PHYSICS

Standard X

Part-2

Government of Kerala
Department of General Education

State Council of Educational Research and Training
(SCERT) Kerala
2019

NT-881-1-PHYSICS-10-E-VOL.2

The National Anthem

Jana-gana-mana adhinayaka jaya he
Bharatha-bhagya-vidhata,
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchala-Jaladhi-taranga
Tava subha name jage,
Tava subha asisa mage,
Gahe tava jaya gatha.
Jana-gana-mangala-dayaka jaya he
Bharatha-bhagya-vidhata,
Jaya he, jaya he, jaya he,
Jaya jaya jaya jaya he!

Pledge

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give my parents, teachers and all elders respect, and treat everyone with courtesy.

To my country and my people, I pledge my devotion. In their well-being and prosperity alone lies my happiness.

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Dear students,

You were provided with opportunities to observe your surroundings and engage in simple experiments and investigative activities in earlier classes. The classroom experience, undoubtedly, might have helped you to record the information systematically and assimilate ideas through discussion and analysis. While understanding the scientific approach, there should also be the attitude to take forward the skills to apply them in day-to-day life. Moreover, an eco-friendly perspective must be adopted too. All these, through direct experiences, enquiry and understanding preferably. This textbook presents ideas in accordance with this.

'Samagra', the education portal and technology enabled QR Code printed textbooks would definitely make your learning activity in classrooms easy and joyful. The National Skills Qualifications Framework, the current relevance of Disaster Management and the possibilities of ICT have also been considered while modifying the textbook.

Go ahead, thinking, asking questions, approaching ideas critically and quizzing with teachers and friends.

Make learning a joyful experience.

Regards,

Dr. J. Prasad
Director, SCERT

CONSTITUTION OF INDIA

Part IV A

FUNDAMENTAL DUTIES OF CITIZENS

ARTICLE 51 A

Fundamental Duties- It shall be the duty of every citizen of India:

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievements;

(k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between age of six and fourteen years.

Content

7P1EEH

Certain icons are used in this textbook for convenience

For further reading (Evaluation not required)

ICT possibilities for making concepts clear

Let us assess

Extended activities

NSQF

5 REFRACTION OF LIGHT

I aimed the arrow at a fish; but what I got was a frog!

Do we observe the objects under water at their original position?

We see an object when the light falling on the object gets reflected and reaches our eyes. Is there any change happening to a ray of light, emerging after reflection, from the bottom of a pond?

Let's try an activity.

Fill three fourth of a transparent vessel with water as shown in the figure. Add one or two drops of milk into it. Fill the portion of the vessel above water with smoke. Close the vessel using an OHP glass sheet. Allow the light from a laser torch to pass through water as shown in the figure. Observe the path of light. Do you observe anything out of the ordinary? Can you depict it in the science diary?

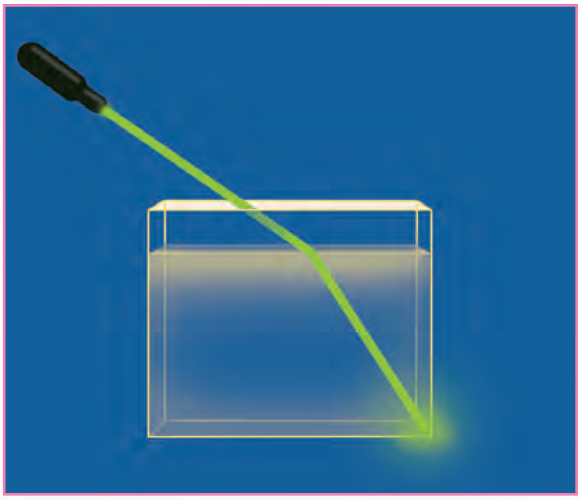

Fig. 5.1

- Which are the media involved here?
- What happens to the path of the light?
- Where does the deviation of the ray take place?

The ray of light entering water undergoes a deviation at the point on the surface where the media get separated.

Why does the ray of light undergo a deviation here?

Let's see.

Does light pass through all the media at the same speed?

Speed of light and optical density

Analyse the table given below.

Medium	Speed of light (m/s)
Vacuum	3×10^8 m/s
Water	2.25×10^8 m/s
Glass	2×10^8 m/s (*approximately*)
Diamond	1.25×10^8 m/s

Table 5.1

On analyzing the table you might have realized that the speed of light through various media differs.

The characteristics of each medium influence the speed of light that passes through the respective medium. Optical density is a measure that shows how a medium influences the speed of light passing through it.

As the optical density of a medium increases, the speed of light through it decreases.

What if the optical density decreases?

Can the media given in the table be arranged in the increasing order of their optical densities?

Air <….. <….. < ……

From this you might have understood that the optical densities of air and water are different.

Refraction of Light

It is the difference in the optical densities that causes the deviation. When a ray of light entering obliquely from one transparent medium to another, its path undergoes a deviation at the surface of separation. This is refraction.

You might have depicted the deviation of the light ray from a laser torch entering from air to water.

Will the deviation of a ray of light entering from air to other media also be alike? Let's do an experiment.

Refraction in different Media

Place a glass slab on a drawing sheet and mark its boundary as ABCD. Remove the glass slab and draw a line PQ on the side AB. Keeping the glass slab in position, pass light from a laser torch through it along PQ. Observe the path of light through the glass slab. Mark the points Q, R and S. Depict the path of light PQRS by joining QR and RS. You can understand from the figure that AB is the surface of separation of air and glass and that CD is the surface of separation of glass and air.

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Draw a normal at Q on AB and at R on CD.

PQ is the incident ray at the surface of separation AB.

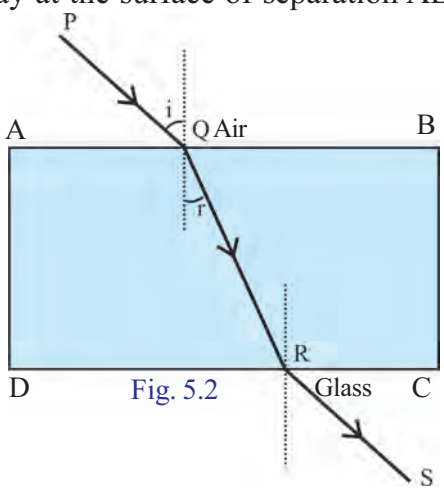


Fig. 5.2

- Which is the incident ray on the surface of separation CD?
- The angle between the incident ray and the normal is called the angle of incidence. If so, can you explain what is angle of refraction?
- Using a protractor measure the angle of incidence and the angle of refraction.
- Is the angle of refraction greater or lower than the angle of incidence when it goes from air to glass?
- What about from glass to air?
- Which is of greater optical density – air or glass?
- While going from air to glass, the refracted ray deviates towards the normal/ deviates away from the normal.

- What happens while it goes from glass to air?
- Are the angle of incidence, angle of refraction and the normal at the point of incidence on the same plane?

While entering from air to glass (from a medium of lower optical density to that of a greater one) the refracted ray deviates towards the normal.

While entering from glass to air (from a medium of greater optical density to that of a lower one) the refracted ray deviates away from the normal.

The angle of incidence, angle of refraction and the normal at the point of incidence are in the same plane.

Does refraction take place for a ray while entering a glass slab normal to it?

Examine using a ray of light from a laser torch.

Ray diagrams of a light ray passing through different media are depicted. Find out the appropriate figures by observing these figures and also based on the concepts you have developed from the textbook.

7PJ6HS

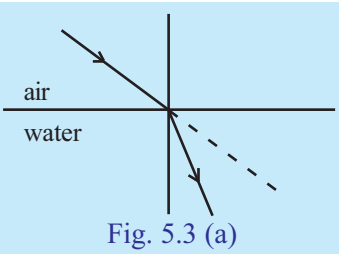


Fig. 5.3 (a)

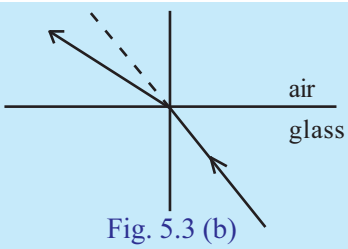


Fig. 5.3 (b)

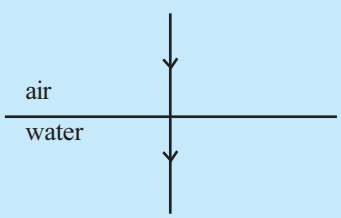


Fig. 5.3 (c)

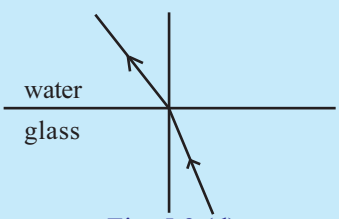


Fig. 5.3 (d)

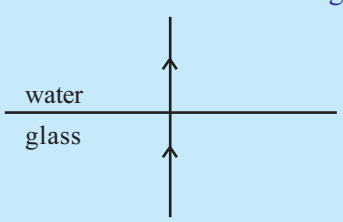


Fig. 5.3 (e)

• No deviation takes place in the case of a light ray falling normally on a medium	5.3 (c), 5.3 (e)
• When light passes obliquely from a medium of higher optical density to a medium of lower optical density, the refracted ray deviates away from the normal.	
• When light is incident obliquely, from a medium of lower optical density to a medium of greater optical density, the refracted ray deviates towards the normal.	

Table 5.2

Its an experiment, can you find out the path of light through a triangular prism using a laser torch? Record it in the science diary.

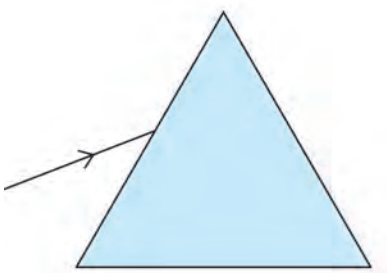


Fig. 5.4

7PT2JF

Using the figure you have depicted, can you find out to which side the ray deviates?

What change occurs in the angle of refraction with the increase in the angle of incidence when a ray enters a medium?

The experimental results of a ray of light entering from air to glass slab and from glass slab to air are tabulated. Can you analyse the table and find out the change?

What other conclusion can you arrive at from the table?

From air to glass

Sl. No.	Angle of incidence (i)	Angle of refraction (r)	sin i	sin r	sin i/sin r
1	20°	13°	0.34	0.22	1.5
2	30°	19.45°	0.5	0.33	1.5
3	45°	28°	0.7	0.47	1.5
4	60°	35°	0.86	0.57	1.5

Table 5.3

Light from glass to air

Sl. No.	Angle of incidence (i)	Angle of refraction (r)	sin i	sin r	sin i/sin r
1	10°	15°	0.17	0.26	0.7
2	14°	23°	0.26	0.39	0.7
3	20°	39°	0.34	0.51	0.7
4	30°	49°	0.50	0.75	0.7

Table 5.4

What speciality is observed in the value of ratio of sine of the angle of incidence to the sine of the angle of refraction, $\frac{\sin i}{\sin r}$?

When light passes through different pairs of media, the angle of refraction increases with the angle of incidence.

The ratio of the sine of the angle of incidence to the sine of the angle of refraction $\left(\frac{\sin i}{\sin r}\right)$ will be a constant. This constant is known as refractive index. This is indicated by the letter n.

The facts that you have understood about refraction can be stated as the following laws:

Laws of Refraction

- **The angle of incidence, the angle of refraction and the normal at the point of incidence on the surface of separation of the two media will always be in the same plane.**
- **The ratio of the sine of the angle of incidence to the sine of the angle of refraction $\left(\frac{\sin i}{\sin r}\right)$ will always be a constant. This is known as Snell's Law.**

The constant from Snell's Law is known as refractive index. This is indicated by the letter n.

Speed of light in media and refractive index

How is the refractive index of a medium related to the speed of light?

Find out from Table 5.3 the refractive index of glass when light enters from air to glass.

Does it have any relation bearing on the ratio of speed of light in air to the speed of light in glass? Find out.

(Speed of light in air is 3×10^8 m/s and that in glass is 2×10^8 m/s.)

$$\frac{\text{Speed of light in air}}{\text{Speed of light in glass}} = \frac{3\times10^8\ \text{m/s}}{2\times10^8\ \text{m/s}} = 1.5$$

You might have understood that this is the refractive index of glass with respect to air.

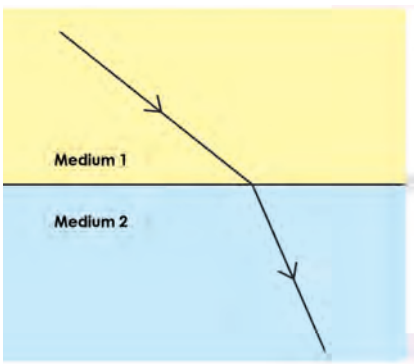


Fig. 5.5

It is shown that the ray of light enters from medium 1 to medium 2.

Imagine that the speed of light in medium 1 is v_1 and that in medium 2 is v_2.

The refractive index of medium 1 with respect to medium 2 is represented as n_{12} and of medium 2 with respect to medium 1 is represented as n_{21}. If so

$$\text{Refractive index } n_{21} = \frac{\text{Speed of light in Medium 1, } V_1}{\text{Speed of light in Medium 2, } V_2}$$

What will be refractive index n_{12}?

Refractive index, n_{12} =

The refractive index of one medium with respect to another is called relative refractive index.

The refractive index of a medium with respect to vacuum is called absolute refractive index.

Since the speed of light in vacuum and that in air are almost equal, the speed of light in vacuum itself is considered as the speed of light in air for calculating the refractive index.

If the speed of light in air (in vacuum) is considered as 'c' and that in a medium is considered as ' v ', then the absolute refractive index of the medium =

$$= \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}} = \frac{c}{v}$$

Absolute refractive index is normally known as refractive index and is represented as n_m.

Based on the details given in Table 5.1, find out the refractive index of the given media and complete Table 5.6 (a).

Medium	Refractive index (n)
Glass	
Water	
Diamond	

Table 5.6 (a)

- The refractive index of glass and water are given in Table 5.6 (b).

Medium	Refractive index (n)
Glass	$^4/_3$
Water	$^3/_2$

Table 5.6 (b)

If the speed of light in water is 2.25×10^8 m/s

(a) Calculate the speed of light in vacuum

(b) Calculate the speed of light in glass

Let's try to do more activities related to refraction.

Activity 1

Place a pencil in an inclined position in a glass trough and fill three fourth of the trough with water. Depict in your science diary, the changes after adding water. What shall be the reason for the change?

Don't you see that the position of the portion of the pencil under water has changed? What may be the reason? Discuss.

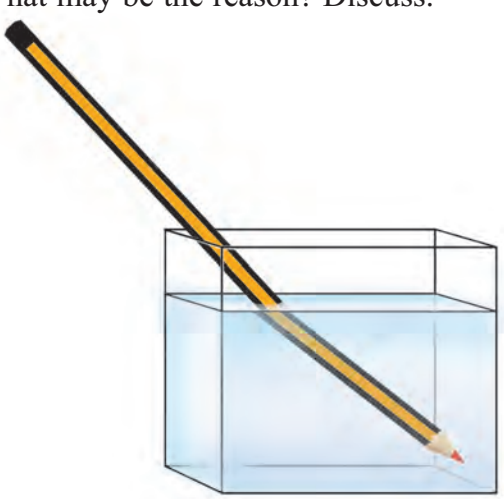


Fig 5.6

Does the ray of light coming after reflection from the pencil undergo a deviation? What is the reason?

Is there any change likely to occur if kerosene or turpentine is used instead of water?

It is due to refraction that the pencil appears bent. The rays of light reflected from the portion in air do not undergo any deviation. But the rays of light from the portion within water reach eyes after undergoing a deviation. Hence we feel a shift in the position of the pencil.

Now, will you be able to explain why a frog was obtained though the arrow was aimed at the fish?

Activity 2

Take an opaque vessel. Place a coin at its bottom. Ask a child to walk backwards looking at the coin. Ask her to stop at the place where the coin disappears. Now ask another child to add water into the vessel without moving the coin.

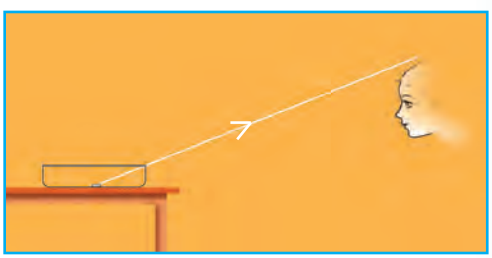


Fig. 5.7 (a)

What is observed here?

What is the reason for this observation? Find out the answer based on the facts in the textbook.

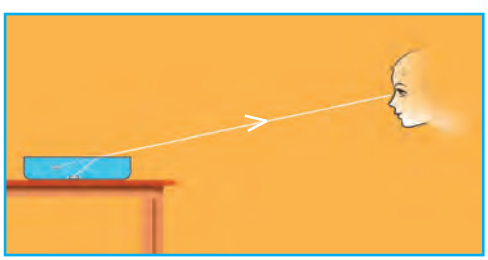


Fig. 5.7 (b)

Activity 3

Draw a thick line on a paper using a pen. Place a glass over it and observe as suggested below.

a) Look from one side as shown in Fig.5.8(a) (placing a glass slab perpendicular to the line)

b) Look from one side as shown in Fig. 5.8(b) (glass slab oblique to the line)

c) Look from one side as shown in Fig. 5.8(c) (from vertically above the glass)

Write down the observation results in the science diary.

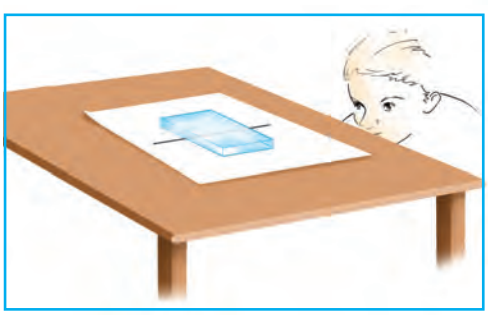


Fig. 5.8 (a)

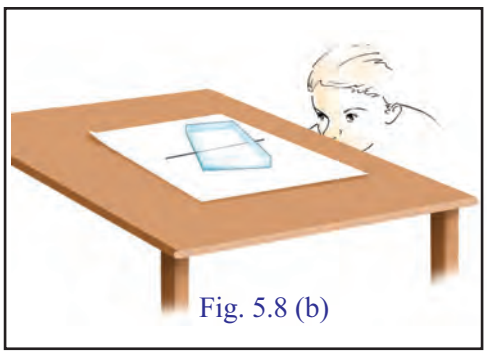


Fig. 5.8 (b)

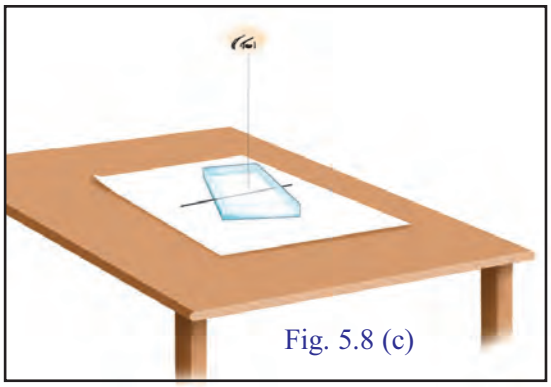


Fig. 5.8 (c)

Activity 4

Try to take out a coin from the bottom of a trough filled with water by viewing it from one side.

Can you easily pick up the coin?

What is the reason for the failure?

Now you have become familiar with many activities regarding refraction. Find out more examples of refraction from daily life.

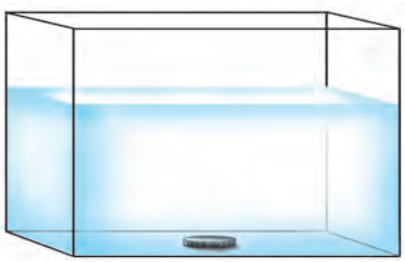


Fig. 5.9

A person who looks at an aquarium as shown in Fig. 5.10 can see the base on the surface of water. What is the reason?

Fig. 5.10

Total Internal Reflection

Take a glass flask and fill half of it with water. Add one spoon of milk to it.

Allow light from a laser torch to fall on the water in the flask. Observe the path of the refracted ray. Gradually increase the angle of incidence. Note the deviation of the refracted ray.

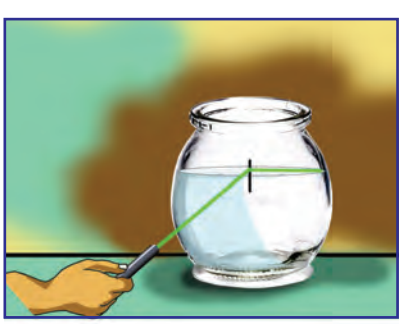


Fig. 5.11

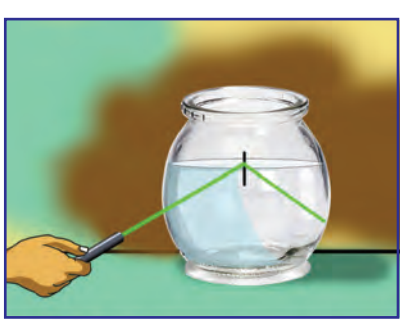


Fig. 5.12

- What will be the angle of refraction when the refracted ray passes along the surface of water?

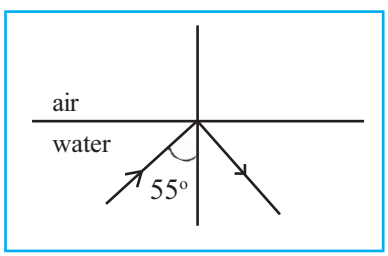
Observe the angle of incidence at this instance.

When a ray of light passes from a medium of greater optical density to that of lower optical density, the angle of incidence at which the angle of refraction becomes 90° is the critical angle. The critical angle in water is 48.6°.

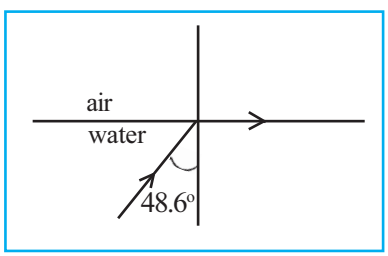
Allow light to fall at an angle of incidence greater than the critical angle. What do you observe?

When a ray of light passes from a medium of higher optical density to a medium of lower optical density at an angle of incidence greater than the critical angle, the ray is reflected back to the same medium without undergoing refraction. This phenomenon is known as total internal reflection.

The path of light in different media is shown in the figures. Analyse them and answer the following questions.



(a)



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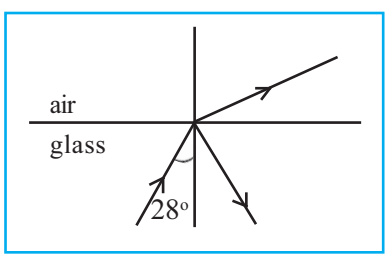

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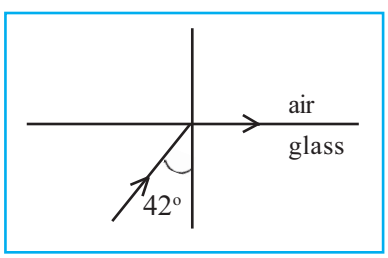
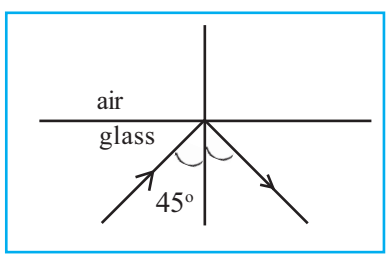


(d)



(e)

Fig. 5.13

7QBTMQ

- Which are the figures that show total internal reflection?
- What is the critical angle of glass?
- Will total internal reflection take place when light passing through water is incident on the surface of separation with air at an angle of incidence of 45° ? Why?

You have already realised that total internal reflection will take place only if the angle of incidence is greater than the critical angle.

Now, it can be explained that it is because of total internal reflection that the bottom of the aquarium is seen reflected on the surface of the water.

- Find out the practical applications of total internal reflection in our day to day life.
  - Medical field → Endoscope.
  - In the field of telecommunications → Optical fibre cables.

Optical fibre in the field of treatment

After its invention, optical fibre was first used in the field of medicine for constructing a device called endoscope. Optical fibre cables are used for the diagnosis of diseases and to identify the action of medicines with in the human body. This is extensively used in the field of telecommunication as well.

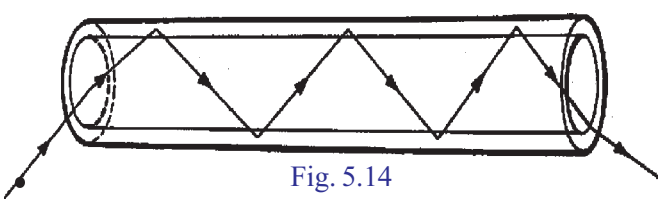


Fig. 5.14

Total internal reflection is made use of in optical fibre cables. Through optical fibres, thousands of signals of different frequencies can be sent to distant places simultaneously, making use of total internal reflection of light, without losing the intensity. This paved the way for optical fibre being used in telecommunications.

Let's see how the refraction of light is made use of in lenses.

Lens

When viewed through the water drop that fell on a magazine, a child noticed that there was a change in the size of letters on the page.

- Why did the letters appear to be bigger in size?

You know that a spherical transparent medium acts like a lens. You have seen different types of lenses. Which are they? Write them down in the Science Diary.

A lens is a transparent medium having spherical surfaces.

Convex and concave lenses are the lenses that we mainly use.

Let's see what are the terms and characteristics associated with convex and concave lenses.

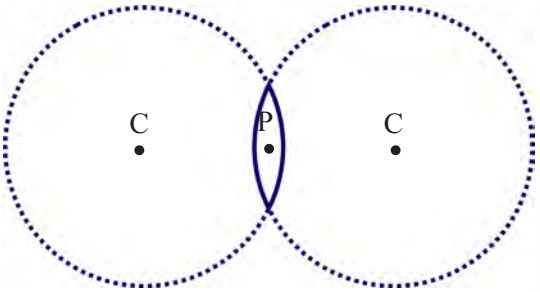


Fig. 5.15

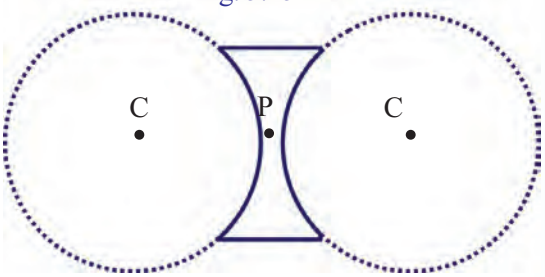


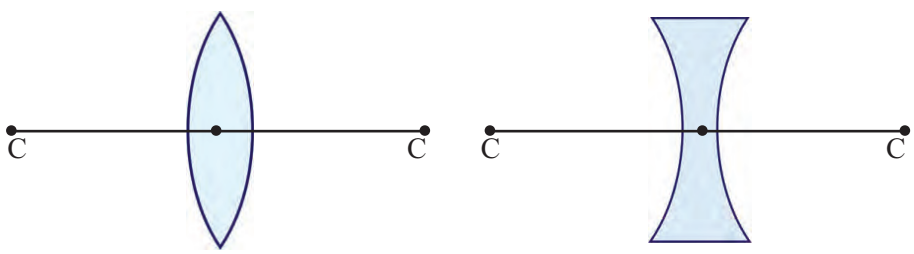
Fig. 5.16

Optic centre

Optic centre is the midpoint of a lens (P).

Centre of curvature

A lens has two spherical surfaces as parts of the lens. Centre of curvature (C) is the centre of the imaginary spheres of which the sides of the lens are parts.



(a) (b)

Fig. 5.17

Principal axis

Principal axis is the imaginary line that passes through the optic centre joining the two centres of curvature.

Principal focus

Let's do an experiment:

Take a rectangular box, the upper part of which is covered with a glass sheet. Place a thermocol stand at its centre. Arrange a comb on the side of lower width as shown in

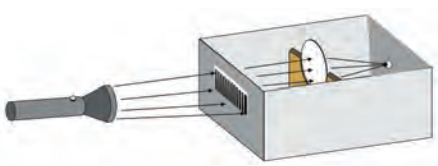


Fig. 5.18

the figure. Fill the box with smoke from an incense stick. Keeping the convex lens on the thermocol stand, pass intense light from a torch through the comb. Observe the path of light through the glass sheet

By adjusting the position of the lens, find out the point at which light is converged.

Light rays incident parallel and close to the principal axis after refraction converges to a point on the principal axis of a convex lens. This point is the principal focus of a convex lens.

The principal focus of a convex lens is real since the light rays converge at a point. This is indicated by the letter F.

- How many principal foci does a convex lens have? Why?

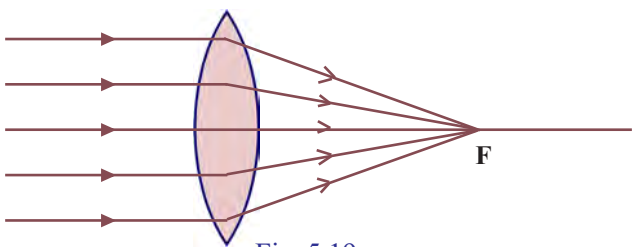


Fig. 5.19

Principal focus of concave lens

Repeat the smoke box experiment using a concave lens. What is your observation?

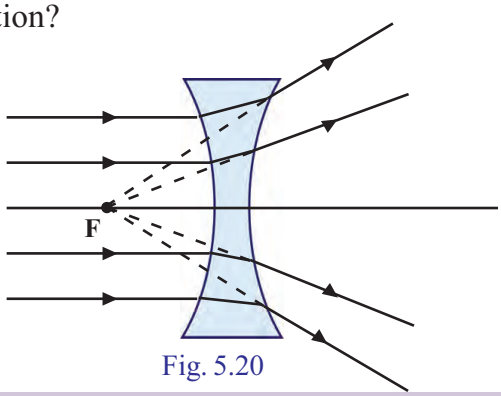


Fig. 5.20

Light rays incident parallel and close to the principal axis diverge from one another after refraction. These rays appear to originate from a point on the same side. This point is the principal focus of a concave lens.

- Why is it said that the principal focus of a concave lens is virtual?

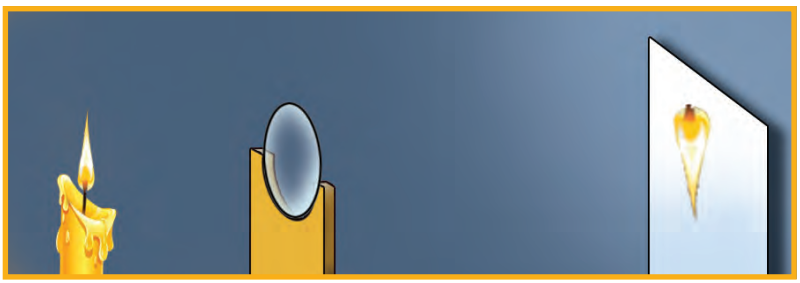
It is impossible to produce real convergence of light using a concave lens. Therefore the principal focus of a concave lens is virtual.

Focal length

Focal length is the distance from the optic centre to the principal focus. This is denoted by the letter f'.

Formation of image using a lens

Cast the image of a distant object on the screen using a convex lens. Measure the distance between the lens and the screen. Repeat the experiment with different distant objects. Find the average of the distances measured. This gives the focal length of the convex lens.



7QUKR1

Fig. 5.21

Adjust the screen as shown in the figure, keeping the convex lens at different positions on the principal axis in front of a lighted candle. See where the image is formed and observe its characteristics. Record them in Table 5.7.

Position of object	Position of image	Nature of image/ size		
		Real/ virtual	Inverted/ erect	Magnified/ diminished/ same size
1. At infinity	At F	Real	Inverted	Diminished
2. Beyond 2 F				
3. At 2 F				
4. Between 2F and F				
5. At F				
6. Between F and lens				

Table 5.7

Ray diagram of formation of images by lenses

We have seen positions of the images formed by lenses for objects at different distances and their characteristics. The positions and characteristics of images formed by lenses can also be found out using ray diagrams.

Let's see the points to be taken care of while drawing ray diagrams.

- When a ray of light passes through the optic centre of a thin lens, it does not undergo deviation.

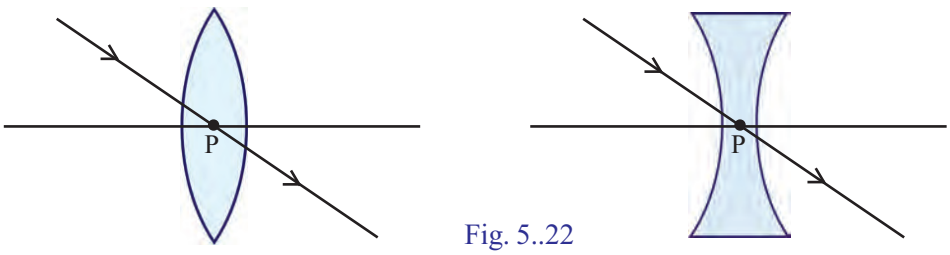


Fig. 5..22

- A ray of light falling parallel to the principal axis of a convex lens passes through the principal focus after refraction.

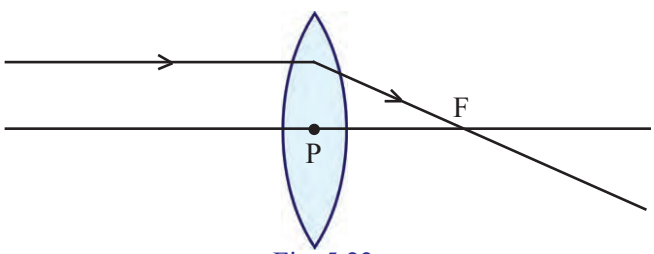


Fig. 5.23

- A ray incident parallel to the principal axis of a concave lens appears to diverge from the focus on the same side of the lens.

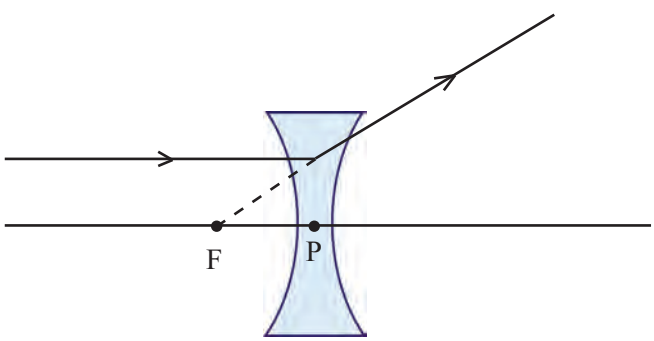


Fig. 5.24

- A ray of light passing through the principal focus of a convex lens passes parallel to the principal axis after refraction.

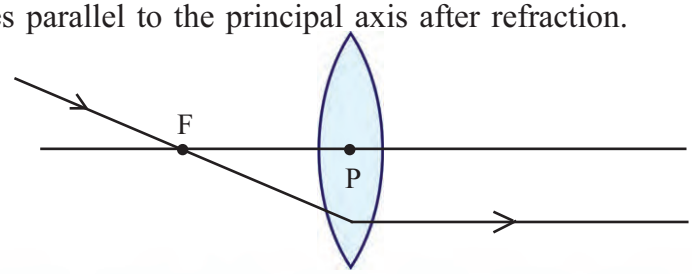


Fig. 5.25

We can make use of any of these rays for drawing the ray diagram.

Object at infinity

Light rays coming from a distant object are considered as parallel rays.

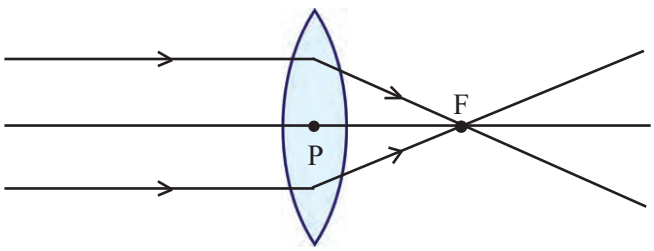


Fig. 5.26

- Where will the rays coming parallel to the principal axis converge?
- Where is the image formed?

Compare the characteristics you found from the ray diagram with those observations you got through the experiment.

Object beyond 2F

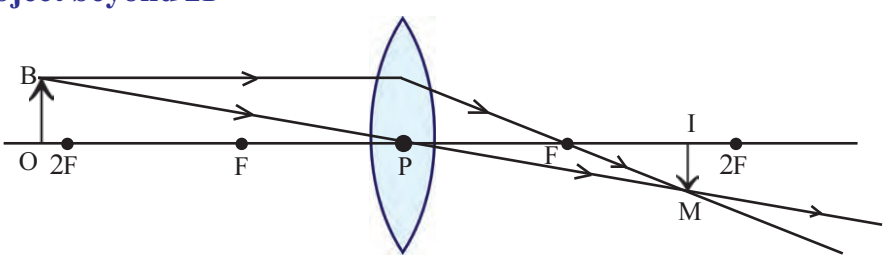


Fig. 5.27

Consider two rays from an object placed beyond 2F as shown in the figure.

One ray incident parallel to the principal axis and passes through the principal focus.

The second ray passing through the optic centre passes without any deviation. Draw a perpendicular to the principal axis at the point where the two rays meet. This is the image (IM) of the object (OB).

Write down the characteristics of the image.

Position of the image : .....

Nature of the image : .....

Size of the image : .....

In this manner draw ray diagrams of images formed when the object is placed at different positions.

Object at 2F

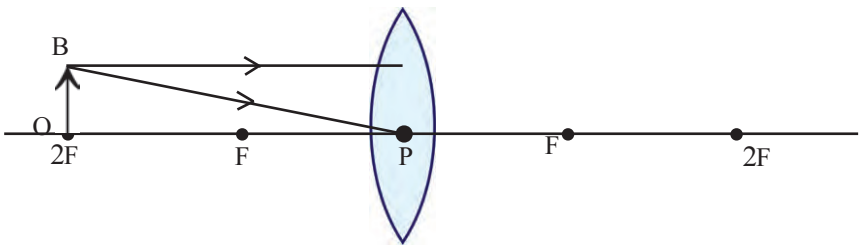


Fig. 5.28

Position of the image : .....

Nature of the image : .....

Size of the image : .....

Object between F and 2F

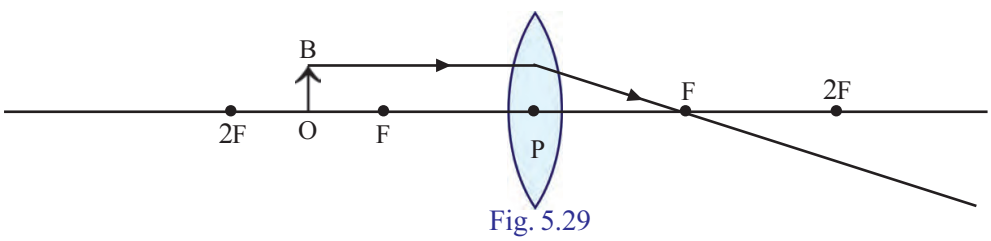


Fig. 5.29

Position of the image : .....

Nature of the image : .....

Size of the image : .....

Object at F

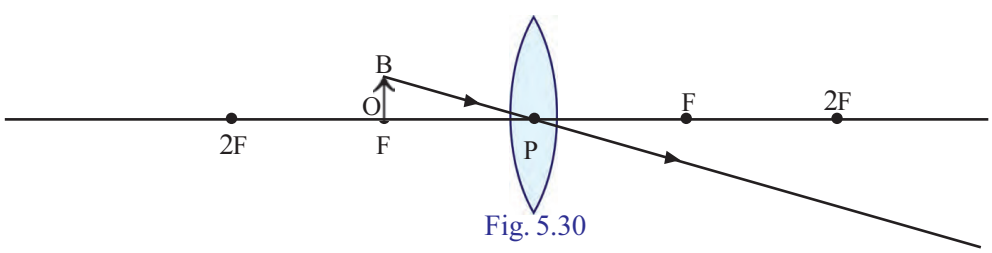


Fig. 5.30

Position of the image : .....

Nature of the image : .....

Size of the image : .....

Object between F and lens

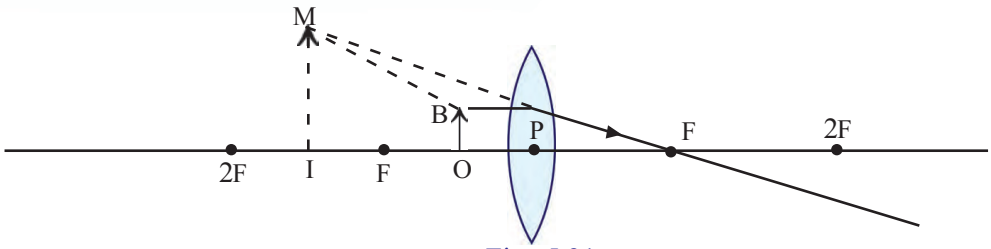


Fig. 5.31

Position of the image : .....

Nature of the image : .....

Size of the image : .....

Images formed by concave lens

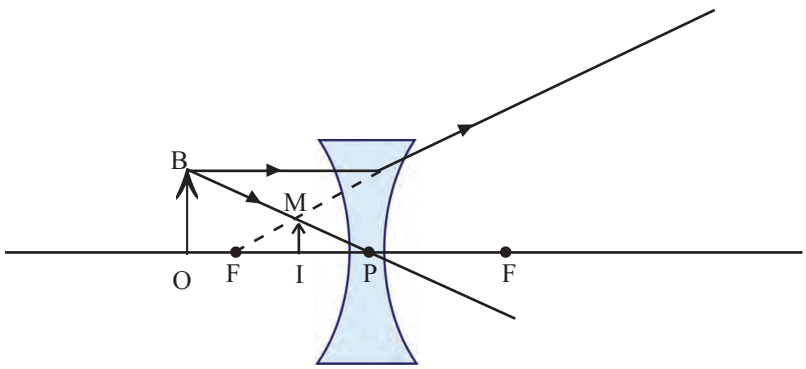


Fig. 5.32

Have you observed images through a concave lens?

- What is the nature of the image?

From the diagram, find out the position of the image and write down the characteristics.

New Cartesian Sign Conventions

In experiments related to lens and mirror, distances are measured in the same manner as in a graph. In the case of lenses, distances are measured considering the optic centre as the origin. All distances are to be measured from the optic centre. Light ray is assumed to travel from left to right. Therefore all distances measured along the direction of incident light is positive and that in the opposite direction is negative. Distances measured upwards from X-axis are positive and those measured downwards are negative. Similarly the focal length of a convex lens is positive and that of a concave lens, negative.

New Cartesian Sign Conventions

In mirrors, lenses etc., when the position of the object changes, the position of the image also changes. In these cases, the equations to find out the focal length will be different. The New Cartesian System is formulated to standardise these equations. But, for getting the real equation in each case, we will have to apply Cartesian Sign Conventions again.

Record the measurement shown in the figure as per the Cartesian System.

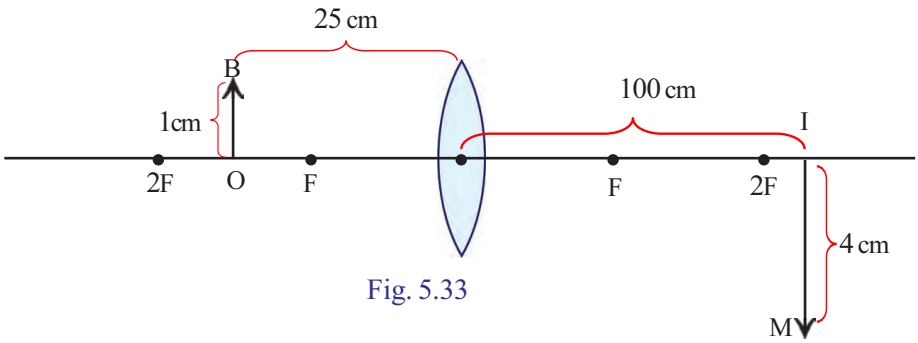


Fig. 5.33

Distance of the object from the lens (u) = ...

Distance of the image from the lens (v) = ...

Height of object (OB) = ...

Height of image (IM) = ...

Let's examine how distances of object and image are related to the focal length of the lens.

Take a convex lens of known focal length. Keep a lighted candle at a certain distance from the lens and adjust the lens to get a clear image on the screen. Then measure the values of u and v and tabulate the values on the basis of the New Cartesian Sign Conventions. Repeat the experiment by changing the position of the object.

Sl. No.	u	v	$f = \frac{uv}{u - v}$
1			
2			
3			

Table 5.8 Average f = ...

Compare the focal length obtained from the earlier experiment with the values in the above table.

You might have understood that $f = \frac{uv}{u - v}$. From this we can formulate the equation $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ This is lens equation.

- When an object is placed at a distance of 15 cm from a convex lens, a real image is formed at a distance of 30 cm. What is the focal length of the lens?

u = -15 cm, v = + 30 cm,

$$f = \frac{uv}{u - v} = \frac{(-15)\times(+30)}{(-15)-(+30)} = \frac{-15\times 30}{-45} = +10\,cm$$

- The focal length of a concave lens is 20 cm. If an object is kept at a distance of 30 cm from the lens, find out the distance to the image formed.

  u = -30 cm, f = -20 cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{-20} = \frac{1}{v} - \frac{1}{-30}$$

$$\frac{1}{v} = \frac{1}{-20} + \frac{1}{-30}$$

$$\frac{1}{v} = \frac{-1}{12}$$

$$v = -12\ cm$$

Is there any relation between the height of an object and the height of its image?

Can it be related to the ratio between the distance to the object and that to the image?

When an object is placed at different positions in front of a lens, isn't there a change in the height of the image?

Magnification

Magnification is the ratio of the height of the image to the height of the object. It shows how many times the image is larger than the object.

$$\text{Magnification} = \frac{\text{Height of the image}}{\text{Height of the object}} = \frac{IM}{OB} = \frac{h_i}{h_o}$$

Mathematically, this can be found out in another way. If the distance of object is taken as u and that of the image as v, magnification $m = \frac{v}{u}$.

- Calculate the magnification of the image formed by convex lens in Fig. 5.33.

Magnification

Magnification is a mere number. The positive and the negative signs of the number indicate the nature of the image. If magnification is negative, the image will be real and inverted. An erect and virtual image indicates that the magnification is positive because from the principal axis, the measurement above is positive and that below is negative.

- When an object of height 3 cm is placed at a distance of 30 cm from a lens, a real image is formed at a distance of 60 cm. Find out the height of the image.

$u = -30$ cm, $v = +60$ cm

$h_o = 3$ cm, $h_i = ?$

$$m = \frac{v}{u} = \frac{60}{-30} = -2$$

$$m = \frac{-h_i}{3}$$

$$-2 = \frac{-h_i}{3}$$

$$h_i = 6 \text{ cm}$$

- An image is formed 15 cm away from a convex lens of focal length 10 cm.

(a) What is the distance of the object from the convex lens?

(b) If the object is 3 cm high what is the height of the image?

(c) What are the other characteristics of the image?

(a) $f = +10$ cm, $v = +15$ cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f}$$

$$\frac{1}{15} - \frac{1}{10} = \frac{2-3}{30} = \frac{-1}{30}$$

$u = -30$ cm

(b) Magnification $(m) = \frac{\text{Height of the image}}{\text{Height of the object}} = \frac{IM}{OB} = \frac{h_i}{h_o}$

$m = \frac{v}{u}$ From these equations,

$$\frac{h_1}{h_o} = \frac{v}{u}$$

$$h_1 = \frac{v}{u} \times h_o$$

$$= \frac{15}{-30} \times 3 = \frac{-1}{2} \times 3 = -1.5 \text{ cm}$$

c) Height of image is -1.5 cm. From this we can understand that the image is inverted, real and magnified.

We have now understood the different types of lenses and the characteristics of images formed by them.

- Find out the uses of lenses in our day-to-day life and record them in the science dairy.
  - In telescope
  - In spectacles
  - In camera
  -

Power of a Lens

When a person suffering from defective vision met a doctor, in the prescription it was written as +2D for buying spectacles.

- What has the doctor indicated in the prescription?

Power is a term related to the focal length of a lens. Power of a lens is the reciprocal of focal length expressed in metres. Power

$$p = \frac{1}{f}$$

Unit of power is dioptre. It is represented by D.

The power of a convex lens is positive and that of a concave lens is negative.

- Calculate the power of a lens of focal length + 25 cm.

You can guess what the +2D in the prescription stands for. What is its focal length? What kind of lens is it?

You might have seen the twinkling of stars at night. But planets do not twinkle. Why?

Atmospheric Refraction

Let's do an experiment. Connect a LED to a cell and arrange it as a source of light in a dark room. Place an electric iron box in front of this to heat air.

Fig. 5.34

When seen from a distance we can see the twinkling of the LED. What may be the reason?

What change happens in the optical density of air on heating it?

How will be the difference in the density of air at regions close to the iron and that at a distance?

What happens to the light when it travels through media of different optical densities?

When light passes through media of different optical densities it undergoes successive refractions. Hence the source of light appears like twinkling.

Light coming from distant stars passes through different layers of air. Each layer differs from the other in their optical densities. Hence light undergoes successive refraction. Since stars at a greater distance they appear like a point source. The rays of light appear to come from different points on reaching the eye after refraction. This is the reason for the twinkling of stars.

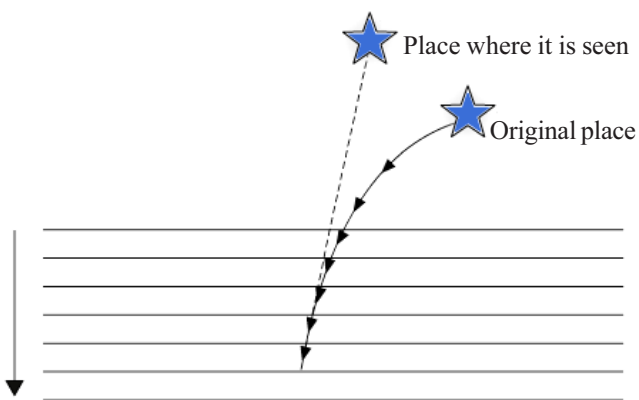


Fig. 5.35

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Let us assess

1) Refractive indices of different materials are given. Find out the medium through which light passes with maximum speed.

Medium	Refractive index
Glass	1.52
Glycerine	1.47
Sun flower oil	1.47
Water	1.33
Flint glass	1.62

2) The nature of images formed by two lenses are given.

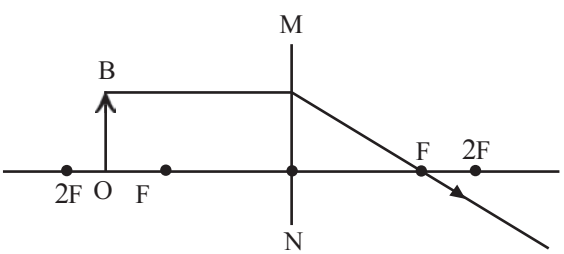
(i) An erect and magnified virtual image

(ii) An erect and diminished virtual image

(a) What type of lens is used in each case?

(b) By using which type of lens will we get an image having the same size as the object? What is the position of the object?

3)



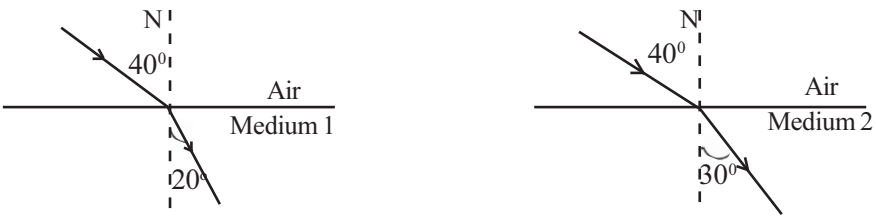
(a) MN represents a lens. What type of lens is this?

(b) What are the characteristics of the image?

(c) Copy the ray diagrams in the science diary and complete it.

4. What do you mean by power of a lens? What is the SI unit of the power of a lens? Calculate the power of a concave lens of focal length 25 cm.

5) Observe the figure. Light falling on two different media are shown.



(a) Which medium has greater optical density? Why?

(b) Which medium has greater refractive index?

6) An object of height 3 cm is placed in front of a convex lens of focal length 20 cm at a distance of 30 cm.

(a) What is the distance to the image formed?

(b) What is the nature of the image?

(c) What is the height of the image?

7) In the table the absolute refractive indices of certain transparent media are given.

Medium	Refractive index
Air	1.0003
Water	1.33
Kerosene	1.44
Turpentine oil	1.47
Crown glass	1.52
Diamond	2.42

(a) Find out from the table the medium of highest and lowest optical densities.

(b) If the speed of light in air is 3×10^8 m/s, what will be the speed of light through kerosene?

(c) Will a ray of light deviate towards the normal or away from the normal when it enters from air to diamond obliquely?

(d) The refractive index of diamond is 2.42. What do you mean by this? Calculate the speed of light through diamond.

Extended activities

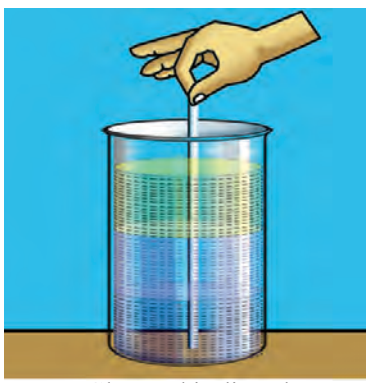
1) Half portion of a convex lens is wrapped with a black paper. Can this lens give a complete real image of an object? Explain.

2) The refractive indices of different media are given. Analyse the table and answer the following.

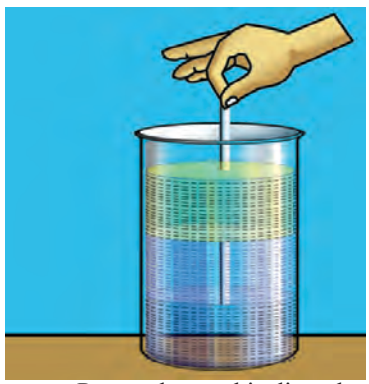
Medium	**Refractive index** (approximately)
Water	1.33
Sun flower oil	1.47
Pyrex glass	1.47
Glycerine	1.47
Crown glass	1.52
Flint glass	1.62

- In which medium will light have the highest speed?
- Glycerine, water and sunflower oil are taken in two beakers. A glass rod is dipped in one and a pyrex glass rod is dipped in the other.

  Do they appear in the same way? In which media are they visible? Justify.

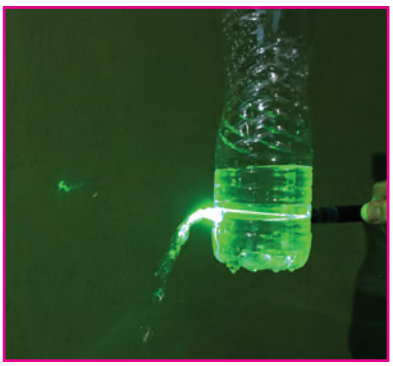


Glass rod is dipped



Pyrex glass rod is dipped

3) Take a clean mineral water bottle and fill it with water. Put a hole on one side of the bottle. Allow water to flow out while passing a laser ray through it. What do you observe? Why?



Beam of light

6 VISION AND THE WORLD OF COLOURS

Flowers of various colours, blueness of the sky, the sky during sunrise and sunset, the reddish Sun, eye delighting rainbow – what a myriad of hues!

How are these various colours formed?

How do they become visible to us? Let's make a journey into the world of vision and colours.

Eye and Vision

Do you know how different objects become visible to us?

Observe the image formation in the eye depicted here. (Fig 6.1)

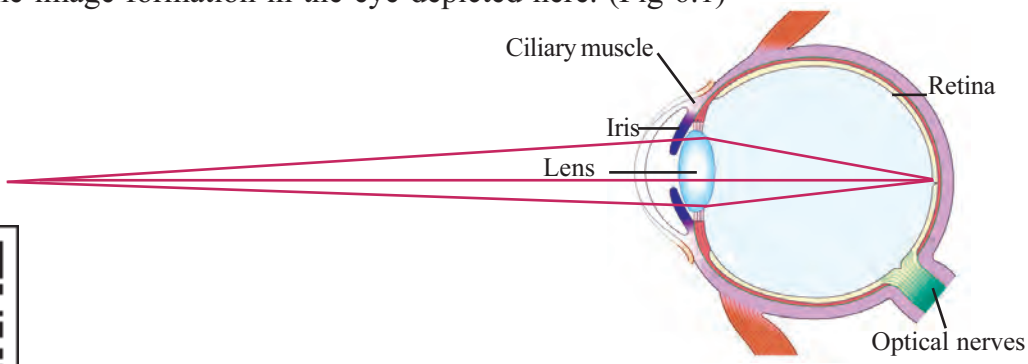


Fig. 6.1

7RDCUB

It is through the pupil, which is in the middle of the iris, that light from an object reaches the lens of the eye. You have already learnt in biology class how you see an object when the image of an object falls on the retina in this manner. But can you see objects at all distances?

Try to read a book, holding it very close to your nose.

Can you see the letters clearly? What happens if the book is moved away? At what distance from the eye can you get a clear vision? Try to measure using a metre scale. This smallest distance that you get is the least distance of distinct vision.

Near point is the nearest point at which the objects can be seen distinctly. The near point of an eye with healthy vision is 25 cm.

Like this what is the farthest point an eye can see clearly?

Far point is the farthest point at which the objects can be seen distinctly. The far point of an eye with healthy vision is at infinity.

How do the images fall on the retina of the eye clearly when we read a book or while we are looking at a star? Here the objects are at different distances. But is there a change in the distance between the retina and the lens? To know how this occurs let's do an experiment (Fig 6.2).

Adjust the distance between the screen and the lens as 40 cm for doing the experiment.

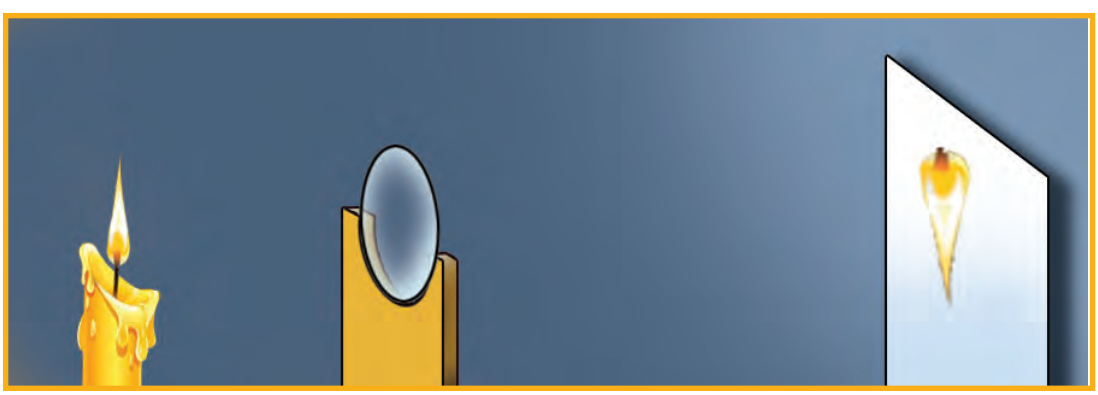


Fig. 6.2

Place a lighted candle at a distance 13 cm from the lens.

Do you get a clear image of the candle on the screen?

Place lenses of focal lengths 10 cm, 15 cm and 20 cm on the lens holder without changing the distance between the lens and the screen. On using which lens is the image clear?

Repeat the experiment by changing the distance to the object (candle) as 24 cm and 40 cm. Compare the focal lengths you got with the values given in the table.

Distance of object from the lens (cm)	**Distance from the lens to the screen** (cm)	**The focal length for getting a clear image** (cm)
13	40	10
24	40	15
40	40	20

Table 6.1

Didn't you have to use lenses of different focal lengths for objects situated at different positions to get clear images on the screen which is at a fixed distance from the lens?

The eyes also have to do the same function.

To get a clear vision, the image of objects from far point upto the near point must be obtained on the retina itself.

When we look at nearer objects, the ciliary muscles related to convex lenses in our eyes are contracted and the curvature of the lens increases. The focal length decreases. While looking at far objects the ciliary muscles are relaxed and the curvature of the lens decreases. The focal length of the lens increases.

The ability of the eye to form an image on the retina by adjusting the focal length of the lens in the eye, by varying the curvature of the lens, irrespective of the position of the object, is the power of accommodation.

Given below are the ray diagrams of image formation in the eye.

- Where is the image formed in each case?
- In which case is the image formed on the retina itself?

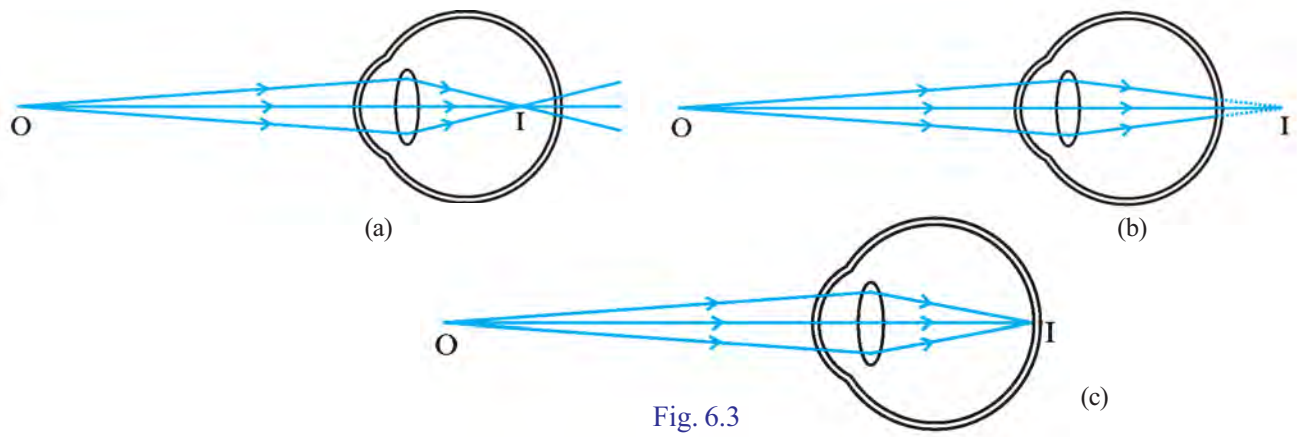


Fig. 6.3

- In the other cases, the image is not formed on the retina. Why?
  - Change in the power of the lens of the eye.
  - Change of the size of the eye ball.

In such cases, will vision be affected? Write down your inferences. What is the remedy?

Hypermetropia or Long-sightedness

The figure shows the image formations in the eyes of a person with long – sightedness.

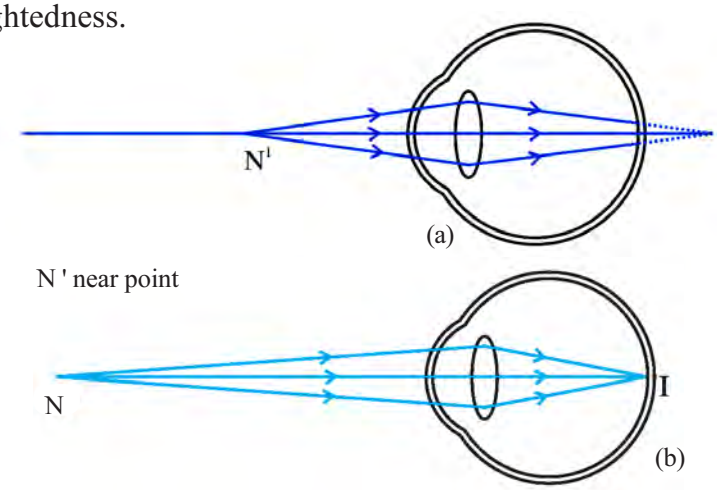


Fig. 6.4

- Will an image be formed on the retina when the object is at the near point (Fig 6.4(a))? Will it be possible to see a clear image?

- Will an image be formed on the retina when the object is at a far distance (Fig 6.4(b))? Will a clear image be formed?

This defect of the eye is the long – sightedness or hypermetropia.

Since the image is not formed at the retina, instead of being formed at the retina, nearer objects cannot be seen clearly even though distant objects are clearly seen. This defect of the eye is the long sightedness. The near point of the eye of such a person will be at a distance of more than 25 cm.

What shall be the reasons behind this defect?

- Can you find out a reason based on the size of the eye ball?
  size larger/ smaller?
- What if it is related to the focal length (or power)?
  Power is high/ low

Note down your inferences in your science diary.

What is the remedy for long - sightedness?

This can be rectified by using a convex lens of suitable power.

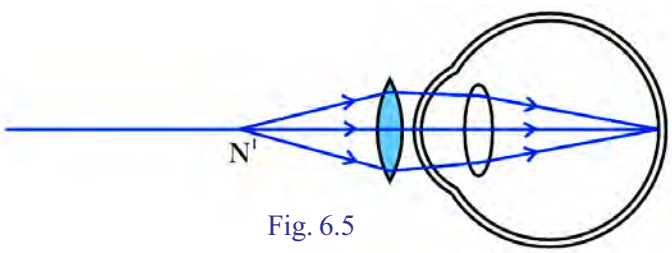


Fig. 6.5

7RH8VY

Myopia or Near-sightedness

For some people, the eyeball may be long. For some others, even though the eyeball is normal in size, power of the lens may be more.

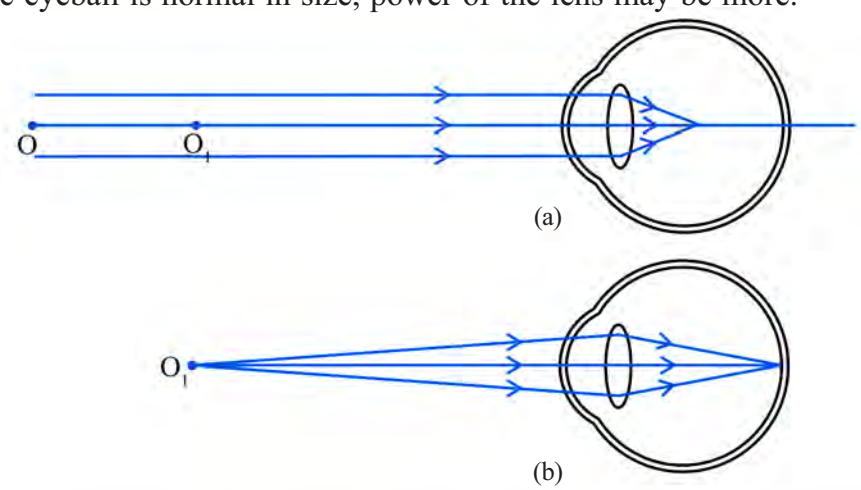


Fig. 6.6

Where is the image formed in these cases? Write down the answer analysing Fig 6.6.

When the object at O is away from the eye, where will be the image formed? Can the object be seen clearly?

Can the object be seen clearly when it is at O_1?

- Why is it not possible to see objects placed at long distances?
- What is its remedy?

For some persons, even though nearby objects can be seen clearly, they may not be able to see distant objects clearly. This defect is the nearsightedness. The near point of such persons will not be at infinity. It will be at a definite distance from the eye.

This can be overcome by using concave lens of suitable power.

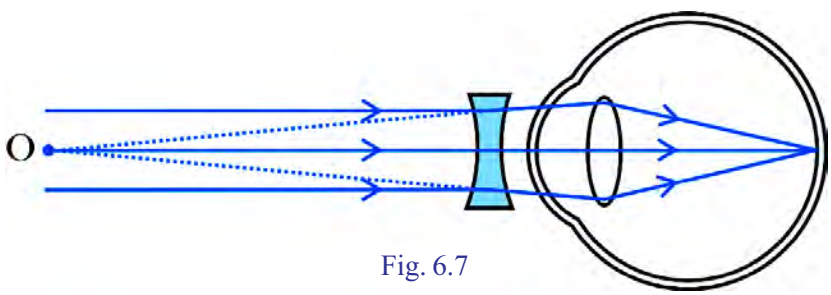


Fig. 6.7

Power of a Lens

When a person suffering from problem in vision met a doctor, he wrote in his prescription the following figures. **+1.5 D, -2D**

- What has the doctor indicated in the prescription?
- Which are the types of lenses prescribed here?

You might have seen elderly people reading newspaper by holding it at a distance. Presbyopia is a defect of the eye seen in elderly people.

Presbyopia

For a healthy vision what is the distance to the near point?

For elderly people the distance to the near point is greater than 25 cm. This is due to the diminishing ability of the ciliary muscles. For such people the power of accommodation will be less. This is presbyopia.

This can be overcome using convex lens of suitable power.

Eye Donation

Eye donation is one of the noblest donations. We can bring at least a few people with impaired eye sight back to the world of vision through donation of cornea.

Any people of any age can donate eyes. Exception is the cornea of those people having certain diseases. The cornea of the donor should be harvested within 6 hours of death. Through eye donation, those who have closed their eyes forever can light up others' lives.

With your friends, conduct activities to promote awareness about eye donation and encourage people to donate their eyes.

So far we have been trying to understand how different things in the nature are made visible. But what is the reason for these objects appearing in different colours when sunlight falls on them? Will there be a change in the colour of an object in accordance with the colour and nature of light? Let's familiarize certain phenomena to know more about it.

3D Vision

Is a single eye not sufficient for vision? Why do we need two eyes? Have you thought of this?

Vision becomes perfect only when both the eyes are used. When one eye alone is used, only a two dimensional view within an angular width of 150° is possible. When we look at an apple keeping one eye closed, it will appear to be flat. When an object is viewed using both the eyes, a three dimensional and wide vision with an angular span of 180° is possible. It is the brain that creates the perception of the distance of the object, by unifying the visions of the two eyes.

Dispersion of light

Pass sunlight through a prism and allow it to fall on a screen (Fig 6.8).
What are the colours seen on the screen?

- Violet
- Indigo
-

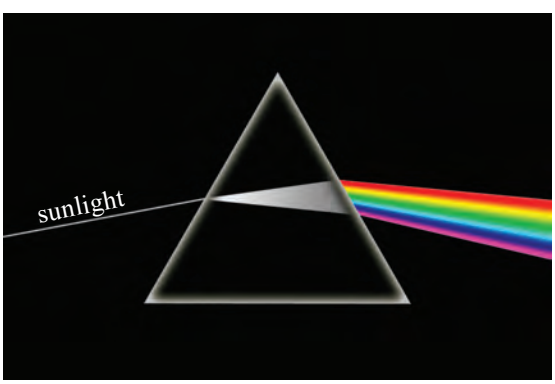


Fig. 6.8

7RH4XL

Is it the sunlight alone that gets split up into component colours? Let's examine.

What happens when white light from a torch is allowed to fall on a prism?

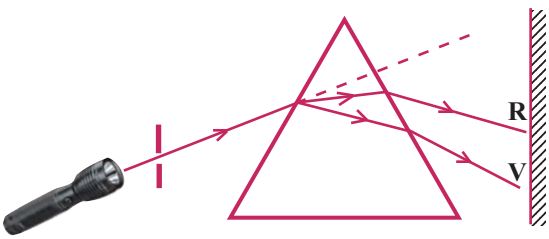


Fig. 6.9

Affix a black paper on the glass cover of a torch. Make a small hole at the centre of the black paper. Arrange a screen, and place a prism between the torch and the screen. Let the beam of white light from the torch fall obliquely on the prism. What do you observe on the screen?

- Which are the colours formed on the screen?
- Aren't these colours the same as the component colours obtained from the sunlight?

Any light that is composed of more than one colour is a composite light.

Dispersion is the phenomenon of splitting up of a composite light into its constituent colours. The regular array of colours formed by dispersion is the visible spectrum.

Observe Fig.6.9.

- Which colour deviates the most due to dispersion?
- Which colour deviates least?

What may be the reason behind this difference in deviation?

Let's compare their wave lengths.

Examine the given table (6.2). In that

Colour	Wavelength in (nanometer nm)
Violet (V)	400 - 440
Indigo (I)	440 - 460
Blue (B)	460 - 500
Green (G)	500 - 570
Yellow (Y)	570 - 590
Orange (O)	590 - 620
Red (R)	620 - 700

Table 6.2

- Which colour has the shortest wavelength?
- Which one has the longest?
- When light passes through the prism, as the wavelength increases, how does the deviation change? Will it increase or decrease?

On the basis of the experiment and the given table, write down your inferences.

Light undergoes refraction when it enters the prism obliquely and when it comes out of the

prism. The extent of deviation depends on the wavelength. Therefore waves undergo deviation at different angles and get separated. This is the reason for dispersion.

Does dispersion occur only when light passes through a prism?

Let's examine.

Rainbow

All of you would have seen a rainbow.

On a sunny day, spray water into the atmosphere facing away from the Sun. What do you observe? The constituent colours of light appear. Compare the spectrum of light thus obtained with that of the rainbow.

- When is the rainbow formed?
- Where will be the Sun when the rainbow is seen in the East?
- Where will be the Sun when the rainbow is seen in the West?

Dispersion of light caused by the water droplets in the atmosphere causes rainbow.

How does dispersion occur when light passes through the droplets of water?

Observe Fig 6.10 and also analyse the information given and answer the following questions.

Fig. 6.10

- How many times does a ray of light undergo refraction when it passes through a water droplet?
- What about the internal reflection?
- What is the colour seen at the upper edge of the rainbow?
- What is the colour seen at the lower edge?

The arc form of Rainbow

Line of vision is the line connecting the centre of rainbow and the eye of the observer. The rays of light incident on the water droplets must be parallel to the line of vision. Each ray of colour emerging from the water drop makes a definite angle ranging from 40.8° to 42.7° with the line of vision. Of these, the higher angle 42.7° is made by the red. The violet makes the lower angle of 40.8°. Hence red colour is seen at the upper edge and violet, at the lower edge.

Primary and Secondary colours

Blue, Green and Red coloured lights are referred to as primary colours of light. We cannot get primary colours by superimposing other colours of light. But other colours can be obtained using these colours. The colour obtained by combining any two primary colours of the same intensity is a secondary colour of light.

Green + Red = Yellow
Green + Blue = Cyan
Blue + Red = magenta

Sunlight, when it passes through water droplets, undergoes refraction and internal reflection. The light ray emerging from the water droplets which make the same angle with the line of vision have the same colour. These droplets appear in the form of an arc of a particular colour. Thus there is red colour at the upper edge and violet colour at the lower edge. All the other colours are seen in between, depending on their wavelengths.

When the position of the sun is near the horizon, the rainbow appears to be bigger. When seen from an aeroplane, the rainbow is seen as a circle. When the sun is much above the horizon, the rainbow disappears.

You have understood many facts about visible light and its constituent colours.

If the constituent colours are mixed together, will you be able to obtain white light?

Let's perform an activity.

Recombination of colours

Pass white light through a prism and obtain the constituent colours on a screen. A prism similar to the first is placed in inverted position, adjacent to the first (Fig.6.11). What do you observe on the screen now?

- What happened to the light when it passed through the first prism?

7SEW1W

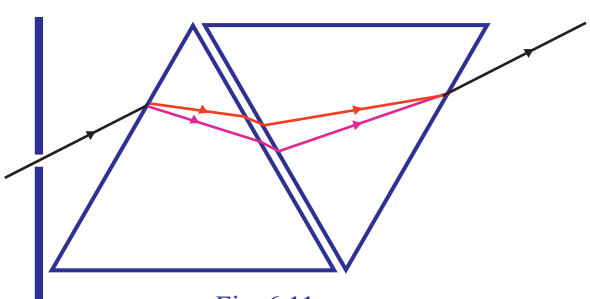


Fig. 6.11

- What happened when it passed through the second one?

Try out another activity as well.

You know how to make Newton's colour disc by painting the constituent colours of white light in the same order and proportion.

Fig. 6.12

- In which colour does the disc appear when rotated fast?
- Give reason.

The disc appears white since all the rays of light from the seven colours reach the retina of the eye within 0.0625 second $\left(\frac{1}{16}s\right)$.

The disc appeared white due to persistence of vision. Find out more examples of persistence of vision and write them down.

- A torch rotated rapidly appears as an illuminated circle.
-

During sunset, you might have noticed that the western horizon becomes reddish. Why is it so?

Persistence of vision

When an object is viewed by a person, its image remains in the retina of the eye for a time interval of 0.0625s $\left(\frac{1}{16}s\right)$ after seeing it.

This phenomenon is called persistence of vision. If more than one scene is viewed within 0.0625s, the effect of all these scenes will be felt by the eye simultaneously.

Scattering of light

Even though light travels in straight lines, we get light in our classrooms and homes during daytime. Have you thought about this?

Fig. 6.13

When sunlight passes through the atmosphere, rays of light are reflected by tiny particles of the atmosphere (dust particles, molecules etc.) as shown in Fig. 6.14.

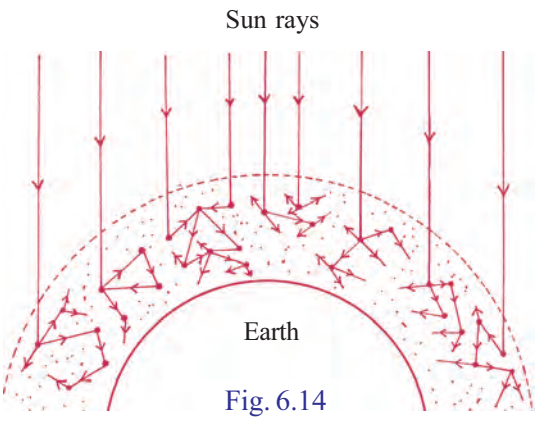


Fig. 6.14

- Is the scattering here regular or irregular?
- Is the distribution of sunlight to all regions made possible by this type of scattering?

Discuss.

Light getting reflected in random directions like this is known as scattering.

Scattering is the change in direction brought out by the irregular and partial reflection of light when it hits the particles of the medium.

Do all the colours of sunlight undergo similar type of scattering? Let's examine.

Water is taken in a beaker as shown in Fig 6.15. Allow light from a torch to fall on the water from one side of the beaker. The light emerging from the beaker is focussed on a white screen. Sodium thiosulphate is dissolved in water in the beaker at the rate of 2 g per litre. Add one or two drops of hydrochloric acid to the water in the beaker. Observe the gradual change in the colour of light in the solution and on the screen.

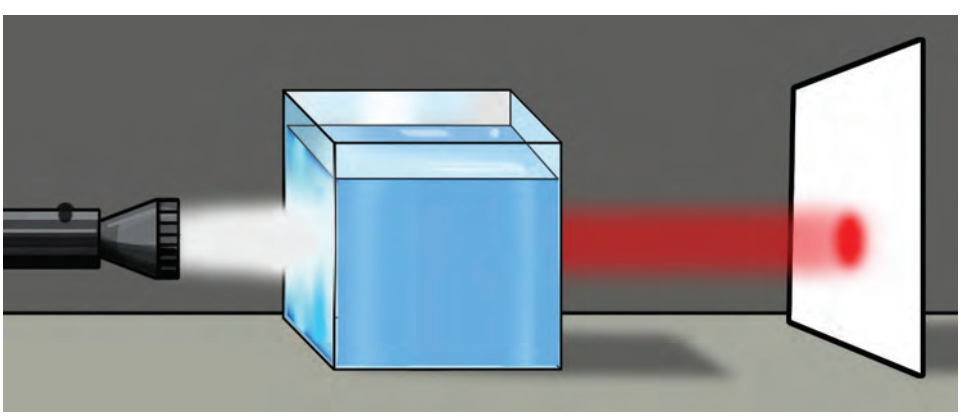


Fig. 6.15

- When hydrochloric acid was added to the solution, which colour did spread first in the solution ?
- Write down the colour changes observed on the screen in the order it occurred.
- What was the final colour observed on the screen?

When sodium thiosulphate reacts with hydrochloric acid, colloidal sulphur is precipitated. As the size of sulphur particles increases the nature of scattering changes. Discuss the relation between wavelength and the change in scattering.

Scattering and wavelength

Colours like violet, indigo and blue have the smallest wavelengths in sunlight. They undergo maximum scattering while interacting with atmosphere particles. Red has comparatively greater wavelength and it can overcome small obstacles and hence scattering is low. As a result they travel greater distance.

Rate of scattering and the size of the particles are interrelated. As the size of the particle increases, the rate of scattering also increases. If the size of the particles is greater than the wavelength of light, then the scattering is same for all colours.

- Which component colour in white light undergoes maximum scattering?

During sunset, the horizon appears to have red colour. What may be the reason?

Colours of the rising and the setting sun

Look at Fig. 6.16 and answer the following questions.

7SNS3J

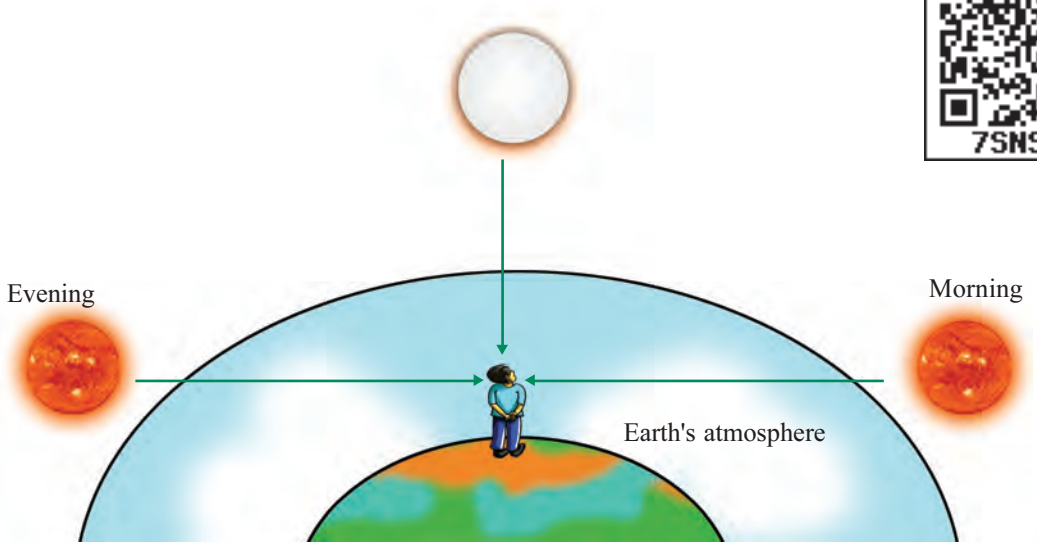


Fig. 6.16

- Which are the occasions when sunlight has to travel greater distance through the atmosphere before reaching the eyes of an observer on the earth?
- As sunlight passes through the atmosphere , which colour in it undergoes maximum scattering? Which colour undergoes minimum scattering?
- When light reaches the observer after travelling long distances through the atmosphere, which colour reaches the eye? What is the reason?
- The western horizon remains reddish for some more time even after sunset. Why?

During sunrise and sunset, light reaching us from the horizon has to travel long distances through the atmosphere. During this long journey, colours of shorter wavelength would be almost fully lost due to scattering. Then, the red light which undergoes only less amount of scattering decides the colour of the horizon. That is why the sun appears red during sunset and sunrise.

You have gone through the discussions on the scattering of light.

- Can you now guess why red colour has been given to the tail lamps of vehicles and signal lights? Discuss and note it down in your science diary.

Tyndal Effect

A misty morning
Fig. 6.17

Look at the figure.

The path of rays of light can be seen clearly. How is it possible?

When rays of light pass through a colloidal fluid or suspension, the tiny particles get illuminated due to scattering. Because of this, the path of light is made visible. This phenomenon is Tyndal Effect. The intensity of scattering depends on the size of particles in the colloid. As the size increases , the intensity of scattering increases.

Light Pollution (Photo Pollution)

We can never imagine a world without light. But what about a world having excess of light? Haven't you heard of the saying 'too much of anything will have a negative effect?'

The use of light in excess in a non-judicious manner is referred to as light pollution.

What will be the consequences of light pollution?

1) The life cycle of living beings will be affected adversely.

2) Sky watching becomes impossible due to diminished sky vision.

3) The light from tall flats misleads the migrating birds. It affects the accuracy of their judgement of direction.

4) The excess light from the high beam of headlight in vehicles causes a hindrance to the vision of others and can cause accidents.

The excessive use of lighting devices increases energy consumption and creates energy crisis.

International Dark Sky Association is an association which deals with the task of reducing light pollution. Every year, the week of the new moon in April is celebrated as International Dark Sky Week. This is the idea originated from Jennifer Barlow, a high school student from Virginia.

Conduct a study on how the light pollution brings about adverse effects in our environment.

Write down what else can be done to minimize the light pollution.

-
-
-

Let us assess

1. How is the condition of the ciliary muscles while watching a distant object? How does this influence the focal length of the eye lens?
2. A child sitting at the back bench of a classroom is unable to see the letters on the board clearly. What is the defect of the eye of the child? How can it be remedied? Draw its ray diagram.
3. A person is not able to see objects beyond 1.3 m. What remedy can you suggest for this defect?
4. In what colour does the sky appear for an astronaut?
5. Red light is used as signal lamps to indicate danger. Explain.
6. What is the reason for using yellow light as fog lamps?
7. Which is the phenomenon behind dispersion of light?

   (a) Reflection (b) Refraction

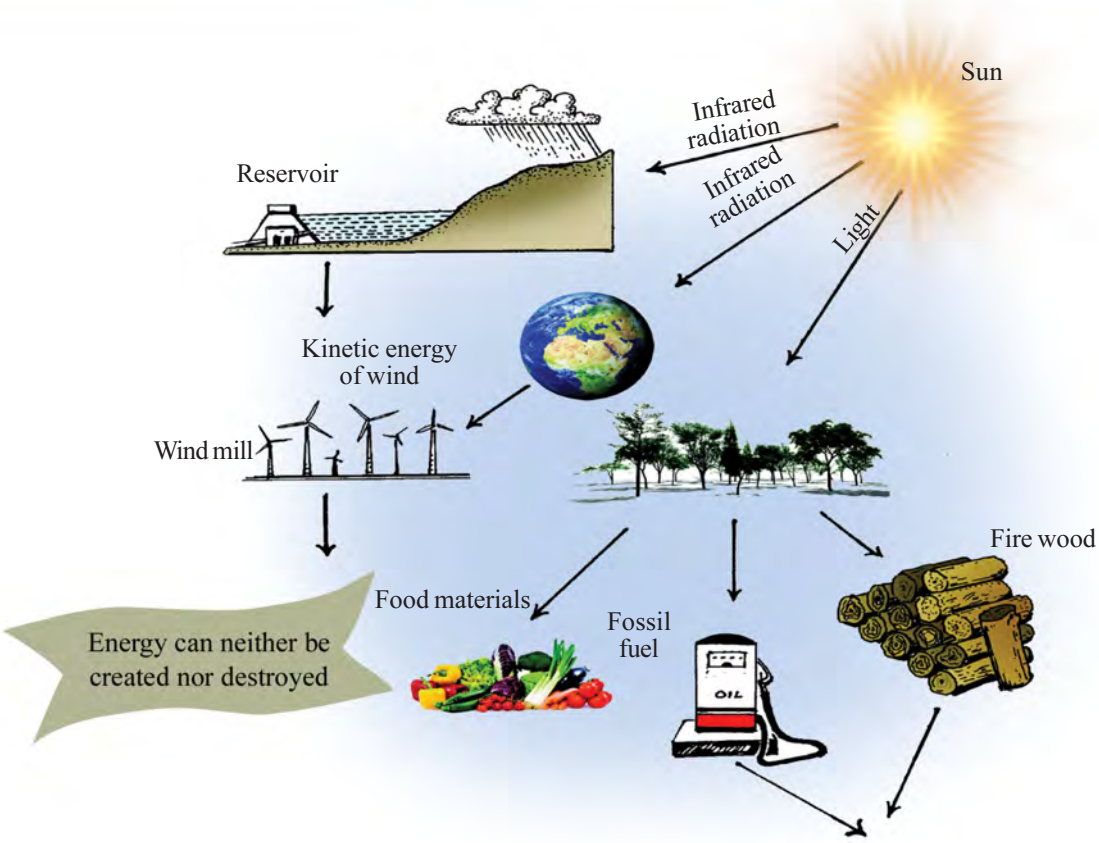
   (c) Tyndal Effect (d) Scattering

8) During dispersion, different colours deviate differently. Explain why.
9. The telescope called 'Chandra X – ray Observatory' is placed in the outerspace. What is the advantage of placing it there? Explain with reference to the scattering of light in the atmosphere.

Extended activities

1. White light is allowed to fall on the bright side of a compact disc (CD). The reflected light is allowed to fall on a white wall. Observe the colours available in the spectrum and write them down in your science diary.

7 ENERGY MANAGEMENT



It is said that energy can neither be created nor destroyed; then how does energy crisis occur?

Are the existing energy resources adequate to meet our energy needs?

Observe the figures given below. Pictures of Kochi, as it was in olden days and now, are given.

Fig 7.1

What are the changes that have been taking place? Write them down.

- Travel facilities – from motor cycle to metro train
- Multi storied buildings
- Business centres
- Population growth

What difference would have been brought in the energy consumption due to these changes? What energy sources would have been used for this?

List down the different forms of energy you use for various purposes from the time you wake up till you reach your school.

- Muscular energy - for different physical activities
- Chemical energy - for cooking
-
-

From which sources are you getting these forms of energy?

We use different forms of energy from physical to electrical energy. We get these forms of energy from different sources like Sun , fuels and power stations.

Speed of travel and the housing facilities had to be increased to keep up with human progress. Accordingly we had to increase the facilities for industries and allied fields. This made it inevitable to transform the available energy from different sources to many other suitable forms.

When energy is transformed from one form to another, some part of it gets lost in other forms. Such a loss is the main cause for energy crisis.

Different sources of energy are to be used for different activities. Judicious and scientific use of different sources of energy without being wasted is a necessity of today.

Let's examine different sources of energy.

Different Sources of Energy

Fuels

Probably heat might have been the first form of energy created by the ancient humans. Heat energy was formed from forest fires. Later men made heat

energy again by burning firewood. Hence the first fuel might have been firewood itself.

What are fuels?

Fuels are substances that release plenty of heat energy on burning.

The main source of energy that we make use of today are fuels. We use different fuels for different purposes including for cooking in the kitchen.

Which are those fuels?

Classify them into solids, liquids and gases, and tabulate.

Solid	Liquid	Gas
• Fire wood •	• Kerosene •	• Biogas •

Table 7.1

Do these fuels burn in the similar way?

Let's do an experiment (Fig 7.2).

Take three papers of the same size. Keep one stretched. Crumble the next. Make the third paper wet using water. Burn each of them over a candle flame using pincers. Compare the burning of each.

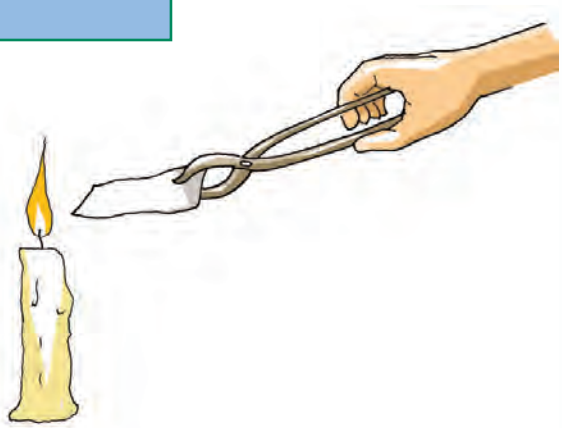


Fig 7.2

Stretched paper	Crumbled paper	Wet paper
• Burns very well •	• •	• • Smoke is formed

Table 7.2

What are the conditions favourable for the complete combustion of different fuels?

- The solid fuels must be dry.
- Liquid fuels must evaporate easily.
- The ignition temperature should be attained.
- Sufficient oxygen must be available for burning.

Combustion of fuels

Fuels burn with the help of oxygen. Generally, complete combustion is a reaction in which fuels react intensively with oxygen, producing carbon dioxide, steam, heat and light. If sufficient oxygen is not available, the rate of combustion decreases. If oxygen is not sufficient, large quantities of carbon monoxide, soot and a little of carbon dioxide will be formed. This type of burning is partial combustion. Haven't you learnt about the problems caused when carbon monoxide mixes with atmospheric air? Pollution test is conducted to know whether the components in the gases released from the vehicle exceeded the permissible limits.

Fossil fuels

Fossil fuels are formed by the transformation of plants and animals that went under the earth's crust millions of years ago. The transformation took place in the absence of air under high pressure and high temperature. Coal, petroleum and natural gases are fossil fuels. They are not replenished or renewed in proportion to their consumption. Hence they are nonrenewable energy sources.

If so, what are the features of complete combustion?

- Carbon monoxide is not formed.
- More heat is generated

Write down the situations/specialities for partial combustion.

-
-
-

What are the drawbacks of partial combustion?

- Loss of fuel
-
-

What are the advantages of using smokeless choolahs at home? Note them down in the science diary.

Visit a nearby pollution testing centre, interact with the staff there and prepare a note on the permissible pollution rate.

Fossil Fuels

Which are the fuels that are used in vehicles and industries?

Tabulate the category to which these fuels belong to.

Coal	Petroleum	Natural gas
• Coke	• Petrol	• LNG
•	• Kerosene	•
•	•	•
•	•	•

Table 7.3

Coal

Coal is the most abundant fossil fuel on the earth. The main component of coal is carbon. Based on the carbon content, it is classified into four groups as peat, lignite, anthracite and bituminous coal. When coal is distilled in the absence of air, the substances obtained are ammonia, coal gas, coal tar and coke.

CNG, LNG, LPG

We make liquefied natural gas (LNG) and compressed natural gas (CNG) from the natural gas obtained along with petroleum. The main component of all these is methane. These are used as fuels in vehicles, industries and thermal power stations. The importance of LNG is that natural gas can be liquefied and transported to distant places conveniently. It can again be converted into gaseous form at atmospheric temperature and distributed through pipe lines.

The full form of LPG is liquefied petroleum gas. This is a colourless, odourless gas obtained through the fractional distillation of petroleum. Domestic LPG produces an odour since ethyl mercaptan is added as an indicator to detect gas leakage. The main constituent of LPG is butane.

- Which are the products obtained from fractional distillation of petroleum?
- Which is the cooking gas that we get in cylinders for domestic use?
- How will you know if there is leakage in a LPG cylinder?

L P G and Safety

Have you ever noticed the expiry date marked on a cooking gas cylinder? This is marked on the top of the cylinder. If it is marked "A 24", the A indicates the months from January to March and 24 indicates the year (2024) We can understand that this cylinder has maturity period upto March 2024. If recorded as B, then it is from April to June, C denotes July to September, and D denotes from October to December. If the smell of LPG is felt then it

means that there is at least 3% of LPG in the atmospheric air. Even the presence of 2% LPG in air can cause fire. LPG is denser than air. If the smell of LPG is felt do not operate electric switch. If there is a fire due to leakage of LPG then due to the heat the cylinder/ tanker will also get heated. Owing to the excess heat, the LPG becomes gas increasing the pressure inside. The ability to expand is 250 times for the gaseous LPG. Therefore when LPG becomes gas, the container cannot accommodate the entire gas. This increases the pressure to a very high level causing a huge explosion. This is known as **BLEVE** (**B**oiling **L**iquid **E**xpanding **V**apour **E**xplosion).

Find out the expiry date of the gas cylinder at your home or school and record it in the science diary.

.....

Never switch on or switch off electricity when there is a leakage of LPG. Why?

.....

If there is a leakage of LPG does it rise up or come down in the atmosphere? Why?

.....

.....

If there is leakage of LPG it is mandatory to open the doors and windows. Why?

.....

What precautions are to be taken to avoid accidents due to LPG leakage? Discuss and record in the science diary.

- Examine the rubber tube at regular intervals and ensure that it does not have a leakage.
- Turn on the knob of stove only after the regulator is turned on.
- .....

- .....

If a gas leak is suspected or if the fire spreads on a cylinder, what else could be done? Think it over.

.....

.....

If you are convinced that there is a gas leak, disconnect electricity from outside the home (switch off the main switches). Switch off the regulator and shift the cylinder to an empty space. Keep the windows and doors open. Request help from the Fire Force by calling in the toll free number 108. Well trained rescue operators can put out the fire by covering the top end of the cylinder with wet sack to prevent the contact with oxygen. If the fire is in flat or the top storey, then one should not try to escape using lifts. Only staircase should be used. Cover the nose and the mouth with soft cloth to avoid the intake of smoke or gases.

Fossil fuels were formed over lakhs of years. Shouldn't we keep them for future generations as well?

Make posters and exhibit them at school showing that fossil fuels are precious and that they are to be used judiciously.

Biomass

From ancient times, we have been using firewood, dried cow dung etc., as fuel. Since these fuels are obtained from plants and animals, they are known as bio-waste or biomass. The burning of such bio-wastes will be partial combustion.

Haven't you seen bio-wastes dumped in public places? Don't you experience a putrid smell, when you pass them by? Which are the gases responsible for this smell?

Besides air pollution, what are the problems that may arise when garbage is heaped? Discuss and record.

Fig 7.3

Biogas

When bio waste is deposited in a biogas plant in the absence of oxygen, biogas is formed by the action of bacteria. Its main constituents are methane and carbon dioxide. The slurry discharged from the biogas plant is good manure. When biomass is converted into biogas, not only a fuel of greater calorific value is obtained but the atmospheric pollution is also minimised.

Discuss the need for a biogas plant at home and prepare notes.

Nobody realises that the waste we throw indiscreetly on the wayside invites contagious diseases. Though we are in the forefront regarding individual hygiene, we are far behind in community hygiene. Organise a seminar in your PTA, describing the advantages of the effective utilization of domestic garbages.

Fuel Efficiency

You are now familiar with different fuels.

Is the heat released from each of them the same when burnt? Let's examine.

- Some of you may be using LPG in your houses. What is the weight of the LPG filled in the cylinders supplied to your homes?

  -

- Using this quantity of LPG for how many days can you cook?

  -

- How many days can you cook using firewood of the same weight?

  -

- What difference do you feel in the efficiency of these two fuels?

  -

Calorific value

The amount of heat liberated by the complete combustion of 1 kg of fuel is its calorific value. Its unit is kilojoule/kilogram.

Some fuels and their calorific values:

Hydrogen	– 150000 kJ/kg
CNG	– 50000 kJ/kg
Dried cow dung	– 6000 – 8000 kJ/kg
LPG	– 55000 kJ/kg
Biogas	– 30000 – 40000 kJ/kg
Coal	– 25000 – 33000 kJ/kg
Petrol	– 45000 kJ/kg
Methane	– 50000 kJ/kg

- Based on its calorific value, which fuel can be considered as the most efficient?

- -

Hydrogen and hydrogen fuel cell

Hydrogen is a fuel with the highest calorific value. This is highly inflammable and explosive in nature. So it is difficult to store and transport it. We make use of hydrogen fuel cell to produce electricity by combining hydrogen and oxygen.

- Which are the instances when hydrogen is used as fuel?

- -

- Why is hydrogen not used as a domestic fuel?

- -

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Now you know about different types of fuels and their calorific values. What are the properties that a good fuel must have?

- Should be easily available.
- Should be of low cost.
- Should have a high calorific value.

- Should cause minimum atmospheric pollution on combustion.
- Should be easily storable.
- A liquid fuel must not evaporate quickly at ordinary temperatures.
-
-
-

Electrical energy is the most important form of energy. Its speciality is that it can easily be converted into many other forms.

Have you ever thought how our life would be if there is no electricity?

The amount of electrical energy received per person is a measure of the progress of the nation.

You have already learned that we get electricity from a generator.

What is the energy conversion in a generator?

-

From where do we get energy required for the working of a generator?

-

Power stations are the centres where electricity is produced on a large scale for distribution.

The mechanical energy required for running power generators is made available in different ways. Power stations can be classified based on the nature of the source providing the energy required to operate the generator.

- Flowing water - hydroelectric power stations
-
-
-

HYDROELECTRIC POWER STATIONS

- Water stored at a height is allowed to flow down through a penstock pipe. The energy of the flowing water is used to rotate the turbine and electricity is generated.
- Such power stations are established at Pallivasal, Moolamattom, etc., in Kerala.
- The energy change taking place here is : Potential energy → Kinetic energy → Mechanical energy → Electrical energy.

Fig. 7.4

THERMAL POWER STATION

- Fuels like coal, naphtha, lignite, etc., are ignited. The heat energy thus liberated is used to convert water into steam at high temperature and pressure.
- The energy of steam is used to rotate the turbines to generate electricity.
- Such power stations are established at Neyveli, Kayamkulam, etc.
- The energy change taking place here is: Chemical energy → Heat energy → Mechanical energy → Electrical energy.

Fig. 7.5

On the basis of notes and discussions, complete the table:

Power station		Energy change
Hydro electric power station	• Moolamattom • Kuttiadi • Pallivasal •	
Thermal power station	• Neyveli • Kayamkulam • Ramagundam •	

Table 7.4

Solar Energy

We get different forms of energy from the Sun.

Attempts are underway now to utilise solar energy to its maximum. What are the devices used for this?

Discuss and expand the list.

- Solar panel
- Solar water heater
-

Electrical energy from solar energy

Solar cell is a means for converting solar energy into electrical energy. This is a p-n junction diode. When solar energy falls on N side of a solar cell, a small electric current is obtained due to the flow of electrons to P region from N region. This phenomenon is the photovoltaic effect. It is the electrical energy thus obtained that is stored in batteries and used whenever necessary.

Solar panel

The voltage and current obtained from a solar cell is insignificant. A large number of solar cells are suitably assembled to form a solar panel. The electric current obtained from a large number of such cells can be stored in a battery and used as and when it is needed. Solar panel is used extensively in lighting street lamps. They are used to meet the energy requirement of artificial satellites. Nowadays solar photo voltaic (SPV) power plants capable of producing electricity of thousands of kilowatt are in use. The solar powerplant at the International Airport in Nedumbassery is an example.

The Solar Power Plant at the International Airport, Nedumbassery. The Power Plant takes care of the complete energy needs of the airport and the excess energy is given to KSEB. It received the Champion of Earth Prize – 2018 instituted by the United Nations for its use of Green Energy.

- What is the energy transformation that takes place in a solar cell?

  -

- There are certain situations in which a solar panel cannot be put to use. Which are they?

  -

- What are the situations where solar panels alone are depended on?

  -

Will it not be possible to solve the energy crisis to some extent if the excess of electrical energy obtained from the solar panel is transferred to the power grid? Many institutions in Kerala are making use of this method.

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Heat energy from solar energy

Let's do an experiment. Take two conical flasks. Paint the outér surface of one with black paint and the other, with white paint. Fill both of them with water and expose them to direct sunlight for the same period of time. Which one gets heated first? What may be the reason?

Solar Cooker

List down the specialities of a solar cooker by examining Fig. 7.7.

- A box with blackened interior
- A glass cover for the box
- A mirror outside the box

What is the function of each?

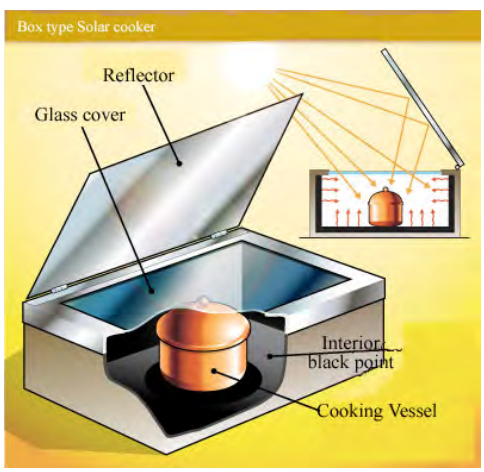


Fig 7.7

Find out the working of solar cookers other than the box type and record them in the science diary.

Solar Water Heater

Solar water heater, solar cooker etc., are devices that make direct use of solar heat radiations. Hot water required for hospitals and hotels for cooking food, and

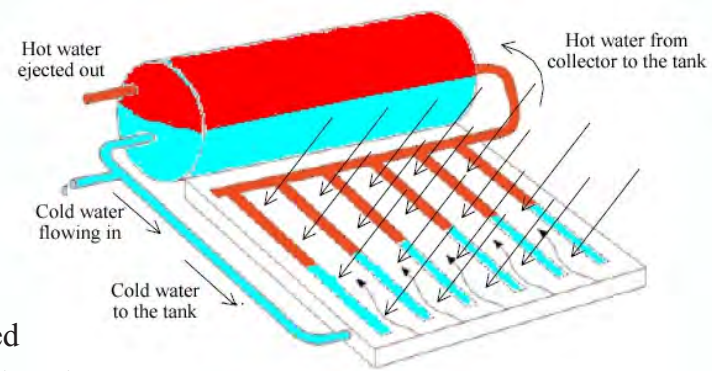


Fig 7.8

for washing vessels in houses etc., can be produced using solar water heater.

Observe the figure. Discuss and record how hot water is formed in the tank of the solar heater.

Take a look at the solar water heater and the solar cooker in your nearby house or institution and prepare notes regarding their working.

Fig 7.9

Solar Thermal Power Plant

Solar thermal power plant generates electricity using solar energy. Concave reflectors are used to focus the sun's rays on the blackened pipes filled with water. As a result, water boils and vaporises. The steam rotates the steam turbine, so that the generator attached to the turbine is activated. About 10 such solar power plants are functioning in India, the majority of which are in Rajasthan.

We are now familiar with certain devices which directly make use of solar energy. Isn't it the Sun that is behind almost all the phenomena on Earth such as wind, waves etc? Hence the Sun can be considered as the source of energy for these.

Energy from wind

Wind energy is a form of energy that is both environment friendly and renewable. Electricity is obtained by turning the turbine of generator using the wind power. Here production of electricity does not incur any recurring expenditure. But it has certain limitations. This can be established only at those places where wind is available for most time of the year. We may require storage systems to use electricity when there is no wind. About 2 hectares of land is needed for the production of one megawatt power. The expense to establish a wind mill is very high and that for repairing it in the event of damages caused by heavy rain, cyclones, heat etc., is also very high.

Denmark is known as the Country of Wind. More than 25% of electricity needed for the nation is generated using the windmills. Germany stands number one among the nations producing electricity from wind. India holds the 5th position in the production of electricity using wind. If the possibilities of wind are exploited we can produce 45000 megawatt electricity. In India it is at Kanyakumari that electricity is generated from the wind to the maximum, which comes to about 380 mega watt. In Kerala electricity is being produced like this at Ramakkalmed and at Kanjikode.

Fig 7.10

Using a mini motor and a paper fan, make a miniature wind mill and operate it.

Energy from sea

Two third of the surface of the Earth is sea. Hence ocean is a major source of energy. Sea waves, high tide, heat from the ocean etc., are the phenomena that we can make use of while producing energy from sea.

Tidal Energy

You have already learnt that the gravitational force on the earth from the moon is the main cause of the high tide. Can we make use of this tidal energy for the production of electricity? Discuss and record with the help of the figure.

Tidal energy is not exploited in Kerala since the rise in water due to high tide is less than a metre.

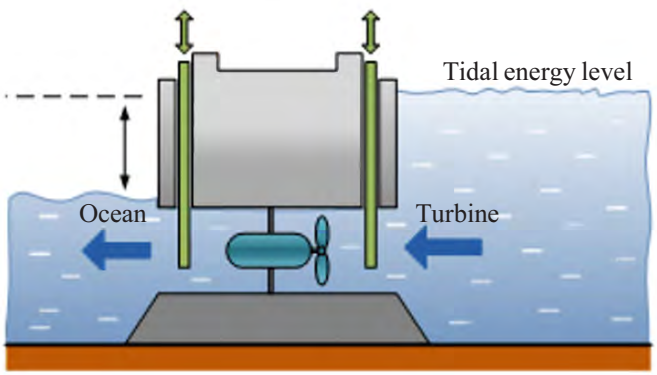


Fig 7.11

Energy from waves

We can operate a generator by turning the turbine by using the power of sea waves. In India also such methods for the production of electricity from sea waves are in operation on an experimental basis.

Ocean thermal energy

The surface of ocean is relatively hot due to solar radiations. But the temperature will be very low at the deep levels. Ocean Thermal

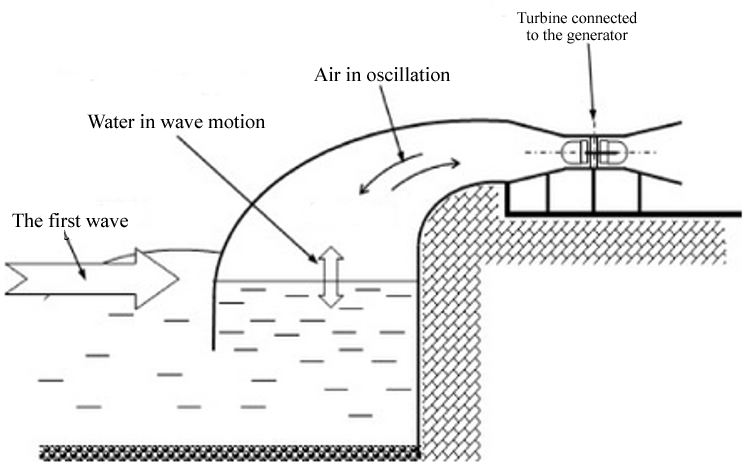


Fig. 7.12

Energy Conversion Plants (OTEC) produce energy, making use of this difference in temperature. The temperature of the surface of ocean and the regions at 2 m depth will vary by more than 20 K in temperature. The heat at the surface boils volatile liquids like ammonia. Using the gas obtained, turbine is rotated. The cold water at the bottom liquefies the gas again. By the continuous action of this we get electrical energy.

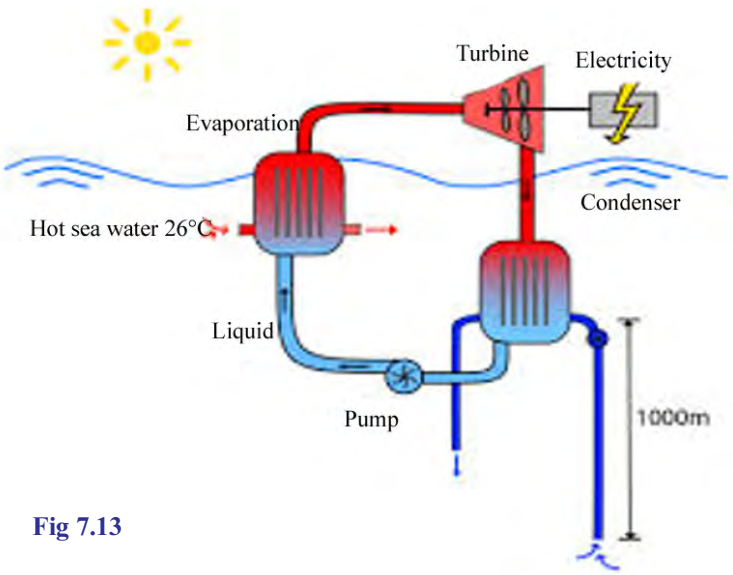


Fig 7.13

Though the ocean is an infinite source of energy, harnessing of this energy on commercial scale is not an easy task.

- 'Ocean as a source of energy: its possibilities and limitations'. Prepare a seminar paper on this.

Geo thermal energy

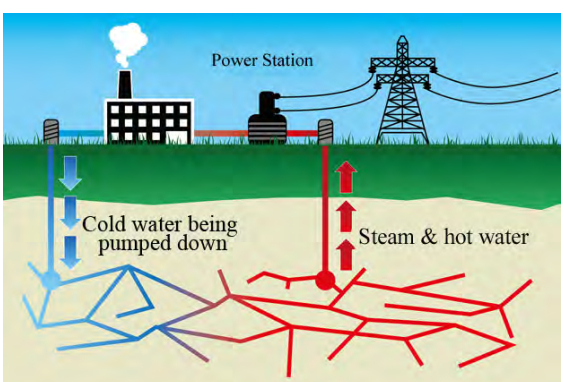


Fig 7.14

Though the surface of the earth has cooled down making it habitable, the interior is still in the molten form. Magma, which is at a higher temperature, comes out of the core through its softer regions. Such places are known as hot spots. Underground water at this place receives heat energy from the hotspot and is converted into steam. This steam, which is confined to the region between rocks, is brought out by drilling pipes through the rocks. Using this steam, turbine is rotated to produce electricity.

- Why is it said that geo thermal power plants are not possible in Kerala? Discuss and record.

Nuclear energy

Look at the newspaper report carefully. Which is the disaster reported in the newspapers?

How was it possible to produce such extremely devastating energy from an atom bomb?

Will it be possible to use this energy for peaceful purposes?


The first ever atom bomb as destructive as 20000 tonne TNT

1945 ആഗസ്ത് 6ന് ആദ്യ ആറ്റംബോംബ് ജപ്പാനിൽ പ്രയോഗിച്ചു. നാശത്തിന്റെ വർഷപാതം ആരംഭിക്കുന്നു.

San Francisco

Japan Hit By Atom Bomb---Mightiest Weapon in History! Tokyo Admits Heavy Damage

New Epoch in Science, War

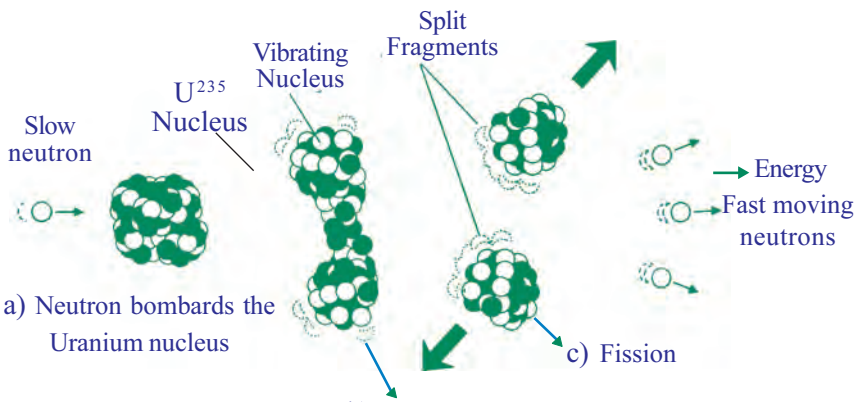
Single Missile Dropped—More Force Than 2000 B-29 Raid; Capitulation May Be Hastened

'Basic Power of Universe' Harnessed in Secret Tests; Truman Reveals the Story

Multiply This by Two Thousand!

Nuclear fission

Nuclear fission is the process by which the nuclei of greater mass are split into lighter nuclei, using neutrons. The mass of small nuclei formed is less than that of parent nucleus. It means that there is loss of matter during such a splitting. The matter that is lost is converted into energy. According to Einstein's equation $E = mc^2$, even if the matter converted is very small, the energy produced will be very large. Uncontrolled fission will end in a huge explosion. This is the process that takes place in an atom bomb.



Fission of U^{235} nucleus

Fig 7.15

Energy from matter

$E = mc^2$ This is the equation for the energy E released when a matter of mass m is converted into energy. c is the velocity of light. Do you know how much energy is produced when 1 kg of matter is converted into energy? $E = 1 \times (3 \times 10^8)^2 = 9 \times 10^{16}$J. You know how huge a quantity is this? If this is completely converted into electricity we will get about 2500 crore unit (kilowatt hour). It is this equation, which gives the information about changing matter into energy, that made Albert Einstein world famous.

Nuclear fusion

Nuclear fusion is the process in which lighter nuclei are combined to form heavier ones. In this process the matter lost is converted into energy. You know that energy is produced in the stars and the Sun in this way. This is the principle used for making a hydrogen bomb. The scientific world has not yet been able to produce energy commercially by controlled nuclear fusion

There are power stations to control fission reaction and produce electricity. They are known as thermal power stations.

Nuclear reactor is a system that converts nuclear energy into electrical energy.

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Enriched uranium is the fuel used in nuclear reactors. India has developed the indigenous technology of using carbide fuel in nuclear reactors. The power station at Kalpakkam in Tamilnadu makes use of such a reactor. Dangerous radioactive radiations and products are also formed in nuclear reactions.

- What are the different methods by which energy is produced from the nucleus?

- -

- Even if the matter converted is very small, the energy produced is very large. What is the reason?

- -

- What is the reason for uncontrolled fission reaction ending in an explosion?

- -

Nuclear power station

- Using nuclear energy water is converted to steam at a high temperature and pressure.
- The force of steam is used to turn the turbines to generate electrical energy.
- Such power stations are established at Tarapur, Kalpakkam, Kota, and Koodamkulam.
- Energy change taking place here is : Nuclear energy → Heat energy → Mechanical energy → Electrical energy

Fig 7.16

Conduct a discussion on the topic "Nuclear energy – Its possibilities and challenges."

Nuclear Pollution

The pollution caused by the presence of radioactive substances and radiations in water, air and environment is known as nuclear pollution.

The nuclear decomposition of polluted materials results in the dangerous pollutions. As a result of nuclear decomposition alpha,

beta and gamma radiations spread out. Density of polluting substance, the type of radiation, proximity of pollution to physical organs etc., are the factors that determine the probability of danger. Nuclear hazards can be artificial or natural. Tabulate them.

Natural	Man made
• Cosmic rays from outer space • Radiations from radioactive materials on the Earth • ..... •	• The use of radioactive isotopes in the medical field. • Wastes from nuclear reactors. • ..... • .....

Table 7.5

Precautions to face nuclear hazards

- Shift out to safe places (Concrete buildings, buildings constructed using bricks etc)
- Strictly follow the directions from the concerned authorities
- Observe the symbols showing the nuclear radiations and behave accordingly.
- Reduce the density of population in places likely to experience nuclear hazards.
- If necessary, consume potassium iodide tablets or take food rich in iodine.

Fig 7.17
Symbol showing warning against nuclear radiation

Renewable Sources of energy

Now you are familiar with different sources of energy. Those which replenish energy as it is being used up are the renewable sources of energy. The natural sources of energy obtained from sunlight, wind, rain, high tide etc can be replenished. Hence these are examples for renewable sources of energy. They do not pollute the environment. Petroleum, coal, natural gases, nuclear energy etc., are non renewable sources. They are harmful to the environment as well.

Green Energy

Green energy is the energy produced from natural sources that does not cause environmental pollution. All the energy produced from renewable sources belong to this category. The renewable sources like solar energy,

wind energy, energy from waves and energy from biomass are considered as green energy. This is also referred to as clean energy.

But the energy produced from nonrenewable sources such as petroleum and coal, and the nuclear energy are named brown energy. These are sources which cause environmental problems including global warming.

Classify the energy from the following sources as green energy and brown energy:

Solar cells, atomic reactors, tidal energy, hydro electric power, diesel engines, windmills, thermal power stations.

Green Energy	Brown Energy

Table 7.6

What must be done to ensure maximum utilization of green energy while constructing a house?

- Sufficient sunlight should be available in the rooms during day time.
- Comfortable warmth, coolness and air circulation must be available without the help of electricity.
-

Energy Crisis

We have started using new energy sources besides the conventional ones. Aren't we forced to face load shedding and power cut inspite of all these? What may be the reason?

Loss of energy through water

If 1 mL water is lost from a tap in one second then 60 mL water is lost in one minute, 3600 mL (3.6 L) water in one hour and 86.4 L in one day. At this rate, what will be the loss in one month! How much energy may be lost in this way! Hasn't the energy used to bring water into the tank also been lost?

Though the need for energy has increased many times the production has not increased proportionally.

'Energy crisis is the consequence of increasing demand but decreasing availability'

What can be done for reducing energy crisis as far as possible? Expand the list.

- Judicious utilisation of energy.
- Maximum utilisation of solar energy.

- Minimising the wastage of water.
- Making use of public transportation as far as possible.
- Construction and beautifying of houses and roads in a scientific manner.
- Controlling of the street lamps with LDR (Light Dependent Resistor).
- Timely maintenance of machines.
- Limiting the size of newly constructed buildings.
- Ensuring of maximum efficiency of the machines used.
-

List down the devices that can be used at home to reduce energy consumption.

- Hot box
- Pressure cooker
- Energy efficient oven

What are the local activities that can be taken up to spread social awareness?

- Poster publicity
- Classes
- Jatha (procession)
-

LDR (Light Dependent Resistor)

LDR is a variable resistor that works based on the intensity of light. Its resistance changes in accordance with the change in the intensity of light. Its resistance (a few mega ohm) is maximum when it is in the dark and much less when it is kept in light. Based on this we can save energy to a great extent by using street lights only when there is less light. This is made possible by including LDR in a relay circuit.

In day time the resistance of LDR decreases due to the intense light falling on it. Hence current flows through the circuit containing it and as a result the main switch is turned off. If it is dark the resistance of LDR increases very much and current through it ceases. The switch in the main circuit gets switched on and the street lamps start giving light.

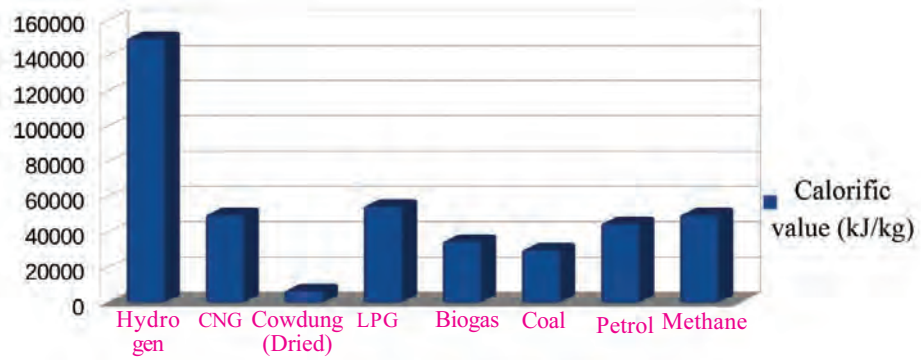
Let us assess

1) In a way most of the important energy sources of today can be said to be solar. Which of the following does not belong to the solar energy?
   a) fossil fuel b) energy from the wind
   c) nuclear energy d) biomass.
2) Which of the following is a green energy?
   a) coal b) naptha
   c) biogas d) petroleum gas

3) Write down the advantages and limitations of solar cooker.

4) Kerala has a long coastal land. Still ocean is not considered as a major source of energy. Why?

5) The graph regarding the calorific value of certain fuels is given below. Analyse the graph and answer the following questions.



a) Which fuel has the highest calorific value? Which has the lowest?

b) How many kilogram of dried cow dung is to be burnt to obtain the same amount of heat produced when 1 kg of LPG burns?

c) From the graph find out the most suitable fuel for household purpose. Justify your answer.

Extended activities

1. Find out the scope of hydrogen as a fuel with a high calorific value and prepare an essay.
2. Visit a hydroelectric power station and try to understand the different stages of the production of electricity. Make use of this principle and find out the scope of mini hydro electric power project.
3. Visit a biogas plant and explore the possibility of establishing a community biogas plant in your region.
4. Write a short play to make the public aware of the need for making use of solar energy.
5. Solar energy has an incredible future in the field of transport. We are in its infant stage. Write an essay on the topic "Prospects of solar energy"
6. Find out the advantages and disadvantages of main energy sources and tabulate them.

Serial number	Source of energy	Advantages	Disadvantages

7. A nuclear reactor is about to be established in Kerala. What is your reaction to this proposal? Justify.
8. A man pointing at a car running on petrol says, "This car is running on solar energy". Write down your responses about this matter.
9. Under the auspices of science club, conduct a seminar on the steps to be taken if a tanker lorry meets with an accident.
10. Understand the working of a fire extinguisher with the help of the fire force.
11. Conduct a seminar on the following.
    - The future of fossil fuels
    - Hydrogen - future energy source
    - Bio gas plant and waste disposal
    - Possibilities of solar energy
    - Energy - from wind and ocean
    - Nuclear energy - possibilities and challenges
    - Energy crisis - problems and solutions

Notes

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While using electricity...

Electricity has become an indispensable part of our day-to-day life. Its consumption has increased and hence the hazards due to this have also increased. Of all the electrical hazards reported in India 10 per cent are from our state. Hence there is no need for specific mentioning to ensure the importance of precautionary measures from electricity related hazards.

Safety measures to be adopted:

- Do not operate switches with wet fingers.
- Do not dry hair using a table fan.
- Do not touch the inner part of the adaptor of a TV. Ensure that the adaptor has a cap which is a non-conductor.
- Do not touch on broken electric wires.
- Do not fly kites near electrical lines.
- Do not use metallic pipes or iron hooks carelessly near electric lines.
- Do not lean against electric posts or stay wires. Cattle should not be tied to them. Do not allow plants or creepers grow on them.
- Switch off the main switch in case of fire on electric appliances or on their vicinity.
- Do not pour water over electric lines or appliances to put out fire. Instead, use dry sand or dry powder type fire extinguishers.
- Use only the electric appliances carrying ISI mark.
- Do not use plastic wires for temporary connections to decorations.
- If a person succumbs to electric shock, he/she should be touched only after disconnecting the electrical contact.
- Detach the victim from the electric connection using dry wooden planks or some dry material which is not a conductor.
- Switch off the main switch immediately, in case electric shock is noted.

Electricity saved is equivalent to electricity generated