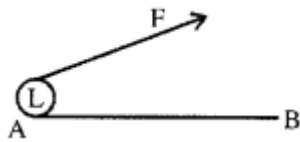


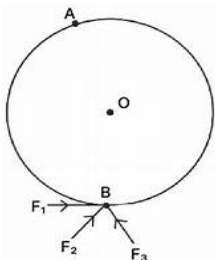
- vii. A boy drags a load 'L' along horizontal plane AB by applying a force F. The boy does



- (a) no work
(b) some positive work
(c) negative work
(d) none of these
- viii. Kilowatt hour is the commercial unit of:
(a) electric power
(b) electric energy
(c) electric force
(d) none of these
- ix. The correct relationship between the efficiency (η), mechanical advantage (M.A.) and velocity ratio (V.R.) of an actual machine is:
(a) $\eta = \text{M.A.} \times \text{V.R.}$
(b) $\eta = \text{M.A.} \div \text{V.R.}$
(c) $\eta \times \text{V.R.} = \text{M.A.}$
(d) both (b) and (c)
- x. A ray of light on entering from medium 'a' to medium 'b' does not suffer refraction. The angle of incidence in medium 'a' is:
(a) 90°
(b) zero
(c) 45°
(d) 60°
- xi. A ray of light is incident on the face of an equilateral prism at angle of 90° . The ray gets totally reflected on the second refracting face. The total deviation produced in the path of ray is :
(a) 60°
(b) 90°
(c) 120°
(d) 180°
- xii. The angle of deviation is maximum for when the dispersion of polychromatic light takes place
(a) red
(b) violet
(c) green
(d) blue
- xiii. Which is not the condition for the formation of echoes ?
(a) Minimum distance between the source of sound and reflecting body should be 17 m.
(b) The temperature of air should be above 20°C .
(c) The wavelength of sound should be less than the height of the reflecting body.
(d) The intensity of sound should be sufficient so that it could be heard after reflection.
- xiv. The amplitude of a sound wave is increased from 1 mm to 2 mm. The loudness of the sound will:
(a) increase two times
(b) increase four times
(c) same
(d) decrease

- xv. The voice of women is shrill as compared to men because of the difference in their :
 (a) speed (b) loudness
 (c) frequency (d) all of these

Question 2

- a. Write three characteristics of the image formed by a convex lens of focal length 20 cm for the object at distance (i) 10 cm, (ii) 30 cm, (iii) 40 cm from the lens. [3]
- b. The diagram shows wheel O pivoted at point A. Three equal forces F_1 , F_2 and F_3 act at point B on the wheel.
 (a) Which force will produce maximum moment about A?
 (b) Give a reason for your answer in [2]
- 
- c. A bucket kept under a running tap is getting filled with water. A person sitting at a distance is able to get an idea when the bucket is about to be filled.
 (i) What change takes place in the sound to give this idea?
 (ii) What causes the change in the sound? [2]
- d. Infra-red radiations are used as signals during war. Explain. [2]
- e. What will be the behaviour of a lens, if it is placed in water instead of air? [2]
- f. Why will an echo not be heard when the distance between the source of sound and the reflecting surface is 10 m? (give your in terms persistence of hearing) [2]
- g. In the atmosphere which colour of light gets scattered the least? And why. [2]

Question 3

- a. The wave lengths for the light of red and blue colours are nearly 7.8×10^{-7} m and 4.8×10^{-7} m respectively.
 (i) Which colour has the greater speed in a vacuum?
 (ii) Which colour has a greater speed in glass? [2]
- b. A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens? Justify your answer. [2]
- c. Amol and Amit purchased ice cream in plastic balls and cones, respectively, during their outing at the fun fair. After consuming their ice creams, Amol stated that regardless of whether they were filled with ice cream or empty, the centre of gravity of the objects would remain unchanged. Do you agree with Amol? Why? [2]
- d. How does the presence of medium affect the amplitude of free vibrations of a body? [2]
- e. State the position of object, position of image, nature of image when: Convex lens is used as objective lens of the photographic camera. [2]

SECTION II (40 Marks)

Attempt any 4 questions from this Section.

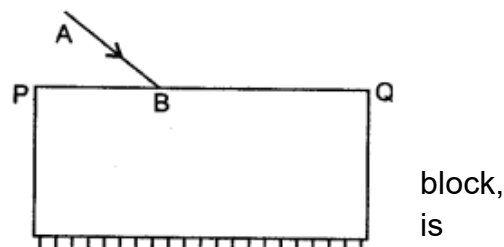
Question 4

a. Give an example for each of the following uses of a machine:

- (i) To change the point of application of the force.
- (ii) To obtain gain in force.
- (iii) To change the direction of force.

[3]

- b. i. Why is the focal length of the lens, used as magnifying glass, kept short?
- ii. The diagram on right shows a ray of white light AB incident on a rectangular glass which is silvered at lower surface. This ray partly reflected and partly refracted.



- (i) Copy the diagram and trace the path of the refracted and reflected ray. Show at least two rays emerging from the surface 'PQ'
- (ii) How many images are formed in the above case? Which image is the brightest?

[3]

- c. i. For a concave lens with $f = -18$ cm, an object is placed 18 cm away. Calculate the image distance.

[2]

- ii. Samir exerts a force of 150 N in pulling a cart at a constant speed of 10 m/s. Calculate the power exerted.

[2]

Question 5

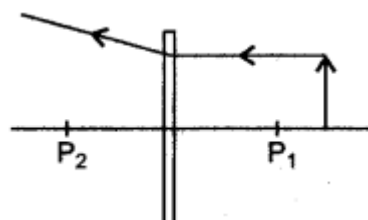
- a. A metre scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it.



- (i) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf?
- (ii) What minimum weight is placed on this metre ruler can balance this ruler when it is pivoted at its center?

[3]

- b. Copy the following figure and complete it to show the formation of the image of the object AB. Name the lens used in the figure.



[3]

- c. (i) A truck weighing 1000 kg changes its speed from 36 km/h to 72 km/h in 2 minutes. Calculate the work done by the engine and its power.

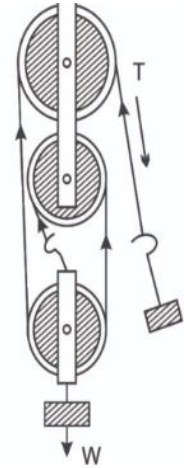
[2]

- (ii) A converging lens has a focal length 40 cm. Calculate its power.

[2]

Question 6

- a. The pulley system shown in the figure is to be used to lift a load W . If the man applying the effort cannot apply a force exceeding 1000 N, what is the maximum load that can be lifted? The actual load that the man is finally able to lift turns out to be 2700 N. What are the values of the actual M.A. obtained and the efficiency of the actual setup?

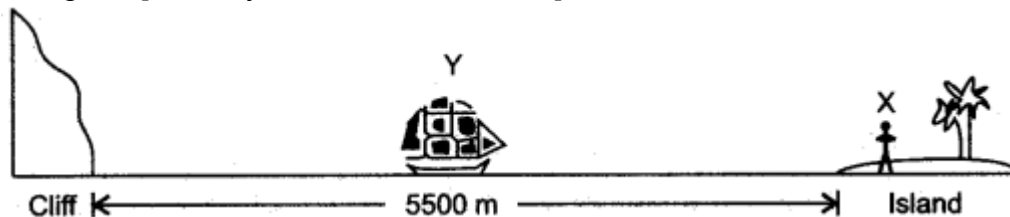


[3]

- b. (i) State two ways in which resonance differs from forced vibrations.
(ii) Explain why strings of different thicknesses are provided on a stringed instrument. [3]
- c. Half metre rod is pivoted at the centre with two weights of 20 gf and 12 gf suspended at a particular distance of 6 cm and 10 cm from the pivot respectively as shown below. (i) Which of the 2 forces acting on the rigid rod causes clockwise moment? (ii) Is the rod in equilibrium? (iii) The direction if 20 gf forces reversed. What is the magnitude of the resultant moment of force on the rod? [4]

Question 7

- a. i) A metallic blade is made to vibrate at its one end by keeping its other end clamped. The vibrations of the blade die away after some time. Explain, how you lower the frequency of the vibration of the blade?
ii) Ranbir claims to have obtained an image twice the size of the object with a concave lens. Is he correct? [3]
- b. i. State the condition when the work done by force is negative.
ii. Calculate the length of arm of couple, if a force of 13 N produces a moment of couple of 14.3 Nm. [3]
- d. An observer X is on an island 5500 m from a vertical cliff on the shore. A ship Y is anchored between the island and the Cliff. A blast on the ship's siren is heard twice by X, the interval being 5s. [Velocity of sound = 330 ms^{-1}]

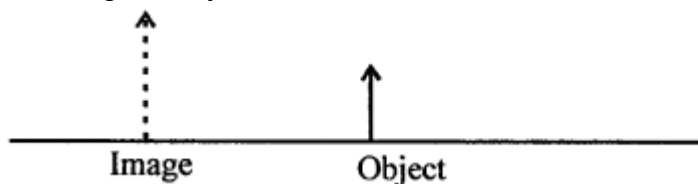


- (i) Find the distance of the ship from the island.
(i) Find the distance of the cliff from the ship.

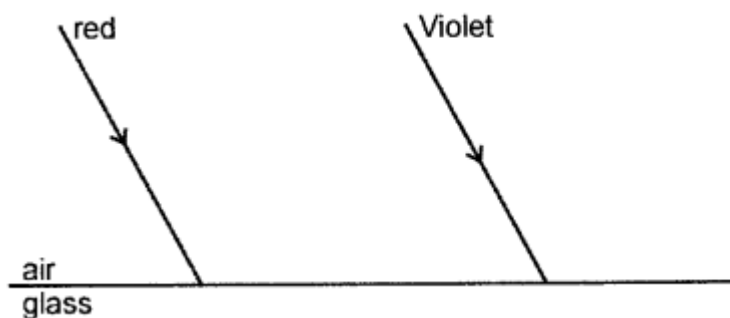
[4]

Question 8

- a. (i) When an arrow is shot from a bow, it has kinetic energy in it. Explain briefly from where does it get its kinetic energy?
(ii) What energy conversions take place in microphone when it is working? [2]
- b. The diagram given below shows the position of an object and its image. Copy the diagram and then by drawing two rays locate the position of the lens and its focus, showing clearly the kind of lens used. [2]



- c. Two parallel rays of Red and Violet travelling through air, meet the air-glass boundary as shown in the figure: [2]



- (i) Will their paths inside the glass be parallel? Give a reason for your answer.
(ii) Compare the speeds of the two rays inside the glass.
- d. A pulley system with velocity ratio 3 is used to lift a load of 60 kgf through a height of 20 m. The force is applied in upward direction, and its magnitude is 25 kgf. Calculate:
(i) Work done by the effort
(ii) Mechanical advantage of pulley system
(iii) Efficiency of pulley system
(iv) Total number of pulleys in the fixed and movable block. [Take $g = 10 \text{ N kg}^{-1}$] [4]

Answer key

SECTION – I (40 Marks)

Attempt all questions from this Section.

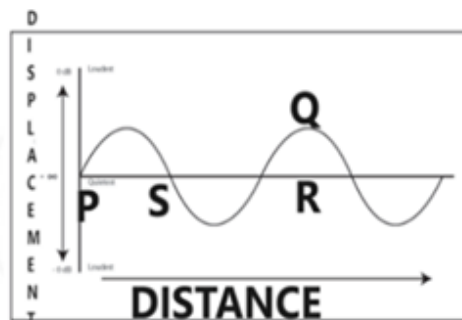
Question 1 Choose the correct answers to the questions from the given options.

(Do not copy the question, write the correct answers only.)

[15]

- (i) Assertion (A): When light passes through a triangular prism, it is observed that for two angles of incidence, the angle of deviation is the same. Reason (R): According to the principle of reversibility, the light retraces the path in reversing the direction.

- (a) A and R are true, and R is the reason for A.
(b) A and R are true, and R is not the reason for A.
(c) A is true, but R is false.
(d) A is false, but R is true.



- ii. Sumit, a teenager, enjoys playing his music loudly. However, his grandmother consistently lowers the volume of the music player. Analyse the wave to identify which characteristic of the wave has been altered when the grandmother reduces the volume.

- (a) The length PS becomes more.
(b) The length SR becomes less.
(c) The length QR becomes less.
(d) The length PR becomes less.

- iii. For a given mass if kinetic energy increases 16 times the momentum:

- (a) increases four times
(b) increases twice
(c) decreases four times
(d) decreases twice

- iv. An object is placed at a distance of more than 40cm from a convex lens of focal length 20cm. The image formed is real, inverted and

- (a) diminished
(b) same as (or equal to)
(c) magnified
(d) none of the above

- v. Which colour of sky would have appeared when there is no atmosphere?

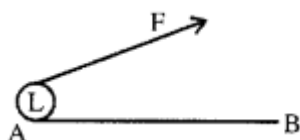
- (a) Blue
(b) Red
(c) No colour
(d) Black

- vi. **Assertion:** A spring has potential energy, both when it is compressed or stretched.

Reason: In compressing or stretching, work is done on the spring against the restoring force.

- (a) Both assertion and reason are true.
(b) Both assertion and reason are false.
(c) Assertion is false but reason is true.
(d) Assertion is true but reason is false.

- vii. A boy drags a load 'L' along horizontal plane AB by applying a force F. The boy does



- (a) no work
(b) some positive work
(c) negative work
(d) none of these

- viii.** Kilowatt hour is the commercial unit of:
 (a) electric power (b) electric energy
 (c) electric force (d) none of these
- ix.** The correct relationship between the efficiency (η), mechanical advantage (M.A.) and velocity ratio (V.R.) of an actual machine is:
 (a) $\eta = \text{M.A.} \times \text{V.R.}$ (b) $\eta = \text{M.A.} \div \text{V.R.}$
 (c) $\eta \times \text{V.R.} = \text{M.A.}$ (d) both (b) and (c)
- x.** A ray of light on entering from medium 'a' to medium 'b' does not suffer refraction. The angle of incidence in medium 'a' is:
 (a) 90° (b) zero
 (c) 45° (d) 60°
- xi.** A ray of light is incident on the face of an equilateral prism at angle of 90° . The ray gets totally reflected on the second refracting face. The total deviation produced in the path of ray is :
 (a) 60° (b) 90°
 (c) 120° (d) 180°
- xii.** The angle of deviation is maximum for when the dispersion of polychromatic light takes place
 (a) red (b) violet
 (c) green (d) blue
- xiii.** Which is not the condition for the formation of echoes ?
 (a) Minimum distance between the source of sound and reflecting body should be 17 m.
 (b) The temperature of air should be above 20°C .
 (c) The wavelength of sound should be less than the height of the reflecting body.
 (d) The intensity of sound should be sufficient so that it could be heard after reflection.
- xiv.** The amplitude of a sound wave is increased from 1 mm to 2 mm. The loudness of the sound will:
 (a) increase two time (b) increase four times
 (c) same (d) decrease
- xv.** The voice of women is shrill as compared to men because of the difference in their :
 (a) speed (b) loudness
 (c) frequency (d) all these

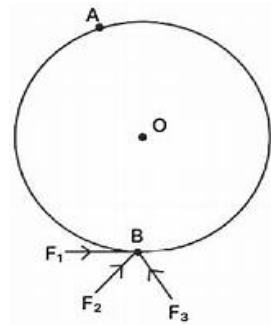
Question 2

- a.** Write the three characteristics of the image formed by a convex lens of focal length 20 cm for the object at distance (i) 10 cm, (ii) 30 cm, (iii) 40 cm from the lens. **[3]**

- Ans:** (i) For the object at distance 10 cm, the image is virtual, upright and enlarged.
(ii) For the object at distance 30 cm, the image is real, inverted and enlarged.
(iii) For the object at distance 40 cm, the image is real, inverted and same size.

[3]

- B.** The diagram shows wheel O pivoted at point A. Three equal forces F_1 , F_2 and F_3 act at point B on the wheel.



- (a) Which force will produce maximum moment about A?

- (b) Give a reason for your answer in

[2]

Ans: (a) F_1

- (b) The moment produced by a force is given by the magnitude of the force multiplied by the perpendicular distance from the point of application of the force to the pivot point. In this case, the perpendicular distance from the line of action of F_2 and F_3 is less than the diameter. Therefore, the moment produced by force F_1 will be greater than the moments produced by forces F_2 and F_3 , since F_1 has the largest perpendicular distance from the pivot point A.

- c.** A bucket kept under a running tap is getting filled with water. A person sitting at a distance is able to get an idea when the bucket is about to be filled.

- (i) What change takes place in the sound to give this idea?

[2]

- (ii) What causes the change in the sound?

Ans: (i) As the bucket is filled the sound gradually increases.

- (ii) Frequency $\propto 1/\text{length}$; Resonance takes place.

[2]

- d.** Infra red radiations are used as signals during war. Explain.

[2]

Ans: Infra red radiations, because of their longer wavelength are scattered less by the fog or mist. So they are used as signals during war.

[2]

- e.** What will be the behaviour of a lens, if it is placed in water instead of air?

[2]

Ans: Focal length depends upon the refractive index of the material of the lens with respect to the medium surrounding it. Since the surrounding medium changes from air to water, the refractive index decreases and so the focal length of the lens increases.

[2]

- f.** Why will an echo not be heard when the distance between the source of sound and the reflecting surface is 10 m?(give your in terms persistence of hearing)

[2]

Ans: Echo will not be heard because minimum distance between the source and the reflecting surface should be 17 m.

[2]

- g.** In the atmosphere which colour of light gets scattered the least? And why.

[2]

Ans: In atmosphere red colour scatters the least. Due to its long wavelength.

[2]

Question 3

- a. The wave lengths for the light of red and blue colours are nearly 7.8×10^{-7} m and 4.8×10^{-7} m respectively.
 (i) Which colour has the greater speed in a vacuum?
 (ii) Which colour has a greater speed in glass? [2]

Ans.

- (i) Both colours of light have same speed in vacuum.
 (ii) In glass, speed of red light is more than that of blue light.

- b. A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens? Justify your answer. [2]

Ans:

Generally, a biconvex lens acts as a converging lens in air because the refractive index of air is less than that of the material of the lens. The refractive index of water (1.33) is more than the refractive index of the material of the lens (1.25). So, on immersing in water it will behave as a diverging lens.

- c. Amol and Amit purchased ice creams in plastic balls and cones, respectively, during their outing at the fun fair. After consuming their ice creams, Amol stated that regardless of whether they were filled with ice cream or empty, the centre of gravity of the objects would remain unchanged. Do you agree with Anu? Why? [2]

Ans: No

For plastic ball it remains same but for cone it changes.

- d. How does the presence of medium affect the amplitude of free vibrations of a body? [2]

Ans: The presence of medium decreases the amplitude of free vibrations of the body since it exerts a frictional force on the body which has a tendency to resist the motion. [2]

- e. State the position of object, position of image, nature of image when: Convex lens is used as objective lens of the photographic camera. [2]

Ans: Object is in between infinity and $2F_1$. Image is formed between F_2 and $2F_1$. Image is real; inverted and diminished. [2]

SECTION II (40 Marks)

Attempt any 4 questions from this Section.

Question 4

- a. Give an example for each of the following uses of a machine:

- (i) To change the point of application of the force.
 (ii) To obtain gain in force.
 (iii) To change the direction of force. [3]

Ans.

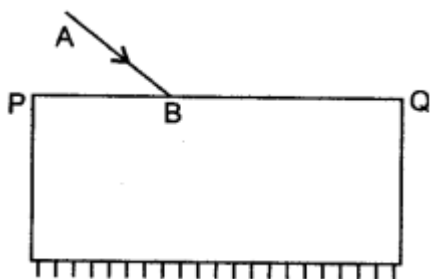
Examples are as follows:

- (i) Rotating the wheel of a cycle by applying force on the paddle with the help of a

chain.

- (ii) Lifting a car with a jack.
- (iii) Lifting a bucket full of water from a well using a single fixed pulley.

- b. i. Why is the focal length of the lens, used as magnifying glass, kept short?
- ii. The diagram on right shows a ray of white light AB incident on a rectangular glass block, which is silvered at lower surface. This ray is partly reflected and partly refracted.

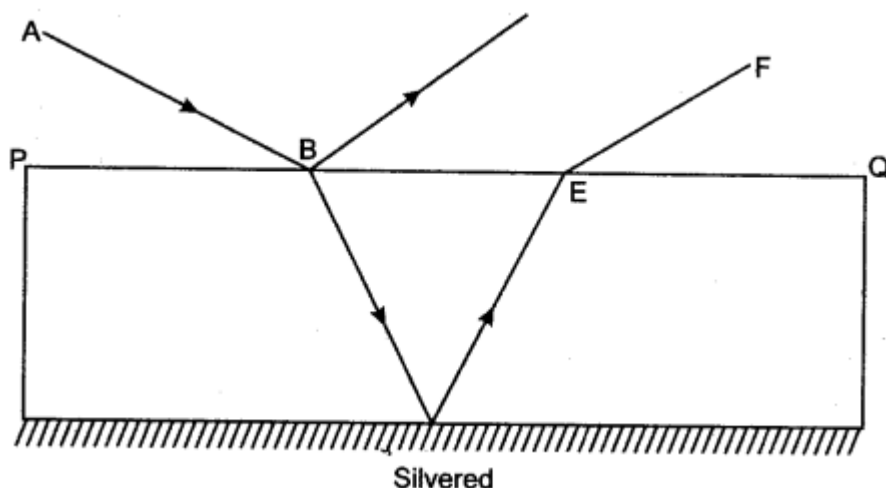


- (i) Copy the diagram and trace the path of the refracted and reflected ray. Show at least two rays emerging from the surface 'PQ'
- (ii) How many images are formed in the above case? Which image is the brightest?

Answer:

- (i) Ans: The focal length of the lens used as magnifying glass is kept small to increase its magnifying power.

(ii)



- (ii) Two images formed are: (a) on account of reflection from the upper surface, and (b) due to reflection from the lower surface. The second image is brighter.

[3]

- c. i. For a concave lens with $f = -18$ cm, an object is placed 18 cm away. Calculate the image distance. [2]
- ii. Samir exerts a force of 150 N in pulling a cart at a constant speed of 10 m/s. Calculate the power exerted. [2]

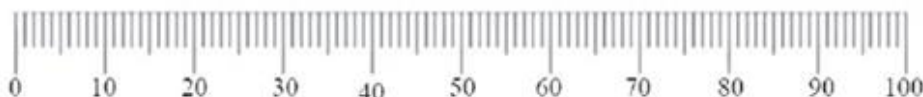
Ans: i. $1/(-18) = 1/v - 1/18$

$$v \approx -9 \text{ cm}$$

- ii. Let Time (t) = 1s,
 $\therefore$ Speed (s) = 10 m
 Force (F) = 150 N
 Work Done = F x s = 150 x 10 = 1500 Nm = 1500 J
 Power exerted = 1500J/1s = 1500 W

Question 5

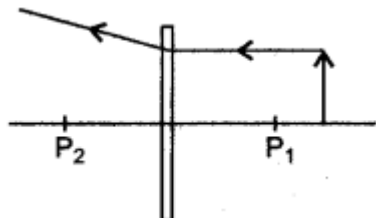
- d. A metre scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it.



- (i) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf?
 (ii) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre? [3]

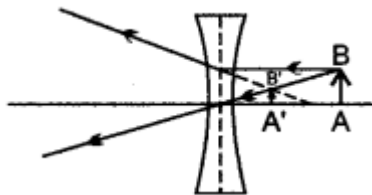
- Ans: (i) Let weight from (0 to 40) cm be W_1 and (40 to 100) cm be W_2 . Hence $W_1 + W_2 = 50$
 $W_1 = 50 - W_2$
 By principle of moments,
 Anti clockwise moment = clockwise moment
 $W_1 \times (40 - 0) = W_2 \times (100 - 40)$
 $(50 - W_2) \times 40 = W_2 \times 60$
 $2000 - 40W_2 = 60W_2$
 $100W_2 = 2000$
 $W_2 = 20 \text{ gf}$
 So, $W_1 = 50 - 20 = 30 \text{ gf}$
 Hence the part (0 – 50 cm) of the ruler will weigh more than 25 gf.
 (ii) Let the minimum weight needed be m.
 In equilibrium, Anti clockwise moment = clockwise moment
 $50 \times (50 - 40) = m \times (100 - 50)$
 $500 = 50m$
 $m = 10 \text{ gf}$

- e. Copy the following figure and complete it to show the formation of the image of the object AB. Name the lens used in the figure. [3]



- Ans: Since the ray is deviated away from the axis, the lens used is a concave lens. The

complete figure showing the image formed is given alongside. The image is virtual, erect and diminished.



[3]

- f. i. A truck weighing 1000 kg changes its speed from 36 km/h to 72 km/h in 2 minutes. Calculate the work done by the engine and its power. [3]
 ii. A converging lens has a focal length 40 cm. Calculate its power.

Ans: i.

$$\begin{aligned} \text{Work done (W)} &= \text{K.E. gained by the truck} = \frac{1}{2} m (v_2^2 - v_1^2) \\ &= \frac{1}{2} \times 1000 \text{ kg} [72^2 (\text{km/h})^2 - 36^2 (\text{km/h})^2] \\ &= \frac{1}{2} \times 1000 [20^2 (\text{m/sec})^2 - 10^2 (\text{m/sec})^2] \\ &= 500 \times 300 = 1.5 \times 10^5 \text{ J} \end{aligned}$$

$$\text{Power of the engine } P = \frac{W}{t} = \frac{1.5 \times 10^5 \text{ J}}{2 \times 60 \text{ sec}} = 1.25 \times 10^3 \text{ W.}$$

ii.

Converging lens means convex lens has focal length +ve

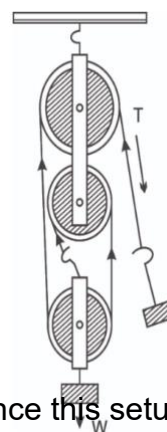
$$f = 40 \text{ cm} = \frac{40}{100} \text{ m}$$

$$\therefore \text{Power of lens} = \frac{1}{f} \text{ expressed in metres}$$

$$P = \frac{100}{40} = + 2.5 \text{ D}$$

Question 6

- e. The pulley system shown in the figure is to be used to lift a load W. If the man applying the effort cannot apply a force exceeding 1000 N, what is the maximum load that can be lifted? The actual load that the man is finally able to lift turns out to be 2700 N. What are the values of the actual M.A. obtained and the efficiency of the actual setup?



[3]

Ans:

The load lifted would be maximum when conditions are ideal. Since this setup uses three

strands of string, the load gets raised only through 1/3rd of the distance through which the effort moves. Hence,

Velocity ration = 3 (number of pulleys)

V.R. = M.A

Hence, Ideal M.A. of the setup = 3.

∴ Maximum load that can be lifted

= Effort × 3 = 1000 N × 3

= 3000 N. Under actual conditions,

M.A. = Load / Effort

= 2700 N / 1000 N ∴ Efficiency = M.A/V.R.=2.7/3 = 0.9 =90

=Effort Load=1000N2700N∴ Efficiency = V.R.M.A=32.7=0.9=90

- f. (i) State two ways in which resonance differs from forced vibrations.
 (ii) Explain why strings of different thicknesses are provided on a stringed instrument. [3]

Ans: (i) a) In resonance it is necessary that frequency of externally applied force should be equal to natural frequency of the body whereas, it is not necessary for forced vibrations.
 b) In forced oscillations the amplitude of oscillations is small whereas, in resonance the amplitude of vibration is large.

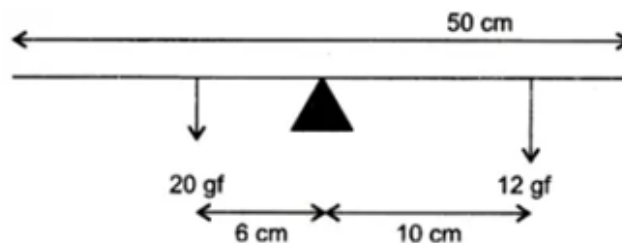
Ans: (ii) So as to produce sound of desired frequency. By plucking the string of more thickness, the frequency of sound produced decreases. [3]

- g. A half metre rod is pivoted at the centre with two weights of 20 g f and 12 g f suspended at a particular distance of 6 cm and 10 cm from the pivot respectively as shown below. (i) Which of the 2 forces acting on the rigid rod causes clockwise moment? (ii) Is the rod in equilibrium? (iii) The direction of 20 g f forces reversed. What is the magnitude of the resultant moment of force on the rod?

Ans: (i) The force 12 gf rotates the rod clockwise. (ii) Clockwise moment = 20 gf × 6 cm = 120 gf cm Anticlockwise moment = 12 gf × 10 cm = 120 gf cm

Since, the clockwise moment is equal to the anticlockwise moment, hence the rod is in equilibrium. (iii) On reversing the direction of force, 20 gf will also produce clockwise moment, total clockwise moment will then be (20 gf × 6 cm) + (12 gf × 10 cm) = 240 gf cm

[4]



Question 7

- a. i) A metallic blade is made to vibrate at its one end by keeping its other end clamped. The vibrations of the blade die away after some time. Explain, how you lower the frequency of the vibration of the blade?
 iii) Ranbir claims to have obtained an image twice the size of the object with a concave lens. Is he correct? [3]

Ans: i. The vibrations of the blade die away after some time due to air resistance (or

damping) The frequency of vibration of the blade can be lowered:

- (i) Increasing the vibrating length of the blade, (ii) Increasing the thickness of blade.
 ii. No., he is not correct. Because concave lens always forms virtual, erect and diminished image. [3]

- b. i. State the condition when the work done by force is negative.
 ii. Calculate the length of arm of couple, if a force of 13 N produces a moment of couple of 14.3 Nm. [3]

Ans: i. Work done by a force is negative when the displacement is in the direction opposite to the force.

ii. **Solution:**

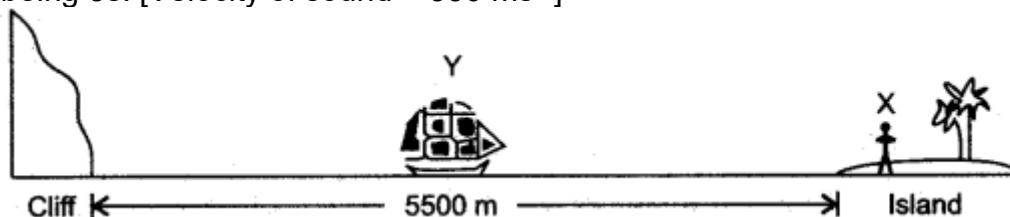
$$\text{Moment of couple} = \text{Force} \times \text{Arm of couple}$$

$$14.3 \text{ Nm} = 13 \text{ N} \times \text{Arm of couple}$$

$$\begin{aligned} \text{Arm of couple} &= \frac{14.3}{13} \\ &= 1.1 \text{ m.} \end{aligned}$$

[3]

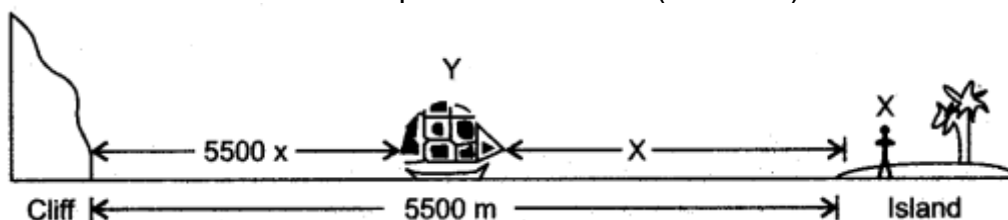
- c. An observer X is on an island 5500 m from a vertical cliff on the shore. A ship Y is anchored between the island and the Cliff. A blast on the ship's siren is heard twice by X, the interval being 5s. [Velocity of sound = 330 ms⁻¹]



- (i) Find the distance of the ship from the island.
 (i) Find the distance of the cliff from the ship.

[4]

Ans: (i) Let distance between the observer X on island and the ship Y = x m
 Distance between the ship Y and the cliff = (5500 – x) m



Let t_1 be the time at which the first blast is heard.

$$\begin{aligned} \therefore t_1 &= \frac{x}{v} \\ &= \frac{x}{330} \left(v = \frac{\text{Distance}}{\text{Time}} \right) \end{aligned}$$

Let t_2 be the time at which the second blast is heard i.e., time taken for the sound to travel from the ship to the cliff and then back to the observer on the island.

$$\therefore t_2 = \frac{\text{Total distance travelled}}{\text{Velocity}}$$

$$\therefore t_2 = \frac{11000 - x}{330} \quad \dots(ii)$$

$$\text{Total distance} = \text{Y to cliff} + \text{Cliff to the island}$$

$$\text{Total distance} = (5500 - x) + 5500$$

$$= (11000 - x)$$

but $t_2 - t_1 = 5s$

$\therefore$ Subtracting equation (i) from equation (ii) we get

$$\frac{11000 - x}{330} - \frac{x}{330} = 5$$

$$\therefore 11000 - 2x = 5 \times 330$$

$$\therefore 2x = 11000 - 1650$$

$$= 9350$$

$$x = 4675 \text{ m.}$$

$\therefore$ Distance between the ship Y and the island = 4675 m.

(ii) Distance between ship Y and the cliff

$$= 5500 - x$$

$$= 5500 - 4675$$

$$\therefore x = 825.$$

Distance of the ship from the island is 4675 m and the distance of the cliff from the ship is 825m.

[4]

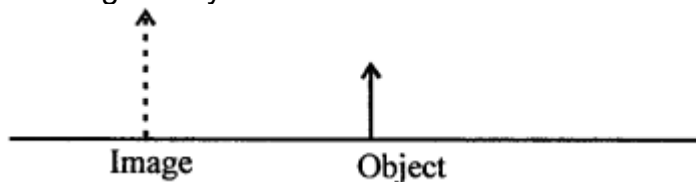
Question 8

e. (i) When an arrow is shot from a bow, it has kinetic energy in it. Explain briefly from where does it get its kinetic energy?

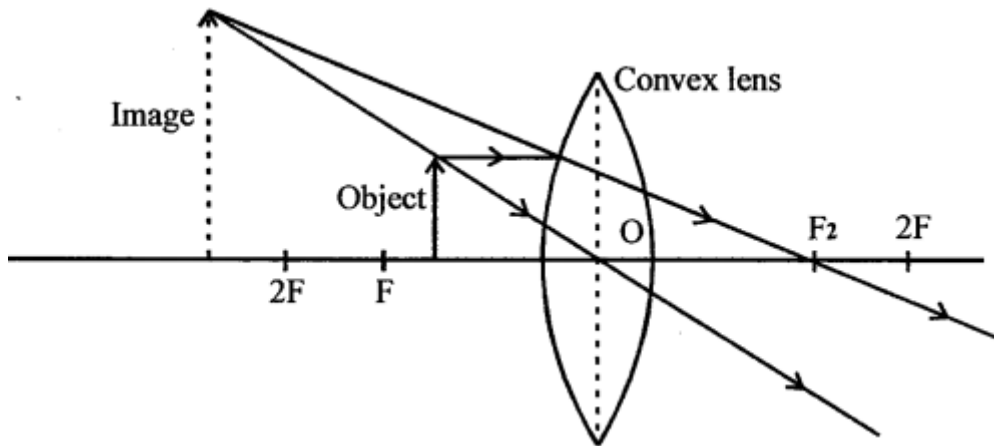
(ii) What energy conversions take place in microphone when it is working?

[2]

f. The diagram given below shows the position of an object and its image. Copy the diagram and then by drawing two rays locate the position of the lens and its focus, showing clearly the kind of lens used.



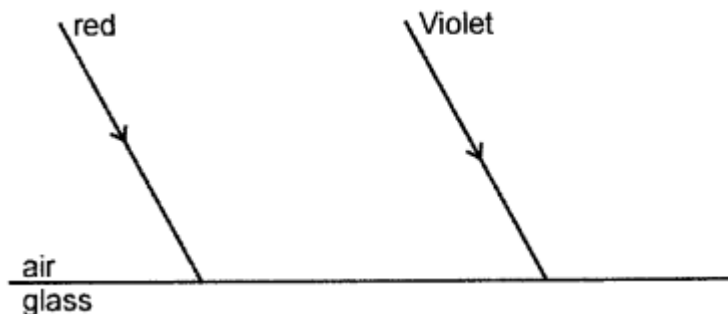
Ans:



As the image is magnified and on the same side of object, the lens must be convex. The object lies within focus and lens.

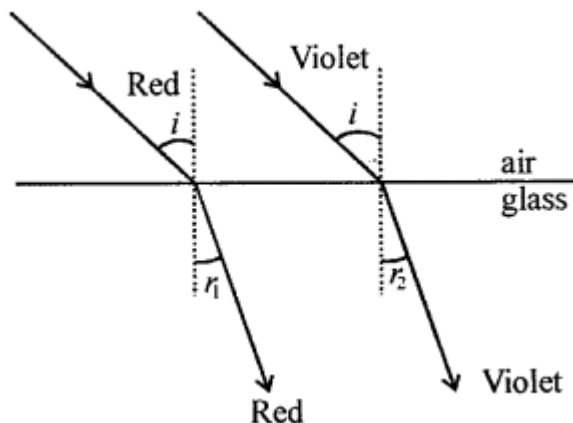
The lens is convex.

- g. Two parallel rays of Red and Violet travelling through air, meet the air-glass boundary as shown in the figure:



- (a) Will their paths inside the glass be parallel ? Give a reason for your answer.
 (b) Compare the speeds of the two rays inside the glass.

Ans:



The two refracted rays inside glass are not parallel . Because the refractive index of glass is less for Red light,

while it is more for violet light ($\mu_r < \mu_v$), So RED ray is deviated less while the violet is deviated more i.e. angle of refraction r_1 for red is more than angle of refraction r_2 for violet ray.

- (a) Since the refractive index of glass for violet colour is more. ($\mu_r < \mu_v$) SO, in glass, the red light travel faster than violet light. The paths inside the glass will not be parallel.

- (b) Velocity of red colours will be more than that of the violet colour.

- h. A pulley system with velocity ratio 3 is used to lift a load of 60 kgf through a height of 20 m. The force is applied in upward direction and its magnitude is 25 kgf. Calculate :

- (a) Work done by the effort
- (b) Mechanical advantage of pulley system
- (c) Efficiency of pulley system
- (d) Total number of pulleys in the fixed and movable block. [Take $g = 10 \text{ N kg}^{-1}$] **[4]**

Ans: V.R. = 3

Load is raised through 20 m

$$\text{V.R.} = \frac{d_E}{d_L}$$

$$3 = \frac{\text{Distance through which effort moves}}{20}$$

(a) $\therefore$ Distance through which effort is applied = $3 \times 20 = 60 \text{ m}$

(b) Work done by effort = $E \times \text{Effort arm}$

$$= 60 \text{ kgf} \times 60 \text{ m}$$

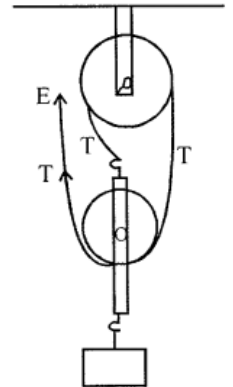
$$= (60 \times 10) \times 60$$

$$= 36000 \text{ N}$$

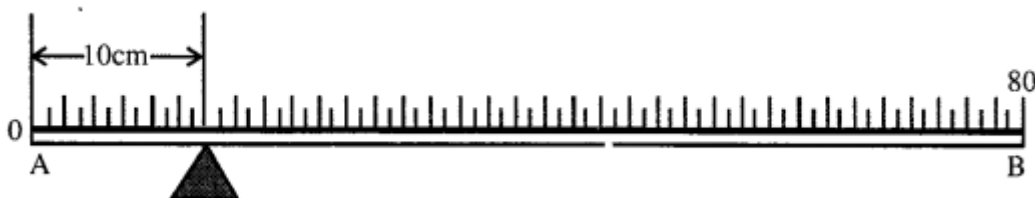
(c) $\text{M.A.} = \frac{L}{E} = \frac{60}{25} = 2.4$

(d) $\eta = \frac{\text{M.A.}}{\text{V.R.}} \times 100 = \frac{2.4}{3} \times 100 = 80\%$

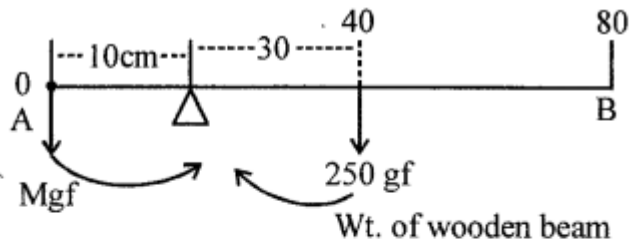
(e) As the effort applied is in upward direction. There are 2 pulley one in fixed block and one in movable block as drawn.



A uniform wooden beam AB, 80 cm long and weighing 250 gf, is supported on a wedge as shown in the figure. Calculate the greatest weight which can be placed on end A without causing the beam to tilt.



Answer:



Let M gf be suspended at A

∴ Anticlock wise moment = clockwise moment

$$M \times 10 = 250 \times (40 - 10)$$

$$M = \frac{250 \times 30}{10} = 750 \text{ gf}$$

A compressed spring is held near a small toy car of mass 0.15 kg. On the release of the spring, the toy car moves forward with a velocity of 10 ms⁻¹. Find the potential energy of the spring.

Answer:

mass of car m = 0.15 kg

velocity v = 10 ms⁻¹

$$\text{kinetic energy K.E.} = \frac{1}{2} mv^2$$

$$\frac{1}{2} \times \frac{15}{100} \times 10 \times 10 = 7.5 \text{ J}$$