

## WISE UP

➤ Light is a form of energy which causes in us the sensation of sight - reflected light from an object, it makes things visible.

➤ Objects that emit light by their own are called Luminous objects.

**Examples :** The sun, The stars, Glow worms and the sirius are natural sources of light.

➤ Objects which do not emit light of their own are called Non - Luminous objects.

**Examples :** Planet, The moon, The Earth, Book etc.

➤ Man made sources of light : Wax - Candle, Oil lamp, torch, electric bulb, tube light etc.

➤ Transparent objects allow light to pass through them and we can see objects clearly through them.

**Examples :** Air, thin glass, clear water of shallow depth etc.

➤ Opaque objects do not allow light to pass through them.

**Examples :** Stone, wood, rubber etc.

➤ Translucent objects allow light to pass through them partially. But things can not be clearly seen. Here the light is absorbed to a great extent.

**Examples :** Ground glass, Oiled paper, tracing paper etc.

➤ Shadows are formed when an opaque objects comes in the path of light.

➤ Formation of shadows required are opaque body, source of light and screen.

➤ Shadows forms only on screen.

Shadows can mislead about the shape of the object.

Pinhole camera can be made with simple materials and can be used to image the sun and brightly lit objects.

➤ Pinhole camera works on principle of rectilinear propagation of light.

➤ We use a plane mirror to look at our face. The face seen in the mirror is called the image.

➤ The phenomenon of light coming back after hitting any surface is called reflection.

➤ Mirror reflection gives us clear images.

➤ Images are different from shadows.

➤ Light travels in straight line.

➤ Light can travel in vacuum. speed of light in vacuum is  $3 \times 10^8$  m/s.

➤ No body can travel faster than speed of light.

➤ Periscope works on the principle of the reflection of light rays on plane mirrors.

➤ Kaleidoscope is an instrument which works on the principle of multiple reflections on plane mirrors.

## NCERT TEXTUAL QUESTIONS

**1. Assess the following :**

1. a) An image that cannot be obtained on a screen is called virtual image.  
b) Image formed by a convex mirror is always virtual and smaller in size.  
c) An image formed by a plane mirror is always of the same size as that of the object.  
d) An image which can be obtained on a screen is called a real image.  
e) An image formed by a concave lens cannot be obtained on a screen.

**2. Mark 'T' if the statement is true and 'F' if it is false**

- |    |  |       |
|----|--|-------|
| A. | a) We can obtain an enlarged and erect image by a convex mirror        | [ F ] |
|    | b) A concave lens always form a virtual image.                         | [ T ] |
|    | c) We can obtain a real, enlarged and inverted image by concave mirror | [ T ] |
|    | d) A real image cannot be obtained on a screen                         | [ F ] |
|    | e) A concave mirror always forms a real image                          | [ F ] |

**3. Match the words given in the column – I with one or more words of column – II**

<b>Column – I</b>	<b>Column – II</b>
a) A plane mirror	i) Used as magnifying glass
b) A convex mirror	ii) Can form image of objects spread over a large area
c) A convex lens	iii) Used by dentists to see enlarged image of teeth.
d) A concave mirror	iv) The image is always inverted and magnified
e) A concave lens	v) The image is erect and of the same size as the object
	vi) The image is erect and smaller than the object.

- A. a – v; b – ii, vi; c – i; d – iii; e – vi

**4. State the characteristics of the image formed by a plane mirror.**

- A. i) Plane mirror forms virtual and erect image.  
ii) The distance of an image is same as that of object.  
iii) Size of the image is same as that of the object.  
iv) Image has lateral inversion.

**5. Find out the letters of the English alphabet or any other language known to you in which the image formed in a plane mirror appears exactly like the letter itself ? Discuss your finding**

- A. Letters like A, H, I, M, O, T, U, V, W, X, Y appear same when seen through a plane mirror.

**6. What is a Virtual image ? Give one situation where a virtual image is formed?**

- A. i) The image cannot be obtained on a screen is called a virtual image  
ii) Image formed by a plane mirror is a virtual image.

**7. State two differences between a convex and a concave lens.**

<b>Convex lens</b>	<b>Concave lens</b>
i) Thick at middle and thin at edges. ii) It forms real (or) virtual images	i) Thin at middle and thick at edges. ii) It forms only virtual images.

**8. Give one use of each concave and convex mirror.**

- A. **Use of concave mirror :** Concave mirror is used by dentists to examine the teeth.  
**Use of convex mirror :** Convex mirror is used as rear view mirror in vehicles.

**9. Which type of mirror can form a real image ?**

- A. A concave mirror can form a real image.

**10. Which type of lens forms always a Virtual image ?**

- A. Concave lens always forms a virtual image.

**II. Choose the correct options in questions 11 – 13 :****11. A virtual image larger than the object can produced by a**

- i) Concave lens      ii) Concave mirror      iii) Convex mirror      iv) Plane mirror

A. Concave mirror.

**12. David is observing his image in a plane mirror. The distance between the mirror and his image is 4m. If he moves 1m towards the mirror, then the distance between David and his image will be**

- i) 3m      ii) 5m      iii) 6m      iv) 8m

A. The distance between mirror and image = 4m

The distance between David and his image =  $4 + 4 = 8$  m

If David moves 1 m towards the mirror then the image also moves 1 m towards the mirror.

$\therefore$  The new distance between David and his image =  $8 - 2 = 6$  m

**13. The rear view mirror of a car is plane mirror, a driver is reversing his car at a speed of 2m/s. The driver sees in his rear view mirror the image of a truck parked behind the car. The speed at which the image of truck parked to approach the driver will be**

- i) 1m/s      ii) 2 m/s      iii) 4m/s      iv) 8 m/s

A. The speed of the car = 2 m/s ( $\because$  The speed of image appears the same speed as object)

The speed of image of truck = 2 m/s

$\therefore$  The speed of image of truck to the driver =  $2 + 2 = 4$  m/s

**ADDITIONAL QUESTIONS**
**VERY SHORT ANSWER QUESTIONS**
**1. How many colours are present in rainbow ? What are they ?**

- A. There are seven colours present in rainbow. They are Red, Orange, Yellow, Green, Blue, Indigo and Violet.



**2. What is lateral inversion of image ?**

- A. The phenomena, where your left appears as the right and right appears as left in your image is referred to as lateral inversion of image.

**3. Why convex lens is used as magnifying glass ?**

- A. Convex lens forms virtual and enlarged image when it places close to an object.

**4. What images are formed by the concave mirror ?**

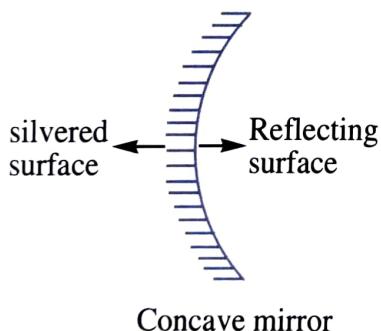
- A. A concave mirror can form
- Real, inverted and diminished image
  - Real, inverted and enlarged image
  - Virtual, erect and enlarged image

**5. Why convex mirror is used as rear view mirror.**

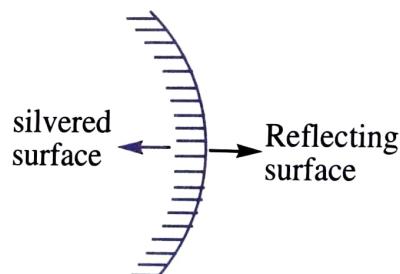
- A. i) Convex mirror has wider field of view  
ii) Convex mirror always forms virtual and diminished image.


**SHORT ANSWER QUESTIONS**
**1. Define convex and concave mirror with a neat diagram.**

- A. If the reflecting surface of a spherical mirror is concave then it is called a concave mirror.  
If the reflecting surface of a spherical mirror is convex then it is called a convex mirror.



Concave mirror



Convex mirror

**2. While standing before a plane mirror, if you move your right hand, which hand does your image move?**

- A. If we move our right hand, our image will move left hand. It is because in a plane mirror our "left appears right" and "right appears left" this is called lateral inversion. Hence we can say that the plane mirror forms laterally inverted images.

**3. Why do we need a shiny surface for regular reflection?**

- A. The extent of reflection depends upon the shiny and smoothness of the surface. More is the shine and smoothness of the surface, more will be the reflection. That is why, mirrors reflect most of the light falling on it. Hence, for regular reflection, shiny surfaces are required.

**4. Write the uses of a convex mirror ?**

- A. i) It is used in street lights.  
ii) It is used in the cars and scooters as rear view mirror.  
iii) It is used in ATM centres as security mirror.

**5. Write the uses of concave mirror ?**

- A. i) It is used in search light, head lights and torches.  
 ii) It is used as shaving and make - up mirror.  
 iii) It is used in solar furnaces.

**6. A man walks towards a plane mirror. At what rate will his image move if**

- a) The mirror is stationary.  
 b) The mirror moves towards the man.

- A. a) If the mirror is stationary the image moves at the same rate as the man.  
 b) When the mirror moves towards the man the image moves at twice the rate of the mirror.

**7. Explain why the word 'AMBULANCE' is written as shown in figure**

- A. When the driver of a vehicle ahead of an ambulance looks in his/her rear view mirror, she/he can read 'AMBULANCE' written on it and give way to it. It is the duty of every one of us to allow ambulance to pass without blocking its way.

**LONG ANSWER QUESTIONS****1. Distinguish between a concave mirror and convex mirror ?**

A.

**Concave mirror**

- i) It reflects light from its inner shiny surface.
- ii) It can form both real and virtual image.
- iii) It can form both erect and inverted image.
- iv) It can form a magnified image.

**Convex mirror**

- i) It reflects light from its outer shining surface.
- ii) It always forms a virtual image.
- iii) It always forms an erect image.
- iv) It always forms a diminished image.

**2. Distinguish between a real image and virtual image ?**

A.

**Real image****Virtual image**

- 1) It is formed when two or more reflected rays actually meet.
- 2) It is always inverted.
- 3) This image can be obtained on a screen.

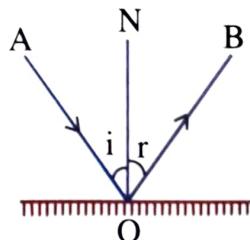
- 1) It is formed when the reflected rays appears meet each other but actually do not meet in reality.
- 2) It is always erect.
- 3) This image can not be obtained on a screen.

**3. What is reflection ? state two laws of reflection ?**

- A. **Reflection :** The phenomenon of light coming back into the same medium after hitting a smooth plane surface is called reflection.

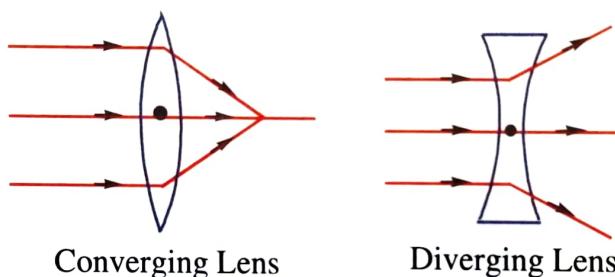
**Laws of Reflection :**

- i) The angle of incidence ( $i$ ) is equal to the angle of reflection ( $r$ )
  - ii) The incident ray, the reflected ray and normal to the surface all lie on the same plane
- O – Point of incidence  
 ON – Normal to the surface  
 AO – Incident ray  
 OB – Reflected ray  
 $i$  – Angle of incidence  
 $r$  – Angle of reflection



**4. What are converging and diverging lenses and draw a neat diagram of them ?**

- A. A convex lens converges the light generally falling on it is called converging lens.  
 When the concave lens diverges the light falling on it is called a diverging lens.



**5. Explain the image formation on stainless steel spoon.**

- A. The front side of a shining spoon is acts like a concave mirror. So if we keep our face at a good distance from the front side of spoon,we will see a real,inverted and a small size of our face in the spoon. The back side of a shining spoon is acts like a convex mirror. So if we keep our face in front of back side of spoon,we will see a virtual,erect and a small size of our face in the spoon.



**6. Explain the activity that formation of different types of images due to concave mirror**

- A. i) Fix a concave mirror on a stand and paste a piece of white paper on a cardboard sheet and kept at a distance of 15 cm . This will act as a screen.
- ii) Keep a lighted candle on the table at a distance of about 50 cm from the mirror.
- iii) Move the screen till a sharp image of the flame is obtained.
- iv) We find that a real,inverted and smaller size of image is formed on screen as shown in fig(i).
- v) Now move the candle towards the mirror and we find that at a particular distance the image is real,inverted and larger size of image is formed on screen as shown in fig(ii).
- vi) Now move the candle very close to the mirror and we find that the image is virtual,erect and larger size of image is formed on mirror as shown in fig(iii)



Fig - (i)



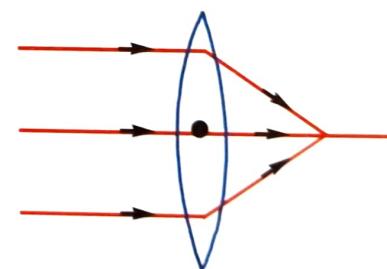
Fig - (ii)



Fig - (iii)

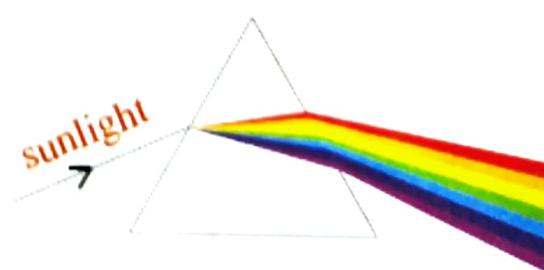
**7. Explain an activity that shows the converging nature of convex lens .**

- A. i) Take a convex lens.Put it in the path of sunrays and place a sheet of paper on ground.
- ii) Adjust the distance between the lens and the paper till you get a bright spot on the paper.
- iii) This bright spot represents the high concentration of sun rays.
- iv) The convex lens converges all the sun rays fall on its surface to a point on paper.
- v) This point is appears like a bright point on paper.



**8. Explain an activity that shows sunlight is the combination of seven colours**

- A. i) Take a glass prism. Allow a narrow beam of sunlight through a small hole in the window of a dark room to fall on one face of the prism.
- ii) Let the light coming out of the other face of the prism fall on a white sheet of paper or on a white wall.
- iii) We find that the seven colours pattern is formed on screen.
- iv) This shows that the sunlight consists of seven colours.



### QUICK REVIEW

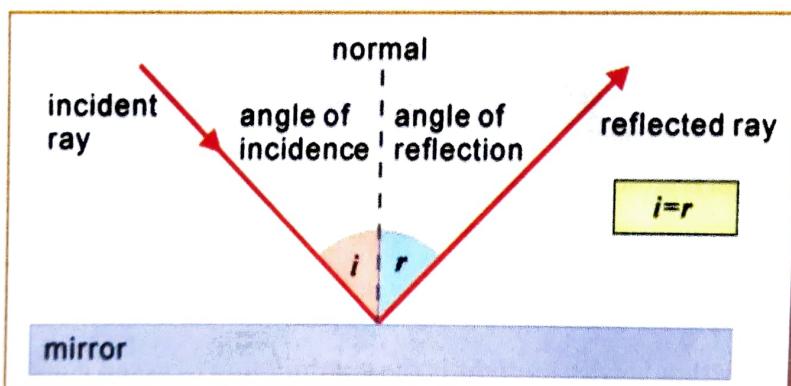
- Light is a form of energy which causes the sensation of sight (or) vision for us.
  - Light travels even in vacuum. It does not require a material medium for its propagation.
  - Light travels with high speed in vacuum, its speed in vacuum ( $c$ ) =  $3 \times 10^8$  m/s.
  - An object which emits light by its own is called source of light/luminous object.
- Ex :** Sun, Candle, Glow - Worm, Sirius etc.



- Candle, bulb etc are called man - made sources of light.
- Light always travels in a straight line, this property of light is called rectilinear propagation of light.
- When light incident on plane mirror, it reflects back in the same medium.
- The property of bouncing back of light in to same medium is called reflection of light.

#### Laws of Reflection :

- ❖ The angle of incidence ( $i$ ) is equal to the angle of reflection ( $r$ ).  $\angle i = \angle r$
- ❖ The incident ray, the reflected ray and normal to the surface are all lie in the same plane.



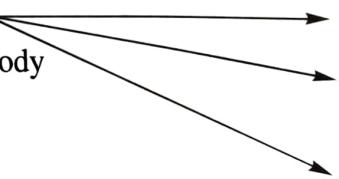
- A plane and smooth shining surface is called a mirror.
- Dispersion of light is the phenomenon of splitting of white light into its constituent colours on passing through prism.
- The dispersion of light through prism is due to different colours have different wavelengths.
- Lenses are also used to get images. Lenses are used to make spectacles, microscopes, magnifying glasses and telescopes etc.
- Lenses are of two types, concave lens and convex lens. Concave lens is also called diverging lens, because it diverges the light falling on it.

- Convex lens is also called converging lens, because it converges the light which fall on it.
- Concave lens forms, virtual erect and diminished image. Convex lens can form both real and virtual images depending upon the position of the object. It magnifies the objects, when they are placed very near the lens.

### ANALYSE AND APPLY

1. Light is the form of \_\_\_\_\_ and causes the sensation of \_\_\_\_\_.
2. Light always travels in \_\_\_\_\_.
3. The angle of incidence is always equal to \_\_\_\_\_.
4. \_\_\_\_\_ lens always form virtual image.
5. Speed of light in vacuum is 3 lakh km/s (T/F).
6. Plane mirror always forms virtual image (T/F).
7. Concave mirrors used in street lamps (T/F).

**Column - I**
**Column - II**

- |                       |  |               |
|-----------------------|--|---------------|
| i) Luminous body      |  | i) Sun        |
| ii) Non-Luminous body |  | ii) Moon      |
| iii) Natural source   |  | iii) Candle   |
| iv) Artificial source |  | iv) Glow warm |

9.

Mirror / Lens	Type of image	Application
i) Plane mirror	Virtual image	Looking glass
ii) Concave mirror	_____	_____
iii) Convex mirror	_____	_____
iv) Convex lens	_____	_____
v) Convex lens	_____	_____

10.

**Situation**
**Ray diagram**

Converging nature of convex lens

Diverging nature of concave lens

Dispersion of sunlight.

### » OBJECTIVE EXERCISE «

#### Multiple choice questions :

1. The objects which emit light of their own are called [ ]  
a) transparent objects    b) translucent objects    c) luminous objects    d) non-luminous objects
2. Light is a form of [ ]  
a) energy                  b) work                  c) power                  d) force
3. The white light consists of [ ]  
a) no colours              b) seven colours              c) three colours              d) ten colours
4. Light travels in a [ ]  
a) Straight line              b) curved line              c) neither straight nor curved              d) none of these
5. In a plane mirror the distance of an image is the [ ]  
a) same as that of the object              b) greater as that of the object  
c) less as that of the object              d) more than 10 m
6. A spherical mirror whose inner hollow surface is the reflecting surface is a : [ ]  
a) convex mirror              b) concave mirror              c) plane convex              d) plane concave
7. The type of lens used as a magnifying glass [ ]  
a) concave lens              b) convex lens  
c) concave-convex lens              d) convex - concave lens

8. Which one shows lateral inversion [ ]  
 a) Plane mirror      b) Convex mirror  
 c) Concave mirror      d) All of these
9. Image formed by a plane mirror is always [ ]  
 a) Virtual and erect      b) Real and erect  
 c) Virtual and inverted      d) Real and inverted
10. The splitting of white light into its seven constituent colours is called [ ]  
 a) Refraction      b) Dispersion  
 c) Deviation      d) Reflection
11. The laws of reflection of light are valid - for [ ]  
 a) Plane mirror      b) Concave mirror  
 c) Convex mirror      d) All
12. Mirror used by Dentist is [ ]  
 a) Convex      b) Concave  
 c) Plane      d) Spherical
13. Angle of incidence = \_\_\_\_\_ [ ]  
 a) Angle of reflection      b) Angle of refraction  
 c) Angle of deviation      d) All the above
14. The irregular reflection, [ ]  
 a) follows laws of reflection  
 b) doesn't follow laws of reflection  
 c) sometimes follows laws of reflection  
 d) none of these
15. Mirror behind the bulb in a car head light [ ]  
 a) Concave      b) Convex  
 c) Plane      d) None
16. A mirror changes the direction of light falls on it. This property is called \_\_\_\_\_ of light. [ ]  
 a) Changing      b) Bending  
 c) Spreading      d) Reflection

#### Assertion and Reason Type questions :

17. **Assertion (A)** : It is necessary that air contains water droplets to form a rainbow  
**Reason (R)** : Rainbows are formed due to the rectilinear propagation of light  
 a) Both A and R are correct and R is the correct explanation of A  
 b) Both A and R are correct but R is not the correct explanation of A  
 c) A is correct, R is incorrect  
 d) A is incorrect, R is correct
18. **Assertion (A)** : Concave mirror is used as reflector in car head light  
**Reason (B)** : Concave mirror convert light into parallel beam when an electric bulb is placed at focus  
 a) Both A and R are correct and R is the correct explanation of A  
 b) Both A and R are correct but R is not the correct explanation of A  
 c) A is correct, R is incorrect  
 d) A is incorrect, R is correct
19. **Assertion (A)** : Concave mirror is used as a shaving mirror  
**Reason (B)** : Concave mirror forms a real and inverted image when the object is at focus  
 a) Both A and R are correct and R is the correct explanation of A  
 b) Both A and R are correct but R is not the correct explanation of A  
 c) A is correct, R is incorrect  
 d) A is incorrect, R is correct

20. **Assertion (A)** : Convex mirror is known as a diverging mirror  
**Reason (B)** : When parallel rays of light fall on a convex mirror it scatters light in different directions
- Both A and R are correct and R is the correct explanation of A
  - Both A and R are correct but R is not the correct explanation of A
  - A is correct, R is incorrect
  - A is incorrect, R is correct

**Olympiad Corner :**

- The path of the light can be changed by \_\_\_\_\_ [ ]  
 a) A polished surface      b) A black body  
 c) A black surface      d) Passing it through vacuum
- The surface of \_\_\_\_\_ acts like a mirror and can change the path of light. [ ]  
 a) A road      b) Water      c) A black board      d) A wooden board
- Among the following which can act like a mirror. [ ]  
 a) surface of water      b) air      c) glass slab      d) all the above
- Mirror used as a reflector in head lights of the vehicles. [ ]  
 a) concave      b) convex      c) plane      d) all the above
- Image of an object in a plane mirror is [ ]  
 a) real      b) inverted      c) small      d) virtual
- Which of the following changes the direction of light ? [ ]  
 a) A board painted black      b) A black body  
 c) Carbon suit      d) A mirror
- Light from a candle is not visible when it is seen through a narrow bent tube, because [ ]  
 a) Light is absorbed by the tube      b) Light travels in a straight line  
 c) Candle does not give light      d) All the above
- Any polished or shiny surface can act as a \_\_\_\_\_ [ ]  
 a) Mirror      b) Shield      c) Concave lens      d) Convex lens
- Mirror used as a rear view mirror [ ]  
 a) concave      b) convex      c) plane      d) all the above
- Light energy travels from the sun [ ]  
 a) in the form of waves and in a straight line      b) in a straight line  
 c) in the form of waves      d) none of these
- When light falls on an object it may [ ]  
 a) pass through it  
 b) bounce back into the same medium  
 c) be completely cut off after being absorbed by the object  
 d) all of these
- The mirrors used as rear view mirror in cars and in car headlights are \_\_\_\_\_ and \_\_\_\_\_ [ ]  
 a) Convex, concave      b) Convex, plane      c) Convex, convex      d) Concave, concave

13. We can see an object [ ]  
 a) when light rays falls on an object  
 b) when reflected light from the object reach our eyes  
 c) when light rays do not fall on an object  
 d) none of these
14. The light ray comes back into the same medium from the surface on which it is incident is called [ ]  
 a) refraction  
 b) interference  
 c) diffraction  
 d) reflection of light
15. According to the laws of reflection [ ]  
 a) The angle of incidence ( $|i|$ ) is equal to angle of reflection ( $|r|$ )  
 b) The incident ray, reflected ray and normal drawn at point of incidence lies in same plane.  
 c) Both a & b  
 d) The incident ray, reflected ray and normal drawn at point of incidence lies in different planes.
16. Choose the in-correct statement for the concave mirror [ ]  
 a) The reflecting surface of mirror is concave    b) It forms always virtual images  
 c) It is a cut part of hollow spherical glass bulb    d) It is also called converging mirror
17. Choose the in-correct statement for the convex mirror [ ]  
 a) The reflecting surface of mirror is convex    b) It is a cut part of hollow spherical glass bulb  
 c) It is also called diverging mirror    d) It always form real images.
18. Mark the True statements from the following : [ ]  
 a) We can obtain an enlarged and erect image by a concave mirror  
 b) A concave mirror always forms a virtual image.  
 c) A real image cannot be obtained on a screen.  
 d) All the above

### KEY

#### Multiple choice questions :

- |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1) c  | 2) a  | 3) b  | 4) a  | 5) a  | 6) b  | 7) b  | 8) d  | 9) a  |
| 10) b | 11) d | 12) b | 13) a | 14) a | 15) a | 16) d | 17) c | 18) a |
| 19) b | 20) a |       |       |       |       |       |       |       |

#### Olympiad corner :

- |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1) a  | 2) b  | 3) a  | 4) a  | 5) d  | 6) d  | 7) b  | 8) a  | 9) b  |
| 10) a | 11) d | 12) a | 13) b | 14) d | 15) c | 16) b | 17) d | 18) a |

➤ Important Physical Quantities and their formulae, units :

S.No.	Physical quantity	Formula	Dimensional formula	SI unit
1.	Volume	length × breadth × height	[M <sup>0</sup> L <sup>3</sup> T <sup>0</sup> ]	m <sup>3</sup>
2.	Density	mass / volume	[ML <sup>-3</sup> T <sup>0</sup> ]	kg m <sup>-3</sup>
3.	Linear density	mass / length	[ML <sup>-1</sup> T <sup>0</sup> ]	kg m <sup>-1</sup>
4.	Relative density	$\frac{\text{density of substance}}{\text{density of water}}$	[M <sup>0</sup> L <sup>0</sup> T <sup>0</sup> ]	no units
5.	Pressure, stress	force / area	[ML <sup>-1</sup> T <sup>-2</sup> ]	N m <sup>-2</sup>
6.	Velocity	displacement / time	[M <sup>0</sup> LT <sup>-1</sup> ]	m s <sup>-1</sup>
7.	Speed	distance / time	[M <sup>0</sup> LT <sup>-1</sup> ]	m s <sup>-1</sup>
8.	Acceleration	force / mass	[M <sup>0</sup> LT <sup>-2</sup> ]	m s <sup>-2</sup>
9.	Force	mass × acceleration	[M <sup>1</sup> LT <sup>-2</sup> ]	kg m s <sup>-2</sup>
10.	Momentum (linear)	mas × velocity	[ML <sup>1</sup> T <sup>-1</sup> ]	kg m s <sup>-1</sup>
11.	Impulse	force × time	[ML <sup>1</sup> T <sup>-1</sup> ]	kg m s <sup>-1</sup>
12.	Moment of force or torque	force × displacement	[ML <sup>2</sup> T <sup>-2</sup> ]	N m
13.	Work	force × displacement	[ML <sup>2</sup> T <sup>-2</sup> ]	joule
14.	All energies		[ML <sup>2</sup> T <sup>-2</sup> ]	joule
15.	Power	force × velocity	[ML <sup>2</sup> T <sup>-3</sup> ]	watt
16.	Specific heat	$\frac{Q}{m\Delta\theta}$	[L <sup>2</sup> T <sup>-2</sup> K <sup>-1</sup> ]	J kg <sup>-1</sup> K <sup>-1</sup>
17.	Molar specific heat	C <sub>P</sub> – C <sub>V</sub> = R	[ML <sup>2</sup> T <sup>-2</sup> K <sup>-1</sup> ]	mol <sup>-1</sup> Jmol <sup>-1</sup> K <sup>-1</sup>
18.	Electric current	i = Q / t	[M <sup>0</sup> L <sup>0</sup> T <sup>0</sup> I <sup>1</sup> ]	ampere
19.	Electric charge	Q = it	[M <sup>0</sup> L <sup>0</sup> T <sup>1</sup> I <sup>1</sup> ]	coulomb
20.	Intensity of electric field	E = F/Q	[MLT <sup>-3</sup> I <sup>-1</sup> ]	N C <sup>-1</sup>
21.	Electric Potential	$\frac{W}{Q}$	[ML <sup>2</sup> T <sup>-3</sup> I <sup>-1</sup> ]	volt
22.	Electromotive force(emf)	$\frac{W}{Q}$	[ML <sup>2</sup> T <sup>-3</sup> I <sup>-1</sup> ]	volt

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23.	Electric resistance	$R = \frac{V}{I} = \frac{\text{Power}}{I^2}$	$[\text{ML}^2\text{T}^{-3}\text{I}^{-2}]$	ohm
24.	Resistivity	$\rho = \frac{RA}{L}$	$[\text{ML}^2\text{T}^{-3}\text{I}^{-2}]$	ohm meter
25.	Conductivity	$\sigma = \frac{1}{\rho}$	$[\text{M}^{-1}\text{L}^{-3}\text{T}^3\text{I}^2]$	$\text{Sm}^{-1}$

➤ In SI, multiples and submultiples are as follows :

S.No.	Multiplication factor	Prefix	Symbol
1.	* $10$	deca	da
2.	* $10^2$	hecto	h
3.	$10^3$	kilo	k
4.	$10^6$	mega	M
5.	$10^9$	giga	G
6.	$10^{12}$	tera	T
7.	$10^{15}$	peta	P
8.	$10^{18}$	exa	E
9.	* $10^{-1}$	deci	d
10.	* $10^{-2}$	centi	c
11.	$10^{-3}$	milli	m
12.	$10^{-6}$	micro	$\mu$
13.	$10^{-9}$	nano	n
14.	$10^{-12}$	pico	p
15.	$10^{-15}$	femto	f
16.	$10^{-18}$	atto	a

Note : The multiplication factors with '\*' are not SI prefixes but are commonly in use.

➤ Some practical units of length in various branches of physics : (These are not SI units)

- Micron ( $\mu m$ ) =  $10^{-6} m$  =  $10^{-4} cm$
- Angstrom ( $A^0$ ) =  $10^{-10} m$  =  $10^{-8} cm$
- Fermi =  $10^{-15} m$  =  $10^{-13} cm$
- Light year =  $9.5 \times 10^{15} m$  =  $9.5 \times 10^{12} km$

(Light year is the distance travelled by light in vacuum in one year)

➤ Some practical units of mass in various branches of physics (These are not SI units) :

**Commercial**

**Units**

- 1 metric ton = 1000 kg
- 1 quintal = 100 kg
- 1 pound = 0.453 kg
- Atomic mass unit (1 amu) =  $1.67 \times 10^{-27}$  kg
- Astronomical Unit of mass (Solar mass) =  $2 \times 10^{30}$  kg

➤ Some practical units of time in various branches of physics (These are not SI units) :

- 1 Shake =  $10^{-8}$  s
- 1 Minute = 60 s
- 1 Hour = 60 minute = 3600 s
- 1 mean solar day =  $1 \times 24$  hour  
=  $1 \times 24 \times 60$  minute  
=  $1 \times 24 \times 60 \times 60$  s  
= 86400 s
- Month = 30 days (April, June, September and November)  
= 31 days (January, March, May, July, August, October and December)  
= 28 days (February in other than leap year)  
= 29 days (February in a leap year)
- Lunar Month = 4 weeks = 27.3 days (approximately)
- Year = 365.25 days  
= 366 days (leap year)
- Decade = 10 years
- Century = 100 years
- Millennium = 1000 years

