PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

OPTICAL INSTRUMENTS

Example

1. (a) An object is seen through a simple microscope of focal length $12cm$. Find the

angular magnification produced if the image is formed at the near point of the eye which is $25cm$ away from it.

(b) A $10D$ lens is used as a magnifier. Where shold the object be placed to obtain maximum angular magnification for a nirmal eye (near point $= 25cm$)?

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2. A small object is placed at a distance of $3.6cm$ from a magnifier of focal length $4cm$.

(a) Find the position of the image.

(b) Final linear magnification.

(c) Find the angualr magnification.

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3. A compound microscope has a magnifying power 30. The focal length of its eye-piece is $5cm$. Assuming the final to be at the least distance of distinct vision $(25cm)$, calculate the magnification produced by objective.

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4. In a compound microscope, the objects is $1cm$ form the objective lens. The lenses are $30cm$ apart and the intermediate image is $5cm$ from the eye-piece. What magnification is produced?

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5. The separation L between the objective $(f = 0.5cm)$ and the eye-piece $(f = 5cm)$ of a compound microscope is $7cm$. Where should

a small object be placed so that the eye is least strained to see the image? Fin dthe angular magnification produced by the microscope.

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6. A compound microscope has an objective of focal length $2cm$ and an eye-piece of focal length $3cm$. An object is placed at a distance of $2.4cm$ in front of the field lens. Find the magnifying power of the instrument and

length of the tube is (a) final image is at infinity and (b) final image is at least distance of distinct vision.

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7. Find the maximum magnifying power of a compound microscope having a $25D$ lens as the objetcive, a $5D$ lens as the eye-piece and the separation $30cm$ between the two lenses. The least distance for clear vision is $25cm$.

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8. A compound microscope has a magnifying power of 100 when the image is formed at infinity. The objective has focal length $0.5cm$ and the tube length is $6.5cm$. Find the focal length of the eye-piece.

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9. A compound microscope consists of an objective of focal length $1cm$ and an eye-piece of focal length $5cm$. An object is placed at a

distance of $0.5cm$ from the objective. What should be the separation between the lenses so that the microscope projects an inverted real image of the object on the screen $30cm$ behind the eye-piece ?

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10. A compound microscope is used to enlarge an object kept at a distance $0.03m$ from uuts objective which consists of serval convex lenses in contact and has focal length $0.03m$.

If a lens focal length $0.1m$is removed from the objective, find out the distance by which the eye-piece of the microscope must be moved to refocus the image.

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11. An astronomical telescope has an angular magnification of magnitude 5 for distant object. The separation between the objective and eyepiece is $36cm$ and the final image is

formed at infinity. Determine the focal length of objective and eyepiece.

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12. A telescope has an objective of focal length $50cm$ and an eyepiece of focal length $5cm$. The least distance of distinct vision is $25cm$. The telescope is focused for distinct vision on a scale $2m$ away from the objective. Calculate (a) magnification produced and (b) separation between objective and eyepiece.

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13. The diameter of the moon is $3.5 \times 10^3 km$ and its distance from the earth is $3.8 \times 10^5 km$. It is seen through a telescope having focal lengths of objective and eye-piece as $4m$ and $10cm$ respectively. Calculate (a) magnifying power of telescope (b) length of telescope tube and (c) anngular size of image of moon.

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14. An astronomical telescope consisting of an objective of focal length $60cm$ and eye-piece of focal length $3cm$ is focused on the moon so that the final image is formed at least distance vision, i.e. $25cm$ from the eye-piece piece. Assuming the angular diameter of moon as $1/2^{\circ}$ at the objective, calculate (a) angular size and (b) lenear size of image seen through the telescope.

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15. (a) A normal eye has retina $2cm$ behind the eye lens. What is the power of the eye lens ehen the eye is (i) fully relaxed, (ii) most strained ?

(b) The near point and the far point of a hild are at $10cm$ and $100cm$. If the retain is $2.0cm$ behind the eye lens, what is the range of the power of the eye lens?

(c) A young boy can adjust the power of his eye lens between $50D$ and $60D$. His fat point is infinity. (i) what is the distance of his retina from the ye lens? (ii) What is near point?

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16. (a) A nearsighted person cannot clearly see beyond $200cm$. Find the power of the lens needed to see objectes at large distances.

(b) A farsighted person cannot see objects placed closer to $50cm$. Find the power of the lens needed to see the objets at $20cm$.

(c) A person wears glasses of power $-2.5D$. Is the person farsighted or nearsighted? What is the far point of the person without the glasses?

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17. The near and far points of a person are at $40cm$ and $250cm$ respectively. Find the power of the lens he/she should use while reading at $25cm$. With this lens on the eye, what maximum distance is clearly visible?

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18. (a) A 40-year-old professor requires eyeglasses with lenses of $2D$ power to read a

book at $25cm$. What is his near point?

(b) After 10 years he finds that while wearing same specks he must hold the book $40cm$ from his eyes. What is his near point now, what power lens does he require now to read a book again at $25cm$?

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19. A lady cannot see objects closer than $40cm$ from the left eye and closer than $100cm$ from the right eye. While on a mountaineering trip,

she is lose from her team. She tries to make an astronomical trip, form her reading glasses to look fro her teammates. (a) Which glass should she use as the eyepiece? (b) What magnification can she get with relaxed eye?

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20. A person uses $+1.5D$ glasses to have normal vision from $25cm$ onwards. He uses a $20D$ lens as a simple microscope to see an object. Calculate the maximum magnifying

power, if he uses the microscope

(a) together with his glasses

(b) without the glasses.

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Exercises

1. Choose incorrect option:

A. The size of image on the retina is roughly proportional to the angle

subtended by the object on the eye. This angle is knows as visual angle. The optical instruments are used to increase the visual angle.

B. In normal adjustement, eye is least strained and final image is formed at infinity.

C. The magnifying power is written with a unit X.

D. All options are correct.

Answer: D

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2. Choose the correct option:

A. When the eye is focused on distant object, the focal length of eye-lens has its maximum value which is equal to its distance form the retina.

B. When the eye is focused on a closer object, the focal length of the eye-lens decreases. The process of adjusting focal length is called accommodation. The focal length cannot be adjusted beyond a limit to from the image on the retina. Thus there is a minimum distance for the clear vision of an object.

C. The nearest point for which the image can be focused on the retina is called

the near point of the eye. The distance of the near point form the eye is called the least distance for clear vision. The farthest point up to which an eye can clearly see is called the far point.

D. All options are correct.

Answer: D

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3. A simple magnifying lens is used in such a way that an image is formed at $25cm$ away from the eye. In order to have 10 times magnification, the focal length of the lens should be

A. $5cm$

B. $2cm$

C. $25mm$

D. $0.1mm$

Answer: C

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4. The size of an object as perceived by an eye depends primarily on

A. actual size of the object

B. distance of the object from the eye

C. aperture of the pupil

D. size of the image formed on the retina

Answer: D

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5. Choose the correct option:

A. The far and near point for normal eye are usually taken to be infinite and $25cm$ respectively.

B. In eye, convex eye-lens forms real, inverted and diminished image at the retina.

C. The human eye is most sensitive to yellow-green light wavelength 5550Å and least to violet red.

D. All options are correct.

Answer: D

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6. Choose the correct option regarding compound microscope:

A. Compound microscope consists of two convergent lenses. Lens (of focal length f_0) facing the object is called objective or field lens while the lens (of focal length f_e) facing the eye, eye-piece or ocular. The objective has a smaller aperture and smaller focal length than eye-piece.

B. For a microscope, magnifying power or angular magnification is minimum when

final image is at ∞ and maximum when final image is at D.

C. For a given microscope, magnifying power (MP) for normal adjustment remians parctially unchanged if objective and ey-piece are interchanged. In normal setting, f_0 and f_e should be smaller to have grater $M.\ P$.

D. All options are correct.

Answer: D

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7. Which of the following is correct regarding telescope?

A. In Astronomical telescope, aperture and focal length of objective is large than eye-piece.

B. In Terrestrial telescope, three convex lenses are used and final image is errect.

C. In Galilean telescope, two lenses, one convex (objective) and one concave (eye-piece) are used.

D. All options are correct.

Answer: D

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8. The magnifying power of a compound microscope is

A. objective magnification / eyepiece magnification

B. objective magnification $\times$ eyepiece magnification

C. eyepiece magnification / objective magnification

D. objective magnification $+$ eyepiece magnification

Answer: B

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9. A compound microscope has a magnifying power 30. The focal length of its eye-piece is $5cm$. Assuming the final to be at the least distance of distinct vision $(25cm)$, calculate the magnification produced by objective.

A. 5

B. 7.5

C. 10

D. 15

Answer: A

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10. A compound microscope has an objective of focal length $2.0cm$ and an eye-piece of focal length $6.25cm$ and distance between the objective and eye-piece is $15cm$. If the final image is formed at the least distance vision $(25cm)$, the distance of the object form the objective is

A. $1.5cm$

B. $2.5cm$

C. $3.0cm$

D. $4.0cm$

Answer: B

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11. In previous question, the magnifying power of the microscope is

A. 10

B. 15

C. 20

D. 30

Answer: C

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12. The focal length of the objective and the eye piece of a compound microscope are 2.0 cm and 3.0 cm, respectively. The distance

between the objective and the eye piece is 15.0 cm. The final image formed by the eye piece is at infinity. The two lenses are thin. The distance in cm of the object and the image produced by the objective, measured from the objective lens, are respectively

A. 2.4 and 12.0

B. 2.4 and 15.0

C. 2.3 and 12.0

D. 2.3 and 3.0

Answer: A

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13. In a compound microscope, the intermediate image is

A. virtual, erect the magnified

B. real, erect and magnified

C. real, inverted and magnified

D. virtual, erect and reduced

Answer: C

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14. The focal lengths of the objective and of the eye-piece of a compound microscope are f_0 and f_e respectively. If L is the tube length and D, the least distance of distinct vision, then its angular magnification, when the image is formed at infinity, is

A. $-\left(1-\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$

B. $-\frac{L}{f_0}\left(1+\frac{D}{f_e}\right)$

C. $-\frac{L}{f_0}\left(1-\frac{D}{f_e}\right)$

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

Answer: D

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15. 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. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. $(i), (iv)$

Answer: C

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16. When the length of a microscope tube increases, its magnifying power

A. decreases

B. increases

C. does not change

D. becomes zero

Answer: A

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17. An astronomical telescope has an angular magnification of magnitude 5 for distant object. The separation between the objective and the eyepiece is 36 cm and the final image

is formed at infinity. The focal length f_0 of the objective and the focal length f_0 of the eyepiece are

A. $45cm$ and $-9cm$

B. $50cm$ and $10cm$

C. $7.2cm$ and $5cm$

D. $30cm$ and $6cm$

Answer: D

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18. Four convergent lenses have focal lengths $100cm$, $10cm$, $4cm$ and $0.3cm$. For a telescope with maximum possible magnificaiton, we choose the lenses of focal lengths

A. $100cm$, $0.3cm$

B. $10cm$, $0.3cm$

C. $10cm$, $4cm$

D. $100cm$, $4cm$

Answer: A

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19. A planet is observed by an astronomical refracting telescope having an objective of ofcal length 16m and an eyepiece of focal length 2 cm. Then,

A. (i),only

B. (ii), only

C. (i), (ii) only

D. all

Answer: D

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20. A simple telescope, consisting of an objective of focal length $60cm$ and a single eye lens of focal length $5cm$ is focused on a distant object in such a way that parallel rays emerge form the eye lens. If the object makes an angle of 2° at the objective, the angular width if the image is

A. 10°

B. 24°

C. 50°

D. 48°

Answer: B

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21. The diameter of the moon is $3.5 \times 10^3 km$ and its distance from the earth is $3.8 \times 10^5 km$. It is seen by a telescope having the focal length of the objective and the eye-piece as $4m$ and $10cm$ respectively. The

diameter of the image of the moon will be approximately

A. 2°

B. 20°

C. 40°

D. 50°

Answer: B

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22. In an astronomical telescope in normal adjustment a straight black line of length L is drawn on inside part of objective lens. The eye piece forms a real image of this line. The length of this image is I. The magnification of the telescope is

A. $\frac{L}{l}$

B. $\frac{L}{l} + 1$

C. $\frac{L}{l} - 1$

D. $\frac{L + l}{L - l}$

Answer: A

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23. An astronomical telescope in normal adjustement receives light from a distant source S. The tube length is now decreased slightly

A. a virtual image of S will be formed at a finite distance

B. no image will be formed

C. a small, real image of S will be formed behind the eye-piece, closer to it

D. a large, real image of S will be formed behind the eye-piece, far away from it

Answer: A

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24. In the pervious quenstion, if the tube length is increased slightly from its position of normal adjustement,

A. a virtual image of S will be formed at a finite distance

B. no image will be formed

C. a small, real image of S will be formed behind the eye-piece, closer to it

D. a large, real image of S will be formed behind the eye-piece, far away from it

Answer: D

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25. In a reflecting astronomical telescope, if the objetcive (a spherical mirror) is replaced by a parabolic mirror of the same focal length and aperture, then

A. the final image will be erect

B. the large image will be obtained

C. the telescope will gather more light

D. spherical aberration will be absent

Answer: D

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26. 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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27. For observing cricket math a binocular is preferred to a terrestrial telescope because

A. the binocular gives the proper three-dimensional view

B. the binocular has a shorter length

C. the telescope has chromatic aberrations

D. the telescope has chromatic aberrations

Answer: A

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28. In which of the following that final image is erect?

(i) Simple microscope

(ii) Compound microscope

(iii) Astronomical telescope

(iv) Terrestrial telescope

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. $(i), (iv)$

Answer: D

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29. For a telescope to have large resolving power the

A. focal length of its objetive should be large

B. focal length of its eye-piece should be large

C. focal length of its eye-piece should be small

D. aperture of its objective should be large

Answer: D

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30. Wavelength of light used in an optical instrument are $\lambda_1 = 4000\text{Å}$ and $\lambda_2 = 5000\text{Å}$ then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is

A. $16:25$

B. $9:1$

C. $4:5$

D. $5:4$

Answer: D

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31. Two points separated by a distance of $0.1mm$ can just be resolved in a microscope when a light of wavelength $6000Å$ is used. If

the light of wavelength $4800Å$ is used this limit of resolution becomes

A. $0.08mm$

B. $0.10mm$

C. $0.12mm$

D. $0.06mm$

Answer: A

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32. The resolving power of an astronomical telescope is 0.2 seconds. If the central half portion of the objective lens is covered, the resolving power will be

A. $0.1\,\text{sec}$

B. $0.2\,\text{sec}$

C. $1.0\,\text{sec}$

D. $0.6\,\text{sec}$

Answer: A

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33. The angular resolution of a $10cm$ diameter telescope at a wavelength 5000Å is of the order

A. $10^6 rad$

B. $10^{-2} rad$

C. $10^{-4} rad$

D. $10^{-6} rad$

Answer: D

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34. The resolving power of acompound microscope can be increased if we

A. use infrared light for illuminating the object under observation instead of visible light

B. use ultraviolet light for illuminating the object under observation instead of visible light

C. use an objective of large focal length

D. none of the above

Answer: B

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35. How can we increase the resolving power of a microscope ?

A. decrease the focal length of the objective

B. increase the focal length of the objetcive

C. decrease the aperture-diameter of the objective

D. increase the aperture-diameter of the objective

Answer: D

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36. Choose the correct option:

A. The limit of resolution of eye is one minute i.e. two objects will be visible distinctly to the eye if the angle subtended by them at the eye is lesser than one minute.

B. The persistance of vision is $(1/10)$ second i.e if time interval between two consecutive light pulses is lesser than 0.1 sec, eye cannot distinguish them

separately. This fact is taken into account in motion pictures.

C. According to Rayleigh criterion, resolving limit of eye $\theta = 1.22\lambda / d$, where λ is wavelength of light values of λ and d for eye, it turns to be one minute.

D. All options are correct.

Answer: D

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37. The focal length of a normal eye lens is about

A. $1mm$

B. $2cm$

C. $25cm$

D. $1m$

Answer: B

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38. When we see an object, image formed on the retina is

(i) real (ii) virtual

(iii) erect (iv) inverted

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. $(i), (iv)$

Answer: D

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39. 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 large distance only

C. strained fro objects at short distance only

D. unstrained for all distances

Answer: A

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40. The human eye has a lens which has

A. soft protion at its centre

B. hard surface

C. varying refractive index

D. constant refractive index

Answer: C

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41. The resolving limit of eye is $1\ \min$. At a distance of xkm from the eye, two persons stand with a lateral separation of $3m$. For the two persons to be just resolved by the naked eye, x shuold be

A. $10km$

B. $20km$

C. $15km$

D. $30km$

Answer: A

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42. Two point white dots are 1mm apart on a black paper. They are viewed by eye of pupil diameter 3mm. Approximately, what is the maximum distance at which these dits can be resolved by the eye? [Take wavelelngth of light =500nm]

A. $6m$

B. $3m$

C. $5m$

D. $1m$

Answer: C

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43. An astronaut is looking down on earth's surface from a space shuttle at an altitude of $400km$. Assuming that the astronaut's pupil

diameter is $5mm$ and the wavelength of visible light is $500nm$. The astronaut will be able to resolve linear object of the size of about .

A. $0.5m$

B. $5m$

C. $50m$

D. $500km$

Answer: C

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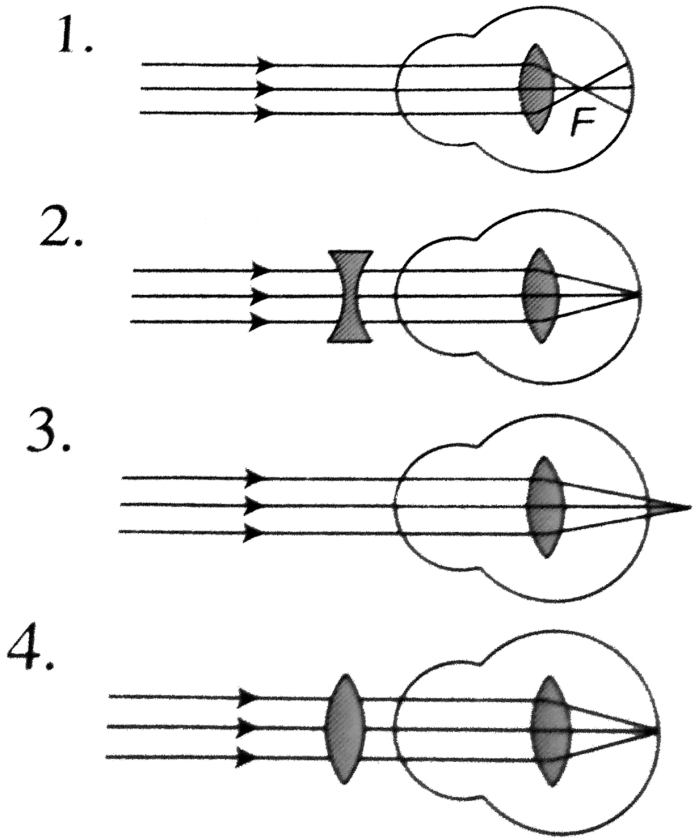

44. 1.

Identify the wrong description of the above figures

A. 1 represents farsightedness

B. 2 correction for shorsightedness

C. 3respresents farsightedness

D. 4correction for farsightedness

Answer: A

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45. Mark the correct options

(i) If the far point goes ahead, the power of the divergent lens should be reduced

(ii) If the near point goes ahead, the power of

the convergent lens should be reduced

(iii) If the far point is $1m$ away from the eye, divergent lens should be used

(iv) If the near point is $1m$ away from the eye, divergent lens should be used

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iv)$

D. $(i), (iv)$

Answer: B

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46. In the case of hypermetropia

(i) the image of a near object is formed behind the retina

(ii) the image of a distant object is formed in front of the retina

(iii) a concave lens should be used fro correction

(iv) a concave lens should be used for correction

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iv)$

D. $(i), (iv)$

Answer: D

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47. Astigmatism for a human eye can be removed by using

A. concave lens

B. convex lens

C. cylindrical lens

D. prismatic lens

Answer: C

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48. A man, wearing glasses of power $+2D$ can read clearly a book placed at a distance of $40cm$from the eye. The power of the lens

required so that he can read at $25cm$ from the eye is

A. $+4.5D$

B. $+4.0D$

C. $+3.5D$

D. $+3.0D$

Answer: C

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49. A person whose far-point is at $30cm$ wants to read at $50cm$. The power of the lens should be

A. $-1.0D$

B. $-1.33D$

C. $-1.62D$

D. $-2.0D$

Answer: B

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50. A person wears glasses of power $-2.5D$. The defect of the eye and the far point of the person without the glasses are, respectively

A. farsightedness,$40cm$

B. nearsightedness, $40cm$

C. astigmatism, $40cm$

D. nearsightedness, $250cm$

Answer: B

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51. A far-sighted man can see clearly at a distance of $1.0m$. The power of the lens that would make him see clearly at a distance of $0.2m$ is

A. $4D$

B. $-4D$

C. $6D$

D. $-6D$

Answer: A

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52. The near point of a person is $50cm$ and the far point is $1.5m$. The spectacles required for reading purpose and for seeing distant objects are respectively

A. $+2D,\ -\frac{2}{3}D$

B. $+\frac{2}{3}D,\ -2D$

C. $-2D,\ +\frac{2}{3}D$

D. $-\frac{2}{3}D,\ +2D$

Answer: A

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53. An eye specialist prescribes spectacles having combination of convex lens of focal length 40cm in contact with a concave lens of focal length 25cm. The power of this lens combination in diopters is

A. $+1.5$

B. -1.5

C. $+6.67$

D. -6.67

Answer: B

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54. How should people wearing spectacles work with a microscope

A. they cannot use the microscope at all

B. they should keep on wearing their spectacles

C. they should take off spectacles

D. (2) and (3) are both way

Answer: C

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55. Chromatic aberrations in the formation of image by a lens arise becauses

A. of non-paraxial rays

B. radii of curvatures of the two sides are not the same

C. of the defect in grinding

D. the focal length varies with wavelength

Answer: D

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56. Which of the following quantities related to a lens depend on the wavelength or wavelengths of the incident light?

(Choose the incorrect option)

A. power

B. focal length

C. chromatic aberration

D. radii of curvature

Answer: D

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57. Let f_v and f_r are the focal lengths of a convex lens for violet and red lights respectively. If F_v and F_r are the focal lengths of a concave lens for violet and red light respectively, then

A. $f_B > f_R$ and $F_B > F_R$

B. $f_B < f_R$ and $F_B > F_R$

C. $f_B > f_R$ and $F_B < F_R$

D. $f_B < f_R$ and $F_B < F_R$

Answer: D

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58. An achromaic convergent system of focal length $+20cm$ is made of two lenses (in contact) of materials having dispersive powers in the ratio $1:2$.Their focal lenths must be respectively

A. $10cm, -20cm$

B. $20cm, 10cm$

C. $-10cm, \ -20cm$

D. $20cm, \ -10cm$

Answer: A

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59. A combination of two thin lenses of the same material with focal lengths f_1 and f_2, arranged on a common axis minimizes chromatic aberration, if the distance between them is

A. $\frac{(f_1 + f_2)}{4}$

B. $\frac{(f_1 + f_2)}{2}$

C. $(f_1 + f_2)$

D. $2(f_1 + f_2)$

Answer: B

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60. The dispersive powers of crown and flint glasses are 0.02 and 0.04 respectively. In an achromatic combination of lenses the focal

length of flint glass lens is $40cm$. The focal length of crown glass lens will be

A. $-20cm$

B. $+20cm$

C. $-10cm$

D. $+10cm$

Answer: A

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61. The dispersive power of the material of lens of focal length $20cm$ is 0.8. The longitudinal chromatic aberration of the lens is

A. $0.08cm$

B. $0.08/20cm$

C. $1.6cm$

D. $0.16cm$

Answer: C

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62. Spherical aberration in a thin lens can be reduced by

A. using monchromatic light

B. using a doublet combination

C. using a circular annular mask over lens

D. increasing the size of lens

Answer: C

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63. Spherical aberration in a lens

A. is minimum when most of the deviation is at the first surface

B. is minimum when most of the deviation is at the second surface

C. is minimun when the total deviation is equally distributed over the two surface

D. does not depend on the above consideration

Answer: A

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