

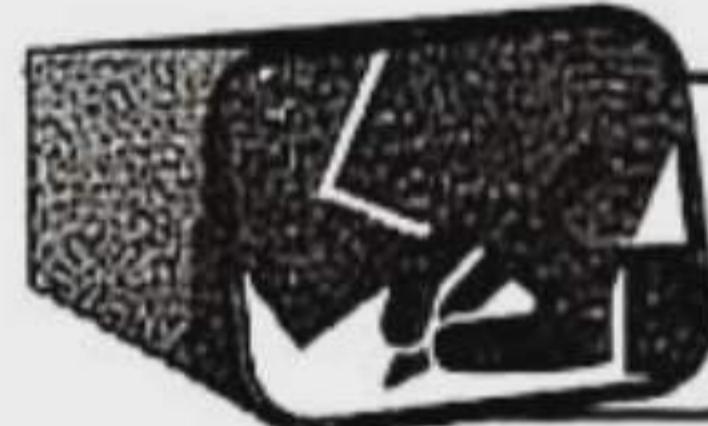
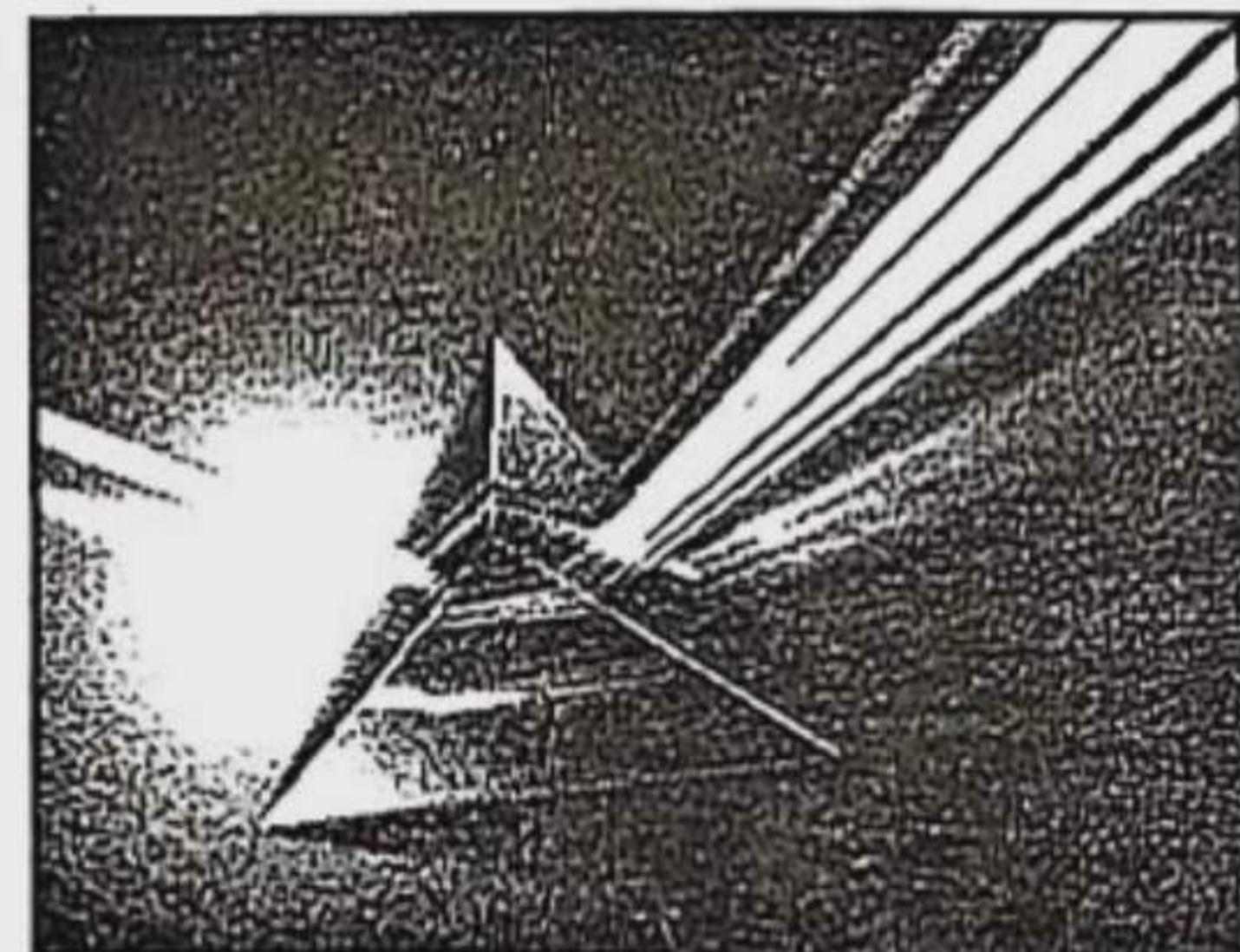
Light

Contents for Discussion

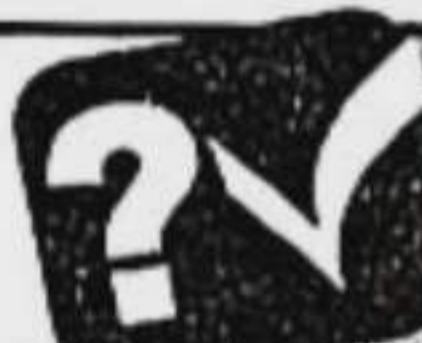
- The refraction of light • Laws of refraction of light • Practical application of refraction • Total internal reflection and critical angle • Optical fibre and magnifying glass • Human eye.

Learning Outcomes : After studying this chapter I will be able to—

- discuss different phenomenon of refraction in daily life by drawing diagrams;
- explain total internal reflection;
- explain how optical fibers work;
- explain the function of magnifying glass;
- explain how spectacles work;
- explain the functions of camera and our eyes;
- appreciate the usefulness of light in performing the different activities in daily life.



Practice



**Multiple Choice, Short & Creative Q/A
following 100% accurate format for best prep.**

Dear learners, the Q/A of this chapter have been divided into exercise, multiple choice, short, creative & exercise-based activities in light of the learning outcomes. Practice the questions well to ensure the best preparation in the exam.



Textual Q/A



Let's learn the textbook Q/A



Fill in the Blanks



- The path of light when it enters a different medium depends on —.
- The ray of light that falls along the normal to the surface emerges —.
- In total internal reflection , the angle of — is greater than the —

Ans. 1. the density of the medium; 2. without changing direction; 3. incidence, critical angle.



Short Answer Questions



Question 1. Why light changes direction when it enters in a different medium?

Ans. While passing through different medium, light changes its direction due to refraction. In a transparent medium light goes in a straight line. So change in its direction takes place at the surface of separation of two media. But if light rays fall perpendicularly, there will be no change in its direction and the light goes in the same straight line in second medium.

Question 2. What is critical angle? When is it formed?

Ans. When a ray of light enters a rarer medium from a denser medium, the refracted ray bends away from the normal drawn at the point of incidence of the ray. As a result the angle of refraction becomes larger than the angle of incidence. In this way as the angle of incidence increases, the corresponding angle of refraction increases. For a particular combination of such pair of media there is a particular value of the angle of incidence, which in this case must be smaller than 90° , the corresponding angle of refraction becomes 90° which means the refracting ray passes along the surface of separation of the two media. The angle of incidence which corresponds to this situation is called the critical angle.

Question 3. What are the differences between a human eye and a camera?

Ans. Differences between a camera and a human eye are as follows :

Camera	Human eye
1. The diaphragm of the camera controls its aperture.	1. Iris of the eye works as the diaphragm.

Camera	Human eye
2. The shutter of a camera regulates the time of exposure of light.	2. Eye lid works as shutter of the eyes.
3. An image is created on the photo-sensitive film.	3. An image is formed on the retina of the eye.
4. Distance adjustment is done by lens.	4. Eye has accommodation power and so distant objects can be seen.

MCQs with Answers

1. What is the term used for the sclera in front of the eye?

Ⓐ Lens Ⓑ Retina
Ⓒ Cornea Ⓒ Iris

► Explanation : **Lens** : It is a convex lens made of soft transparent jelly-like material located behind the cornea.

Retina : It is a light sensitive rose colored translucent membrane behind the eye-ball.

Cornea : Frontal part of the sclera is called cornea.

Iris : It is an opaque membrane which stays just behind the cornea.

2. Optical fibre is used for—.

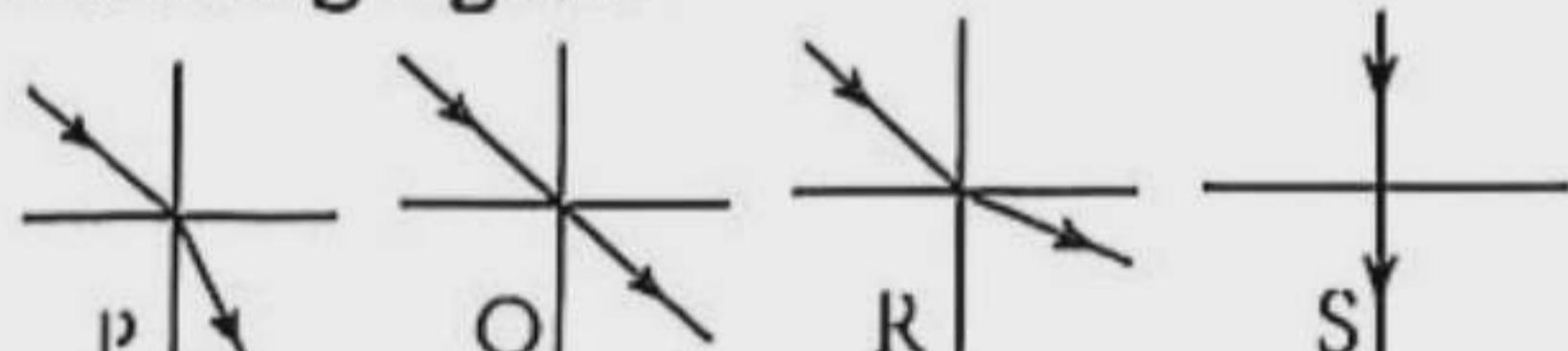
- i. fuel
ii. examining stomach
iii. telecommunication

Which one of the following is correct?

Ⓒ Ⓐ i & ii Ⓑ i & iii Ⓒ ii & iii Ⓓ i, ii & iii

► Explanation : Optical fiber is used to carry light, to see inside the human body like stomach, colon etc. It is also used in telecommunication.

- Answer questions no. 3 and 4 from the following figure



3. In which figure light is propagating from denser medium into rare medium?

Ⓒ Ⓐ P Ⓑ Q Ⓒ R Ⓓ S

► Explanation : According to the law of refraction of light, we know that when a light ray enters a lighter medium from a denser medium, the light ray is deflected away from the normal. In this case the angle is smaller than the refraction angle. Again, when the light ray enters from a light medium to a dense medium, it moves towards the normal. In this case the angle of incidence is greater than the angle of

refraction. Similarly looking at the R image, it can be seen that its angle of incidence is smaller than angle of refraction. That is, in figure R, light rays are entering from a denser medium to a lighter medium.

4. In which of the figures the angle of incidence is equal to the refracting angle?

Ⓐ P & R Ⓑ Q & R
Ⓒ Q & S Ⓒ S & P

► Explanation : According to the law of refraction of light, we know that when two mediums are the same, when light rays pass from one medium (air) to another medium (air), the values of angle of incidence and angle of refraction are equal. Which is seen in the case of figure Q. Again, when light rays enter perpendicularly, they return perpendicularly. In this case the values of angle of incidence and angle of refraction are zero or equal. Which is seen in the case of Figure S. So the values of angle of incidence and angle of refraction of images Q and S between the stimulus images are the same.

Creative Questions with Answers

Ques. 01 One day Anis went to a pond to take a bath. He put his feet on the visible steps under transparent water. But since the steps were at a greater depth than they appeared to, he fell down. On the other hand his younger brother is catching fish in the pond using spear failed to throw the spike correctly.

- a. What is refraction of light? 1
b. What is the cause of change in the direction of light? 2
c. Explain why Anis fell in the pond? 3
d. What type of trick makes Anis' brother successful in hunting the fish? Explain your answer. 4

Answer to Question No. 01 :

a The change of direction of light travelling from one transparent medium to another transparent medium at surface of separation is called refraction of light.

b While passing through a different medium a light ray alters its direction due to refraction. In a transparent medium light goes in a straight line. Change in its direction takes place at the common surface of the two media.

- c** Anis could not place his feet correctly due to refraction of light making the step appear slightly higher than its actual position. That's why he fell into the pond. The matter is explained below-

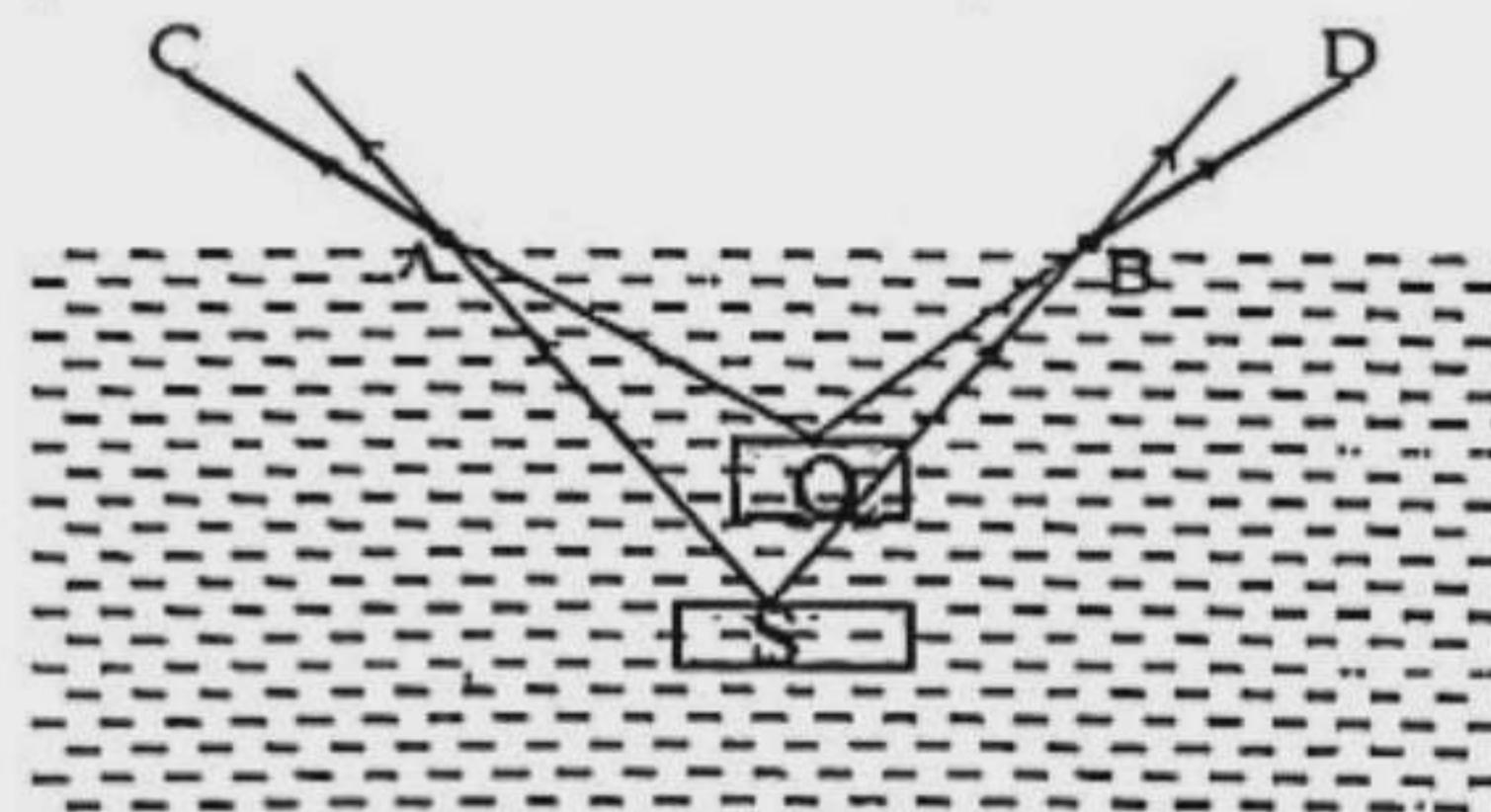


Figure : Changing the position of the pond ladder for refraction of light

Anis was through the air medium while the step was through water. That is, Anis was in the rarer medium and the step was in the denser medium. We know that when a light ray enters from a rarer medium into a denser medium, the refracted ray moves towards the normal and when it enters a rarer medium from a denser medium, it moves away from the perpendicular.

- d** Anis's younger brother would have been able to catch fish if he had driven a little below instead of driving in the visible position of the fish. My opinion is presented below with arguments :

We know that when light rays enter from a denser medium into a rarer medium, they are deflected away from the normal and when they enter from a rarer medium into a denser medium, they are deflected toward the normal. The actual and visible location of the fish is shown in the diagram below-

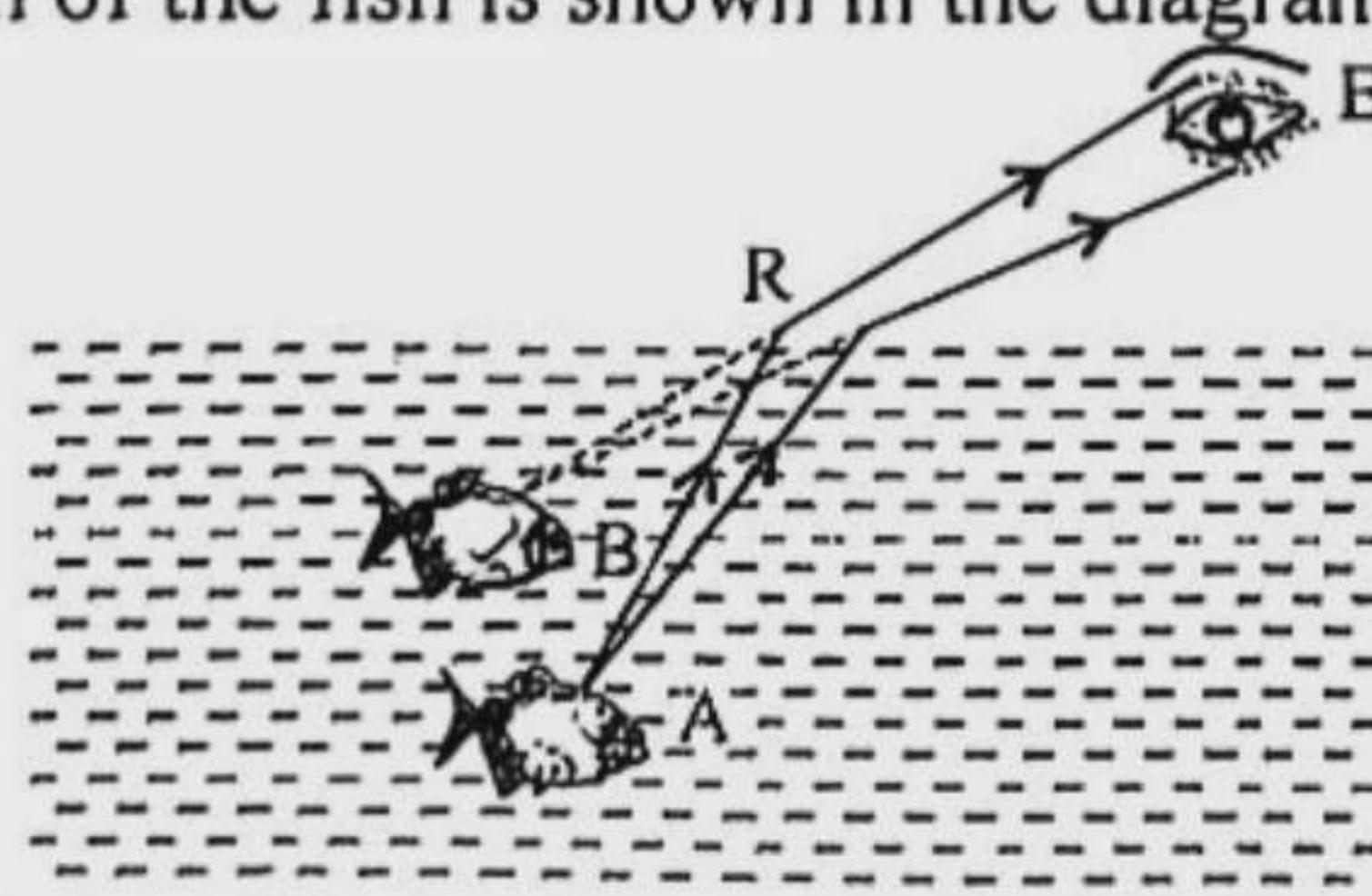


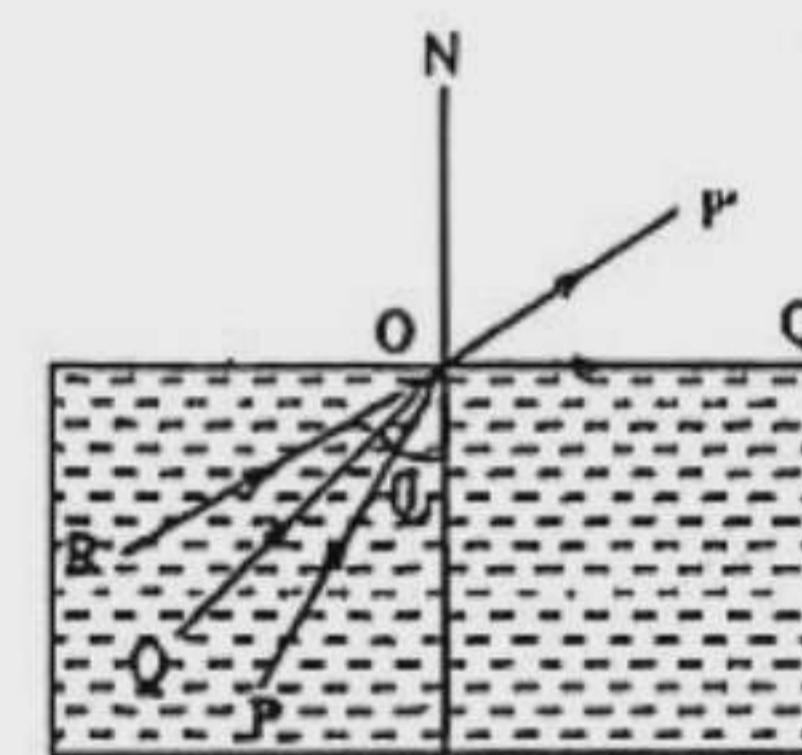
Figure : Change in position of fish due to refraction of light

The actual position of the fish is shown in A and the position of the eye in E. The light ray AR from A is refracted i.e. bent from the normal and reaches the eye of Anis's younger brother. If the refracted ray extends ER backwards, it meets at point B, the point B being the visible position of the fish. That is, Anis's younger brother sees the position of fish at point B.

Therefore, from the above discussion, it can be said that if Anis's younger brother threw the spike at point A instead of point B, he would be successful in hunting the fish.

Ques. 02

C 3 MTC
Simpler
rlt 201
Trn.



- What is total internal reflection? 1
- What is meant by optical fiber? 2
- Explain critical angle in the figure. 3
- Explain the path of Ray RO with diagram. 4

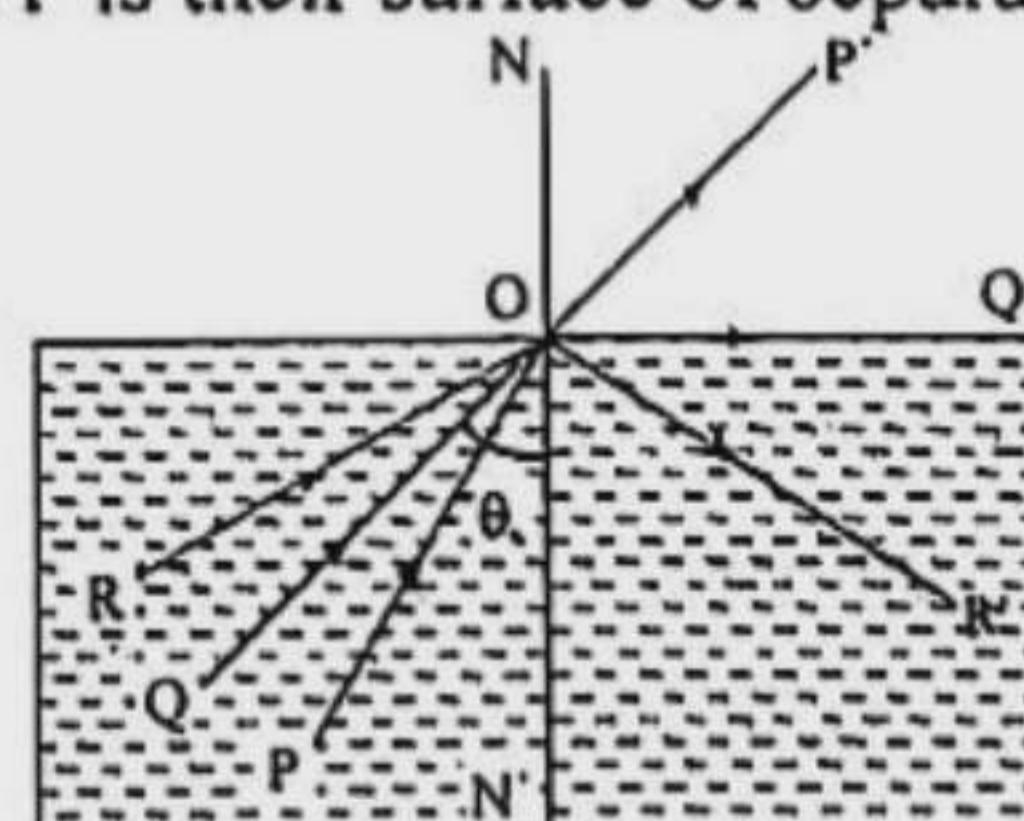
Answer to Question No. 02 :

a When light refracted from denser medium to rarer medium, for a value of incidence angle greater than critical angle light rays return to denser medium reflected at the boundary surface. This is called total internal reflection.

b Optical fibre is a very narrow and flexible glass fibre. It is used for transmitting rays of light. When light ray enters through one end of the fibre, successive total internal reflections of light takes place on the wall of the fibre until the ray emerges through the other end. A bunch of optical fibre is called the optical tube which is used in observing an internal part of human body and in the field of telecommunication.

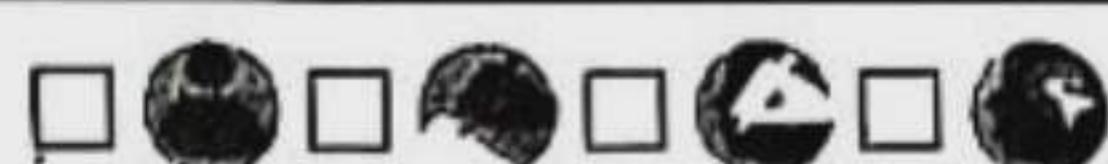
c In the given figure, a ray of light incident along PO in the denser medium is refracted along OP' in the rarer medium. Now if the angle of incidence gradually increases, the corresponding angle of refraction also increases. Thus ultimately for a definite value of incidence angle, the angle of refraction becomes 90° . In that case, due to incident ray, QO is refracted along OQ'. Under this condition the value of incidence angle is called critical angle. In the figure, $\angle QON'$ is the critical angle which is expressed with θ_c .

d A number of rays have been drawn in the figure. These rays enter from denser medium below to rarer medium air. XY is their surface of separation.



According to the figure, angle of incidence is $\angle QON'$ and angle of refraction is $\angle NOY$. For this pair of media, critical angle (θ_c) is QON' . For incident ray RO, the angle of incidence is greater than the critical angle ($\angle RON' > \angle QON'$). So this ray will not be refracted. It will rather be reflected along OR' and come back to the denser medium causing total internal reflection.



**Lesson 1: The refraction of light**

► Textbook Page 114

1. The change of direction of incident light ray to a plane of separation of two transparent medium is called —. (Knowledge) [JB '16]

- a** Ⓛ Reflection Ⓜ Refraction
b Ⓝ Diffused reflection Ⓞ Dispersion

Lesson 2-3: Laws of refraction of light

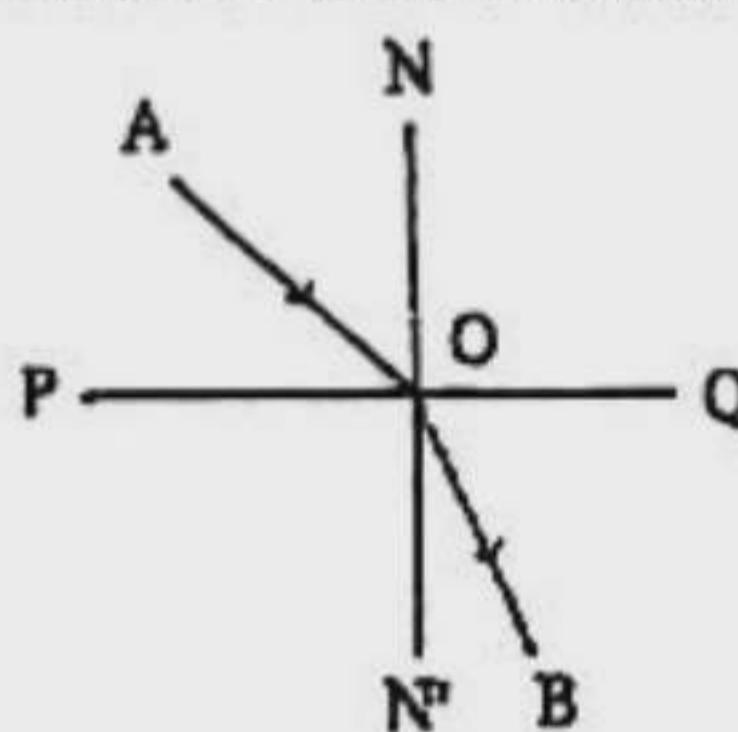
► Textbook Page 115

2. In case of a rays entering from a rarer medium to a denser medium —. (Higher ability)

- i. $i > r$ ii. $i = c$
 iii. $r < c$

Which one of the following is correct?

- a** Ⓛ i Ⓜ ii & iii Ⓝ i & iii Ⓞ i, ii & iii
b Focusing on the figure below, answer to the question no. 3 and 4 :



[DB '19]

3. Which is the angle of refraction in the figure? (Application)

- a** Ⓛ $\angle AON$ Ⓜ $\angle BON'$
b Ⓝ $\angle AOP$ Ⓞ $\angle NOQ$

4. The cause of the change of direction of the ray OB is—. (Higher ability)

- i. light a dense medium from light medium
 ii. light enters into light medium from dense medium
 iii. enters towards the normal

Which one is correct?

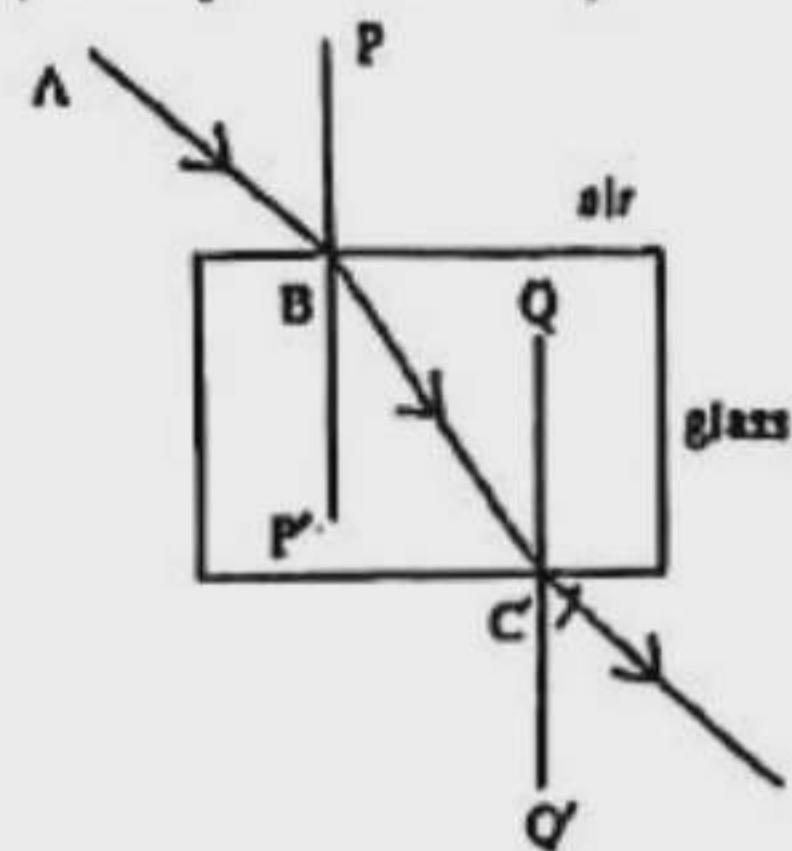
- c** Ⓛ i & ii Ⓜ i & iii Ⓝ ii & iii Ⓞ i, ii & iii

5. When a ray of light enters to wind medium from glass medium if the angle of incidence is 32° the refraction ray goes through the surface of separation medium. In this case what is the refraction angle? (Comprehension)

[CB '19]

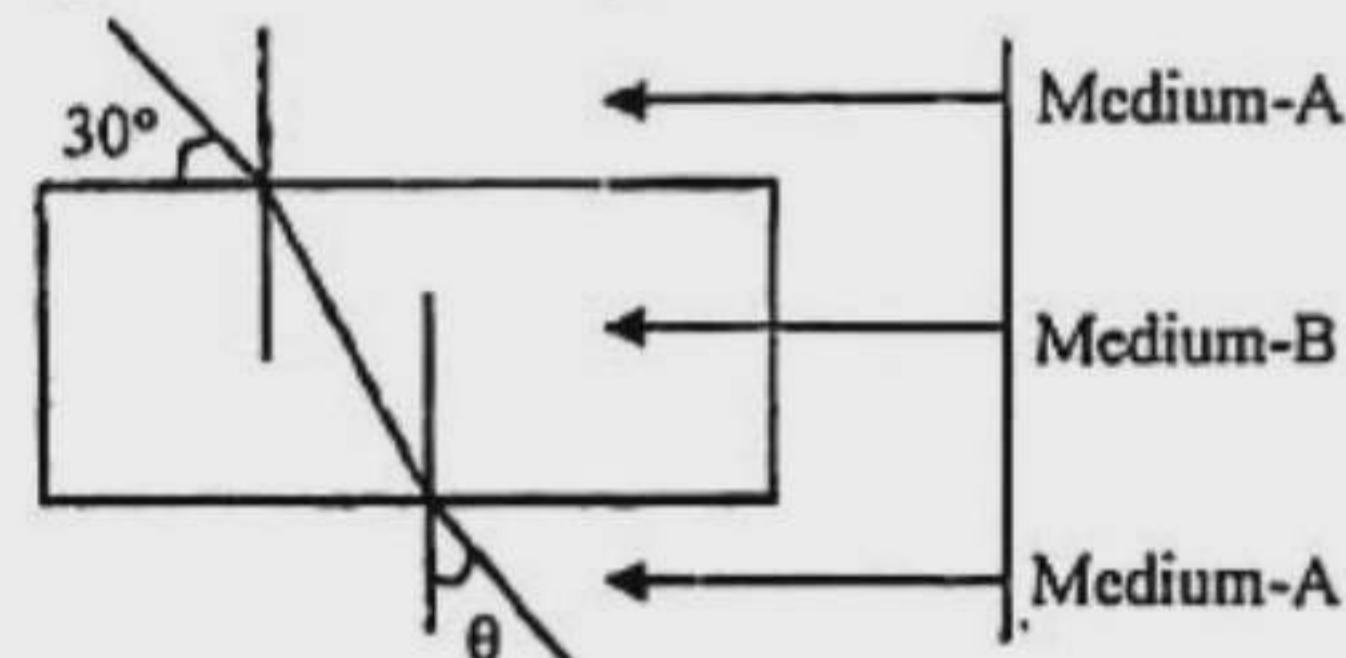
- a** Ⓛ 0° Ⓜ 32°
c Ⓝ 90° Ⓞ 180°

6. Which two angles below are equal? (Comprehension) [CB '19]



[CB '19]

- a** Ⓛ $\angle ABP$ and $\angle P'BC$ Ⓜ $\angle ABP$ and $\angle BCQ$
d Ⓝ $\angle BCQ$ and $\angle DCQ'$ Ⓞ $\angle ABP$ and $\angle DCQ'$
e Answer the questions no. 7 and 8 in the light of the figure below :



[BB '19]

7. What is the value of θ in above figure? (Comprehension)

- a** Ⓛ 30° Ⓜ 45°
d Ⓝ 50° Ⓞ 60°

8. In the figure of above stem— (Higher ability)

- i. medium-B is denser
 ii. incident angle and refracted angle are equal
 iii. incident angle and emergent angle are equal

Which one is correct?

- b** Ⓛ i & ii Ⓜ i & iii Ⓝ ii & iii Ⓞ i, ii & iii

9. What is the value of θ in above figure? (Comprehension)

- a** Ⓛ 30° Ⓜ 45°
d Ⓝ 50° Ⓞ 60°

10. In the figure of above stem— (Higher ability)

- i. medium-B is denser
 ii. incident angle and refracted angle are equal
 iii. incident angle and emergent angle are equal

Which one is correct?

- b** Ⓛ i & ii Ⓜ i & iii Ⓝ ii & iii Ⓞ i, ii & iii

11. What is the lowest value of angle of refraction? (Comprehension) [DB '17]

- a** Ⓛ 0° Ⓜ 30° Ⓝ 45° Ⓞ 90°

12. Which one of the following is the law of refraction of light? (Comprehension) [RB '17]

- a** Ⓛ $\angle i = \angle r$ Ⓜ $\angle r > \angle i$
b Ⓝ $\angle i \geq \angle r$ Ⓞ $\angle r \geq \angle i$



13. Light runs about 0.3 million km per second. How much crore kilometer it covers in 8 minutes and 20 seconds? (Application) [RB '17]

C @ 12 B @ 13 C @ 15 D @ 18

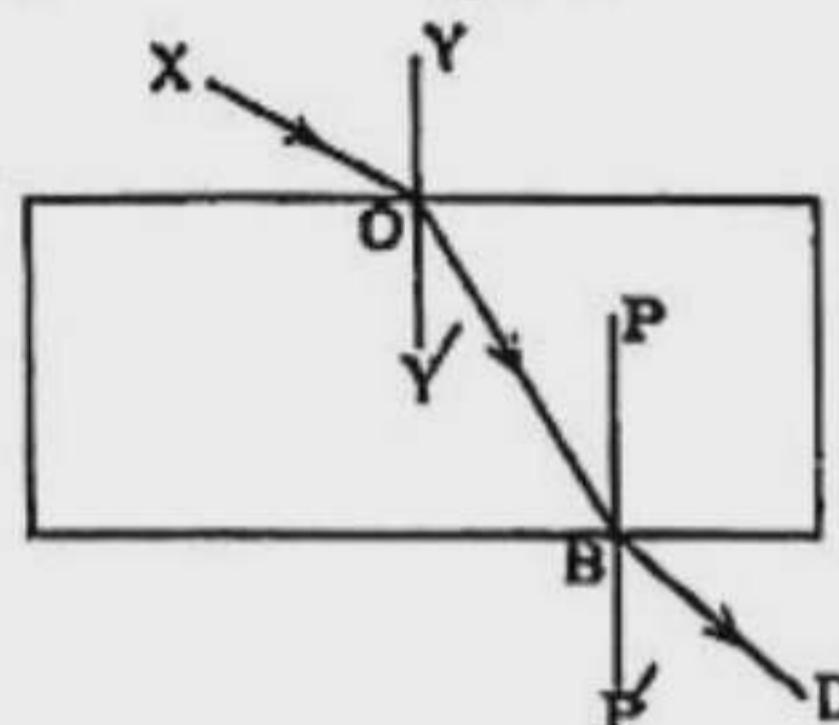
14. What will be the angle of refraction if the value of the angle of incidence is 0° ? (Application) [CtgB '17]

A @ 0° B @ 30° C @ 60° D @ 90°

15. How many laws does the refraction obey? (Knowledge) [DB '16]

B @ 2 B @ 3 C @ 4 D @ 5

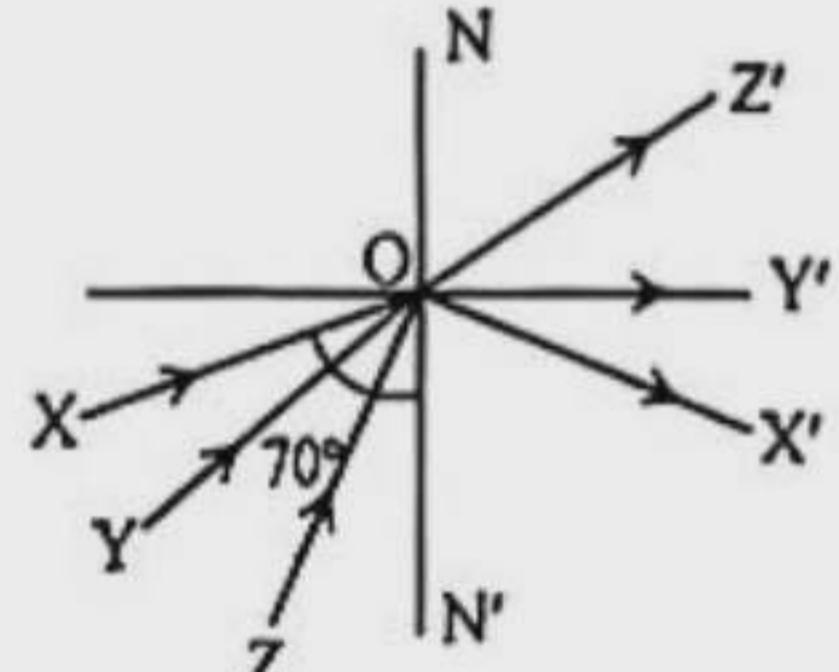
16.



In figure, if $\angle XYO = 40^\circ$, then $\angle P'BD = ?$ (Comprehension) [DB '16]

C @ 20° B @ 30° C @ 40° D @ 50°

17.



If $\angle XON' = 70^\circ$ then what is the value of $\angle X'CY'$? (Application) [Ideal School & College, Dhaka]

A @ 70° B @ 90°
C @ 45° D @ 20°

Lesson 4-5: Practical application of refraction

► Textbook Page 116

18. You are seeing a coin below one transparent glass. In this case - which one is correct? (Comprehension)

[Viqarunnisa Noon School & College, Dhaka]

- A The entranced ray within the glass go away from the normal
B emergence ray from glass will come towards the normal
C The ray will go along 90°
D No one is correct

19. A stick is immersed partly in water, it will appear—. [CB '16]

- i. thick
ii. short
iii. thin

Which one is correct?

A @ i & ii B @ i & iii C @ ii & iii D @ i, ii & iii

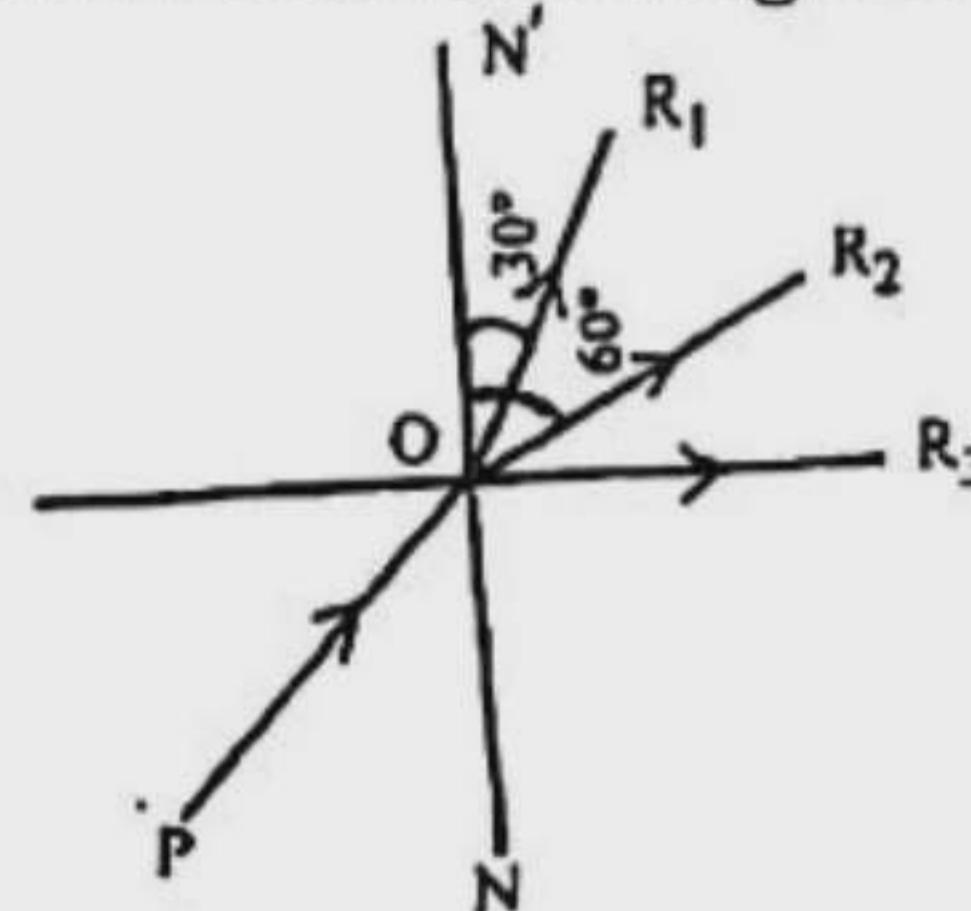
Lesson 6-7: Total internal reflection and critical angle

► Textbook Page 117

20. What is the magnitude of refraction angle relative to critical angle? (Comprehension)

B @ $> 90^\circ$ B @ 90° C @ $< 90^\circ$ D @ $\geq 45^\circ$

- Answer the questions number 21 and 22 from the following stem :



[RB '19; CtgB '19]

21. If the light ray is reflected on the path 'NO' which is the refraction angle? (Comprehension)

A @ 0° B @ 30°
C @ 60° D @ 90°

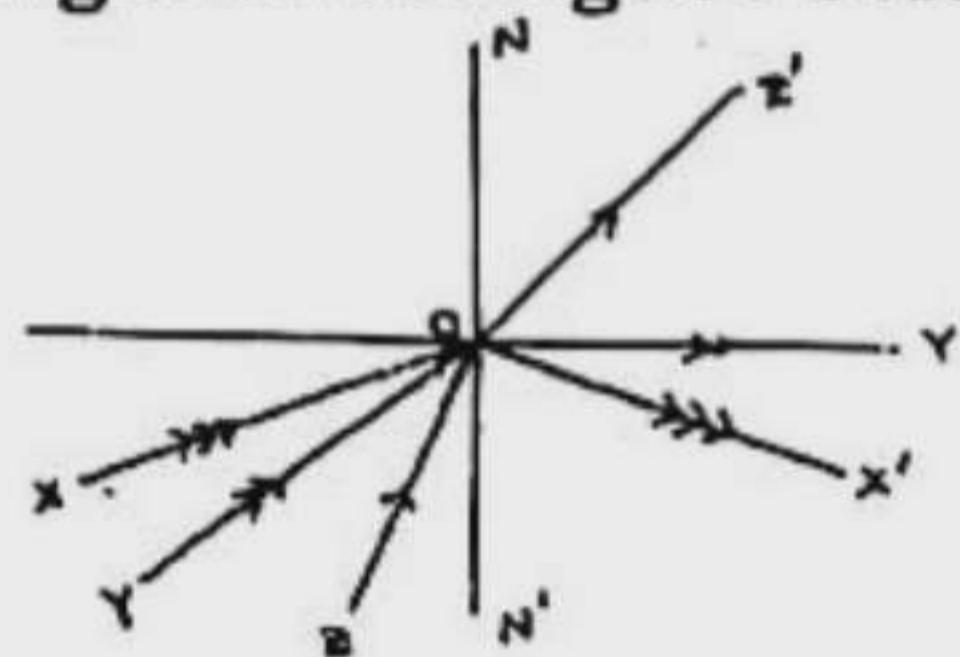
22. In the above stem if $\angle PON$ is critical angle— (Higher ability)

- i. the refracted ray goes on OR_3
ii. the value of refraction angle is $\angle NOR_3$
iii. the incident angle will be smaller than the refraction angle

Which one is correct?

B @ i & ii B @ i & iii C @ ii & iii D @ i, ii & iii

- Answer the question no. 23 and 24 in the light of the figure below :



[SB '19]

23. In above figure $\angle XON' = 70^\circ$, In this case what is the value of $\angle X'QY'$? (Comprehension)

A @ 20° B @ 30°
C @ 50° D @ 70°

24. In the above figure— (Higher ability)

- i. OX' is refracted ray
ii. $\angle YON' =$ critical angle
iii. light ray enters into rearer medium from denser medium

Which one of the followings is correct?

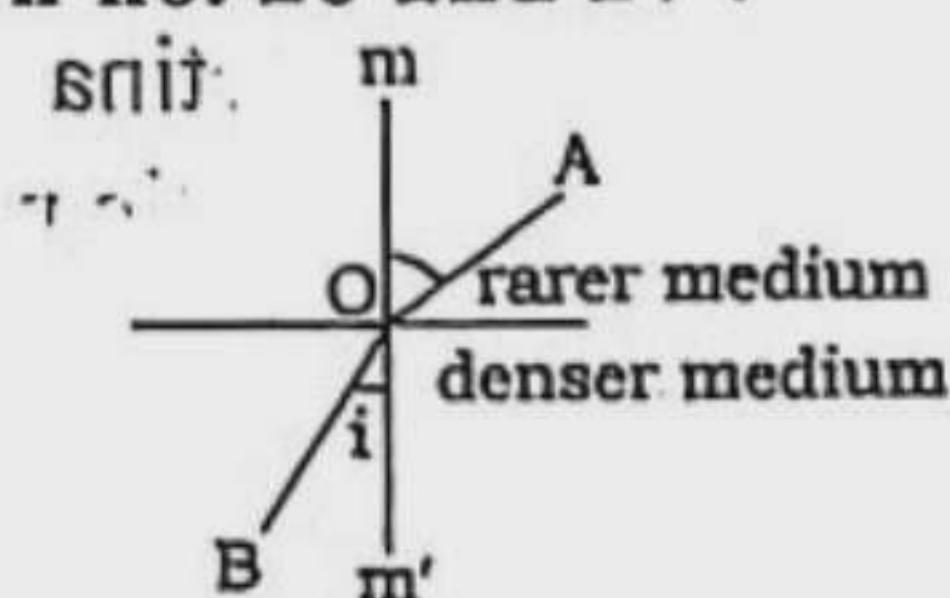
C @ i & ii B @ i & iii C @ ii & iii D @ i, ii & iii

25. Which one is the incidence angle for total internal reflection, while the critical angle is 60° ? (Comprehension) [MB '19]

A @ 30° B @ 45°
C @ 60° D @ 75°



- Notice the figure below and answer question no. 26 and 27 :



[DB '18]

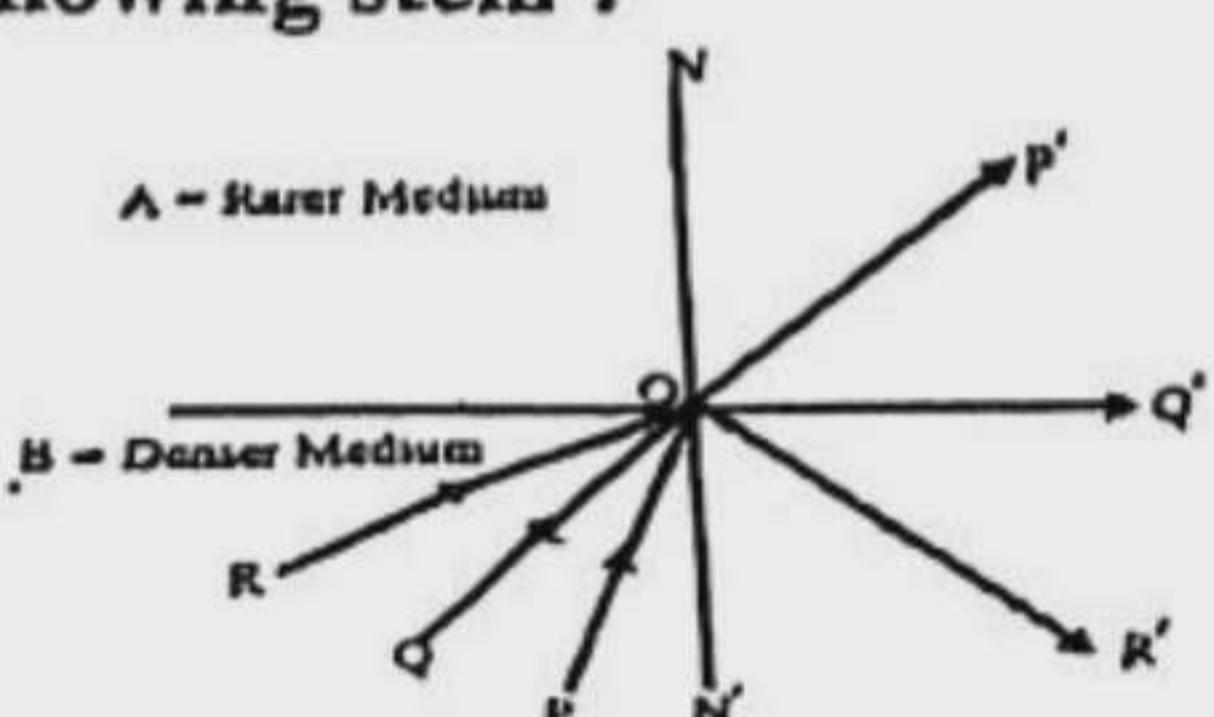
26. In the figure $\angle MOA$. (Comprehension)
 a) angle of incidence b) angle of refraction
 b) angle of reflection d) critical angle
27. If the angle $\angle MOA$ is greater than 90° —. (Higher ability)
 i. creation of critical angle
 ii. creation of reflection angle
 iii. creation of total internal reflection angle

Which one of the following is correct?

- c) a) i & ii b) i & iii c) ii & iii d) i, ii & iii
28. When the light ray pass from glass medium to air medium (Higher ability) [JB '18]
 i. refractive angle is greater than incident angle
 ii. incident ray, refraction ray and normal remain in same plane
 iii. occurs total internal reflection

Which one is correct?

- d) a) i & ii b) i & iii c) ii & iii d) i, ii & iii
- Answer questions number 29 and 30 from the following stem :

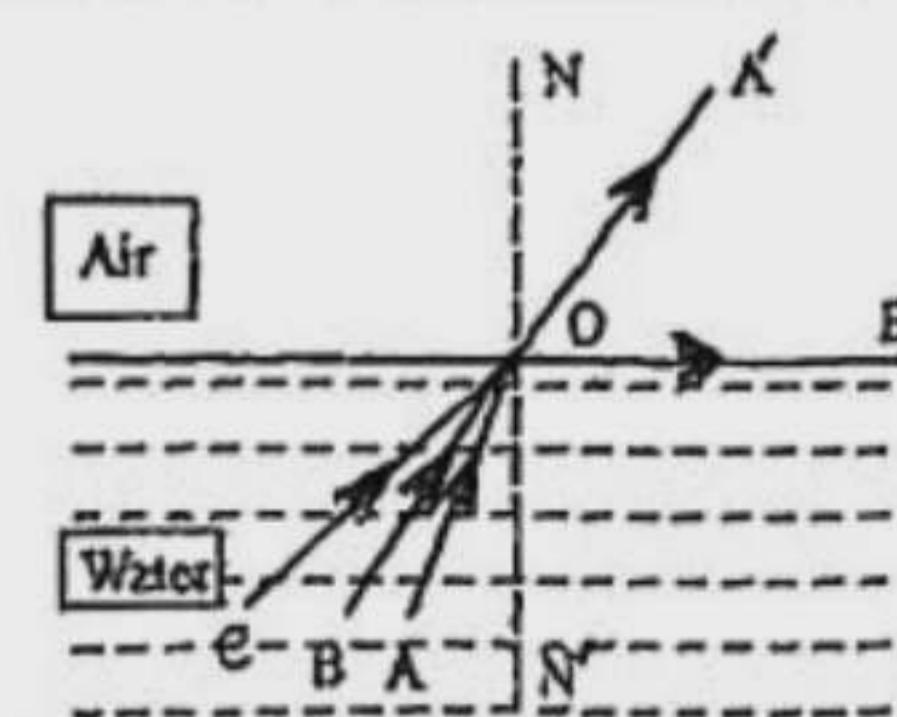


[SB '18]

29. Which one is critical angle? (Comprehension)
 a) $\angle PON'$ b) $\angle POQ$
 c) $\angle N'QO$ d) $\angle N'OR$
30. For getting the OR' ray —. (Higher ability)
 i. light ray must go from B medium to the A medium
 ii. the angle of incidence must be greater than the critical angle
 iii. light ray must be reflected not to be refracted

Which one of the following is correct?

- a) i & ii b) i & iii
 b) c) ii & iii d) i, ii & iii
31. What is condition for total internal reflection? (Comprehension) [DB '17; SB-'16]
 a) One b) Two c) Three d) Four



- On the basis of the above figure answer questions no. 32 and 33 :

32. In the figure $\angle BON'$ is —. (Application) [JB '16]
 a) Angle of reflection b) Angle of refraction
 c) Critical angle d) Angle of deviation
33. Due to CO, incident ray —. (Higher ability) [JB '16]
 i. refracted ray change its direction in the air medium
 ii. CO ray reflected back to water medium
 iii. the angle of incident equals to the angle of reflection

Which one is correct?

- c) a) i & ii b) i & iii c) ii & iii d) i, ii & iii
- See the picture below and answer the questions no. 34 and 35 :



34. Which one in the picture is a critical angle? (Comprehension) [CtgB '16]

- a) $\angle AON'$ b) $\angle BON'$
 c) $\angle CON'$ d) $\angle DON'$

35. Do ray returns to the same medium? Which one from causes it? (Comprehension) [CtgB '16]
 a) Reflection of light b) Refraction of light
 c) Creation of critical angle
 d) Total internal reflection

36. Optical fiber is— (Comprehension) [Rajuk Uttara Model College, Dhaka]

- a) thin metallic plate b) thin glass fiber
 b) c) metallic wire d) plastic wire

37. Which one is happened in case of total internal reflection? (Comprehension) [Viqarunnisa Noon School & College, Dhaka]

- a) angle of incidence $i >$ critical angle θ_c
 b) angle of incidence $i <$ critical angle θ_c
 c) angle of incidence $i =$ critical angle θ_c
 d) angle of incidence $i = 90^\circ$

Lesson 8: Optical fibre and magnifying glass

► Textbook Page 118

38. Use of optical fibre includes —. (Application)

- i. endoscopy
 ii. proctoscopy
 iii. colonoscopy

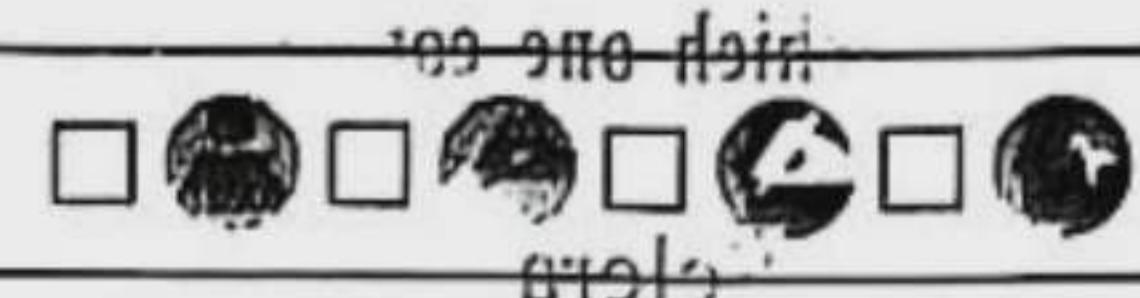
Which one of the following is correct?

- a) i & ii b) i & iii c) ii & iii d) i, ii & iii

- 39. Which one is used in magnifying glass? (Comprehension) [MB '19]**
- a** Concave lens **b** Concave mirror
c Convex lens **d** Convex mirror
- 40. In favour of optical fibre—. (Application) [CtgB '18]**
- Many signal are send in the same time
 - Sending signal does not appear stain
 - It is made of glass but is flexible
- Which one of the following is correct?**
- a** i & ii **b** i & iii
c ii & iii **d** i, ii & iii
- 41. Optical fibre— (Higher ability) [JB '17]**
- is even thinner than hair and flexible
 - used in medical sector
 - used in telecommunication
- Which one is correct?**
- a** i & ii **b** i & iii **c** ii & iii **d** i, ii & iii
- Read the following passage and answer the two questions :**
- Shaymol went to the doctor for his different difficulties. In that time, doctor use an special type flexible tube to examine his stomach and colon.
- 42. By which, the special type of tube is prepared? (Comprehension) [SB '17]**
- a** Silicon **b** Glass
c Polymer **d** Plastic
- 43. In the thintube—. (Higher ability) [SB '17]**
- The ray passes easily
 - Total interval reflection is occurred
 - Can carry much more information at a time
- Which one is correct?**
- a** i & ii **b** i & iii **c** ii & iii **d** i, ii & iii
- Lesson 9-10: Human eye ▶ Textbook Page 119**
- 44. Which one of the following protects the eyes? (Knowledge)**
- a** Sclera **b** Choroid **c** Retina **d** Pupil
- 45. Which one of the following parts determines the shape of the eyes? (Knowledge)**
- a** Choroid **b** Retina
c Sclera **d** Pupil
- 46. Which one of the following parts prevent internal reflection of light within the eye? (Knowledge)**
- a** Choroid **b** Pupil
c Shutter **d** Retina
- 47. Which one of the following is of different colours? (Knowledge)**
- a** etina **b** Iris
c Pupil **d** Aqueous humour
- 48. What part of the eye lies just behind the eye lens? (Knowledge) [on page 119]**
- a** Pupil **b** Retina
c Vitreous humour **d** Optic nerve
- 49. Membrane / membrane-like substances in the eye—. (Higher ability)**
- scler
 - iris
 - retina
- Which one of the following is correct?**
- a** i & ii **b** i & iii **c** ii & iii **d** i, ii & iii
- 50. Colours of an iris—. (Higher ability)**
- blue
 - brown
 - purple
- Which one of the following is correct?**
- a** i & ii **b** i & iii **c** ii & iii **d** i, ii & iii
- Read the following passage and answer the question numbers 51 and 52 :**
- Mitu has a MINOLTA TR100 Japanese camera. Photography is her favourite pastime. During vacations she goes to the countryside to take snapshots of scenic beauty. She finds a number of similarities between an eye and a camera.
- 51. What part of a camera can be compared to the eye lid? (Application)**
- a** Shutter **b** Iris **c** Cornea **d** Retina
- 52. Mitu's finding is correct in the sense that —. (Higher ability)**
- the eye-ball works as the light proof chamber of a camera
 - both an eye and a camera produces a real, inverted and diminishing image of an object
 - both of them adjust focal length in the same way
- Which one of the following is correct?**
- a** i & ii **b** i & iii **c** ii & iii **d** i, ii & iii
- 53. Which part of human eyes is translucent? (Knowledge) [DB '19]**
- a** Retina **b** Pupil
c Irish **d** Sclera
- 54. Which part of the following protects the eye from external harmful effects? (Knowledge) [RB '19]**
- a** Sclera **b** Iris
c Eye-ball **d** Cornea
- 55. Actually what is Sclera? (Comprehension) [JB '19]**
- a** Cornea **b** Light sensitive membrane
c Circular hole **d** Opaque covering

56. Which one contain the correct eye shape? (Knowledge) [CtgB '19]
- ① Sclera ② Cornea
 - ③ Eyeball ④ Iris
57. The front part of the sclera is called— (Knowledge) [DjB '19; CB '17]
- ① cornea ② iris
 - ③ pupil ④ retina
58. Which one helps in the sensation of sight in the brain? (Knowledge) [RB '18]
- ① Pupil ② Iris
 - ③ Retina ④ Cornea
59. In which of the following the colour is different due to place and man? (Knowledge) [JB '18]
- ① Iris ② Moni
 - ③ Retina ④ Cornea
60. Which of the following parts rescue our eye from the various kinds of outer harms. (Knowledge) [CtgB '18]
- ① Eye ball ② Iris
 - ③ Sclera ④ Retina
61. How many main parts are there in human eye? (Knowledge) [BB '18]
- ① 2 ② 3
 - ③ 8 ④ 9
- 62.
-
- In the above picture—. (Higher ability) [BB '18]
- PO is incident ray
 - OQ is refracted ray
 - a is denser medium
- Which one of the following is correct?
- ① i & ii ② ii & iii
 - ③ i & iii ④ i, ii & iii
63. What is the term used for the cornea behind the eye? (Knowledge) [DjB '18]
- ① Lens ② Retina
 - ③ Pupil ④ Irish
64. What are the similarity between a human eye lid and a part of camera? (Knowledge) [DjB '18]
- ① Charoid ② Aperture
 - ③ Shutter ④ Screen
65. What is called the front part of eye sclera? (Knowledge) [JB '17; CtgB '16]
- ① Lens ② Retina
 - ③ Cornea ④ Pupil

66. What is the colour of retina of eye? (Knowledge) [CtgB '17]
- ① rose ② brown
 - ③ blue ④ black
67. For which part, reflection if entered light in the eye does not occur? (Knowledge) [BB '17]
- ① Cornea ② Retina
 - ③ Choroid ④ Irish
68. When light falls on retina— (Higher ability) [CB '17]
- one kind of excitements in those nerves
 - produce the sensation of sight in the brain
 - The size of the aperture of the pupil
- Which one is correct?
- ① i & ii ② i & iii ③ ii & iii ④ i, ii & iii
69. Which of the following produces the sensation to the brain? (Knowledge) [DjB '17; RB '16]
- ① Retina ② Cornea ③ Irish ④ Pupil
70. Which one is the following is the frontal part of the sclera? (Knowledge) [RB '16]
- ① Pupil ② Irish ③ Choroid ④ Cornea
71. How many main parts are there of a human eye? (Comprehension) [RB '16]
- ① 12 ② 10 ③ 9 ④ 8
72. In between the space of where vitreous hummour is present? (Comprehension) [SB '16]
- ① Lens and retina ② Lens and cornea
 - ③ Irish and retina ④ Cornea and Irish
73. Which one is opaque coloured membrane? (Knowledge) [Ideal School & College, Dhaka]
- ① Sclera ② Cornea
 - ③ Choroid ④ Iris
74. How many parts are there in a camera? (Knowledge) [Ideal School & College, Dhaka]
- ① 5 ② 6
 - ③ 7 ④ 8
75. When light falls on retina—. (Higher ability) [Viqarunnesa Noon School & College, Dhaka]
- One kind of excitements is created in the nerve
 - feelings of vibration is created in the brain
 - reflection of light does not happen
- Which one is correct?
- ① i & iii ② i & ii ③ ii & iii ④ i, ii & iii
76. Which one becomes different colour according to place and people? (Comprehension) [Viqarunnesa Noon School & College, Dhaka]
- ① Iris ② Pupil
 - ③ Retina ④ Cornea

**Short Q/A****Designed as per topic****► Lesson 1: The refraction of light**

► Textbook Page 114

Question 1. Explain the refraction of light.

Ans. Light travels in straight lines. When light passes from a lighter medium to a denser medium, it changes its direction of travel. This phenomenon of light is called refraction of light.

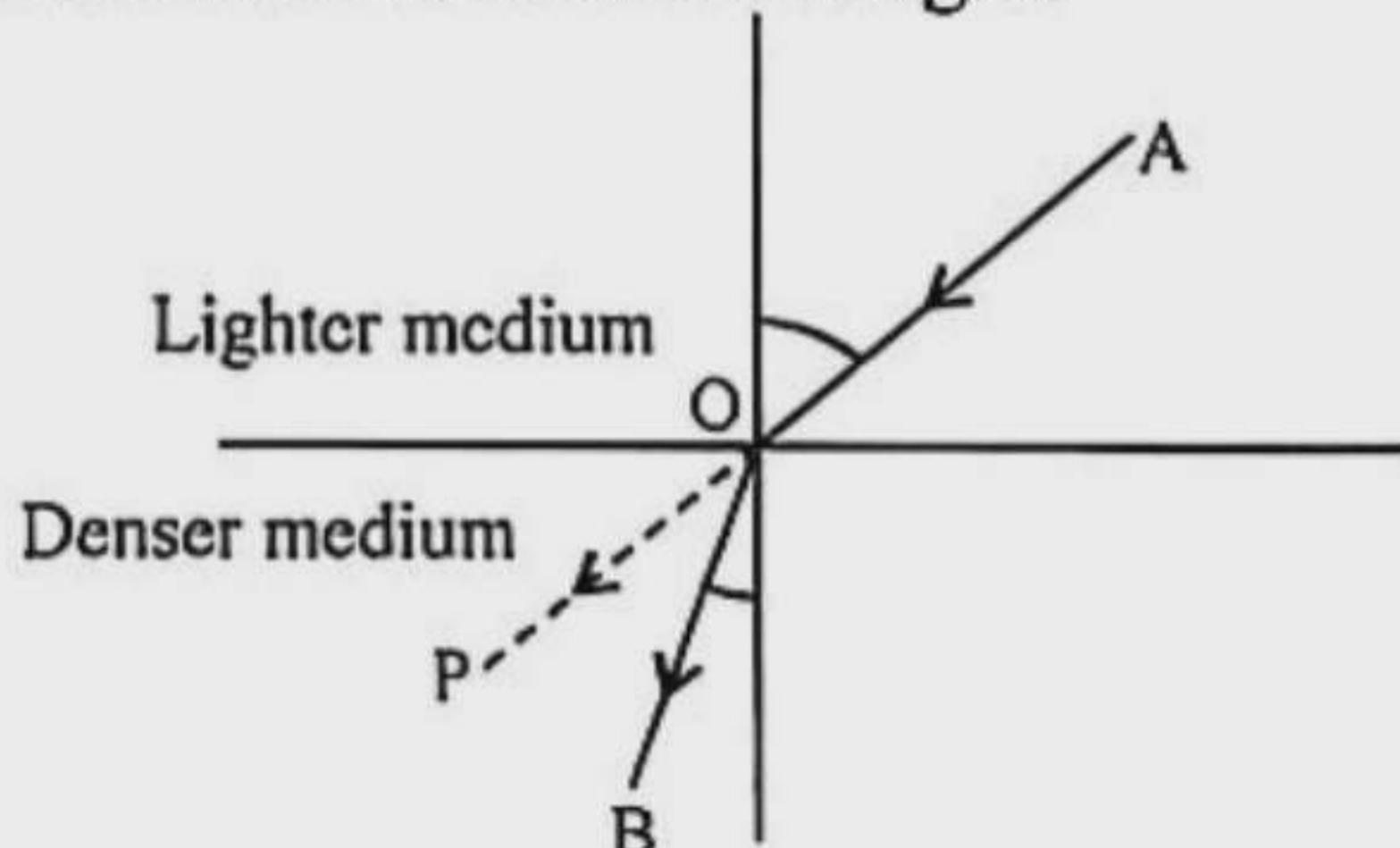


Figure : Refraction of light

In the figure, AO light goes through path OB instead of path OP.

Question 2. Why does the ray of light change direction?

Ans. Light travels in straight lines in a certain transparent medium. But as soon as it enters another medium, it changes direction according to the optical properties of the medium. The light changes direction for the optical density of the medium. The phenomenon of change of direction of light is called refraction of light. The denser a medium is, the slower the speed of light will be within that medium. That is why light rays change direction when the medium changes.

► Lesson 2-3: Laws of refraction of light

► Textbook Page 115

Question 3. Write the laws of refraction of light.

Ans. The laws of refraction of light are-

- When a ray of light enters from rarer medium to a denser medium then it bends towards the normal. In this case the angle of incidence is greater than the angle of refraction. When the light ray passes from denser medium to rarer medium, then it bends away from the normal. In this case the angle of incidence is smaller than the angle of refraction.
- The incident ray, the refracted ray and the normal drawn at the incident point on the surface separating the two media, all lie in the same plane.
- When the ray of light is incident along the normal, then the angle of incidence, the angle of refraction and the angle of emergence are all zero.

Question 4. Explain the role of ^{refract} in hunting fish.

Ans. Usually, the place where the fish is seen in the water is not the actual place where the fish stays. The place where we see the fish is an unreal image of it. The fish stays at a position which is a bit lower and further away where it appears to be. We look at the fish a little higher due to the refraction of light. That's why one must keep in mind the refraction of light while hunting fish. So, the role of refraction in fishing is immense.

► Lesson 4-5: Practical application of refraction

► Textbook Page 116

Question 5. When a straight stick is submerged in water and looked at from above, why does the part of the stick in the water look raised upwards?

Ans. When a straight stick is immersed in a glass of water, the part of the stick in the water looks raised upwards. It appears so because of refraction. Here, light is refracted from the denser medium water into the rarer medium air and enters our eyes. Every part of the emerged stick is raised upwards. So, when viewed from above, the stick part appears lifted upwards.

Question 6. Why does a coin appear to float when it is dipped in water?

Ans. A coin immersed in water appears to float on the surface due to refraction. In this case, light is refracted from the dense medium water and reflected to our eyes through the light medium air. In this case, it seems that every dot of the submerged part of the coin lifted upwards. So, when viewed from above, the coin appears to be floating above.

Question 7. When are the angle of incidence and angle of refraction equal?

Ans. When the light ray is reflected from one medium (like air) into another medium (like glass) and finally emerge out in the original medium angle of incidence is equal to the angle of emergence.

Question 8. When is the angle of refraction 0° ?

Ans. When the ray of light is incident along the normal, the refracted ray returns along the normal and then the angle of incidence, the angle of refraction and the angle of emergence are all zero. In this case there is no change in direction of the incident ray.



Question 9. Why do the stones in the clear water of the Sera Island seem to be much higher?

Ans. The bottom rock seems too high for refraction in the clear water of the Sera Island. Light is refracted from the dense medium clear water and reflected to our eyes through the light medium air. As a result, each point of the lower rock submerged in water seems raised up a little. So, the lower rock seems to be higher.

► Lesson 6-7: Total internal reflection and critical angle

► Textbook Page 117

Question 10. Write the conditions for total internal reflection.

Ans. The conditions for total internal reflection are :

1. It occurs only when the light ray goes from a denser medium to a rarer medium.
2. The angle of incidence in the denser medium must be greater than the critical angle corresponding to the pair of media chosen.

Question 11. What is meant by total internal reflection?

Ans. When light passes from a denser medium to a lighter medium at an angle greater than the critical angle, the light ray instead of being refracted is reflected in the medium from the surface level. The boundary surface here acts as a reflecting surface and this reflection occurs according to the laws of ordinary reflection. This phenomenon is called total internal reflection.

Question 12. Explain the critical angle.

Ans. When light passes from a denser medium to a lighter medium, the angle of incidence in the denser medium which causes the angle of refraction is 90° , is called the critical angle. Then total internal reflection of light occurs when the angle of incidence is greater than critical angle.

Question 13. What is the difference between ordinary reflection and total internal reflection?

Ans. Reflection is the characteristic of light. Reflection is the phenomenon of bouncing back of light when it is intercepted by an opaque surface. During ordinary reflection, some part of the light is refracted. But in case of total internal reflection all light rays are reflected.

Question 14. Write the difference between the angle of incidence and critical angle.

Ans. Differences between the angle of incidence and critical angle are mentioned below-

Angle of incidence	Critical angle
1. The angle at which the light reflects on the surface is called the angle of incidence.	1. The angle of incidence for which the angle of refraction of light from a denser medium to a lighter medium is 90° is the critical angle.
2. The angle of incidence may occur on any medium.	2. Critical angle occurs only on dense medium.

► Lesson 8: Optical fibre and magnifying glass

Optical fibre

► Textbook Page 118

Question 15. What does optical fibre mean?

Ans. Optical fibre is a very thin fibre of glass. It is even thinner than human hair and is flexible and extremely transparent. It is used as the carrier of the light rays.

Question 16. Why does total internal reflection occur in optical fibres?

Ans. Optical fibre is composed of core and cladding parts. The core part is a denser medium than the cladding part. Total internal reflection occurs as light is incident on the core at an angle greater than the critical angle. This process continues till the rays reach the other end of the fibre.

Question 17. Why is optical fibre used in telecommunications?

Ans. Optical fibre cables are currently used for information or data transfer or telecommunication. Electrical signals of data or information are converted into light signals, and it can be transferred quickly through the optical fibre. There is no data noise in the process. As a result, information is protected. That is why optical fibre is used in telecommunication.

Question 18. Write two uses of optical fibre.

Ans. Two uses of optical fibre are as follows-

1. Optical fibre is used in telecommunication.
2. The tube that the doctor uses to see the inside of the human body (colon, stomach) is made up of optical fibres.

Question 19. What is a magnifying glass? Explain.

Ans. A magnifying glass is a type of convex lens that makes objects appear larger. When an object is placed within a certain distance of a convex lens and viewed from the opposite side, an upright, magnified, and virtual image of the object is seen.

Question 20. Why is a magnifying glass used to make small objects look bigger?

Ans. A magnifying glass is a convex lens enclosed in a suitable frame. By placing an object at the focal length of a convex lens and viewing the object from the other side of the lens, an upright, magnified, and virtual image of the object is seen. The closer this image is formed to the eye, the larger the eye's viewing angle will be, making the image appear larger. For this reason, magnifying glass is used to make small objects look bigger.

Question 21. What is the focal length? Explain.

Ans. When a ray of light parallel to the lens's axis strikes a convex lens, the point where the light rays converge is called the focal point. The distance from this focal point to the lens along its axis is known as the focal length.

Question 22. Why is the magnifying glass called a simple microscope?

Ans. Small objects can be seen with the help of simple microscope. A magnifying glass also makes small objects appear larger. That is why the magnifying glass is called a simple microscope.

Lesson 9-10: Human eye ▶ Textbook Page 119**Question 23. Why is the light not reflected inside the eye?**

Ans. Choroid is a black membrane covering the inner body of sclera. Because of its blackness, the light entering the eye is not reflected. Because black absorbs all light.

Question 24. Write two differences between aqueous humour and vitreous humour.

Ans. Two differences between aqueous humour and vitreous humour are as follows-

Aqueous humour	Vitreous humour
1. It is the middle part between the lens and the cornea.	1. It is the middle part between the lens and the retina.
2. It contains a transparent watery substance.	2. It contains a jelly-like matter.

Question 25. What is Sclera? Explain.

Ans. The sclera is a white covering of the eye-ball which is hard, fibrous and opaque. It protects the eye from external harmful effects and preserves the shape of the eye.

Question 26. Write about Cornea.

Ans. Frontal part of the sclera is called cornea. This part of the sclera is transparent and is bulged outwards more than other parts.

Question 27. What does pupil mean?

Ans. The pupil is a circular hole at the centre of the cornea which is connected to muscular cells. The size of the aperture of the pupil can be changed by the expansion and shrinkage of the muscles attached to it.

Question 28. What is retina? Explain.

Ans. Retina is a light sensitive rose colored translucent membrane located behind the eyeball. When light falls on retina it creates some excitement in those nerves and produces the sensation of sight in the brain.

Question 29. How many parts are there in a camera and what are they?

Ans. There are seven parts in a camera, namely-

1. Camera box, 2. Camera lens, 3. Aperture, 4. Shutter, 5. Screen, 6. Photographic plate and 7. Slide.

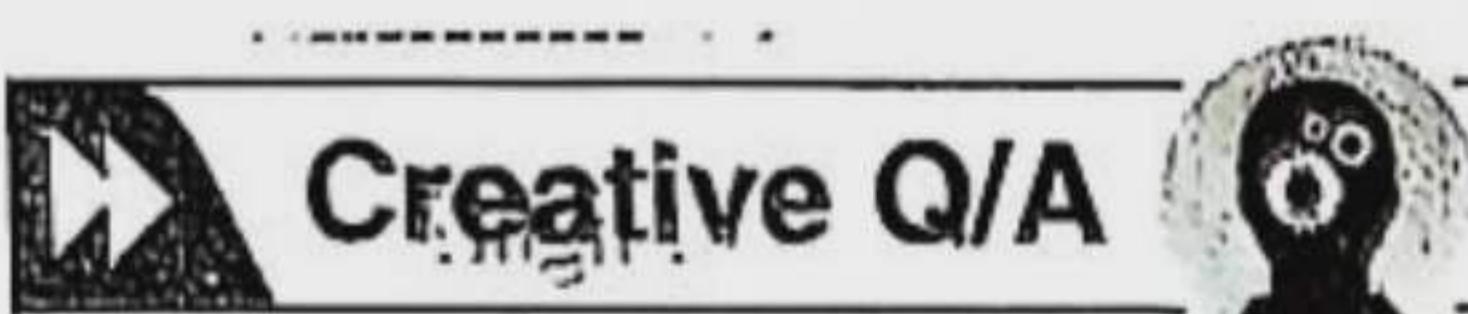
Question 30. Functions of camera aperture and eye pupil are same – Explain.

Ans. Camera aperture has circular hole. This hole allows the light needed to form the image to enter the camera. Similarly, the pupil of the eye is a round hole located in the centre of the cornea of the eye. By contracting and refracting automatically through the corneal hole depending on the intensity of the incident light, it allows the necessary light to form the image to enter in the eye. That is why the functions of camera aperture and eye pupil are same.

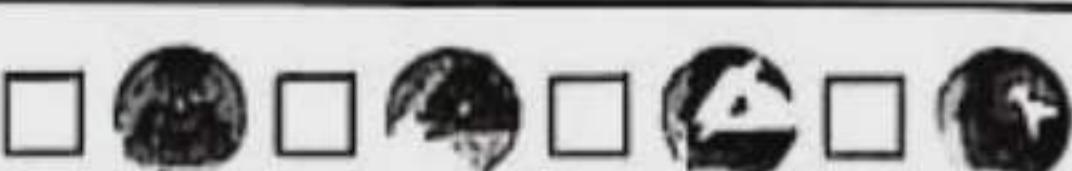
Question 31. Why is a real, inverted and short image of the object formed in human eye?

Ans. A real, inverted and short image of the object is formed in human eye. Because the human eye has a convex lens. It is located behind the cornea. The image formed in a convex lens is real, inverted and short.





Designed as per learning outcomes

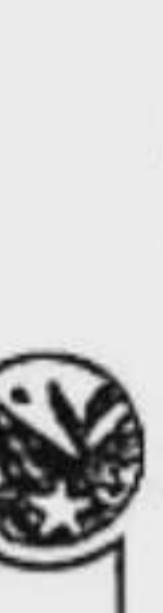


Ques. 01 Tasnimun is involved in scientific experiments. One day she kept a stick half sunk in a pot full of water. She noticed that the stick looked curved. Another day she dropped a coin weighing 2gm in the water of a glass. She noticed that the coin looked a little higher than its real position.

- What is gravity? 1
- Why is it easy to get down through stairs? 2
- Calculate the weight of the coin in the equation. 3
- Are both the experiments by Tasnimun same? 4

Analyze with logic.

• Dhaka Board 2019



Science

Answer to Question No. 01 :

- a Gravity is the force of attraction between the earth and other object in the universe.
- b It is easy to get down through stairs because of work done by the force of gravitation. But it is hard to get up through stairs, because during this time work is done against the gravity.
- c We know that weight of a body is the force acting on the body by the earth towards its centre. The weight of a body can be symbolically expressed as—

$$W = mg$$
, where m = mass and g = acceleration due to gravity.
 Here, m = mass of the coin
 $= 2 \text{ gm.}$
 $= 0.002 \text{ kg.}$

At the surface of the earth, the value of g is 9.8 ms^{-2}

$$\therefore \text{Weight of the coin, } W = mg \\ = 0.002 \times 9.8 \\ = 0.0196 \text{ newton.}$$

- d Yes, both the experiments by Tasnimun are same because both are the incidents of refraction of light.
 Incident -1 : When a stick is immersed obliquely in water and looked from the above, the stick appears smaller, thicker and curved. In fact it happens because of refraction of light. As it is seen in the figure, light is refracted from the denser medium water into the rarer medium air and enters eyes. Every part of the emerged stick is raised upwards. As a result the stick appears curved.



Fig. : Refraction of light

Incident -2 : If a coin is dropped in the water of a glass the coin looked a little higher than its real position. It has been possible due to refraction of light. Due to refraction light bends in passing from the denser medium water into rarer medium air and create a virtual image of the coin.

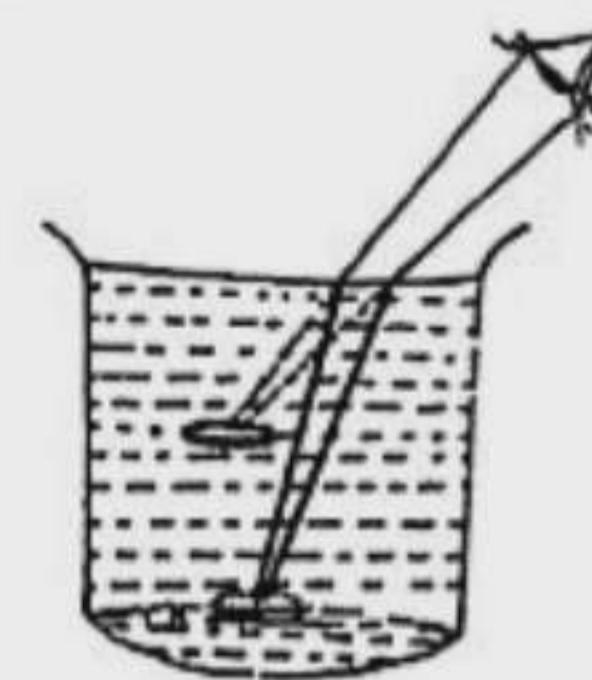
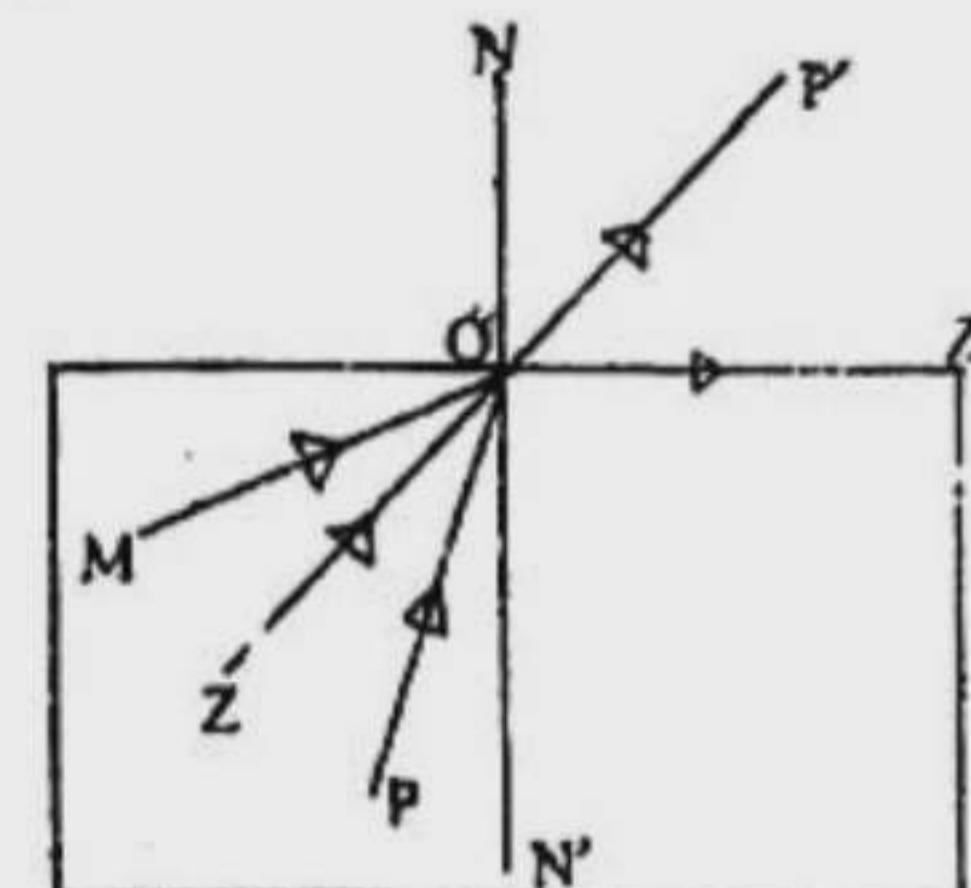


Fig : Virtual image of a coin due to refraction of light

Ques. 02



- What is critical angle? 1
- What do you mean by magnifying glass? 2
- Explain the critical angle by identifying it from the stem's Figure. 3
- Is it possible to come back incident ray, MO in the same medium? Analyze with logic. 4

• Jashore Board 2019

Answer to Question No. 02 :

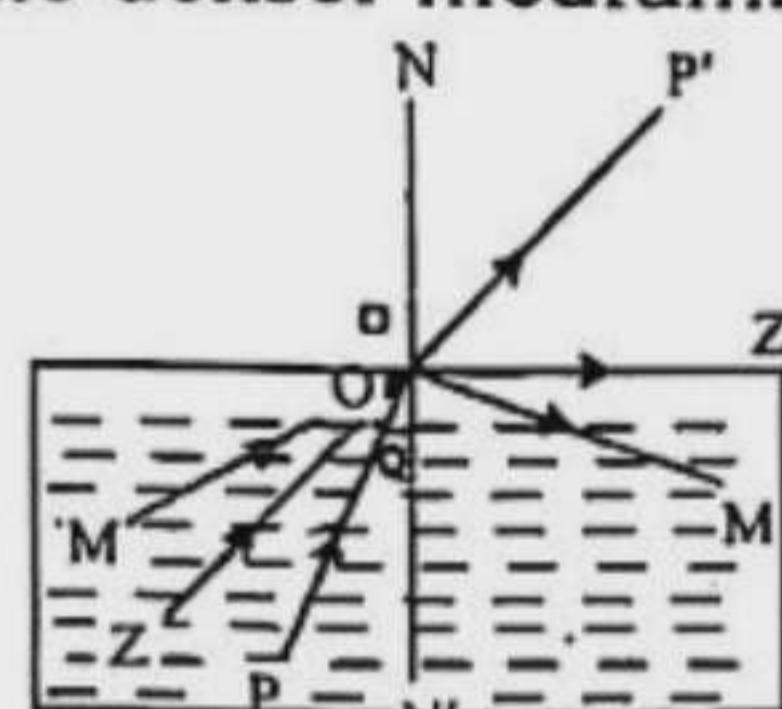
- a The angle of incidence of light against of which the corresponding refracted angle is 90° is called critical angle.
- b A properly formed convex lens is called a magnifying glass or reading glass. It is also known as simple microscope. By using a convex lens one can see a virtual erect and magnified image of an object, if it is placed within the focal length of the lens and observed from the other side of lens. Closer the former image is to the eye, greater will be the angle subtended to the eye by the image and it will appear larger accordingly.
- c When a ray of light enters a rarer medium from a denser medium, the refracted ray bends away from the normal drawn at the point of incidence of the ray. As a result the angle of refraction becomes larger than the angle of incidence. In this way as the angle of incidence increases the corresponding angle of refraction increases. For a particular combination of such pair of media there is a particular value of the angle of incidence, which in

In this case must be smaller than 90° , the corresponding angle of refraction becomes 90° which means the refracting ray passes along the surface of separation of the two media. The angle of incidence which corresponds to this situation is called the critical angle.

In the figure of the stem, $\angle ZON'$ is the critical angle.

d Yes, it is possible to come back incident ray, MO in the same medium. Because in this case, the angle of incidence $\angle MON'$ is greater than the critical angle $\angle ZON'$.

It has been observed experimentally that in this case the light ray instead of being refracted is reflected back in the medium from the surface level. Thus the boundary surface here acts as a reflecting surface and this reflection occurs according to the laws of ordinary reflection. This phenomenon is called total internal reflection. This means that the light ray from denser medium in this case is reflected at the boundary surface following the ordinary law of reflection and returns back totally to the denser medium.



According to the figure the angle of incidence corresponding to the incident ray PO is less than the critical angle and the corresponding reflected ray is OP'. For the incident ray ZO the angle of incidence is equal to the critical angle, and the corresponding reflected ray is Z'O which is traveling along the boundary surface. This means the corresponding angle of refraction is 90° . For the ray MO the angle of incidence is greater than the critical angle. In the case the ray MO is reflected back by the total internal reflection. In the case of ordinary reflection there is always some partial refraction along with the reflection. But in the total reflection it is observed that the incident ray is totally reflected.

- What is aqueous hummour? 1
- What do you mean by refraction of light? 2
- Explain the incidence angle produced by the incidence ray PO in the stem. 3
- What will be the change if QO light ray entrance the glass medium? Give your opinion with comparative details. 4

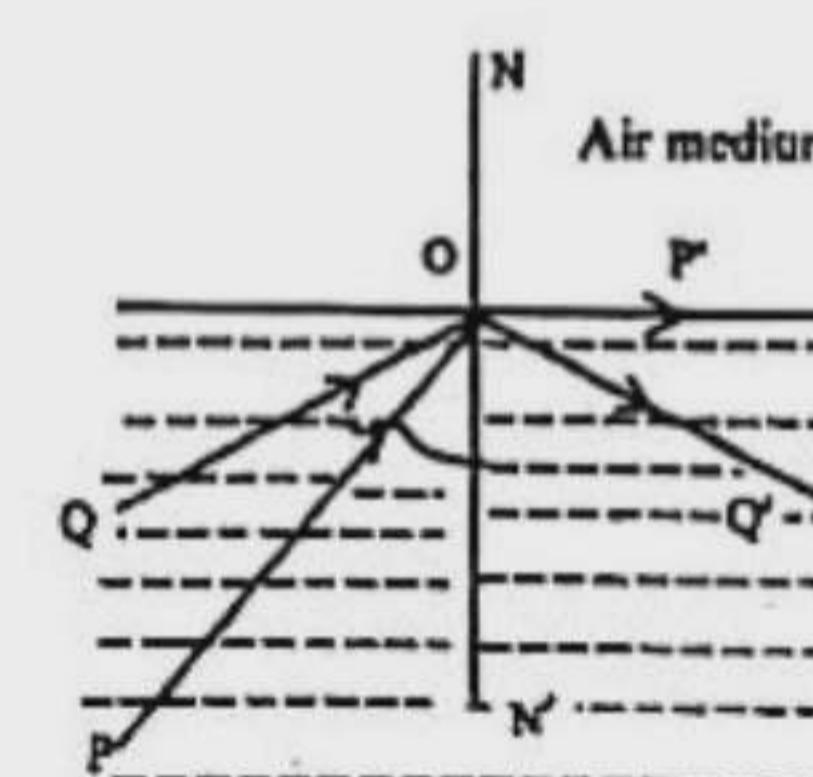
• Jashore Board 2017

Answer to Question No. 03 :

a The watery substance that exists in the space between the lense and the cornea of an eye is called aqueous hummour.

b Light travels in a straight line when it is passed through a homogeneous transparent medium. But when a ray of light enters into a transparent medium from another transparent medium of distinct density, it change its direction of motion at a point on the line of separation of surface of the two media. This type of phenomenon of light is called refraction of light.

c In the stem, we see that a ray of light PO travels through a denser medium towards a rarer medium (Air). When a ray of light enters into rarer medium from a denser medium, the refracted ray bends away from the normal drawn at the point of incidence of the ray. As a result the angle of refraction becomes larger than the angle of incidence.



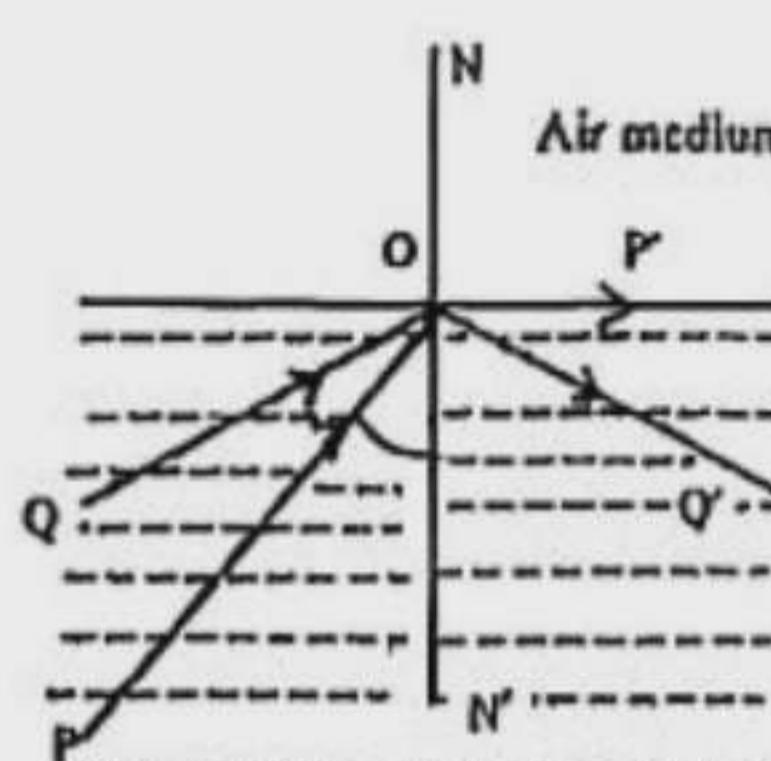
Here, incidence ray is PO and refracted ray is OP' that means the refracting ray passes along the surface of separation of the two media. The angle of incidence which corresponds to this situation is called the critical angle. In this, incidence angle is $\angle PON'$ and refracted angle is $\angle N'OP' = 90^\circ$. The angle of incidence of light against of which the corresponding refracted angle is 90° is called critical angle.

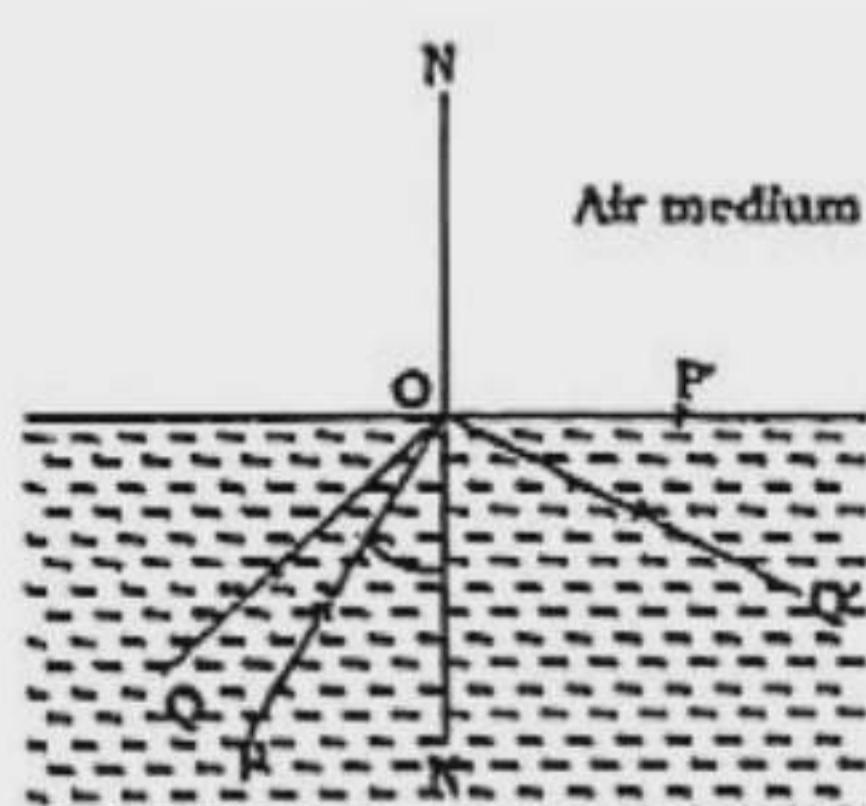
So, here the incidence angle produced by the incidence ray PO is a critical angle.

d In the stem it is seen that, light rays have entered from water medium to air medium. Water medium is denser than air medium.

So, light rays have entered from denser medium to rarer medium. When light rays in passing from denser medium to rarer medium it bends away from the normal. In this case the angle of incidence is smaller than the angle of refraction.

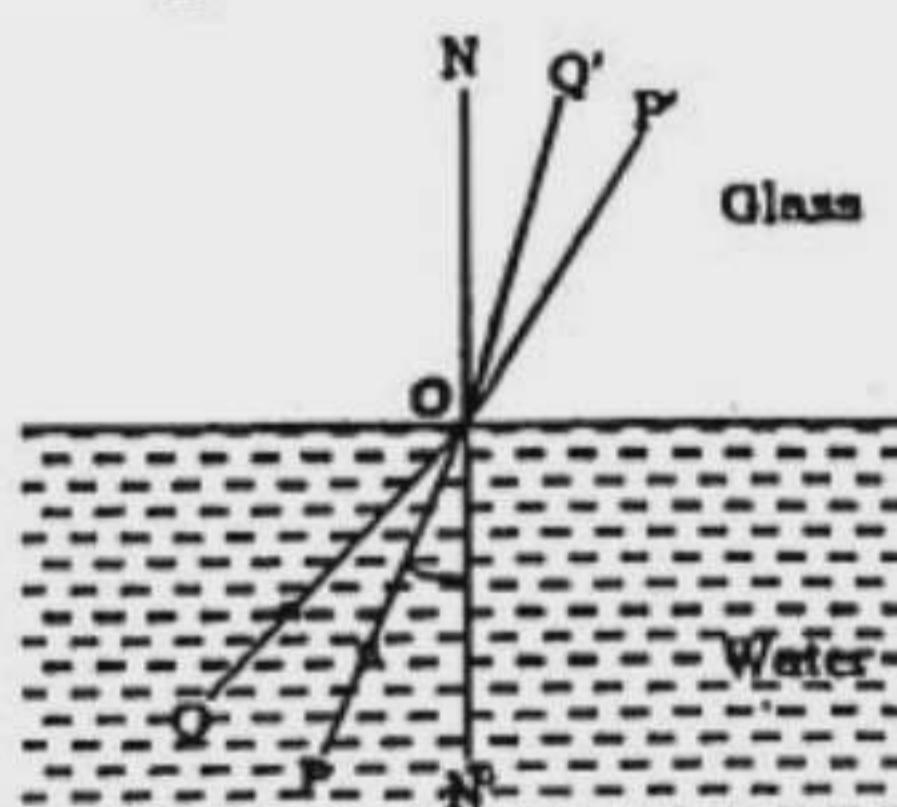
Ques. 03





In this fig., the angle of incidence corresponding to the incident ray QO is greater than the critical angle $\angle PON'$. In this case the ray OQ' is reflected back by the total internal reflection. In this case, the angle of incidence $\angle QON'$ is smaller than the angle of refraction $\angle Q'ON'$.

Now, if the ray of light QO enters from water medium to glass medium, the refracted ray of light will change. Because glass medium is denser than water medium. When a ray of light enters from rarer medium to a denser medium it bends towards the normal. In this case the angle of incidence is greater than the angle of refraction.



In this fig. OQ' is the corresponding refracted ray of incidence ray QO . Here, the angle of incidence $\angle QON'$ is greater than the angle of refraction $\angle Q'ON$.

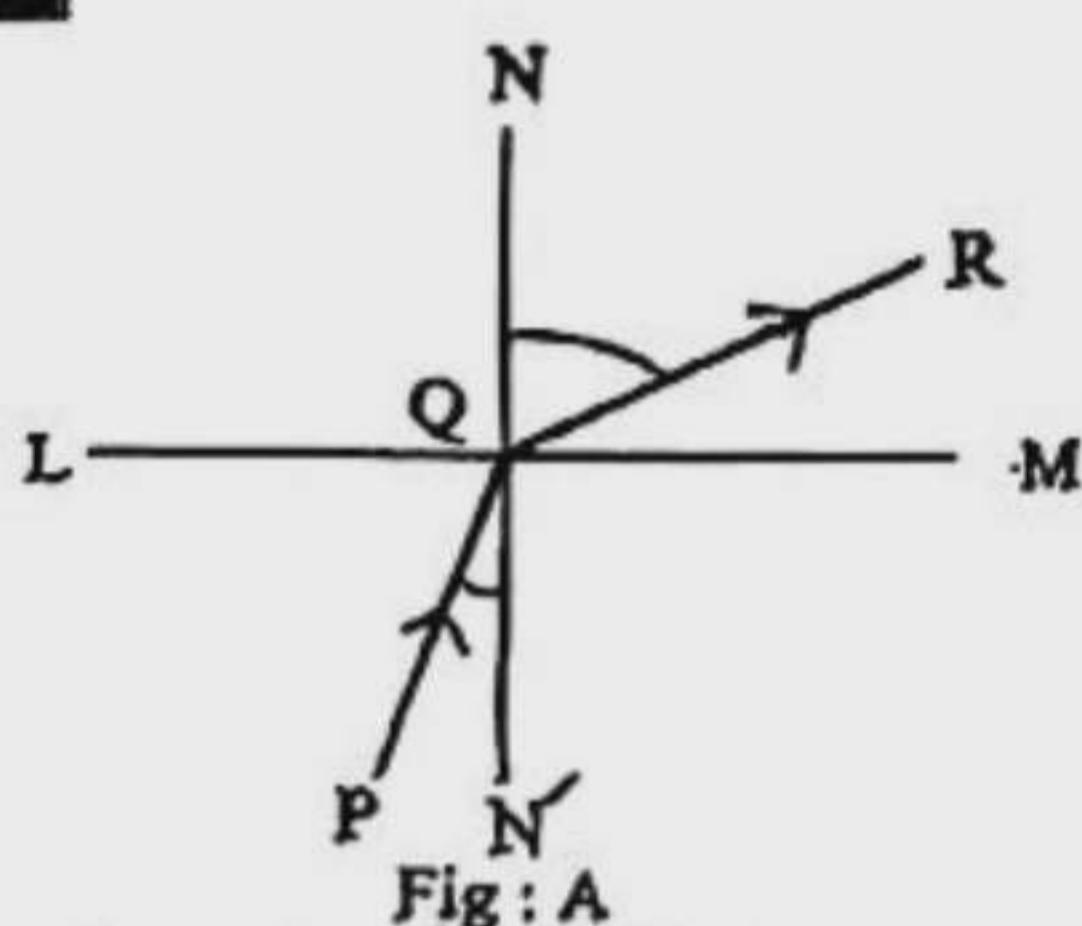
Ques. 04

Fig. A

- a. What is refraction of light? 1
- b. What do you mean by total internal reflection? 2
- c. Explain the incident of figure 'A'. 3
- d. Discuss the real application of figure 'A'. 4

• Dhaka Board 2017

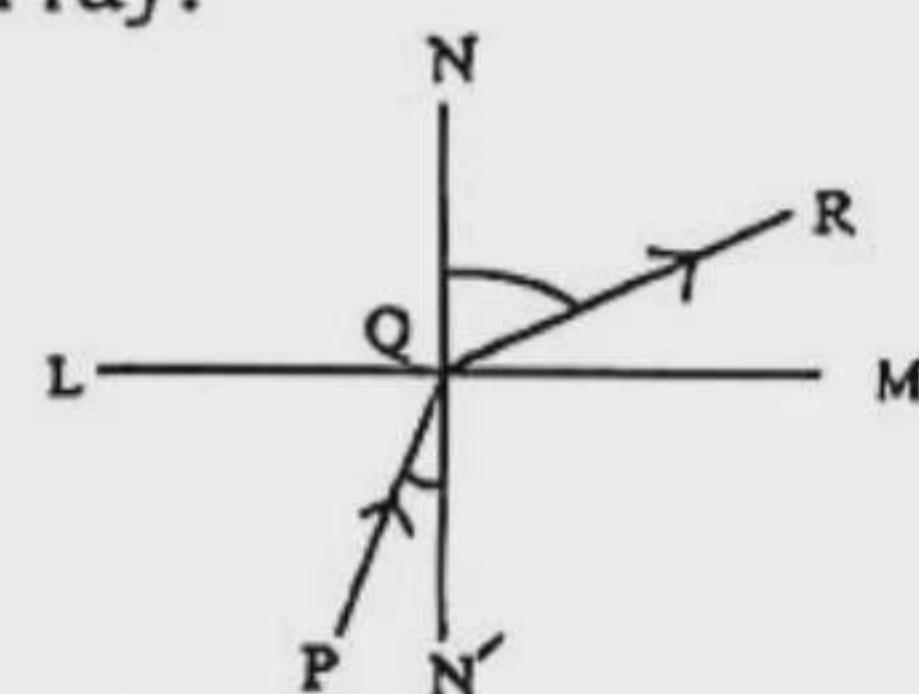
Answer to Question No. 04 :

a The change of direction of light travelling from one transparent medium to another transparent medium at surface of separation is called refraction of light.

b Total internal reflection of light refers to the phenomenon of light based on which light travelling from denser to rarer medium, total light come back to the denser medium reflecting at the boundary surface of the two media.

For total internal reflection the angle of the incidence in the denser medium must be greater than the critical angle that corresponds to the two media.

c The incident of figure 'A' indicates refraction of light. Here, light ray PQ is entering from dense medium to rarer medium. Here LQM is the surface of separation of two media and NQN' is the normal at the surface. Q is the point of incidence. PQ ray travels from rarer medium and refracted away from the normal QN . So, PQ ray is incident ray and QR is the refracted ray.



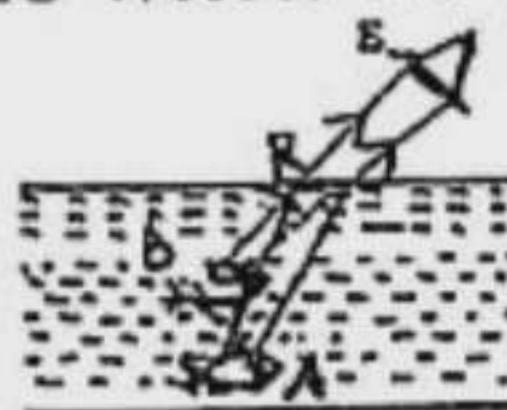
When light rays in passing from denser medium to rarer medium, it bends away from the normal. In this case the angle of incidence $\angle PQN'$ is smaller than the angle of refraction $\angle RQN$. The phenomenon of this change in direction of a ray is called the refraction of light.

d The real application of figure 'A' can be seen at the time of fishing.

When we see a fish in water, it is found to stay at a place which is a bit upwards compared to its actual position. This happens due to refraction of light.

We know, when a ray of light enters into a rarer medium from a denser medium, the ray of light bends away from the normal drawn at the point of incidence of the ray. Again, if a ray of light enters into a denser medium from a rarer medium, the ray bends towards the normal drawn at the point of incidence. In this case the following picture can be observed :

The fish stays at a position which is a bit lower than where it appears to be. If someone hunt a fish with a spear, he has to aim it at a deeper position than its apparent position. Something similar happens about the appearance of steps under transparent water. The real position of a step under water is lower than it appears when we look obliquely.



In the above figure, A and E represent the actual position of fish and eye respectively. Rays of light from A fall on R , the point of incidence on the line of separation of water and air and then refracting a little. They reach to the eye E , located on the bank of water body. When the refracted rays are extended to the back along ER , they coincide with the point B . So, it is seemed that the fish is at B .

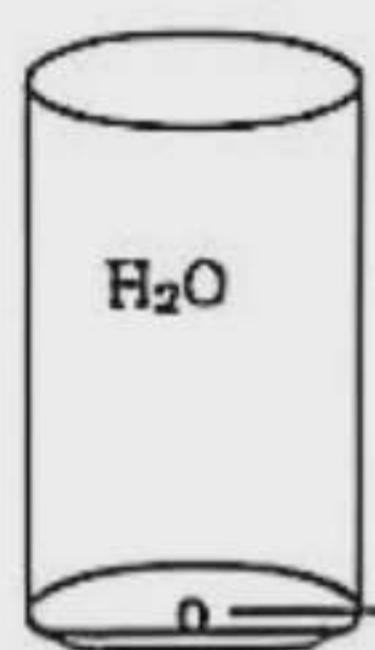
Ques. 05

Fig- (i)

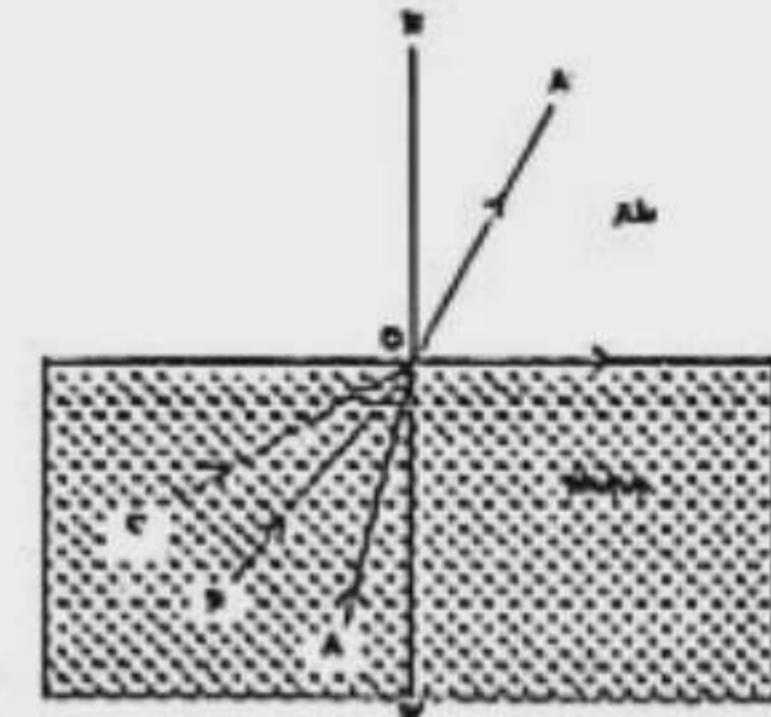


Fig-(ii)

- Define critical angle. 1
- Why is magnifying glass used? Explain it. 2
- How the imaginary image of fig (i) will be seen? Describe by drawing the path of ray of light. 3
- In fig (ii), if the ray of light CO enters from air medium to water medium, then refracted ray of light will change. Draw that ray of light and analyze comparatively. 4

© Dinajpur Board 2017

Answer to Question No. 05 :

a The angle of incidence of light against of which the corresponding refracted angle is 90° is called critical angle.

b A properly formed convex lens is called a magnifying glass or reading glass. It is also known as simple microscope. By using a convex lens one can see a virtual erect and magnified image of an object, if it is placed within the focal length of the lens and observed from the other side of lens. Closer the former image is to the eye, greater will be the angle subtended to the eye by the image and it will appear larger accordingly.

c In the fig. (i) it is shown that, a coin is into a mug full of water. To see the coin, eyes should be kept in such a position that one just fail to see the coin. Now if water is poured in the mug, the coin will be come visible at one stage. It has been possible due to refraction phenomenon. Due to refraction, light bends in passing from the denser medium water into rarer medium air and create a virtual image of the coin.

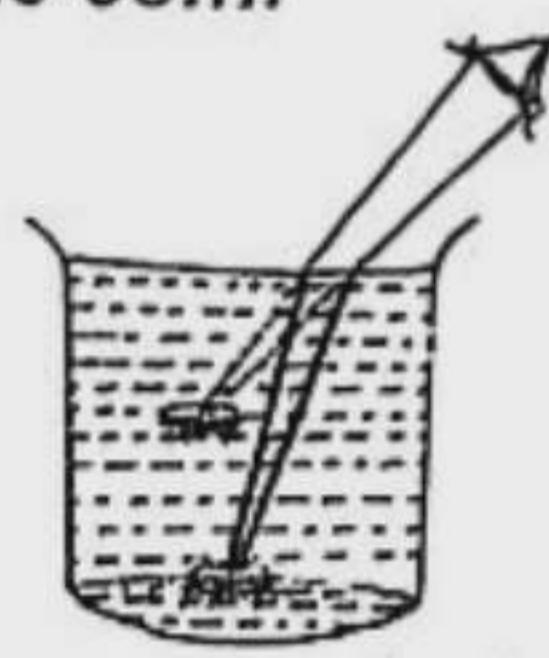
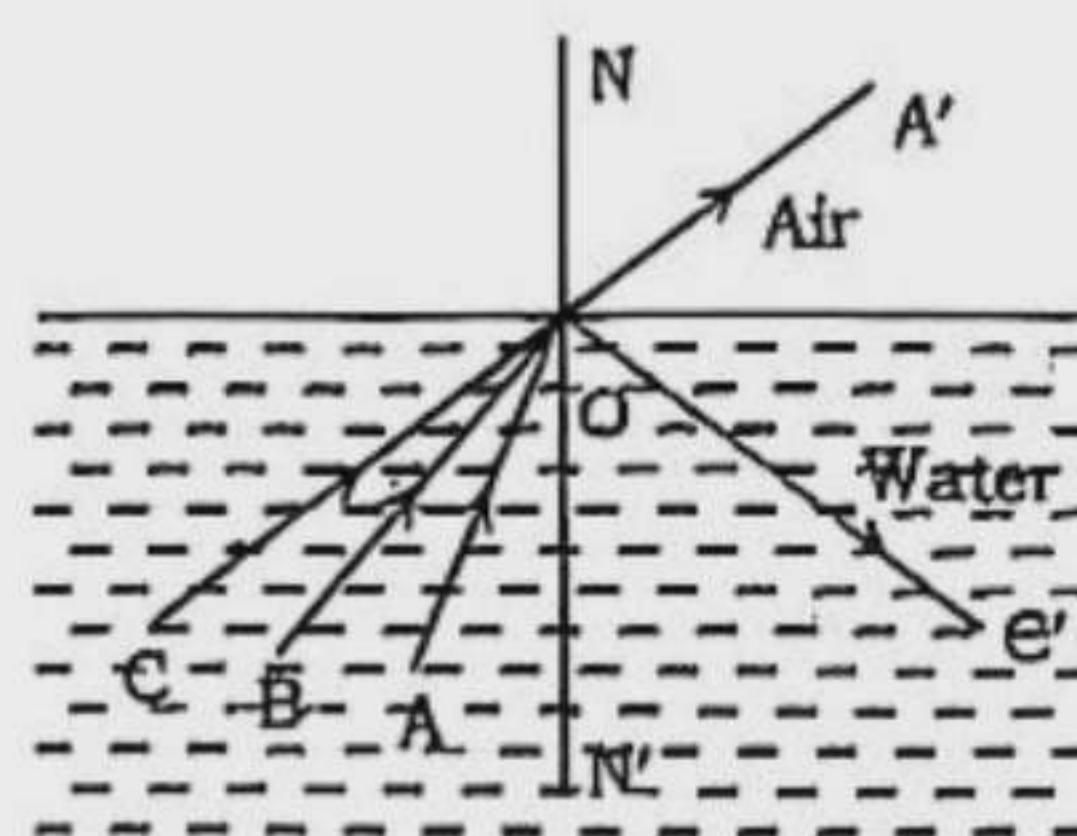


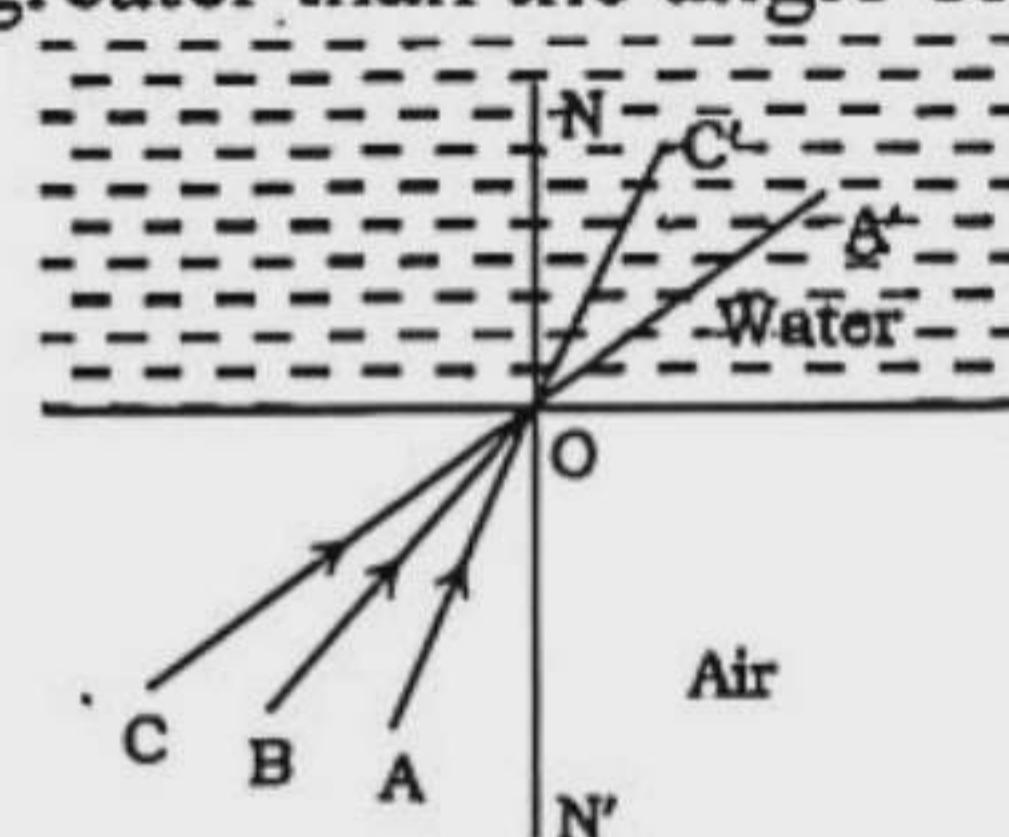
Fig 11.5: Virtual image of a coin due to refraction of light

d In fig. (ii) of the stem, refraction of light is shown. Here, light rays have entered from water medium to air medium. Water medium is denser than air medium. So, light rays have entered from denser medium to rarer medium. When light rays in passing from denser medium to rarer medium bends away from the normal. In this case the angle of incidence is smaller than the angle of refraction.

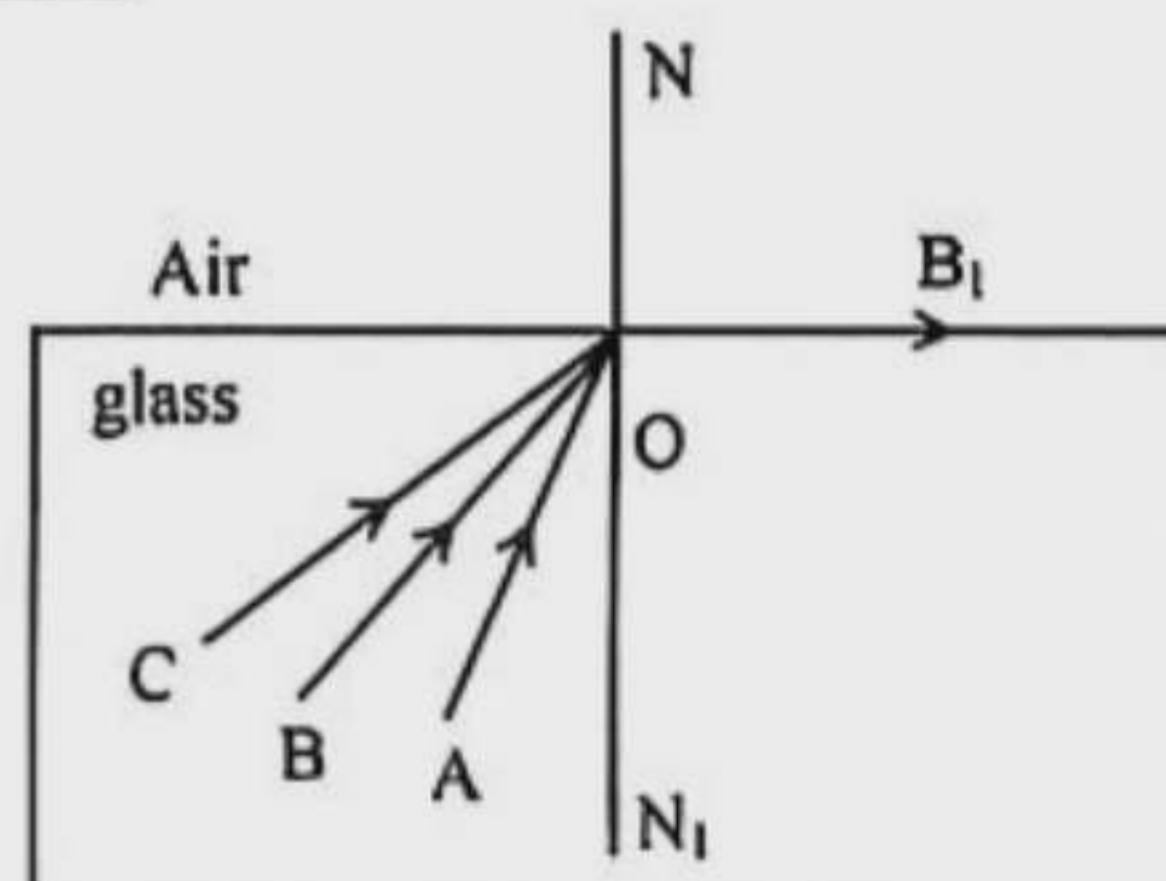


In this fig. the angle of incidence corresponding to the incident ray CO is greater than the critical angle. In this case the ray OC' is reflected back by the total internal reflection. In this case, the angle of incidence $\angle CON'$ is smaller than the angle of refraction $\angle C'ON'$.

Now, if the ray of light CO enters from air medium to water medium, the refracted ray of light will change. Because when a ray of light enters from rarer medium to a denser medium then it bends towards the normal. In this case the angle of incidence is greater than the angle of refraction.



In this figure, corresponding refracted ray of CO is shown which is OC'. Here, refraction angle is $\angle C'ON$ which is less than incidence angle $\angle CON$. So, if the ray of light CO enters from air medium to water medium, then refracted ray of light will change.

Ques. 06

- What is called critical angle? 1
- Explain why diamond looks glitter? 2
- What will happen for the ray BO? Explain with ray diagram. 3
- What will happen for the ray CO? Analyze with ray diagram. 4

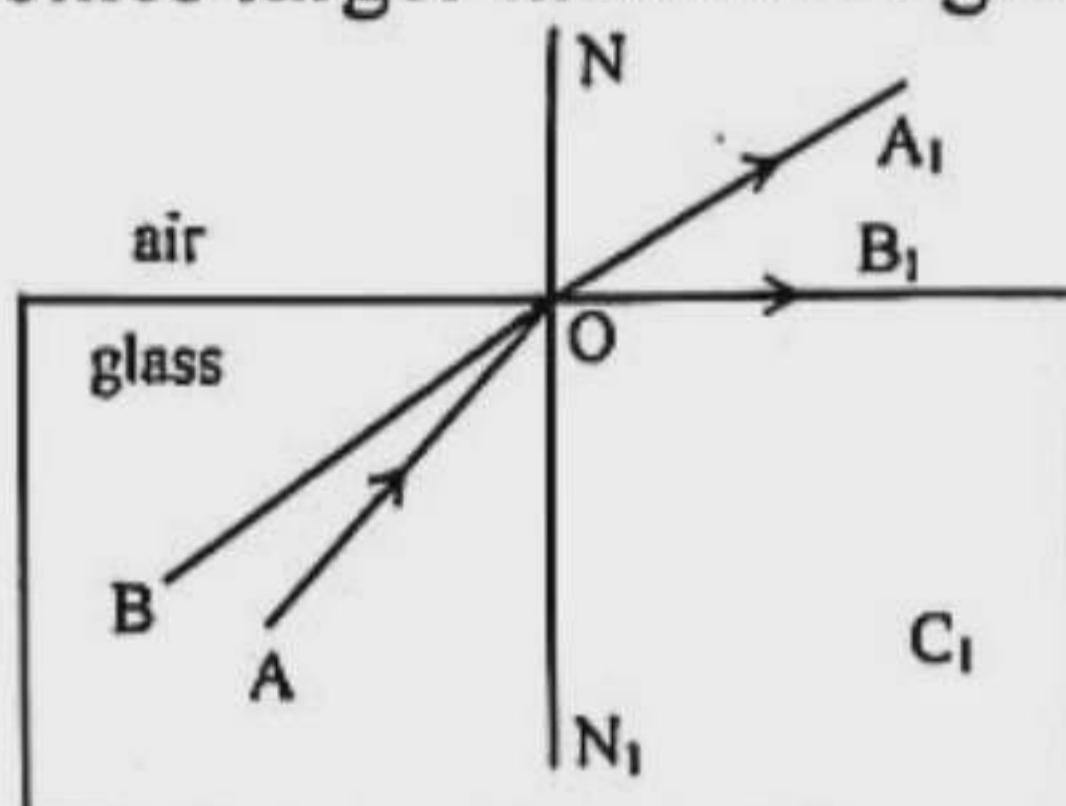
© Rajuk Uttara Model College, Dhaka

Answer to Question No. 06 :

a The angle of incidence of light against of which the corresponding refracted angle is 90° is called critical angle.

b The ratio of the speed of light in a vacuum to its speed in a specific medium is called refractive index. Due to high refractive index light bends as it passes from one medium to another – an effect referred to as refraction. As this light travels through the diamond, it strikes another surface within the stone, causing part of the light to be reflected back. So when light enters a diamond, it has trouble getting back out. This is why diamond glitters.

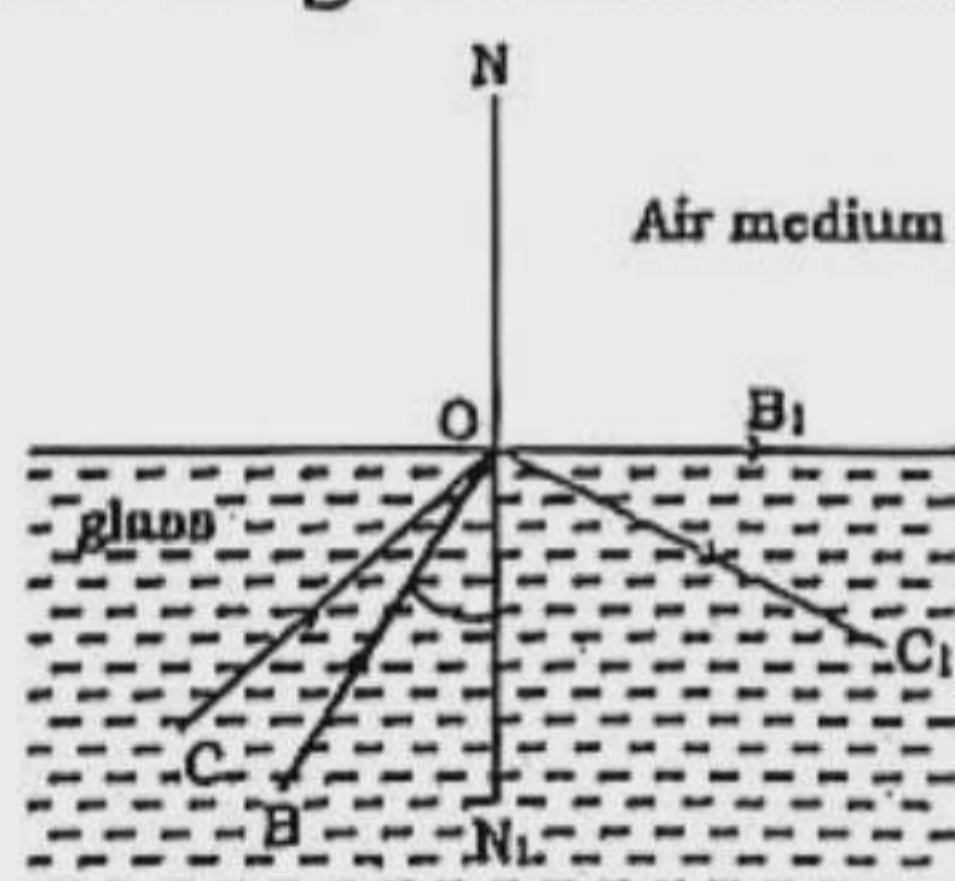
c In the stem, we see that a ray of light BO travels through a denser medium towards a rarer medium (air). When a ray of light enters into rarer medium from a denser medium, the refracted ray bends away from the normal drawn at the point of incidence of the ray. As a result the angle of refraction becomes larger than the angle of incidence.



Here, incidence ray is BO and refracted ray is OB₁, this means the refracting ray passes along the surface of separation of the two media. The angle of incidence which corresponds to this situation is called the critical angle. In this incidence angle is $\angle BON_1$ and refracted angle is $\angle N_1OB_1 = 90^\circ$. The angle of incidence of light against of which the corresponding refracted angle is 90° ; that is called critical angle.

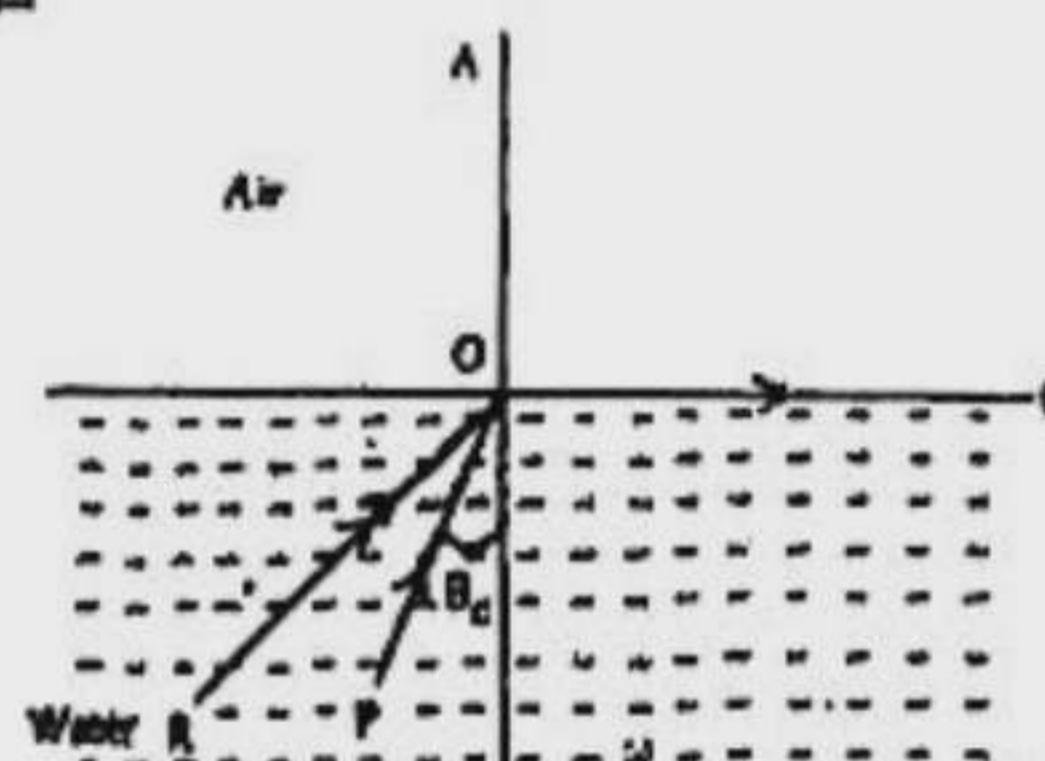
d In the stem it is seen that, light rays have entered from glass medium to air medium. Glass medium is denser than air medium.

So, light rays have entered from denser medium to rarer medium. When light rays in passing from denser medium to rarer medium it bends away from the normal. In this case the angle of incidence is smaller than the angle of refraction.



In this fig., the angle of incidence corresponding to the incident ray CO is greater than the critical angle $\angle BON_1$. In this case the ray OC₁ is reflected back by the total internal reflection. In this case, the angle of incidence $\angle CON_1$ is smaller than the angle of refraction $\angle C_1ON_1$.

Ques. 07



In the above figure, PO is the incident ray and OQ is the refracted ray.

- What is critical angle? 1
- What do you mean by 5 ampere fuse? 2
- If the incident ray is indicated by RO in that time draw the ray diagram of the refracted ray and describe it. 3
- If the incident ray, RO moves from air medium to the water medium, in that time which one is incident ray and refracted ray? Explain your logic by drawing figure. 4

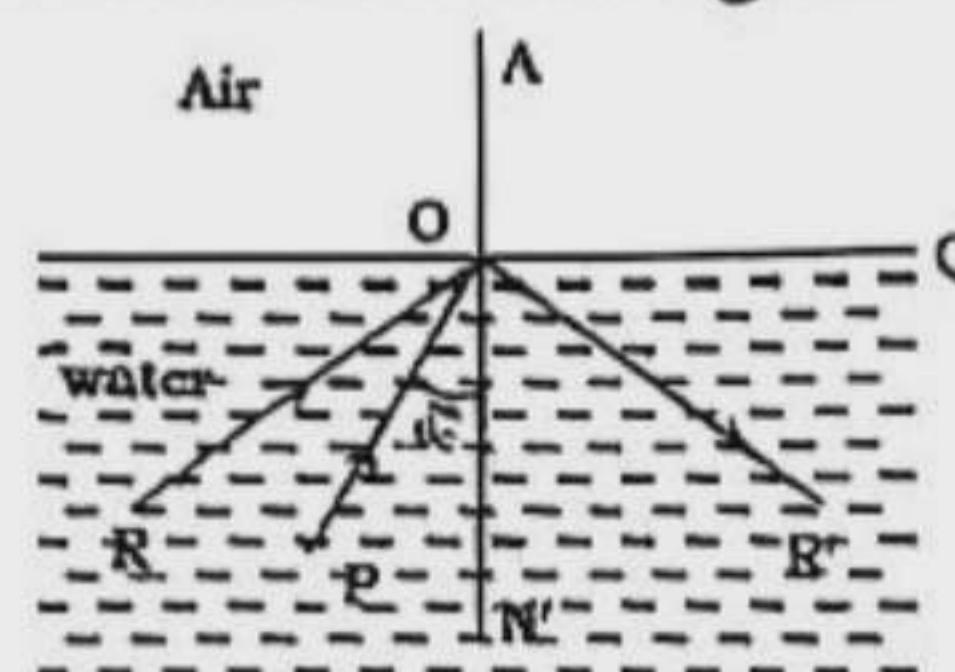
© Rajshahi Board 2017

Answer to Question No. 07 :

a The angle of incidence of light against of which the corresponding refracted angle is 90° is called critical angle.

b A 5-ampere fuse means a flow of current higher than 5 ampere melts the fuse wire. A television set needs a 5 ampere fuse. If we use a 10 ampere fuse for a television set, it will burn the set. So only a fuse of 5 ampere is suitable for a television set.

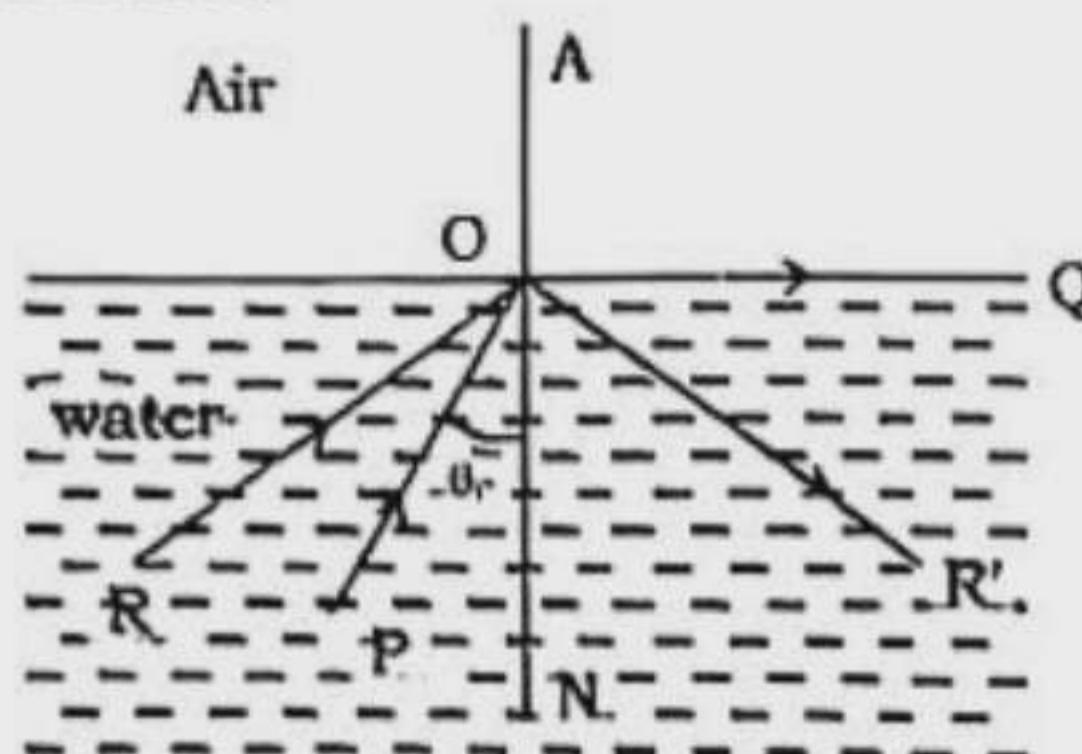
c In the stem, we see that a ray of light RO travels through a denser medium towards a rarer medium forming an incident angle which is greater than the critical angle. So, the ray of light RO does not enter into the rarer medium by nature. Had rather the ray reflects at the boundary surface following the ordinary law of reflection and returns back to the denser medium due to the phenomenon of total internal reflection of light.



According to the figure, for the ray RO, the angle of incidence $\angle RON$ is greater than the critical angle $\angle PON$. In the case the ray OR' is reflected back by the total internal reflection.

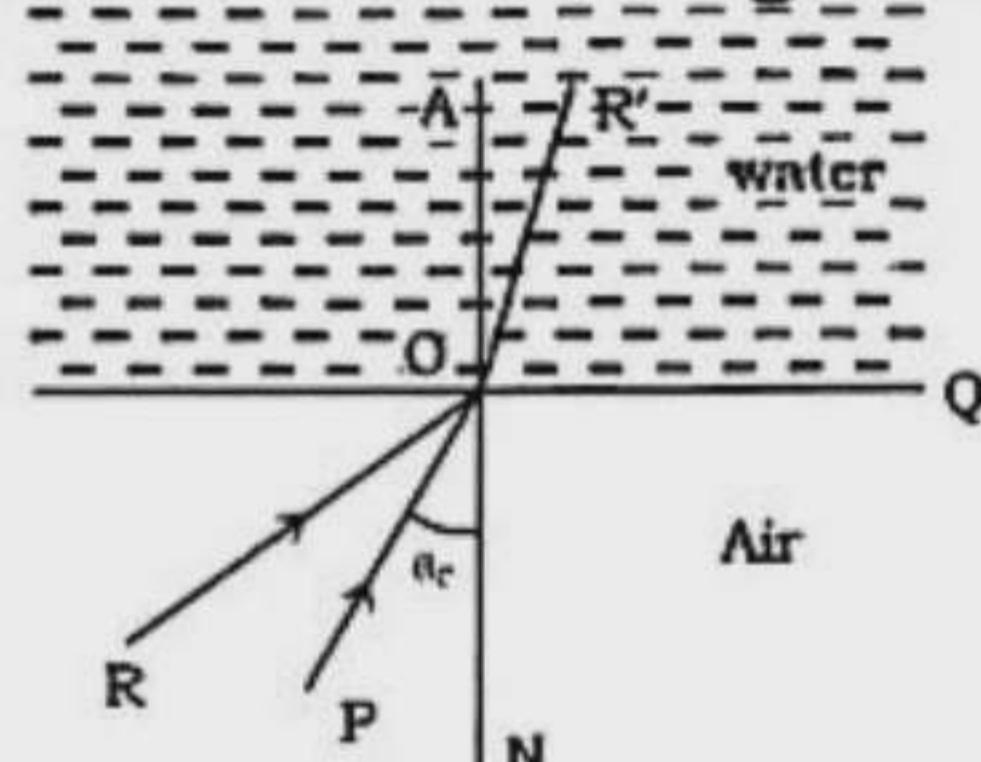
d In the stem it is noticed that light rays have entered from water medium to air medium. Water medium is denser than air medium. So, light rays have entered from denser medium to rarer medium. When light rays in passing from denser medium to rarer medium it bends away from the normal. In

In this case the angle of incidence is smaller than the angle of refraction.



In this fig, the angle of incidence corresponding to the incident ray RO is greater than the critical angle θ_c . In this case the ray OR' is reflected back by the total internal reflection. In this case, the angle of incidence $\angle RON$ is smaller than the angle of refraction $\angle R'ON$.

Now, if the ray of light RO enters from air medium to the water medium, the refracted ray of light will change. Because when a ray of light enters from rarer medium to a denser medium then it bends towards the normal. In this case the angle of incidence is greater than the angle of refraction.



In this figure, OR' is the corresponding refracted ray of incidence ray RO.

Ques. 08



Figure-1

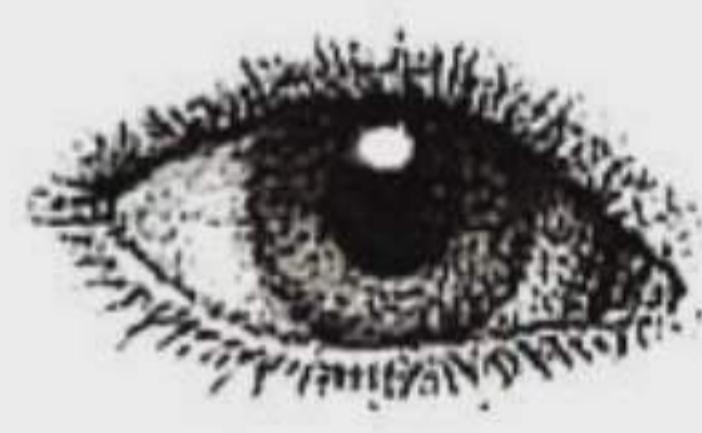


Figure-2

- a. What is optical fibre? 1
- b. What do you mean by critical angles? 2
- c. Describe the function of figure-1 3
- d. Which function is similar with figure '2'? Describe the structure and function of the diagram. 4

© Dinajpur Board 2018

Answer to Question No. 08 :

a Optical fibre is a very thin fibre of glass which is even thinner than human hair and is flexible and extremely transparent.
It is used for transmitting rays of light.

b For incidence from a denser to a rarer medium, the incidence angle of which the angle of refraction becomes 90° is called critical angle of the denser medium with respect to the rarer one. It takes place when the refracted ray coincides with the surface of separation of the two media.

c Figure-1 of the stem shows a magnifying glass. By using a convex lens one can see a virtual erect and magnified image of an object, if it is placed within the focal length of the lens and observed from the other side of lens. Closer the former image is to the eye, greater will be the angle subtended to the eye by the image and it will appear larger accordingly. But if the image is formed at a distance closer than the point of near view of the eye then the image will be blurred.



When the image is formed at the point of near view that is at the least distance of distinct vision, only then it appears most distinct and magnified. When an object is not clearly visible, a convex lens of short focal length is used to see it magnified and with clarity. A properly formed convex lens is called a magnifying glass or reading glass. It is also known as a simple microscope. This type of magnifying glass does not give much enlargement of objects.



d Figure-2 of the stem is human eye. The function of human eye is similar to the functions of a camera. The structure and function of different parts of human eye is described below :

- a. **Eye-ball** : In the cavity of the eye there is a spherical object which can be rotated within a certain limit. This is known as eye ball.
- b. **Sclera** : This is a white covering of the eye-ball which is hard, fibrous and opaque. It protects the eye from external harmful effects and preserves the shape of the eye.
- c. **Cornea** : Frontal part of the sclera is called cornea. This part of the sclera is transparent and is bulged outwards more than other parts.
- d. **Choroid** : It is a black membrane covering the body of sclera. Because of its blackness, the light entering the eye is not reflected.
- e. **Iris** : It is an opaque membrane which stays just behind the cornea. This membrane can be of different colour like blue, deep brown, black etc. for different persons.
- f. **Pupil** : It is a circular hole at the centre of the cornea which is connected to muscular cells. The size of the aperture of the pupil can be adjusted by the movement of the muscles attached to it.
- g. **Crystalline convex lens** : This is a convex lens made of soft jelly like material which is situated behind the cornea.

h. **Retina** It is a light sensitive rose coloured translucent membrane located behind the eyeball. When light falls on retina it creates some excitations in those nerves and produce the sensation of sight in the brain.

i. Aqueous humour and vitreous humour: The space between the lens and the cornea is filled with some kind of transparent watery substance. This is called aqueous humour.

The space between the lens and the retina is filled with jelly like material. This is called vitreous humour.

d Picture 'A' of the stem is human eye and picture 'B' is a camera. The working of the human eye is similar to the working of a camera. Similarities between the activities of human eye and a camera is described below :—

1. Camera is a light proof closed box which is painted black inside. For this black colour, light incident on it is not reflected. Similarly the eye behave as a light proof enclosure. Its walls are black so light falling on it is not reflected.
2. Using the shutter the lens of the camera can be kept exposed to light for any length of time. Similarly with the help of the eye lid the eye lens can be kept exposed to light for any length of time.
3. The amount of light needed to form the picture can be controlled by adjusting the circular aperture of the camera. Similarly in case of eye, depending on the intensity of light the aperture of the cornea is automatically adjusted to allow the necessary light to form the image.
4. Every lens of camera has a definite focal length. Similarly, by adjusting the muscles attached to the eye lens, its focal length can be changed by changing its curvature.
5. The image of the object is formed by its converging lens in case of camera. Similarly in case of eye, cornea, aqueous humour, eye lens, vitreous humous together make a convergent lens, like system to form the image of an object.
6. A real inverted and reduced image of the object is formed on the photographic plate of camera. Similarly, a real inverted and reduced image of the object is formed on the light sensitive retina of eye.

- | | |
|---|---|
| a. What is cornea? | 1 |
| b. Explain the total internal reflection. | 2 |
| c. Which one is the denser medium between medium 'R' and 'S'? Describe the reasons. | 3 |
| d. If the density of medium 'R' and 'T' is same, then what will happen? Analyze it. | 4 |

© Sylhet Board 2019

Answer to Question No. 09 :

a Frontal part of the sclera of eye is called cornea. This part of the sclera is transparent and is bulged outwards more than other parts.

b Total internal reflection of light refers to the phenomenon of light based on which light travelling from denser to rarer medium, total light come back to the denser medium reflecting at the boundary surface of the two media.

In this case, the angle of incidence is greater than the critical angle.

c In the stem, medium 'R' is air medium and medium- 'S' is glass medium. Here light is entering from air medium to glass medium. When a ray of light enters from rarer medium to a denser medium then it bends towards the normal. In this case the angle of incidence is greater than the angle of refraction. From the measurement of angles it is observed from the stem is that the angle of incidence $\angle PON$ is greater than the angle of refraction $\angle N'OO'$ and is equal to the emerging angle. It is happened when light enters from rarer medium to a denser medium. So medium 'S' is denser than medium 'R'.

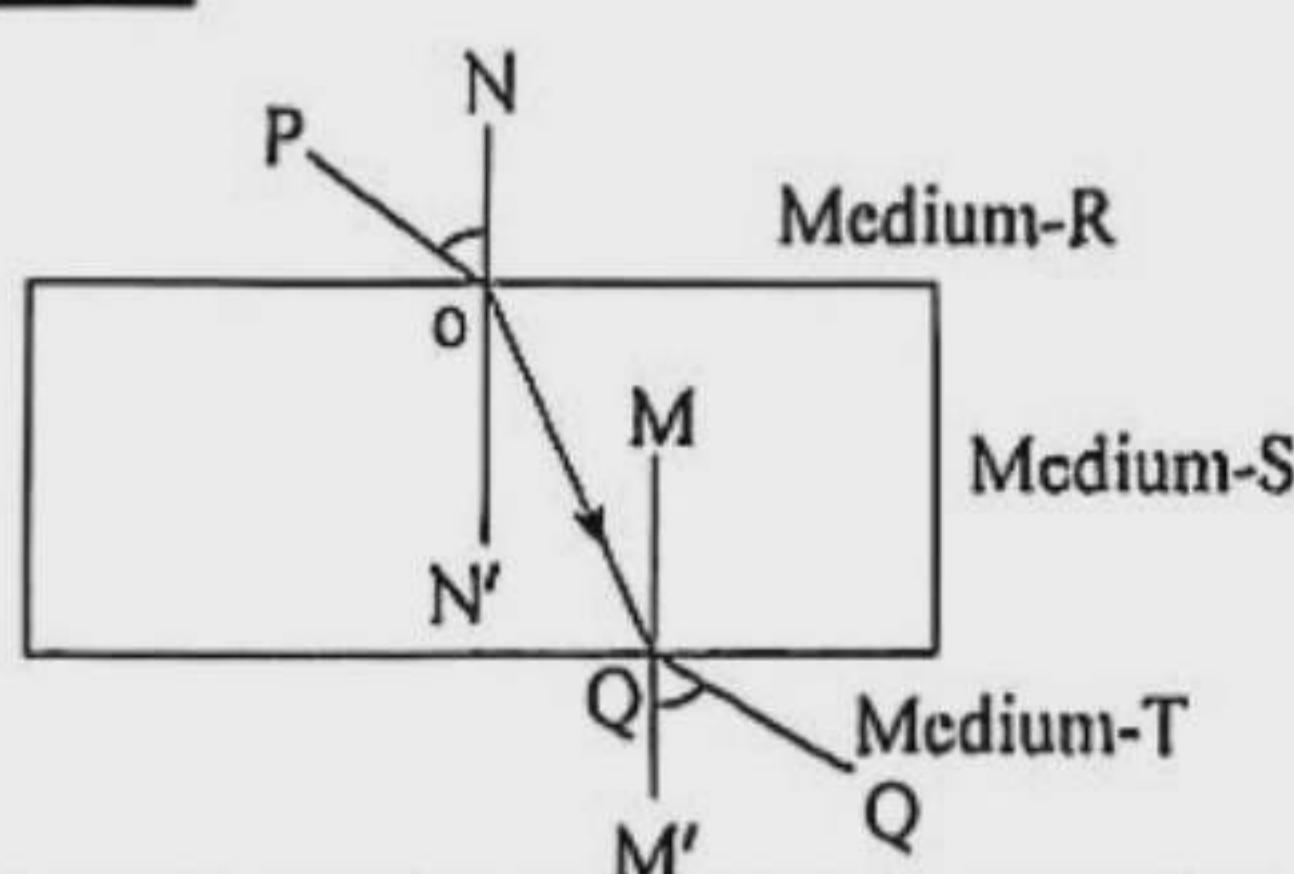
d According to the stem, medium-R is rarer medium and medium- 'S' is denser medium. Now, if the density of medium 'R' and 'T' is same medium S must be denser than medium 'T'. In that case following incidence will happen—

(i) Angle of incidence $\angle PON$ will be equal to the angle of emergence $\angle M'O'Q$. Because when the light ray is reflected from the one medium (like air) into another medium (like glass) and finally emerge out in the original medium angle of incidence is equal to the angle of emergence.

(ii) The incident ray, the refracted ray and the normal drawn at the incident point on the surface separating the two media, cell will lie in the same plane.

(iii) Light rays in passing from denser medium to rarer medium bends away from the normal. In this case the angle of incidence is smaller than the angle of refraction. So, here, angle of incidence $\angle MO'O$ will be smaller than the angle of refraction $\angle QO'M'$.

Ques. 09



Ques. 10 When Sagar bring kerosene by a glass bottle, he observed that, the lower part of the bottle looking slightly thick and upward than before. To find out the above when he entered the long stick inside it, then it looks bent.

- What is refraction of light? 1
- Explain the importance of optical fibre in the telecommunication process. 2
- Explain the reason for which the thickness and looking upward of the end point of the bottle seen by Sagar. 3
- Is there any similarity in between the above stem's two phenomenon on the basis of the differences of medium and density? Analyze it. 4

© Sylhet Board 2017

Answer to Question No. 10 :

a. The change of direction of light travelling from one transparent medium to another transparent medium at surface of separation is called refraction of light.

b. The optical fibre is a very thin fibre of glass. The use of optical fibre in the telecommunication process is very important. Since light consists of high frequency electro-magnetic waves, it can carry much more information. In optical fibre the loss of signal strength is very low and one can send information to long distances and along curved paths by using it.

c. In the stem, Sagar brought kerosene by a glass bottle. Then he observed that, the lower part of the bottle looking slightly thick and upward than before. This is the incident of refraction of light. The change of direction of light travelling from one transparent medium to another transparent medium at surface of separation is called refraction

of light. Kerosene is denser medium than air. So, light from the end point of the bottle reaches our eyes after refraction. Due to refraction, light bends in passing from the denser medium kerosene into rarer medium air and create a virtual image of the bottom of the glass.

As a result the lower part of the bottle appears lifted upwards and slightly thick.

d. The cause of the two incidents of the stem is the same that is refraction of light. The two incidents are as follows—

1st incident : The 1st incident is that the lower part of the bottle with kerosene looking slightly thick and upward than before. The reason for which the thickness and looking upward of the end point of the bottle seen by Sagar is refraction of light. Due to refraction, light bends in passing from the denser medium kerosene into rarer medium air and create a virtual image of the bottom of the glass. That's why it looks upward and slightly thick.

2nd incident : The 2nd incident is that, when Sagar entered the long stick inside the bottle filled with kerosene, then it looks bent. The reason is that light from the immersed part of the stick reaches us after refraction. Before the light from the immersed part of the stick reaches our eyes it passes from the denser transparent medium kerosene to rarer medium air and is deflected in the surface.

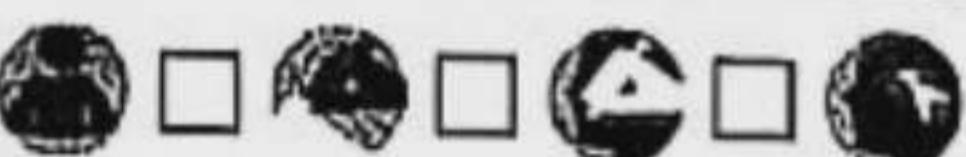
The apparent bending of the stick gives evidence that light is refracted at the surface between the two different medias. Thus bending of the light path at the surface separating two different medias occurs because, the velocity of light is different in different media.



Knowledge & Comprehension-based Q/A



Designed as per topic



Preparatory Knowledge-based Q/A

Question 1. What is the incidence angle?

Ans. The angle that the incident ray makes with the normal is called the incidence angle.

Question 2. What is the critical angle?

Ans. When a ray of light is incident on a denser to rarer medium, the angle of incidence for which the value of the angle of refraction is 90° is called critical angle.

Question 3. What is the value of angle of refraction in terms of critical angle?

Ans. Angle of refraction is 90° for critical angle.

Question 4. What is called optical fiber?

Ans. A bundle of narrow glass fibers used to carry light rays is called an optical fiber.

Question 5. What is the eyeball?

Ans. In the cavity of the eye there is a spherical object which can be rotated within a certain limit. This is known as eye ball.

Question 6. What is the cornea?

Ans. Frontal part of the sclera is called cornea.

Question 7. What is Iris?

Ans. The iris is an opaque membrane located just behind the cornea. The membrane can be of different colors like blue, deep brown, black etc for different people.

Question 8. What is retina?

Ans. Retina is a light sensitive pink colored translucent membrane located behind the eye-ball.

Question 9. What is the pupil?

Ans. It is a circular hole at the centre of the cornea which is connected to muscular cells.

Question 10. What is a convex lens?

Ans. A lens which is thick in the middle and narrow at the edges is called a convex lens.

Question 11. What is aqueous humour?

Ans. The space between the lens and cornea is filled with some kind of transparent watery substance. This is called aqueous humour.

Question 12. What is the chemical name of hypo?

Ans. The chemical name of hypo is sodium thiosulphate.

Preparatory Comprehension-based Q/A**Question 1. Why does light change direction in the separation plane between two mediums?**

Ans. Light travels in a straight path through a transparent medium. The speed of light depends on the density of the medium. The denser the medium, the slower the speed of light and the lighter the medium, the faster the speed of light. That is, the speed of light is different in different mediums. Due to this difference in the medium, when the light enters a different medium from one medium, the light changes direction due to refraction in the separation plane.

Question 2. Why does a stick seem to be bent when submerged in water?

Ans. When a stick is tilted and immersed in water, the stick appears bent due to refraction. In this case light is refracted from the dense medium water and reflected to our eyes in the rarer (air) medium. This causes each point of the submerged part of the stick to rise slightly. As a result the stick looks bent.

Question 3. Explain total internal reflection.

Ans. When a light ray is incident at an angle greater than the critical angle from a denser medium to a rarer medium, instead of refraction, the light ray is completely reflected inside the denser medium according to the law of reflection. This phenomenon is called total internal reflection.

Question 4. What happens if the angle of incidence is 0° in optical fibre?

Ans. If the angle of incidence is 0° , the light ray will be incident along the perpendicular. That is, light rays incident through an optical fiber will not change direction and there will be no total internal reflection.

Question 5. Magnifying glass is unique in making small objects look larger-explain.

Ans. Magnifying glass is a kind of convex lens. By placing an object at the focal length of a convex lens and viewing the object from the other side of the lens, a straight, magnified and virtual image of the object is seen. Now the closer this poison is formed to the eye, the greater the viewing angle of the eye and the larger the image. Because of this, the magnifying glass is unique in making small objects look bigger.

Question 6. What do you mean by near point of the eye?

Ans. If we bring an object as close to the eye as possible it is clearly seen. But bringing it closer comes a time when the object is no longer clearly visible or it is very difficult for the eyes to see clearly. The near point is the closest distance that the eye can see clearly without straining. The near point of clear vision for a normal eye is 25 cm.

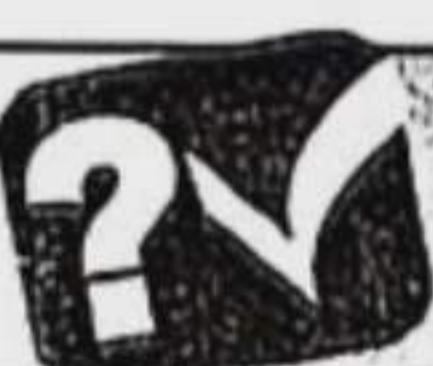
Question 7. What is the reason for the reflection of light entering inside the eye?

Ans. The choroid is a black membrane covering the inner body of sclera. Because of its blackness, the light entering inside the eye is not reflected.

Question 8. Write two similarities between camera and eye.

Ans. Two similarities between camera and eye are mentioned below :

1. Both the camera and the human eye do not reflect incoming light.
2. Both the camera and the human eye form a real, inverted and reduced image of the object.

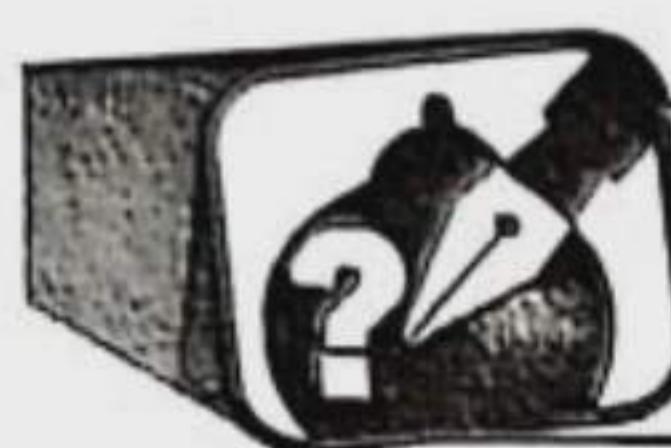
**Super Suggestions**

Super Suggestions with 100% preparatory questions selected by the Master Trainer Panel

Dear learners, important multiple choice, short, creative, knowledge & comprehension-based questions of this chapter selected by Master Trainer Panel for Half-Yearly and Annual Exams are presented below. Learn the answers to the mentioned questions well to ensure 100% preparation.

Question Pattern	7*	5*
● MCQs with Answers	Learn each MCQs in this chapter thoroughly.	
● Short Q/A	1, 3, 6, 7, 10, 12, 14, 18, 29, 30, 31	4, 8, 15, 19, 24, 25, 27, 28
● Creative Q/A	1, 2, 3, 5, 8, 9	4, 7, 10
● Knowledge-based Q/A	2, 4, 5, 6, 7, 8, 11	1, 9, 10, 12
● Comprehension-based Q/A	2, 3, 5, 6, 8	1, 4, 7

Exclusive Tips ► Master the solutions to all the activities in this chapter along with exercise and other Q/A to develop the creative thinking and assess your talent.



Assessment & Evaluation



A question bank presented in the form
of a class test to assess the preparation.



Class Test

Time : 3 hours

Science

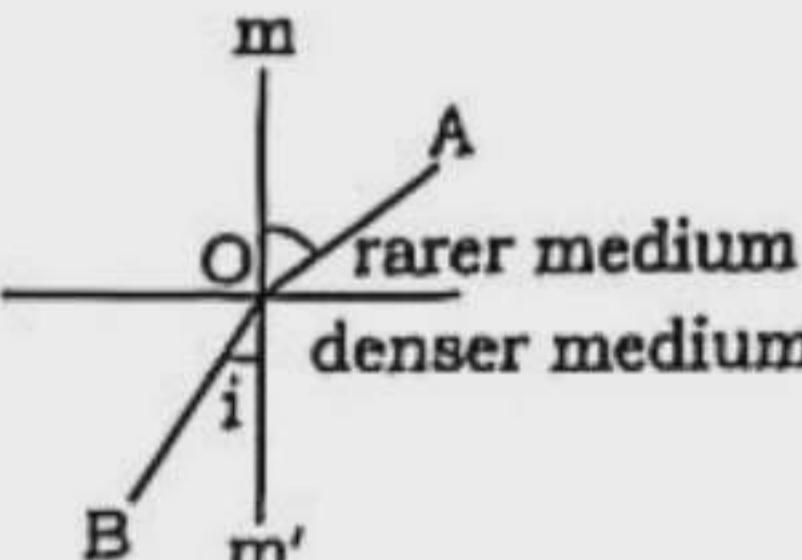
Class : Eight

Full marks : 100

Multiple Choice Questions (Each question carries 1 mark)

 $1 \times 30 = 30$

[N.B. : Answer all the questions. Each question carries one mark. Block fully, with a ball-point pen, the circle of the letter that stands for the correct/best answer in the "Answer Sheet" for Multiple Choice Question Type Examination.]

1. The change of direction of incident light ray to a plane of separation of two transparent medium is called—
 A Reflection B Refraction
 C Diffused reflection D Dispersion
2. In case of a rays entering from a rarer medium to a denser medium—
 i. $i > r$ ii. $i = c$
 iii. $r < c$
 Which one of the following is correct?
 A i B ii & iii C i & iii D i, ii & iii
3. What is the lowest value of angle of refraction?
 A 0° B 30° C 45° D 90°
4. Which one of the following is the law of refraction of light?
 A $\angle i = \angle r$ B $\angle r > \angle i$ C $\angle i \geq \angle r$ D $\angle r \geq \angle i$
5. What will be the angle of refraction if the value of the angle of incidence is 0° ?
 A 0° B 30° C 60° D 90°
6. How many laws does the refraction obey?
 A 2 B 3 C 4 D 5
7. Notice the figure below and answer question no. 7 and 8 :


7. In the figure $\angle MOA$.
 A angle of incidence B angle of refraction
 C angle of reflection D critical angle
8. If the angle $\angle MOA$ is greater than 90° —
 i. creation of critical angle
 ii. creation of reflection angle
 iii. creation of total internal reflection angle
 Which one of the following is correct?
 A i & ii B i & iii C ii & iii D i, ii & iii
9. Use of optical fibre includes—
 i. endoscopy
 ii. proctoscopy
 iii. colonoscopy
 Which one of the following is correct?
 A i & ii B i & iii C ii & iii D i, ii & iii
10. Which one is used in magnifying glass?
 A Concave lens B Concave mirror
 C Convex lens D Convex mirror
11. Which one of the following protects the eyes?
 A Sclera B Choroid C Retina D Pupil

12. Which one of the following parts determines the shape of the eyes?
 A Choroid B Retina C Sclera D Pupil
13. Which one of the following parts prevent internal reflection of light within the eye?
 A Choroid B Pupil C Shutter D Retina
14. Which one of the following is of different colours?
 A Retina B Iris C Pupil D Aqueous humour
15. What part of the eye lies just behind the eye lens?
 A Pupil B Retina
 C Vitreous humour D Optic nerve
16. Which part of the following protects the eye from external harmful effects?
 A Sclera B Iris C Eye-ball D Cornea
17. Actually what is Sclera?
 A Cornea B Light sensitive membrane
 C Circular hole D Opaque covering
18. Which one contain the correct eye shape?
 A Sclera B Cornea C Eyeball D Iris
19. The front part of the sclera is called—
 A cornea B iris C pupil D retina
20. In which of the following the colour is different due to place and man?
 A Iris B Moni C Retina D Cornea
21. Which of the following produces the sensation to the brain?
 A Retina B Cornea C Irish D Pupil
22. Which one is the following is the frontal part of the sclera?
 A Pupil B Irish C Choroid D Cornea
23. How many main parts are there of a human eye?
 A 12 B 10 C 9 D 8
24. What is the term used for the cornea behind the eye?
 A Lens B Retina C Pupil D Irish
25. What are the similarity between a human eye lid and a part of camera?
 A Charoid B Aperture C Shutter D Screen
26. What is called the front part of eye sclera?
 A Lens B Retina C Cornea D Pupil
27. Which one is opaque coloured membrane?
 A Sclera B Cornea C Choroid D Iris
28. How many parts are there in a camera?
 A 5 B 6 C 7 D 8
29. Which one helps in the sensation of sight in the brain?
 A Pupil B Iris C Retina D Cornea
30. For which part, reflection if entered light in the eye does not occur?
 A Cornea B Retina
 C Choroid D Iris

Answer Sheet ▶ Multiple Choice Questions

1	<input type="radio"/> B	2	<input type="radio"/> A	3	<input type="radio"/> A	4	<input type="radio"/> B	5	<input type="radio"/> A	6	<input type="radio"/> B	7	<input type="radio"/> B	8	<input type="radio"/> C	9	<input type="radio"/> A	10	<input type="radio"/> C	11	<input type="radio"/> A	12	<input type="radio"/> C	13	<input type="radio"/> A	14	<input type="radio"/> B	15	<input type="radio"/> B
16	<input type="radio"/> A	17	<input type="radio"/> D	18	<input type="radio"/> A	19	<input type="radio"/> A	20	<input type="radio"/> A	21	<input type="radio"/> A	22	<input type="radio"/> D	23	<input type="radio"/> C	24	<input type="radio"/> D	25	<input type="radio"/> C	26	<input type="radio"/> C	27	<input type="radio"/> A	28	<input type="radio"/> C	29	<input type="radio"/> C	30	<input type="radio"/> C



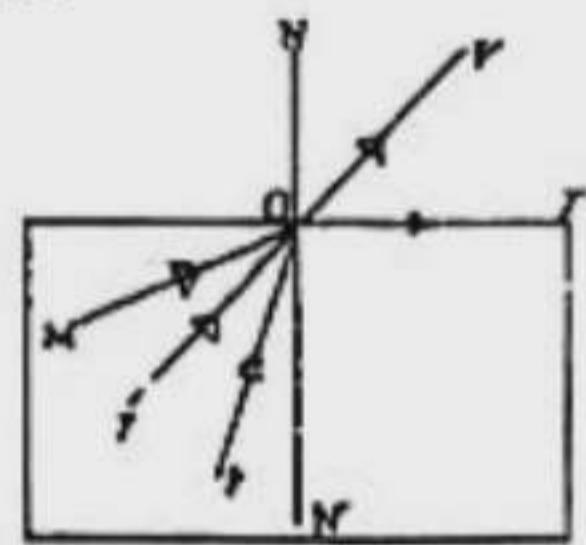
Short-Answer Question (Each question carries 2 marks)**Answer any 10 of the following questions :** $2 \times 10 = 20$

1. Explain the refraction of light.
2. Why does the ray of light change direction?
3. Explain the role of refraction in hunting fish.
4. Why does a coin appear to float when it is dipped in water?
5. When are the angle of incidence and angle of refraction equal?
6. When is the angle of refraction 0° ?
7. Write the conditions for total internal reflection.
8. Write the difference between the angle of incidence and critical angle.

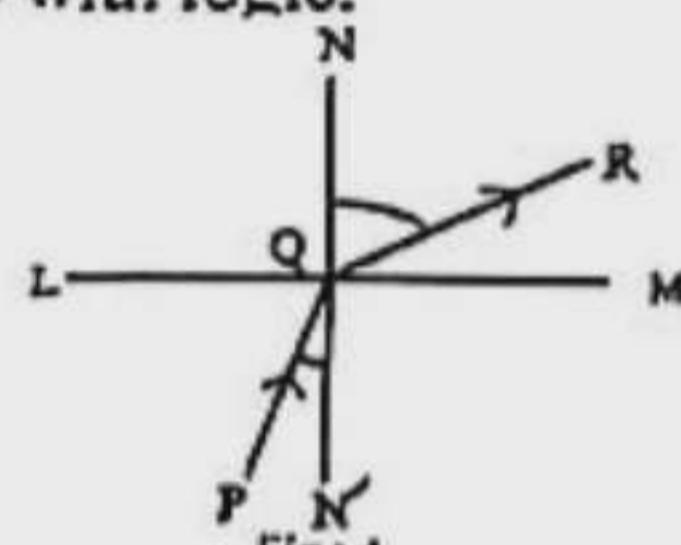
9. Why is optical fibre used in telecommunications?
10. What is a magnifying glass? Explain.
11. Why is a magnifying glass used to make small objects look bigger?
12. Why is the light not reflected inside the eye?
13. Write about Cornea.
14. What does pupil mean?
15. Why is a real, inverted and short image of the object formed in human eye?

Creative Question (Each question carries 10 marks)**Answer any 5 of the following questions :** $10 \times 5 = 50$

1. Tasnimun is involved in scientific experiments. One day she kept a stick half sunk in a pot full of water. She noticed that the stick looked curved. Another day she dropped a coin weighing 2gm in the water of a glass. She noticed that the coin looked a little higher than its real position.
 - a. What is gravity?
 - b. Why is it easy to get down through stairs?
 - c. Calculate the weight of the coin in the equation.
 - d. Are both the experiments by Tasnimun same? Analyze with logic.



- a. What is critical angle?
- b. What do you mean by magnifying glass?
- c. Explain the critical angle by identifying it from the stem's Figure.
- d. Is it possible to come back incident ray, MO in the same medium? Analyze with logic.



- a. What is refraction of light?
- b. What do you mean by total internal reflection?
- c. Explain the incident of figure 'A'.
- d. Discuss the real application of figure 'A'.

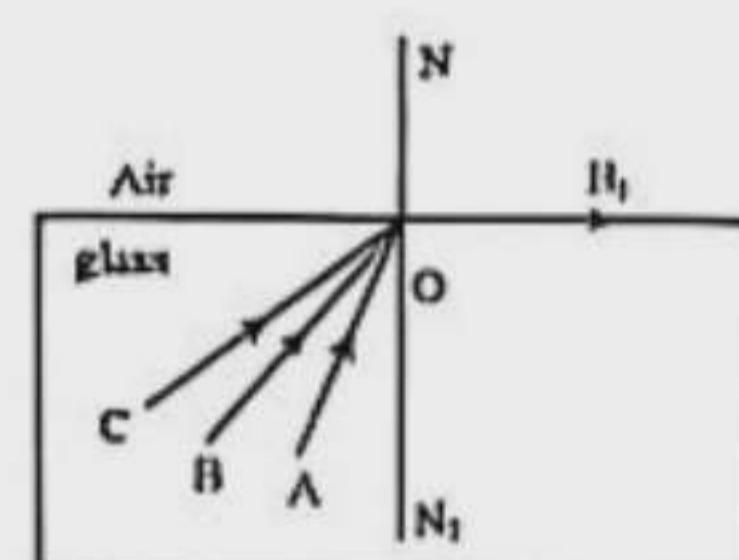
4.

Fig-(i)

Fig-(ii)

- a. Define critical angle.
- b. Why is magnifying glass used? Explain it.
- c. How the imaginary image of fig (i) will be seen? Describe by drawing the path of ray of light.
- d. In fig (ii), if the ray of light CO enters from air medium to water medium, then refracted ray of light will change. Draw that ray of light and analyze comparatively.

5.



- a. What is called critical angle?
- b. Explain why diamond looks glitter?
- c. What will happen for the ray BO? Explain with ray diagram.
- d. What will happen for the ray CO? Analyze with ray diagram.

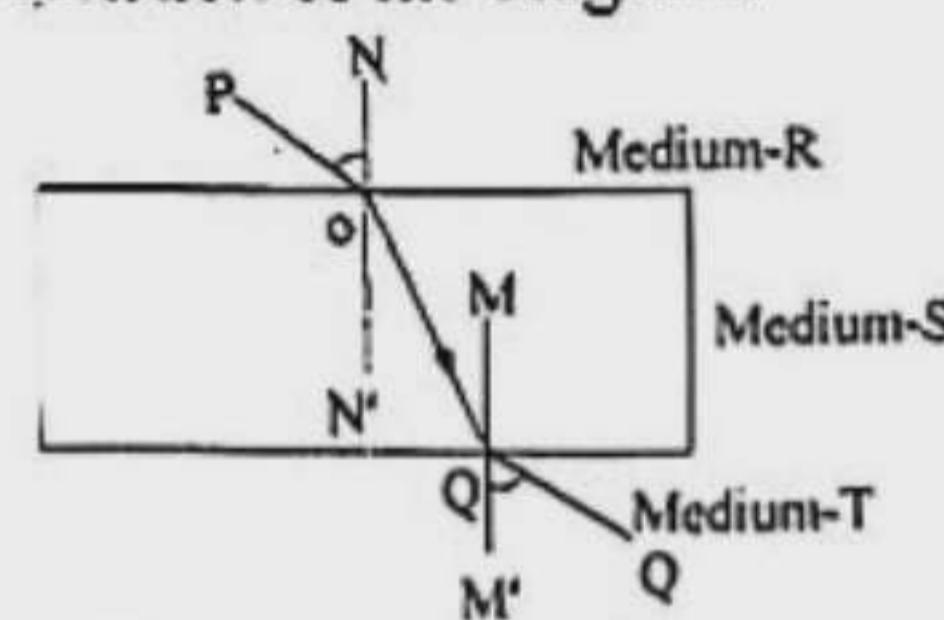
6.



Figure-1 Figure-2

- a. What is optical fibre?
- b. What do you mean by critical angles?
- c. Describe the function of figure-1
- d. Which function is similar with figure '2'? Describe the structure and function of the diagram.

7.



- a. What is cornea?
- b. Explain the total internal reflection.
- c. Which one is the denser medium between medium 'R' and 'S'? Describe the reasons.
- d. If the density of medium 'R' and 'T' is same, then what will happen? Analyze it.

8. When Sagar bring kerosene by a glass bottle, he observed that, the lower part of the bottle looking slightly thick and upward than before. To find out the above when he entered the long stick inside it, then it looks bent.

- a. What is refraction of light?
- b. Explain the importance of optical fibre in the telecommunication process.
- c. Explain the reason for which the thickness and looking upward of the end point of the bottle seen by Sagar.
- d. Is there any similarity in between the above stem's two phenomenon on the basis of the differences of medium and density? Analyze it.

Answering Reference ► Short-Answer Questions

- | | | |
|--------------------------------|--------------------------------|---------------------------------|
| 1 ► See this Chapter, Ques. 01 | 5 ► See this Chapter, Ques. 07 | 9 ► See this Chapter, Ques. 17 |
| 2 ► See this Chapter, Ques. 02 | 6 ► See this Chapter, Ques. 08 | 13 ► See this Chapter, Ques. 26 |
| 3 ► See this Chapter, Ques. 04 | 7 ► See this Chapter, Ques. 10 | 10 ► See this Chapter, Ques. 19 |
| 4 ► See this Chapter, Ques. 06 | 8 ► See this Chapter, Ques. 14 | 14 ► See this Chapter, Ques. 27 |
| | | 11 ► See this Chapter, Ques. 20 |
| | | 15 ► See this Chapter, Ques. 31 |
| | | 12 ► See this Chapter, Ques. 23 |

Answering Reference ► Creative Questions

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 1 ► See this Chapter, Ques. 01 | 3 ► See this Chapter, Ques. 04 | 5 ► See this Chapter, Ques. 06 |
| 2 ► See this Chapter, Ques. 02 | 4 ► See this Chapter, Ques. 05 | 6 ► See this Chapter, Ques. 08 |
| | | 7 ► See this Chapter, Ques. 09 |
| | | 8 ► See this Chapter, Ques. 10 |