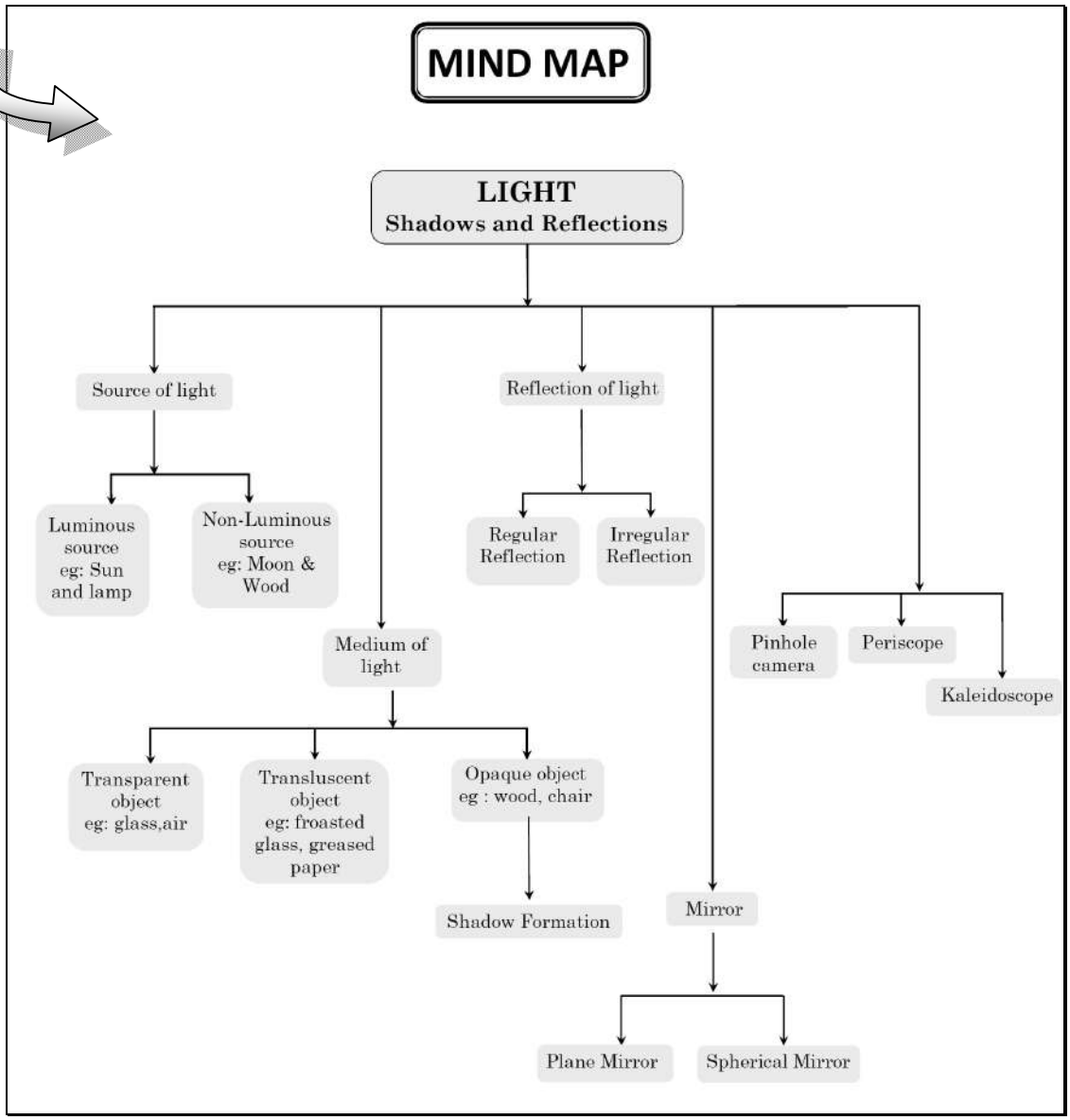
Career Point offers this Class 7 Study Package to support complete learning for school syllabus as well as Olympiad and other foundation exams. This sample represents our set of six books: **Physics**, **Chemistry**, **Biology**, **Mathematics**, **English** and **Mental Ability**. Each book provides clear concepts, examples and practice exercises to strengthen understanding and enhance problem-solving skills. The material is designed to build a strong academic foundation and prepare students with the confidence needed for higher classes and future competitive studies.

COMPONENTS OF EACH CHAPTER

These books are designed with an engaging and preparation-focused pedagogy and offer a perfect balance of conceptual learning and problem solving skills.

Mind Map

Each chapter contains many articles (Concepts, Theories etc.). Mind map interconnect all these articles logically. By this student can understand whole chapter articles interconnectivity clearly in a single picture frame.



Theory & Concepts

Each chapter consist of exhaustive theory which gives conceptual clarity and command over topics. Appropriate explanation of theory with the help of images, diagrams, flowcharts, mind maps, info graphics, and tables.

Introduction

Light is a invisible form of energy that causes the sensation of vision.

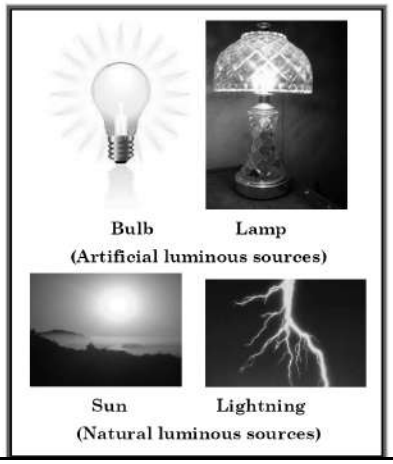
Source of Light

Those bodies which emit light in all directions are called sources of light. The sources can be point one or extended one. The sources of light are of two types:

◈ **Luminous sources**

Those objects which by itself emit light are called luminous sources.

e.g.: Sun and stars (natural luminous sources), electric lamps, candles and lanterns (artificial luminous sources).



Competitive Level

Competitive level is specially designed for competition exam rquirements and to better understanding the concepts, well explained theory, clearly explained formulas with good number of quality examples are given in this.

COMPETITIVE LEVEL

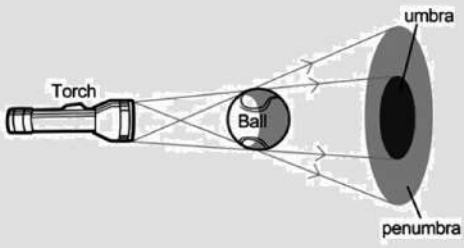
◈ **A Shadow has two Regions**

When an object blocks light from a large (extended) light source, its shadow has two distinct parts:

1. **Umbra :** The umbra is the innermost and darkest part of the shadow. No light from the source reaches this region because the object completely blocks it. Umbra means "shade" in Latin.
2. **Penumbra :** The penumbra surrounds the umbra and is the region of partial darkness. Here, only some light rays are blocked while others still reach the surface. This makes the penumbra appear lighter and fuzzier. Pene means "almost" in Latin—so it is "almost dark."

These two shadow regions are formed clearly only when the light source is large and the object is comparatively small.

- If you stand in the umbra, you cannot see the light source at all.
- If you stand in the penumbra, the light source is partially visible.

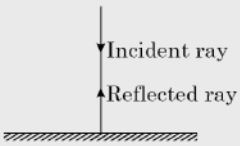


In Chapter Example

To understand the application of concepts, there is ***in chapter solved example*** are given. It contains large variety of all types of solved examples with explaination to ensure understanding the application of concepts.

Ex.1 What happens when a ray of light falls normally (or perpendicularly) on the surface of a mirror?

Sol.



Normal incidence

A ray of light which is incident normally on a mirror, is reflected back along the same path because the angle of incidence as well as angle of reflection for such a ray of light are zero.

Practice Exercises

Includes three sets of exercises covering all the topics. Helps the students to assess their strengths and weaknesses and work on them accordingly. Separate exercises for subjective as well as objective questions and previous year competitive exams questions (NTSE, Olympiads)

NCERT Exercise

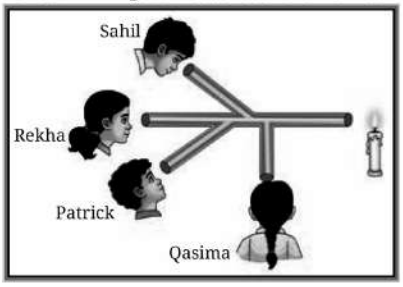
[Let Us Enhance Our Learning]

Q.1 Which of the following are luminous objects?
Mars, Moon, Pole Star, Sun, Venus, Mirror

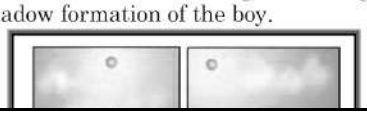
Q.2 Match the items in Column A with those in Column B.

Column A	Column B
Pinhole camera	Blocks light completely
Opaque object	The dark region formed behind the object
Transparent object	Forms an inverted image
Shadow	Light passes almost completely through it

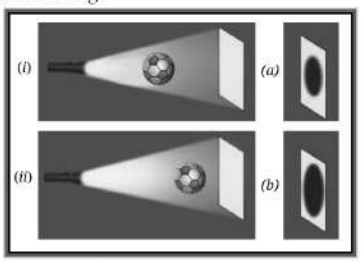
Q.3 Sahil, Rekha, Patrick, and Qasima are trying to observe the candle flame through the pipe as shown in Fig. Who can see the flame?



Q.4 Look at the images shown in Fig. and select the correct image showing the shadow formation of the boy.



Q.5 The shadow of a ball is formed on a wall by placing the ball in front of a fixed torch as shown in Fig.



In scenario (i) the ball is closer to the torch, while in scenario (ii) the ball is closer to the wall. Choose the most accurate representation of the shadows formed in both scenarios from the options provided (a and b).

Q.6 Based on Fig., match the position of the torch in Column A with the characteristics of the ball's shadow in Column B.

Column A	Column B
If the torch is close to the ball	The shadow would be smaller
If the torch is far away	The shadow would be larger
If the ball is removed from the set-up	Two shadows would appear on the screen
If two torches are present in the set-up on the left side of the ball	A bright spot would appear on the screen

Exercise -1

➢ Very Short Answer Type Questions

Q.1 Name two materials that we can see through.

Q.2 Can we see a shadow if there is no light?

Q.3 What kinds of surfaces reflect light?

Q.4 What is reflection?

Q.5 What is the cause of formation of shadows?

➢ Short Answer Type Questions

Q.6 What are incident and reflected rays?

Q.7 What are the conditions needed for a shadow to be formed?

Q.8 We can see through transparent objects but cannot see through opaque objects. Why?

Q.9 Write down the main differences between a reflected image and a shadow.

Q.10 State the characteristics of image formed by a pinhole camera.

Q.11 What is meant by lateral inversion?

Q.16 Explain reflection with diagram.

➢ Fill in the Blanks

Q.17 (i) Clear glass is a ..... material.

(ii) A ..... material does not allow any light to pass through it.

(iii) A ..... shows details of the object, like colour, etc., as well as its shape.

(iv) A flat mirror is an example of a ..... reflecting surface.

(v) The bouncing of light from a surface is called .....

➢ True or False

Q.18 (i) The image in a plane mirror increases in size

(ii) A plane mirror forms a virtual image

(iii) We can see the image of an object if light from it is reflected from plane mirrors.

(iv) An opaque object allow light completely to pass through them.

Exercise -2

Q.1 The change in direction of light after striking a mirror is called
(A) beam of light
(B) searchlight
(C) reflection of light
(D) path of light

Q.2 When light falls on a polished or shiny surface
(A) the light is absorbed by it
(B) the direction of light changes
(C) the light gets transmitted
(D) there is no change in its direction

Q.3 You cannot see the flame of a lighted candle through a bent pipe but you can see it through a straight pipe, because
(A) light travels in a straight line
(B) pipe is polished
(C) bent pipe was blocked
(D) the straight pipe is transparent

Q.4 Objects become visible to us because
(A) light is absorbed by them
(B) light is reflected by them before reaching our eyes
(C) they obstruct the path of light
(D) light passes through them

Q.8 In reflection, the angle of incidence is always equal to the
(A) angle of reflection
(B) angle of refraction
(C) angle of emergence
(D) angle of diffraction

Q.9 A polished or a shiny surface can act as a
(A) lens (B) glass
(C) mirror (D) surface

Q.10 The shadow of an object does not show
(A) the shape of the object
(B) the outline of the object
(C) the colour of the object
(D) none of these

Q.11 Clear water is
(A) transparent
(B) translucent
(C) opaque
(D) none of these

Q.12 Which of these materials could produce a shadow?
(A) clear glass
(B) a clean cellophane paper
(C) clear water
(D) a piece of wood

Exercise -3

(Previous Year Olympiad Questions)

Q.1 Which of the following statements are incorrect?

(A) The size of a shadow changes with the distance between the light source and the object.

(B) The dark part of a shadow that receives no light from the source is called the penumbra.

(C) The image formed by a pinhole camera is always of the same size as the object.

(D) During solar eclipse the shadow of the Moon falls on the Earth.

Q.2 Read the given statements and select the correct option.

Statement 1 : At sunrise or at sunset , the shadows on the ground become much longer than the sizes of the objects.

Statement 2 : The size of the shadow becomes smaller when the object is brought near the light source or the screen is moved away from the object.

(A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.

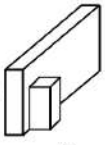
(B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.

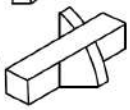
(C) Statement 1 is true but statement 2 is false.

(D) Statement 1 is false but statement 2 is true.

Q.3 An opaque object can form two shadows as shown. Which objects do the shadows belong to?

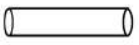
(A) 

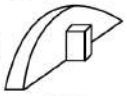
(B) 

(C) 

(D) 

Q.4 The object which can form both circular and rectangular shadows is

(A) 

(B) 

(C) 

(D) 

Q.5 A blurred view is obtained through a paper when a little amount of oil or grease is applied on it because the paper becomes _____

(A) Clear (B) Transparent

(C) Translucent (D) Opaque

Q.6 In the given images, a boy is looking through a material. Which one of the following represents translucent?

(A) 

(B) 

(C) 

(D) All of these

Q.7 Which of the following statements about the size of image formed in a plane mirror is wrong?

(A) The image can be taller than the mirror

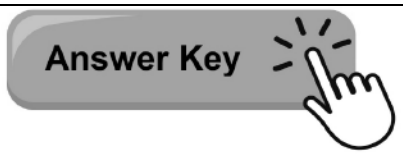
(B) The height of the image depends on the distance of object from the mirror

(C) The width of the image is the same as the width of the object

(D) The height of image depends on the height of the object

Answer key

Answer key is provided at the end of the exercise sheets.



EXERCISE - 1

- **Fill in the Blanks:**

17. (i). transparent
(ii). opaque
(iii). reflected image
(iv). regular
(v). reflection

- **True & False:**

18. (i). False
(ii). True
(iii). True
(iv). False
(v). False

- **Match the Column:**

19. [a → (ii); b → (iv); c → (v); d → (iii); e → (i)]

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	A	B	A	C	C	A	C	C	A	D	A	D	A
Ques.	16	17	18	19	20										
Ans.	B	C	C	D	B										

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	D	A	C	B	B	D	C	A	C	B	A	C	B
Ques.	16	17	18	19	20										
Ans.	A	B	B	C	B										

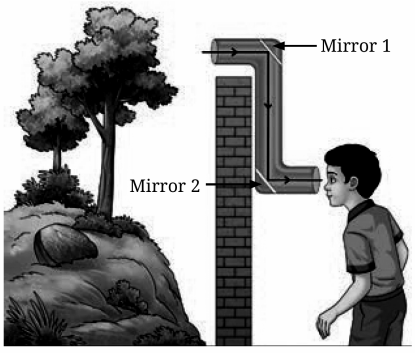
SCIENCE

Chapter 4

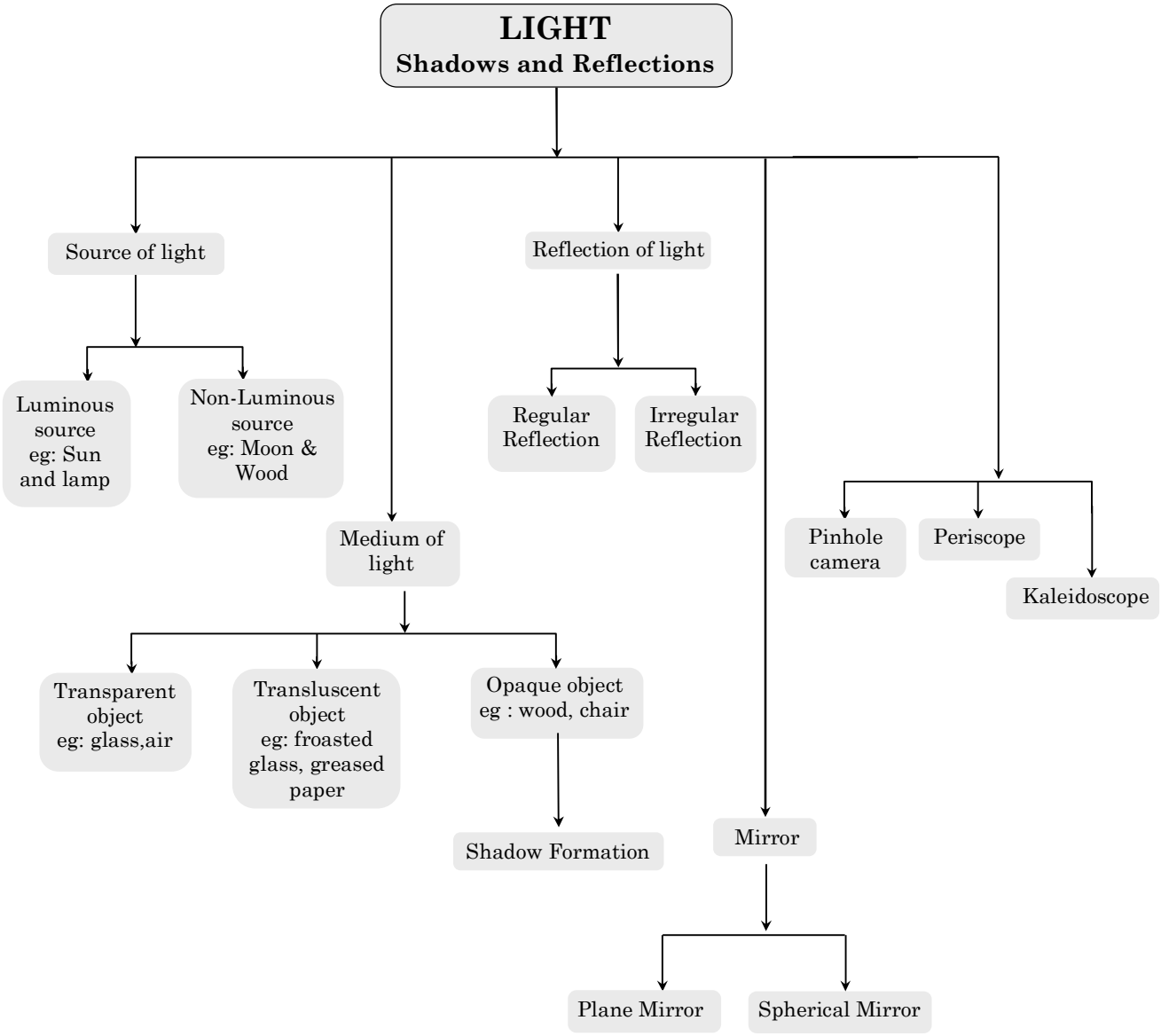
LIGHT: SHADOWS AND REFLECTIONS

Chapter Outline

- Light
- Source of light
- Medium of light
- Rectilinear propagation of light
- Shadow Formation
- Reflection of light
- Regular and diffused reflection
- Plane mirror
- Image Formation by Plane Mirror
- Characteristics of the image formed by a plane mirror
- Uses of plane mirror
- Multiple reflection
- Pinhole camera
- Periscope
- Kaleidoscope



MIND MAP


LIGHT
Shadows and Reflections
Source of light
Luminous source eg: Sun and lamp
Non-Luminous source eg: Moon & Wood
Medium of light
Transparent object eg: glass,air
Transluscent object eg: froasted glass, greased paper
Opaque object eg : wood, chair
Shadow Formation
Reflection of light
Regular Reflection
Irregular Reflection
Mirror
Plane Mirror
Spherical Mirror
Pinhole camera
Periscope
Kaleidoscope

LIGHT : SHADOWS AND REFLECTIONS

Introduction

Light is a invisible form of energy that causes the sensation of vision.

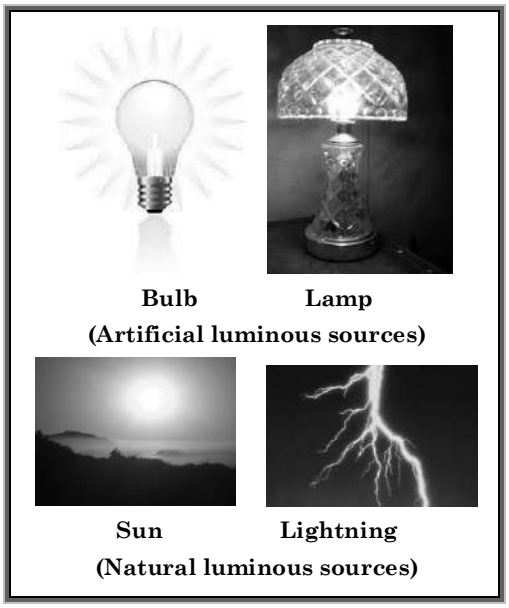
Source of Light

Those bodies which emit light in all directions are called sources of light. The sources can be point one or extended one. The sources of light are of two types:

◈ Luminous sources

Those objects which by itself emit light are called luminous sources.

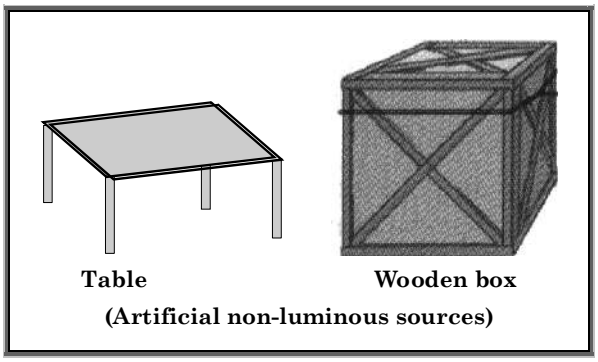
e.g.: Sun and stars (natural luminous sources), electric lamps, candles and lanterns (artificial luminous sources).



◈ Non-luminous sources

Those objects which do not emit light but become visible only when light from luminous objects falls on them. They are called non-luminous sources.

e.g.: Moon, planets (natural non- luminous sources), wooden box, table (artificial non-luminous sources) etc.



Planet **Moon**

(Natural non-luminous sources)

Bioluminescence : The production or emission of light by a living organism as a result of some chemical energy getting converted into light energy is called bioluminescence. The name originates from the Greek word bios for 'living and the Latin word lumen for 'light'.

Fireflies are insects that give off a pale, greenish-yellow light that flashes or glows in the dark. Some of the fish, such as angler fish, living deep under the sea are also bioluminescent.

Firefly

Science And Society (NCERT)

Light Emitting Diode (LED) lamps are modern light sources that consume much less power, are brighter and last longer than traditional lamps. This not only reduces electricity bills but is also better for environment. Recognising their advantages, the Indian government has made substantial efforts to promote the use of LED lamps nationwide. At their end of life, LED lamps must be appropriately disposed or recycled, and not thrown in the garbage.

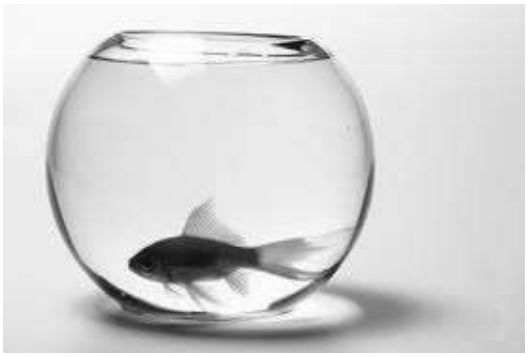
Light through Transparent, Translucent and Opaque Materials

Substance through which light propagates or tends to propagate is called a medium of light.

According to the medium of light objects are divided into three parts:

- **Transparent object**

Bodies that allow light to pass through them i.e. transmit light through them, are called transparent bodies. e.g.: Glass, water, air etc.



Transparent beaker filled with water

◈ Translucent object

Bodies that can transmit only a part of light through them are called translucent objects.

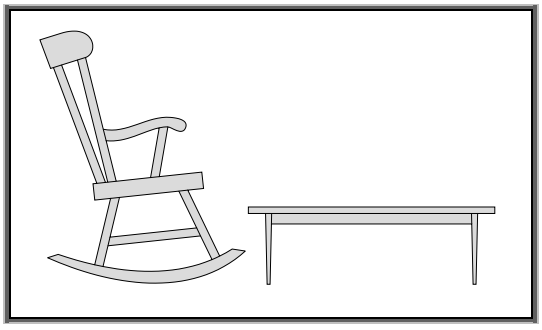
e.g.: Frosted or ground glass, greased paper, paraffin wax etc.

Frosted or ground glass

◈ Opaque object

Bodies that do not allow light to pass through them at all are called opaque objects.

e.g.: Chair, desk etc.

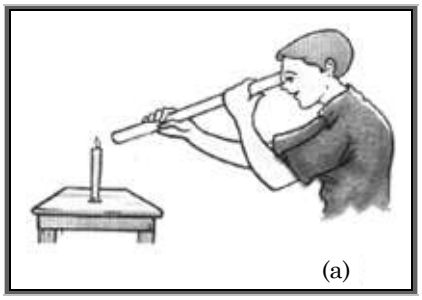


Rectilinear Propagation of Lights

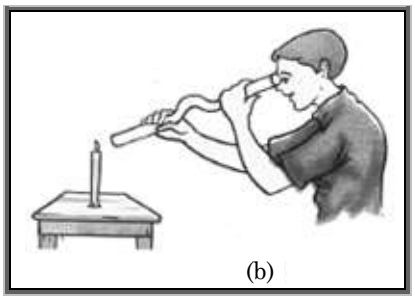
Light travels in a straight line.

- **Activity :** If we see at a lighted candle through a straight pipe as shown in figure, we are able to see the candle flame but if we see the candle through a bent pipe we are not able to see the candle flame.

This activity showed that light travels along straight lines.



(a) we can see the candle flame through the straight pipe.



(b) we cannot see the candle flame through bent pipe.

Examples of rectilinear propagation of light in everyday life :

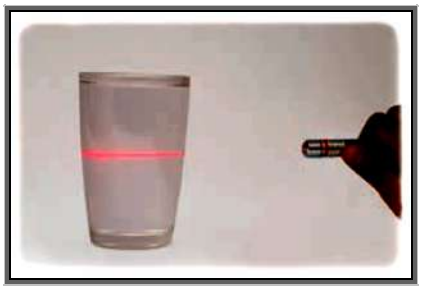
- When the sunlight enters through a small hole in a dark room, it appears to travel in straight lines.
- The light emitted by the head light of a scooter at night appears to travel in straight lines.
- If we almost close our eyes and try to look towards a lighted bulb, it appears to give light in the form of straight lines, which travel in various direction.

Let's Do It :

Pass a laser beam through a glass filled with water in which a drop of milk is added to make the laser beam easily visible.

What do you observe?

You will observe that the beam of laser light inside water follows a straight path.



Characteristics of Light

Some common characteristics of light are given below :

(i) Light is invisible form of energy.

(ii) Light does not require material medium for its propagation i.e. light can travel through vacuum.

(iii) The speed of light in free space (vacuum) is 3×10^8 m/s. Its speed is marginally less in air. Its speed decreases considerably in glass or water.

(iv) Light undergoes reflection from polished surfaces such as mirrors etc.

(v) When light goes from one medium to another, it changes its path. This phenomena is called refraction.

Shadows

The opaque objects do not allow light to pass through them, therefore they give rise to the formation of shadow of the opaque object on the opposite side of the source of light.

◈ Essentials of a shadow

(i) Source of light

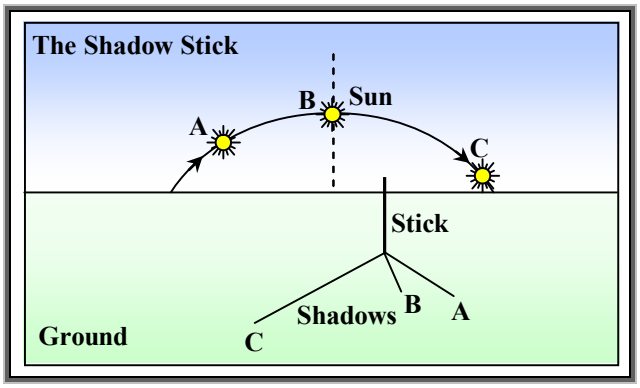
(ii) Presence of opaque object in the path of light

(iii) Screen on which shadow is formed

◈ Formation of shadow

Sunlight is parallel, so its shadows remain the same size as the object's profile. A desk lamp or a street light also casts shadows because the light is streaming out in all directions away from the source. However, since its rays are not parallel, shadows get bigger farther away from the object.

- **Shadow sticks:** A shadow stick is a vertical pole placed in the ground. Sunlight casts its shadow on to a level surface below. (e.g. a sheet of card or just level ground).



As the Sun moves from A to C, the shadow shortens and then lengthen accordingly. The length and position of the shadow then depends on both the time of year and the time of day. Local noon can be found from the time when the shadow is shortest. At this time the Sun is highest in the sky and crossing the meridian.

However, shadow sticks are not good clocks - the azimuth of the Sun's shadow at a given time changes throughout the year with the Sun's declination.

◈ The shape, size and other characteristics of a shadow depend upon

(i) Position and distance of the source of light with respect to the object.

(ii) The distance between the object and the surface on which the shadow falls.

(iii) The size of the source of light.

Fascinating Facts (NCERT)

Shadow play, or shadow puppetry, has been a part of our cultural heritage for centuries. In this art form, flat cut-out figures called shadow puppets are placed between a light source and a screen. By moving the puppets and the light, puppeteers can create life-like movements, bringing the characters to life. Different regions have their own unique styles, like the ***Charma Bahuli Natya*** in Maharashtra, ***Keelu Bomme*** and ***Tholu Bommalata*** of Andhra Pradesh, ***Togalu Gombeyaata*** in Karnataka, ***Ravana Chhaya*** in Odisha, ***Tholpavakoothu*** in Kerala and ***Bommalattam*** in Tamil Nadu. These are used not only for entertainment but also communicate important messages to the community.

COMPETITIVE LEVEL

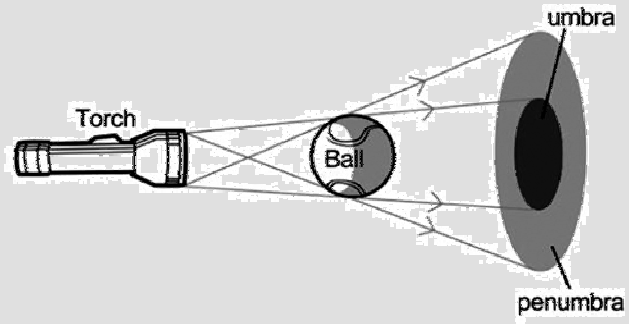
◈ A Shadow has two Regions

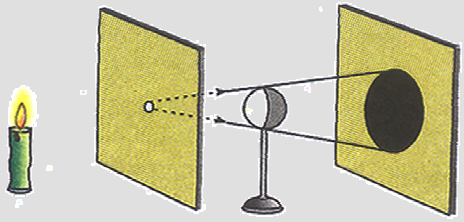
When an object blocks light from a large (extended) light source, its shadow has two distinct parts:

1. **Umbra :** The umbra is the innermost and darkest part of the shadow. No light from the source reaches this region because the object completely blocks it. Umbra means "shade" in Latin.
2. **Penumbra :** The penumbra surrounds the umbra and is the region of partial darkness. Here, only some light rays are blocked while others still reach the surface. This makes the penumbra appear lighter and fuzzier. Pene means "almost" in Latin—so it is "almost dark."

   These two shadow regions are formed clearly only when the light source is large and the object is comparatively small.

   - If you stand in the umbra, you cannot see the light source at all.
   - If you stand in the penumbra, the light source is partially visible.

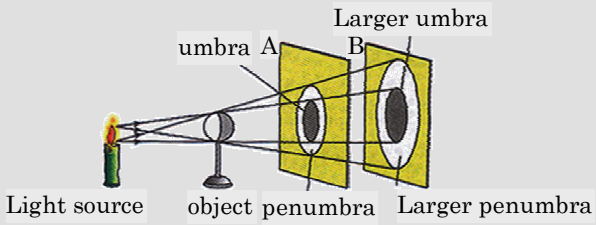




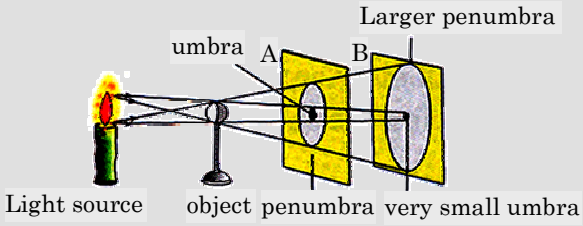
Shadow formed by a point source of light

Size and Sharpness of Shadows :

- When an object is closer to the light, the shadow becomes larger and more blurred.
- When the object is closer to the screen, the shadow becomes smaller and sharper.
- As the screen moves farther away, the umbra becomes smaller, and the penumbra becomes larger and lighter.



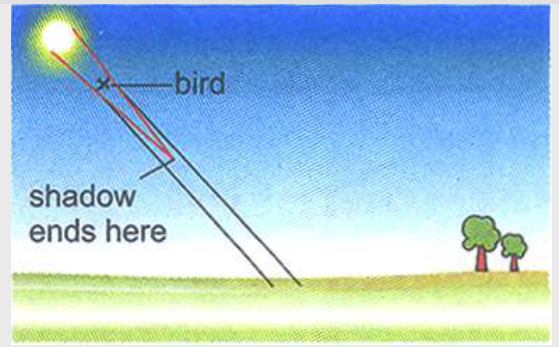
Shadow formed by an extended source
(When size of source is smaller than object)



Shadow formed by an extended source
(When size of source is bigger than object)

Why Some Shadows Are Hard to See ?

All real light sources have some size. Light rays from the edges of the source spread out slightly, causing a faint and wide penumbra. This is why we cannot see the shadow of a bird flying high in the sky—the penumbra becomes so large and faint that the shadow disappears.



Shadow of a flying bird is not visible

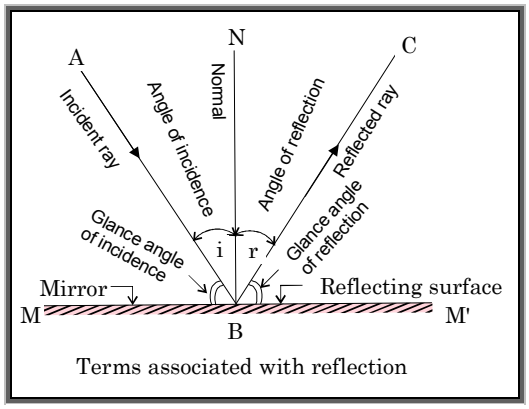
Reflection of Light

When a beam of light falls on any surface, a part of it is sent back into the same medium from which it is coming. This phenomenon is known as the reflection of light.

Fig.: Using mirror to redirect sunlight on a wall

◈ General definitions about reflection

(i) Mirror : A smooth polished surface from which regular reflection can take place is called mirror. MM' is the mirror as shown in figure.



Terms associated with reflection

(ii) Incident ray: A ray of light which travels towards the mirror is called incident ray. Ray AB is incident ray in figure.

(iii) Point of incidence: The point on the mirror, where an incident ray strikes is called point of incidence. 'B' is the point of incidence in figure.

(iv) Reflected ray: A ray of light which bounces off the surface of a mirror, is called reflected ray. BC is reflected ray in figure.

(v) Normal: The perpendicular drawn at the point of incidence, to the surface of mirror is called normal. BN is the normal in figure.

(vi) Angle of incidence: The angle made by the incident ray with the normal is called angle of incidence. ∠ABN is the angle of incidence in figure. It is denoted by ∠i.

(vii) Angle of reflection: The angle made by the reflected ray with the normal is called angle of reflection. ∠CBN is the angle of reflection in figure. It is denoted by ∠r.

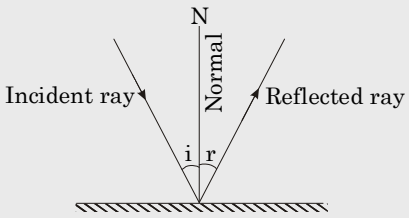
(viii) Glance angle of incidence: The angle which the incident ray makes with the **mirror** is called glance angle of incidence. ∠ MBA is the glance angle of incidence in figure.

(ix) Glance angle of reflection: The angle which the reflected ray makes with the **mirror** is called glance angle of reflection. ∠M'BC is the glance angle of reflection in figure.

COMPETITIVE LEVEL

◈ Laws of Reflection

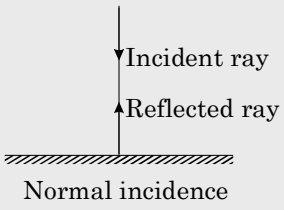
The reflection of light from a surface obeys certain laws called laws of reflection. They are:



- Angle of incidence is equal to the angle of reflection, i.e., $\angle i = \angle r$.
- Incident ray, reflected ray and normal to the reflecting surface always lie in the same plane.

Ex.1 What happens when a ray of light falls normally (or perpendicularly) on the surface of a mirror?

Sol.



Normal incidence

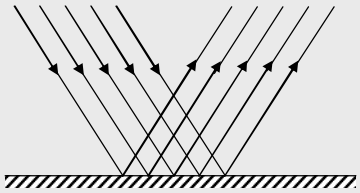
A ray of light which is incident normally on a mirror, is reflected back along the same path because the angle of incidence as well as angle of reflection for such a ray of light are zero.

Regular & Diffused Reflection

◈ Regular Reflection

In this reflection, parallel beam of light goes parallel after reflection from plane surface.

This reflection follows the laws reflection.

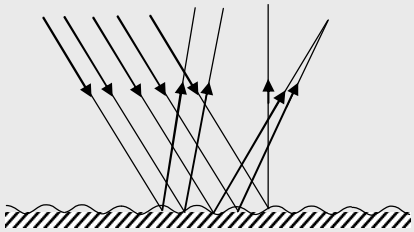


Regular reflection

◈ Irregular Reflection/Diffused Reflection

In this reflection, parallel beam of light goes random after reflection from a rough surface.

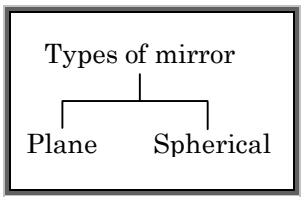
This reflection also follows the laws of reflection.



Irregular or diffused reflection

Mirror

◈ Types of mirror



It is a highly polished surface, which is quite smooth and capable of reflecting a good fraction of light from its surface.

◈ Object

Anything which gives out light rays (either its own or reflected) is called an object.

◈ Image

The reproduction of object formed by mirror or lens is called an image.

(i) Real image: An image which is formed by actual convergence of the rays of light is called real image. It can be obtained on a screen.

(ii) Virtual image: An image which only appears to the eye to be formed by the rays of light is called virtual image. It cannot be obtained on a screen.

Plane Mirror

◈ Image Formation by Plane Mirror

- **Formation of image of a point object by a plane mirror:** Consider a plane mirror XY. Let a point object O is placed in front of the mirror as shown in figure. A ray OA is incident on the plane mirror at right angle to the mirror (i.e. $\angle i = 0$). The reflection takes place at A and the reflected ray retraces its path along AO. ($\therefore \angle r = 0$).

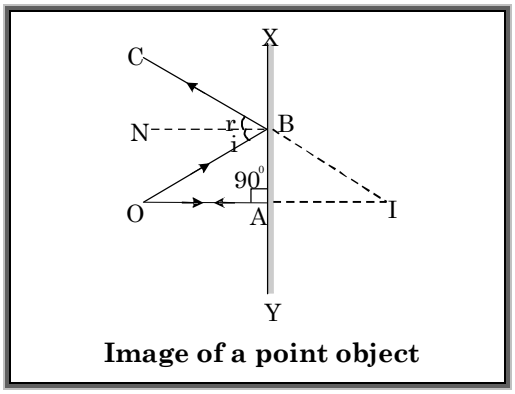


Image of a point object

Another ray starting from O incident at point B on the mirror and the reflected ray goes along BC such that $\angle i = \angle r$. The reflected rays AO and BC never meet each other.

When the reflected rays AO and BC are produced backward, they appear to be coming from point I. In other words, reflected rays appear to diverge from point I. So point I is the virtual image of a point object O. Since there is no actual meeting of rays at point I.

The position of image I is as far behind the plane mirror as the position of the object O in front of the plane mirror.

i.e. OA = IA (see in figure).

- **Formation of image of an extended object by the plane mirror :**

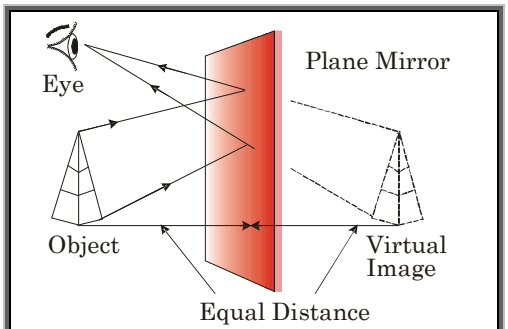


Image of an extended object

◈ Characteristics of the image formed by a plane mirror:

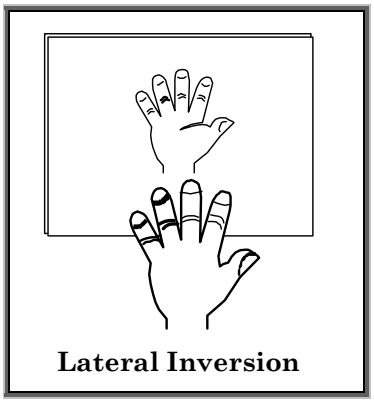
(i) The image formed by a plane mirror is virtual.

(ii) The image formed by a plane mirror is erect.

(iii) The size of the image formed by a plane mirror is same as that of the size of the object. If object is 10 cm high, then the image of this object will also be 10 cm high.

(iv) The image formed by a plane mirror is at the same distance behind the mirror as the object is in front of it. Suppose, an object is placed at 5 cm in front of a plane mirror then its image will be at 5 cm behind the plane mirror.

(v) The image formed by a plane mirror is laterally inverted, i.e., the right side of the object appears as the left side of its image and vice-versa.



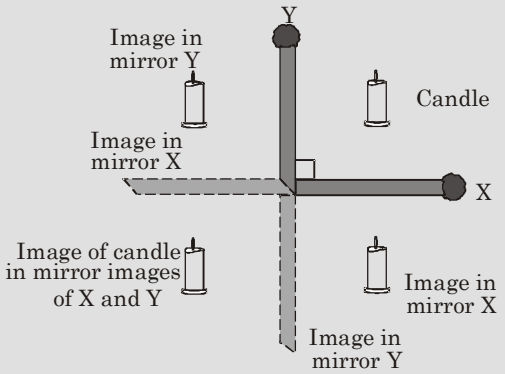
Lateral Inversion

◈ Uses of Plane Mirror

- As a looking glass.
- In the optician's room to increase the effective length of the room by keeping a plane mirror on the front wall and the sign board on the opposite wall behind the patient. For the patient, the sign board is at double the length of the room.
- In the barber's shop for seeing the hair at the back of the head, two mirrors facing each other, are fixed on the opposite walls at the front and back of the viewer.
- In a periscope, two plane mirrors each inclined at 45° with the vertical and facing each other, are kept parallel to each other.
- In a kaleidoscope, three plane mirrors inclined with each other at 60° are used.

◈ Multiple Reflection

Place two plane mirrors vertically along their edges so that they make a certain angle with each other. Now place an object symmetrically between these two mirrors. You will observe that more than two images are formed. It is because the image in one mirror will act as the object for the second mirror. Thus, besides the image formed in each mirror due to actual reflection of the object, image of images will also be seen.



Multiple images of a candle

If the mirrors are placed in such a manner that they make a 90º angle with each other then, you will observe three images as shown in figure.

However, the number of images formed depends upon the angle between the mirrors and can be determined by using the formula given below:

If $\frac{360}{\theta}$ = even number

then, $n = \frac{360}{\theta} - 1$

where n = number of images formed

θ = angle between the two mirrors

For example, if the mirrors are inclined at an angle of 60º, they will form

$$n = \frac{360}{60} - 1 = 5 \text{ images}$$

If $\frac{360}{60}$ = odd

Then there are two cases:

(i) If object is placed symmetrically between mirrors, then no. of images will be (n-1) $= \frac{360}{\theta} - 1$

(ii) If object is placed asymmetrically between mirrors, then no. of images will be $n = \frac{360}{\theta}$

Further, if $\frac{360}{\theta}$ = fraction then remove fraction part and integral value of is the number of images.

Ex.2 When an object is placed symmetrically between two plane mirrors inclined at an angle 45. Find out the number of images.

Sol. $n = \frac{360^o}{45^o} = 8$, since n is even so number of image =

$n - 1 = 8 - 1 = 7$

Ex.3 What will be the angle between two plane mirrors if 8 images of an object placed symmetrically are to be formed?

Sol. If two mirrors are inclined at angle θ, then number of images of an object placed symmetrically between the mirrors formed is given by:

$n = \frac{360^o}{\theta} - 1$

$\theta = 40^o$

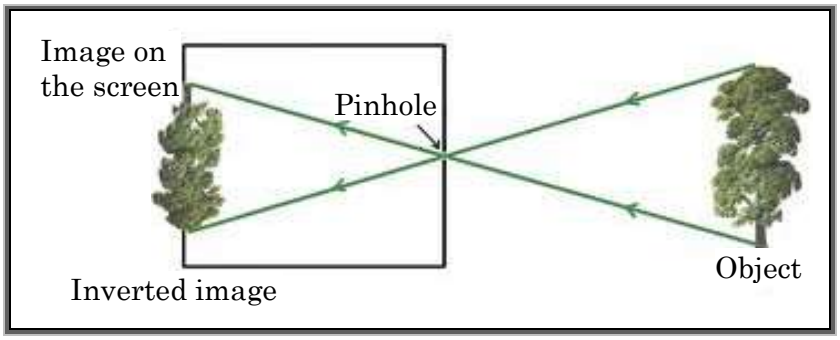
So two mirrors inclined at 40^o will give 8 images.

Difference Between the Image and the Shadow of an Object

Image	Shadow
Has the colour of the object.	Is always black, regardless of the colour of the object.
Gives the details as well as the outline of the object.	Gives only the outline of the object.
Undergoes lateral inversion (i.e., left-right reversal).	Does not undergo lateral inversion.

Pinhole Camera

- The word camera comes from the Greek kamara, a vaulted chamber.
- A pinhole camera is the simplest camera possible. It consists of a **light-proof box**, some sort of **film** and a **pinhole**.
- A pinhole camera works on principle of rectilinear propagation of light and pin-hole acts as a lens.



Activity (NCERT)

Aim : To observe image formation through a small pinhole.

Materials Required : Cardboard with pinhole, Candle, Screen, Matches

Procedure :

1. Light the candle.
2. Place the cardboard with pinhole between the candle and the screen.
3. Observe the image on the screen in a dark rule.

Observation :

An inverted image of the candle flame forms on the screen.

Conclusion :

A pinhole allows light from the object to form an inverted image on a screen.

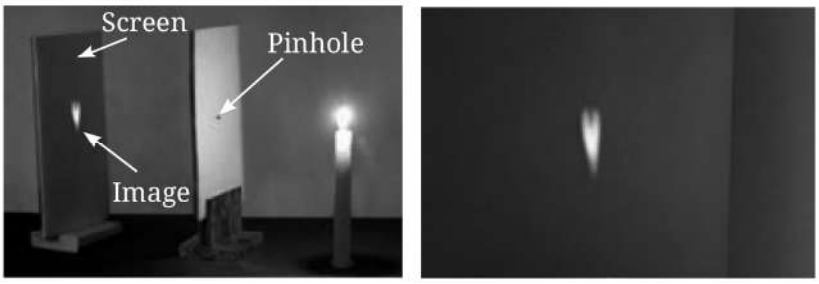


Fig. (a)
A simple pinhole camera

Fig. (b)
Image of a candle flame on screen

Periscope

A simple periscope can be made by placing two plane mirrors in a Z-shaped box as shown in figure below. It enables us to see objects which are not visible directly by reflection form two plane mirrors.

Periscopes are used in submarines, tanks or by soldiers.

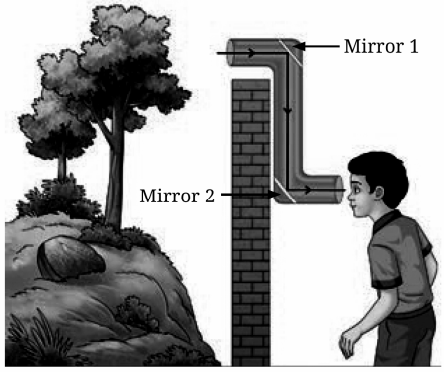
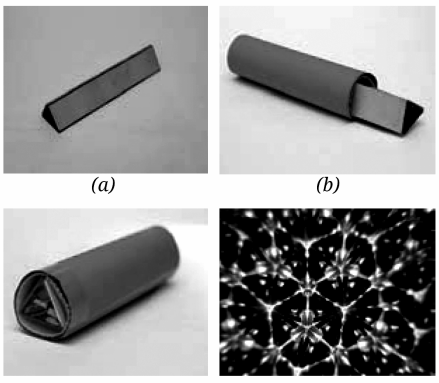


Fig. : A periscope

Kaleidoscope

A kaleidoscope can be made by combining three rectangular plane mirror strips of equal width in a triangular manner in a circular tube of thick chart paper. Place several broken pieces of coloured bangles or beads on this and cover it with a tracing paper using a rubber band or an adhesive tape as shown in figure below.

A beautiful pattern view is formed due to multiple images formed by reflections of reflections through three mirror strips. Designers and artists often use kaleidoscopes to get ideas for new patterns.



(a) *(b)*

(c) *(d)*

Fig.: A kaleidoscope

Chapter at a glance

- Light allows us to see the world and always travels in straight paths.
- Some objects like the Sun, lamps, and candles give their own light and are called luminous, while objects like the Moon, walls, or books do not produce light and are seen only when illuminated.
- Depending on how they interact with light, materials may be ***transparent***, allowing most light through; ***translucent***, allowing only part of the light; or ***opaque***, blocking light completely.
- When an opaque object obstructs light, a shadow is formed on a screen.
- The shadow's size and clarity depend on how far the object is from the light source and the screen, and it contains a dark central region called the umbra and a lighter region called the penumbra.
- Light changes direction when it reflects from smooth, shiny surfaces, and this property allows mirrors to form images.
- A plane mirror produces an image that is upright, virtual, and the same size as the object, but reversed left to right.
- Reflection from rough surfaces does not produce clear images.
- Since light travels in straight lines, a pinhole camera forms an inverted image on its screen.
- Devices such as periscopes and kaleidoscopes use the reflection of light to help us see objects or create repeating patterns.

NCERT Exercise

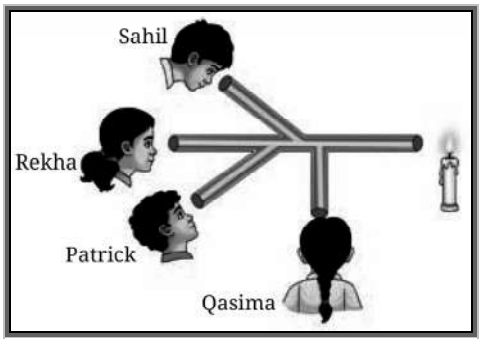
[Let Us Enhance Our Learning]

Q.1 Which of the following are luminous objects? Mars, Moon, Pole Star, Sun, Venus, Mirror

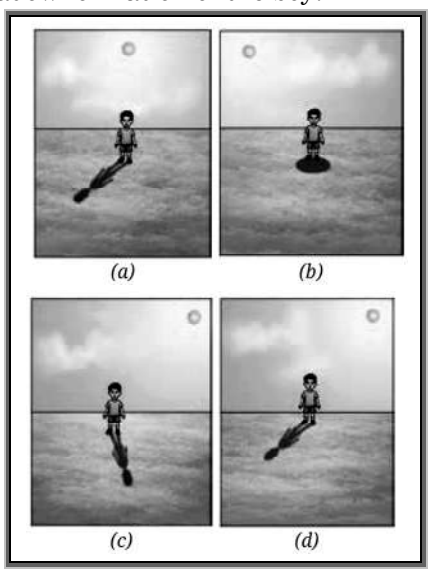
Q.2 Match the items in Column A with those in Column B.

Column A	Column B
Pinhole camera	Blocks light completely
Opaque object	The dark region formed behind the object
Transparent object	Forms an inverted image
Shadow	Light passes almost completely through it

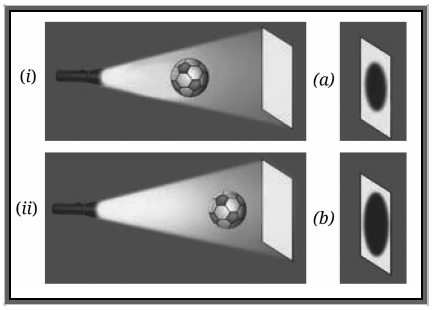
Q.3 Sahil, Rekha, Patrick, and Qasima are trying to observe the candle flame through the pipe as shown in Fig. Who can see the flame?



Q.4 Look at the images shown in Fig. and select the correct image showing the shadow formation of the boy.



Q.5 The shadow of a ball is formed on a wall by placing the ball in front of a fixed torch as shown in Fig.



In scenario (i) the ball is closer to the torch, while in scenario (ii) the ball is closer to the wall. Choose the most accurate representation of the shadows formed in both scenarios from the options provided (a and b).

Q.6 Based on Fig., match the position of the torch in Column A with the characteristics of the ball's shadow in Column B.

Column A	Column B
If the torch is close to the ball	The shadow would be smaller
If the torch is far away	The shadow would be larger
If the ball is removed from the set-up	Two shadows would appear on the screen
If two torches are present in the set-up on the left side of the ball	A bright spot would appear on the screen

Q.7 Suppose you view the tree shown in Fig., through a pinhole camera. Sketch the outline of the image of the tree formed in the pinhole camera.

Fig.

Q.8 Write your name on a piece of paper and hold it in front of a plane mirror such that the paper is parallel to the mirror. Sketch the image. What difference do you notice? Explain the reason for the difference.

Q.9 Measure the length of your shadow at 9 AM, 12 PM, and 4 PM with the help of your friend. Write down your observations :

(i) At which of the given times is your shadow the shortest?

(ii) Why do you think this happens?

Q.10 On the basis of following statements, choose the correct option.

Statement A : Image formed by a plane mirror is laterally inverted.

Statement B : Images of alphabets T and O appear identical to themselves in a plane mirror.

(i) Both statements are true

(ii) Both statements are false

(iii) Statement A is true, but statement B is false

(iv) Statement A is false, but statement B is true

Q.11 Suppose you are given a tube of the shape shown in the Fig. and two plane mirrors smaller than the diameter of the tube. Can this tube be used to make a periscope? If yes, mark where you will fix the plane mirrors.

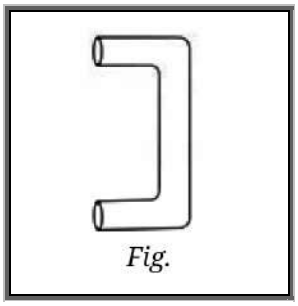


Fig.

Q.12 We do not see the shadow on the ground of a bird flying high in the sky. However, the shadow is seen on the ground when the bird swoops near the ground. Think and explain why it is so.

Exercise -1

➢ Very Short Answer Type Questions

Q.1 Name two materials that we can see through.

Q.2 Can we see a shadow if there is no light?

Q.3 What kinds of surfaces reflect light?

Q.4 What is reflection?

Q.5 What is the cause of formation of shadows?

➢ Short Answer Type Questions

Q.6 What are incident and reflected rays?

Q.7 What are the conditions needed for a shadow to be formed?

Q.8 We can see through transparent objects but cannot see through opaque objects. Why?

Q.9 Write down the main differences between a reflected image and a shadow.

Q.10 State the characteristics of image formed by a pinhole camera.

Q.11 What is meant by lateral inversion?

➢ Long Answer Type Questions

Q.12 What are the characteristics of light.

Q.13 Classify the objects or materials given below as Opaque, Transparent or Translucent and Luminous or Non-luminous: Air, water, a piece of rock, a sheet of aluminum, a mirror, a wooden board, a CD, smoke, a sheet of plane glass, fog, a piece of red hot iron, an umbrella, a lighted fluorescent tube, a wall, a sheet of carbon paper, the flame of a gas burner, a sheet of cardboard, a lighted torch, a sheet of cellophane, kerosene stove, sun, fire fly, moon, planets.

Q.14 Discuss the shadow formation of object by point source of light.

Q.15 We can't see the flame of a candle through a bent pipe. Explain.

Q.16 Explain reflection with diagram.

➢ Fill in the Blanks

Q.17 (i) Clear glass is a ..... material.

(ii) A ..... material does not allow any light to pass through it.

(iii) A ..... shows details of the object, like colour, etc., as well as its shape.

(iv) A flat mirror is an example of a ..... reflecting surface.

(v) The bouncing of light from a surface is called .....

➢ True or False

Q.18 (i) The image in a plane mirror increases in size

(ii) A plane mirror forms a virtual image

(iii) We can see the image of an object if light from it is reflected from plane mirrors.

(iv) An opaque object allow light completely to pass through them.

(v) A translucent object allow light completely to pass through them.

➢ Match the Column

Q.19

Column-A		Column-B	
(a)	Rectilinear propagation	(i)	Glass
(b)	Umbra	(ii)	Travel in straight line
(c)	Virtual image	(iii)	Real image
(d)	Pinhole camera	(iv)	Darkest part
(e)	Refraction of light	(v)	Plane mirror

Exercise -2

Q.1 The change in direction of light after striking a mirror is called
(A) beam of light
(B) searchlight
(C) reflection of light
(D) path of light

Q.2 When light falls on a polished or shiny surface
(A) the light is absorbed by it
(B) the direction of light changes
(C) the light gets transmitted
(D) there is no change in its direction

Q.3 You cannot see the flame of a lighted candle through a bent pipe but you can see it through a straight pipe, because
(A) light travels in a straight line
(B) pipe is polished
(C) bent pipe was blocked
(D) the straight pipe is transparent

Q.4 Objects become visible to us because
(A) light is absorbed by them
(B) light is reflected by them before reaching our eyes
(C) they obstruct the path of light
(D) light passes through them

Q.5 The type of shadow formed can be determined by the size of
(A) an object and the size of source of light
(B) an object
(C) the source of light
(D) a person observing the shadow

Q.6 The image formed in a pinhole camera is :
(A) real and erect
(B) virtual and inverted
(C) real and inverted
(D) virtual and erect

Q.7 The incident ray, the reflected ray and the normal at the point of incidence all lie in :
(A) different plane
(B) neighboring plane
(C) same plane
(D) opposite plane

Q.8 In reflection, the angle of incidence is always equal to the
(A) angle of reflection
(B) angle of refraction
(C) angle of emergence
(D) angle of diffraction

Q.9 A polished or a shiny surface can act as a
(A) lens (B) glass
(C) mirror (D) surface

Q.10 The shadow of an object does not show
(A) the shape of the object
(B) the outline of the object
(C) the colour of the object
(D) none of these

Q.11 Clear water is
(A) transparent
(B) translucent
(C) opaque
(D) none of these

Q.12 Which of these materials could produce a shadow?
(A) clear glass
(B) a clean cellophane paper
(C) clear water
(D) a piece of wood

Q.13 Which of these conditions is/are not essential for a shadow to be produced?
(A) the sun
(B) a light source
(C) an opaque object
(D) a screen/surface

Q.14 An artificial source of light:
(A) Sun
(B) Firefly
(C) Jellyfish
(D) Electric bulb

Q.15 We can see a reflected image on :
(A) a polished surface
(B) a rough surface
(C) a shadow
(D) none of these

Q.16 We cannot get a shadow when there is :
(A) an opaque object
(B) no light source
(C) a light source
(D) a screen

Q.17 Which of these materials can we see through?
(A) a piece of iron
(B) a piece of wood
(C) a glass of clear water
(D) a thick book

Q.18 Light causes the sensation of :
(A) Vision (B) Sight
(C) Both A and B (D) None

Q.19 Light is :
(A) an electromagnetic radiation
(B) form of energy
(C) massless
(D) all of the above

Q.20 Which of the following objects does not allow light to pass through them?
(A) Transparent
(B) opaque
(C) Translucent
(D) none of these

Exercise -3

(Previous Year Olympiad Questions)

Q.1 Which of the following statements are incorrect?

(A) The size of a shadow changes with the distance between the light source and the object.

(B) The dark part of a shadow that receives no light from the source is called the penumbra.

(C) The image formed by a pinhole camera is always of the same size as the object.

(D) During solar eclipse the shadow of the Moon falls on the Earth.

Q.2 Read the given statements and select the correct option.

Statement 1 : At sunrise or at sunset , the shadows on the ground become much longer than the sizes of the objects.

Statement 2 : The size of the shadow becomes smaller when the object is brought near the light source or the screen is moved away from the object.

(A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.

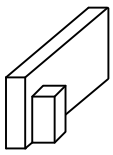
(B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.

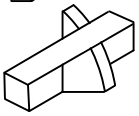
(C) Statement 1 is true but statement 2 is false.

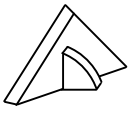
(D) Statement 1 is false but statement 2 is true.

Q.3 An opaque object can form two shadows as shown. Which objects do the shadows belong to?

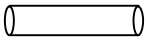
(A) 

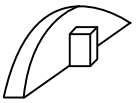
(B) 

(C) 

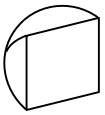
(D) 

Q.4 The object which can form both circular and rectangular shadows is

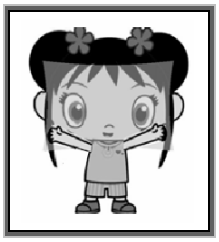
(A) 

(B) 

(C) 

(D) 

Q.5 A blurred view is obtained through a paper when a little amount of oil or grease is applied on it because the paper becomes _____



(A) Clear (B) Transparent

(C) Translucent (D) Opaque

Q.6 In the given images, a boy is looking through a material. Which one of the following represents translucent?

(A) 

(B) 

(C) 

(D) All of these

Q.7 Which of the following statements about the size of image formed in a plane mirror is wrong?

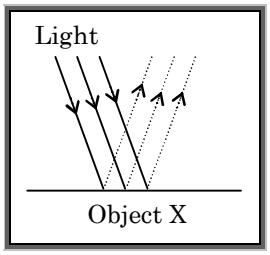
(A) The image can be taller than the mirror

(B) The height of the image depends on the distance of object from the mirror

(C) The width of the image is the same as the width of the object

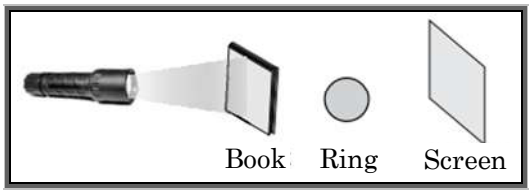
(D) The height of image depends on the height of the object

Q.8 Study the given diagram carefully and select the correct option



(A) Object X has rough surface
(B) Object X is a source of light
(C) Object X is made from a magnetic material
(D) Object X reflects light very well

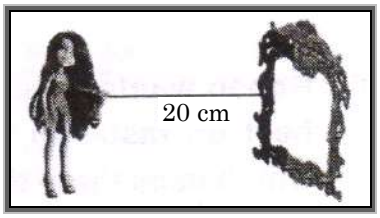
Q.9 Study the set-up given here. Which of the following options shows the correct shape of the shadow formed on the screen?



(A) 
(B) 
(C) 
(D) 

Q.10 In case of three plane mirrors meeting at a point to form a corner of a cube, if incident light suffers one reflection on each other
(A) The emergent ray is anti parallel to incident one
(B) The emergent ray is perpendicular to incident one
(C) The incident ray can not emerge
(D) None of these

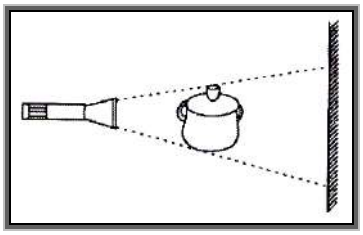
Q.11 Miss Megha is 20 cm away from the plane mirror. If she moves few steps closer to the mirror, What will happen to the image size in the mirror?



(A) The size of image will decrease.
(B) The size of image will increase.
(C) The size of image will be same.
(D) Cannot say.

Direction (Q No. 12 & 13) : Read the passage carefully and answer the given questions.

Aman sets up the experiment as shown. The position of the torch and object are fixed.

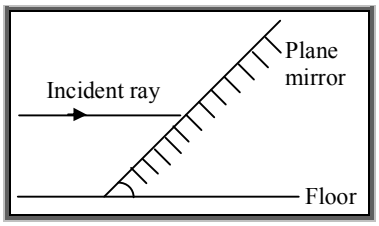


Q.12 When Aman switches the torch on, which one of the following shows the correct shadow formed on the screen?

(A) 
(B) 
(C) 
(D) 

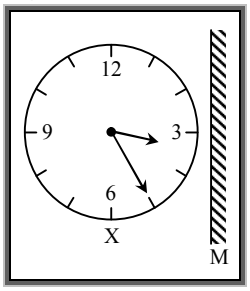
Q.13 To cast a bigger shadow on the screen, Aman should move ——.
(A) The object closer to the torch.
(B) The screen closer to the object.
(C) The object away from the torch.
(D) The torch away from the object.

Q.14 A ray of light parallel to the floor strikes a plane mirror, which is inclined at an angle 40º as shown in figure. What is the angle of reflection?



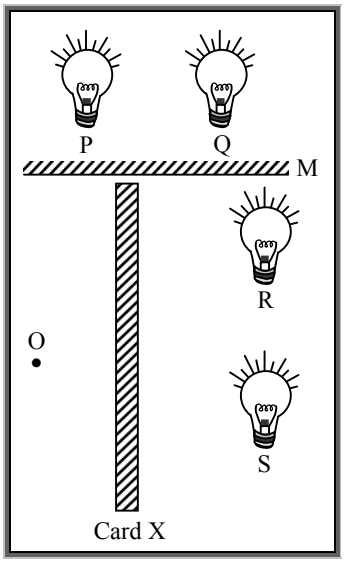
(A) 40º (B) 80º (C) 50º (D) 90º

Q.15 A clock X is placed in front of a mirror M as shown in the given figure. Time in the mirror image of X is :



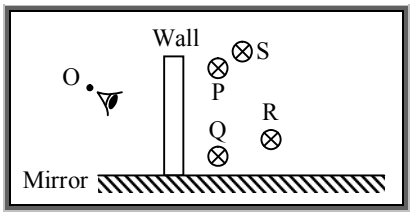
(A) 3 : 25 (B) 8 : 35 (C) 7 : 35 (D) 6 : 35

Q.16 Four lamps P, Q, R and S are placed around a mirror M, as shown in the given figure.
The card X prevents the observer O from seeing the lamps directly. Which of the following statements are incorrect?



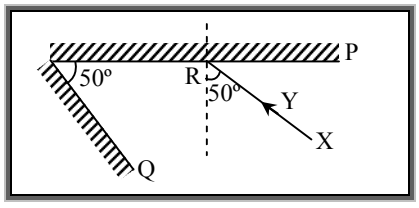
(I) Observer O can see the image of R.
(II) Observer O can see the image of S.
(III) Observer O cannot se the image of P.
(IV) Observer O can see the image of Q.
(A) I and IV only (B) II and III only
(C) III and IV only (D) II, III and IV only

Q.17 Four light bulbs P, Q, R and S are placed behind a wall as shown in the given figure.
An observer (O) can see the bulbs :



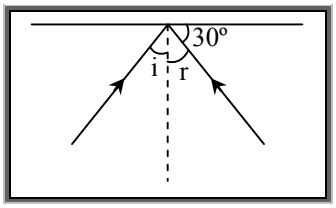
(A) P and R only (B) Q and R only
(C) R and S only (D) P, R and S only

Q.18 Tow plane mirrors P and Q are kept with an angle of 50º between them as shown in given figure.
A light ray XY strikes the mirror P at 'R', making an angle of 50º.



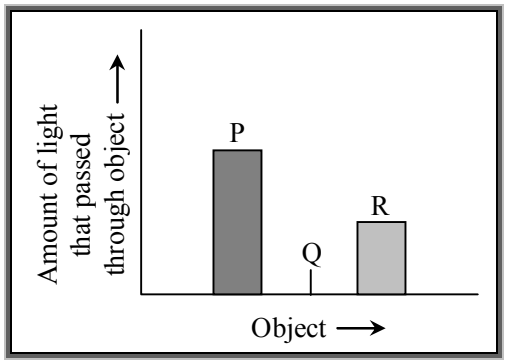
What will be the angle of reflection of the light ray for the mirror Q?
(A) 60º (B) 0º (C) 50º (D) 90º

Q.19 Find the angle of incidence with respect to the following figure.



(A) 30º (B) 45º (C) 60º (D) 90º

Q.20 Radha, a Science teacher passed torchlight through objects P, Q and R one at a time and measured the amount of light that passed though each one of them by using suitable device. The results of the experiment are shown in the following graph.



Based on the above experiment, select the correct statement from the following :
(A) R can be wooden cardboard as it allows light to pass partially through it.
(B) P can be a window pane and Q can be a metal sheet.
(C) Q can be a butter paper as it allows light to pass completely thorough it.
(D) Q is a translucent material while P is an opaque material.

Answer Key

EXERCISE - 1

- **Fill in the Blanks:**

17. (i). transparent
(ii). opaque
(iii). reflected image
(iv). regular
(v). reflection

- **True & False:**

18. (i). False
(ii). True
(iii). True
(iv). False
(v). False

- **Match the Column:**

19. [a → (ii); b → (iv); c → (v); d → (iii); e → (i)]

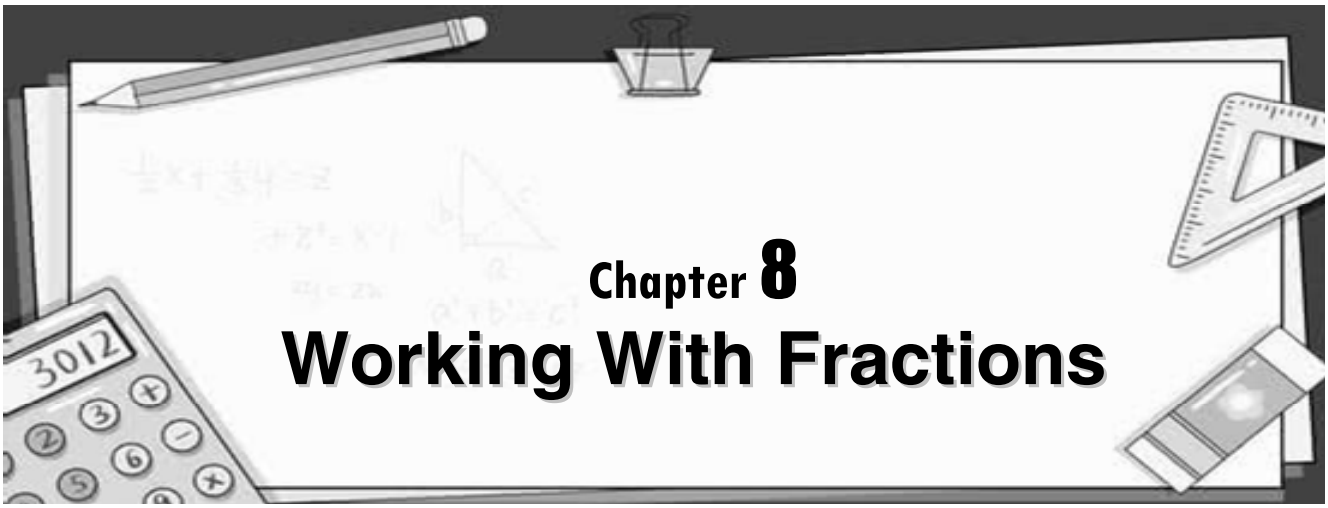
EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	A	B	A	C	C	A	C	C	A	D	A	D	A
Ques.	16	17	18	19	20										
Ans.	B	C	C	D	B										

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	D	A	C	B	B	D	C	A	C	B	A	C	B
Ques.	16	17	18	19	20										
Ans.	A	B	B	C	B										

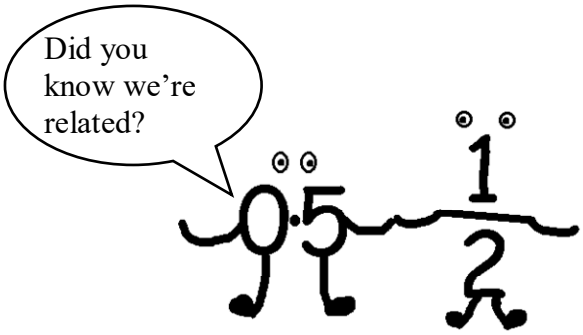
MATHEMATICS

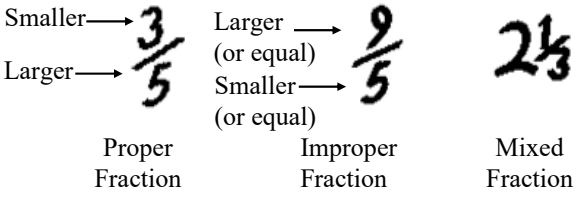


Chapter 8
Working With Fractions

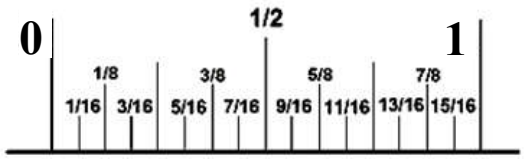
Chapter Outline

- **Fraction**
- **Types of Fraction**
- **Simplest form of Fractions**
- **Comparison of Fractions**
- **Addition, Subtraction, Multiplication and Division of Fractions**
- **Fractional Relations**

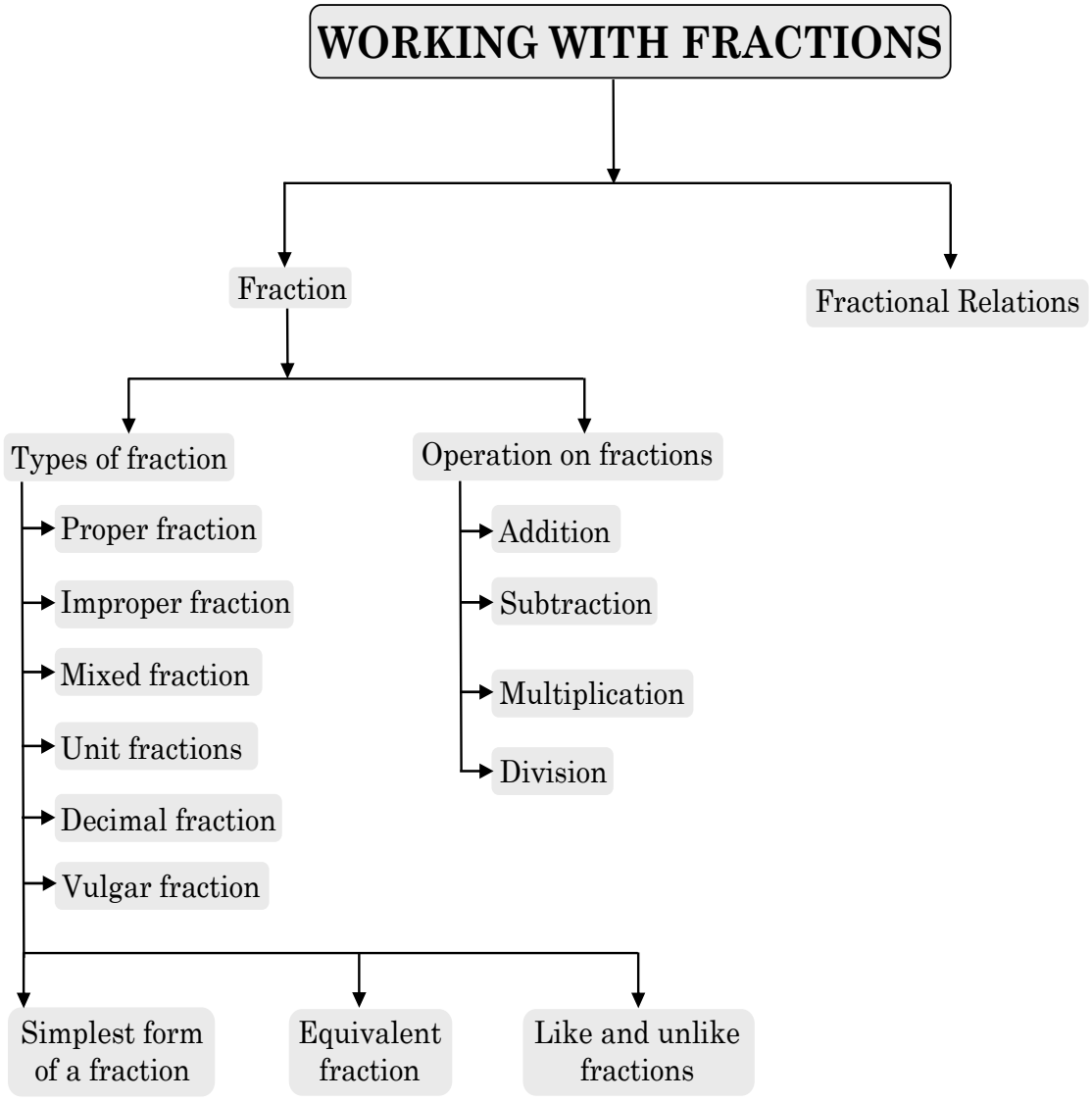




Fraction on Number Line



MIND MAP


WORKING WITH FRACTIONS
Fraction
Fractional Relations
Types of fraction
Operation on fractions
Proper fraction
Improper fraction
Mixed fraction
Unit fractions
Decimal fraction
Vulgar fraction
Addition
Subtraction
Multiplication
Division
Simplest form of a fraction
Equivalent fraction
Like and unlike fractions

WORKING WITH FRACTIONS

Fraction

A fraction is a number representing a part of a whole. The fraction representing 3 parts out of 7 equal parts in which the whole is divided is, denoted by $\frac{3}{7}$ and is read as "three - sevenths". A fraction can be expressed in the form $\frac{a}{b}$, where **a**, **b** are whole numbers and **b** $\neq$ **0**. In a fraction $\frac{a}{b}$, we call '**a**' as numerator and '**b**' as denominator..

For example, $\frac{2}{5}, \frac{1}{3}, \frac{0}{5}, \frac{7}{15}$, are fractions.

Types of Fraction

- **Proper Fraction :** A proper fraction is a fraction in which the numerator is smaller than the denominator.

  For example : $\frac{2}{9}, \frac{3}{7}, \frac{12}{29}$,..., etc. are proper fractions.

- **Improper Fraction :** An improper fractions is a fraction in which the numerator is greater than the denominator.

  For example : $\frac{7}{5}, \frac{29}{17}, \frac{17}{13}$,....., etc. are improper fractions.

- **Mixed Fraction :** Mixed numerals are combination of a whole number and a proper fraction.

  For example : fractions $3\frac{1}{2}, 5\frac{1}{3}, 8\frac{1}{4}$, etc. are mixed numerals or mixed fractions.

- **Like Fractions :** The fractions with the same denominator are called like fractions.

  For example : $\frac{7}{12}, \frac{5}{12}, \frac{11}{12}$,....., etc. are like fractions.

- **Unlike Fractions :** The fractions with different denominators are called unlike fractions.

  For example : $\frac{2}{3}, \frac{4}{5}, \frac{11}{13}, \frac{7}{8}$,...., etc. are unlike fractions.

- **Unit Fractions :** The fraction with numerator 1 are called unit fractions.

  For example : $\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \frac{1}{7}$,...., etc. are unit fractions.

- **Decimal Fractions :** A fraction whose denominator is any of the number 10,100,1000 etc. is called a decimal fraction.

  For example : $\frac{8}{10}, \frac{11}{100}, \frac{17}{1000}$ etc. are decimal fractions.

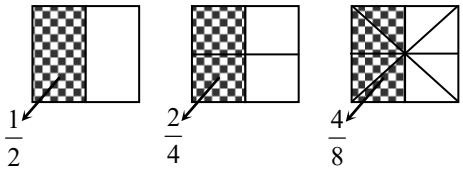
- **Vulgar Fractions :** A fraction whose denominator is a whole number, other than 10,100,1000 etc. is called a vulgar fractions.

  For example : $\frac{2}{7}, \frac{3}{8}, \frac{11}{17}$ etc. are vulgar fractions.

◈ **Equivalent Fractions :** If $\frac{c}{d} = \frac{m \times a}{m \times b}$, then the fractions $\frac{a}{b}$ and $\frac{c}{d}$ are called equivalent fractions because they represent the same portion of the whole.

For example : $\frac{4}{6} = \frac{2 \times 2}{3 \times 2}$; $\frac{15}{48} = \frac{5 \times 3}{16 \times 3}$

For example, the shaded parts of each of the following figures are same but they are represented by different fractional numbers.



They are called equivalent fractions.

So we write $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$, etc.

◈ **Conversion of Unlike Fractions to Like Fractions :**

To convert unlike fractions into like fractions, we use the following steps :

Step I : Find the LCM of the denominators of the given fractions.

Step II : Convert each of the given fractions into an equivalent fraction having denominator equal to the LCM obtained in step I.

Ex.1 Convert the unlike fractions $\frac{7}{6}$, $\frac{5}{9}$ and $\frac{5}{12}$ into like fractions.

Sol. We have,

LCM of (6, 9, 12) = (3 × 2 × 3 × 2) = 36

Now, $\frac{7}{6} = \frac{7 \times 6}{6 \times 6} = \frac{42}{36}$; $\frac{5}{9} = \frac{5 \times 4}{9 \times 4} = \frac{20}{36}$

and $\frac{5}{12} = \frac{5 \times 3}{12 \times 3} = \frac{15}{36}$

Clearly, $\frac{42}{36}$, $\frac{20}{36}$ and $\frac{15}{36}$ are like fractions.

Comparison of Fractions

Step I : Find the LCM of the denominators of the given fractions.

Step II : Convert each fraction to its equivalent fraction with denominator equal to the LCM obtained in step I.

Step III: Arrange the fractions in ascending or descending order by arranging numerators in ascending or descending order.

Ex.2 Which is larger $\frac{3}{4}$ or $\frac{5}{12}$?

Sol. First find the LCM of 4 and 12.

∴ LCM of 4 and 12 is 2 × 2 × 3 = 12

Now we convert the given fractions to equivalent fractions with denominator 12.

We have,

$\frac{3}{4} = \frac{3 \times 3}{4 \times 3} = \frac{9}{12}$

We know that 9 > 5

$\therefore \frac{9}{12} > \frac{5}{12} \Rightarrow \frac{3}{4} > \frac{5}{12}$

Ex.3 Arrange the following in descending order : $\frac{1}{5}, \frac{3}{7}, \frac{7}{10}$

Sol. $\frac{1}{5}, \frac{3}{7}, \frac{7}{10}$ [L. C. M of 5, 7 and 10 = 70]

$\Rightarrow \frac{1\times14}{5\times14}, \frac{3\times10}{7\times10}, \frac{7\times7}{10\times7}$

$\Rightarrow \frac{14}{70}, \frac{30}{70}, \frac{49}{70}$

Descending order is $\frac{49}{70} > \frac{30}{70} > \frac{14}{70}$

i.e., $\frac{7}{10} > \frac{3}{7} > \frac{1}{5}$

$\Rightarrow \frac{7}{10}, \frac{3}{7}, \frac{1}{5}$ are in descending order.

Addition and Subtraction of Fractions

There are two cases of adding and subtracting fractions :

1. Fractions with Similar Denominators. (Like fractions)
2. Fractions with Different Denominators (Unlike fractions)

◈ Fractions with Similar Denominators :

Ex.4 Solve the following :

(i) $\frac{2}{5}+\frac{3}{5}$ (ii) $\frac{4}{7}-\frac{3}{7}$

Sol. (i) $\frac{2}{5}+\frac{3}{5} = \frac{2+3}{5} = \frac{5}{5} = 1$

(ii) $\frac{4}{7}-\frac{3}{7} = \frac{4-3}{7} = \frac{1}{7}$

◈ Fractions with Different Denominators :

Use of L.C.M. of denominators.

Ex.5 Solve the following :

(i) $\frac{2}{5}+\frac{4}{3}$ (ii) $\frac{3}{9}-\frac{1}{8}$

Sol. (i) $\frac{2}{5}+\frac{4}{3}$ [L.C.M. of 5 and 3 = 15]

$= \frac{2\times3+4\times5}{15} = \frac{6+20}{15} = \frac{26}{15} = 1\frac{11}{15}$

(ii) $\frac{3}{9}-\frac{1}{8}$ [L.C.M. of 8 and 9 = 72]

$= \frac{3\times8-9\times1}{72} = \frac{24-9}{72} = \frac{15}{72} = \frac{5}{24}$

Multiplication of Fractions

Rule : Product of two fractions = $\frac{\text{Product of their Numerators}}{\text{Product of their Denominators}}$

◈ Multiplication of whole number by a fraction :

NCERT Examples

Q. Aaron's pet tortoise walks at a much slower pace. It can walk only $\frac{1}{4}$ kilometre in 1 hour. How far can it walk in 3 hours?

Ans. Distance covered in 1 hour = $\frac{1}{4}$ km

Therefore, distance covered in 3 hours = $3 \times \frac{1}{4}$ km

$= \frac{3}{4}$ km

Q. Aaron can walk 3 kilometres in 1 hour. How far can he walk in $\frac{1}{5}$ hours?

Ans. Distance covered in 1 hour = 3 km

Therefore, distance covered in $\frac{1}{5}$ hours $= \frac{1}{5} \times 3$ km

$= \frac{3}{5}$ km

Q. Rahul can walk 3 kilometres in 1 hour. How far can he walk in $\frac{2}{5}$ hours?

Ans. Distance covered in 1 hour = 3 km

Therefore, distance covered in $\frac{2}{5}$ hours $= \frac{2}{5} \times 3$ km

$= \frac{6}{5}$ km

Q. If 1 hour of internet time costs ₹ 8. How much will $1\frac{1}{4}$ hours of internet time cost?

Ans. $1\frac{1}{4}$ hours = $\frac{5}{4}$ hours

Cost of $\frac{5}{4}$ hour of internet time = $\frac{5}{4} \times 8$

$= 5 \times 2$

$= 10$

It costs ₹10 for $1\frac{1}{4}$ hours of internet time.

Ex.6 Find the product of :

(i) $3 \times \frac{2}{7}$ (ii) $3 \times \frac{1}{8}$ (iii) $\frac{7}{9} \times 6$

Sol. (i) $3 \times \frac{2}{7} = \frac{3}{1} \times \frac{2}{7} = \frac{3 \times 2}{1 \times 7} = \frac{6}{7}$

(ii) $3 \times \frac{1}{8} = \frac{3}{1} \times \frac{1}{8} = \frac{3 \times 1}{1 \times 8} = \frac{3}{8}$

(iii) $\frac{7}{9} \times 6 = \frac{7}{9} \times \frac{6}{1} = \frac{14}{3} = 4\frac{2}{3}$

◈ **Multiplication of a Unit Fraction by a Unit Fraction :**

If we multiply a unit fraction to other unit fraction, we get also unit fraction.

If $\frac{1}{b}$ and $\frac{1}{d}$ are two unit fractions, then multiplication of $\frac{1}{b}$ and $\frac{1}{d}$ is $\frac{1}{b} \times \frac{1}{d} = \frac{1}{bd}$

i.e. Product of unit fractions = $\frac{1}{(\text{Production of denominators})}$.

Note When a fraction is multiplied by 1, the value of fraction stays the same.

e.g. $\frac{1}{4} \times 1 = \frac{1}{4}$

NCERT Example

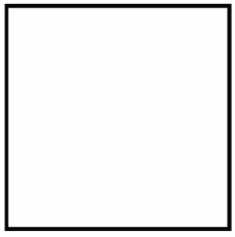
Q. Aaron's pet tortoise can walk only $\frac{1}{4}$ km in 1 hour. How far can it walk in half an hour?

Ans. Distance covered in 1 hour = $\frac{1}{4}$ km

Therefore, distance covered in $\frac{1}{2}$ hours $= \frac{1}{2} \times \frac{1}{4}$ km

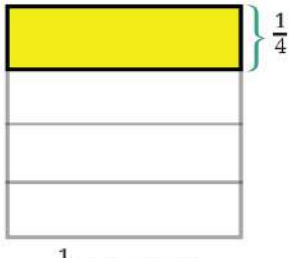
$= \frac{1}{8}$ km

It is useful to represent fractions using the unit square to stand for a "whole".



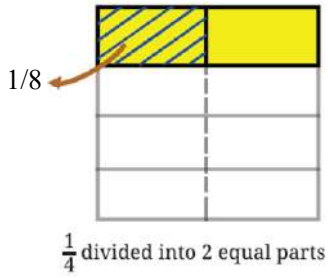
Unit square as a "whole"

Now divided this unit square into 4 equal parts



$\frac{1}{4}$ of the whole

Now we divide this $\frac{1}{4}$ into 2 equal parts.

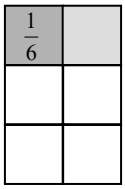


$\frac{1}{4}$ divided into 2 equal parts

Since the whole is divided into 8 equal parts and one of the parts is shaded i.e $\frac{1}{8}$ of the whole is shaded. So, the distance covered by the tortoise in half an hour is $\frac{1}{8}$ km.

◈ **Connection Between the Area of a Rectangle and Fraction Multiplication :**

We are given a unit square with side length 1 unit. A rectangle is drawn inside the unit square the length and breadth are $\frac{1}{2}$ unit and $\frac{1}{3}$ unit respectively.



We see that 6 such rectangles give the square of area 1 square units.

So, the area of each rectangle is $\frac{1}{6}$ square units. Product of length and breadth = $\frac{1}{2}\times\frac{1}{3}=\frac{1}{6}$

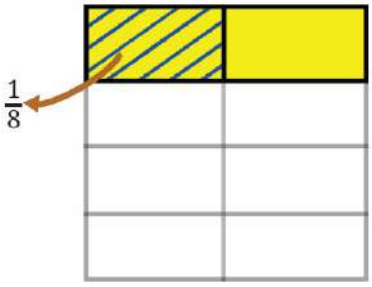
We conclude that the area of a rectangle with fractional sides equals the product of its sides.

NCERT Example

Q. Find the area of rectangle whose length is $\frac{1}{2}$ unit and breadth is $\frac{1}{4}$ unit ?

Ans. Area of rectangle = length × breadth

$= \frac{1}{2}\times\frac{1}{4} = \frac{1}{8}$ sq. unit



◈ **Multiplication of a Fraction by a Fraction :**

To multiply a fraction by a fraction, multiply their numerators and denominators.

$\therefore$ Product of fractions = $\frac{\text{Product of numberators}}{\text{Product of denominators}}$

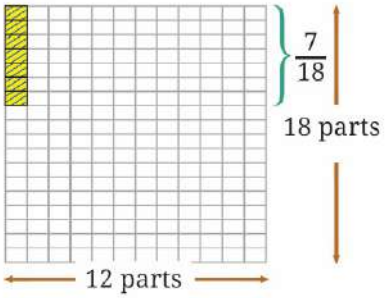
We express this as : $\frac{a}{b}\times\frac{c}{d} = \frac{a\times c}{b\times d}$

NCERT Examples

Q. Find $\frac{5}{12}\times\frac{7}{18}$.

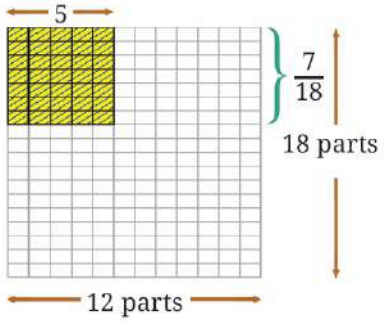
Ans. First, the whole is divided into 18 rows and 12 columns creating 12 × 18 equal parts.

The value we get by dividing $\frac{7}{18}$ into 12 equal parts is $\frac{7}{(12\times18)}$.



Then, we multiply this result by 5 to get the product. This is $\frac{(5\times7)}{(12\times18)}$.

$\Rightarrow \frac{5}{12}\times\frac{7}{18} = \frac{(5\times7)}{(12\times18)} = \frac{35}{216}$.



Q. Find the product of : $3\times\frac{3}{4}$

Ans. $3\times\frac{3}{4} = \frac{3}{1}\times\frac{3}{4}$

$= \frac{3\times3}{1\times4} = \frac{9}{4}$

Q. Find the product of : $\frac{3}{5}\times4$

Ans. $\frac{3}{5}\times4 = \frac{3}{5}\times\frac{4}{1}$

$= \frac{3\times4}{5\times1} = \frac{12}{5}$

Ex.7 Find the product : (i) $\frac{5}{8}\times\frac{3}{7}$ (ii) $\frac{6}{14}\times\frac{7}{9}$

Sol. (i) $\frac{5}{8}\times\frac{3}{7} = \frac{5\times3}{8\times7} = \frac{15}{56}$

(ii) $\frac{6}{14}\times\frac{7}{9} = \frac{2\times1}{2\times3} = \frac{1\times1}{1\times3} = \frac{1}{3}$

Simplest Form of Fractions

If numerator and denominator of a fraction have no common factor other than 1, then the fraction is said to be in its simplest or lowest form i.e. HCF of both is 1.

For example, $\frac{3}{5}, \frac{4}{5}, \frac{3}{7}, \frac{12}{13}$, etc. are the fractions in simplest form.

NCERT Examples

Q. Multiply the following fractions and express the product in its lowest form:

$\frac{12}{7} \times \frac{5}{24}$

Ans. $\frac{12}{7} \times \frac{5}{24} = \frac{\cancel{12}}{7} \times \frac{5}{\cancel{24}}$

$= \frac{1 \times 5}{7 \times 2} = \frac{5}{14}$

Q. Multiply the following fractions and express the product in its lowest form:

$\frac{14}{15} \times \frac{25}{42}$

Ans. $\frac{14}{15} \times \frac{25}{42} = \frac{\overset{1}{\cancel{14}}}{\underset{3}{\cancel{15}}} \times \frac{\overset{5}{\cancel{25}}}{\underset{3}{\cancel{42}}}$

$= \frac{1 \times 5}{3 \times 3} = \frac{5}{9}$

◈ Fraction Multiplication and its outcomes :

Situation 1	Multiplication	Relationship
Situation 1	Both numbers are greater than 1 $\left(\text{e.g. } \frac{7}{3} \times 4\right)$	The product $\left(\frac{28}{5}\right)$ greater than both the numbers
Situation 2	Both numbers are between 0 and 1 $\left(\text{e.g. } \frac{1}{7} \times \frac{4}{9}\right)$	The product $\left(\frac{4}{63}\right)$ is less than both the numbers
Situation 3	One number is between 0 and 1, and one number is greater than 1 $\left(\text{e.g. } \frac{3}{8} \times 7\right)$	The product $\left(\frac{21}{8}\right)$ is less than the number greater than 1 and greater than the number between 0 and 1

NCERT Examples

Q. Find the product of : 3×5

Ans. $3 \times 5 = 15$

The product, 15, is more than both 3 and 5.

Q. Find the product of : $\frac{1}{4} \times 8$

Ans. $\frac{1}{4} \times 8 = \frac{1}{4} \times \frac{8}{1}$

$= \frac{8}{4} = 2$

In the above multiplication the product, 2, is greater than $\frac{1}{4}$, but less than 8.

Q. Find the product of : $\frac{3}{4} \times \frac{2}{5}$

Ans. $\frac{3}{4} \times \frac{2}{5} = \frac{3 \times 2}{4 \times 5}$

$= \frac{6}{20}$

The product $\frac{6}{20}$ is less than both $\frac{3}{4}$ and $\frac{2}{5}$.

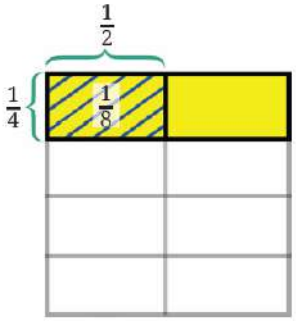
◈ **Order of Multiplication :**

Just like with whole numbers, the order in which we multiply fractions does not affect the result.

Thus, $\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}$

NCERT Example

Q. Find the area of rectangle whose length is $\frac{1}{2}$ unit and breadth is $\frac{1}{4}$ unit.



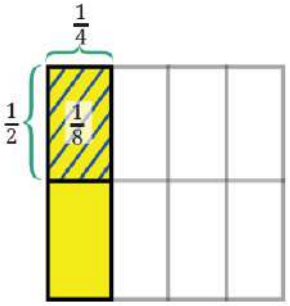
Ans. Area of rectangle = length × breadth

$= \frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$ sq. unit

Now if length is $\frac{1}{4}$ unit and breadth is $\frac{1}{2}$ unit, then

Area of rectangle = length × breadth

$= \frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$ sq. unit



Hence, the area of a rectangle remains the same even if the length and breadth are interchanged.

◈ Multiplication of Whole Number by a Mixed Fraction :

Ex.8 Find $8 \times 5\frac{1}{6}$

Sol. $8 \times 5\frac{1}{6} = 8 \times \frac{31}{6} = \frac{248}{6} = \frac{124}{3} = 41\frac{1}{3}$

◈ Multiplication of Mixed Fractions :

Ex.9 Find the product of :

(i) $3\frac{4}{5} \times \frac{10}{21}$ (ii) $\frac{15}{22} \times 4\frac{5}{7}$ (iii) $2\frac{4}{7} \times 2\frac{3}{4} \times 1\frac{2}{5}$

Sol. (i) $3\frac{4}{5} \times \frac{10}{21} = \frac{19}{5} \times \frac{10}{21} = \frac{38}{21} = 1\frac{17}{21}$

Thus, $3\frac{4}{5} \times \frac{10}{21} = 1\frac{17}{21}$

(ii) $\frac{15}{22} \times 4\frac{5}{7} = \frac{15}{22} \times \frac{33}{7} = \frac{15}{2} \times \frac{3}{7} = \frac{45}{14} = 3\frac{3}{14}$

(iii) $2\frac{4}{7} \times 2\frac{3}{4} \times 1\frac{2}{5} = \frac{18}{7} \times \frac{11}{4} \times \frac{7}{5}$

$= \frac{9 \times 11}{2 \times 5} = \frac{99}{10} = 9\frac{9}{10}$

Note :

1. It is not necessary first to multiply the fractions and then simplify. We may simplify first then multiply. For example,

   (i) $\frac{21}{25} \times \frac{45}{68} = \frac{21 \times 45}{25 \times 68} = \frac{21 \times 9}{5 \times 68} = \frac{189}{340}$

   (ii) $\frac{25}{7} \times \frac{12}{5} \times \frac{7}{4} = \frac{25 \times 12 \times 7}{7 \times 5 \times 4} = \frac{5 \times 3 \times 1}{1 \times 1 \times 1} = 15$

2. If word 'OF' is in between two fractions then multiply those fractions.

3. Product of two proper fractions < Each proper fraction.

   Ex. $\frac{2}{7} \times \frac{1}{3} = \frac{2}{21}$ $\therefore$ $\frac{2}{21} < \frac{2}{7}$ and $\frac{2}{21} < \frac{1}{3}$

4. Product of two improper fractions > Each improper fraction.

   Ex. $\frac{9}{4} \times \frac{7}{3} = \frac{63}{12} = \frac{21}{4}$ $\therefore$ $\frac{21}{4} > \frac{9}{4}$ & $\frac{21}{4} > \frac{7}{3}$

5. Proper fraction < Product of proper and improper fraction < Improper fraction

   Ex. $\frac{1}{7} \times \frac{5}{2} = \frac{5}{14}$ $\therefore$ $\frac{1}{7} < \frac{5}{14} < \frac{5}{2}$

Ex.10 Find : (i) $\frac{3}{4}$ of 16 (ii) $\frac{1}{4}$ of $\frac{3}{5}$ (iii) $\frac{1}{2}$ of $2\frac{3}{4}$

Sol. (i) $\frac{3}{4}$ of $16 = \frac{3}{4} \times 16 = \frac{3}{4} \times \frac{16}{1} = \frac{3 \times 4}{1 \times 1} = 12$

(ii) $\frac{1}{4}$ of $\frac{3}{5} = \frac{1}{4} \times \frac{3}{5} = \frac{1 \times 3}{4 \times 5} = \frac{3}{20}$

(iii) $\frac{1}{2}$ of $2\frac{3}{4} = \frac{1}{2} \times \frac{11}{4} = \frac{1 \times 11}{2 \times 4} = \frac{11}{8}$

Ex.11 The weight of one packet of tea is $\frac{1}{4}$ kg. What is the weight of 20 such packets ?

Sol. Weight of one packet of tea = $\frac{1}{4}$ kg

Therefore, weight of 20 packets of tea = $\frac{1}{4} \times 20 = 5$ kg.

Ex.12 In a Cinema hall's parking, 90 cars can be parked at a time. During a night show, $\frac{5}{9}$ of the parking lot was full. How many cars were there at that time ?

Sol. Total capacity of Parking place = 90 cars

$\therefore$ Number of cars during night show = $90 \times \frac{5}{9} = \frac{90 \times 5}{9} = 10 \times 5 = 50$ cars.

Ex.13 Vidya and Pratap went for a picnic. Their mother gave them a water bottle that contained 5 litres of water. Vidya consumed $\frac{2}{5}$ of the water. Pratap consumed the remaining water.

(i) How much water did Vidya drink ?

(ii) What fraction of the total quantity of water did Pratap drink ?

Sol. Total water = 5 litres.

(i) Water consumed by Vidya = $\frac{2}{5}$ of 5 litres = $\frac{2}{5} \times 5$ litres = 2 litres

(ii) Water drunk by Pratap = (5 – 2) = 3 litres.

The fraction of total quantity of water that Pratap drunk = $\frac{3}{5}$

Ex.14 A car runs 16 km using 1 litre of petrol. How much distance will it cover using $2\frac{3}{4}$ litres of petrol ?

Sol. Car runs in 1 litre of petrol = 16 km

$\therefore$ Car will run in $2\frac{3}{4}$ litres of petrol

$= \left(16 \times 2\frac{3}{4}\right)$ km

$= \left(\frac{16}{1} \times \frac{11}{4}\right)$ km $= \left(\frac{4 \times 11}{1 \times 1}\right)$ km = 44 km.

Hence, car will go 44 km in $2\frac{3}{4}$ litres of petrol.

◈ **Reciprocal of a Fraction :**

When the product of two fractions is 1, each of the fractions is called the reciprocal of the other.

Reciprocal of any non-zero fraction $\frac{a}{b}(a \neq 0, b \neq 0) = \frac{b}{a}$

Another term used for reciprocal is multiplicative inverse.

Ex.15 Find the reciprocal of : (i) 4 (ii) $\frac{2}{5}$ (iii) $7\frac{1}{3}$ (iv) $\frac{1}{7}$

Sol.(i) Reciprocal of 4, i.e., $\frac{4}{1} = \frac{1}{4}$.

(ii) Reciprocal of $\frac{2}{5} = \frac{5}{2}$

(iii) Reciprocal of $7\frac{1}{3}$ = Reciprocal of $\frac{22}{3} = \frac{3}{22}$.

(iv) Reciprocal of $\frac{1}{7} = \frac{7}{1} = 7$

Division of Fractions

If $\frac{a}{b}$ and $\frac{c}{d}$ are two fractions, where $\frac{c}{d} \neq 0$, then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$, i.e., the dividend is multiplied by the reciprocal of the divisor.

◈ **Division of Whole Number by a Fraction :**

To divide a whole number by any fraction, we have to multiply that whole number by the reciprocal of that fraction.

NCERT Examples

Q. What is $1 \div \frac{2}{3}$?

Ans. We have, $1 \div \frac{2}{3} = \frac{1}{1} \times \frac{3}{2}$

$= \frac{3}{2}$

Q. What is $3 \div \frac{2}{3}$?

Ans. We have, $3 \div \frac{2}{3} = \frac{3}{1} \times \frac{3}{2}$

$= \frac{9}{2}$

Ex.16 Find : (i) $75 \div \frac{1}{2}$ (ii) $5 \div \frac{3}{4}$

Sol. (i) We have, $75 \div \frac{1}{2} = 75 \times \frac{2}{1}$

$= \frac{75}{1} \times \frac{2}{1} = \frac{150}{1}$

(ii) We have, $5 \div \frac{3}{4} = 5 \times \frac{4}{3}$

$= \frac{5}{1} \times \frac{4}{3} = \frac{20}{3}$

◈ **Division of a Fraction by Another Fraction :**

To divide a fraction by another fraction, the first fraction is multiplied by the reciprocal of the second fraction.

Thus, $\left(\frac{a}{b} \div \frac{c}{d}\right) = \left(\frac{a}{b} \times \frac{d}{c}\right)$

NCERT Examples

Q. What is $\frac{1}{5} \div \frac{1}{2}$?

Ans. We have, $\frac{1}{5} \div \frac{1}{2} = \frac{1}{5} \times \frac{2}{1}$

$= \frac{2}{5}$

Q. What is $\frac{2}{3} \div \frac{3}{5}$?

Ans. We have, $\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3}$

$= \frac{10}{9}$

Ex.17 Find the value of : (i) $\frac{5}{7} \div \frac{25}{21}$ (ii) $\frac{7}{8} \div \frac{15}{8}$ (iii) $1\frac{2}{7} \div 2\frac{1}{14}$

Sol. (i) $\frac{5}{7} \div \frac{25}{21} = \frac{5}{7} \times \frac{21}{25} = \frac{3}{5}$

(ii) $\frac{7}{8} \div \frac{15}{8} = \frac{7}{8} \times \frac{8}{15} = \frac{7}{15}$

(iii) $1\frac{2}{7} \div 2\frac{1}{14} = \frac{9}{7} \div \frac{29}{14} = \frac{9}{7} \times \frac{14}{29} = \frac{18}{29}$

◈ **Division of Whole Number by a Mixed Fraction :**

To divide a whole number by a mixed fraction, first convert the mixed fraction into improper fraction and then solve it.

Ex.18 Find : (i) $5 \div 3\frac{1}{4}$ (ii) $12 \div 7\frac{1}{6}$

Sol. (i) We have, $5 \div 3\frac{1}{4} = 5 \div \frac{13}{4}$

$= \frac{5}{1} \times \frac{4}{13} = \frac{20}{13}$

(ii) We have, $12 \div 7\frac{1}{6} = 12 \div \frac{43}{6}$

$= \frac{12}{1} \times \frac{6}{43} = \frac{72}{43}$

◈ **Division of a Fraction by a None-Zero Whole number :**

To divide a fractional number by a whole number, multiply the fractional number by the reciprocal of the whole number.

Ex.19 Solve it $\frac{7}{15} \div 4$

Sol. We have, $\frac{7}{15} \div 4 = \frac{7}{15} \times \frac{1}{4}$

$= \frac{7}{60}$

◈ **Division of a Mixed Fraction by a Whole number :**

To divide a mixed fraction by a whole number, convert the mixed fraction into improper fraction and then solve it.

Ex.20 Solve it $4\frac{1}{5} \div 4$

Sol. We have, $4\frac{1}{5} \div 4 = \frac{21}{5} \div 4$

$= \frac{21}{5} \times \frac{1}{4}$

$= \frac{21}{20}$

Dividend, Divisor and the Quotient when dividing whole number

◈ **Dividend, Divisor and the Quotient**

(i) When dividing a whole number by a whole number

$6 \div 3 = 2$

$2 < 6$

Here the quotient is less than both the dividend and the divisor

(ii) When dividing a whole number by a fraction

$6 \div \frac{1}{4} = \frac{6}{1} \times \frac{4}{1}$

$= 24$

$24 > 6$

Here the quotient is greater than both the dividend and the divisor

(iii) When dividing a fraction by another fraction

$\frac{1}{8} \div \frac{1}{4} = \frac{1}{8} \times \frac{4}{1}$

$= \frac{4}{8} = \frac{1}{2}$

Here too the quotient is greater than both the dividend and the divisor

Note :

1. $\frac{a}{b} \div 1 = \frac{a}{b}$; **Ex.** $\frac{2}{3} \div 1 = \frac{2}{3} \times \frac{1}{1} = \frac{2}{3}$

2. $0 \div \frac{a}{b} = 0$ (always)

3. For $\frac{a}{b} \neq 0$; $\frac{a}{b} \div \frac{a}{b} = 1$; **Ex.** $\frac{2}{3} \div \frac{2}{3} = \frac{2}{3} \times \frac{3}{2} = 1$

4. '0' cannot be a divisor ($\because$ reciprocal of zero is not possible)

Ex.21 Simplify : $\dfrac{2\frac{3}{4}}{1\frac{5}{7}}$

Sol. $\dfrac{2\frac{3}{4}}{1\frac{5}{7}}$ is same as $2\frac{3}{4} \div 1\frac{5}{7}$

Now, $2\frac{3}{4} \div 1\frac{5}{7} = \frac{11}{4} \div \frac{12}{7} = \frac{11}{4} \times \frac{7}{12}$

$= \frac{77}{48} = 1\frac{29}{48}$

Ex.22 The area of a rectangle is $50\frac{1}{2}$ sq. cm. If its breadth is $2\frac{1}{4}$ cm. find its length.

Sol. Area of rectangle = length × breadth

$50\frac{1}{2}$ = length × $2\frac{1}{4} \Rightarrow \frac{101}{2}$ = length × $\frac{9}{4}$

$\frac{101}{2} \div \frac{9}{4}$ = length

$\left(\frac{101}{2} \times \frac{4}{9}\right)$ cm = length

Length = $\frac{101 \times 2}{9}$ cm = $\frac{202}{9} = 22\frac{4}{9}$ cm

Hence, length of rectangle = $22\frac{4}{9}$ cm.

Simplifying Brackets in Fractions

Ex.23 Simplify : $\frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \left(\frac{1}{5} + \overline{\frac{3}{7} - \frac{1}{5}}\right)\right\}\right]$

Sol. Let us first solve bar brackets :

$\frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \left(\frac{1}{5} + \overline{\frac{3}{7} - \frac{1}{5}}\right)\right\}\right] = \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \left(\frac{1}{5} + \overline{\frac{15-7}{35}}\right)\right\}\right]$

$= \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \left(\frac{1}{5} + \frac{8}{35}\right)\right\}\right] = \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \left(\frac{7+8}{35}\right)\right\}\right]$

$= \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \frac{15}{35}\right\}\right] = \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{3}{4} - \frac{3}{7}\right\}\right] = \frac{4}{7} + \left[\frac{1}{2} - \left\{\frac{21-12}{28}\right\}\right]$

$= \frac{4}{7} + \left[\frac{1}{2} - \frac{9}{28}\right] = \frac{4}{7} + \left[\frac{14-9}{28}\right] = \frac{4}{7} + \left[\frac{5}{28}\right] = \frac{4}{7} + \frac{5}{28} = \frac{16+5}{28} = \frac{21}{28}$

Ex.24 Simplify : $\dfrac{\dfrac{2}{3}-\overline{\dfrac{1}{2}-\dfrac{1}{3}}\ \text{of}\ \dfrac{1}{2}}{\dfrac{5}{6}-\dfrac{2}{3}\ \text{of}\ \dfrac{1}{3}+\dfrac{1}{9}}$

Sol. We have $\dfrac{\dfrac{2}{3}-\overline{\dfrac{1}{2}-\dfrac{1}{3}}\ \text{of}\ \dfrac{1}{2}}{\dfrac{5}{6}-\dfrac{2}{3}\ \text{of}\ \dfrac{1}{3}+\dfrac{1}{9}} = \dfrac{\dfrac{2}{3}-\dfrac{\overline{3-2}}{6}\ \text{of}\ \dfrac{1}{2}}{\dfrac{5-4}{6}\ \text{of}\ \dfrac{1}{3}+\dfrac{1}{9}}$

$$= \frac{\dfrac{2}{3}-\dfrac{1}{6}\ \text{of}\ \dfrac{1}{2}}{\dfrac{1}{6}\ \text{of}\ \dfrac{1}{3}+\dfrac{1}{9}} = \frac{\dfrac{2}{3}-\dfrac{1}{6}\times\dfrac{1}{2}}{\dfrac{1}{6}\times\dfrac{1}{3}+\dfrac{1}{9}} = \frac{\dfrac{2}{3}-\dfrac{1}{12}}{\dfrac{1}{18}+\dfrac{1}{9}}\text{s}$$

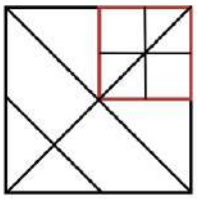
$$= \frac{\dfrac{8-1}{12}}{\dfrac{1+2}{18}} = \frac{\dfrac{7}{12}}{\dfrac{3}{18}} = \frac{7}{12}\times\frac{18}{3} = \frac{7\times 6}{12\times 1} = \frac{7}{2}$$

Fractional Relations (NCERT)

Q. Here is a square with some lines drawn inside.

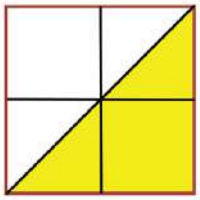
What fraction of area of the whole square does the shaded region occupy?

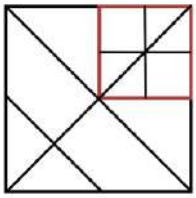
Ans. Let the area of the whole square be 1 square unit.



the top right square (in Fig.), occupies $\frac{1}{4}$ of the area of the whole square.

Area of red square = $\frac{1}{4}$ square units.

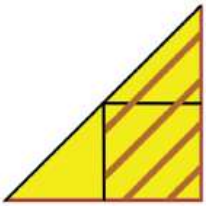




The area of the triangle inside it (coloured yellow) is half the area of the red square. So,

the area of the yellow triangle = $\frac{1}{2}\times\frac{1}{4}=\frac{1}{8}$ square units.

The shaded region occupies $\frac{3}{4}$ of the area of the yellow triangle.



The area of shaded part = $\frac{3}{4}\times\frac{1}{8}=\frac{3}{32}$ square units.

Thus, the shaded region occupies $\frac{3}{32}$ of the area of the whole square.

A DRAMMA-TIC DONATION (NCERT)

This is homorous historical problem from Bhaskarcharya's Lilavati (1150 CE). It tells the tale of miser who donates a very small fraction of a silver coin (called a dramma) to beggar. The donation involved multiplying several small fraction together : $\frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \times \frac{5}{6} \times \frac{1}{10} \times \frac{1}{4} = \frac{1}{1280}$

Since 1 dramma = 1280 cowrie shells, the beggar received just one cowrie shell. Showing the miser stinginess with a touch of Bhaskara's wit.

Around the 12th century, various coins were used across different kingdoms in Indian sub continent. Gold coins (called dinars/gadyanas and hunas). Were high value coins used for larger transactions and wealth storage.

Silver coins (called drammas/tankas) were used for daily trade, while copper coins (called kasus/panas and mashakas) were used for smaller exchanges. Cowrie shells, being of the lowest value, were used as small change. The value of these coins varied by region, weight and purity.

A PINCH OF HISTORY (NCERT)

Fractions have played a crucial role throughout history, particularly in problems involving sharing and dividing quantities. The general concept of non-unit fractions and their arithmetic operations (addition, subtraction, multiplication, division) developed significantly in India.

- Ancient Texts (Shulbasutra, c 800 BCE): These texts, concerned with constructing fire altars for rituals, used general non-unit fractions extensively, including performing division.
- Earily Commonh place Use (c. 150 BCE). Evidence suggests fractions became common in popular culture, indicated by references to reducing fractions to lowest terms (apavartana) in the philosophical work of the Jain scholar Umasvati.

  Codification by Brahmagupta (c.628 CE): General rules for arithmetic operations on fractions, similar to modern methods, were first codified by Brahmagupta in his work Brahmasphutasiddanta.

  - **Multiplication:** "Multiplication of two or more fractions is obtained by taking the product of the numerators divided by the product of the denominators" (Versa 12.1.3).

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

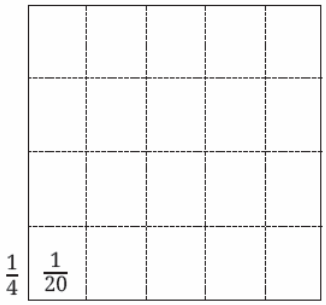
  - **Division:** The division of fractions is performed by interchanging the numerator and denominator of the divisor; the numerator of the dividend is then multiplied by the (new) numerator, and the denominator by the (new) denominator:

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{a \times d}{b \times c}$$

- Clarification by Bhaskara II (Lilavati c.1150 CE): Bhaskara II further clarified Brahmagupta's statement on division using the explicit notion of the reciprocal: Division of one fraction by another is equivalent to multiplication of the first fraction by the reciprocal of the second." (Verse 2.3.40)

- Geometric interpretations (Bhaskara I.c 629 CE): In his commentary on Aryabhata's work, Bhaskara I described geometric interpretations of fraction multiplication and division using the division of a square into rectangles (similar to the area model discussed earlier).

- Other Indian Mathematicians: Many others like Shridharacharya (c. 750 CE), Mahaviracharya (c. 850 CE), Caturveda Prithudakasvami (c. 860 CE), and Bhaskara II further developed the use of arithmetic fractions.



Bhaskara I' s Visual explanation that

$$\frac{1}{5}\times\frac{1}{4} = \frac{1}{20}$$

- Transmission: The Indian theory of fractions and arithmetic operations was transmitted to and developed further by Arab and African mathematicians (lie al-Hassar, c, 1192 CE, Morocco). It was then transmitted to Europe via the Arabs over subsequent centuries, coming into general use around the 17th century and becoming indispensable in modern mathematics.

NCERT EXERCISE (FIGURE IT OUT)

Q.1 Tenzin drinks $\frac{1}{2}$ glass of milk every day. How many glasses of milk does he drink in a week? How many glasses of milk did he drink in the month of January?

Q.2 A team of workers can make 1 km of a water canal in 8 days. So, in one day, the team can make ___ km of the water canal. If they work 5 days a week, they can make ___ km of the water canal in a week.

Q.3 Manju and two of her neighbours buy 5 litres of oil every week and share it equally among the 3 families. How much oil does each family get in a week? How much oil will one family get in 4 weeks?

Q.4 Safia saw the Moon setting on Monday at 10 pm. Her mother, who is a scientist, told her that every day the Moon sets $\frac{5}{6}$ hour later than the previous day. How many hours after 10 pm will the moon set on Thursday?

Q.5 Multiply and then convert it into a mixed fraction:

(a) $7 \times \frac{3}{5}$ (b) $4 \times \frac{1}{3}$

(c) $\frac{9}{7} \times 6$ (d) $\frac{13}{11} \times 6$

Q.6 Find the following products. Use a unit square as a whole for representing the fractions:

(a) $\frac{1}{3} \times \frac{1}{5}$ (b) $\frac{1}{4} \times \frac{1}{3}$

(c) $\frac{1}{5} \times \frac{1}{2}$ (c) $\frac{1}{6} \times \frac{1}{5}$

Q.7 Find the following products. Use a unit square as a whole for representing the fractions and carrying out the operations.

(a) $\frac{2}{3} \times \frac{4}{5}$ (b) $\frac{1}{4} \times \frac{2}{3}$

(c) $\frac{3}{5} \times \frac{1}{2}$ (d) $\frac{4}{6} \times \frac{3}{5}$

Q.8 A water tank is filled from a tap. If the tap is open for 1 hour, $\frac{7}{10}$ of the tank gets filled. How much of the tank is filled if the tap is open for

(a) $\frac{1}{3}$ hour _____

(b) $\frac{2}{3}$ hour _____

(c) $\frac{3}{4}$ hour _____

(d) $\frac{7}{10}$ hour _____

(e) For the tank to be full, how long should the tap be running ?

Q.9 The government has taken $\frac{1}{6}$ of Somu's land to build a road. What part of the land remains with Somu now? She gives half of the remaining part of the land to her daughter Krishna and $\frac{1}{3}$ of it to her son Bora. After giving them their shares, she keeps the remaining land for herself.

(a) What part of the original land did Krishna get?

(b) What part of the original land did Bora get?

(c) What part of the original land did Somu keep for herself?

Q.10 Find the area of a rectangle of sides $3\frac{3}{4}$ ft and $9\frac{3}{5}$ ft.

Q.11 Tsewang plants four saplings in a row in his garden. The distance between two saplings is $\frac{3}{4}$ m. Find the distance between the first and last sapling. **[Hint:** Draw a rough diagram with four saplings with distance between two saplings as $\frac{3}{4}$ m]

Q.12 Which is heavier : $\frac{12}{15}$ of 500 grams or $\frac{3}{20}$ of 4 kg ?

Q.13 Evaluate the following:

$3 \div \frac{7}{9}$	$\frac{14}{2} \div 2$	$\frac{2}{3} \div \frac{2}{3}$	$\frac{14}{6} \div \frac{7}{3}$
$\frac{4}{3} \div \frac{3}{4}$	$\frac{7}{4} \div \frac{1}{7}$	$\frac{8}{2} \div \frac{4}{15}$	
$\frac{1}{5} \div \frac{1}{9}$	$\frac{1}{6} \div \frac{11}{12}$	$3\frac{2}{3} \div 1\frac{3}{8}$	

Q.14 For each of the questions below, choose the expression that describes the solution. Then simplify it.

(a) Maria bought 8 m of lace to decorate the bags she made for school. She used $\frac{1}{4}$ m for each bag and finished the lace. How many bags did she decorate ?

(i) $8 \times \frac{1}{4}$ (ii) $\frac{1}{8} \times \frac{1}{4}$

(iii) $8 \div \frac{1}{4}$ (iv) $\frac{1}{4} \div 8$

(b) $\frac{1}{2}$ meter of ribbon is used to make 8 badges. What is the length of the ribbon used for each badge ?

(i) $8 \times \frac{1}{2}$ (ii) $\frac{1}{2} \div \frac{1}{8}$

(ii) $8 \div \frac{1}{2}$ (iv) $\frac{1}{2} \div 8$

(c) A baker needs $\frac{1}{6}$ kg of flour to make one loaf of bread. He has 5 kg of flour. How many loaves of bread can he make?

(i) $5 \times \frac{1}{6}$ (ii) $\frac{1}{6} \div 5$

(ii) $5 \div \frac{1}{6}$ (iv) 5×6

Q.15 If $\frac{1}{4}$ kg of flour is used to make 12 rotis, how much flour is used to make 6 rotis?

Q.16 *Pāṭīgaṇita*, a book written by Sridharacharya in the 9th century CE, mentions this problem: "Friend, after thinking, what sum will be obtained by adding together $1 \div \frac{1}{6}$, $1 \div \frac{1}{10}$, $1 \div \frac{1}{13}$, $1 \div \frac{1}{9}$, and $1 \div \frac{1}{2}$''. What should the friend say?

Q.17 Mira is reading a novel that has 400 pages. She read $\frac{1}{5}$ of the pages yesterday and $\frac{3}{10}$ of the pages today. How many more pages does she need to read to finish the novel?

Q.18 A car runs 16 km using 1 litre of petrol. How far will it go using $2\frac{3}{4}$ litres of petrol ?

Q.19 Amritpal decides on a destination for his vacation. If he takes a train, it will take him $5\frac{1}{6}$ hours to get there. If he takes a plane, it will take him $\frac{1}{2}$ hour. How many hours does the plane save ?

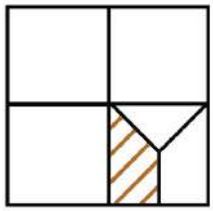
Q.20 Mariam's grandmother baked a cake. Mariam and her cousins finished $\frac{4}{5}$ of the cake. The remaining cake was shared equally by Mariam's three friends. How much of the cake did each friend get?

Q.21 Choose the option(s) describing the product of $\left(\frac{565}{465}\times\frac{707}{676}\right)$:

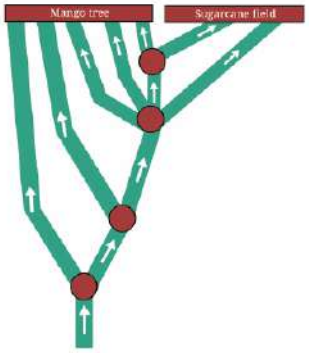
(a) $> \frac{565}{465}$ (b) $< \frac{565}{465}$ (c) $> \frac{707}{676}$

(d) $< \frac{707}{676}$ (e) > 1 (f) < 1

Q.22 What fraction of the whole square is shaded ?



Q.23 A colony of ants set out in search of food. As they search, they keep splitting equally at each point (as shown in the Fig.) and reach two food sources, one near a mango tree and another near a sugarcane field. What fraction of the original group reached each food source?



Q.24 What is $1-\frac{1}{2}$?

$\left(1-\frac{1}{2}\right)\times\left(1-\frac{1}{3}\right)$?

$\left(1-\frac{1}{2}\right)\times\left(1-\frac{1}{3}\right)\times\left(1-\frac{1}{4}\right)\times\left(1-\frac{1}{5}\right)$?

$\left(1-\frac{1}{2}\right)\times\left(1-\frac{1}{3}\right)\times\left(1-\frac{1}{4}\right)\times\left(1-\frac{1}{5}\right)\times$

$\left(1-\frac{1}{6}\right)\times\left(1-\frac{1}{7}\right)\times\left(1-\frac{1}{8}\right)\times\left(1-\frac{1}{9}\right)\times\left(1-\frac{1}{10}\right)$?

Make a general statement and explain.

Exercise -1

➢ Very Short Answer Type Questions

Q.1 Simplify the following :

(i) $3+\frac{4}{5}$ (ii) $\frac{5}{6}+\frac{2}{7}$

(iii) $5-\frac{2}{3}$ (iv) $\frac{3}{10}+\frac{2}{5}+\frac{1}{2}$

(v) $4\frac{3}{7}-3\frac{2}{5}$ (vi) $5\frac{3}{7}+4\frac{1}{2}+7\frac{3}{7}$

(vii) $9\frac{1}{2}+8\frac{2}{7}$ (viii) $9\times\frac{7}{8}$

(ix) $\frac{11}{3}\times\frac{3}{10}$ (x) $7\times4\frac{1}{2}$

Q.2 Multiply and reduce to lowest form (if possible) :

(i) $\frac{2}{3}\times\frac{5}{4}$ (ii) $\frac{1}{3}\times\frac{15}{8}$

(iii) $\frac{4}{5}\times\frac{12}{7}$

Q.3 Find :

(i) $\frac{1}{5}$ of a rupee (ii) $\frac{5}{8}$ of a day

(ii) $\frac{7}{8}$ of a kilogram (iv) $\frac{4}{5}$ of an hour

Q.4 Simplify :

(i) $\frac{4}{9}\div\frac{2}{3}$ (ii) $3\frac{3}{7}\div\frac{8}{21}$

(iii) $15\frac{3}{7}\div1\frac{23}{49}$

Q.5 Simplify each of the following :

(i) $\frac{4}{5}-\frac{3}{10}\div\frac{1}{2}$ (ii) $\frac{4}{5}+\frac{3}{10}\times\frac{2}{9}$

Q.6 Out of a 1-litre bottle, 2/5 litre of milk is used. How much milk is left ?

Q.7 Find the value of the following fractions of numbers.

(i) $\frac{1}{3}$ of 15 (ii) $\frac{1}{4}$ of 20

Q.8 Find the value of the following division of fractions.

(i) $2\div\frac{8}{9}$ (ii) $1\frac{3}{5}\div\frac{1}{2}$

(iii) $2\frac{1}{2}\div2\frac{3}{5}$

➢ Short Answer Type Questions – Type I

Q.9 Ankita organised a picnic and invited $\frac{1}{6}$ of all her classmates. If $\frac{1}{2}$ of the classmates invited were girls, find how many boys were there at Ankita's picnic, if there were 60 students in her class.

Q.10 Rohan caught 5 fishes. Their total weight was $7\frac{1}{2}$kg. If all fishes have equal weight, find the weight of one fish.

Q.11 Sheela's mother bought $\frac{3}{4}$ kg of toffees. She distributed the toffees to some children. If each child was given $\frac{1}{8}$kg toffees, find how many children were distributed the toffees ?

Q.12 How many boards of length $1\frac{1}{2}$ feet can be cut from a piece of a wooden log that measures $22\frac{1}{2}$ feet in length ?

Q.13 Ramesh can iron a shirt in $4\frac{3}{4}$ minutes, how long will he take to iron 16 shirts ?

Q.14 A tailor uses $\frac{2}{3}$ metre of cloth to make a blouse for a dancer. If 150 students are taking part in the dance, then how many metres of cloth will the tailor be using ?

Q.15 In a class of 48 students, $\frac{1}{4}$ of them regularly watch a particular TV programme. How many of the students do not regularly watch the programme ?

Q.16 Ramu finished $\frac{1}{3}$ part of a work in 1 h. How much part of the work will be finished in $2\frac{1}{5}$ h ?

Q.17 The weight of an object on Moon is $\frac{1}{6}$ of its weight on Earth. If an object weight $5\frac{5}{3}$kg on Earth, how much would it weight on the Moon ?

➢ Short Answer Type Questions – Type II

Q.18 A cook adds $4\frac{3}{7}$ cups of water to a stew. If the cup holds $\frac{3}{14}$ of a litre, how many litres of water were added ?

Q.19 It takes $3\frac{1}{4}$ minutes for a cub scout to clean a pair of shoes. If he cleans 36 pairs of shoes to raise money for a charity, how long does he spend to this job ?

Q.20 A pharmacist counts 24 tablets and put them into a bottle. Each tablet weighs $\frac{1}{4}$ of a gram and the weight of the bottle is $112\frac{1}{2}$ grams. What is the total weight ?

Q.21 A field has an area of 5/6 hectare. Out of this, 1/3 is used for wheat and the rest for vegetable, Find the area used for each.

Q.22 A school uses 3/4 litres of sanitizer per classroom per day. If there are 24 classrooms, how many litres of sanitizer are used in 10 days ?

Q.23 Amit has one piece of chocolate cake. Sumit has one piece of strawberry cake. Amit slices his cake into 8 equal pieces. Sumit slices his cake into 16 equal pieces. Amit wants to exchanges a portion of his cake for an equal portion of Sumit's cake. If he gives

Q.24 A picture hall has seats for 820 persons. At a recent film show, user Mr. X guessed it was $\frac{3}{4}$ full, another user Mr. Y guessed that it was $\frac{2}{3}$ full. The ticket office reported 648 sales. Which user (X or Y)made the better guess ? What value depict here ?

➢ Long Answer Type Questions

Q.25 While helping father put in a new driveway, Shyam carried 14 bags of sand from the garage to the cement mixer. If each bag weighed $25\frac{1}{4}$kg , what was the total weight of all the sand that Shyam carried ?

Q.26 Simplify :

(i) $\frac{1}{4}+\left[\frac{1}{2}\times\frac{1}{2}\div\left\{\frac{1}{2}\times\frac{1}{2}\div\frac{1}{2}+\left(\frac{1}{2}\div\frac{1}{2}\right)\right\}\right]$

(ii) $\cfrac{1}{1+\cfrac{\frac{2}{3}}{1+\frac{2}{3}+\cfrac{\frac{8}{9}}{1-\frac{2}{3}}}}$

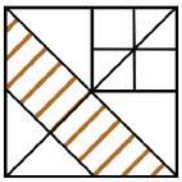
Q.27 A 60-metre ribbon is cut into pieces, each of length 3/4 metre. How many such pieces can be cut ?

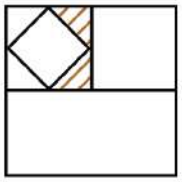
Q.28 The product of two numbers is $15\frac{5}{6}$. If one of the numbers is $6\frac{2}{3}$. Find the other.

Q.29 Rita has bought a carpet of size 4 m × $6\frac{2}{3}$ m. But her room size is $3\frac{1}{3}$ m × $5\frac{1}{3}$ m. What fraction of area should be cut-off of fit carpet into the room ?

Q.30 A hill $101\frac{1}{3}$ m in height, has $\frac{1}{4}^{th}$ of its height under water. What is the height of the hill visible above the water ?

Q.31 In each of the figure below, find the fraction of the big square that the shaded region occupies.

(i) 

(ii) 

➢ Fill in the Blanks

Q.32 (i) The lowest form of the product $2\frac{3}{7} \times \frac{7}{9}$ is .....

(ii) The reciprocal of $\frac{2}{7}$ is.....

(iii) $\frac{1}{5} \div \frac{5}{6} = \frac{1}{5}$ ..... $\frac{6}{5}$

➢ True or False

Q.33 (i) The reciprocal of a proper fraction is a proper fraction.

(ii) 1 is the only number which is its own reciprocal.

(iii) 2/3 of 8 is same as 2/3 ÷ 8.

(iv) $\frac{1}{3}$ of 6 is same as $\frac{1}{3} \div 6$.

(v) The reciprocal of $\frac{1}{2}$ is $\frac{1}{2}$.

➢ Match the Column

Q.34 Each question contains statements given in two columns which have to be matched. Statement (i, ii, iii, iv) in column I have to be matched with statement (a, b, c, d) in column II.

In a class of 40 students $\frac{1}{5}$ of the total number of students like to study English, $\frac{2}{5}$ of the total number like to study Mathematics and the remaining students like to study Science.

Match the following :

Column-I	**Column-II**
(i) No. of students like to study English	(a) 8
(ii) No. of students like to study Mathematics	(b) 16
(iii) Fraction of the total number of students like to study Science	(c) $\frac{16}{40}$
(iv) Fraction of the total number of students like to study English	(d) $\frac{8}{40}$

Q.35 Match the column A to Column B.

	Column A		**Column B**
(i)	$4\frac{6}{9} \div \frac{1}{81}$	(a)	378
(ii)	$7\frac{5}{6} \times \frac{3}{47} \times 46$	(b)	$\frac{5}{43}$
(iii)	$2\frac{6}{13} \div \frac{1}{13}$	(c)	23
(iv)	$3\frac{1}{3} \div 14\frac{1}{3} \times \frac{1}{2}$	(d)	32

Exercise -2

Q.1 If $x = \frac{1}{2}$, then find the value of $x + \frac{1}{1+\frac{1}{1+\frac{1}{x}}}$

(A) $\frac{5}{4}$ (B) $\frac{4}{5}$ (C) $\frac{3}{4}$ (D) $\frac{4}{3}$

Q.2 The product of the ten fractions $\frac{0}{1}\times\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\frac{5}{6}\times\frac{6}{7}\times\frac{7}{8}\times\frac{8}{9}\times\frac{9}{10}$ is

(A) $\frac{1}{10}$ (B) $\frac{362880}{3628800}$

(C) 0 (D) $\frac{9}{10}$

Q.3 The value of $\frac{\frac{1}{2}\div\frac{1}{2}\text{ of }\frac{1}{2}}{\frac{1}{2}+\frac{1}{2}\text{ of }\frac{1}{2}}$ is ?

(A) $2\frac{2}{3}$ (B) 1 (C) $1\frac{1}{3}$ (D) 3

Q.4 Which of the following is improper fraction :

(A) $\frac{4}{7}$ (B) $\frac{7}{4}$ (C) $\frac{5}{7}$ (D) $\frac{9}{11}$

Q.5 If in a fraction the numerator is less than the denominator then it is called

(A) like fraction (B) unlike fraction
(C) improper fraction (D) proper fraction

Q.6 The reciprocal of $\frac{3}{7}$ is

(A) $\frac{7}{3}$ (B) $2\frac{1}{3}$

(C) both (A) and (B) (D) none of these

Q.7 What is $5 \times 4\frac{1}{5}$?

(A) $20\ \frac{1}{5}$ (B) 21

(C) $20\ \frac{5}{25}$ (D)22

Q.8 Find the missing numerator :

$2\frac{?}{6} + 4\frac{5}{12} = 6\frac{7}{12}$

(A) 5 (B) 2 (C) 1 (D) 4

Q.9 $\frac{1}{9}$ of $\frac{1}{6}$ of $\frac{1}{3}$ of 56052 =?

(A) 356 (B) 336
(C) 376 (D) 346

Q.10 A recipe calls for $\frac{3}{8}$ of a cup of sugar. Jordan wants to make $\frac{1}{3}$ of the recipe. How much sugar will Jordan need?

(A) $\frac{1}{8}$ (B) $\frac{1}{3}$ (C) $\frac{1}{4}$ (D) $\frac{4}{11}$

Q.11 In the gym $\frac{1}{4}$ of the people are men, $\frac{1}{3}$ of the people are women, and the rest are children. If there are 420 people in the gym, how many are children?

(A) 105 (B) 175
(C) 245 (D) 120

Q.12 The product of $\frac{11}{13}$ and 4 is :

(A) $3\frac{5}{13}$ (B) $5\frac{3}{13}$ (C) $13\frac{3}{5}$ (D) $13\frac{5}{3}$

Q.13 The product of 3 and $4\frac{2}{5}$ is :

(A) $17\frac{2}{5}$ (B) $\frac{24}{5}$ (C) $13\frac{1}{5}$ (D) $5\frac{1}{13}$

Q.14 $\frac{1}{5} \div \frac{4}{5}$ equal to

(A) $\frac{4}{5}$ (B) $\frac{1}{5}$ (C) $\frac{5}{4}$ (D) $\frac{1}{4}$

Q.15 $5\frac{1}{6} \div \frac{9}{2}$ is equal to

(A) $\frac{31}{6}$ (B) $\frac{1}{27}$ (C) $5\frac{1}{27}$ (D) $\frac{31}{27}$

Q.16 The value of $\frac{3}{4}$ of 27 is

(A) 36 (B) $\frac{81}{4}$

(C) $\frac{1}{36}$ (D) $\frac{4}{81}$

Q.17 Lowest from of $\frac{2}{3} \times 4\frac{2}{3}$ is

(A) $3\frac{1}{9}$ (B) $1\frac{3}{9}$

(C) $4\frac{2}{9}$ (D) $\frac{1}{9}$

Q.18 The value of box :

$$\frac{3}{5} \times \square = \frac{24}{50} \text{ is}$$

(A) $\frac{6}{30}$ (B) $\frac{6}{25}$

(C) $\frac{8}{10}$ (D) $\frac{6}{15}$

Q.19 If M = 9, N = $\frac{33}{5} \times \frac{15}{11}$, find the value of $\frac{M}{N}$.

(A) 1 (B) 9

(C) 3 (D) 6

Q.20 If a chocolate bar weighs 5/6 kg and you eat 1/3 of it, how much did you eat ?

(A) 5/18 kg (B) 5/9 kg

(C) 1/3 kg (D) 5/6 kg

Exercise -3

Q.1 Aman, Rahul, Raj and Nikhil each took the same spelling test.

- ☞ Aman spelled 7/10 of the words correctly.
- ☞ Rahul spelled 3/4 of the words correctly.
- ☞ Raj spelled 4/5 of the words correctly.
- ☞ Nikhil spelled 2/3 of the words correctly.

Who spelled the least number of words correctly and arrange their fraction in ascending order ?

(A) Aman, $\frac{7}{10} < \frac{3}{4} < \frac{4}{5} < \frac{2}{3}$

(B) Rahul, $\frac{3}{4} < \frac{2}{3} < \frac{4}{5} < \frac{7}{10}$

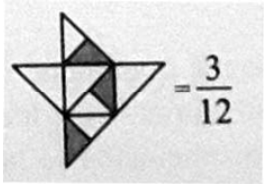
(C) Raj, $\frac{2}{3} < \frac{3}{4} < \frac{7}{10} < \frac{4}{5}$

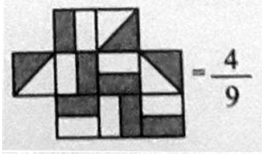
(D) Nikhil, $\frac{2}{3} < \frac{7}{10} < \frac{3}{4} < \frac{4}{5}$

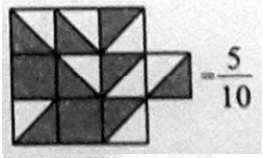
Q.2 The value of $\frac{3}{2}$ of $\left(\frac{3\frac{1}{2} \div 1\frac{1}{2} \text{ of } 5\frac{1}{2}}{2\frac{1}{2} + 1\frac{1}{2} \text{ of } 3\frac{1}{2}}\right)$ is ..... .

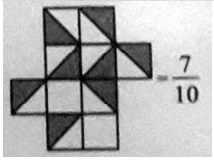
(A) $\frac{56}{99}$ (B) $\frac{56}{1023}$ (C) $\frac{28}{341}$ (D) $\frac{182}{31}$

Q.3 Which of the following is correct with respect to shaded part of a figure ?

(A)  $= \frac{3}{12}$

(B)  $= \frac{4}{9}$

(C)  $= \frac{5}{10}$

(D)  $= \frac{7}{10}$

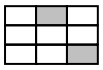
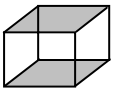
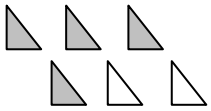
Q.4 Find the value of

$$\frac{\left(3\frac{2}{3}\right)^2 - \left(2\frac{1}{2}\right)^2}{\left(4\frac{3}{4}\right)^2 - \left(3\frac{1}{3}\right)^2} \div \frac{3\frac{2}{3} - 2\frac{1}{2}}{4\frac{3}{4} - 3\frac{1}{3}}$$

(A) $\frac{37}{97}$ (B) $\frac{74}{97}$

(C) $1\frac{23}{74}$ (D) none of these

Q.5 Select the correct Match.

	Figure	**Fraction of unshaded part**
(A)		$\frac{2}{9}$
(B)		$\frac{2}{3}$
(C)		$\frac{1}{6}$
(D)		$\frac{2}{3}$

Q.6 A 5 kg bag of rice cost ₹ 8 per kg. Mr. Mohit bought ₹ 120 worth of rice. If he repacked the rice into smaller packets each weighing $\frac{3}{5}$ kg, how many packets would he get?

(A) 15 (B) 12

(C) 9 (D) 25

Q.7 It takes 17 full specific type of trees to make one tonne of paper. If there are 221 such trees in a forest, then to save $\frac{7}{13}$ part of the forest, how much of paper we have to save?

(A) 6 tonnes (B) 8 tonnes

(C) 7 tonnes (D) 4 tonnes

Q.8 Shivam purchased $42\frac{1}{4}$ litres on Monday and $42\frac{3}{4}$ litres of juice on Tuesday. How many litres of juice did he purchase together in two days?

(A) 85 litres (B) $72\frac{3}{4}$ litres

(C) $76\frac{1}{4}$ litres (D) $67\frac{1}{4}$ litres

Q.9 Which of the following statements is correct?

(A) The reciprocal of a proper fraction is a proper fraction.

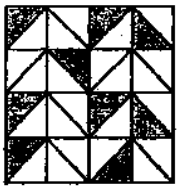
(B) The product of two improper fractions is less than both the fractions.

(C) To multiply a decimal number by 1000, we move the decimal in the number to the right by three places

(D) Product of two fractions

$$= \frac{\text{Product of their denominators}}{\text{Product of their numerators}}$$

Q.10 How many more triangles in the given figures must be shaded to make the fraction of unshaded part equal to $\frac{5}{8}$?



(A) 3 (B) 4 (C) 2 (D) 5

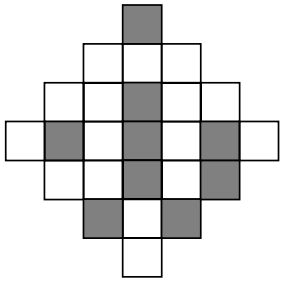
Q.11 A bottle is $\frac{3}{4}$ full of soft drink. The drink in the bottle can fill 6 glasses. If the drink in the bottle is poured out to fill 4 glasses, find the fraction of drink left in the bottle.

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{1}{6}$ (D) $\frac{1}{2}$

Q.12 Solve : $\left[3\frac{1}{4} \div \left\{1\frac{1}{4} - \frac{1}{2}\left(2\frac{1}{2} - \overline{\frac{1}{4} - \frac{1}{6}}\right)\right\}\right]$

(A) 78 (B) 100 (C) 128 (D) 26

Q.13 How many more unit squares in the figure must be shaded so that the fraction of unshaded squares becomes $\frac{2}{5}$?



(A) 5 (B) 6 (C) 3 (D) 2

Q.14 $5\frac{1}{4}$ kg of oranges and $2\frac{3}{5}$ kg of grapes were bought together by Alisha from the supermarket. What is the total weight of the fruits will she be carrying out of supermarket?

(A) $8\frac{5}{13}$kg (B) $7\frac{17}{20}$kg

(C) $7\frac{17}{21}$kg (D) $8\frac{9}{13}$kg

Q.15 A field has area 5/6 hectare. 1/2 of it is sown with wheat. What area is under wheat ?

(A) 2/3 ha. (B) 1/2 ha.

(C) 10/12 ha. (D) 5/12 ha.

Q.16 Calculate the value of

$$\frac{2}{5} + 2\frac{4}{9} \div \left[\left(7\frac{5}{12} - 5\frac{3}{4}\right) \div 22\frac{1}{2} + 10 \times \frac{5}{18}\right] - \frac{4}{5}$$

(A) $\frac{9}{35}$ (B) $\frac{17}{25}$

(C) $\frac{16}{35}$ (D) $\frac{19}{35}$

Q.17 Which of the following represents $\frac{1}{3}$ of $\frac{1}{6}$?

(A) $\frac{1}{3} + \frac{1}{6}$ (B) $\frac{1}{3} - \frac{1}{6}$

(C) $\frac{1}{3} \times \frac{1}{6}$ (D) $\frac{1}{3} \div \frac{1}{6}$

Q.18 A ribbon of length $5\frac{1}{3}$ m is cut into small pieces, each of length $\frac{2}{3}$ m. The number of pieces will be

(A) 5 (B) 6
(C) 7 (D) 8

Q.19 $\frac{5}{12}$ part of what amount will be equal to $3\frac{3}{4}$ part of ₹100 ?

(A) ₹ 900 (B) ₹ 940
(C) ₹ 875 (D) ₹ 925

Q.20 $\frac{4}{5}$ of 5 kg apples were used on Monday. The next day $\frac{1}{3}$ of what was left was used. Weight (in kg) of apples left now is

(A) $\frac{2}{7}$ (B) $\frac{1}{14}$
(C) $\frac{2}{3}$ (D) $\frac{4}{21}$

Answer Key

EXERCISE - 1

1. (i) $\frac{19}{5}$ (ii) $\frac{47}{42}$ (iii) $\frac{13}{3}$ (iv) $\frac{6}{5}$ (v) $\frac{36}{35}$ (vi) $\frac{243}{14}$ (vii) $\frac{249}{14}$ (viii) $\frac{63}{8}$ (ix) $\frac{11}{10}$ (x) $\frac{63}{2}$

2. (i) $\frac{5}{6}$ (ii) $\frac{5}{8}$ (iii) $1\frac{13}{35}$ **3.** (i) 20 paise (ii) 15 hours. (iii) 875 g. (iv) 48 min.

4. (i) $\frac{2}{3}$ (ii) 9 (iii) $10\frac{1}{2}$ **5.** (i) $\frac{1}{5}$ (ii) $\frac{13}{15}$ **6.** $\frac{3}{5}$ **7.** (i) 5 (ii) 5

8. (i) $2\frac{1}{4}$ (ii) $3\frac{1}{5}$ (iii) $\frac{25}{26}$ **9.** 5 boys **10.** $1\frac{1}{2}$ kg **11.** 6 children

12. 15 boards **13.** 76 minutes or 1 Hour 16 minutes **14.** 100 m **15.** 36 students

16. $\frac{11}{15}$ **17.** $\frac{14}{15}$ kg **18.** $\frac{93}{98}$ litre **19.** 117 minutes or 1 Hour 57 minutes

20. $118\frac{1}{2}$ g **21.** $\frac{5}{9}$ hectare **22.** 180 L **23.** 8 pieces **24.** Mr. X **25.** $353\frac{1}{2}$ kg

26. (i) $\frac{5}{12}$ (ii) $\frac{13}{15}$ **27.** 80 **28.** $2\frac{3}{8}$ **29.** $\frac{1}{3}$ **30.** 76

31. (i) $\frac{3}{8}$ (ii) $\frac{1}{16}$ sq. unit **32.** (i) $\frac{17}{9}$ (ii) $\frac{7}{2}$ (iii) '×'

33. (i) False (ii) False (iii) False (iv) False (v) False

34. (i) → (a); (ii) → (b); (iii) → (c); (iv) → (d)

35. (i) → (a), (ii) → (c), (iii) → (d), (iv) → (b)

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	C	A	B	D	C	B	C	D	A	B	A	C	D	D
Ques.	16	17	18	19	20										
Ans.	C	A	C	A	A										

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	C	A	B	B	D	C	A	C	A	A	A	B	B	A
Ques.	16	17	18	19	20										
Ans.	C	C	D	A	C										

MENTAL ABILITY

Chapter 2

ALPHABET AND LETTER REPEATING SERIES

◈ Alphabet Series

Alphabet Series problems deals with alphabets and Alpha-Numeric. While attempting to solve the question, you have to check the pattern of the series.

Type of questions asked in the examination :

(i) Find the missing term(s).

(ii) Find the wrong term(s).

In these types of questions, a series of single or pairs of groups of letters is given. The terms of the series form a certain pattern as regards the position of the letters in the English alphabet.

Position of Alphabet :

(i) Alphabet in order

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

(ii) Alphabet in reverse order

Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

Direction : (Ex.1 to Ex.4) Find the missing term :

Ex.1 A, C, ?, G, I

(A) D (B) E

(C) F (D) H

Sol. **(B)** Series consists of alternate letter in order . So, the missing term would be E.

Ex.2 V, T, R, ?, N, ?

(A) L,P (B) P,M

(C) P,L (D) O,L

Sol. **(C)** Given series consists of alternate letters in reverse order. So, the missing terms would be P and L.

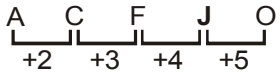
Ex.3 A, C, F, ?, O

(A) G (B) H

(C) I (D) J

Sol. **(D)** First , second, third,.....letters is moved two, three, four, five, ...steps forward respectively.

So, the missing terms would be J.



Ex 4. DOU,EPV, FQW, GRX, HSY, ?

(A) IJZ (B) ITZ

(C) IRZ (D) IUZ

Sol. **(B)** The first, second and third letters of each term are moved one steps forward to obtain the corresponding letters of the next term. So missing term is ITZ

Direction : (Ex.5 & Ex.6) Find the wrong term (s) :

Ex.5 A, C, E, F, I, K

(A) C (B) E

(C) F (D) I

Sol. **(C)** Each letter of the series differs by one letter. Hence, F is the wrong term and should be replaced by G.

Ex.6 DOU, EPV, FQW, GRX, HTY, ITZ

(A) FQW (B) GRX

(C) HTY (D) EPV

Sol. **(C)** In every term first second and third letter is in alphabetical order to its next term respectively. Fourth term is not following the same rule. Hence, HTY is the wrong term and should be replaced by HSY.

◈ Alpha-Numeric Series

The terms of the given series are a combination of letters and numerals, which move according to a set pattern.

Ex.7 Find the next term in the alpha-numeric series :
Z1A, X2D, V6G, T21J, R88M, P445P, ?
(A) N2676S (B) N2676T
(C) T2670N (D) T2676N

Sol. **(A)** Clearly, the patterns followed by the letters are as follows :

Ist letter :

$\mathbf{Z} \xrightarrow{-2} \mathbf{X} \xrightarrow{-2} \mathbf{V} \xrightarrow{-2} \mathbf{T} \xrightarrow{-2} \mathbf{R} \xrightarrow{-2} \mathbf{P} \xrightarrow{-2} N$

IInd letter $\mathbf{A} \xrightarrow{+3} \mathbf{D} \xrightarrow{+3} \mathbf{G} \xrightarrow{+3} \mathbf{J} \xrightarrow{+3} \mathbf{M} \xrightarrow{+3} \mathbf{P} \xrightarrow{+3} S$

The series formed by the numerals i.e. 1, 2, 6, 21, 88, 445, ….. follows the pattern × 1 + 1, × 2 + 2, × 3 + 3 , × 4 + 4, × 5 + 5, …

So, numeral in the desired term = 445 × 6 + 6 = 2676

Hence, desired term is N2676S.

Ex.8 Find the term which does not fit into the series given below :
G4T, J10R, M20P, P43N, S90L
(A) G4T (B) J10R
(C) M20P (D) P43N

Sol. **(B)** The patterns followed by the letters are :

Ist letter : $G \xrightarrow{+3} J \xrightarrow{+3} M \xrightarrow{+3} P \xrightarrow{+3} S$

3rd letter : $T \xrightarrow{-2} R \xrightarrow{-2} P \xrightarrow{-2} N \xrightarrow{-2} L$

The number-series 4, 10, 20, 43, 90 should follow the pattern × 2 + 1, × 2 + 2, × 2 + 3, × 2 + 4.

So, 10 is wrong and must be replaced by (4 × 2 + 1) i.e. 9.

Thus, the term J10R does not fit in the given series. The correct term is J9R.

◈ Letter Repeating Series

These type of questions usually consists of a series of small letters which follow a certain pattern. However, some letters are missing from the series. These missing letters are then given in a proper sequence as one of the alternatives.

Pattern of such questions is that some letters in sequence are missing.

(i) The letters may be in cyclic order (clockwise or anti-clockwise).

(ii) To solve a problem, we have to select one of the alternative from the given alternatives. The alternative which gives a sequence form of letters is the choice.

Direction : (Ex.9 to Ex.16) Find the missing term(s) :

Ex.9 a _ cab _ a _ c _ b c
(A) bbac (B) abab
(C) abba (D) bcba

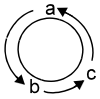
Sol. **(D)** We proceed step by step to solve the above series :

Steps :

1. We have three letters **a,b** and **c** making the series.

2. The first blank space should be filled in by '**b**' so that we have pattern **abc** .

3. Second blank space should be filled in by '**c**' so that the same pattern followed till end.



Series is abc/ abc/ abc/ abc. So, pattern abc is repeated.

Ex.10 _ abb _ a _ baa _ b
(A) baba (B) abba
(C) aabb (D) aaab

Sol. **(C)** Series is aabb/ aabb/ aabb. So, pattern aabb is repeated.

Ex.11 bc _ b _ c _ b _ ccb

(A) cbcb (B) bbcb

(C) cbbc (D) bcbc

Sol. **(A)** Series is bccb / bccb / bccb. So, pattern bccb is repeated

Ex.12 cab_a_c_bc_bc_b

(A) bcbba (B) bcbbc

(C) acaca (D) cbaaa

Sol. **(D)** Series is cab / cab / cab / cab / cab. So, pattern cab is repeated.

Ex.13 _ ha _ hach_ c_ _

(A) ccaha (B) achac

(C) chaaa (D) aaach

Sol. **(A)** Series is c h a / c h a / c h a / c h a. So, pattern cha is repeated.

Ex.14 abca__ bcaab__ ca __ bbc __ a

(A) ccaa (B) bbaa

(C) abac (D) abba

Sol. **(C)** The series is abc/aabc/aabbc/aabbcc/a

Ex.15 a__ bccb__ ca __ cca __ baab __ c

(A) ababc (B) abcaa

(C) accab (D) bacaa

Sol. **(A)** The series is aabcc/bbcaa/ccabb/aabcc the letters move in a cyclic order and in each group, the first and third letters occur twice.

Ex.16 mnonopqopqrs__ __ __ __ __

(A) mnopq (B) oqrst

(C) pqrst (D) qrstu

Sol. **(C)** The series is mno/nopq/opqrs/pqrst

EXERCISE

Direction : (Q.1 to Q.10) Find the missing term

Q.1 B, E, H, ?
(A) K (B) L
(C) J (D) M

Q.2 Y, W, U, S, Q, ?
(A) A (B) P
(C) O (D) B

Q.3 AH, DL, GP, JT, ?
(A) MY (B) NX
(C) MX (D) NY

Q.4 LO, IL, FI, CF, ?
(A) ZB (B) AB
(C) ZC (D) ZO

Q.5 AP, CN, EK, GG, ?
(A) ID (B) IB
(C) IA (D) JB

Q.6 MAAL, AALM, ALMA, LMAA, ?
(A) AMLA (B) MAAL
(C) AAML (D) LAAM

Q.7 ABCA, BCDB, CDEC, DEFD, ?
(A) EFHE (B) FEGF
(C) EFGF (D) EFGE

Q.8 CDFI, EFHK, IJLO, KLNQ, OPRU, ?
(A) QRTW (B) MNPS
(C) QRST (D) RSUX

Q.9 AN, CP, ER, GT, ?
(A) MZ (B) JW
(C) HU (D) IV

Q.10 A , E , I , M , Q, ?
(A) P (B) U
(C) V (D) W

Direction : (Q.11 to Q.15) Find the wrong term (s)

Q.11 CN, FK, IH, KE, OB
(A) IH (B) KE
(C) FK (D) OB

Q.12 EPU, FQW, GRX, HSY, ITZ
(A) FQW (B) EPU
(C) GRX (D) HSY

Q.13 HI, JI, KL, ML, NO, PQ
(A) KL (B) PQ
(C) NO (D) ML

Q.14 3F, 6G, 10I, 18L, 27P
(A) 27P (B) 3F
(C) 18L (D) 10I

Q.15 2, A, 9, B, 6, C, 14, D, 10
(A) 9 (B) 14
(C) 6 (D) 2

Direction : (Q.16 to Q.30) In each of the following letter series, some of the letters are missing which are given in that order as one of the alternatives belows it. Choose the correct alternative.

Q.16 _ bbca _ bcca _ ac _ a _ cb
(A) abcba (B) acbab (C) bacab (D) bcaab

Q.17 _ bcc _ ac _ aabb _ ab _ cc
(A) aabca (B) abaca (C) bacab (D) bcaca

Q.18 ab _ aa _ caab _ c _ abb _ c
(A) bbcaa (B) bcbca (C) cabac (D) cbbac

Q.19 c _ baa _ aca _ cacab _ acac _ bca
(A) acbaa (B) bbcaa (C) bccab (D) cbaac

Q.20 _ aba _ cabc _ dcba _ bab _ a
(A) abdca (B) bcadc (C) abcdd (D) cbdaa

Q.21 a _ cdaab _ cc _ daa _ bbb _ ccddd
(A) bdbda (B) bddca (C) dbbca (D) bbdac

Q.22 aa _ abbb _ ccccd _ ddccc _ bb _ ba
(A) abcda (B) abdbc (C) abdcb (D) abcad

Q.23 _ bcdbc _ dcabd _ bcdbc _ dc _ bd
(A) aaaaa (B) ccccc (C) bbbbb (D) ddddd

Q.24 adb _ ac _ da _ cddcb _ dbc _ cbda
(A) bccba (B) cbbaa (C) ccbba (D) bbcad

Q.25 c _ bbb _ _ abbbb _ abbb _
(A) aabcb (B) abccb (C) abacb (D) bacbb

Q.26 b _ abbc _ bbca _ bcabb _ ab
(A) acaa (B) acba (C) cabc (D) cace

Q.27 ac _ cab _ baca _ aba _ acac
(A) aacb (B) acbc (C) babb (D) bcbb

Q.28 _ acca _ ccca _ acccc _ aaa
(A) acca (B) caaa (C) ccaa (D) caac

Q.29 _ bc _ _ bb _ aabc
(A) acac (B) babc (C) abab (D) aacc

Q.30 _ baa _ aab _ a _ a
(A) aabb (B) aaba (C) abab (D) baab

ANSWER KEY

ALPHABET AND LETTER REPEATING SERIES

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	C	C	B	B	D	A	D	B	B	B	B	D	B	B	C	D	A	A
Que.	21	22	23	24	25	26	27	28	29	30										
Ans.	D	C	A	B	B	C	A	B	A	C										

ENGLISH

Chapter 1

NOUN

Definition

What is a noun?

A noun is a part of speech that is used to name a person, place, thing, quality, or idea. A noun can function as a subject, object, complement, appositive, or object of a preposition.

Classification of Nouns

◈ Proper Nouns

- Proper nouns are nouns that refer to specific entities.
- They refer to the name of a particular person, place, animal or thing.
- Writers of English capitalize proper nouns .
- Examples are *Nebraska, Steve, Harvard, White House* .

◈ Common Nouns

- Common nouns refer to general, unspecific categories of entities.
- Its a name given in common to every person or thing of the same class or kind.
- Whereas *Nebraska* is a proper noun because it signifies a specific state, the word *state* itself is a common noun because it can refer to any of the 50 states in the United States. *Harvard* refers to a particular institution of higher learning, while the common noun *university* can refer to any such institution.

◈ Material Nouns

- Material nouns refer to materials or substances from which things are made.
- While *cotton* is an adjective when used in *cotton dress, cotton* is a material noun when used to describe a crop being grown - The farm grew *cotton*.

◈ Collective Nouns

- A collective noun refers top a collection of people or things.
- A collective noun contains two or more persons, animals or things of a same kind joined together to make a single noun.
- Examples are :- a bouquet of flowers, a bunch of grapes, an army of soldiers etc.
- Consider the following sentences :-

  Look at the *gaggle* of geese. There used to be *herds* of wild buffalo on the prairie. A *bevy* of swans is swimming in the pond. A *colony* of ants live in the anthill.

  In the above examples, *gaggle, herds, bevy*, and *colony* are collective nouns.

◈ Abstract Nouns

- An abstract noun refers to a quality or state.
- Concepts like *freedom, love, power*, and *redemption* are all examples of abstract nouns.

They *hate* us for our *freedom*. All you need is *love*. We must fight the *power*.
In these sentences, the abstract nouns refer to concepts, ideas, philosophies, and other entities that cannot be concretely perceived.

Countable & Uncountable Nouns

Here we will learn about countable and uncountable nouns but before we continue the lesson, look at the following chart and study the nouns.

Countable	**Uncountable**
books	money
friends	meat
teachers	juice
tables	milk

- **Countable nouns**

Countable nouns have a singular and a plural form. In plural, these nouns can be used with a number- they can be counted. (That's why they are called "countable nouns").
Example:
1 friend, 2 friends, 3 friends...
1 book, 2 books, 3 books...

Countable nouns take *many*.
Example:
100 friends – *many* friends

- **Uncountable nouns**

Uncountable nouns can only be used in singular. These nouns cannot be used with a number- they can't be counted. (That's why they are called "uncountable nouns").
Examples:
I have a lot of money. (Not ~~1000~~ money)
You say I drink a lot of milk. (Not ~~5~~ milk)

- **Uncountable nouns take *much*.**

Example:
100 money – *much* money
Note: Of course we can count money, milk, meat; but then we would use the currency, liter, kilo, glass:

- 5 euros or dollars... (but not ~~5~~ money).
- 2 liters, pints, glasses... of milk (but not ~~2~~ milk)
- 3 kilos... of meat (but not 3 meat)
- 10 bottles of mineral water... (but not ~~10~~ mineral water)

Plurals

English plural nouns:
In order to change a singular noun to its plural form in English, we usually add "s". For example, the plural of *book* is *books*. The plural of *table* is *tables*. These are ***regular plurals***.

But there are many nouns which don't follow this rule. For example the plural of *fish* is *fish*. The plural of *tooth* is *teeth*. These are ***irregular plurals.***

Regular plurals:
Form:
Add "s" to the noun:
Noun + **S**
While many plural nouns follow this rule, the spelling sometimes differ.
Examples:

Singular	**Plural**
snake	snake**s**
window	window**s**
box	box**es**
boy	boy**s**
lorry	lorr**ies**
potato	potato**es**
knife	kni**ves**

Spelling of plurals:
The plural form of most nouns is created simply by adding the letter "s".

- more than one snake = snakes
- more than one girl = girls
- more than one window = windows

Nouns that end in *-ch, x, s, z* or *s-like* sounds, however, will require an 'es' for the plural:

- more than one witch = witches
- more than one box = boxes
- more than one gas = gases
- more than one bus = buses
- more than one kiss = kisses

Nouns that end in a vowel + *y* take the letter **s**:

- more than one boy = boys
- more than one way = ways

Nouns that end in a consonant + *y* drop the y and take ' **ies'**:

- more than one baby = babies
- more than one lorry = lorries

A lot of nouns that end in '*o'* take 'es' in the plural:

- more than one potato = potatoes
- more than one hero = heroes

o* becomes *oes	
echo	echo**es**
embargo	embargo**es**
hero	hero**es**
potato	potato**es**
tomato	tomato**es**
torpedo	torpedo**es**
veto	veto**es**

Some nouns ending in '*o*' break the above rule and get 'os' in the plural form:

o* becomes *os	
auto	auto**s**
kangaroo	kangaroo**s**
kilo	kilo**s**
memo	memo**s**
photo	photo**s**
piano	piano**s**
pimento	pimento**s**
pro	pro**s**
solo	solo**s**
soprano	soprano**s**
studio	studio**s**
tattoo	tattoo**s**
video	video**s**
zoo	zoo**s**

Other nouns ending in '*o*' get either 'os' or 'oes' in the plural forms:

o* becomes os or *oes	
buffalo	buffalo**s**/buffalo**es**
cargo	cargo**s**/cargo**es**
halo	halo**s**/halo**es**
mosquito	mosquito**s**/mosquito**es**
motto	motto**s**/motto**es**
no	no**s**/no**es**
tornado	tornado**s**/tornado**es**
volcano	volcano**s**/volcano**es**
zero	zero**s**/zero**es**

Plurals of nouns that end in '*f* ' or '*fe*' usually change the '*f*' sound to a '*v*' sound and add '*s*' or –'*es.*'

- more than one knife = knives
- more than one leaf = leaves
- more than one hoof = hooves

- more than one life = lives
- more than one self = selves
- more than one elf = elves

◈ **Irregular plurals**

There are several nouns that have irregular plural forms.

Singular	**Plural**
fish	fish
sheep	sheep
barracks	barracks
foot	feet
tooth	teeth
goose	geese
tooth	teeth
goose	geese
child	children
man	men
woman	women
person	people
mouse	mice

Plurals formed in this way are sometimes called ***irregular plurals or mutated (or mutating) plurals.***

- more than one child = **children**
- more than one woman = **women**
- more than one man = **men**
- more than one person = **people**
- more than one goose = **geese**
- more than one mouse = **mice**
- more than one barracks = **barracks**
- more than one deer = **deer**

Other irregular plural forms include the following:

Some foreign nouns retain their plural. (Note that some of them adapted the *s* of the English plural form!)

	Foreign plural	***English plural***
alga	algae	
amoeba	amoebae	amoebas
antenna	antennae	antennas
formula	formulae	formulas
larva	larvae	
nebula	nebulae	nebulas
vertebra	vertebrae	

Nouns ending in '*us*' get '*a*', '*I*' or the '*s*' of the English plural:

Singular	***Foreign plural***	***English plural***
corpus	corpora	
genus	genera	
alumnus	alumni	
bacillus	bacilli	
cactus	cacti	cactuses
focus	foci	
fungus	fungi	funguses
nucleus	nuclei	
octopus	octopi	octopuses
radius	radii	
stimulus	stimuli	
syllabus	syllabi	syllabuses
terminus	termini	

Nouns ending in '*um*' get '*a*', '*I*' or the '*s*' of the English plural:

Singular	***Foreign plural***	***English plural***
addendum	addenda	
bacterium	bacteria	
curriculum	curricula	curriculums
datum	data	
erratum	errata	
medium	media	
memorandum	memoranda	memorandums
ovum	ova	
stratum	strata	
symposium	symposia	symposiums

Nouns ending in '*ex*' or '*ix*' get '*ice's* or get the '*s*' of the English plural:

Singular	***Foreign plural***	***English plural***
apex	apices	apexes
appendix	appendices	appendixes
cervix	cervices	cervixes
index	indices	indexes
matrix	matrices	matrixes
vortex	vortices	

Nouns ending in '*Is*' becoming '*es*' in plural :

Singular	***Plural form***
analysis	analyses
axis	axes
basis	bases
crisis	crises
diagnosis	diagnoses
emphasis	emphases
hypothesis	hypotheses
neurosis	neuroses
oasis	oases
parenthesis	parentheses
synopsis	synopses
thesis	theses

Nouns ending in 'on' becoming 'a' in plural :

singular	**plural**
criterion	criteria
phenomenon	phenomena
automaton	automata

Nouns that are always singular:

A handful of nouns appear to be plural in form but take a singular verb:

- The **news** is bad.
- **Gymnastics** is fun to watch.
- **Economics**/**mathematics**/**statistics** is said to be difficult.

Some nouns never take the s of the plural and are always singular:

- Your **luggage** / **baggage** is so heavy.
- I'd like to buy new **furniture** for the house.
- You can find more **information** in our website.

Masculine and Feminine Nouns

◈ **Grammatical gender**

Grammatical gender is a system of noun classification. A common gender classification includes masculine and feminine categories. Masculine nouns are words used for men, boys and male animals. Feminine nouns are words for women, girls and female animals.

Masculine and feminine nouns :

Masculine	***Feminine***
actor	actress
author	authoress
bachelor	spinster
boy	girl
bridegroom	bride
brother	sister
conductor	conductress
count	countess
czar	czarina
dad	mum
daddy	mummy
duke	duchess
man	woman
emperor	empress
father	mother
god	goddess
grandfather	grandmother
heir	heiress
hero	heroine
host	hostess
husband	wife
king	queen
man	woman
master	mistress
murderer	murderess
nephew	niece
poet	poetess
policeman	policewoman
prince	princess
sir	madam
son	daughter
uncle	aunt
wizard	witch
waiter	waitress

Common gender nouns :

Some nouns are used for both males and females. These nouns are referred to as ***common gender nouns.***

Examples

- baby
- bird
- cat
- cattle

- child
- companion
- comrade
- cousin
- dancer
- deer
- friend
- guardian
- guest
- infant
- owner
- parent
- passenger
- pig
- president
- pupil
- relative
- sheep
- singer
- student
- swan
- teacher

Animals

There is one general word for the animal. There are however many species of animals, particularly those domesticated, have been given specific names for the male and the female.

animal	***masculine***	***feminine***
rabbit	buck	doe
horse	stallion	mare
sheep	ram	ewe
pig	boar	sow
chicken	rooster	hen
duck	drake	duck
cattle	bull	cow
goose	gander	goose
fox	fox	vixen
tiger	tiger	tigress
lion	lion	lioness

EXERCISE

I. Find Common, Proper, Abstract, Material, Collective, Countable, Uncountable, Concrete Nouns from the following list.

1. Which of the following noun is a Proper Noun?
   (A) singer (B) Peter (C) milk (D) sister

2. Which of the following noun is a Common Noun?
   (A) birds (B) London (C) iron (D) India

3. Which of the following noun is a Collective Noun?
   (A) team (B) book (C) marbles (D) ships

4. Taj Mahal is a ..... Noun?
   (A) Proper (B) Abstract (C) Concrete (D) Countable

5. Family is a ..... Noun?
   (A) Collective (B) Abstract (C) Concrete (D) Countable

6. Which of the following noun is not an Abstract Noun?
   (A) goodness (B) bravery (C) family (D) childhood

7. Which of the following noun is not a Countable Noun?
   (A) books (B) gold (C) horse (D) apple

8. Which of the following noun is not a Proper Noun?
   (A) team (B) London (C) Monday (D) Nelson

9. Birds fly in the sky -
   (A) Proper Noun (B) Common Noun (C) Abstract Noun (D) Collective Noun

10. I saw a bunch of grapes-
    (A) Common Noun (B) Material Noun (C) Collective Noun (D) Abstract Noun

II. Fill in the blanks in the following sentences with suitable collective nouns :
(good ness, bunch, iron, gallery, queen, school, hive, set, wood, horse, paper)

11. I have lost a ..... of keys.
12. There seems to be a plan behind this ..... of events.
13. There is a large ..... of fish near the coast.
14. Do not disturb that ..... of bees.
15. There is a fine ..... of pictures in the palace.

III. Fill in the blanks in the following sentences with Feminine forms of the words given at the end :

(lass, niece, mare, baroness, spinster, heroine, priestess, heiress, hostess)

16. She is the ..... of the story. (hero)
17. The young ..... did not know what to say. (lad)
18. She remained a ..... all her life. (bachelor)
19. He bought a beautiful chestnut .....(horse)
20. The ..... wore a diamond necklace. (baron)

IV. Fill in the blanks with the correct forms of the Plural of the words given at the end :

21. She is the ..... of the story. (synopsis)
22. I saw many ..... on the underside of the leaf. (larva)
23. The building was six ..... high. (storey)
24. My two ..... have come to see me.(son-in-law)
25. He is good at telling funny ..... (story)

V. Common Nouns Exercises: Name the professionals

26. One who cuts hair is a
27. One who cures sick people is a
28. One who sells medicines and drugs is a
29. One who makes bread is a
30. One who operates on sick people is a
31. One who makes chairs and tables is a
32. One who sells tickets on a bus is a
33. One who cultivates the land is a

ANSWER KEY

1. NOUN

I.	1. (B)	2. (A)	3. (A)	4. (A)	5. (A)
	6. (C)	7. (B)	8. (A)	9. (B)	10. (C)
II.	11. bunch	12. set	13. school	14. hive	15. gallery
III.	16. heroine	17. lass	18. spinster	19. mare	20. baroness
IV.	21.	22.	23. storeys	24. sons-in-law	25. stories
V.	26. Barber	27. Doctor	28. Chemist	29. Baker	30. Surgeon
	31. Carpenter	32. Conductor	33. Farmer		