



# PHYSICS

## BOOKS - CENGAGE PHYSICS

### OPTICAL INSTRUMENTS

#### Examples

1. A camera has a lens of focal length 50 mm .  
By how much outward the lens has to be

moved while changing the focus from an object at infinity to an object at 1 m ?



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2. The eye lens has a focal length of 2.5 cm .  
Find the range of accommodation while changing the focus from infinity to  $D = 25$  cm .



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3. Find the power of the lens required to correct a myopic eye having the far point at 1 m .



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4. Find the power of the lens required to correct farsightedness with a near point at 50 cm .



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5. A compound microscope has an objective of focal length 0.5 cm , a tube length 15 cm and eyepiece of focal length 3 cm .Find the magnification produced .

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## Mandatory Exercis Exercise Set I

1. Can the length of a simple astronomical telescope be  $> (f_0 + f_e)$  ? Explain .

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2. What kind of lens is used to correct myopia ?



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3. Out of the objective and the eyepiece , which has smaller focal length in a

(i) telescope

(ii) microscope ?



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4. To read small letters in a newspaper , an aged person keeps it farther than 25 cm .  
Explain the reason .



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5. What are the functions of shutter and diaphragm in a camera ?



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6. Write the expression for the magnification produced by a compound microscope .Explain the symbols .



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7. Among cornea ,aqueous humour and lens ,where does maximum refraction take place ?  
Why ?



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8. Why is inner coating of a camera black in colour ?



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9. If f number 8 means the diameter for f aperture is 16 mm , what will be the diameter for f number 12 ?



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**10.** Do human and animals see the same colour corresponding to the same wevelegth ?



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**11.** Least distance of distant vision is 25 cm .  
This means we cannot see anything clearly at distances less than 25 cm . True or false ?



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1. \_\_\_\_\_ controls the amount of light entering the camera .

A. Film

B. Shutter

C. Diaphragm

D. Lid

**Answer: C**



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2. The part of the eye , similar to film in a camera is

A. cornea

B. iris

C. Diaphragm

D. retina

**Answer: D**



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3. When the brightness of light increases , the size of the pupil

A. decreases

B. increases

C. remains the same

D. first decreases and then increases

**Answer: A**



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4. Myopia is same as

A. nearsightedness

B. far -sightedness

C. astightedness

D. cataract

**Answer: A**



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5. \_\_\_\_\_ is the defect of vision normally found in aged people .

A. Myopia

B. Far sightedness

C. astigmatism

D. night blindness

**Answer: B**



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6. \_\_\_\_\_ lens is used to correct myopia .

A. concave

B. convex

C. bifocal

D. coloured

**Answer: A**



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7. The near point of a normal eye is at

A. 50 cm

B. 25 cm

C. 1 m

D. infinity

**Answer: B**



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**8. The far point of a normal eye is at**

A. 50 cm



B. 25 cm

C. 1 m

D. infinity

**Answer: D**



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**9. The visual activity of a normal eye is**

A. 1 minute of an arc

B.  $1^\circ$

C. 1 radian

D.  $\frac{1}{400}$  degree

**Answer: A**



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**10.** For an astronomical telescope at normal adjustment , with  $f_0$  and  $f_e$  as the focal lengths of objective and eyepiece respectively , the magnification is

A.  $f_0 \times f_e$

B.  $\frac{f_0}{f_e}$

C.  $f_0 + f_e$

D.  $\frac{f_e}{f_0}$

**Answer: B**



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**11.** For an astronomical telescope at normal adjustment , with  $f_0$  and  $f_e$  as the focal

length of objective and eyepiece , respectively ,  
the length of the telescope is

A.  $f_0 \times f_e$

B.  $\frac{f_0}{f_e}$

C.  $f_0 + f_e$

D.  $\frac{f_e}{f_0}$

**Answer: C**



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12. \_\_\_\_\_ has shorter focal length convex lens

A. Objective of a telescope

B. Eyepiece of a microscope

C. Eyepiece of a telescope

D. Both the lenses in a telescope

**Answer: C**



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13. The image formed on the film of a photographic camera is

- A. virtual and erect
- B. virtual and inverted
- C. real and erect
- D. real and inverted

**Answer: D**



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14. Which part of a camera controls the exposure of the film ?

A. Lens

B. Shutter

C. Diaphragm

D. Film

**Answer: B**



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15. Which part of the human eye behave similar to diaphragm of a camera ?

A. Iris

B. Retina

C. Cornea

D. Lens

**Answer: A**



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16. Which of the following colours is not directly sensitive by cones cells ?

A. Red

B. Blue

C. Green

D. Yellow

**Answer: D**



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17. Night blindness is due to defect in

A. lens

B. iris

C. rods

D. cones

**Answer: C**



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**18.** Hypermetropia is also known as

- A. far sightedness
- B. near sightedness
- C. presbyopia
- D. astigmatism

**Answer: A**



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19. Which type of lens is used to correct hypermetropia ?

A. Convex lens

B. Concave lens

C. Bi focal

D. Lens with cylindrical curvature

**Answer: A**



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20. Night blindness occurs due to deficiency of

A. Vitamin D

B. Vitamin K

C. Vitamin A

D. Vitamin C

**Answer: C**



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21. Which defect is due to less of power of accommodation of human eye ?

A. Myopia

B. Hyperopic

C. presbyopia

D. astigmatism

**Answer: C**



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22. Which type of lens is used to correct astigmatism ?

A. Convex lens

B. Concave lens

C. Bi focal

D. Lens with cylindrical curvature

**Answer: D**



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23. What is the persistence of vision on a human retina ?

A.  $\left(\frac{1}{8}\right)th_{\text{a second}}$

B.  $\left(\frac{1}{16}\right)th_{\text{a second}}$

C.  $\left(\frac{1}{32}\right)th_{\text{a second}}$

D.  $\left(\frac{1}{64}\right)th_{\text{a second}}$

**Answer: B**



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24. For a compound microscope

A. Diameter of objective lens = Diameter of eyepiece

B. Diameter of objective lens = Diameter of eyepiece

C. Diameter of objective lens = Diameter of eyepiece

D. Independent of diameter of lens

**Answer: C**



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25. For an astronomical telescope

A. Diameter of objective lens = Diameter of eyepiece

B. Diameter of objective lens = Diameter of eyepiece

C. Diameter of objective lens = Diameter of eyepiece

D. Independent of diameter of lens

**Answer: B**



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**26.** Binocular is a type of

- A. simple microscope
- B. compound microscope
- C. astronomical telescope
- D. terrestrial telescope

**Answer: D**



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27. Magnifying glass is an example of

- A. simple microscope
- B. compound microscope
- C. astronomical telescope
- D. terrestrial telescope

**Answer: A**



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28. Which of the following animals have compound eyes ?

A. Lion

B. Snake

C. Fly

D. Carb

**Answer: C**



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29. the film speed is measured by the code set  
by

A. ASA

B. ISI

C. SI

D. IUPAC

**Answer: A**



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30. Aperture setting is done by

A. p - number

B. f- number

C. d- number

D.  $\alpha$  - number

**Answer: B**



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31. If  $h_i$  = height of image ,  $h_o$  = height of object  
and  $m$  = magnification , then

Question No.	Choice
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42	

A.  $m = \frac{h_0}{h_i}$

B.  $m = \frac{h_i}{h_0}$

C.  $m = h_0 h_i$

D. none of these

**Answer: B**



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## Mandatory Exercise Set Iii

1. In which of the following is the final image erect ?

- A. Simple microscope
- B. compound microscope
- C. astronomical telescope
- D. Galilean telescope

**Answer: A::B::D**



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2. The maximum focal length of the eye lens of a person is greater than its distance from the retina. The eye is

A. always strained in looking at an object

B. strained for objects at larger distances

only

C. strained for objects at short distances

only

D. unstrained for all distances

**Answer: A**



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**3. Mark the correct options :**

A. If the far point goes ahead , the power of  
the divergent lens should be reduced

B. If the near point goes ahead , the power  
of the convergent lens should be  
reduced

C. If the far point is 1 m away from the eye  
divergent lens should be used

D. If the near point is 1 m away from the  
eye divergent lens should be used

**Answer: A::C::D**



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4. The focal length of the objective of a compound microscope is  $f_0$  and its distance from the dyepiefe is L. The object is placed at a

distance  $u$  from the objective. For proper working of the instrument.,

A.  $L < u$

B.  $L > u$

C.  $f_0 < L < 2f_0$

D.  $L > 2f_0$

**Answer: A::B::D**



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5. The final image produced by a compound microscope is

- A. erect with respect to object
- B. erect with respect to first image
- C. virtual
- D. magnified

**Answer: A::B::C::D**



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6. A fly is sitting on the objective of a telescope pointed towards the moon .When the photograph of moon is taken through the telescope , the fly does not affect

- A. the field of view
- B. the portion of image
- C. size of the image
- D. intensity of the image

**Answer: A::B::D**



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7. Which of the following defects can be corrected by using suitable lens ?

A. Myopia

B. Cataract

C. Night blindness

D. astigmatism

**Answer: A::D**



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8. Where is light refracted ?

A. cornea

B. Lens

C. Aqueous human

D. Retina

**Answer: A::B::C**



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9. The visual angle subtended by which of them will be visible ?

A.  $\left(\frac{1}{120^\circ}\right)^\circ$

B.  $\left(\frac{1}{80^\circ}\right)^\circ$

C.  $\left(\frac{1}{40^\circ}\right)^\circ$

D.  $\left(\frac{1}{\infty 0^\circ}\right)^\circ$

**Answer: C::D**



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10. Which of the following contains more than one lens ?

A. Simple microscope

B. compound microscope

C. Reflecting Telescope

D. Binocular

**Answer: B::D**



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11. For a human eye , which of the following is true ?

A. Focal length is fixed

B. Distance between lens and retina is fixed

C. Image and retina are temporary

D. The size of pupil is fixed

**Answer: B::C**



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# Mandatory Exercise Set IV

## 1. Optical Instruments

A	B
(1) Accommodation	(a) Adjustment to variation of brightness
(2) Contraction and expansion of iris	(b) 25 cm
(3) Angle subtended by an object at the eye	(c) Instrument used to see far objects
(4) Visual activity	(d) Variation of focal length of the eye lens
(5) Least distance of distinct vision of human eye	(e) Microscope

(6) Instrument used to see tiny objects	(f) Visual angle
(7) Telescope	(g) Height of image/height of object
(8) Magnification	(h) Limit to see tiny objects



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## 2. Defects of Vision

A	B
(1) Myopia	(a) Deficiency of vitamin A
(2) Hypermetropia	(b) Uneven curvature of the cornea
(3) Presbyopia	(c) Eyeball is too short or $f$ of the eye lens is large
(4) Astigmatism	(d) Loss of transparency of the eye lens
(5) Cataract	(e) Loss of flexibility of eye lens due to ageing
(6) Night blindness	(f) Eyeball is too long or $f$ of the eye lens is small



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**Mandatory Exercise Set V**

1. Match the parts of the human eye with its function .

A	B
(1) Choroid	(a) Control amount of light
(2) Lens	(b) Sensitive to bright and dim light
(3) Iris	(c) To cut off the incoming light
(4) Retina	(d) Converging rays
(5) Rods	(e) Avoid internal reflections
(6) Cones	(f) Record the image
(7) Eye lids	(g) Colour sensing



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2. Complete the ray diagram showing image formation in Galilean telescope :



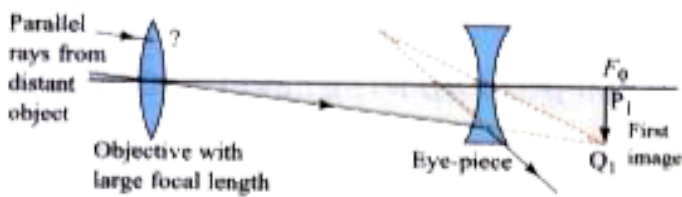


Figure shows a simple model of Galilean telescope . A convergent lens is used as the objective and a divergent lens as the eyepiece .The objective L would form a real inverted image  $P_1O_1$  of a distant object in its focal plane .The eyepiece intercepts the converging ray in between  $P_1Q_1$  then acts as a virtual object for the eyepiece .The position of the eyepiece is so adjusted that the final image is formed at the final image is formed at infinity producing least strain on the eyes . If the final

image is formed at the least distance of clear vision , the angular magnification is maximum .



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## Mandatory Exercise Set Vi

1. Find the power of the lens required to correct far sightedness with a near point at 75 cm .



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2. A lens used as a simple magnifier has focal length 5 cm .What is the magnification produced ?



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3. A compound microscope has an objective of focal length 4 mm , tube length 20 cm , and eyepiece of focal length 2.5 cm . Find the magnification produced .



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4. An astronomical telescope under normal adjustment produces a magnification of 50 . If the objective has the focal length of 1 m , find the focal length of the eyepiece and the length of the telescope .



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5. A person cannot see clearly beyond 10 m .What type of corrective lenses should the person use ? Find the power of required lens .



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6. If a person can see most clearly at a distance of 1000 cm .Find the power of the lens used to see object at 40 cm .



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7. The power of a lens used by a short -sighted person is 4 D .find the distance of an object which he can see without spectacles .



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8. A magnifying glass has magnification 10 .What is the focal length of the magnifying glass ?



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9. A compound microscope has magnification 200 . If the focal length of objective lens and eye piece are 1 cm and 8 cm respectively .Find the length of microscope .



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**10.** The magnification by the objective lens in a compound microscope is 50 and the magnification by eyepiece is 15 .What is the magnification of the compound microscope ?



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**11.** A compound microscope has magnification 400 . The focal length of the object lens is 2

cm and the magnification of eyepiece is 10

.What is the tube length of the microscope ?



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**12.** The magnification of a compound microscope is 250 and the magnification of objective lens is 50 . Find the focal length of eyepiece .



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**13.** The focal length of objective lens is 1.2 m and focal length of eye piece is 5 cm .For the telescope , find

(i) Length of telescope .

(ii) Magnification under normal adjustment



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**14.** For a telescope , the magnification is 58 and the length of the telescope is 118 cm . Find the focal length of the two lenses .





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## General Exercise

1. What is blind spot ?



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2. How can we see erect images even through the images formed on our retina are inverted ?



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3. Which muscle of the human body is used to change the focal length of lenses ?



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4. Explain the role of iris human vision ?



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5. Explain the types of photosensitive cells located on the human retina .



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6. Presbyopia is common in aged people .Explain.



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7. How is cataract treated ?



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8. Explain why an object when kept nearer , appears bigger and clearer ?



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9. Write down the differences between a simple microscope and a compound microscope .



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**10.** What are the difference between reflecting telescope and refracting telescope ? Explain with ray diagram .



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**11.** What is Galiean telescope ?



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12. Write down the different methods by which the final image by a telescope can be made erect .



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## Challenging Exercise

1. A camera has a lens of focal length 70 mm .It is focused to infinity .By how much distance

should it be moved forwards /backwards to focus on an object at 70 cm ?



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2. Find the power of the required to correct a myopic eye having the far point at 50 cm .



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3. The separation  $L$  between the objective ( $f=0.5$  cm) and the eye piece ( $f=5$  cm) of a



compound microscope is 7 cm .where should a small object be placed so that eye is least strained to see the image ?



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4. A person suffering from defective vision can see objects clearly only beyond 100 cm from the eye . Calculate the power of the lens required so that he can see clearly the object placed at least distance of distinct vision ( $D=25$  cm).



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5. A person has clear vision between 50 cm and 100 cm He used lens to cure myopia .The due to the lens used where will be the near point ?



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**Olympiad And Ntse Level Exercises**

1. A man can see only between  $75\text{cm}$  and  $200\text{cm}$ . The power of lens to correct the near point will be

A.  $+8/3D$

B.  $+3D$

C.  $-3D$

D.  $-8/3D$

**Answer: A**



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2. A man suffering from myopia can read a book placed at 10 cm distance .for reading the book at a distance of the lens required will be

A. 45 cm

B. – 20 cm

C. – 12 cm

D. 30 cm

**Answer: C**



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3. Two parallel pillars are  $11\text{km}$  away from an observer. The minimum distance between the pillars so that they can be seen separately will be

A.  $3.2\text{ m}$

B.  $20.8\text{ m}$

C.  $91.5\text{ m}$

D.  $183\text{ m}$

**Answer: A**



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4. A person's near point is  $50\text{cm}$  and his far point  $3\text{m}$ . Power of the lenses he requires for

(i) reading and

(ii) for seeing distant stars are

A.  $-2$  and  $0.33D$

B.  $2D$  and  $-0.33D$

C.  $-2D$  and  $3D$

D.  $2$  and  $-3D$

**Answer: B**



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5. The exposure time of a camera lens at the  $\frac{f}{2.8}$  setting is  $\frac{1}{200}$  second. The correct time of exposure at  $\frac{f}{5.6}$  is

A. 0 . 4 sec

B. 0. 02 sec

C. 0. 002 sec

D. 0.0.4 sec

**Answer: B**



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6. The length of the compound microscope is  $14\text{cm}$ . The magnifying power for relaxed eye is 25. If the focal length of eye lens is  $5\text{cm}$ , then the object distance for objective lens will be

A. 1.8 cm



B. 1.5 cm

C. 2.1 cm

D. 2.4 cm

**Answer: A**



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7. If the focal length of the objective lens is increased then

A. Magnifying power of microscope will increase but that of telescope will decrease

B. Magnifying power of microscope and telescope both will increase

C. Magnifying power of microscope and telescope both will decrease

D. Magnifying power of microscope will decrease but that of telescope will increase

**Answer: D**



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**8. Assertion :** By increasing the diameter of the objective of telescope, we can increase its range.

**Reason :** The range of a telescope tells us how far away a star of some standard brightness can be spotted by telescope.

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true but reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

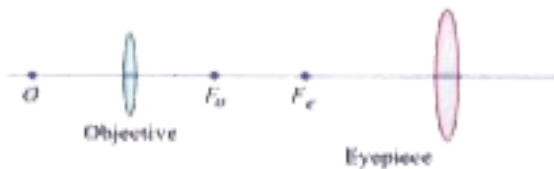
D. If assertion and reason both are false .

**Answer: B**



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9. The actual lens set - up of microscope is depicted in figure. Light from the object (O) first passes through the objective and an enlarged, inverted first image is formed. The eyepiece then magnifies this image. Usually the magnification of the eyepiece is fixed (either X10 or X15) and three rotating objective lenses are used: X10,X40 and X60.



What type of image would have to be produced by the objective magnification?

A. Either virtual or real

B. Virtual

C. Real

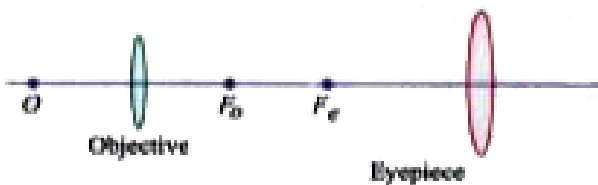
D. It depends on the focal length of the lens

**Answer: C**



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10. The actual lens set - up of microscope is depicted in figure. Light from the object (O) first passes through the objective and an enlarged, inverted first image is formed. The eyepiece then magnifies this image. Usually the magnification of the eyepiece is fixed (either X10 or X15) and three rotating objective lenses are used: X10, X40 and X60.



The magnification of the eyepiece of a compound microscope is X15. The image

height is 25 mm and the magnification of the objective is X40. What is the object height?

A. 1.67 mm

B. 0.60 mm

C. 0.38 mm

D. 0.04 mm

**Answer: D**



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