ICSE 2025 EXAMINATION

Sample Question Paper - 13

Time: 2 Hours.   **Physics**   **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) An archer shoots an arrow. Consider the action force to be the bowstring against the arrow. What will be the reaction force?
   (a) Arrow pushing against bow string.
   (b) Weight of the arrow.
   (c) Air resistance against the bow.
   (d) Grip of the archer's hand on the bow.

ii) The electrical appliances in a house are connected in _____.
   (a) Series
   (b) Parallel
   (c) Either in series or parallel
   (d) Both in series and parallel

iii) Which non-conventional source of energy uses the energy mass equation ($E = \Delta mc^2$) to generate electricity?
   (a) Geothermal Energy
   (b) Tidal energy
   (c) Nuclear energy
   (d) Solar cells

iv) A beam of light enters from air to glass. The property of the light that does not change with a change in the medium is _____.
   (a) Wavelength
   (b) Velocity
   (c) Frequency
   (d) Amplitude

v) **Assertion (A):** The periodic vibrations in the absence of any external force are called free vibrations.
Reason (R): A body executes natural vibrations when an external force is applied.
(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) A ray of light incident on the optical center of a spherical lens, after refraction, passes through:
(a) Principal focus
(b) Radius of curvature
(c) Twice the focal length
(d) Optical center

vii) The S.I. unit of specific heat capacity is:
(a) $J\,kg^{-1}$
(b) $J\,K^{-1}$
(c) $J\,kg^{-1}K^{-1}$
(d) $kilo\text{-}Cal\,kg^{-10}C^{-1}$

viii) The resistance of a conductor is said to be 1 ohm if _____.
(a) 1 ampere of current flows through it when the potential difference across the ends is 1 volt.
(b) 1 ampere of current flows through it when the potential difference across the ends is 0.
(c) 0 ampere current flows through it when the potential difference across the ends is 1 volt.
(d) 1 ampere of current flows through it when the potential difference across the ends is 10 volts.

ix) Name the high energetic invisible electromagnetic waves which help in study of structure of crystals.
(a) microwaves
(b) Ultraviolet waves
(c) X-rays
(d) gamma rays

x) Controlled water cycle and precipitation results due to _____.
(a) High specific latent heat of vaporization of water
(b) Low specific latent heat of vaporization of water
(c) High specific capacity of water
(d) High specific latent heat of fusion of ice

xi) Gear is similar in certain attributes to a simple machine. Name that machine.
    (a) lever
    (b) pulley
    (c) inclined plane
    (d) wedge

xii) What is not true about energy?
    (a) Energy can be stored.
    (b) Energy can move from one object to another.
    (c) Energy can be transformed from one type of energy to another type of energy.
    (d) Energy can be created.

xiii) Uniform Circular Motion is an example of _____.
    (a) Uniform acceleration with constant speed
    (b) Non-uniform acceleration with constant speed
    (c) Uniform acceleration with non-uniform speed
    (d) Non-uniform acceleration with non-uniform speed

xiv) When the temperature of a substance increases, what happens to the speed of the molecules?
    (a) stays the same.
    (b) decreases
    (c) increases
    (d) not measurable

xv) A radioactive source emits three types of radiation. Can you identify the one with the lowest ionizing power?
    (a) Alpha
    (b) Beta
    (c) Gamma
    (d) All radiation will have the same ionizing power.

Question 2

i) Complete the following by choosing the correct answer from the bracket:
    (a) The rate of change in momentum is *[energy/force/impulse]*.
    (b) The statement –'To every action there is an equal and opposite reaction' is the _____ *[Newton's first law/Newton's second law/Newton's third law]*.
    (c) If the object is brought closer and closer to the convex lens. The size of the image _____ *[Increases/Decreases/Remains same]*.
    (d) Small current in a circuit is detected by _____ *[Galvanometer/Voltmeter/Fleming's left hand rule]*.

(e) The uniform linear motion is an _____ *[unaccelerated/ accelerated/circular]* motion, while an uniform circular motion is an _____ *[unaccelerated/ accelerated/circular/motion].*

ii) (Red + Blue + Yellow) light is incident on a glass block and on a prism. Show the diagrams by drawing the refracted and emergent rays. [2]

iii) Reema fires a gun in front of a building 167 m away. If the speed of sound is 334 m/s, calculate the time interval in which she hears an echo. [2]

Question 3

i) [3]
   (a) Can a machine be 100% efficient? If not, explain why.
   (b) Can the couple acting on a rigid body produce translatory motion?
   (c) How are the angle of incidence and the angle of emergence related to each other in minimum deviation?
ii) In a single movable pulley, if the weight of the load is L and the weight of the movable pulley is W, find out the expression for its mechanical advantage. [2]
iii) Obtain the relation between SI and CGS unit of work. [2]
iv) Two identical glass beakers contain 100 ml of water at the same temperature. In one beaker, m kg of steam is allowed to flow at 373 K. In the other beaker, m kg of water is added at 100°C. In which beaker will the water be observed to have a higher temperature and why? [2]
v) In glass, which coloured light travels fast and why? [2]
vi) Explain the meaning of the statement 'the specific latent heat of ice is 336000 J kg^{-1}'. [2]
vii) Complete the ray diagram in the case given below to show the formation of the image. Find the position, nature and focal length of the lens. [2]
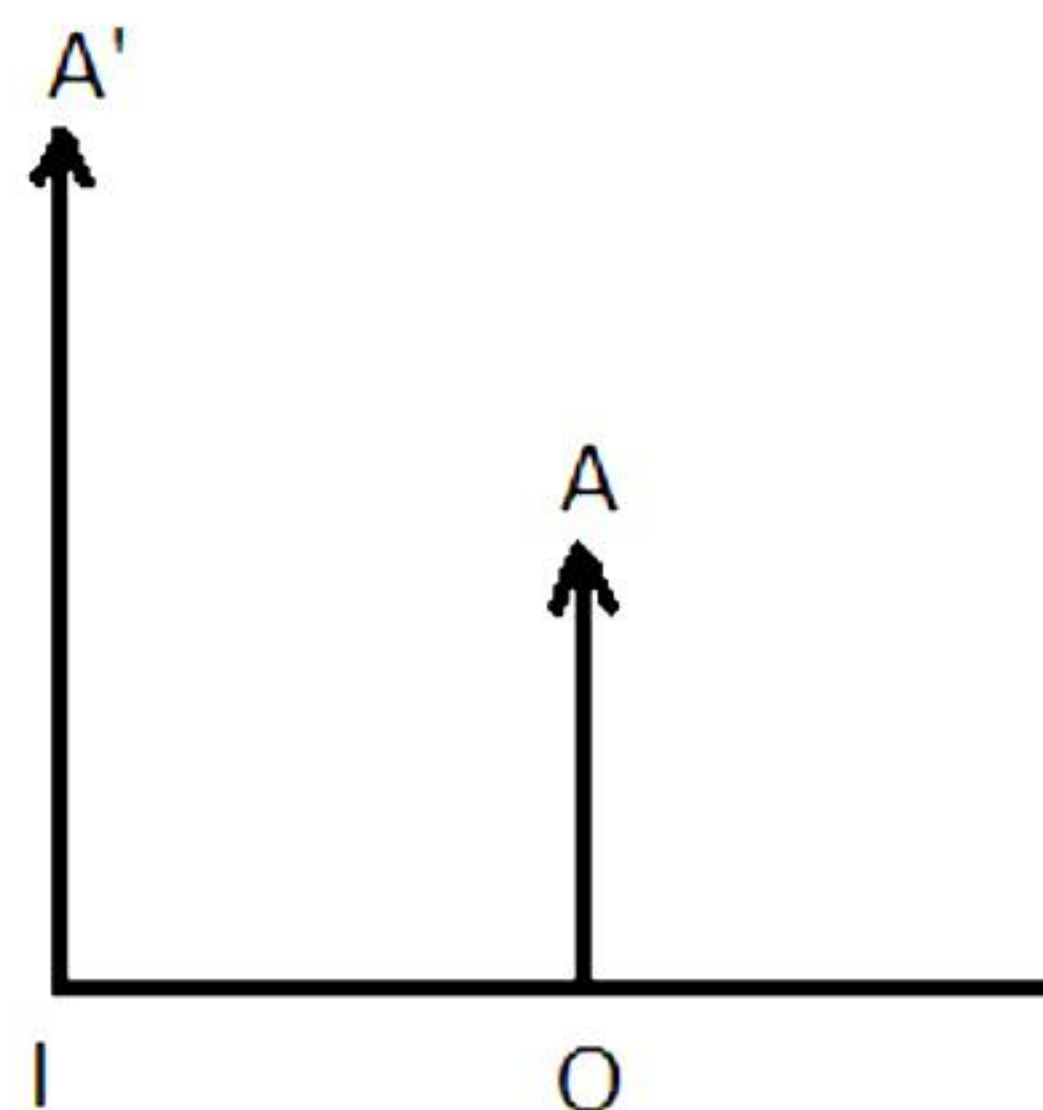
SECTION B

*(Attempt **any four** questions from this Section)*
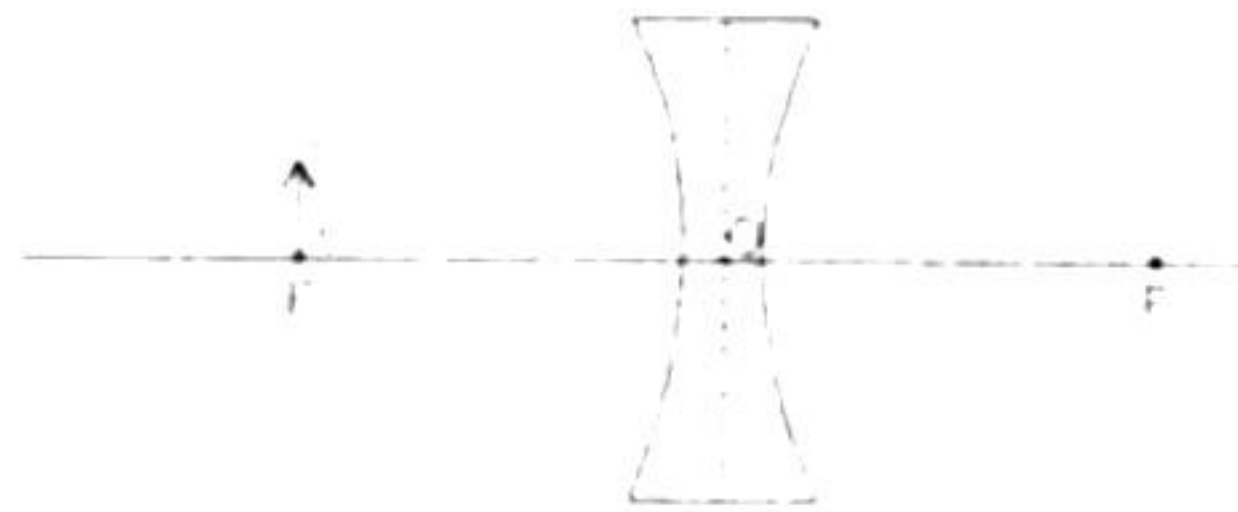
Question 4

i)   [3]

    (a) Name all the colors of the spectrum in the decreasing order of their wavelengths.

    (b) Give one instance where visible spectrum as in a rainbow can be seen as natural phenomena.

    (c) What is scattering of light? Give two examples.

ii)   [3]

(a) How will you experimentally determine the focal length of a convex lens by the distant object method?

(b)

The above diagram shows a small linear object AB placed at the principal focus F_1 of a diverging lens. The points O and F_2 are the optical center and the first focus of the lens. Draw a ray diagram using two rays to locate the image formed in the lens. Mention two characteristics of this image.

(c) An arrow-shaped object is placed at a distance of 40 cm from a convex lens of focal length 200 mm. Draw a ray diagram showing how the image of this object is formed. What is the nature of this image?

iii)   [4]

(a) What is the power of a converging lens of focal length 0.25 m?

(b) What is the focal length of the lens of power – 5D?

(c) If lenses (a) and (b) are put together, what is the power and focal length of this combination?

Question 5

i)   [3]

(a) Name the two kinds of lens? Draw diagrams to illustrate them.

(b) Describe with the help of a diagram, the nature, size and position of the image formed by a convex lens, when an object is placed:

1. between the optical centre and focus F.
2. At infinity

ii)   [3]

(a) An object AB is placed between $2F_1$ and F_1 on the principal axis of the convex lens as shown in the diagram below:


Copy the diagram and using three rays starting from point A, obtain the image of the object formed by the lens.

(b) Name the radiations:
1. That are used for photography at night.
2. That are used for detection of fracture in bones.

iii) A monochromatic point source of light O is seen through a rectangular glass block PQRS. The path of two rays, in and outside the blocks, are shown in the figure. [4]
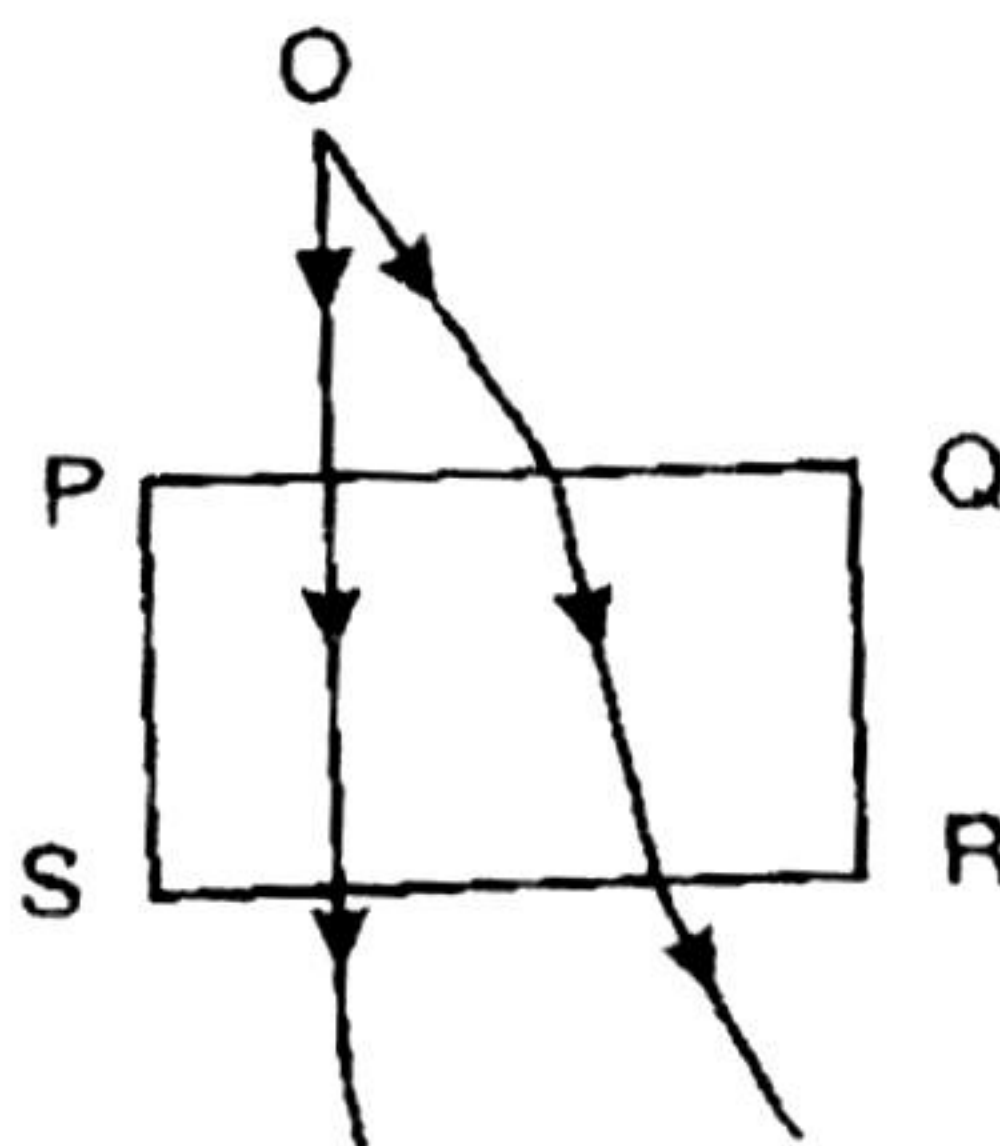
(a) Does the source O appear to be nearer or farther with respect to the surface PQ?
(b) How does the shift depend on the thickness PS or QR of the block?
(c) Justify your answer in (b) with the help of an appropriate ray diagram.
(d) For the same rectangular glass block, which colour from the visible spectra (violet to red) will produce the maximum shift?

Question 6
i) [3]
(a) Why isn't a machine 100% efficient?
(b) Why do we use a bicycle despite its being a mechanical disadvantage?
(c) Draw a labelled diagram of an arrangement of two pulleys, one fixed and other moveable. In the diagram, mark the directions of all forces acting on it.

ii) [3]
(a) Define inertia, and what are the two forms of inertia?
(b) Why does a fan continue to move for some time even after it has been switched off?
(c) Define moment of force and state its S.I. unit.

iii) A pulley system lifts a load of 600 N by an effort of 200 N. If the resistance due to movable parts of machine is 400 N, find: [4]
(a) M.A.
(b) V.R.
(c) No. of pulleys
(d) Efficiency

Question 7

i) [3]

    (a) How does a device's power rating help us decide the type of leads (connecting wires) to be used for that?

   (b) How are the electric appliances in a room connected (in series/parallel) and why?

ii) [3]

    (a) Which formula do we use to calculate the work done when a body is moved against gravity?

    (b) Differentiate between work and power.

    (c) Express 7 kWh in joule.

iii) [4]

    (a) In the circuit given below, find the potential difference between points A and B. Assume that both the batteries have zero internal resistance.

    (b) In the given circuit calculate:
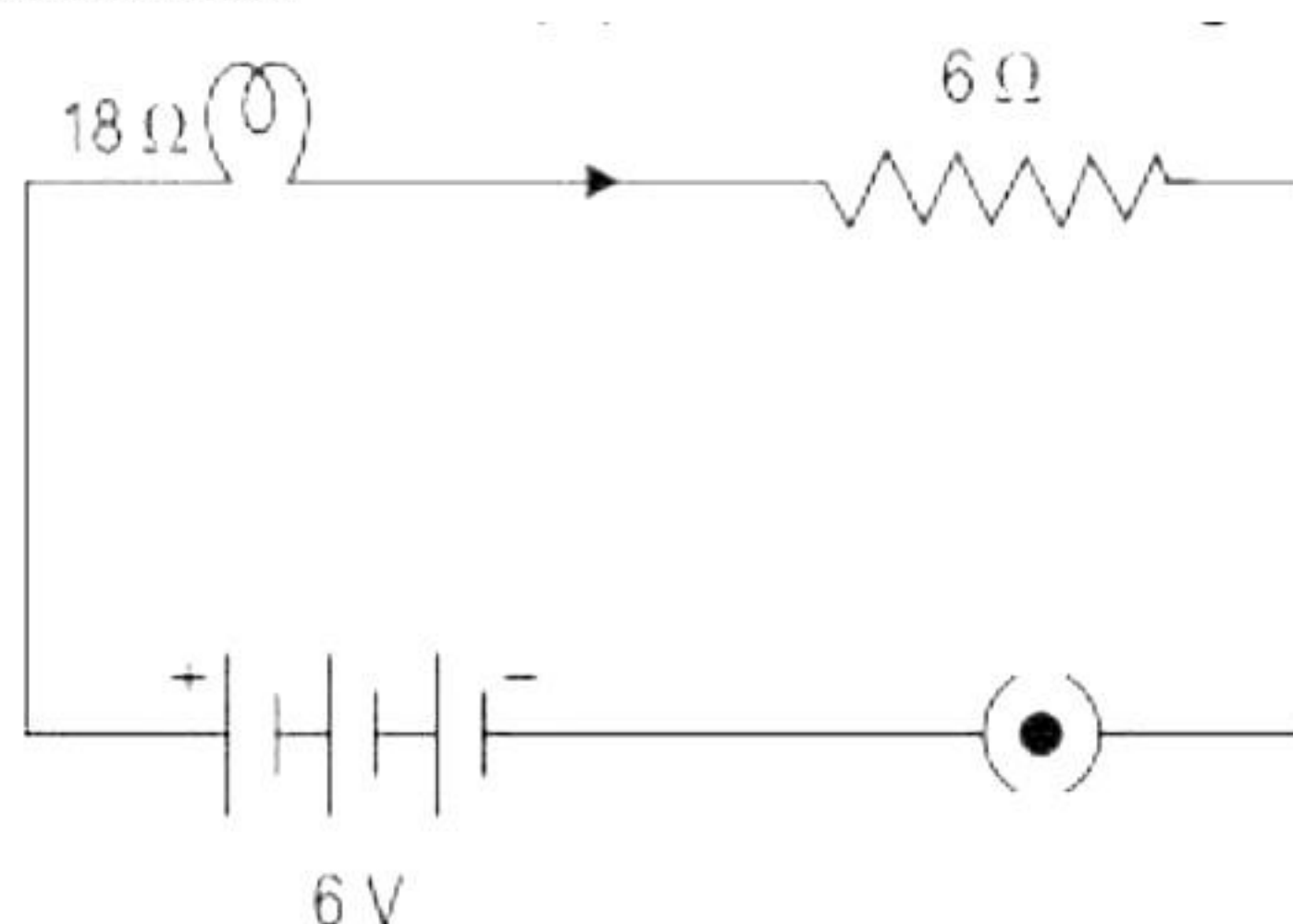
       1.   Current flowing through the circuit,

       2.   Potential difference across the lamp and the resistor.

Question 8

i) [3]

    (a) What do you mean by degraded form of energy? Explain with an example.

    (b) Write one example in day-to-day life where potential energy is converted into kinetic energy.

    (c) Give examples of atmospheric phenomena that have large kinetic energy?

ii) [3]
    (a) Mention the factors on which the direction of force experienced by a current-carrying conductor placed in a magnetic field depend.
    (b) Under what condition is the force experienced by a current-carrying conductor placed in a magnetic field maximum?
    (c) A proton beam is moving along the direction of a magnetic field. What force is acting on the proton beam?

iii) [4]
    (a) Is fire extinguished more effectively using hot water or cold water?
    (b) In a calorimeter box, the calorimeter is surrounded by a coaxial shining cylindrical vessel. Why?
    (c) What is the effect of the increase in pressure on the melting point of ice and boiling point of water?
    (d) Why do the farmers fill their fields with water on a cold winter night?

Question 9

i) [3]
    (a) Give reasons for the following:
        1. The sound of a kettle drum is unmusical.
        2. The rattling of a factory is unpleasant.
    (b) What is the function of the wooden box in the sonometer? Does it increase or decrease the duration of emission?

ii) [3]
    (a) How is the frequency of wave related to its time period?
    (b) State any two characteristics of a musical sound.
    (c) Two friends were playing on identical guitars whose strings were adjusted to give notes of the same pitch. Will the quality of the two notes be the same? Give a reason for your answer.

iii) [4]
    (a) How are thermions different from free electrons?
    (b) What is the difference between:
        1. A β-particle and an electron?
        2. An α-particle and a helium nucleus?
        3. Give two equations of each representing α-decay and β-decay respectively.

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 – a: Arrow pushing against bow string.
Action and reaction force acts in the opposite direction. Action force: Bowstring against the arrow; Reaction force: Arrow pushing against the bowstring.

ii) Correct answer – b: Parallel
Electrical appliances in a house are connected in parallel.
Hint: On connecting the electrical appliances in parallel, each appliance works independently without being affected by whether the other appliance is switched on or off.

iii) Correct answer – c: nuclear energy
In nuclear fission, the difference in mass, Δm, between the original nucleus and the product nuclei gets converted to energy E at a rate governed by Einstein's energy-mass equation ($E = \Delta mc^2$)

iv) Correct answer – c: Frequency
With the change in medium, the frequency of light remains the same but the velocity and wavelength (i.e., color of light) change.

v) Correct answer – d: Assertion is true reason is false.
Natural vibrations are also called free vibrations.
The periodic vibrations which occur in the absence of external force are called natural or free vibrations. A body executes natural vibrations only when restoring forces are present (or external forces are absent).

vi) Correct answer – d: Optical center
A ray of light passes through an optical center of a lens is refracted back along the same path i.e., through optical center itself.

vii) Correct answer – c: $J\ kg^{-1}\ K^{-1}$

viii) Correct answer – a: 1 ampere of current flows through it when the potential difference across the ends is 1 volt.
Apply Ohm's law V = IR. Thus, R = V/I = 1V/1A = 1Ω

ix) Correct answer – c: X-rays

X-rays are highly energetic invisible electromagnetic waves which help in the study of structure of crystals.

x) Correct answer - a: High specific latent heat of vaporization of water.

The specific latent heat of vaporization of water is very high i.e. 2260000 J/kg. It means 2260000 joules of heat energy is required to vaporize one kilogram of water. Therefore, water from various water bodies like lakes, ponds etc. evaporate very slowly under the sun. This results in controlled water cycle and precipitation. In other words, rainfall all over the world is regulated.

xi) Correct answer – a: lever

Gear can be considered as a lever because each tooth of a gear acts like a small lever.

xii) Correct answer – d: Energy can be created.

According to the law of conservation of energy, energy can neither be created nor destroyed but can be transformed from one form to another.

xiii) Correct answer – a: Uniform acceleration with constant speed

Uniform Circular Motion is an example of Uniform acceleration acting towards the center of circle while the linear speed remains constant.

xiv) Correct answer – c: increases

When the temperature of a substance increases, its k.e. energy increases and hence the speed of its molecules also increases.

xv) Correct answer – c: Gamma

The radiation which has the lowest ionizing power is gamma.

Solution 2

i)
   (a) The rate of change of momentum is equal to **_force_**.
   (b) The statement – 'To every action there is an equal and opposite reaction' is the **_Newton's third law._**
   (c) If the object is brought closer and closer to the convex lens. The size of the image **_Increases_**.
   (d) Small current in a circuit is detected by **_Galvanometer._**
   (e) The uniform linear motion is an **_unaccelerated motion_**, while an uniform circular motion is an **_accelerated motion._**

ii)
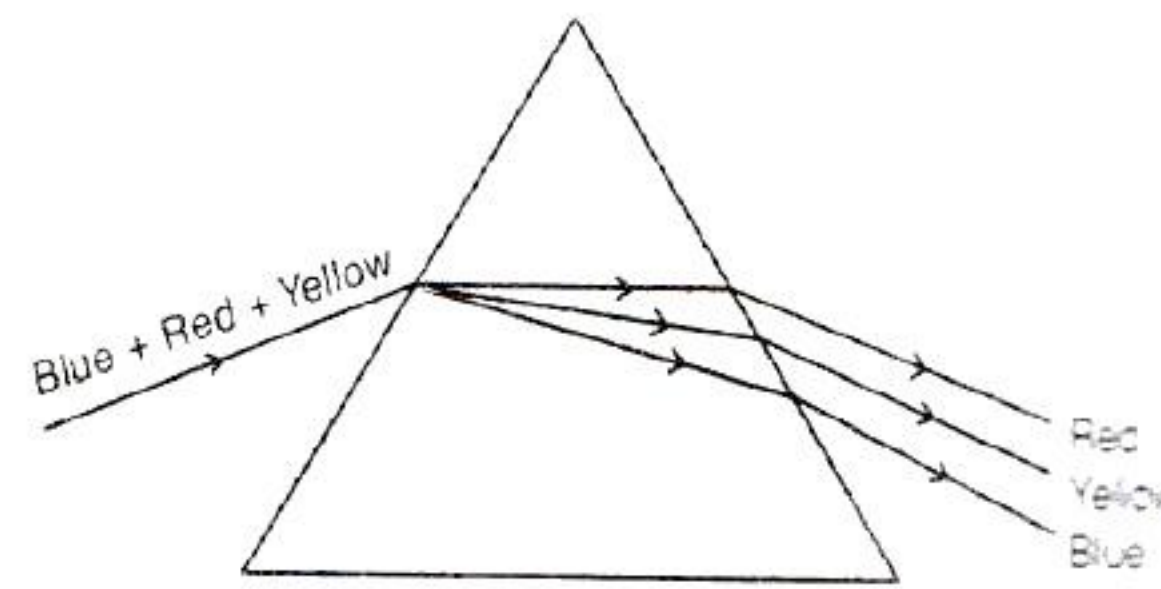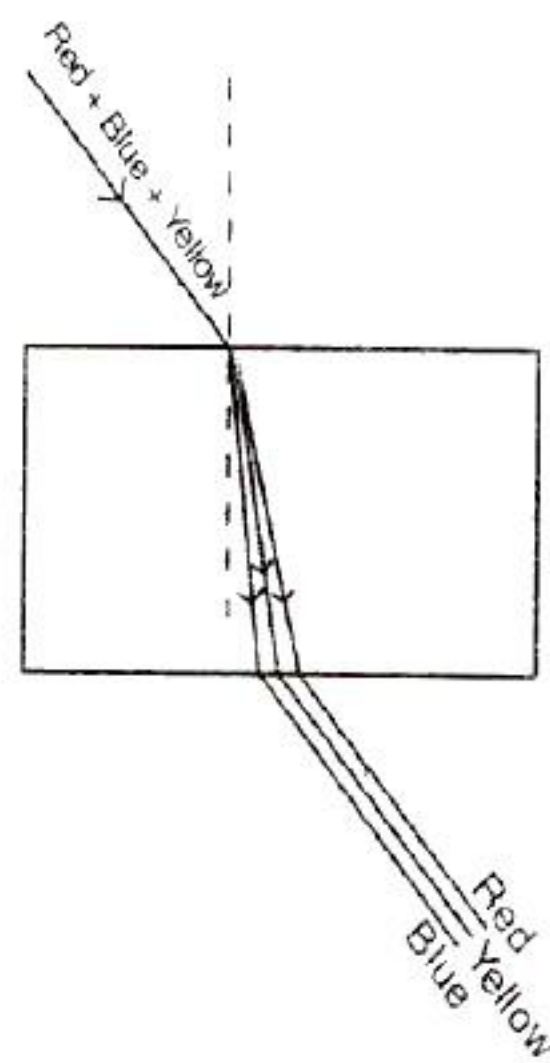
iii) Given:

Distance between Reema and the building, (d) = 167 m

Speed of sound (v) = 334 m s^{-1},

t =?

Time interval $t = \dfrac{2d}{v} = \dfrac{2 \times 167 \text{ m}}{334 \text{ ms}^{-1}} = 1 \text{ s}$

Solution 3
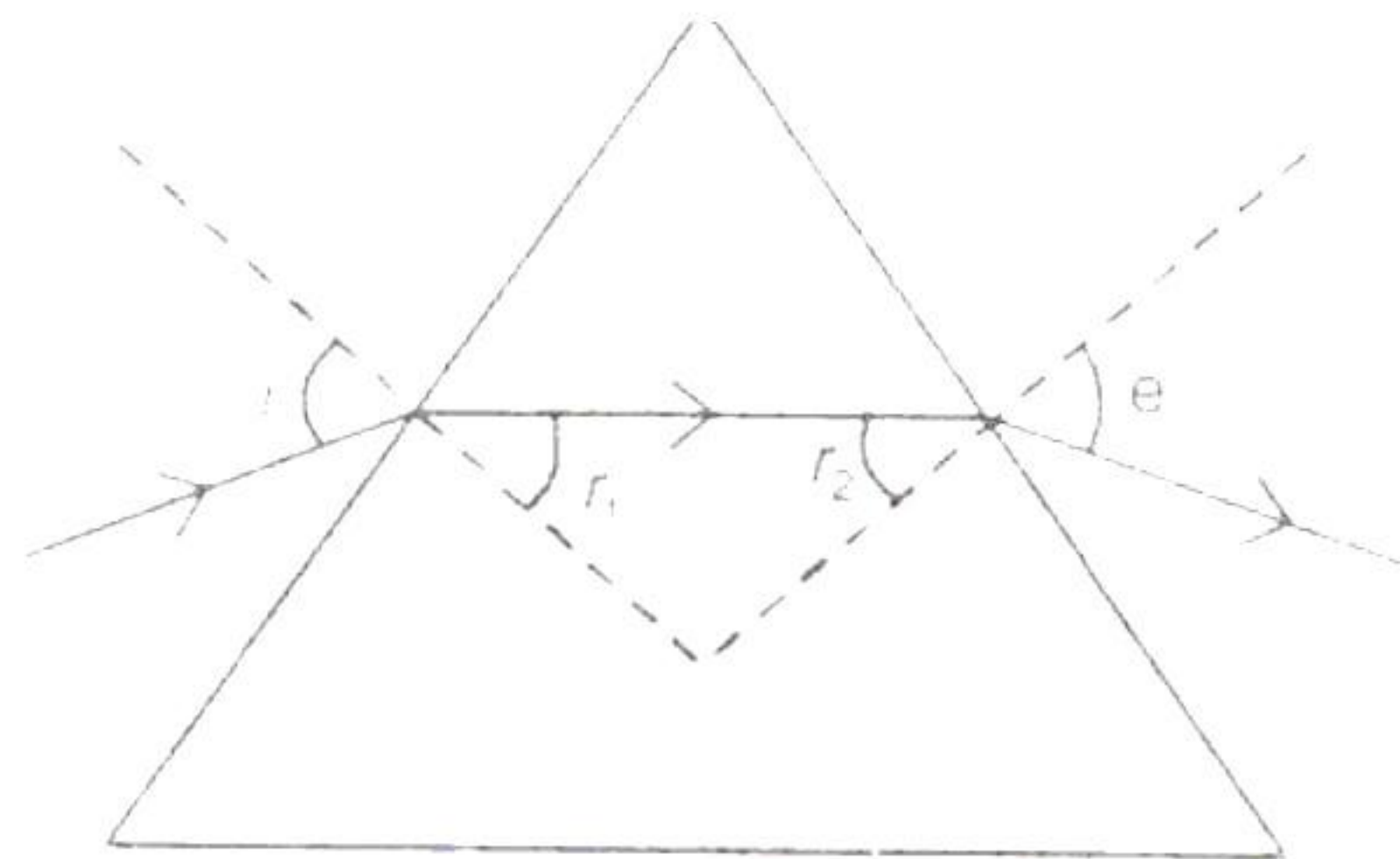
i)

(a) No, because a part of input is wasted.

- in moving the parts of the machine
- in overcoming friction between various parts of machine

(b) No, the couple acting on a rigid body can cause only rotatory motion. It cannot produce translatory motion.

(c) In the minimum deviation position,

Angle of incidence (i) = Angle of emergence (e)

Angle of refraction (r_1) = Angle of refraction (r_2)

ii)
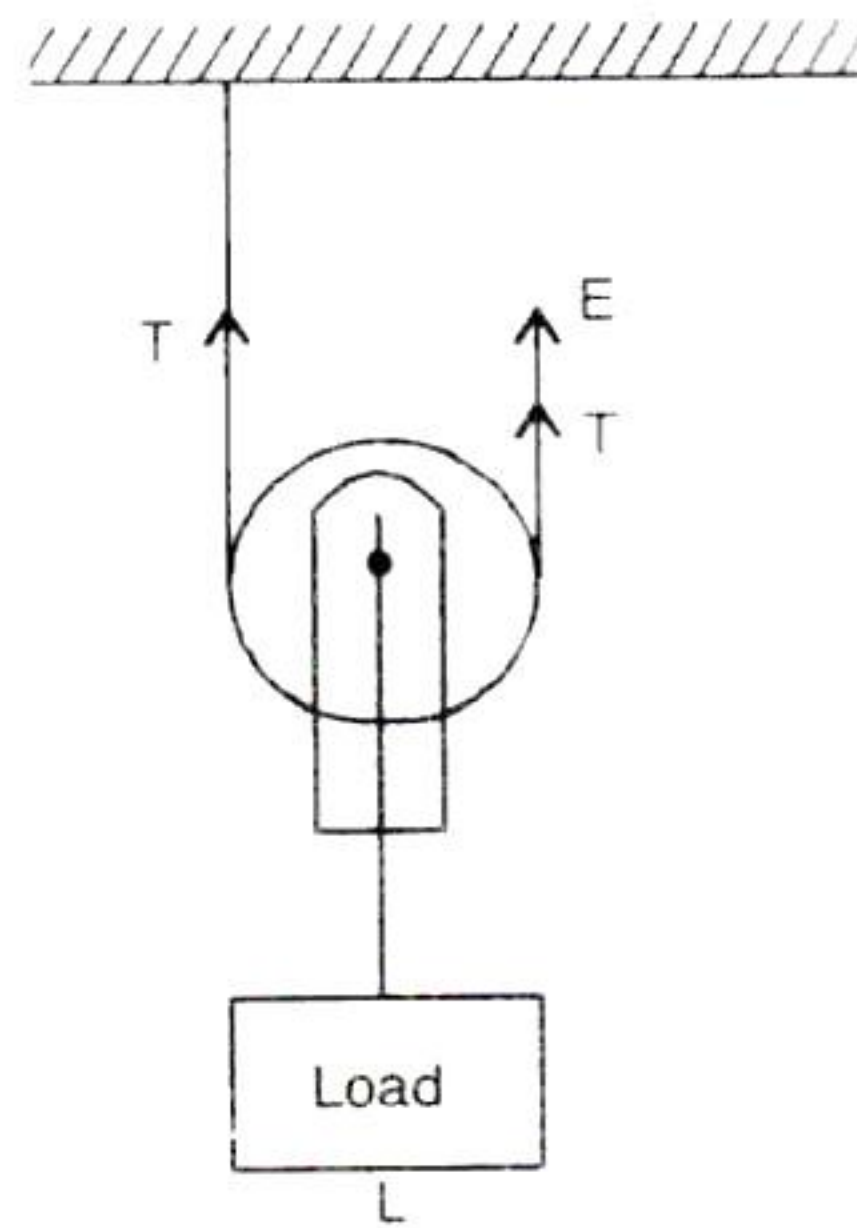
According to question,

L + W = 2 T and E = T

L = 2 T – W

Mechanical advantage $= \dfrac{L}{E} = \dfrac{2T - W}{T}$

$$= 2 - \dfrac{W}{T}$$

$$= 2 - \dfrac{W}{E}$$

iii)

1 J = 1 N × 1 m

= 1 kg m s^{-2} × 1 m

= 1 kg m^2 s^{-2}

= 1000 g × (100 cm)^2 s^{-2}

= 10^7 g cm^2 s^{-2}

1 J = 10^7 ergs

iv) The first beaker will have water at a higher temperature because of hidden heat (latent heat) which is released by steam at 100°C when it condenses to form water at 100°C.

v) $\mu_r < \mu_v$ as $\mu = \dfrac{c}{v}$ $\therefore v_r > v_v$, i.e. red light in glass travels faster than voilet light

vi) The specific latent heat of ice means that 1 kg of ice at 0°C absorbs 336000 J of heat to convert it into water at 0°C, or 1 kg of water at 0°C will liberate 336000 J of heat to convert into ice at 0°C.

vii) The image is enlarged and erect; therefore, the lens is convex, and the measurement of O′F will give the focal length of the lens.
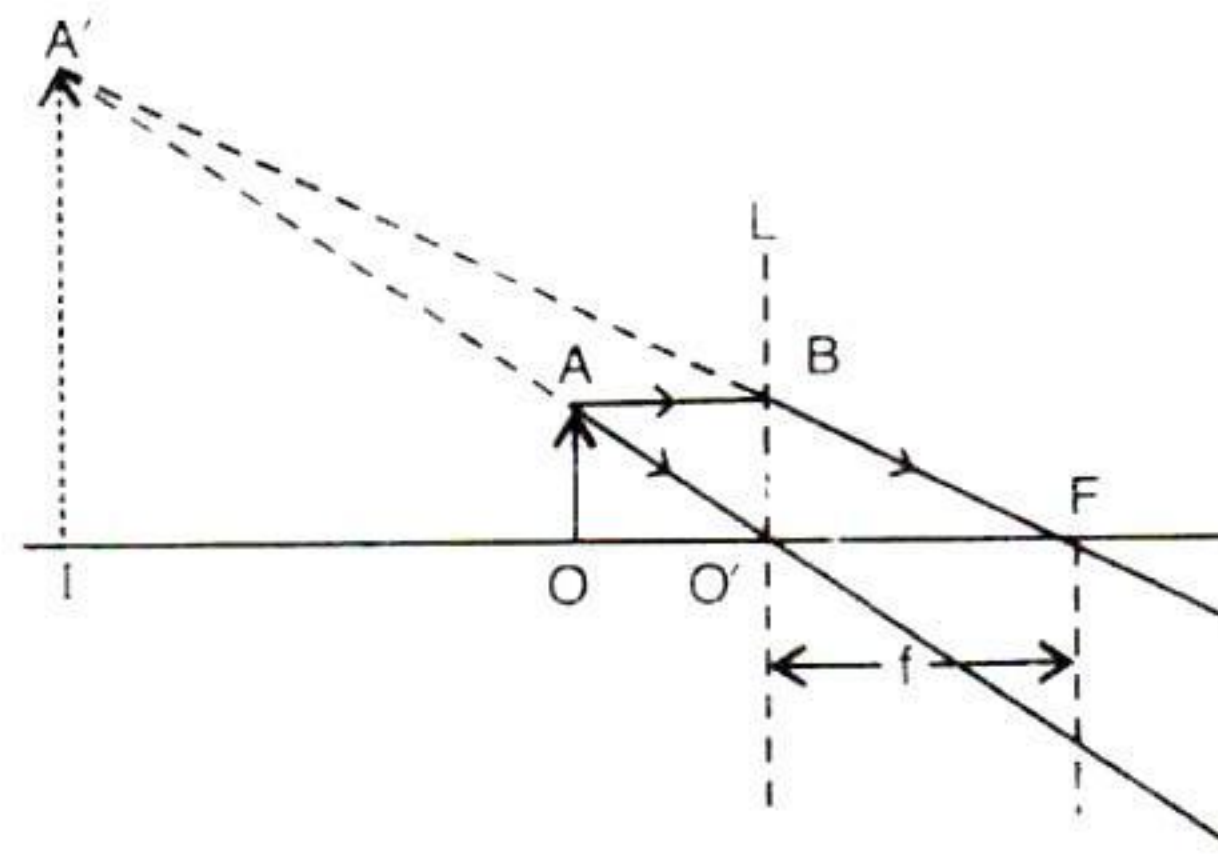
SECTION B

Solution 4

i)

(a) The colours of the spectrum in the decreasing order of their wavelengths are: Red, Orange, Yellow, Green, Blue, Indigo and Violet.

(b) When we look at the sky through a water fall or a water fountain with the sun behind us, we see a rainbow.

(c) The phenomenon by which the beam of light is redirected in random direction after interacting with the particles of the medium is called scattering. Examples of scattering of light Sun looks red at sunset and sunrise. Sky looks dark to astronomers.

ii)

(a). Estimation of focal length by distant object method – The approximate focal length of a convex lens can be determined by using the principle that a beam of parallel rays incident from a distant object converges in the focal plane of the lens.

For this, a meter scale is placed against a white wall with its 0 cm end touching the wall. An illuminated object is placed at a very large distance in front of the wall and is focused on the wall by moving the convex lens towards the other end of the scale.

Focal Plane
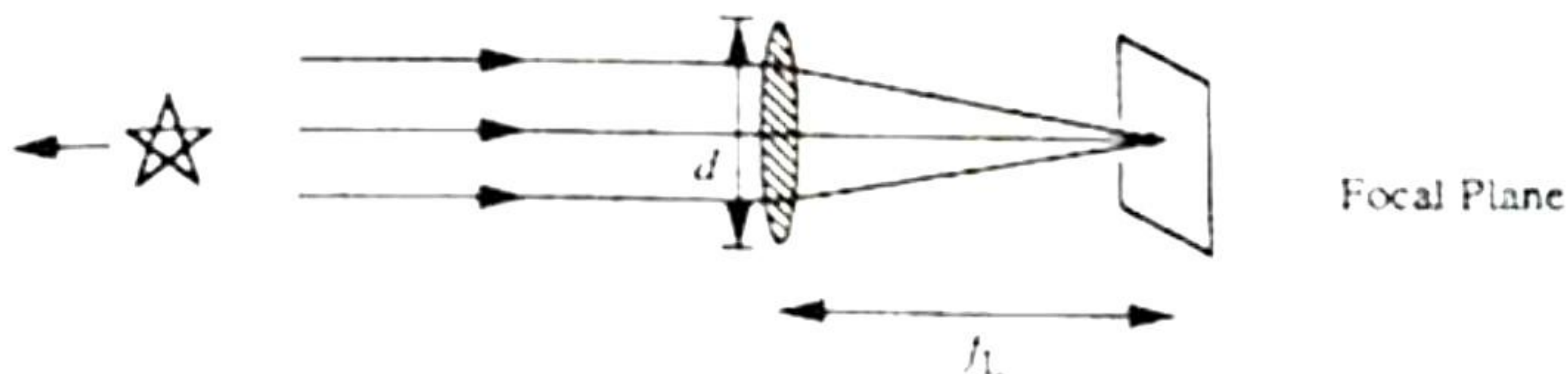
Since the light rays are incident from a distant object and nearly parallel, the image of it formed on the wall is read directly by the meter scale. This gives the approximate focal length of the scale.
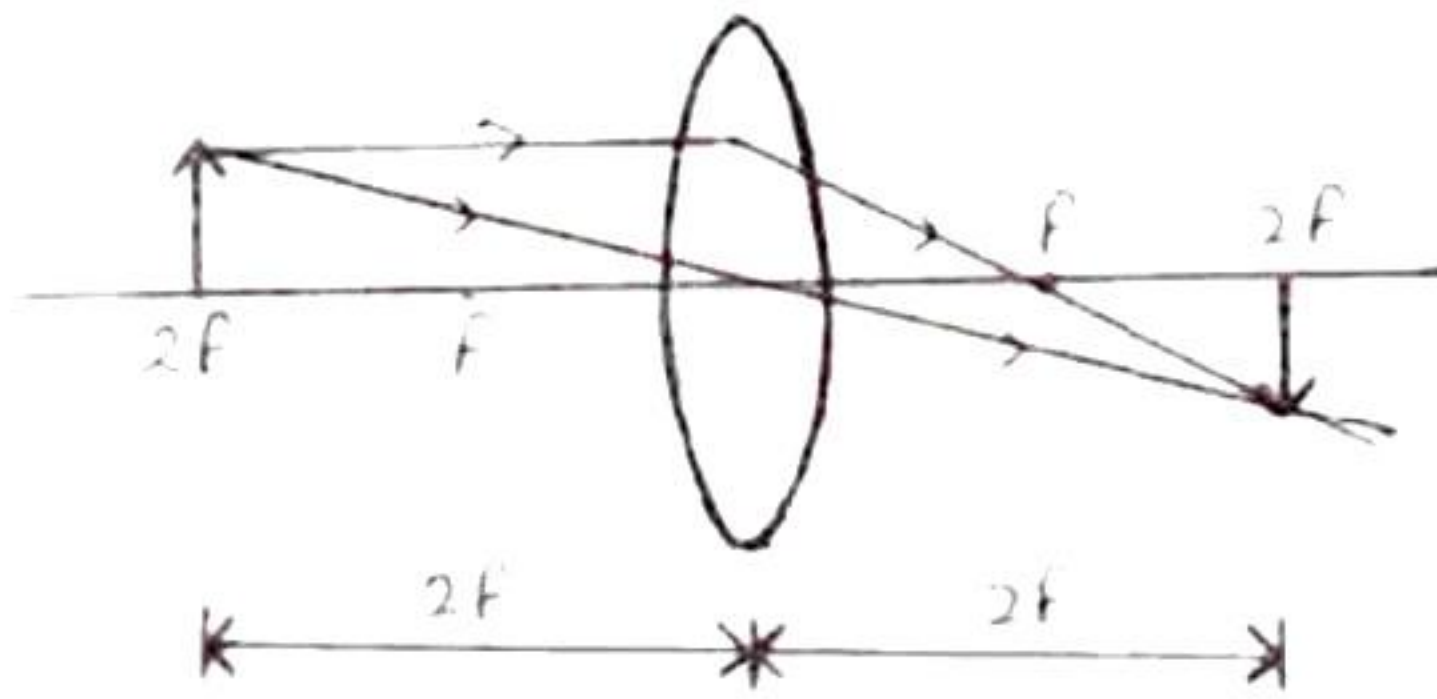
(b).
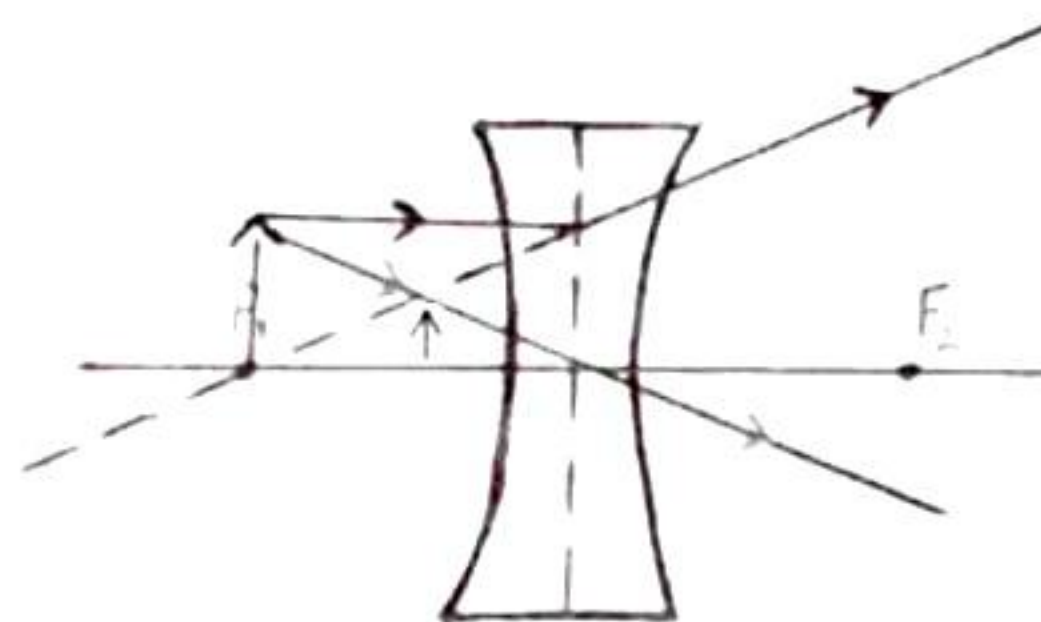
At the end, the image will be smaller, virtual and erect.

(c).

The image will be of the same size, real and inverted.

iii)

(a) The Power of the lens is given by

$$p = \frac{1}{F(metre)}$$

$$\therefore \ p = \frac{1}{0.25} = 4D$$

(b) The focal length of the lens is given as

$$F = \frac{1}{p} = \frac{1}{5}$$

$$F = 0.2m$$

(c) If both the lenses are put together then the focus will be

$$\frac{1}{F} = \frac{1}{F_1} + \frac{1}{F_2}$$

But as one of the lenses is diverging, it will have a negative focal length.

$$\Rightarrow \quad \frac{1}{F} = \frac{1}{25} - \frac{1}{20} = -\frac{1}{100}$$

$$\Rightarrow \quad F = 100 \, cm$$

Now the power will be, $P = \dfrac{1}{F(in\,cm)} = \dfrac{100}{100} = -1D$

Solution 5

i)

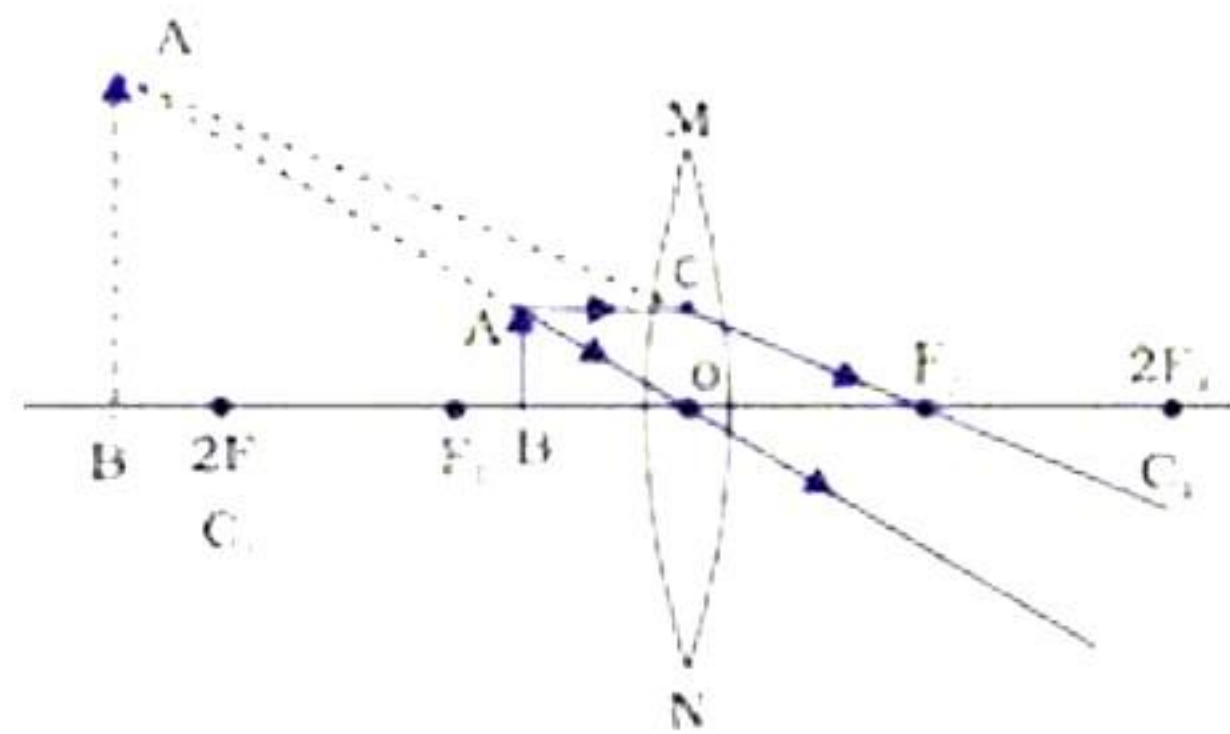(a) Lenses are of two types:

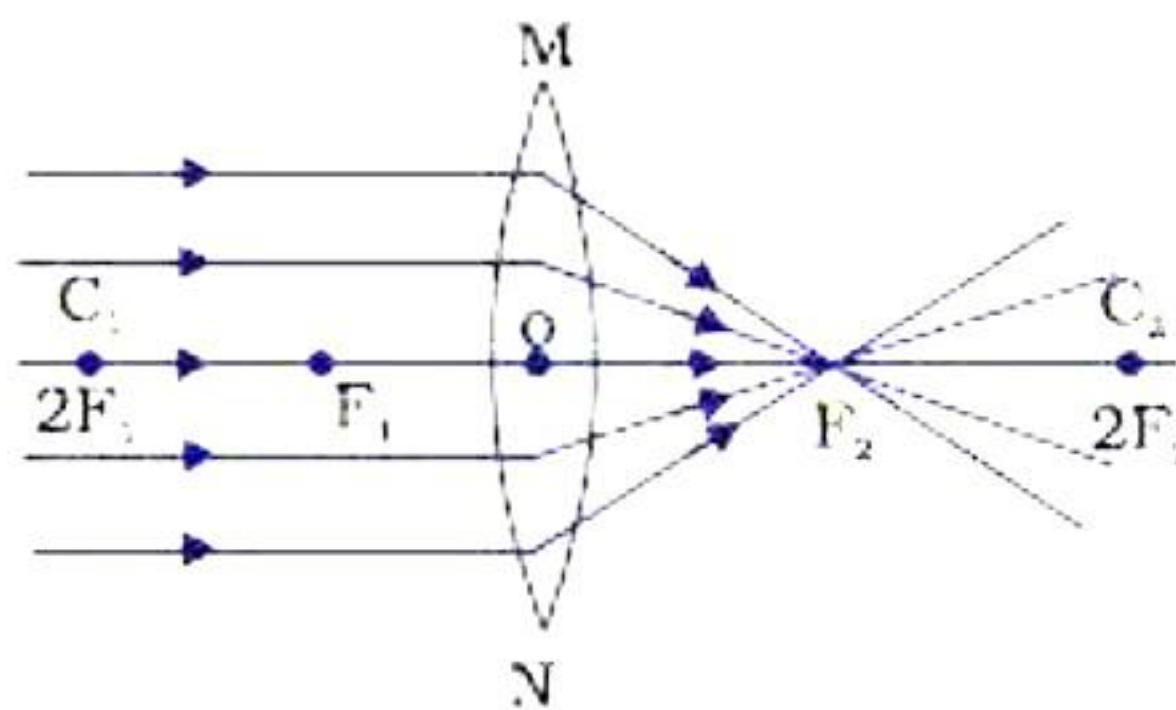- Convex or converging lens,

- Concave or diverging lens.

1.

Nature and size of the image: Virtual and erect and Enlarged Position of the image: Beyond F on side as the object.
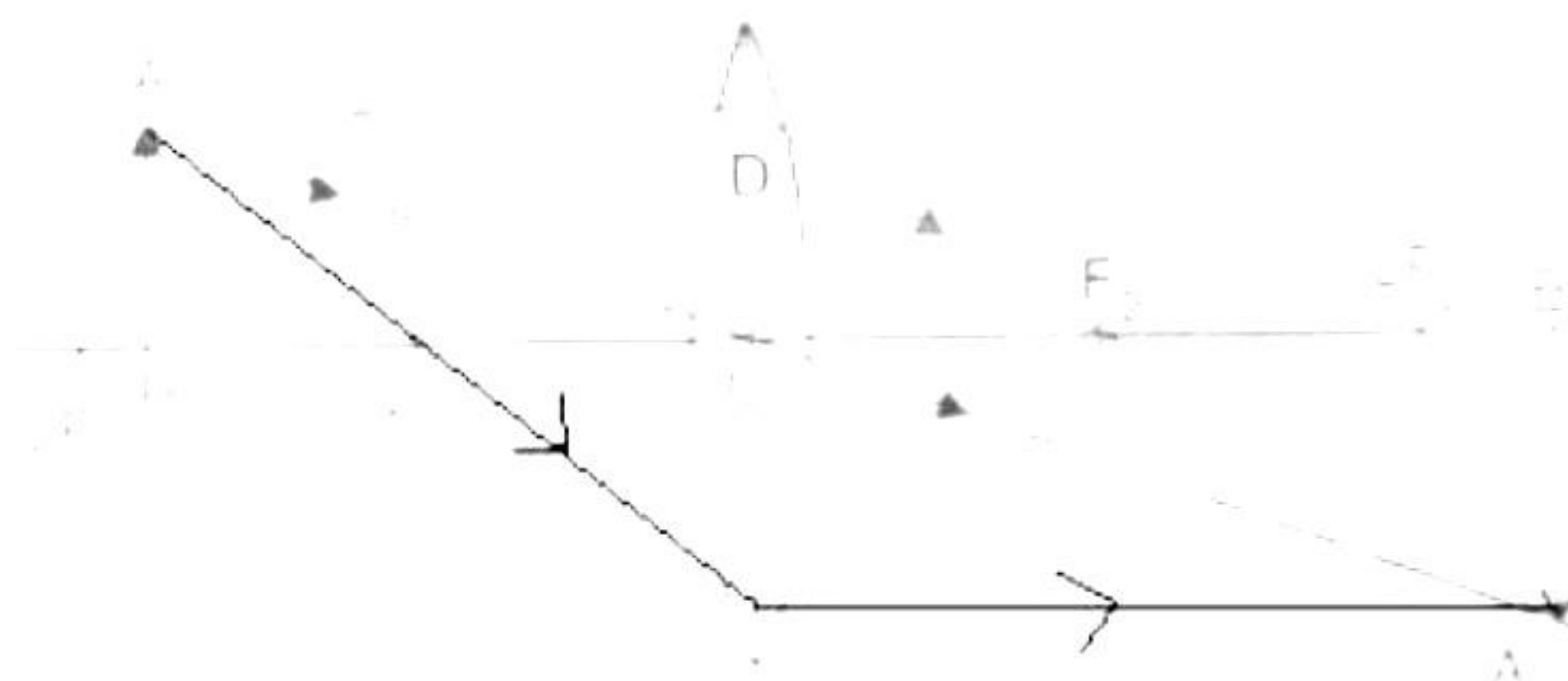
2.

Nature and size of the image: Real and inverted and highly diminished Position of the image: Formed at focus F.
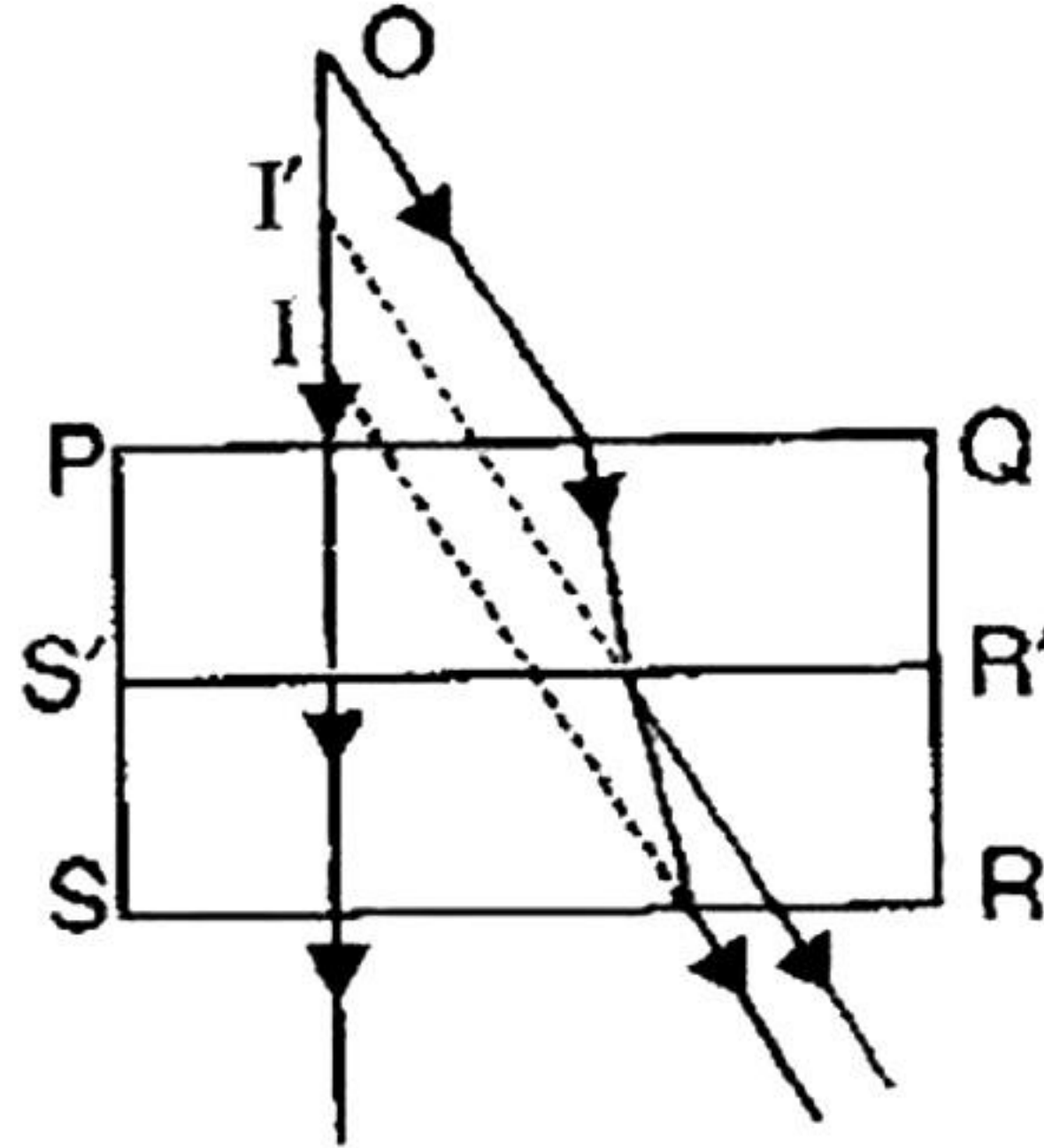
ii)

(a)

(b)
1. Infrared radiations.
2. X-rays.

iii)

    (a) The source O appears to be nearer with respect to the surface PQ when viewed through the surface RS.

    (b) The shift decreases with the decrease in thickness PS or QR of the block.

    (c) The ray diagram is shown in the figure in which for the thickness PS, the image is at I, while the thickness PS′ (<PS), the image is at I′. Now the shift is OI′ which is less than the shift OI for the thickness PS of the block.

    (d) The same rectangular glass block will produce maximum shift for the violet light incident on it for which the refractive index of glass is most.


Solution 6

i)

    (a) The efficiency of a machine cannot be 100% because of the following reasons:
- The moving parts in it are not perfectly smooth (or frictionless).
- The string in it (if any) is not perfectly elastic.
- Its different parts are not perfectly rigid.
- Its moving parts are not weightless.

    Due to these factors, there is always some loss of energy in the machine. Thus, output energy from a machine is always less than the input energy. Therefore, no machine is 100% efficient.

    (b) Bicycles normally have a large gear wheel with a pedal. When the pedal is revolved the chain pulls around the gear wheel at the back. This enables one to convert a slow motion at some point into a more rapid motion at some other desired point. In a bicycle, we are interested in increasing the velocity ratio, and a decreased mechanical advantage is the price we pay for it.

(c)
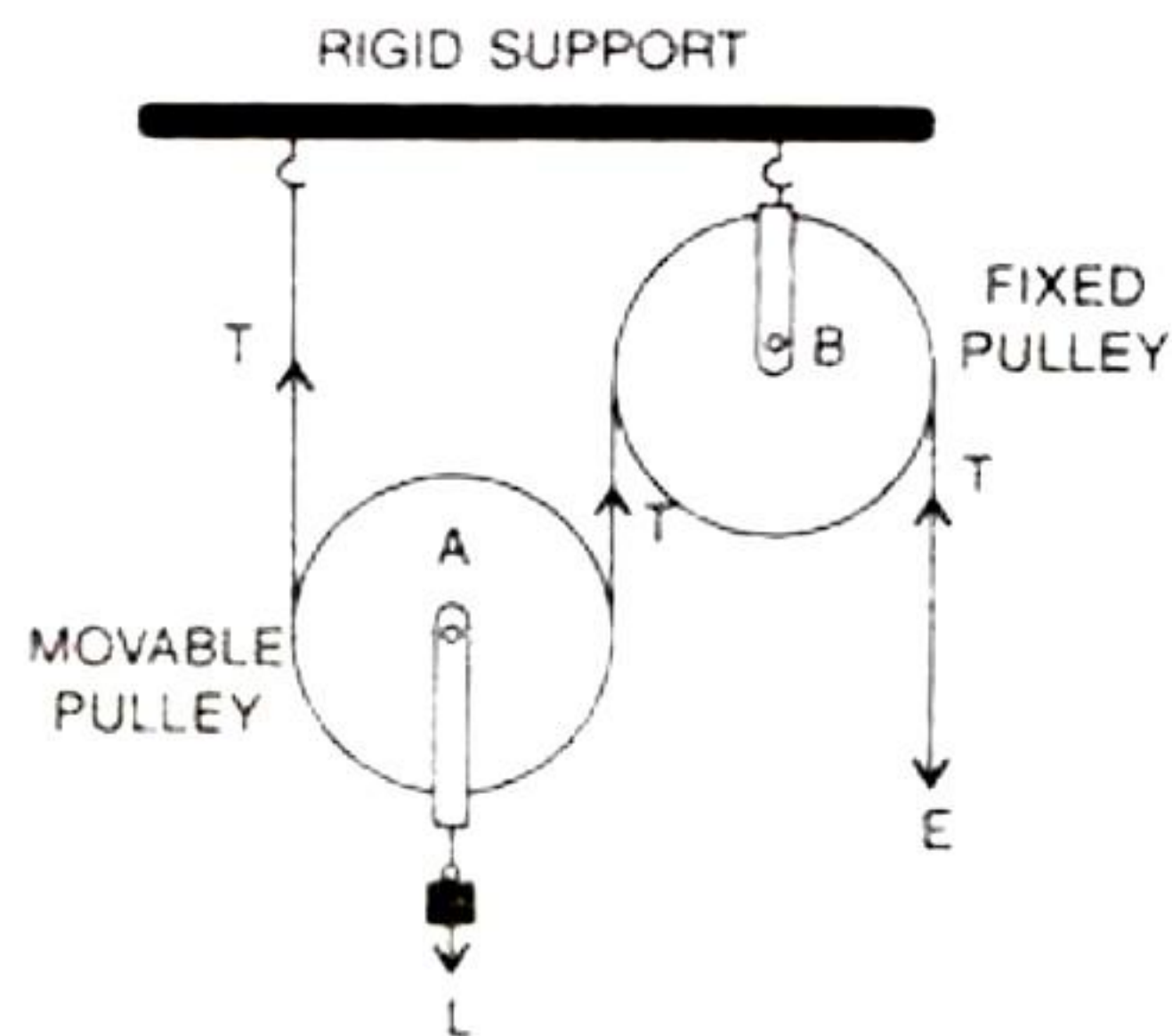
ii)

(a) The tendency of a body to resist the change in its state of rest or uniform motion is known as inertia. Inertia may be thought of as having two forms:

- Inertia of rest: The inherent property of a body by virtue of which it resists any change in its state of rest.
- Inertia of motion: The inherent property of a body by virtue of which it resists any change in its state of motion.

(b) The fan has a tendency to continue its circular motion even after it is switched off due to the inertia of motion. Thus, the fan continues to move for some time even after switching it off.

(c) The moment of force is equal to the product of the magnitude of the force and the perpendicular distance of the line of action of force from the axis of rotation.
S.I. unit of moment of force is Newton metre (Nm).

iii) Given that,

L = 600 N

E = 200 N

F = 400 N

Now,

(a) $M.A = \dfrac{L}{E} = \dfrac{600}{200} = 3$

(b) M.A = V.R. - $\dfrac{400}{200}$

3 = V.R. – 2

$\Rightarrow$ V.R = 5

(c) No. of pulleys = V.R = 5

(d)

$$\eta = \frac{M.A}{V.R} \times 100$$

$$= \frac{3}{5} \times 100 = 60\%$$

∴ Efficiency = 60%

Solution 7

i)

(a) We know that P = VI or I = P/V. Thus, the current flowing through a device is directly proportional to its power. Thus, knowledge of the power-voltage rating of a device helps us to know the current flowing through it. This, in turn, helps us to decide about the type of leads to be used for it. We use thick wires (or leads) if the current flowing is more than 5 A. For currents less than 5A, we use relatively thinner wires (or leads).

(b) All the electrical appliances like bulbs, fans and sockets, etc. in a room are connected in parallel across the live wire and the neutral wire because of the following advantages:

1) In a parallel circuit, if one of the appliances is switched off, or gets fused, there would be no effect on the other appliances, and they keep on operating.

2) In parallel circuit, same voltage of the mains is available for all the electrical appliances. Example: all bulbs connected in parallel would get same voltage and would glow brightly whereas, if connected in series, bulbs would get less voltage and would glow less brightly.

ii)

(a) When the work is done against gravity, then the amount of work done is equal to the weight of the body times the vertical distance through which it is lifted.

Work done = Weight of body x vertical distance against gravity

W = mg x h= mgh

Were,

W - Work

m - Mass

g - acceleration due to gravity

h - vertical distance.

(b) Work:

- Work done by a force is equal to the product of force and the displacement in the direction of force.
- Work done does not depend on time.
- S.I unit of work is joule (J).

Power:
- The power of a source is the rate of doing work by it.
- Power spent depends on the time in which work is done.
- S.I unit of power is watt (W).

(c) 1 kilowatt hour (kWh) = 1000 W × (60 × 60 s)

= $3.6 × 10^6$

Therefore,

7 kWh = $7 × 3.6 × 10^6$

= $2.52 × 10^7$ J

iii)

(a) The potential difference between A and B is given as

E.m.f = 20 - 8 = 12 V

Total resistance = 4 Ω

Then the current in the circuit is = I = V/R = 12/4 = 3 A

Therefore, potential difference across R_1 = 3 × 3 = 9 V

The Potential difference across A and B = 20 – 9 = 11 V

(b)

1. I = V/R = 0.25 A
2. Potential difference across the lamp $V_1 = IR_1$

= 0.25 × 18Ω

∴ V_1 = 4.5 V

P.D. across the resistor R_2

i.e., $V_2 = IR_2$ = 0.25 × 6Ω →V_2 = 1.5 V.

Solution 8

i)

(a) When energy is required for certain purpose, we transform energy from the given form to the desired form. While transformation of energy from one form to the other desired form, the entire energy does not change into the desired form, but a part of it always changes to some other form (usually heat due to friction). which is not useful (or is undesirable). This conversion of energy to the undesirable (or non-useful) form is called the dissipation of energy. Since this part of energy cannot be used for any productive purpose, it is said to be the degraded form of energy. For example, when we run a vehicle, only a part of energy obtained from its fuel is used up in running the vehicle, major part of it is wasted in heating the moving parts of machine, in doing work against friction between the ground and its tyres and in the form of sound.

(b) A wound-up watch spring has the elastic potential energy because of its wound-up state. As the spring unwinds itself, the potential energy stored in it changes into the kinetic energy which does work in moving the hands of the watch.

(c) Hurricanes, tornadoes, and jet stream are some of the atmospheric phenomena having large kinetic energy on account of their high speeds.

ii)

    (a) Factors on which the direction of force experienced by a current-carrying conductor placed in a magnetic field depend are:
1. The direction of current
2. The direction of magnetic field

    (b) The force acting on a current-carrying conductor placed in a magnetic field is maximum when the direction of current is at right angles to the direction of the magnetic field.

    (c) As a proton beam is moving parallel to the direction of the magnetic field, no force acts on it.

iii)

    (a) Hot water is better than cold water because it's absorption of heat and conversion into steam whilst extinguishing fire is much more efficient than that of cold water. For, cold water takes longer to turn into hot water and then eventually absorb heat.

    (b) In a calorimeter box, the calorimeter is surrounded by a coaxial shining cylindrical vessel because the polish (shine) reduces the loss of heat due to radiation.

    (c) The melting point of ice decreases with an increase in the pressure and boiling point of water increases with an increase in the pressure.

    (d) In the absence of water, if on a cold winter night, the atmospheric temperature falls below 0°C, the water in the fine capillaries of plant will freeze, so the veins will burst due to the increase in the volume of water on freezing. As a result, plants will die, and the crops will be destroyed. In order to save the crop on such cold nights, farmers fill their fields with water because water has high specific heat capacity, so it does not allow the temperature in the surrounding area of plants to fall up to 0°C.

Solution 9

i)

    (a)
1. The sound of a kettle drum is unmusical because it is produced by the kettle's irregular successions of disturbances and is discontinuous.
2. Rattling of factory is unpleasant because it does not produce a periodic and uniform sound but a harsh sound.

    (b) A sono-meter is provided with a wooden box which has a column of air in it. This air column is set into forced vibrations when the strings vibrate. This box does not increase or decrease the duration of emission. However, it increases the loudness of the sound.

ii)

  (a) Frequency is reciprocal of time period Frequency = 1/Time period

     i.e., $\nu = \dfrac{1}{T}$

  (b)

    1. Loudness is the sensation produced in the ear which enables to distinguish between a loud and faint sound. It depends upon the intensity of sound and sensitiveness of ear. It is measured in terms of bel.

    2. Pitch of sound is that subjective property which distinguishes a sharp sound from a dull one. It depends upon the frequency of the source.

    3. Quality is that subjective characteristic of sound which enables us to distinguish between two sounds of the same loudness and same pitch but emitted from two different sources. It depends upon the waveforms which is determined by the number of overtones present and their respective intensities.
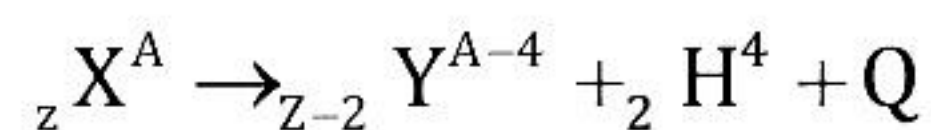
  (c) No, because both the guitars emit the same fundamental note, but the subsidiary notes will not be exactly same due to which the waveforms of the two guitars will be different, so they will differ in quality.

iii)

  (a) Each metal contains a large number of free electrons but when they are imparted with heat energy emitted from the metal surface, then they are known as thermions.

  (b)

    1. Basically, there is no significant difference between an electron and a β particle, β particle is the name given to an electron which is emitted from the nucleus.

    2. α particle is equivalent to a helium nucleus. A helium atom has lost its two electrons, i.e., a doubly ionised helium atom.

    3. Alpha-decay can be represented as

     $_{z}X^{A} \rightarrow _{Z-2}Y^{A-4} + _{2}H^{4} + Q$

     Beta-decay can be represented as

     $_{z}X^{A} \rightarrow _{Z-1}Y^{A} + _{-1}e^{0} + Q$

     Where Q is energy