HANDS ON EXPERIMENTS

FOCAL LENGTH OF A CONCAVE MIRROR

Experiment no 4 **Date:**

AIM

To determine the focal length of a concave mirror by obtaining image of a distant object.

THEORY

A concave mirror, like a plane mirror, obeys the laws of reflection of light. The rays of light coming from a distant object such as the sun or a distant tree or a distant building can be considered to be parallel to each other.

When parallel rays of light fall on a concave mirror along its axis, the rays meet at a point in front of the mirror after reflection from it. This point is the focus of the mirror.

For a parallel beam of light coming from a distant object, a real, inverted and very small image size is formed at the focus of the mirror .Since the image formed by the mirror is real, it can be obtained on a screen.

The distance between the pole O of the concave mirror and the focus F is the focal length of the concave mirror. Thus, the focal length of a concave mirror can be estimated by obtaining a real image of a distant object at its focus.

MATERIALS REQUIRED

A concave mirror, a mirror holder, a small screen fixed on a stand, and a measuring scale.

PROCEDURE

- Fix a concave mirror in the mirror holder and place it on the table near an open window. Turn the face of mirror towards a distant object (a tree or a distant building).
- Place the screen fitted to a stand in front of the concave mirror.
- Move the screen back and forth until a sharp, clear and inverted image of the distant object is formed on it.
- Mark the position of the centre of the stand holding the mirror and the screen when a sharp image of the distant object has been obtained on the screen.
- Measure the horizontal distance between the centre of the concave mirror and the screen with the help of a measuring scale.
- Record your observations in the observation table

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PRECAUTIONS

- Concave mirror should be placed near an open window through which sufficient sunlight enters, with its polished surface facing the distant object.
- There should be no obstacle in the path of rays of light from the distant object, incident on the concave mirror.

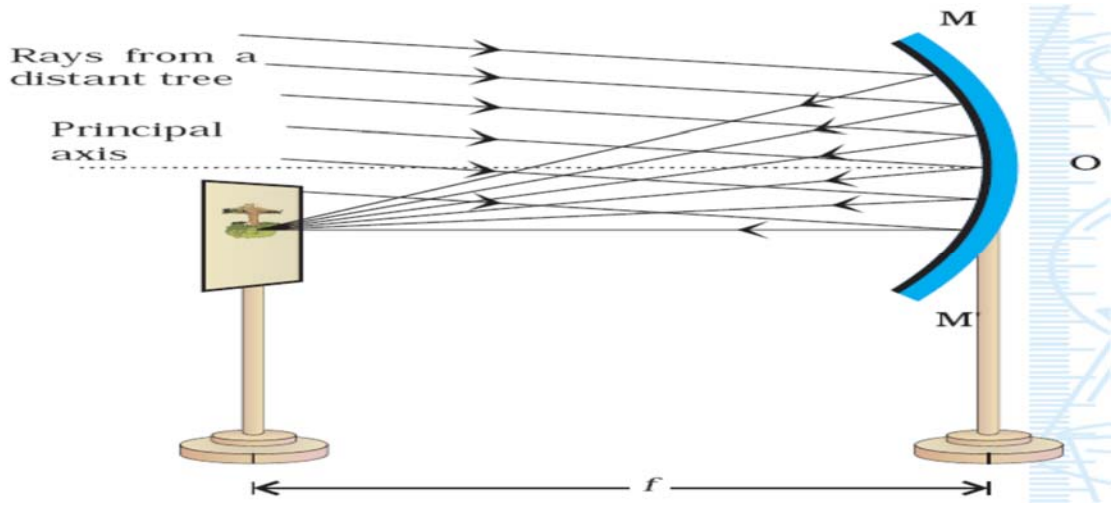
- The base of the stands of the concave mirror and screen should be parallel to the measuring scale.
- The mirror holder along with the mirror should be kept perpendicular to the measuring scale for precise measurements.

RESULT

The approximate value of focal length of the given concave mirror = cm.

NOTE to the Student:
The following content should be on the unruled side of the Journal

DETERMINATION OF FOCAL LENGTH OF A CONCAVE MIRROR

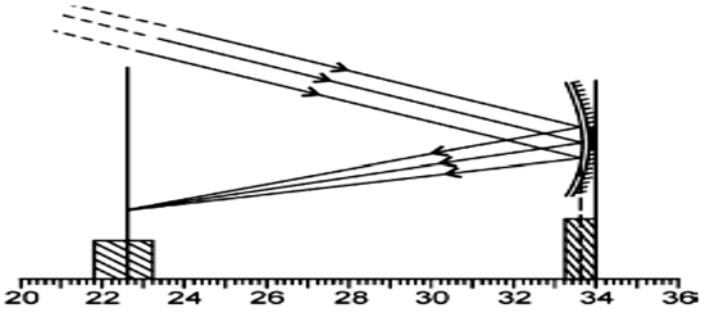


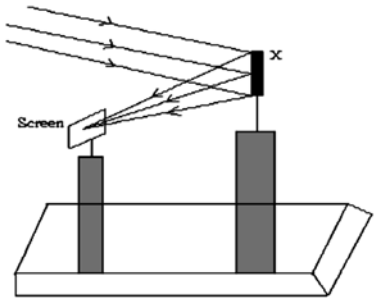
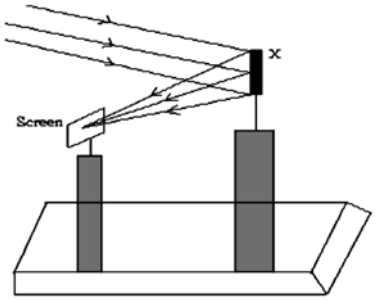
OBSERVATIONS

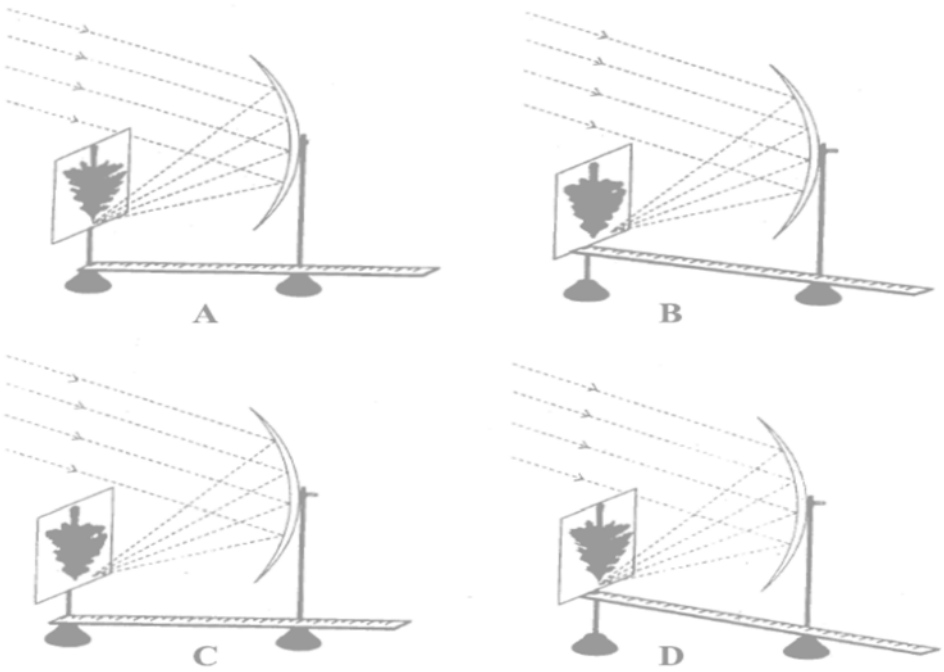
No	Name of the distant object	Distance between the concave mirror and the screen (f cm)	Mean focal length (f cm)
1			
2			

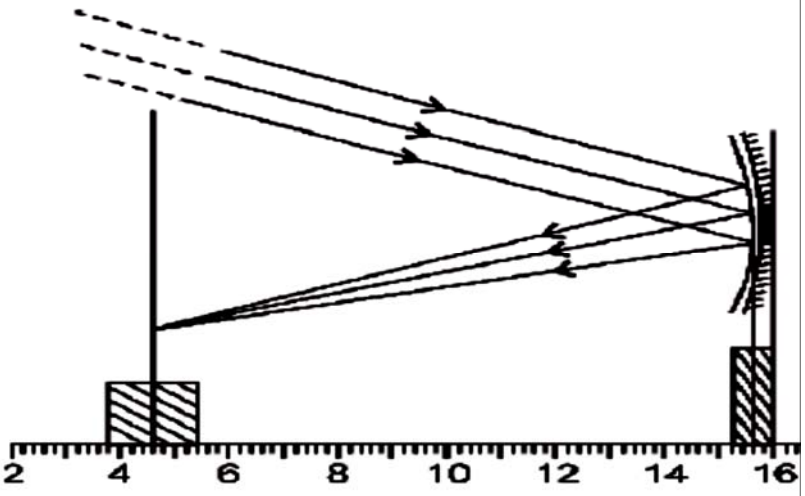
Mean focal length of the concave mirror = cm

MCQ QUESTIONS

A		MCQ BASED ON PRACTICAL SKILL	Mks	Level
1		The image of a distant object is obtained on a screen by using a concave mirror. The focal length of the mirror can be determined by measuring the distance between a. the object and the mirror b. the object and the screen c. the mirror and the screen d. the mirror and the screen as well as that between the object and the screen	1	C
2		The focal length of the concave mirror in the experimental set up is  a.10.2 cm b.11.4 cm c.12.2 cm d.11.0 cm	1	U
3		Your school laboratory has a large window. To determine the focal length of a concave mirror by focusing on a very distant object, using a screen, the screen should be placed	1	HOT

		a. In front of the mirror b. Behind the mirror c. Image formed only on the table top d. No image is formed		
4		An object is placed at a distance of 20cm in front of concave mirror of focal length 10cm. The image produced is a. real, inverted & diminished b. real, inverted & enlarged c. real inverted & same size d. virtual, erect and enlarged	1	HOT
5		To determine the focal length of a concave mirror, a student focuses on a distant object to obtain the image on the screen. The image will be a. Inverted and diminished b. Erect and diminished c. Inverted and magnified d. Erect and magnified 	1	U
6		A student determines the focal length of X by focusing a far off object to obtain the image of it on the screen positioned as shown in the figure below. X is a a. Concave mirror b. Convex mirror c. Plane mirror d. Convex lens 	1	HOT
7		A parallel beam of light coming from the distant object incident on a concave mirror parallel to its principal axis. After reflection from the mirror, the beam a. passes through its principal focus	1	C

		b. appears to pass through its principal focus c. appears to reflect from the point of incidence d. appears to pass through its center of curvature		
8		 Identify the correct experimental set up a. A b. B c. C d. D	1	U
9		The image of a distant object is obtained on a screen by using a concave mirror. The focal length of the mirror can be determined by measuring the distance between a. the object and the mirror b. the object and the screen c. the mirror and the screen d. the mirror and the screen as well as that between the object and the screen	1	A

10		The focal length of the concave mirror in the experimental set up shown below is  a. 10.3 cm b. 11.0 cm c. 11.7 cm d. 12.2 cm	1	A

ANSWER KEY

1	2	3	4	5	6	7	8	9	10

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		To determine the focal length of a concave mirror, a student focusses a classroom window, a distant tree and the sun on the screen with the help of a concave mirror. In which case will the student get more accurate value of focal length? What is focal length of a concave mirror?	2	C
2.		A student takes a mirror which is depressed at the centre and mounts it on a mirror stand. An erect and enlarged image of his face is formed. He places the mirror on a stand along a metre scale at 10 cm mark. In front of this mirror, he mounts a white screen and moves it back and forth along the metre scale till a highly sharp, well-defined image of a distant building is formed on the screen at 25.5 cm mark. a. Name the mirror and find its focal length. b. Why does the student get sharp image of the distant building at 25.5 cm mark?	2	U
3.		a. A ray of light passing through the center of curvature of a concave mirror is incident on its reflecting surface. What is the angle of incidence and angle of reflection of this ray? b. The radius of curvature of concave mirror is 42 cm. What is its focal length?	2	U
4.		The following is part of a student's report on an experiment to measure the focal length of a concave mirror. "I started with the object 6 cm from the mirror but couldn't get an image to form on the screen. I moved the object back a few cm and tried again, but I couldn't get an image to form on the screen until the object was 24 cm from the mirror. From then on I moved the object back 8 cm each time and measured the corresponding image distances. I wrote my results in the table." *u*/cm: 24.0, 32.0, 40.0, 48.0 *v*/cm: 72.5, 40.3, 33.0, 27.9	2	A

		a. Give two precautions that should be taken when measuring the image distance. b. Explain why the student was unable to form an image on the screen when the object was close to the mirror.		
5.		Is the image formed by a concave mirror at focus real or virtual? Write two differences between real and virtual image.	2	C

FOCAL LENGTH OF A CONVEX LENS

Experiment no 6 **Date:**

AIM

To determine the focal length of a convex lens by obtaining the image of a distant object.

THEORY

The rays of light coming from a distant object such as a distant tree or a distant building can be considered to be parallel to each other.

When a parallel beam of light falls on a convex lens, the rays, after refraction, converge at a point on its other side. This point is one of the two foci of the lens.

If the parallel beam of light comes from a distant object, a real, inverted image of very small size is formed at the focus of the lens. Since the image formed by the lens is real, it can be obtained on a screen.

The distance between the optical centre O of the convex lens and the focus point F1 or F2 is its focal length. Thus, the focal length of a convex lens can be estimated by obtaining a real image of a distant object at its focus.

MATERIALS REQUIRED

A thin convex lens, a lens holder, a small screen fixed to a stand, and a measuring scale.

PROCEDURE

- Fix a thin convex lens on a lens holder and place it on the table or platform near an open window through which sufficient sunlight enters. Turn the face of lens towards a distant object (a tree or a distant building).
- Place the screen fixed to a stand on the other side of the lens. Adjust the position of screen (by moving it back and forth in front of the convex lens) to get a sharp, clear and inverted image of the distant object on it .
- Mark the position of the centre of the stands holding the lens and that of the screen when a sharp image of the distant object has been obtained on the screen.
- Measure the horizontal distance between the centre of the convex lens and the screen with the help of a measuring scale. Record your observations in the observation table. This will give the focal length of the convex lens.

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PRECAUTIONS

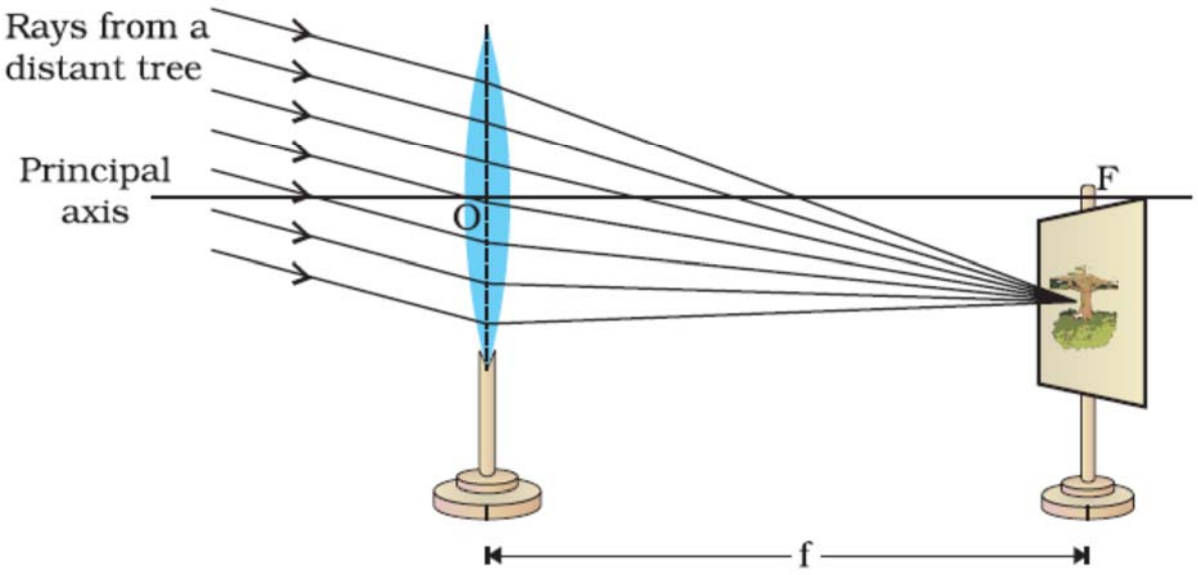
- The principal axis of the convex lens should be horizontal, that is, the lens should be placed vertically.
- There should be no obstacle in the path of rays of light from the distant object incident on the convex lens. Adjust the position of convex lens such that the light rays coming from the distant object fall on the lens without any obstruction.

- The base of the stands of the convex lens and screen should be parallel to the measuring scale. To determine the focal length, the distance between the convex lens and the screen should be measured horizontally (placed at the focus point on the other side of the lens).

RESULT

The approximate value of focal length of the given convex lens = cm.

DETERMINATION OF FOCAL LENGTH OF A CONVEX LENS

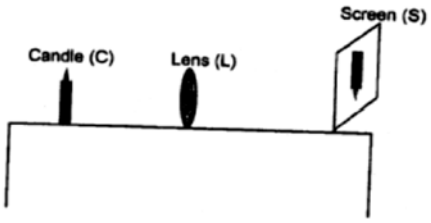


OBSERVATIONS

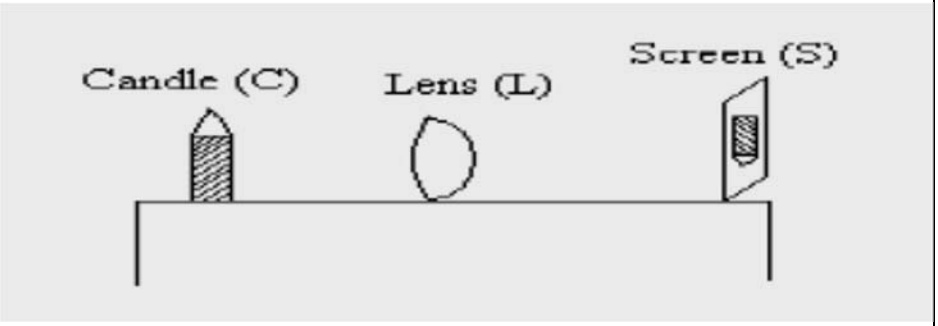
No	Name of the distant object	Distance between the convex lens and the screen (f cm)	Mean focal length (f cm)
1			
2			

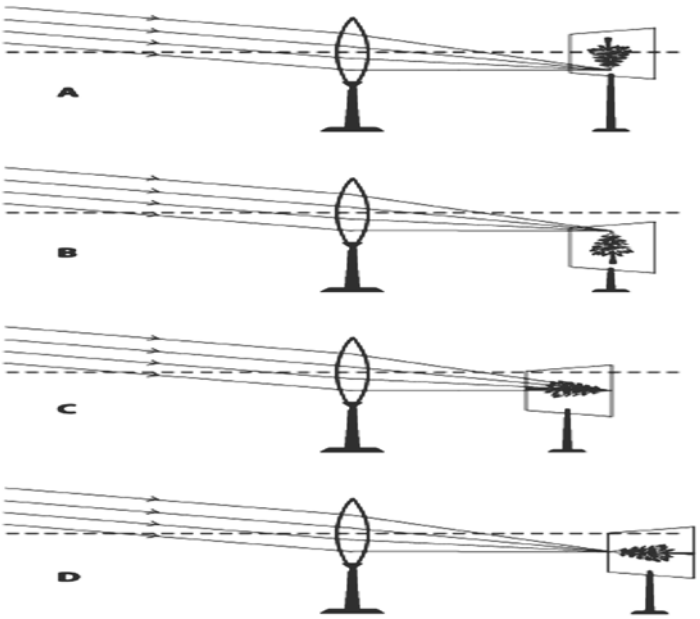
Mean focal length of the convex lens = cm

MCQ QUESTIONS

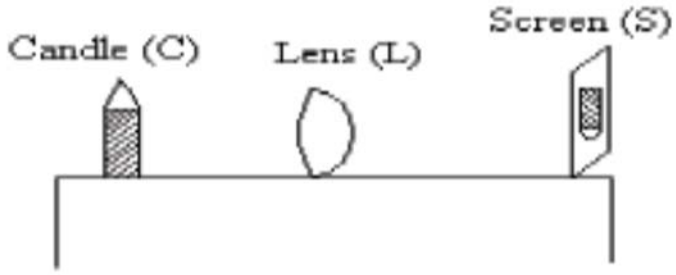
A		MCQ BASED ON PRACTICAL SKILL	Mks	Level
1		A glowing electric lamp kept at the focus of a convex lens produces a. Parallel beam b. Convergent beam c. Divergent beam d. No beam	1	C
2		A student obtains a sharp image of the candle flame on a screen using a convex lens by placing a lighted candle at one end of the table, a screen on the other end and the lens in between the candle and the screen as shown in the figure.  If now the candle flame were to be replaced by a distant lamp on a far away electric pole, the student would be able to get the sharp image of the lamp on the screen by moving a. The screen closer to the lens b. The lens away from the screen c. Moving the lens and the screen away from each other d. Neither the screen nor the lens	1	U
3		Parallel rays of light entering a convex lens always converge at a. centre of curvature b. principal focus c. optical centre	1	C

		d. the focal plane		
4		In order to determine the focal length of a convex lens, a student obtained a sharp image of a distant object on a screen. For getting better results, the student should focus at? a. grill b. distant tree c. distant building d. distant illuminated building	1	HOT
5		For determining the image of a distant object by a convex lens, you use a screen. The screen should be placed at: a. at the focal plane of the lens b. always from the focal plane of the lens c. before the focal plane of the lens d. at any position before the lens	1	U
6		In an experiment to determine the focal length, a student obtained a sharp inverted and diminished image of the distant tree on a screen. When she removed the lens and looked through the lens in the direction of the tree, she will see a. No image as the screen has been removed. b. An erect image of the tree c. An inverted image of the tree d. A blurred image of the tree	1	HOT

7		A student performs an experiment by placing the screen on one side of a table, a lighted candle on the other end of the table and a convex lens in between them as shown in the figure given below. The image of the candle flame would be,  a. Inverted and diminished b. Erect and magnified c. Erect and diminished d. Erect and same size	1	C
8		In order to determine the focal length of a convex lens, a student obtained a sharp image of the window grill on a screen. For getting better results, the teacher suggested of focusing a distant tree instead of the grill. In which direction should the lens be moved a. Away from the screen b. Towards the screen c. Very far away from the screen d. Behind the screen	1	U
9		Identify the correct experimental set up	1	A

		 a. A b. B c. C d. D		
10		A student performs an experiment on finding the focal length of a convex lens by keeping a lighted candle on one end of laboratory table, a screen on its other end and the lens between them as shown in the figure. The positions of the three are adjusted to get a sharp image of the candle flame on the screen a. the screen in the direction of the lens or the lens in the direction of the screen b. the screen in the direction of the lens or the lens away from the screen c. the screen away from the lens or the lens in the direction of the screen	1	A

d. neither the screen nor the lens



ANSWER KEY

1	2	3	4	5	6	7	8	9	10

<table>
<tr><th>B</th><th></th><th>PRATICAL BASED QUESTIONS</th><th>MARK</th><th>LEVEL</th></tr>
<tr><td>1.</td><td>  </td><td>What is the nature of an image formed by a thin convex lens for a distant object? What change do you expect if the lens were rather thick?</td><td>2</td><td>C</td></tr>
<tr><td>2.</td><td>  </td><td>A teacher sets up a stand carrying a convex lens of focal length 15 cm at 20.5 cm on the optical bench. She asks the students to suggest the position of the screen on the optical bench so that a distinct image of a distant tree is obtained on it. What should be the correct position of screen as suggested by the students and why?</td><td>2</td><td>U</td></tr>
<tr><td>3.</td><td>  </td><td>A student focused the image of a candle flame on a white screen by placing the flame at various distances from a convex lens. He noted his observations as given below:
<table>
<tr><th>S. No</th><th>Distance of flame from the lens (cm)</th><th>Distance of the screen from the lens (cm)</th></tr>
<tr><td>1.</td><td>60</td><td>20</td></tr>
<tr><td>2.</td><td>40</td><td>24</td></tr>
<tr><td>3.</td><td>30</td><td>30</td></tr>
<tr><td>4.</td><td>24</td><td>40</td></tr>
<tr><td>5.</td><td>12</td><td>70</td></tr>
</table>
(a) What is the focal length of a given convex lens?
(b) Which set of observations is incorrect and why?</td><td>2</td><td>A</td></tr>
<tr><td>4.</td><td>  </td><td>Suppose you move the candle from the focus of a convex lens towards infinity. In which direction should the screen be moved to get the real and sharp image? Why?</td><td>2</td><td>U</td></tr>
<tr><td>5.</td><td>  </td><td>The image of a candle formed by a convex lens is obtained on a screen. Will the full size of image be obtained if the lower half of the lens is covered with black paper and made completely opaque?</td><td>2</td><td>U</td></tr>
</table>

REFRACTION OF LIGHT THROUGH A GLASS SLAB

AIM : To trace the path of a ray of light passing obliquely through a rectangular glass slab and to measure the angle of incidence, angle of refraction, the angle of emergence and interpret the results.

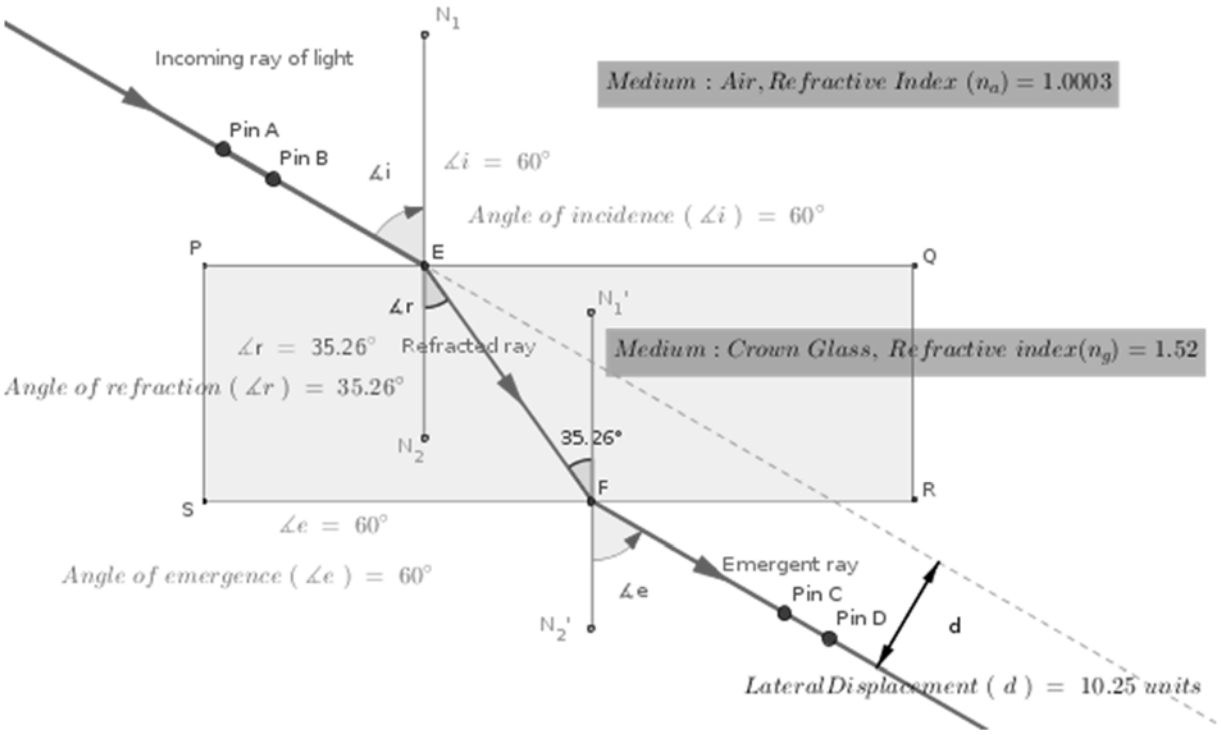
APPARATUS:

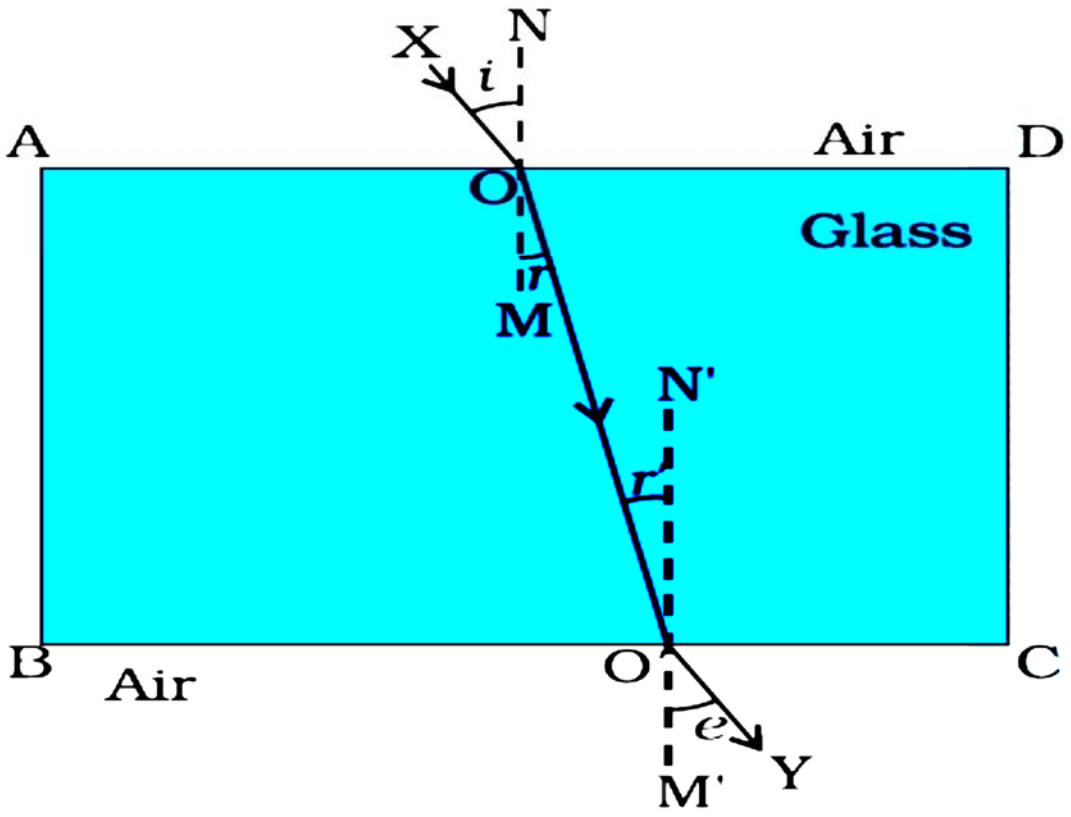
Drawing board, sheets of white paper, drawing pins, pencil, glass slab, protractor

PROCEDURE :

1. Fix a sheet of white paper on a drawing board with drawing pins. Place the given glass slab nearly in the middle of the sheet.
2. Mark the boundary of the glass slab with a sharp pencil and label it as PQRS after removing the slab from its position.
3. On the line PQ mark a point E and draw a normal N1EN2 at it. Draw a line AE making angle AEN1 with the normal. The angle should neither too small nor too large (say about 40 degree).
4. Now place the glass slab again on its boundary PQRS and fix two pins A and B vertically about 10 cm apart on the line AE (say points A and B).
5. Look through the glass slab along the plane of the paper from the side SR and move your head until the images of the two pins A and B are seen clearly. Closing your one eye, adjust the position of your head in such a way that the images of the pins A and B lie in the same straight line.
6. Fix two other pins C and D vertically in such a way that the images of the pins A and B and pins C and D, all these four, lie in the same straight line. Ensure that the feet of the pins (not their heads) lie in the same straight line.
7. Remove the slab and also the pins from the board and encircle the pin-pricks on the paper, with a sharp pencil.
8. Join the points D and C and produce the line DC towards the slab so that it meets the boundary line RS at the point F. Join the points e and F. Thus for the incident ray represented by line AE, the refracted ray and the emergent ray are represented by EF and FD respectively.
9. On the line RS draw a normal N1'FN2' at point F. Now, with a protractor, measure angle AEN1, angle FEN2 and angle DFN2' labelled as angle i, angle r and angle e respectively.

10. Now place the glass slab at some other position on the sheet of paper fixed on the board and repeat all the above steps again taking another angle of incidence.
11. Measure the angle of incidence i.e angle of refraction, angle of emergence, again.
12. Make a record of your observations in the observation table as shown below.





OBSERVATIONS

No	Angle of incidence	Angle of refraction	Angle of emergence

PRECAUTIONS:

1. The glass slab should be perfectly rectangular with all its faces smooth.
2. The angle of incidence should preferably be between 30˚ and 60˚.
3. Thin lines should be drawn, using a sharp pencil

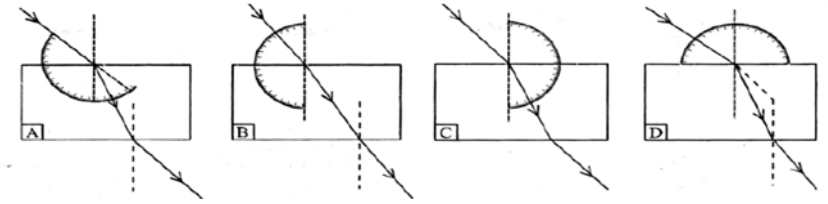
4. The angles should be measured accurately, using a good quality protractor having clear marking by keeping the eye above the marking.

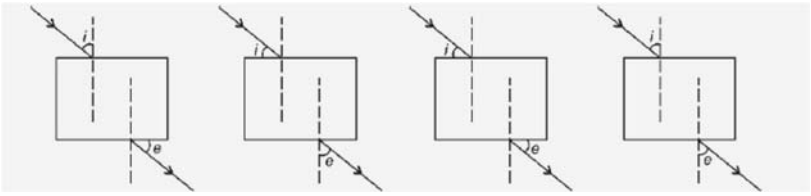
RESULT :

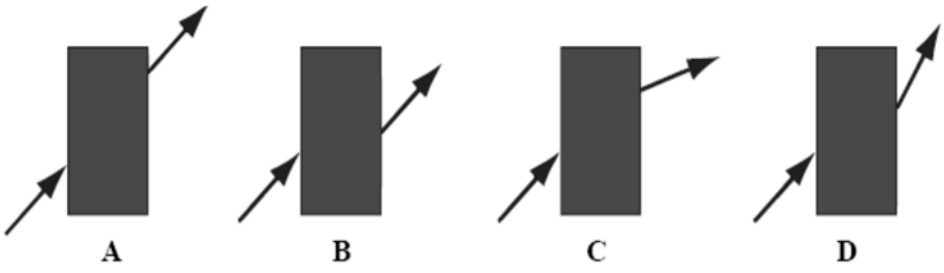
1. The path of the ray of light through a glass slab is shown.
2. As angle of refraction is less than angle of incidence, the ray entering from air to glass (denser medium) bends towards normal
3. As angle of incidence and angle of emergence are equal, the emergent ray emerging out of the rectangular glass slab, is parallel to, but laterally displaced with respect to the incident ray.

QUESTIONS

A.		MCQ BASED ON PRACTICAL SKILL	Mks	Level
1		A student performs the experiment on tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. He measures the angle of incidence i, angle of refraction r and angle of emergence e for all his observations. He would find that in all cases a)Angle i is more than angle r but (nearly) equal to angle e b)Angle i is less than angle r but (nearly) equal to angle e c)Angle i is more than angle e but (nearly) equal to angle r d)Angle i is less than angle e but (nearly) equal to angle r	1	U
2		A student suggested the following 'guidelines' to his friend for doing the experiment on tracing the path of a ray of light passing through a rectangular glass slab for three different angles of incidence: A. Draw the 'outline' of the glass slab at three positions on the drawing sheet. B. Draw 'normal' on the top side of these 'outline' near their left end. C. Draw the incident rays on the three 'outline' in directions making angles of 30^o, 35^o and 40^o with the normal drawn.	1	U

		D. Fix two pins vertically on each of these incident rays. E. Look for the images of the 'heads' of these pins while fixing two pins from the other side, to get the refracted rays. The incorrect statement is a) B b) C c) D d) E		
3		Four students to measure the angle of incidence of a light ray which passes through a rectangular glass slab, positions the protractor in a manner as shown in the figure. The correct way of positioning the protractor to measure the angle of incidence is that of the student **A** **B** **C** **D**  a) A b) B c) C d) D	1	U
4		4. Four students A, B, C and D performed an experiment to trace the path of the emergent ray through a rectangular glass slab for three different angles of incidence. They tabulated their observations of < i, < r and < e as per the tables given below.	1	U

		<table><tr><td>∠i</td><td>∠r</td><td>∠e</td></tr><tr><td>30°</td><td>32°</td><td>30°</td></tr><tr><td>40°</td><td>42°</td><td>40°</td></tr><tr><td>50°</td><td>55°</td><td>50°</td></tr></table> (A) <table><tr><td>∠i</td><td>∠r</td><td>∠e</td></tr><tr><td>30°</td><td>20°</td><td>30°</td></tr><tr><td>40°</td><td>25°</td><td>39°</td></tr><tr><td>50°</td><td>31°</td><td>49°</td></tr></table> (B) <table><tr><td>∠i</td><td>∠r</td><td>∠e</td></tr><tr><td>30°</td><td>25°</td><td>29°</td></tr><tr><td>40°</td><td>35°</td><td>39°</td></tr><tr><td>50°</td><td>45°</td><td>49°</td></tr></table> (C) <table><tr><td>∠i</td><td>∠r</td><td>∠e</td></tr><tr><td>30°</td><td>20°</td><td>32°</td></tr><tr><td>40°</td><td>30°</td><td>43°</td></tr><tr><td>50°</td><td>40°</td><td>52°</td></tr></table> (D) The student, who has done the experiment best of all, is a) A b) B c) C d) D		
5		Four students in an experiment to plot the path of the emergent ray through a rectangular glass slab labelled the angle of incidence ***i*** and the angle of emergence ***e*** as shown below.  **A** **B** **C** **D** The correct labelling of the angle of incidence ***i*** and the angle of emergence ***e*** is that of the student a) A b) B c) C d) D	1	U
6		While performing the experiment on tracing the path of a ray of light passing through a glass slab as shown in the	1	U

		given diagram, four students interpreted the results as given below. Which one of the four interpretations in correct? a) r > e b) r = e c) i = r d) i > r		
7		On the basis of their experiment 'to trace the path of a ray of light passing through a rectangular glass slab' four students arrived at the following interpretations: (1) Angle of incidence is greater than the angle of emergence. (2) Angle of emergence is less than the angle of refraction. (3) Emergent ray is parallel to the incident ray. (4) Emergent ray is parallel to the refracted ray. The correct interpretation is that of the student a) I b) II c) III d) IV	1	U
8		Four students A, B, C and D performed an experiment to trace the path of the emergent ray through a rectangular glass slab. The trace most likely to be correct is that of the student  A B C D	1	U

a) A
b) B
c) C
d) D

9 To trace the path of the emergent ray through a rectangular glass slab, four students measured the angle of incidence< I, angle of refraction<r and the angle of emergence <e as given

/i	/r	/e
30°	40°	30°
40°	50°	40°
50°	60°	50°

I

/i	/r	/e
30°	20°	30°
40°	30°	40°
50°	40°	50°

II

/i	/r	/e
30°	20°	40°
40°	30°	50°
50°	40°	60°

III

/i	/r	/e
30°	20°	20°
40°	30°	30°
50°	40°	40°

IV

The correct observation would be of the student

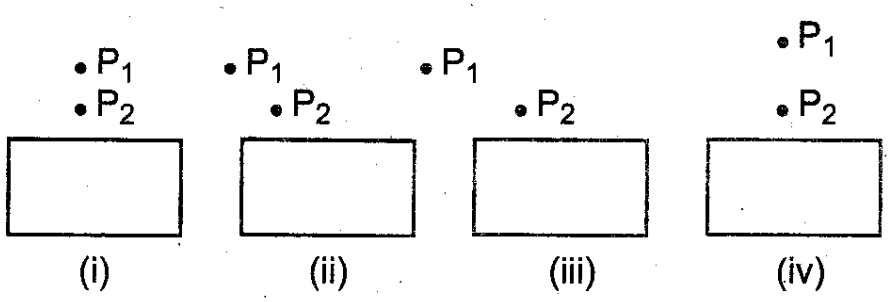
a) I
b) II
c) III
d) IV

1 U

Two dots P_1 and P_2 shown in each of the following diagrams denote the position of two pins in respect of the distance and direction for performing an experiment on tracing the path of a ray of light passing through a rectangular glass slab.

1 U

In which one of the 'four cases, one is likely to get the best result?



a) ii
b) iii
c) iv
d) i

SI.NO	1	2	3	4	5	6	7

SI.NO	8	9	10

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		In a experiment to trace the path of a ray of light through a glass slab, a) if the angle of incidence is increased, how does the angle of refraction change? b) What relationship students work out when they measure the angle of incidence and angle of emergence	2	C
2.		In a experiment with a rectangular glass slab, a student observed that a ray of light incident at an angle of 55˚ with the normal on one face of the slab, after refraction, strikes the opposite face of the slab before emerging out into air making an angle of 40˚ with the normal. What value would you assign to the angle of refraction and angle of emergence?	2	U
3.		A ray of light, incident obliquely on a face of a rectangular glass slab placed in air, emerges out from the opposite face. a) Draw a ray diagram to show the path of the ray of light and identify two points where refraction takes place. b) If this experiment is repeated with the different angles of incidence, what relation would you observe among the angle of incidence, the angle refraction and angle of emergence?	2	U
4.		Why the glass slab must not be displaced from tis boundary during the experiment to trace the path of a ray of light through a glass slab?	2	A
5.		What would be the observations of a student who performed the experiment to trace the path of a ray of light through a glass slab, whose two opposite faces are not parallel to each other?	2	C

REFRACTIVE INDEX OF PRISM

AIM :

To trace the path of rays through a rectangular glass prism

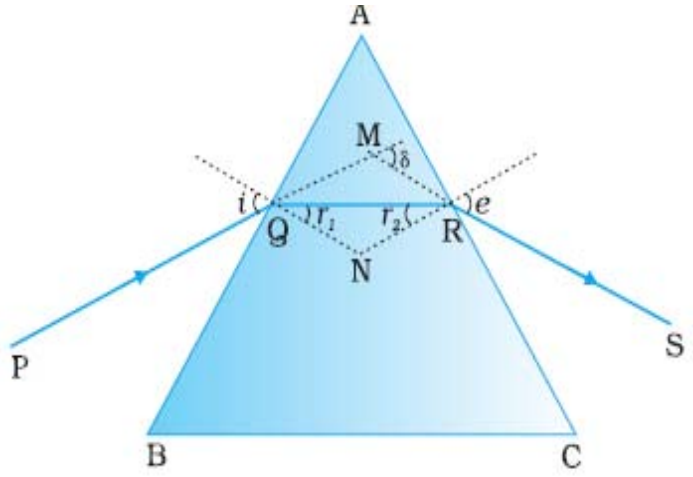
APPARATUS:

Drawing board, sheets of white paper, drawing pins, pencil, protractor.

THEORY:

When a ray of light passes from air to glass through a rectangular glass prism, it bends towards the normal at the surface of the air glass boundary. The phenomenon of change in the direction of light ray when it enters from one medium to another is known as refraction.

The angle between the incident ray produced forward and emergent ray produced backward is called angle of deviation.



i = angle of incidence

e= angle of emergence

δ = angle of deviation

r_1 & r_2 = angle of refraction

- As the angle of incidence increases, the angle of deviation first decreases and then increases.
- For an equilateral prism

Angle of incidence + angle of emergence = Angle of prism + angle of deviation.

$$\angle i + \angle e = \angle A + \angle \delta$$

PROCEDURE

1 Fix the white sheet of paper in the drawing board. Place the prism and draw its boundary with the help of a sharp pencil.

2 Draw a normal N on the face AB and draw an incident ray PQ making an angle of incidence I say 35^0.

3 Fix two pins P_1 and P_2 on the incident line PQ.

4 Now see the images P_1 and P_2 through the face Ac. Fix other pins P_3 andP_4 in such a way that these two pins and images of pins P1 and P_2 all appear in the same line.

5 Remove the pins P_3 andP_4 and join their positions getting the emergent ray RS.

6 Measure the angle of incidence, angle of refraction on the first face, angle of refraction on the second face, angle of emergence and angle of deviation δ corresponding to this angle of incidence.

SOURCES OF ERROR

1 The pins are not fixed vertically.

2 Prism is disturbed while taking observations.

PRECAUTIONS

1 The angle of incidence should be between 30^0 and 60^0.

2 The distance between pins should be at least 6 cm.

3 The pins must be vertical

4 The position of the prism should disturb on the white sheet

OBSERVATIONS

Angle of prism A = ----------

Sl no	Angle of incidence	Angle of refraction on face AB r_1(degrees)	Angle of refraction on face AC r_2(degrees)	Angle of emergence (degrees)	Angle of deviation δ(degrees)	$r_1 + r_2$	i + e	A + δ
1								
2								
3								

RESULT

1. As angle of incidence is increased, angle of deviation decreases then increases.
2. Angle of incidence + angle of emergence = Angle of prism + angle of deviation.
3. Angle of prism A = Angle of refraction on face AB (r_1) + Angle of refraction on face AC (r_2)

VIVA QUESTIONS WITH ANSWERS

1 Define angle of deviation.
Ans. The angle through which a ray of lights turns its original path on passing through a prism is called angle of deviation.

2 On what factors does the angle of deviation depend?

Ans. The angle of deviation depends upon the following factors:

(i) The angle of incidence

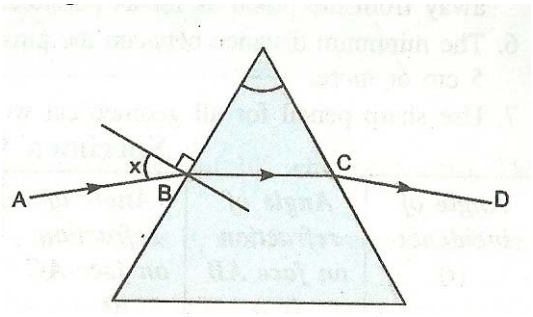
(ii) The refracting angle of the prism

(iii) The material of the prism

3 Define angle of minimum deviation?

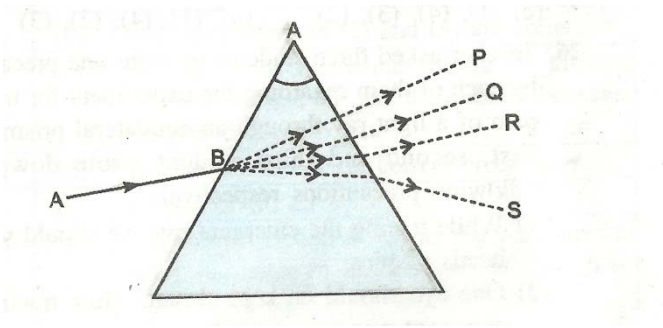
Ans. The least value of the angle of deviation is known as the angle of minimum deviation.

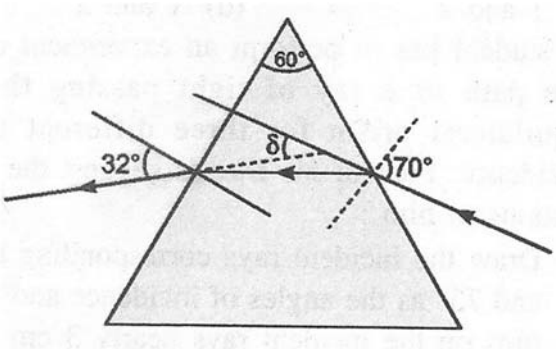
QUESTIONS

A.		Very Short Answer Questions (VSA)	Mks	Level
1		1. The angle between the given two refracting surfaces of a prism is called a. angle of refraction b. angle of a prism c. refracting angle d. any of the (b) or (c)	1	C
2		2. In the diagram AB and x are  a. incident ray and the angle of incidence b. incident ray and angle of emergence	1	U

		c. incident ray and the angle of refraction d. refracted ray angle of incidence		
3		In the case of glass prism when refraction takes place at its first refracting surface the angle of incidence is a. more than the angle of refraction b. equal to the angle of refraction c. less than the angle of refraction d. depends upon the angle of prism	1	U
4		In the case of prism when the refraction takes place at second refracting surfaces the angle r_2 inside the glass is always a. more than the angle of emergence b. equal to the angle of emergence c. less than the angle of emergence d. none of the above	1	U
5		The angle between the incident ray (produced forward) and the emergent ray (produced backward) is called a. angle of prism b. angle of emergence c. angle of refraction d. angle of deviation	1	U
6		The correct relation for <i, <A, <δ and <e for a prism is a. <i + <δ = <A + <e b. <i +<A = <δ +<e c. <i + <e = <A + <δ d. <i + <e + <δ = <A	1	U

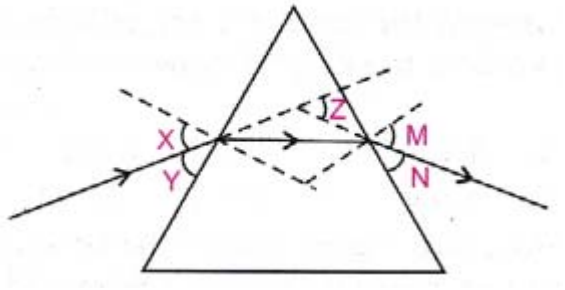
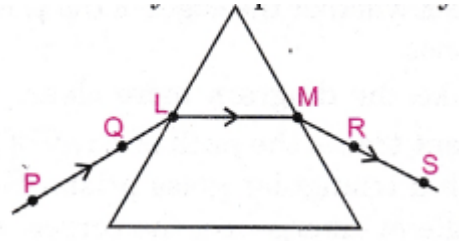
7		The correct relation for $<A$, $<r_1$ and $<r_2$ for a prism is a. $<r_1 = <A + <r_2$ b. $r_2 = <A + <r_1$ c. $<A + <r_1 + <r_2 = 90^0$ d. $<A = <r_1 + <r_2$	1	U
8		When a prism is in the minimum deviation position then a. $<i$ greater than $<e$ b. $<i$ less than $<e$ c. $<i = <e$ d .none of the above	1	U
9		When a prism is in minimum deviation position then a. $<r_1 = <r_2$ b. $<i$ greater than $<r_2$ c. $<r_1$ less than $<r_2$ d..None of the above	1	U
10		In an equilateral prism, $<e = 39^0$, $<\delta = 39^0$. The angle of incidence is a.45^0 b.50^0 c.70^0 d.60^0	1	A
11		In an equilateral prism, if the angle of incidence and the angle of emergence are 30^0 and 77^0 respectively, then the angle of deviation is a.47^0 b.44^0 c.39^0	2	A

		d.49^0		
12		In an equilateral prism, if the angle of incidence and the angle of deviation are 40^0 and 39^0 respectively, then the angle of emergence is a .47^0 b.49^0 c.55^0 d.59^0	2	A
13		In an equilateral prism if $<r_1 = 31^0$, then $<r_2$ on the second refracting surface is a.39^0 b.31^0 c.29^0 d.27^0	2	A
14		In the diagram, an incident ray AB strikes the refracting surface of an equilateral glass prism. The correct path of emergence is shown by  a. P b .Q c. R d .S		U

15		15. In the diagram the angle of deviation is  a.32^0 b.**36^0** c.42^0 d.44^0		U

SI.NO	**1**	**2**	**3**	**4**	**5**	**6**	**7**

SI.NO	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		1.For the refraction of a ray of light through a glass prism, the path of a ray of light is shown below.  Represent the angle of incidence, the angle of emergence ,and the angle of deviation respectively .Is angle of incidence equal to angle of emergence?	2	C
2.		Identify PL,LM AND RS. Why does the ray of light bend through the prism?  	2	U
3.		In the experiment to trace the path of a ray of light through a triangular glass prism, 1. a student is asked to draw the boundary of prism on the paper, why? 2. if the angle of incidence is 30°, what can be the measure of angle of emergence at the minimum deviation condition of the prism?	2	U
4.		In the experiment to trace the path of a ray of light through a triangular glass prism, 1. if the emergent ray makes an angle of 35° with the second face of prism, then what is the angle of emergence?	2	A

		2. can the angle of deviation be zero and why?		
5.		A very thin narrow beam of white light is made incident on one face of rectangular glass slab and one face of the combination of two prisms, one up and one down in contact. Comment on the nature of the behaviour of the emergent beam in the above two cases.	2	C

PRACTICAL SKILLS

LIST OF EXPERIMNTS

- To study the dependence of potential difference (V) across a resistor on the current (I) passing through it and determine its resistance. Also plot a graph between V and I.

- To determine the equivalent resistance of two resistors when connected in series.

- To determine the equivalent resistance of two resistors when connected in parallel.

OHM'S LAW

Experiment No: 1 Date:

AIM

To study the dependence of the potential difference across a resistor on the current through it and to determine its resistance and to verify the Ohm's law

APPARATUS

A resistor, an ammeter, a voltmeter, a rheostat, a battery eliminator, a plug key, connecting wires, and a piece of sand paper.

THEORY

According to the Ohm's law, the potential difference (*V*) across the ends of a resistor is directly proportional to the current (*I*) through it provided its temperature remains the same.

That is
$V \propto I$
$V = IR$
constant = R

Here *R* is a constant for the given resistor at a given temperature and is called its resistance.

The SI unit of resistance is ohm (Ω).

A graph between the potential difference across the two ends of a resistor and the current through it is a straight line passing through the origin. The slope of this graph gives the resistance *R* of the resistor.

To verify the Ohm's law, we measure the potential difference across the two ends of a resistor at different currents through it in an electric circuit. The current through the resistor is measured by connecting an ammeter in series with it. The potential difference across the two ends of the resistor is measured by connecting the voltmeter in parallel with it.
A straight line graph obtained between *V* and *I* verify the ohm's law.

PROCEDURE

- Note the range and least count of the given ammeter and the voltmeter.
- Fresh connecting wires have an insulating layer on it. Similarly the connecting wires lying unused for some time may also develop an insulating layer. It is therefore important to clean the ends of connecting wires using a sand paper.
- Draw a circuit diagram for studying the Ohm's law .Observe how different components like the ammeter, voltmeter, resistor, and the plug key are connected with the cells (or battery eliminator).

- Set up the circuit by connecting different components with the help of connecting wires. Make sure that the positive and negative terminals of the ammeter and voltmeter are correctly connected in the circuit.
- Insert the key in the plug to let the current establish in the circuit.
- Note the readings of the ammeter and voltmeter and record them. The voltmeter measures the potential difference (*V*) across the two ends X and Y of the resistor, and the ammeter measures the current *I* through it. Remove the key from the plug to avoid unnecessary heating of wire
- Repeat the experiment by moving the sliding contact of the rheostat

GRAPH

- Find the range of variation in the values of *I* and *V*. Choose appropriate scales for *I* and *V* along the *x*- and *y*-axes respectively on the graph paper.
- Mark the points on the graph paper for each value of current *I* and corresponding value of potential difference *V*.
- Join all the points as a smooth line as possible such that most of the points lie on it.
- Find the slope of this straight line graph by choosing two points P and Q on it. This slope is the resistance of the resistor used in the circuit.

PRECAUTIONS

- The connecting wires should be thick copper wires and the insulation of their ends should be removed using the sand paper.
- Connections should be tight otherwise some external resistance may introduce in the circuit.
- The ammeter should be connected in series with the resistor such that the current enters at the positive terminal and leaves at the negative terminal of the ammeter.
- Voltmeter should always be connected in parallel to resistor.
- The pointers of the ammeter and voltmeter should be at zero mark when no current through the circuit.
- Current should be passed through the circuit for a short time while taking observations; otherwise current would cause unnecessary heating in the circuit. Heating may change the resistance of resistors

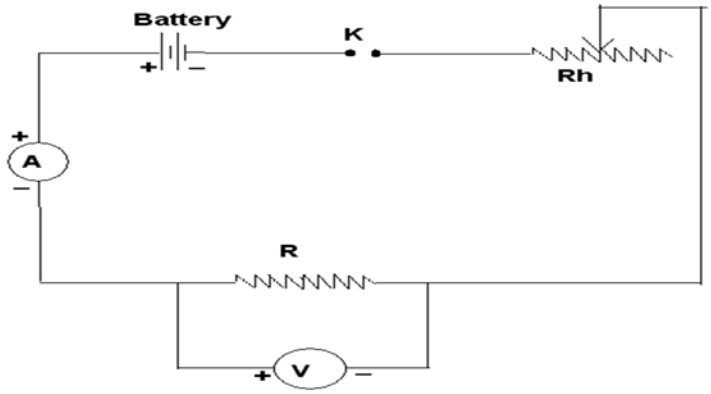
RESULTS

- The ratio of voltmeter to the ammeter reading is found to be a constant.
- Resistance of the material of the wire = Ohms
- The graph between *V* and *I* is a straight line and passes through the origin. This verifies the Ohm's law.

NOTE to the Student:
The following content should be on the unruled side of the Journal

VERIFICATION OF OHM'S LAW

CIRCUIT DIAGRAM



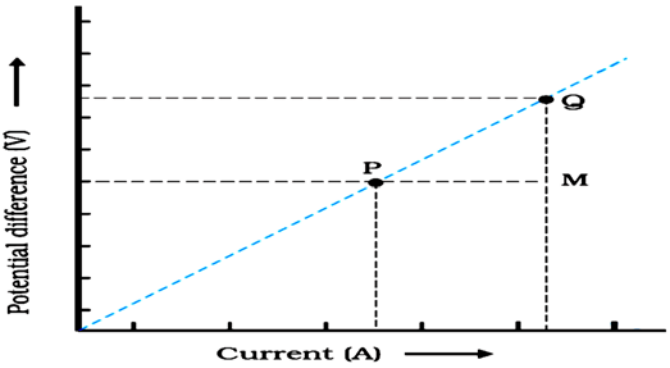
OBSERVATIONS AND CALCULATIONS

Range of the ammeter = 0 to A.
Least count of the ammeter = Amperes.
Range of the voltmeter = 0 to Volts.
Least count of the voltmeter = Volts.

No	VOLTMETER READING (V Volts)	AMMETER READING (I Amperes)	RESISTANCE = V/I (R Ohms)
1	0	0	
2			
3			
4			

Mean resistance of the wire = Ohms

V- I Graph



Resistance from V- I graph = $\frac{QM}{PM}$ = ohms.

MCQ QUESTIONS

		MCQ'S (PRACTICAL BASED)	Mks	Level
1		In the experiment to study the dependence of current with voltage, three students tabulated their readings as shown below.	1	

I

L.C. of milliammeter = 2 mA

L.C. of voltmeter = 0.1 V

S. No.	Reading of the	
	Voltmeter	milliammeter
1.	1	20
2.	2	38
3.	3	60
4.	4	80

II

L.C. of milliammeter = 2mA

L.C. of voltmeter = 0.1 V

S. No	Reading of the	
	Voltmeter	milliammeter
1.	1	20
2.	2	39
3.	3	61
4.	4	80

III

L.C. of millammeter = 2mA

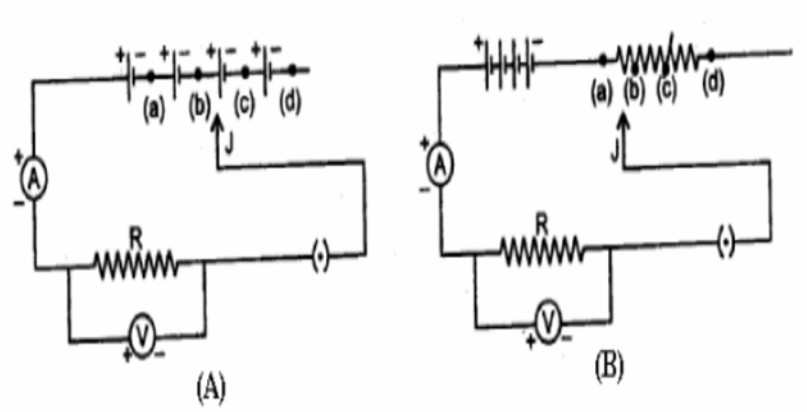
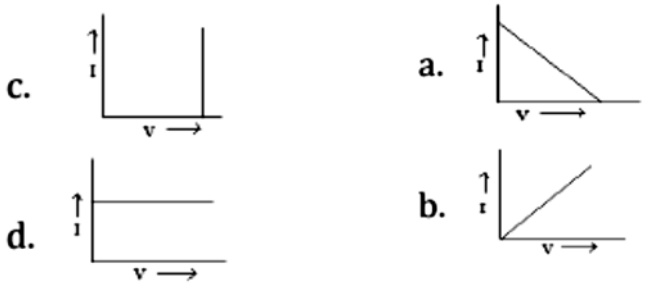
L.C. of voltmeter = 0.1V

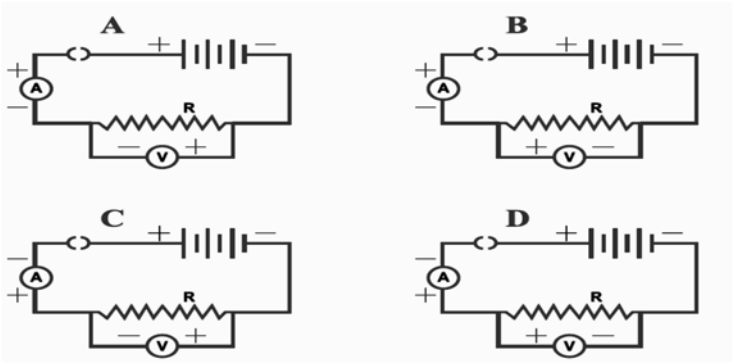
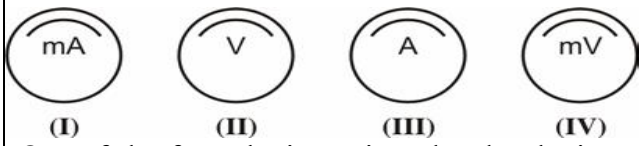
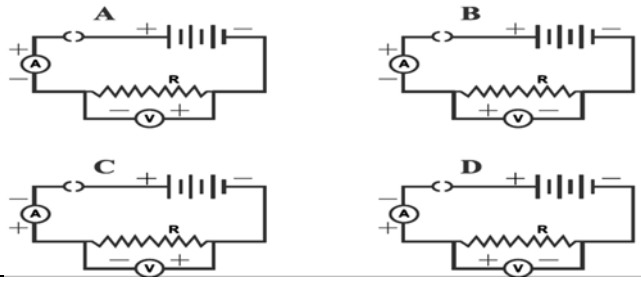
S. No	Reading of the	
	Voltmeter	milliammeter
1.	1.0	20
2.	2.0	40
3.	3.0	62
4.	4.0	80

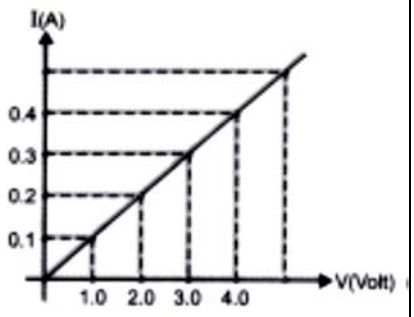
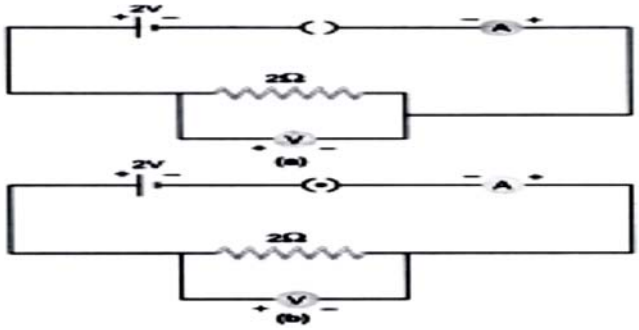
The reading is likely to be correct is that of the student:

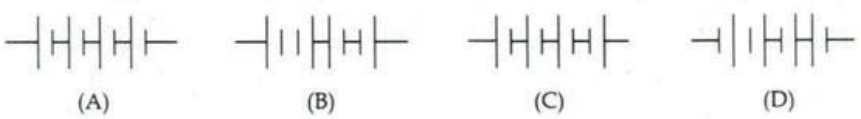
a) Student I
b) Student II
c) Student III
d) Student I and III

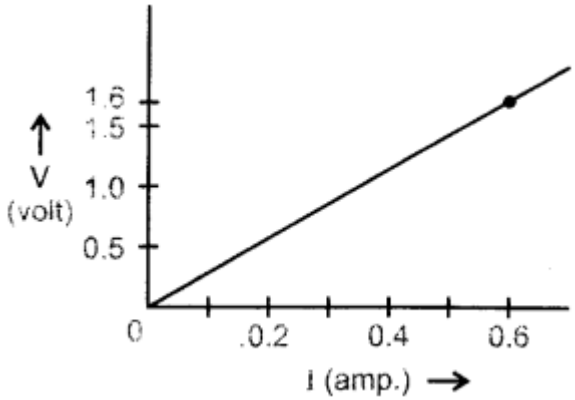
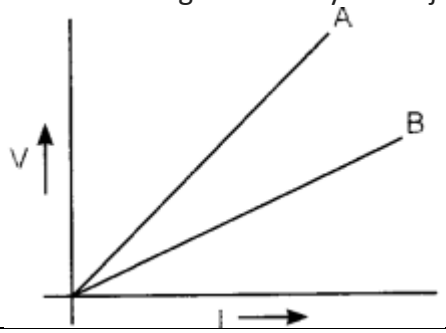
2		To study the dependence of current (I) with potential difference (V) across the resistor (R), two students used the set up s as shown the figure A and B. For the students, ammeter and voltmeter readings will be minimum when the contact J is in positions,	1	

		 a) **a** and **d** b) **b** and **c** c) **c** and **b** d) **d** and **a**		
3		Identify the correct voltage- current graph from the following a) a b) b c) c d) d 	1	
4		The correct circuit diagram to determine the value of unknown resistance is : a) A	1	

		b) B c) C d) D 		
5		Four different measuring devices are given below.  Out of the four devices given be the devices which can be used to measure current are: a) I and II b) I and III c) I and IV d) I and II	1	
6		Of the four experimental set ups, the voltmeter and ammeter are correctly connected in a) A b) B c) C d) D 	1	
7			1	

		In an experiment to study the dependence of current on potential difference across a resistor, a student obtained the graph as shown in Fig. The value of resistance of the resistor is : a) 4 Ω b) 20 Ω c) 10 Ω d) 2 Ω 		
8		For the circuits shown in Fig. (a) and (b), the voltmeter reading would be :  a) 2 V in circuit (*a*) and 0 V in circuit (*b*) b) 0 V in both circuits c) 2 V in both circuit d) 0 V in circuit (*a*) and 2 V in circuit (*b*)	1	
9		The following 'precautions' were listed by a student in the experiment on study of 'Dependence of current on potential difference.' (A) Ammeter should be connected in parallel and voltmeter in series to the resistor. (B) All the connections should be kept tight. (C) The positive terminal of the battery should be connected to the positive terminals of voltmeter and the ammeter. (D) The 'zero error' in the ammeter and the voltmeter should be noted and taken into consideration while recording the measurements.	1	

		(E) The 'key' in the circuit, once plugged in, should not be taken out till all the observations have been completed. The 'precautions' that need to be corrected and revised are: a) (A), (C) and (E) b) (C) and (E) c) (B) and (E) d) (A) and (E)		
10		A student has to connect 4 cells of 1.5 V each to get a voltage of 6V. The correct way of connecting the cells is shown in the figure: a) A b) B c) C d) D  (A) (B) (C) (D)	1	

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		a)A bulb can not be used in place of a resistor to verify Ohm's law. Justify this statement with reason? (hint: The condition of Ohm's law is constant temperature) b) what is likely to happen if the positions of the ammeter and voltmeter interchanged in Ohm's law verification experiment?	2	C
2.		Draw a closed-circuit diagram consisting of a 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V each and a plug key. (ii)Following graph was plotted between V and I values:  What would be the values of V /I when the potential difference is 1.6 V? Define the unit of the physical quantity obtained from the ratio V/I? (ans:2.67Ω)	2	U
3.		V-I graph for two wires A and B are shown in the figure. If both wires are of same length and same thickness, which of the two is made of a material of high resistivity? Give justification for your answer.  	2	U
4.		When a high resistance voltmeter is connected directly across a resister its reading is 2 V. An electric cell is sending the current of 0.4 A, (measured by an ammeter) in the electric circuit in which a rheostat is	2	A

		also connected to vary the current. (a) Draw an equivalent labelled circuit for the given data. (b) Find the resistance of the resister. (c) Name and state the law applicable in the given case. A graph is drawn between a set of values of potential difference (V) across the resister and current (I) flowing through it. Show the nature of graph thus obtained.?		
5.		When a high resistance voltmeter is connected directly across a resister its reading is 2 V. An electric cell is sending the current of 0.4 A, (measured by an ammeter) in the electric circuit in which a rheostat is also connected to vary the current. (a) Draw an equivalent labelled circuit for the given data. (b) Find the resistance of the resister. (c) Name and state the law applicable in the given case. A graph is drawn between a set of values of potential difference (V) across the resister and current (I) flowing through it. Show the nature of graph thus obtained.?	2	C

RESISTORS IN SERIES

Experiment No: 2 Date:

AIM

To determine the equivalent resistance of two resistors connected in series combination.

THEORY

When two resistors of resistance *R1* and *R2* respectively are connected in a series combination, then their equivalent resistance R_s is given by

$$R_s = R_1 + R_2$$

In order to determine the resistance of a combination of resistors in series, the current *I* flowing through the circuit is measured with an ammeter connected in series with the combination. The potential difference *V* across the combination of resistors is measured with a voltmeter connected in parallel

MATERIALS REQUIRED

Two resistors, an ammeter, a voltmeter, a battery eliminator, a plug key, connecting wires and a piece of sand paper.

PROCEDURE

- Note the range and least count of the given ammeter and the voltmeter.
- Draw a circuit diagram for the series combination of resistors. Observe how different components like the ammeter, voltmeter, combination of resistors in series (of known resistances *R1* and *R2*) and the plug key are connected with the battery eliminator.
- Place the given resistors one after the other and join the ends in series. Set up the circuit by connecting different components with the help of connecting wires as shown in the circuit diagram.
- Make sure that the positive and negative terminals of the ammeter and voltmeter are correctly connected in the circuit.
- Insert the key in the plug to let the current establish in the circuit.
- Note the readings of the ammeter and voltmeter and record them.
- The voltmeter measures the potential difference (*V*) across the two ends of the series combination of two resistors, and the ammeter measures the current *I* through the series combination.
- Remove the key from the plug to avoid unnecessary heating of wires

- Repeat the activity for three different values of current through the circuit and record the readings of the ammeter and voltmeter in each case.

PRECAUTIONS

- The connecting wires should be thick copper wires and the insulation of their ends should be removed using the sand paper.
- Connections should be tight otherwise some external resistance may introduce in the circuit.
- The ammeter should be connected in series with the combination of resistors such that the current enters at the positive terminal and leaves at the negative terminal of the ammeter.
- Voltmeter should always be connected in parallel to the combination of resistors.
- The pointers of the ammeter and voltmeter should be at zero mark when no current flows through the circuit.

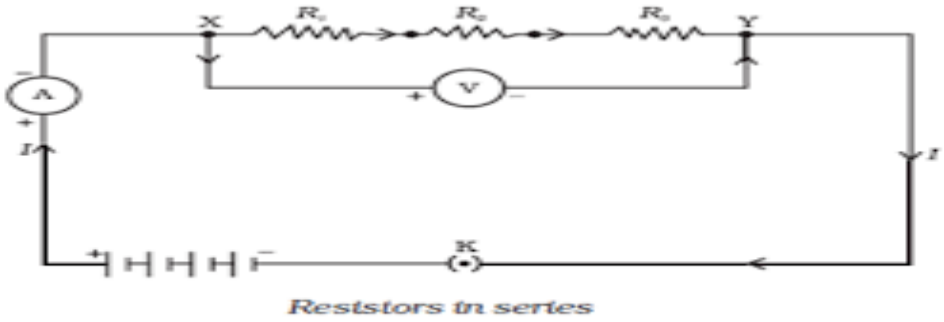
RESULT

Observed value of the equivalent resistance of the series combination =

Calculated value of equivalent resistance =

NOTE to the Student:
The following content should be on the unruled side of the Journal

VERIFICATION OF THE LAW OF COMBINATION OF RESISTORS IN SERIES



Reststors tn serles

Figure 3

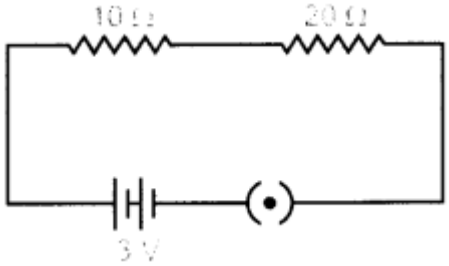
OBSERVATIONS AND CALCULATIONS

Range of the ammeter = to A
Least count of the ammeter = A
Range of the voltmeter = to V
Least count of the voltmeter = V
Resistance of first resistor *R1* = Ω
Resistance of second resistor, *R2* = Ω

Equivalent resistance $R_S = R1 + R2$ = Ω

No	VOLTMETER READING (V Volts)	AMMETER READING (I Amperes)	RESISTANCE = V/I (Rs Ohms)
1			
2			
3			
4			

Mean equivalent resistance by series combination = Ohms

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		There are three resistors joined in series in a system having resistance equal to 10 Ω, 20 Ω and 30 Ω respectively. If the potential difference of the circuit is 240 V, find the total resistance and current through the circuit.	2	C
2.		There are two electric lamps M and N which are joined in a series having resistance equal to 15 Ω and 20 Ω respectively. If the potential difference between two terminals of electric circuit is 220V, find the total resistance and electric current through the circuit. Also find the potential difference across the two lamps separately.	2	U
3.		Name the physical quantity which is (i) same and (ii) different in all the bulbs when three bulbs of: a. Same wattage is connected in series b. Different wattage is connected in series. or a. Same current and same potential difference b. Same current and different pd.	2	U
4.		Study the following electric circuit and find (i) the current flowing in the circuit and (ii) the potential difference across 10 Ω resistor. 	2	A
5.		Two resistors of 10 Ω and 15 Ω are connected in series to a battery of 6 V. How can the values of current passing through them be compared?	2	C

RESISTORS IN PARALLEL

Experiment No: 3 Date:

AIM

To determine the equivalent resistance of two resistors connected in parallel combination.

THEORY

When two resistors of resistance *R1* and *R2* respectively are connected in a parallel combination, then their equivalent resistance *Rp* is given by

$$1/R_p = 1/R_1 + 1/R_2$$

In order to determine the resistance of a combination, of resistors connected in parallel, the current *I* flowing through the circuit is measured with an ammeter connected in series with the combination.

The potential difference *V* across the combination of resistors is measured with a voltmeter connected in parallel

MATERIALS REQUIRED

Two resistors, an ammeter, a voltmeter, a battery eliminator, a plug key, connecting wires, and a piece of sand paper.

PROCEDURE

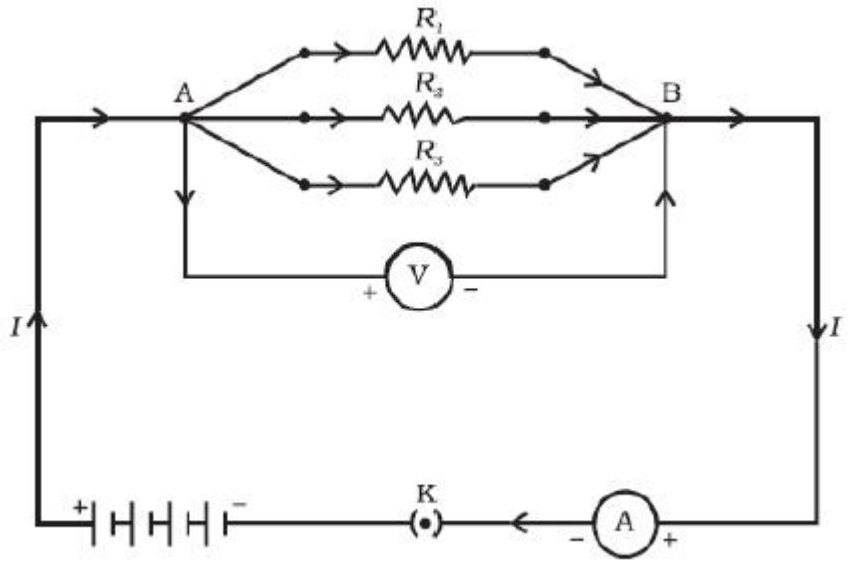
- Note the range and least count of the given ammeter and the voltmeter.
- Draw a circuit diagram for the parallel combination of resistors. Observe how different components like the ammeter, voltmeter, combination of resistors in parallel (of resistances *R1* and *R2*) and the plug key are connected with the battery eliminator.
- Place the given resistors side by side and join them in parallel. Set up the circuit by connecting different components with the help of connecting wires.
- Make sure that the positive and negative terminals of the ammeter and voltmeter are correctly connected in the circuit.
- Insert the key in the plug to let the current establish in the circuit.
- Note the readings of the ammeter and voltmeter and record them.
- Repeat the activity for three different values of current through the circuit and record the readings of the ammeter and voltmeter in each case.

PRECAUTIONS AND SOURCES OF ERROR

- The connecting wires should be thick copper wires and the insulation of their ends should be removed using the sand paper.
- Connections should be tight otherwise some contact resistance may introduce in the circuit.
- The ammeter should be connected in series with the combinations of resistors such that the current enters at the positive terminal and leaves at the negative terminal of the ammeter.

NOTE to the Student:
The following content should be on the unruled side of the Journal

VERIFICATION OF THE LAW OF COMBINATION OF RESISTORS IN PARALLEL



OBSERVATIONS AND CALCULATIONS

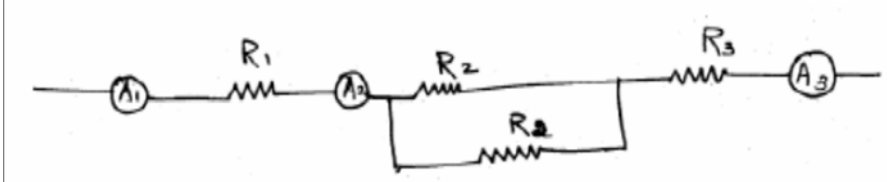
Range of the ammeter = to A.
Least count of the ammeter = A.
Range of the voltmeter = to V.
Least count of the voltmeter = V.
Resistance of first resistor *R1* = Ω.
Resistance of second resistor, *R2* = Ω.
Equivalent resistance
$R_p = R_1R_2/R_1 + R_2$ = Ω

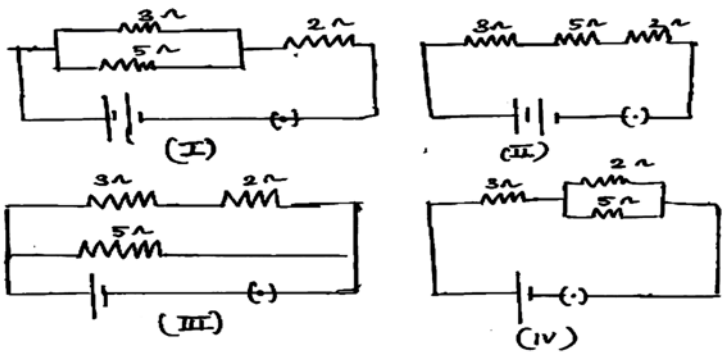
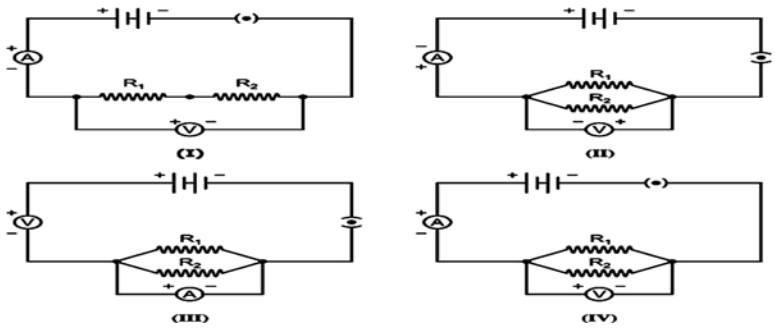
		AMMETER READING	RESISTANCE = V/I

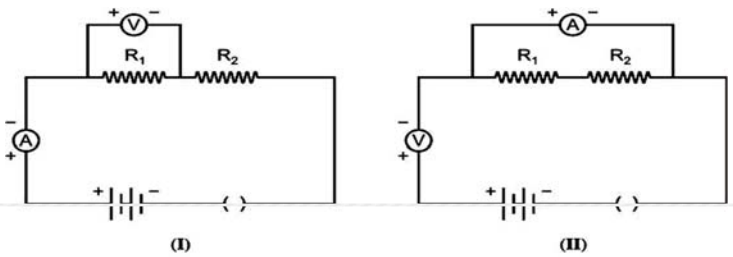
No	VOLTMETER READING (V Volts)	(I Amperes)	(R_p Ohms)
1			
2			
3			
4			

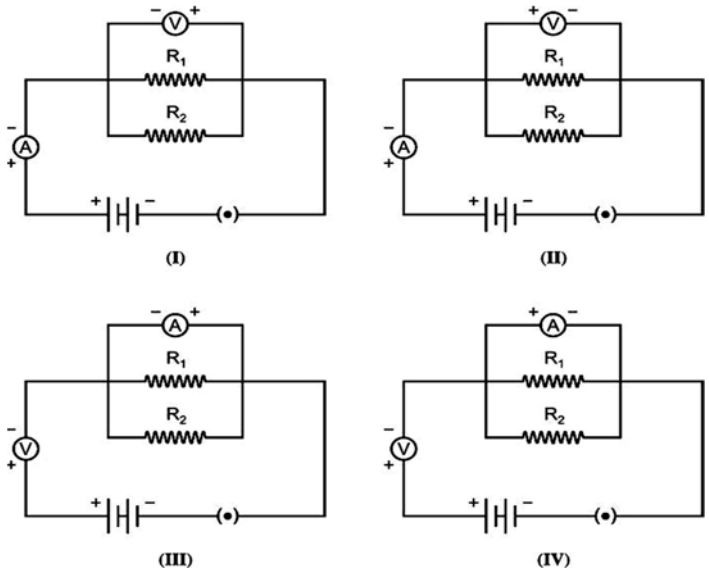
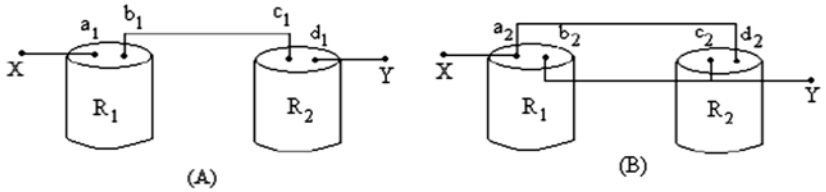
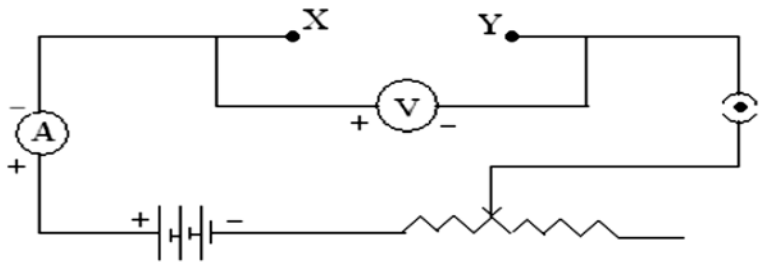
Mean equivalent resistance by parallel combination = Ohms

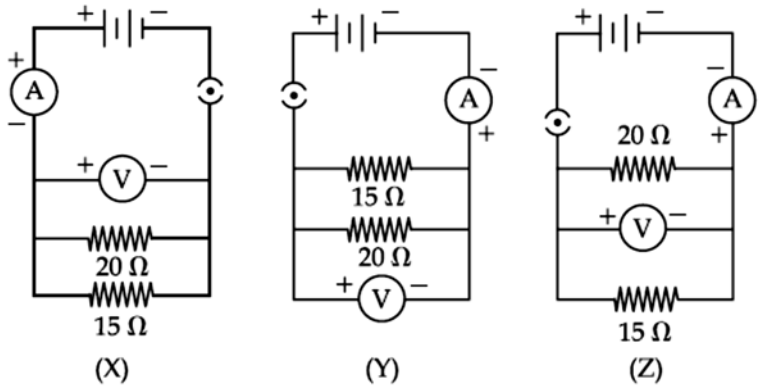
MCQ QUESTIONS

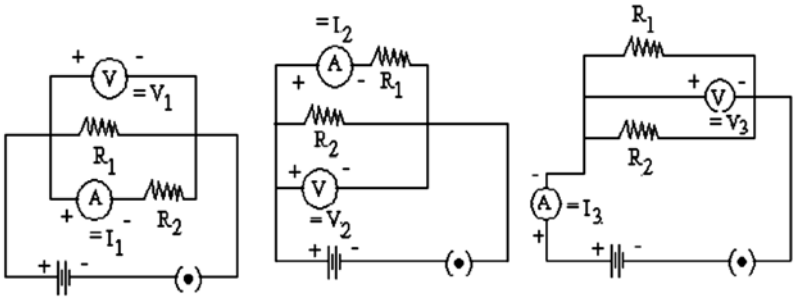
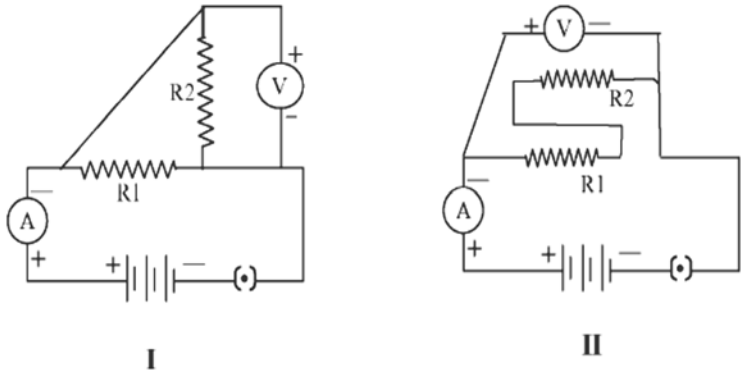
A		Very Short Answer Questions (VSA)	Mks	Level
1		The ammeter which shows maximum current is :  a) A1 b) A2 c) A3 d) All the ammeters show the same current.	1	
2		The three resistors 2 ohms, 3 ohms, and 5 ohms are connected in order to get a resultant of 2.5ohms. Of the four Circuit diagrams given below, the correct circuit diagram is :	1	

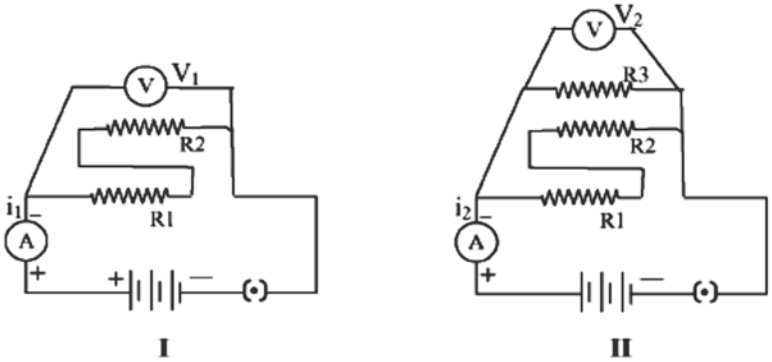
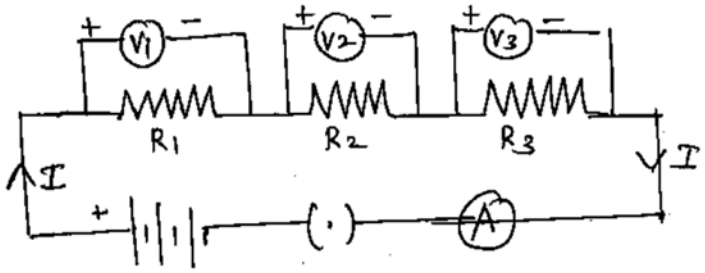
		 a) I b) II c) III d) IV		
3		Of the four circuit diagrams given below, the correct circuit diagram to determine the resultant resistance in series is :  a) I b) II c) III d) IV	1	
4		Of the four experimental set ups, the voltmeter and ammeter are correctly connected in : a) I b) II c) III d) IV	1	

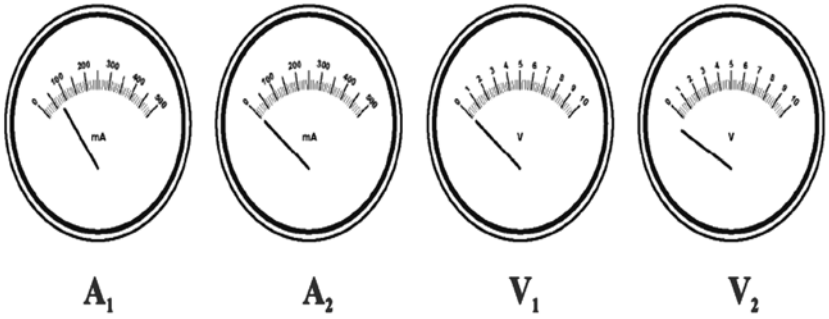
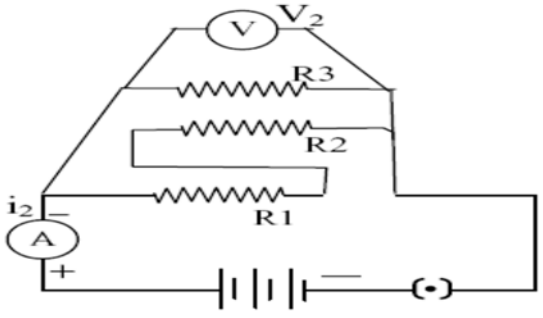


5		Following Circuits were drawn by four students, to determine the equivalent resistance of two resistors when connected in parallel. The correct circuit is drawn by the student:  a) I b) II c) III d) IV	1	
6		Students A and B connected the two resistors R 1and R2 given to them in the manners shown below.  And then they inserted between the terminals X and Y into the measuring circuit given below  We can say that,	1	

		a) Both the students A and B will determine the resultant resistance of R_1 and R_2 in series. b) Both the students A and B determine the resultant resistance in parallel. c) Student A determines the resultant of R_1 and R_2 in series and the student B determines the resultant of R_1 and R_2 in parallel. d) Student A determines the resultant of R_1 and R_2 in parallel and the student B determines the resultant of R1 and R2 in series.		
7		To determine the resultant of two resistors of 20 ohms and 15 ohms in parallel, three students connected the circuit as shown in the figure.  The current circuit diagram to determine the resultant resistance is that of : a) Student X b) Student Y c) Student Z d) All the 3 students X , Y and Z	1	

8		The same resistors R_1 and R_2 have been connected in parallel and the ammeter and the voltmeter have been connected in three different ways. The relation between the three voltmeter and ammeter readings will be,  a) $V_1 = V_2 = V_3$; $I_1 = I_2 = I_3$ b) $V_1 \neq V_2 \neq V_3$; $I_1 \neq I_2 \neq I_3$ c) $V_1 \neq V_2 \neq V_3$; $I_1 = I_2 = I_3$ d) $V_1 = V_2 = V_3$; $I_1 \neq I_2 \neq I_3$	1	
9		The resistors R_1 and R_2 are connected in  I II a) Series in both the circuits b) Parallel in both the circuits c) Series in circuit I and parallel in circuit II d) Series in circuit II and parallel in circuit I	1	
10		Circuit I: Ammeter reads i_1 and Voltmeter reads V_1	1	

		Circuit II: Ammeter reads i_2 and Voltmeter reads V_2  Relation between the readings is a) $i_1 > i_2$; $v_1 = v_2$ b) $i_1 > i_2$; $v_1 > v_2$ c) $i_1 < i_2$; $v_1 < v_2$ d) $i_1 < i_2$; $v_1 = v_2$		
11		Three resistors R1, R2 and R3 are connected in series as sown in the figure. Also $R_1 = R_2$. The potential differences across R1, R2 and R3 are : a) $V_1 = V_2 = V_3$ b) $V_1 = V_2 \neq V_3$ c) $V_1 \neq V_2$; $V_1 = V_3$ d) $V_1 \neq V_2 \neq V_3$  	1	
12		The initial positions of the pointers of ammeters and the voltmeters available in the lab are shown below. In the circuit to verify the law of combination of resistors, a student should use,	1	

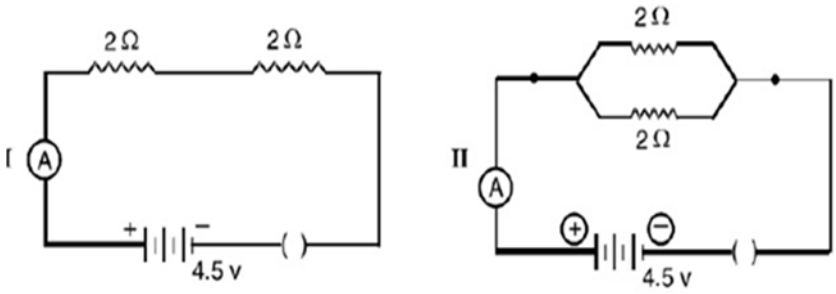
		 A_1 A_2 V_1 V_2 a) Ammeter A_1 & Voltmeter V_1 b) Ammeter A2 & Voltmeter V1 c) Ammeter A1 & Voltmeter V2 d) Ammeter A2 & Voltmeter V2		
13		The following apparatus is available in the laboratory **Cell Adjustable from 0 to 1.5 V** **Resistor 4 Ohms and 12 Ohms** **Ammeter A_1 of range 0 to 3A. Least count 1 A** **A2 of range 0 to 1A. Least count 0.05 A** **Voltmeter V1 of range 0 to 10V Least count 0.5V** **V2 of range 0 to 5V. Least count 0.1 V** The best combination of ammeter and voltmeter to determine the equivalent resistance of the resistors in **parallel** will be a) Ammeter A1 & Voltmeter V1 b) Ammeter A2 & Voltmeter V1 c) Ammeter A1 & Voltmeter V2 d) Ammeter A2 & Voltmeter V2	1	
	14	In the following circuit, which of the following statement is true?  a) R1, R2, R3 are connected in series to each other b) R1, R2 and R3 are connected in parallel to each other.	1	

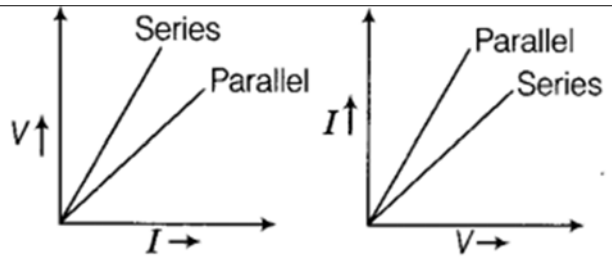
c) R1 and R2 are connected in series and R3 parallel to them

d) R3 and R2 are in series and R1 parallel to them.

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
11	**12**	**13**	**14**	**15**					

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		In the circuit I two resistors, each of 2 Ω are connected in series and in circuit II two resistors each of 2 Ω are connected in parallel. The potential difference across the two terminals of the battery in both the circuit are 4.5V. What will be the ammeter reading in circuit I and circuit II ? 	2	C
2.		Two students perform the experiments on series and parallel combination of two given resistors R1 and R2 and plotted the following V-I graphs. Identify the correctly labelled graph. Justify your answer.	2	U

				
3.		The following apparatus is available in a laboratory Cell : Adjustable from 0-1.5V Resistor : 4 Ω and 12 Ω Ammeters A1 of range 0 to 3 A ; least count 0.1A A2 of range 0 to 1A ;least count 0.05A Voltmeters : V1 of range 0 to 10 V;least count 0.5V V2 of range 0 to 5V ;least count 0.1V Find the best combination of ammeter and voltmeter for finding the equivalent resistance of resistors connected in parallel	2	U
4.		How the ammeter and voltmeter should be connected in a circuit.What is the resistance of an ideal ammeter and voltmeter?	2	A
5.		An ammeter can measure current up to 500 mA. There are 20 equal divisions between 0 and 100mA marks on the scale .During an experiment to determine the equivalent resistance of the two resistors joined in parallel a student observes ammeter point in 3rd graduation mark after 0 when the key is off and the pointer at 17th graduation mark after 200 mA when the key is closed. Find the value of current in the circuit?	2	C

CONVEX LENS

AIM

To find the image distance for various object distances in the case of convex lens and to draw ray diagrams to show the nature of the image.

APPARATUS

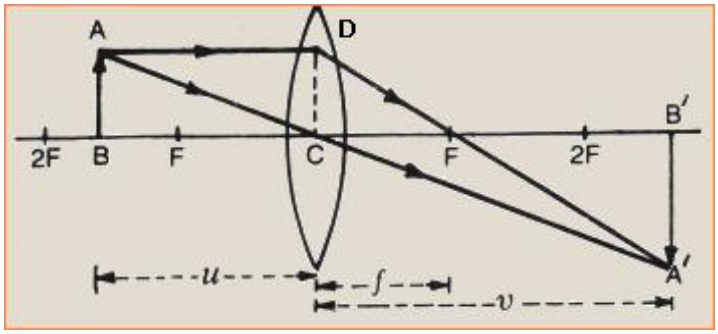
Convex lens, optical bench, two needles and meter scale.

THEORY

The position of the image formed by a convex lens depends upon the position of object with respect to lens. The relation between u, v and f for convex lens is

1/f = 1/v - 1/u

DIAGRAM



PROCEDURE

1. Find the rough focal length of the convex lens is found by taking the image of a distant object on the screen.
2. Place lens and the two needles are mounted on a vertical upright. The tips of the needles and the centre of the lens should be kept at the same height from the end of the bench. The object needle is placed between F and 2F of the convex lens and the image needle on the other side of the lens. The image needle is moved forward and backward till the real and inverted image of the object needle is seen through the lens just over the image needle.
3. Then the distance between the object needle and lens u and the image needle and lens v is measured.
4. Repeat the above steps for different positions of object needle and image needle.
5. A graph is plotted between u and v between 1/u and 1/v.

SOURCES OF ERROR

1. The convex lens is very thick.
2. The principal axis of the lens may not be parallel to the optical bench scale.
3. The parallax is not removed from tip to tip

PRECAUTIONS

1. Always place the convex lens in the middle of the optical bench.

2. Always choose a lens of small focal length.

3. The parallax should be removed from tip to tip

4. The uprights should be vertical &stable.

5. Eyes should be placed at a distance of about 100 cm from the needle while removing

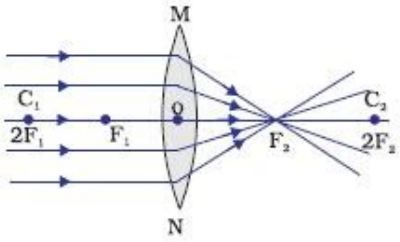
OBSERVATIONS

Rough focal length of convex lens = ----------cm

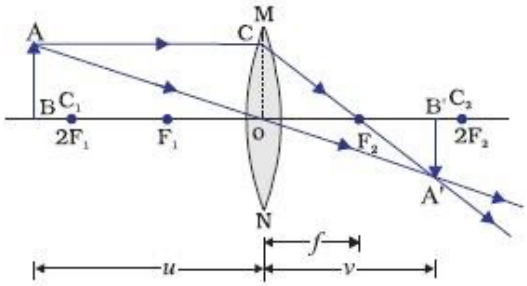
S.No	Position of			Distance b/w object needle & lens(u) [a-b]	Distance b/w image needle & lens(v) [c-a]
	Convex lens(a)cm	Object needle(b)cm	Image needle c (cm)		
1					
2					
3					
4					
5					

RESULT:

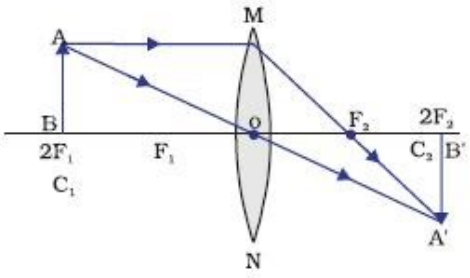
The following ray diagrams are verified for various object distances.



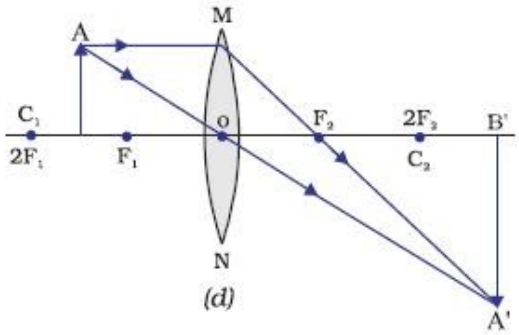
(a)



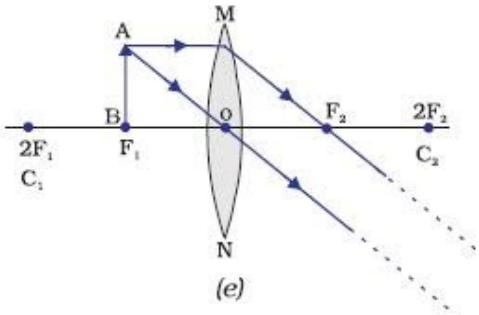
(b)



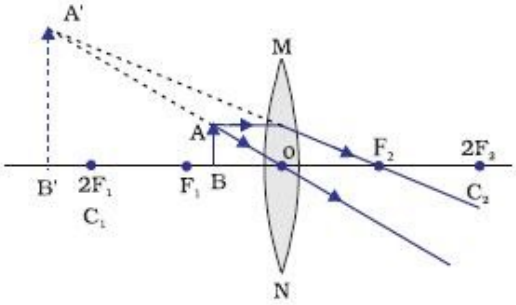
(c)



(d)



(e)



(f)

ORAL QUESTIONS WITH ANSWERS

1. Define focal length of a lens.
   Ans: The distance of optical centre from the principal focus of a lens, is called its focal length .

2. Define power of a lens.
   Ans : The reciprocal of focal length of a lens is called power of that lens.

3. What is the unit of power of a lens?
   Ans Dioptre.

4. Define dioptre.
   Ans: Power of lens in dioptre = 1/ focal length in metres

5. What is the property of the optical centre?
   Ans: A ray

6. What is the least distance between the object and its real image formed by a convex lens?
   Ans : It is equal to 4 times the focal length of that convex lens.

7. Are the positions of object and image interchangeable?
   Ans: Yes

8. Can convex mirror ever form a real image?
   Ans: No

9. Does the focal length of a lens change when immersed in water?
   Ans: Yes the focal increases when immersed in water.

10. Does focal length of a lens depend upon u and v?
    Ans: No

B		PRATICAL BASED QUESTIONS	MARK	LEVEL
1.		A student places a candle flame at a distance of about 60 cm from a convex lens of focal length 10 cm and focuses the image of the flame on a screen. After that he gradually moves the flame towards the lens and each time focuses the image on the screen. (a) In which direction-toward or away from the lens, does he move the screen to focus the image? (b) How does the size of the image change? (c) How does the intensity of the image change as the flame moves towards the lens? (d) Approximately for what distance between the flame and the lens, the image formed on the screen is inverted and of the same size?	2	C
2.		A student focuses the image of a well illuminated distant object on a screen using a convex lens. After that he gradually moves the object	2	U

		towards the lens and each time focuses its image on the screen by adjusting the lens. (a) In which direction—towards the screen or away from the screen, does he move the lens? (b) What happens to the size of the image—does it decrease or increase? (c) What happens to the image on the screen when he moves the object very close to the lens?		
3.		An object of height 2.5 cm is placed at a distance of 15 cm from the optical centre 'O' of a convex lens of focal length 10 cm. Draw a ray diagram to find the position and size of the image formed. Mark optical centre 'O', principal focus F and height of the image on the diagram.	2	U
4.		A 4 cm tall object is placed on the principal axis of a convex lens. The distance of the object from the optical centre of the lens is 12 cm and its sharp image is formed at a distance of 24 cm from it on a screen on the other side of the lens. If the object is now moved a little away from the lens, in which way (towards the lens or away from the lens) will he have to move the screen to get a sharp image of the object on it again? How will the magnification of the image be affected?	2	A
5.		To find the image-distance for varying object-distances in case of a convex lens, a student obtains on a screen a sharp image of a bright object placed very far from the lens. After that he gradually moves the object towards the lens and each time focuses (a) In which direction-towards or away from the lens, does he move the screen to focus the object? (b) What happens to the size of image—does it increase or decrease? (c) What happen when he moves the object very close to the lens?	2	C