ICSE 2025 EXAMINATION

Sample Question Paper - 15

Physics

Time: 2 Hours. **Total Marks: 80**

General Instructions:

1. *Attempt **all** questions from **Section A** and **any three** questions from **Section B**.*
2. *The intended marks of questions or parts of questions are given in brackets [ ].*

SECTION A

*(Attempt **all** questions)*

Question 1

Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answer only.)

i) Most of the energy we use originally comes from
   (a) oceans
   (b) air
   (c) soil
   (d) sun

ii) There is some water in the beaker placed on the pan of a spring balance. If we dip our finger in the water without touching the bottom of the beaker, what is the change in the spring balance reading?
   (a) Reading remains unaffected.
   (b) Reading increases
   (c) Reading decreases
   (d) Reading increases twice

iii) What is the velocity ratio of a single fixed pulley?
   (a) 1
   (b) 0
   (c) 2
   (d) 3

iv) A prism is said to be in minimum deviation when _____.
   (a) Angle of incidence = Angle of emergence
   (b) Angle of incidence > Angle of emergence
   (c) Angle of incidence < Angle of emergence
   (d) Angle of incidence = 0^o

v) **Assertion (A):** A concave lens is used in cinema and slide projectors.
Reason (R): In slide projectors, the magnified image is obtained from a screen which is placed at a large distance on the other side of the lens.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is not the correct explanation of A
(c) Assertion is false but reason is true.
(d) Assertion is true reason is false.

vi) What causes the twinkling of stars at night?
(a) The fact that the stars do not emit light
(b) Frequent absorption of star light by their own atmosphere.
(c) Frequent absorption of star light by the earth's atmosphere.
(d) The refractive index fluctuations in the earth's atmosphere.

vii) A 1kW hair dryer is used for half an hour. How much energy is used?
(a) 1 unit
(b) 0.5 unit
(c) 1.5 unit
(d) 0.05 unit

viii) Arrange the following in the order of their increasing wavelength: X-rays, infrared rays, radio waves, gamma rays and microwaves.
(a) Gamma rays, X-rays, infrared rays, radio waves, microwaves
(b) Gamma rays, X-rays, infrared rays, microwaves, radio waves
(c) Gamma rays, infrared rays, X-rays, microwaves, radio waves
(d) Gamma rays, infrared rays, X-rays, radio waves, microwaves

ix) What is the velocity ratio of a single fixed pulley?
(a) 1
(b) 2
(c) 3
(d) 4

x) Quality of sound is determined by ____.
(a) Frequency and amplitude
(b) Amplitude and loudness
(c) Frequency and pitch
(d) Amplitude and pitch

xi) The direction of force experienced by a current carrying conductor placed in a magnetic field can be found by _____.

(a) Fleming's right-hand rule
(b) Right-hand thumb rule
(c) Oersted's experiment
(d) Fleming's left-hand rule

xii) Which of the following is most harmful for the human being:

(a) Alpha particles
(b) Beta particles
(c) Gamma rays
(d) Light rays

xiii) A man throws a ball weighing 200 g vertically upwards with a speed of 10m/s. What will be Its momentum at its highest point of flight?

(a) 2000 kg.m/s
(b) 2 kg. m/s
(c) Zero
(d) Insufficient data to find the momentum.

xiv) Deviation of light as it passes through the atmosphere due to variation in air density is called _____.

(a) atmospheric dispersion
(b) atmospheric scattering
(c) atmospheric refraction
(d) atmospheric reflection

xv) SI unit of power of lens is _____.

(a) Metre
(b) Kilometre
(c) Dioptre
(d) Micrometre

Question 2

i) Complete the following by choosing the correct answer from the bracket:

(a) Sound wave is a _____ *[longitudinal /electromagnetic/transverse]* wave.
(b) The change in focal length of an eye lens is caused by the action of the _____ *[pupil/retina/ciliary muscles].*
(c) The lens which forms an inverted image of an object is _____ *[Concave/Convex/Can be both convex and concave].*
(d) The moment of a force about a given axis depends _____ *[only on the magnitude of force/ both on the force and its perpendicular distance from the axis/only on the perpendicular distance of force from the axis].*

(e) The _____ *[neutral/earth/live]* and _____ *[neutral/earth/live]* wires are at the same potential.

ii) Which material prism is used for obtaining the spectrum of ultraviolet radiation and why? [2]

iii) You have three resistors of values 2Ω, 3Ω and 5Ω. How will you join them so that the total resistance is more than 7Ω? [2]

1) Draw a diagram for the arrangement.
2) Calculate the equivalent resistance.

Question 3

i) [3]

(a) Explain why the speed of a falling body increases continuously.

(b) Two bodies of equal mass are dropped from a cliff. At any instant, which physical quantity (momentum, acceleration, kinetic energy, and potential energy) will be the same?

(c) Would the speed of sound on a warm day be different from the speed of sound on a cold day? If yes, what would be the difference?

ii) Calculate the length of the arm of a couple if a force of 13 N produces a moment of a couple of 14.3 N m. [2]

iii) What is the use of a control grid in an electron gun? [2]

iv) Name two rules used to determine the direction of induced current in a closed circuit of the coil. [2]

v) The resistance of two lamps is in the ratio 4: 5. What will be the ratio of their wattage? [2]

vi) A waiter uses a sound pipe to communicate with the chef in the kitchen. Name the principle on which the sound pipe works. Explain with the help of a suitable diagram. [2]

vii) A ray of light travels from one medium to another, it bends. State the condition when the angle of deviation of the ray is (1) Positive (2) Negative. [2]

SECTION B

*(Attempt **any four** questions from this Section)*

Question 4

i) [3]

(a) Where must a point source of light be placed in front of a convex lens so as to obtain a parallel beam of light?

(b) An object is placed in front of a converging lens at a distance greater than twice the focal length. Draw a ray diagram to show the formation of the image and state the nature of the image.

ii) [3]

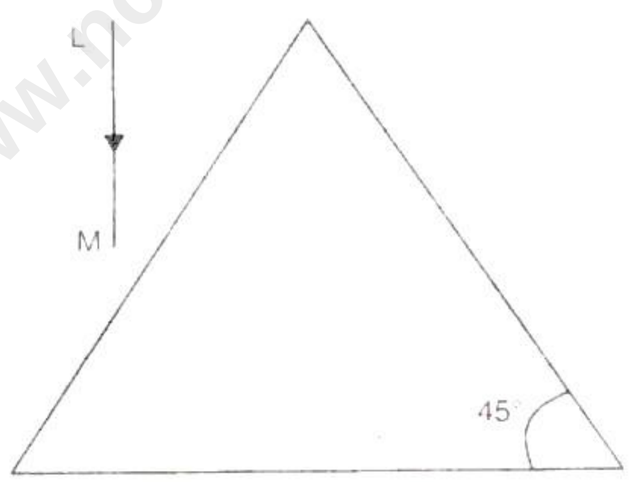
(a) Give two such properties of infrared radiation which differ front the visible light.

(b) Name the seven prominent colours of the white light spectrum in order of their increasing frequencies.

(c) Define the term dispersion of light. Explain the cause of dispersion of white light through a prism.

iii) [4]

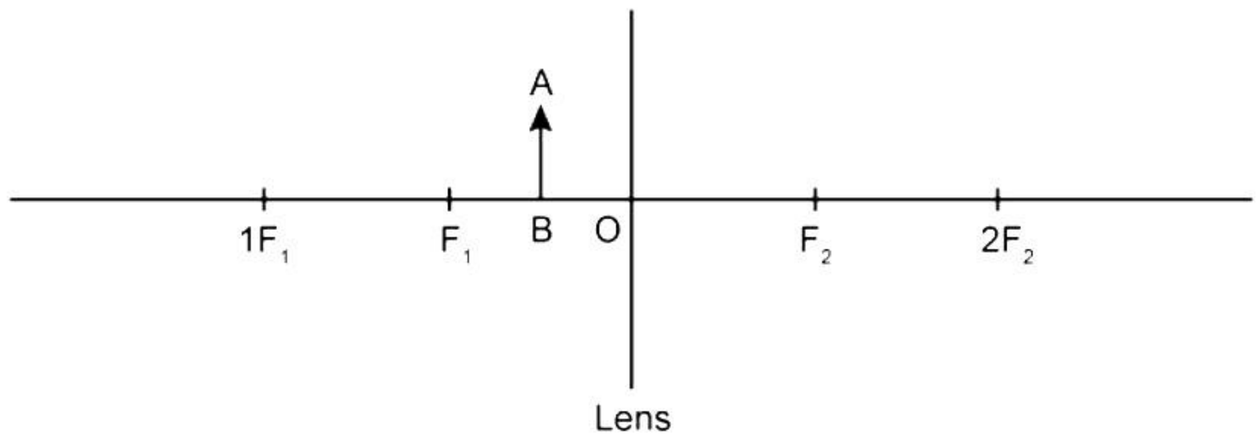
(a) For the incident ray LM shown, complete the diagram to show the path of the ray into and out of the prism. The critical angle of glass is 42°.



(b) For the same angle of incidence, the angles of refraction in three different medium I, II and III are 15°, 25° and 35°, respectively. In which medium will the speed of light be minimum?

Question 5

i) An object AB is placed between O and F_1 on the principal axis of a converging lens as shown in the diagram. [3]



(a) Copy the diagram and by using three standard rays starting from point A, obtain an image of the object AB.

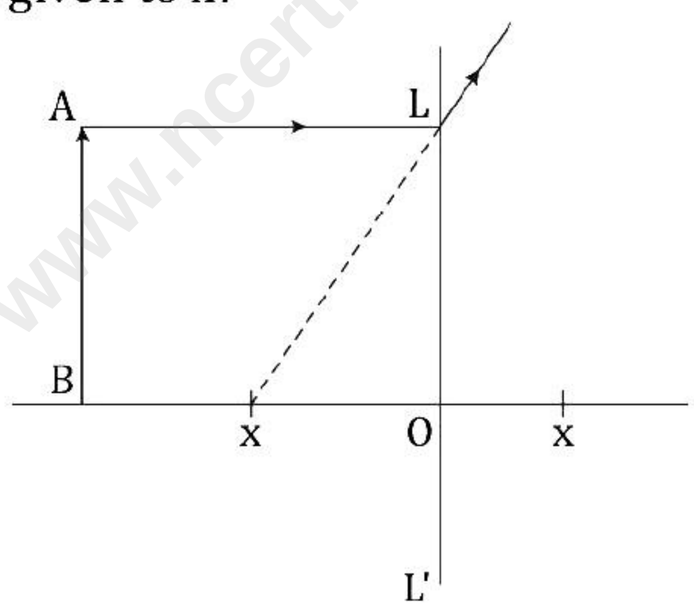
(b) Describe the nature of the image formed for the given case.

(c) Which type of lens is used for the given case?

ii) [3]

(a) A lens of power +2.5 D is kept in contact with another lens of power -2.5 D. Draw a path of ray passing through the lens combination.

(b) Copy and complete the diagram to show the formation of the image of the object AB. What is the name given to x?



iii) An object is placed at a distance of 12 cm from a convex lens of focal length 8 cm. Find: [4]

(a) the position of the image

(b) nature of the image

(c) Find the magnification power of the lens.

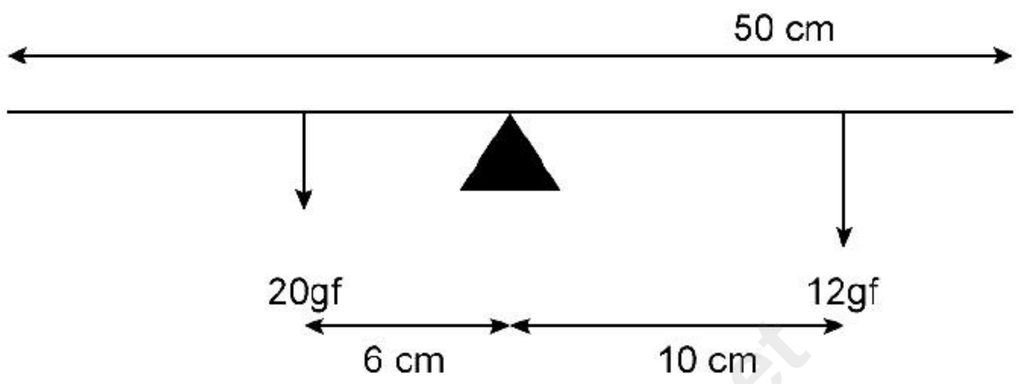
Question 6

i) [3]

(a) State the work–energy theorem.

(b) A water pump can raise 20 kg of water through a height of 10 m in 10 s. What is the total work done by the pump? Define power and explain it whit the help of the given example? (Take g = 10 ms^{-2})

ii) A half metre rod is pivoted at the centre with two weights of 20gf and 12gf suspended at a perpendicular distance of 6 cm and 10 cm from the pivot respectively as shown below. [3]

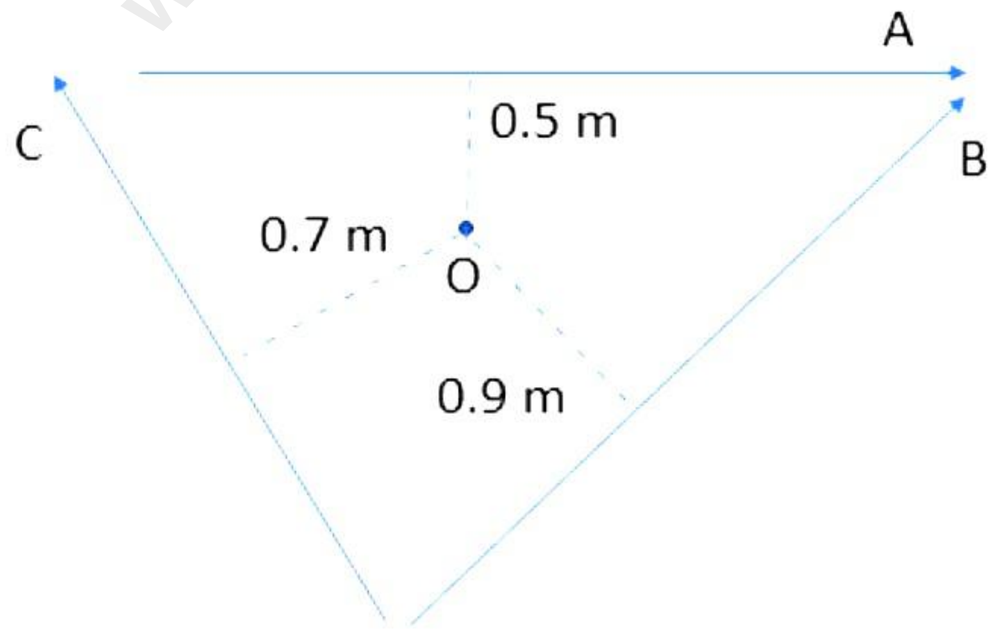


(a) Which of the two forces acting on the rigid rod causes clockwise moment?

(b) Is the rod in equilibrium?

(c) The direction of 20 kgf force is reversed. What is the magnitude of the resultant moment of the forces on the rod?

iii) Three forces each of magnitude 10 N are acting in the same plane with point O lying somewhere between them as shown in the figure below. [4]



Answer the following questions based on the given information.

(a) Which of the following forces will have highest moment about point O? Justify your answer.

(b) Which of the following forces will have the least moment about point O? Justify your answer.

(c) Which of the following forces produced will be in clockwise direction?

(d) Calculate the resultant torque at point O.

Question 7

i) [3]

(a) How will you locate a current-carrying wire concealed in a wall? Justify your answer.

(b) Why do we use steel or alnico for making permanent magnets? In which devices are permanent magnets used?

(c) What important property of the field is indicated by the field line pattern of a long straight solenoid? Name any two factors on which the magnitude of the magnetic field due to the solenoid depends.

ii) [3]

(a) Give two characteristic properties of copper wire which make it unsuitable for use as fuse wire. Name the material which is used as a fuse wire?

(b) Of the three connecting wires in a household circuit,

1. Which two wires are at the same potential.
2. In which of the three wires should the switch be connected?

iii) [4]

(a) What is an electric fuse? Given two characteristics of a fuse.

(b) An electric heater is rated 1kW, 220V. Calculate the resistance of the heating filament?

(c) An electric bulb is marked 100 W, 230 V. If the supply voltage drops to 115 V, what is the heat and light energy produced by the bulb in 20 minutes?

Question 8

i) [3]

(a) It is observed that the temperature of the surrounding starts falling when the ice in a frozen lake starts melting. Give a reason for the observation.

(b) How is the heat capacity of the body related to its specific heat capacity?

(c) Draw a well labelled diagram showing the changes taking place while heating of naphthalene.

ii) An electric bulb is marked 100 W, 230 V. [3]

(a) Find the resistance of bulb.

(b) If the supply voltage drops to 115 V, what is the heat and light energy produced by the bulb in 20 minutes?

iii) [4]

(a) What energy change would you expect to take place in the molecules of a substance when it undergoes:

1. a change in its temperature?
2. a change in its state without anu change in its temperature?

(b) 40 g of water at 60°C is poured into a vessel containing 50 g of water at 20°C. The final temperature of the mixture is 30°C. Taking the specific heat capacity of water as 4.2 J g^{-1} K^{-1}, calculate the thermal capacity of the vessel.

Question 9

i) [3]

(a) An observer standing between two parallel cliffs emits an intense sound note. Two successive echoes are then heard after 5 s and 7 s. Calculate the distance between the cliffs (velocity of sound = 340 m s^{-1}).

(b) Give anyone dissimilarities and similarities between sound waves and light waves.

ii) Mention α, β and γ in [3]

(a) Increasing order of their penetrating power

(b) Decreasing order of their ionising power

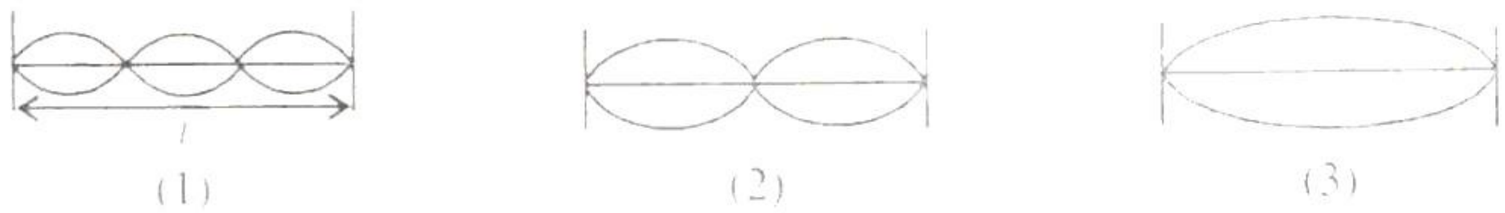
(c) Complete the following nuclear reaction:

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{*}_{57}La + {}^{85}_{*}Br + 3\,{}^{1}_{0}n + 186\ Mev$$

iii) [4]

(a) What adjustment will you make for tuning a stringed instrument such as a violin to emit a desired pitch?

(b) The figure below shows the modes of vibrations of a string:



1. Which of these represents vibration of the largest amplitude and fundamental note?
2. What is the ratio of frequency between (3), (2) and (1)?

Solution

SECTION A

Solution 1

Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answer only.)

i) Correct answer – d: Sun
The energy in biomass, wind, solar energy and fossil fuels originally come from the Sun.

ii) Correct answer – b: Reading increases
When we dip our finger in the water, the water exerts an upward thrust on the finger (Archimedes' principle). Because of Newton's third law of motion, the finger will exert an equal and opposite force on the water in the downward direction resulting in an increase of the weight of water. Thus, the reading of the spring balance will increase.

iii) Correct answer – a: 1
The velocity ratio of a single fixed pulley is 1.

iv) Correct answer – a: Angle of incidence = Angle of emergence
When the angle of incidence is equal to the angle of emergence, the prism is said to be in minimum deviation.

v) Correct answer – c: Assertion is false but reason is true.
A convex lens is used in cinema and slide projectors so that the inverted and magnified image is formed on the screen which is placed at a large distance on the other side of the lens. The slide in an inverted position beyond the focus for erecting the inverted image.

vi) Correct answer – d: The refractive index fluctuations in the earth's atmosphere.
The refractive index fluctuations in the earth's atmosphere cause the twinkling of stars at night.

vii) Correct answer – b: 0.5 unit
1 unit = 1 kWh Energy = power x time = 1kW x 0.5 h = 0.5 units

viii) Correct answer – b: Gamma rays, X-rays, infrared rays, microwaves, radio waves
Arranging in order of increasing wavelength: Gamma rays, X-rays, infrared rays, microwaves, radio waves

ix) Correct answer – a: 1
The velocity ratio of a single fixed pulley is 1.

x) Correct answer – a: Frequency and amplitude
The quality of sound is determined by frequency and amplitude.

xi) Correct answer – d: Fleming's left-hand rule
Fleming's left-hand rule gives the direction of motion, that is, force on the current carrying conductor placed in a magnetic field.

xii) Correct answer – c: Gamma ray.
Gamma rays are most harmful for human beings.

xiii) Correct answer – c: Zero
Momentum = Mass × Velocity At the highest point, velocity is zero. Hence, the momentum is also zero.

xiv) Correct answer – c: atmospheric refraction
Deviation of light as it passes through the atmosphere due to variation in air density is called atmospheric refraction.

xv) Correct answer – c: Dioptre.
Dioptre is the SI unit for measuring power of a lens.

Solution 2

i)

(a) Sound wave is a ***longitudinal*** wave.

(b) The change in focal length of an eye lens is caused by the action of the ***ciliary muscles.***

(c) The lens which forms an inverted image of an object is ***convex***.

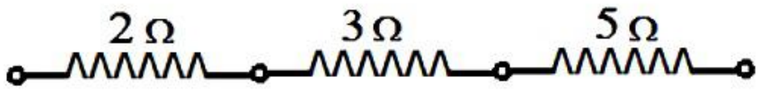
(d) The moment of a force about a given axis depends ***both on the force and its perpendicular distance from the axis.***

(e) The ***neutral*** and ***earth*** wires are at the same potential.

ii) Quartz prism is used for obtaining the spectrum of ultraviolet radiation because ordinary glass absorbs the ultraviolet radiation.

iii)

1)



2) We must connect them in a series to get equivalent resistance:
$2\ \Omega + 3\ \Omega + 5\ \Omega = 10\ \Omega$

Solution 3

i)

(a) This is because the earth attracts the body and there is acceleration due to gravity acting on it.

(b) When bodies of equal mass are dropped from a cliff. At any instant, acceleration will be the same.

(c) Speed of sound depends on the temperature, pressure and characteristics of the medium through which it is travelling. Therefore, the speed of sound would be greater on a warm day as compared to speed of sound on a cold day because with increase in temperature speed of sound increases.

ii)

Given:

Force F = 13 N,

Moment of couple = 14.3 N m

Length of arm of a couple =?

$$\text{Length of arm of couple} = \frac{14.3 \text{ m}}{13 \text{ N}} = 1.1 \text{ m}$$

iii) Control grid is given a negative potential relative to the cathode in order to repel electrons and thus, to control the number of electrons passing through it.

iv) The two rules used to determine the direction of induced current in a closed circuit of the coil are as follows:

1. Lenz's law
2. Fleming's right hand rule

v)

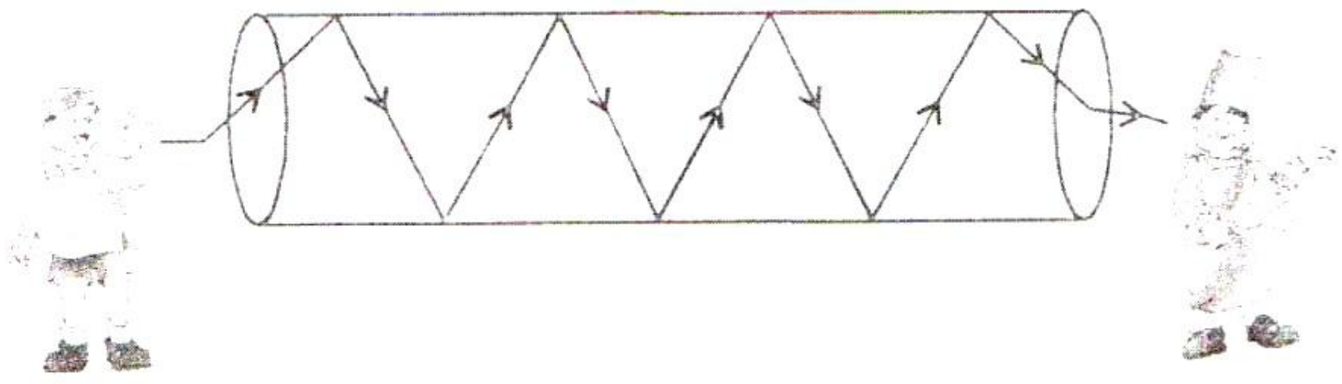
Now,

$$P = \frac{v^2}{R}$$

For constant voltage $P \alpha \frac{1}{R}$

$\therefore P_1 : P_2 = 5 : 4$

vi) Sound pipe works on the principle of total internal reflection of sound.



vii)

1. For Positive Deviation: The ray of light travels from rarer to denser medium
2. For Negative Deviation: The ray of light travels from denser to rarer medium.

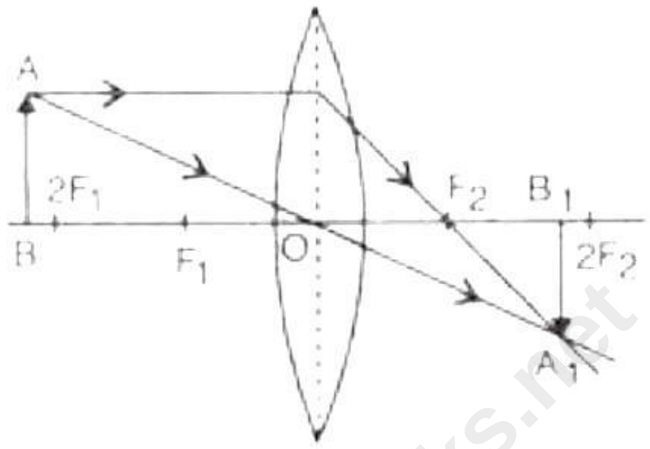
SECTION B

Solution 4

i)

(a) If the point source of light is placed at the 'first focal point' (i.e., the focal point on the left of the optical center of the convex lens), then the rays of light after being refracted through the length obtain a parallel beam of light.

(b) A real, inverted, and diminished image is formed between F_2 and 2 F_2.



ii)

(a) They do not affect ordinary photographic films.

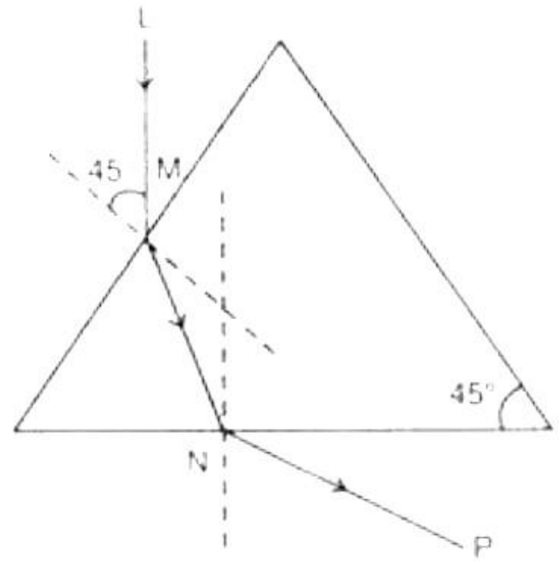
(b) The seven colours in the order of increasing frequencies are red, orange, yellow, green, blue, indigo, and violet.

(c) The phenomenon of splitting white light by a prism into its constituent colours is known as dispersion of light.

When white light is incident on the first surface of a prism and enters in glass, light of different colours due to different speeds in glass, is refracted or deviated through different angles. Thus, the dispersion of white light into its constituent colours takes place at the first surface of prism. Thus the cause of dispersion is the change in speed of light with wavelength or frequency.

iii)

(a)



The angle of incidence at N inside the prism is less than 42°; therefore, the ray is able to emerge along NP.

(b) The absolute refractive index of a medium is given by

$$n = \frac{\sin i}{\sin r} = \frac{c}{v}$$

where c – speed of light in vaccum, v- speed of light in medium. Thus for some angle of incidence

$$v = \frac{c \sin r}{\sin i}$$

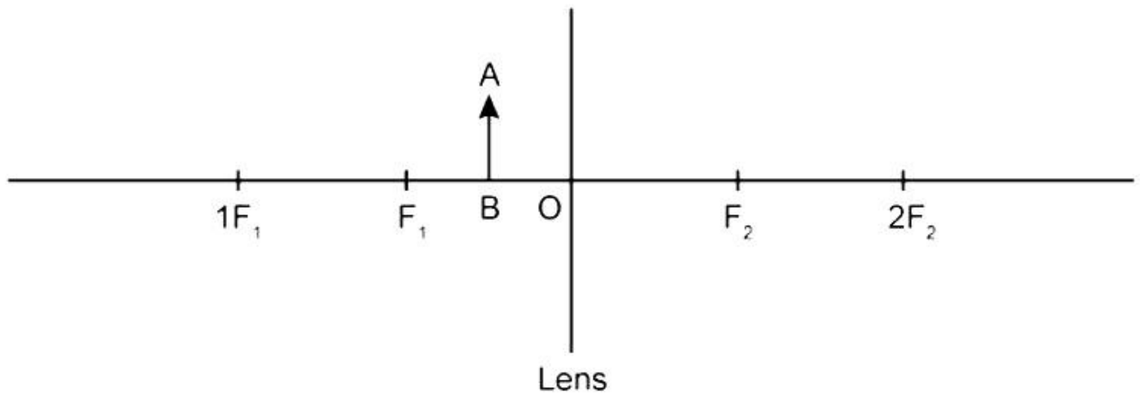
or $v \alpha \sin r$

i.e. v will be minimum for the medium in which r or angle of refraction r is minimum. Thus, the speed of light is minimum in medium (I).

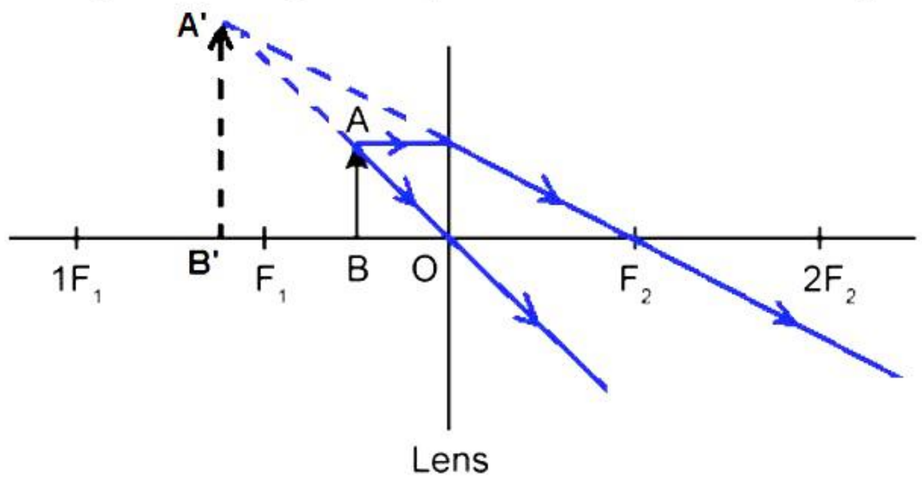
Solution 5

i)

(a) An object AB is placed between O and F_1 on the principal axis of a converging lens as shown in the diagram.



Using three standard rays starting from point A, obtain an image of the object AB.

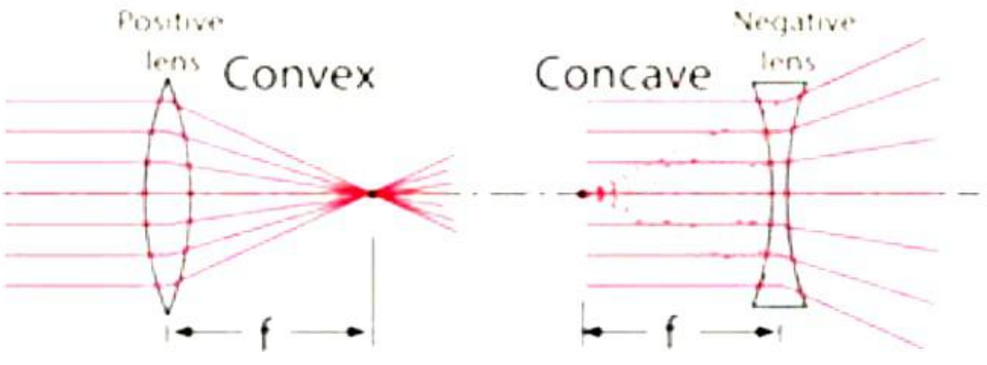


(b) From the above figure we can conclude that, the image formed will be virtual, erect and enlarged.

(c) As mentioned, the lens used for the given case is converging or convex lens.

ii)

(a) The path of ray passing through each convex and concave lens are as shown below:



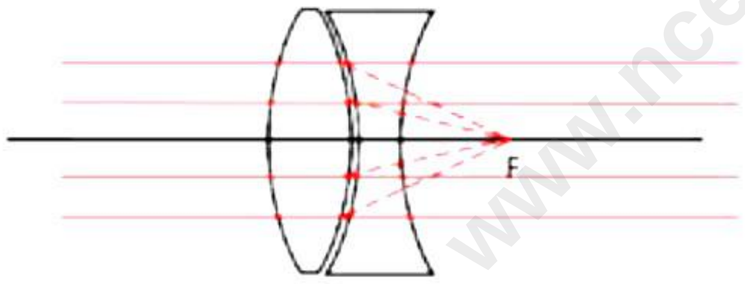
Now, for the given case we have a convex lens of power +2.5 D and a concave lens of power -2.5 D.

When both of them are kept in contact the combined power of lens will be

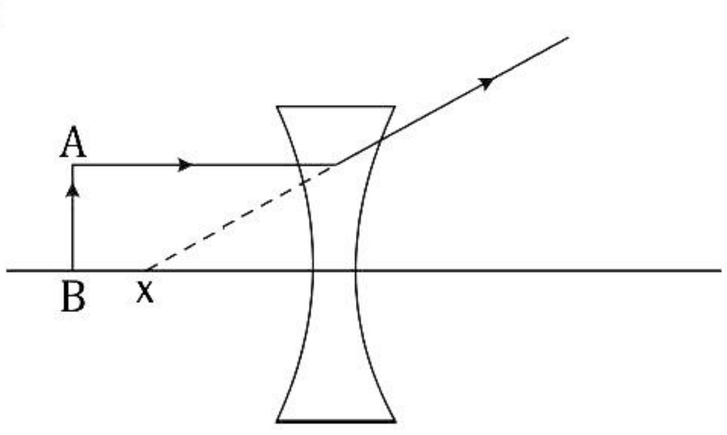
P = + 2.5 + (-2.5) = 0 D

It means when two lenses of equal and opposite powers are kept in contact, the combination behaves like a plane glass sheet.

Thus, the ray of light passing through the lens combination will continue to travel in a straight line without any deviation.



(b)



The name of the point x is focus.

iii) Given that,

Object distance, u = -12 cm

Focal length, f = +8 cm

(a) Now,

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

i.e., $\frac{1}{v}=\frac{1}{8}-\frac{1}{12}$

$\therefore v = +24$ cm

The image will be formed at 24 cm on the other side of the lens.

(b) The image is inverted, real and magnified.

(c) Now,

Magnification, m = -v/u =

m = 24/ (−12) = −2.

Solution 6

i)

(a) According to the work-energy theorem, the work done by a force on a moving body is equal to the increase in its kinetic energy.

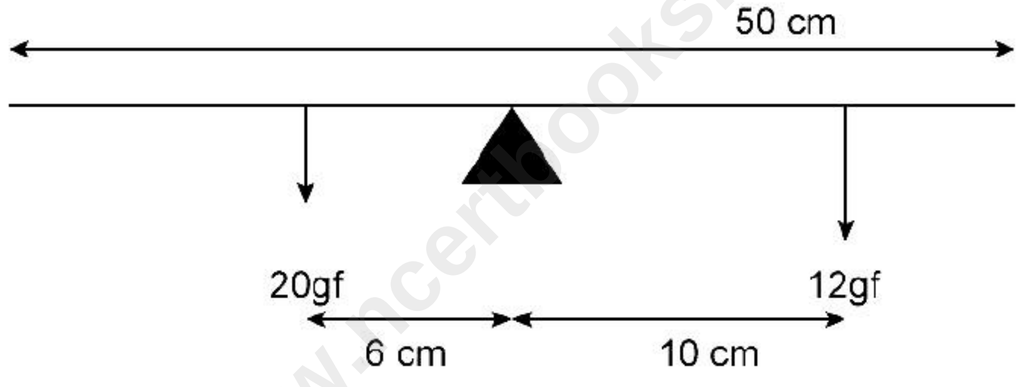
(b) Weight of water lifted = 20 × 10 N = 200 N

Work done = 200 N × 10 m = 2000 J

Power is the rate at which work is done or energy is converted. It is usually measured in watts.

$$\text{Power} = \frac{\text{Work done}}{\text{Time Taken}} = \frac{2000 \text{ joule}}{10 \text{ s}} = 200 \text{ Js}^{-1} = 200 \text{ watt}$$

ii)



(a) 12 gf acting on the rigid rod causes clockwise moment.

(b) Yes, the rod is in equilibrium because both clockwise and anti-clockwise moments are the same.

(c) If 20 gf is reversed, both forces give clockwise moment.

Total clockwise moment is 2 × 120 × 9.8 × 10^{-3} N-m = 2.352 N-m

iii)

(a) The moment of a force is given by the product of the magnitude of the force and the perpendicular distance from the line of action of the force to the point about which the moment is taken.

For the given case all three forces have the same magnitude, thus the force with the highest moment will be the one with the greatest perpendicular distance from point O.

Hence force B will have the greatest moment about O.

(b) The force with the least moment about point O would force A, as it has the shortest perpendicular distance from point O.

(c) A and C will the forces producing clockwise moments.

(d) To calculate the resultant torque at point O, we would need to know more information about the directions of each force and their lines of action relative to point O.

Solution 7

i)

(a) By using the magnetic effect of current, i.e., when a magnetic needle is placed on the wall, it will show deflection due to the concealed current-carrying wire.

(b) Steel or alnico is used for making permanent magnets because of their large value of coactivity.

(c) Important Property: The magnetic field (of a long straight solenoid) is nearly uniform inside it. The magnitude of the field depends on the strength of current and the number of loops of the solenoid.

ii)

(a) Copper cannot be used as fuse wire because:

- It has a high melting point.
- low resistivity

Also, alloys of lead and tin are used in making fuse wire because of its low melting point and low specific resistance.

(b)

1. The neutral wire and the earth wire are at the some potential.
2. The switch wire should always connected in live wire circuit.

iii)

(a) The electric fuse is a device used to limit the current in an electric circuit. It has following characteristics:

- Fuse has high resistance and low melting point
- Fuse is made up of the aolly of lead and tin.
- Fuse is always connected to the live wire of the circuit.

(b)

$$P = \frac{V^2}{R}$$

$$1000 = \frac{220 \times 220}{R}$$

$$R = \frac{220 \times 220}{1000} = 48.4\Omega$$

(c) Here P = 100 W, V = 230 volt, t = 20 × 60 s

$$\therefore \text{Resistance of bulb, } R = \frac{V^2}{P} = \frac{(230\ V)^2}{100\ w}$$

$$= 529\ \Omega$$

Supply voltage V' = 115 V

$\therefore$ Energy dissiplated by the bulb (as light and heat)

$$= \frac{V^2}{R} t = \frac{(115\ V)^2 \times (20 \times 60)\ s}{529\Omega}$$

$$= 30,000\ J$$

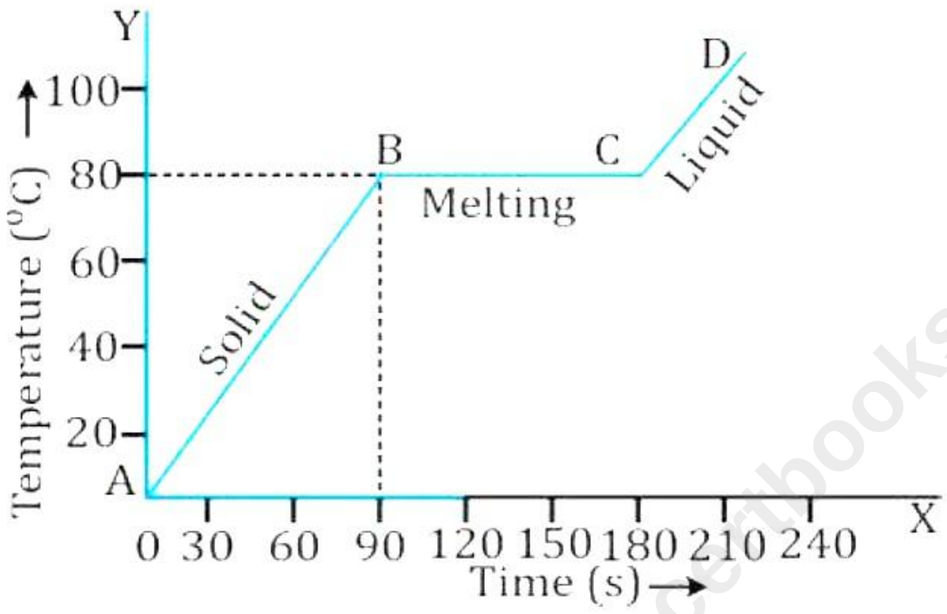
Solution 8

i)

(a) When ice in a frozen lake starts melting, the heat energy required for melting the frozen lake is absorbed from the surrounding atmosphere. As a result, the temperature of the surrounding starts falling.

(b) Heat capacity = mass × specific heat capacity.

(c)



ii) Given:

P = 100 W

V = 230 volt

T= 20 × 60 s

(a) Now,

$\therefore$ Resistance of bulb, $R = \frac{V^2}{P} = \frac{(230\ V)^2}{100\ W}$

(b) Supply voltage V'= 115

Therefore displaced by the bulb

$$= \frac{V'^2}{R} t = \frac{(115\ V)^2 \times (20 \times 60)s}{529\ \Omega}$$

= 30,000 J

iii)

(a)

1) The energy of the molecules of a body increases with the rise in temperature and decreases with the fall of temperature.
2) Since the temperature remains constant, there is no change in the kinetic energy of the molecules. The energy given to substance to change the state of the substance increases potential energy of the molecules.

(b) Let the thermal capacity of the vessel be C′ J K^{-1}

Heat energy given by hot water = $40 \times 4.2 \times (60 - 30) = 5040$ J

Heat energy taken by cold water = $50 \times 4.2 \times (30 - 20) = 2100$ J

Heat energy taken by vessel = $C' \times (30 - 20) = 10\ C'$ J

If there is no loss of heat energy,

Heat energy given by hot water = Heat energy taken by cold water and vessel

Or $5040 = 2100 + 10\ C'$

Or $10\ C' = 2940$

Or $C' = 294$ J K^{-1}

Thus, the thermal capacity of the vessel = 294 J K^{-1}.

Solution 9

i)

(a) Let x_1 and x_2 be the distances of the two cliffs from the observer.

Then, $2x_1 = 340$ m $s^{-1} \times 5$ s

$\Rightarrow 2x_1 = 1700$ m

$\Rightarrow x_1 = 850$ m

$2x_2 = 340$ m $s^{-1} \times 7$ s $= 2380$

$\Rightarrow x_2 = 1190$ m

Distance between the two cliffs = $x_1 + x_2$

$= 850 + 1190$

$= 2040$ m

(b) **Dissimilarities:**

Sound waves	Light waves
i. These are longitudinal waves (also known as mechanical waves) which need a medium to travel.	i. These are transverse waves (also known as electromagnetic waves) which do not need a medium to travel.
ii. Their speed in air is 332 ms^{-1}.	ii. Their speed is 3×10^8 ms^{-1}.

Similarities: Both sound waves and light waves obey the laws of reflection and refraction and also exhibit the phenomenon of interference.

ii)

a. $\alpha < \beta < \gamma$

b. $\alpha > \beta > \gamma$

c. $^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{148}_{57}La + ^{85}_{35}Br + 3\,^{1}_{0}n + 186\ Mev$

iii)

(a) We know that the frequency of the string depends on the length of the string (l), mass per unit length of the string (m) and tension of the string (T).

i.e. $v = \frac{1}{2l}\sqrt{\frac{T}{m}}$

Hence, the tension and length are generally changed to bring about the desired tuning.

(b)

1. Figure (2) represents the vibrations of the largest amplitude, and Figure (3) represents the vibration of the fundamental note.

2. For figure (1), $l = 3 \times \frac{\lambda_1}{2} \Rightarrow \lambda_1 = \frac{2}{3}l$

$\therefore$ Frequency, $\nu_1 = \frac{v}{\lambda_1} = \frac{v}{2l/3} = \frac{3v}{2l}$

For figure (2), $l = 2 \times \frac{\lambda_2}{2} \Rightarrow \frac{v}{l} = \frac{2v}{2l}$

For figure (3),

$\therefore$ Frequency, $\nu_3 = \frac{v}{\lambda_3} = \frac{v}{2l}$

$v_1 : v_2 : v_3 = \frac{3v}{2l} : \frac{2v}{2l} : \frac{v}{2l} = 3:2:1$