QUESTION BANK

EXERCISE - 1

Q.1 When a monochromatic light passes through a prism, will it show dispersion ?
Q.2 Will a star appear to twinkle if seen from free space (say moon) ?
Q.3 Can a beam of white light when passed through a hollow prism give spectrum ? Explain.
Q.4 What do you mean by a pure spectrum ?
Q.5 What is the common name for short sightedness ?
Q.6 Name the defect which is corrected by using an astigmatic lens.
Q.7 A person with a myopic eye cannot see objects beyond 1.2m distinctly. What should be the type of the corrective lens used to restore proper vision ?
Q.8 The far point of a myopic person is 80 cm. in front of the eye. What is the nature and power of lens required to correct the problem ?
Q.9 A person cannot see objects nearer than 75 cm. from his eyes while a person with normal vision can see objects upto 25 cm. from his eyes. Find the nature, the focal length and the power of the correcting lens used for the defective vision.
Q.10 A person can see clearly only up to 3 metres. Prescribe a lens for spectacles so that he can see clearly up to 12 metres. Defect is myopia.
Q.11 What is Cataract ?
Q.12 Name a natural spectrum.
Q.13 What is colour blindness ?
Q.14 How do we see colours ?
Q.15 The far point of a myopic person is 80 cm. in front of the eye. What is the power of the lens required to enable him to see the distant objects clearly ?
Q.16 Why does it take some time to see objects in a dim room when you enter the room from bright sunlight outside?
Q.17 A person with a defective eye-division is unable to see the objects nearer than 1.5m. He wants to read books at a distance of 30m. Find the nature, focal length and power of the lens he needs in his spectacles.
Q.18 A ray of light is travelling in water medium falls on the water-air interface at an angle of 45° with the vertical. Will it be possible by the ray of light to come out of the water surface ?
Q.19 A person having a myopic eye uses a concave lens of focal length 50 cm. What is the power of the lens ?
Q.20 What are fibre cables ?
Q.21 Why do different coloured rays deviate differently in the prism ?
Q.22 Why does a diamond sparkle ?
Q.23 Who do stars twinkle on a clear night ?

Passage based questions (Q.24-Q.28)

The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained the curvature of lens increases (that means radius of curvature decreases) and focal length decreases. For a clear vision the image must be on retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye-lens. It is about 2.5 cm for a grown-up person.

A person can theoretically have clear vision of objects situated at any large distance from the eye. The smallest distance at which a person can clearly see is related to minimum possible focal length. The ciliary muscles are most strained in this position. For an average grown-up person minimum distance of object should be around 25 cm.

A person suffering for eye defects uses spectacles (Eye glass). The function of lens of spectacles is to form the image of the objects within the range in which person can see clearly. The image of the spectacle-lens becomes object for eye-lens and whose image is formed on retina.

The number of spectacle-lens used for the remedy of eye defect is decided by the power of the lens required and the number of spectacle-lens is equal to the numerical value of the power of lens with sign. For example power of lens required is +3D (converging lens of focal length 100/3 cm) then number of lens will be +3.
For all the calculations required you can use the lens formula and lens maker's formula. Assume that the eye lens is equiconvex lens. Neglect the distance between eye lens and the spectacle lens.

Q.24 Minimum focal length of eye lens of a normal person is –
(A) 25 cm. (B) 2.5 cm. (C) 25/9 cm. (D) 25/11 cm.

Q.25 Maximum focal length of eye lens of normal person is –
(A) 25 cm (B) 2.5 cm. (C) 25/9 cm. (D) 25/11 cm.

Q.26 A nearsighted man can clearly see object only upto a distance of 100 cm and not beyond this. The number of the spectacles lens necessary for the remedy of this defect will be.
(A) +1 (B) – 1 (C) + 3 (D) – 3

Q.27 A farsighted man cannot see object clearly unless they are at least 100 cm from his eyes. The number of the spectacles lens that will make his range of clear vision equal to an average grown up person
(A) + 1 (B) – 1 (C) + 3 (D) – 3

Q.28 A person who can see objects clearly from distance 10 cm to ∞, then we can say that the person is –
(A) Normal sighted person (B) Near-sighted person
(C) Far-sighted person (D) A person with exceptional eyes having no eye defect

PASSAGE (QUESTIONS 29 - 34)

In the normal human eye, light from an object is refracted by the cornea-lens system at the front of the eye and produces a real image on the retina at the rear of the eye. For a given eye, its lensto-retina distance is fixed at about 2.5 cm. Most of the focusing of an image is done by the cornea, which has a fixed curvature that is convex with respect to incoming light. The importance of the lens is that its radius of curvature can be changed, allowing the lens to fine-tune the focus.
The lens is surrounded by the ciliary muscle. Contraction of the muscle decreases tension on the lens. This allows the natural elasticity of the lens to produce an increase in the radius of curvature. When the muscle relaxes, the lens flattens out, decreasing its radius of curvature. Unfortunately, the lens loses elasticity with age and the ability to alter curvature decreases.
The range over which clear vision is possible is bounded by the far point and the near point. In normal vision the far point is infinity and the near point depends on the radius of curvature of the lens. For normal eyes the average near point for reading is 25 cm.

AGE, years	NEAR POINT, cm
10	7
20	10
30	14
40	22
50	40
60	200

In the myopic (nearsighted) eye, the lens-to-retina length, is too long and/or the radius of curvature of the cornea is too great. This causes rays from an object at infinity to focus at a point in front of the retina. The far point is closer than normal. A corrective, lens will put a virtual image of a distant object at the position of the actual far point of the eye.
In the hyperopic (farsighted) eye, the lens-to-retina length is too short and/or the radius of the curvature of the cornea is not great enough. This causes rays from an object at infinity to focus at
a point behind the retina. The near point is farther away than normal. A corrective lens will put a virtual image of the close object at the position of the actual near point.

The relation among the object (o) and image (i) distances from the eye and the focal length (f') of the lens is given by the lens-distance rule : $\frac{1}{o}+\frac{1}{i}=\frac{1}{f}$

When using this equation, all distances are given in centimeters.

The power of corrective lenses is usually given in units called diopters. Power, in diopters, is the reciprocal of the focal length in meters : $P_{diopter}=\frac{1}{f_{meter}}$

By convention:

I. Converging lenses have positive focal lengths, and diverging lenses have negative focal lengths.

II. Real images have positive distances from the lens, and virtual images have negative distances from the lens.

Q.29 The lens system of the myopic eye is best described as :

(A) producing too much convergence (B) producing too little convergence

(C) producing too much divergence (D) producing too little divergence

Q.30 An optometrist examined John's eyes. The farthest object he can clearly focus on with his right eye is 50cm away. What is the power of the contact lens required to correct the vision in his right eye?

(A) –0.50 diopters (B) –2.0 diopters (C) +2.0 diopters (D) +5.0 diopters

Q.31 In a mildly hyperopic eye, the focal length of the eye's natural lens can be corrected by:

(A) contracting the ciliary muscle and increasing the radius of curvature

(B) contracting the ciliary muscle and decreasing the radius of curvature

(C) relaxing the ciliary muscle and increasing the radius of curvature

(D) relaxing the ciliary muscle and decreasing the radius of curvature

Q.32 Jane must wear a contact lens with a power of +3.00 diopters in one eye to be able to clearly focus on an object 25 cm in front of the eye. Based on the vision in this eye, which of the following is the most likely age range for Jane ?

(A) Less than 40 years old (B) From 40 to 49 years old

(C) From 50 to 59 years old (D) 60 years or older

Q.33 George wears eyeglasses that sit 2.0 cm in front of his eyes. His uncorrected far point is 50 cm. What is the focal length of his eyeglasses –

(A) –50 cm (B) +50 cm (C) – 48 cm (D) + 48 cm

Q.34 In a surgical procedure called Radial Keratotomy, (RK), a laser is used to flatten the cornea by placing a series of hairline cuts around the perimeter of the cornea. Which statement is most accurate –

(A) RK corrects myopia by decreasing the focal length of the eye

(B) RK corrects myopia by increasing the focal length of the eye

(C) RK corrects hyperopia by decreasing the focal length of the eye

(D) RK corrects hyperopia by increasing the focal length of the eye

EXERCISE - 2

Fill in the Blanks :

Q.1 Lens which is used for correcting the presbyopia defect of the eye is .....

Q.2 The colour that deviates maximum while passing through a glass prism is .....

Q.3 Water droplets act as tiny prism in the formation of .....

Q.4 The transparent spherical membrane covering the front of the eye is known as .....

Q.5 The coloured diaphragm between the cornea and the lens is .....

Q.6 The middle point of the iris has a hole, which is called .....

Q.7 The screen on which the image is formed by the lens system of the human eye is called .....

Q.8 ..... responds to the intensity of light.

Q.9 ..... respond to colour by generating electrical nerve pulses.

Q.10 For young adult with normal vision LDDV = ...
Q.11 The closest distance at which the eye can focus clearly is called the .....
Q.12 For a normal eye, the range of vision is from .....
Q.13 The eye which suffers from myopia as well as from hypermetropia is said to suffer from .....
Q.14 The eye which cannot simultaneously see with the same distinctness all objects or lines making different inclinations is said to suffer from .....
Q.15 The defect of the eye due to which a person is unable to distinguish between certain colours, known as .....
Q.16 Newton demonstrated that white light is made up of ..... constituent colours.
Q.17 The phenomenon of splitting of white light into its constituent colours is called .....
Q.18 The band of colours produced on the screen is called .....
Q.19 The ability of the eye to focus both near and distant objects, by adjusting its focal length, is called the .....
Q.20 The smallest distance, at which the eye can see objects clearly without strain, is called the ..... of the eye.
Q.21 The common refractive defects of vision include ....., ... and .....
Q.22 The splitting of white light into its component colours is called .....
Q.23 ..... causes the blue colour of sky and the reddening of the Sun at sunrise and sunset.
Q.24 Sunlight comprises ..... colours.
Q.25 The wavelength of violet colour is .....
Q.26 The wavelength of red colour is .....
Q.27 In the minimum deviation position, the path of ray of light entering a prism is such that the angle of ..... is ..... to the angle of emergence; also the refracted ray in the prism is ..... to the base of the prism.

True-False statements.

Q.28 The eye which can see near object clearly is said to suffer from hypermetropia.
Q.29 The eye which cannot see distant objects clearly is said to suffer from myopia.
Q.30 Colour blindness is a genetic disorder which occurs by inheritance.
Q.31 The ciliary muscles can modify the curvature of the lens.
Q.32 In Myopia the image of distant objects is focussed before the retina.
Q.33 Hypermetropia is corrected by using a convex lens of suitable power.
Q.34 The refractive index of diamond is 2.4. Its critical angle is 24° 38'. (twenty four degree, and thirty eight minutes)
Q.35 For total internal reflection to take place, the angle of incidence in the given (denser) medium must be less than the critical angle for that medium.

EXERCISE - 3

Q.1 The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to
(A) presbyopia (B) accommodation (C) near-sightedness (D) far-sightedness

Q.2 The human eye forms the image of an object at its –
(A) cornea (B) iris (C) pupil (D) retina

Q.3 The least distance of distinct vision for a young adult with normal vision is about –
(A) 25 m (B) 2.5 cm (C) 25 cm (D) 2.5 m

Q.4 The change in focal length of an eye lens is caused by the action of the –
(A) pupil (B) retina (C) ciliary muscles (D) iris

Q.5 Prism angle of a prism is 10^o. Their refractive index for red & violet colour is 1.51 & 1.52 respectively. Then dispersive power will be
(A) 0.5 (B) 0.15 (C) 0.019 (D) 0.032

Q.6 Prism angle & refractive index for a prism for a 60^o & 1.414. Angle of minimum deviation will be -
(A) 15^o (B) 30^o (C) 45^o (D) 60^o

Q.7 Diameter of the moon is 3.5×10^3 km and its distance from earth is 3.8×10^5 km. It is seen by a telescope whose objective and eyepiece have focal lengths 4m and 10cm respectively. The angular diameter of the image of the moon will be nearly –
(A) 5° (B) 10° (C) 20° (D) 25°

Q.8 A telescope consisting of an objective of focal length 60 cm and a single–lens eyepiece of focal length 5 cm is focussed at a distant object in such a way that parallel rays emerge from the eye piece. If the object subtends an angle of 2° at the objective, then the angular width of the image will be –
(A) 10° (B) 24° (C) 50° (D) 1/6°

Q.9 A near sighted person cannot see distinctly beyond 50cm. from his eye. The power in diopter of spectacle lenses which will enable him to see distant objects clearly is –
(A) +50 (B) –50 (C) +2 (D) –2

Q.10 The following one is not a primary colour –
(A) Yellow (B) Red (C) Green (D) Blue

Q.11 Fraunhofer lines in the Sun's spectrum are present because –
(A) Vapours of certain elements present in the atmosphere absorb certain colours
(B) The temperature of the sun is very high (C) The sun does emit certain light
(D) Certain elements present in the sun interfere

Q.12 When a mirror is rotated an angle the reflected ray moves through double that angle, the instrument based on the above principle is –
(A) Periscope (B) Odometer (C) Refractometer (D) Sextant

Q.13 Rainbow is caused due to –
(A) Reflection of sun light air (B) Dispersion of sun light from water drops
(C) Refraction of sun light from water drops (D) Diffraction of sun rays from water drops

Q.14 In the visible spectrum the colour having the shortest wavelength is –
(A) Green (B) Red (C) Violet (D) Blue

Q.15 At the moment dew formation starts on a cool night, the air
(A) Must loose all water vapour (B) Must remain unsaturated
(C) Must get mixed up with some other vapour (D) Must become saturated

Q.16 At sun rise or at sun set the sun appears to be reddish while at mid day it looks white. This is because –
(A) Scattering due to dust particles and air molecules causes this phenomenon
(B) The sun is cooler at sun rise or at sunset
(C) Refraction causes this phenomenon
(D) Diffraction sends red rays to the earth at these times.

Q.17 Sometimes blurred and less sharply defined images are formed. This defect is called –
(A) Chromatic aberration (B) Spherical aberration
(C) Blurred lens (D) None of the above

Q.18 A person cannot see objects clearly which are nearer than 75cms from his eyes, the disease he is suffering from is –
(A) Astigmatism (B) Myopia (C) Hypermetropia (D) Presbyopia

Q.19 On entering a glass prism, sun rays are –
(A) Deviated but not dispersed (B) Deviated and dispersed
(C) Dispersed but not deviated (D) Neither deviated nor dispersed.

Q.20 A piece of cloth looks red in sun light. It is held in the blue portion of a solar spectrum, it will appear –
(A) red (B) black (C) blue (D) white

Q.21 The angle of minimum deviation of a ray of light of glass prism is greatest for the light of colour –
(A) violet (B) orange (C) yellow (D) red

Q.22 To get line spectrum, the substances are excited in their –
(A) solid state (B) molecular state (C) gaseous state (D) atomic state

Q.23 The frequency of light whose wavelength is 5000 Å is –
(A) 15×10^{13} cycles per second (B) 5000 cycles per second
(C) 6×10^{14} cycles per second (D) 15×10^{16} cycles per second

Q.24 The pupil of the eye changes in size to adjust for –
(A) objects at different distances (B) objects of different sizes
(C) different colors (D) different amounts of light

Q.25 To use a magnifying glass, the object should be placed –
(A) as close to the lens as possible (B) just within the lens' focal point
(C) just beyond the focal point (D) some distance beyond the focal point

Q.26 A camera employs a ..... lens to form ..... images –
(A) diverging ..... real (B) diverging ..... virtual
(C) converging ... real (D) converging ... virtual

Q.27 In the eye, the position of the image on the retina is adjusted by changing the
(A) position of the lens (B) focal length of the lens
(C) diameter of the pupil (D) length of the eyeball

Q.28 What power lens is needed to correct for nearsightedness where the uncorrected far point is 250 cm?
(A) +2.5 diopters (B) –2.5 diopters (C) + 0.4 diopters (D) –0.4 diopters

Q.29 What power lens is needed to correct for farsightedness where the uncorrected near point is 250 cm?
(A) + 3.6 diopters (B) – 3.6 diopters (C) + 0.28 diopters (D) – 0.28 diopters

Q.30 In a room, artificial rain is produced at one end and a strong source of white light is switched on at the other end. To observe the rainbow an observer must –
(A) Look anywhere in the room (B) Look towards the source (C) Look towards the raindrops
(D) Look in a direction equally inclined to the source of raindrops

Q.31 For which of the following pairs the critical angle is smallest–
(A) Water to air (B) Glass to water (C) Glass to air (D) Glass to glass

Q.32 For which colour the critical angle is maximum in water-air system –
(A) Red (B) Violet (C) Yellow (D) It is same for all colours

Q.33 A direct vision spectrometer uses the phenomenon of –
(A) Diffraction (B) Interference without deviation
(C) Dispersion without deviation (D) Deviation without dispersion

Q.34 A combination is made of two lenses of focal length f and f' in contact, the dispersive powers of the material of the lenses are ω and ω'. The combination is achromatic when–
(A) $\omega = \omega_0, \omega' = 2\omega_0, f' = 2f$ (B) $\omega = \omega_0, \omega' = 2\omega_0, f' = f/2$
(C) $\omega = \omega_0, \omega' = 2\omega_0, f' = -f/2$ (D) $\omega = \omega_0, \omega' = 2\omega_0, f' = -2f$

Q.35 In case of hypermetropia –
(A) The image of near objects is formed in front of retina
(B) The image of near objects is formed behind the retina
(C) A concave lens should be used for correction
(D) A convex lens cannot be used for correction

Q.36 Astigmatism can be corrected by –
(A) Bifocal lenses (B) Cylindrical lenses (C) Concave lenses (D) Planoconvex lenses

Q.37 For seeing a cricket match, we prefer binoculars to the terrestrial telescope, because –
(A) Binoculars give three-dimensional view (B) Terrestrial telescope gives inverted image
(C) To avoid chromatic aberration (D) To have larger magnification

Q.38 The electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of the radiation in the glass slab will be, respectively–

(A) $n, \frac{\lambda}{\mu}, v$ (B) $\frac{n}{\mu}, \lambda, \frac{v}{\mu}$ (C) $n, \frac{\lambda}{\mu}, \frac{v}{\mu}$ (D) $\frac{n}{\mu}, \frac{\lambda}{\mu}, \frac{v}{\mu}$

Q.39 The convex lens is not used –

(A) in camera (B) as glasses to correct for short sight

(C) as glasses to correct for light sight (D) all of the above

Q.40 The defect that may occur in a lens are –

(A) spherical aberration and chromatic aberration

(B) coma and astigmation (C) distortion (D) all of the above

Q.41 When blue light is used in a thin convex lens then the focal length is found to be f. If instead red light is used, then the focal length will be –

(A) equal to f (B) less than f (C) greater than f (D) nothing can be predicted

Q.42 One of the refracting surfaces of a prism is silvered, and the angle of prism is A. It is found that a ray of light incident at an angle of incidence 2A after suffering refraction return back through the same path due to reflection from the second silvered refracting surface. Then the refractive index of the material of the prism is –

(A) 2 sin A (B) 2 cos A (C) tan A (D) ½ cos A

Q.43 Out of the following, which statements are correct –

(A) Sunlight filtering through a tree often makes circular patches on the ground because sun is round

(B) A beam of white light passing through a hollow prism gives no spectrum

(C) The number of images observable between two parallel plane mirrors is infinite

(D) A virtual object placed between the pole and the principal focus of a convex mirror produces an image which is virtual, diminished and upright.

Q.44 Due to refraction of light in atmosphere –

(A) Stars appear to twinkle (B) The sun appears to be oval in morning and evening

(C) The period of visibility of the sun is increased

(D) The phenomena of mirage and looming take place

Q.45 White light is incident on an equilateral prism. In the position of minimum deviation –

(A) Angle of incidence is equal to angle of emergence

(B) The ray inside the prism is parallel to its base

(C) The angle of refraction inside the prism is equal to the angle of prism

(D) The dispersion of all colours is same

Q.46 Out of the following, select the correct statements –

(A) Refractive index varies inversely as the fourth power of the wavelength of light.

(B) When the moon is near the horizon, it appears bigger. This is due to optical illusion.

(C) The colour of light which travels with the maximum speed in glass is red.

(D) If sun is shining brightly in one part of the sky after rain, two rainbows are usually observed.

Q.47 A diver at a depth of 12m in water ($\mu = 4/3$) sees the sky in a cone of semi-vertical angle –

(A) $\sin^{-1}(4/3)$ (B) $\tan^{-1}(4/3)$ (C) $\sin^{-1}(3/4)$ (D) 90°

Q.48 The refractive index of water is 4/3 and that of glass is 5/3. What will be the critical angle for the ray of light entering water from the glass –

(A) $\sin^{-1}(4/5)$ (B) $\sin^{-1}(5/4)$ (C) $\sin^{-1}(1/2)$ (D) $\sin^{-1}(2/1)$

Q.49 Relation between critical angles of water and glass is –

(A) $C_w > C_g$ (B) $C_w < C_g$ (C) $C_w = C_g$ (D) $C_w = C_g = 0$

Q.50 Critical angle for light going from medium (i) to (ii) is θ. The speed of light in medium (i) is v then speed in medium (ii) is –

(A) $v(1 - \cos\theta)$ (B) $v / \sin\theta$ (C) $v / \cos\theta$ (D) $v(1 - \sin\theta)$

Q.51 If light travels a distance x in t_1 sec. in air and 10x distance in t_2 sec. in a medium, the critical angle of the medium will be –
(A) $\tan^{-1}(t_1/t_2)$ (B) $\sin^{-1}(t_1/t_2)$ (C) $\sin^{-1}(10t_1/t_2)$ (D) $\tan^{-1}(10t_1/t_2)$

Q.52 Dispersion is the term used to describe –
(A) the propagation of light in straight lines
(B) The splitting of a beam of light into component colours
(C) The bending of a beam of light when it strikes a mirror
(D) The change that takes place in white light after passage through red glass.

Q.53 In a glass prism –
(A) Blue light is dispersed more than red light (B) Red light is dispersed more than blue light
(C) Both red light and blue light are equally dispersed (D) None of these

Q.54 Deviation δ produced by a prism of refractive index μ and small angle A is given by –
(A) $\delta = (\mu - 1)\, A$ (B) $\delta = (\mu + 1)\, A$ (C) $\delta = (A - 1)\, \mu$ (D) $\delta = (A + 1)\, \mu$

Q.55 If for a given prism the angle of incidence is changed from 0° to 90°, the angle of deviation –
(A) Increases (B) Decreases
(C) First decreases and then increases (D) First increases and then decreases

Q.56 The refracting angle of a prism is A and the refractive index of the prism is cot A/2. The angle of minimum deviation is–
(A) 180° – 3A (B) 180° + 2A (C) 90° – A (D) 180° – 2A

Q.57 A ray is incident at an angle of incidence i on one face of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to –
(A) A/μ (B) $A/2\mu$ (C) μA (D) $\mu A/2$

Q.58 An optician while testing the eyes finds the vision of a patient to be 6/12. By this he means that –
(A) The person can read the letters of 6 inches from a distance of 12 m
(B) The person can read the letters of 12 inches from 6 m
(C) The person can read the letters of 6 m which the normal eye can read from 12 m
(D) The focal length of eye lens had become half that of the normal eye

Q.59 A person cannot see objects clearly beyond 50 cm. The power of the lens to correct the vision is –
(A) +5 D (B) –0.5 D (C) –2 D (D) +2 D

Q.60 A long sighted person has a minimum distance of distinct vision of 50 cm. He wants to reduce it to 25 cm. He should use a –
(A) Concave lens of focal length 50 cm. (B) Convex lens of focal length 25 cm.
(C) Convex lens of focal length 50 cm. (D) Concave lens of focal length 25 cm.

Q.61 A long-sighted person cannot see objects clearly at a distance less than 40 cm. from his eye. The power of the lens needed to read an object at 25 cm. is –
(A) – 2.5 D (B) + 2.5 D (C) – 6.25 D (D) + 1.5 D

Q.62 In which of the following cases, is total internal reflection not possible –
(A) A ray incident from water to glass (B) A ray incident from glass to water
(C) A ray incident from glass to air (D) A ray incident from water to air

Q.63 Critical angle of light passing from glass to air is maximum for –
(A) violet (B) blue (C) yellow (D) red

Q.64 A mirage occurs because –
(A) The refractive index of atmosphere increases with height
(B) The refractive index of atmosphere decreases with height
(C) The hot ground acts like a mirror
(D) Refractive index remains constant with height

Q.65 A well cut diamond appears bright because –

(A) Of reflection of light (B) Of dispersion of light

(C) The total internal reflection (D) Of refraction of light

Q.66 Twinkling of stars is on account of –

(A) Large distance of stars and storms in air (B) Small size of stars

(C) Large size of stars (D) Large distance of stars and fluctuations in the density of air.

Q.67 You are under the water in a clear lake looking at the surface and see the image of a fish due to total internal reflection. What is the minimum angle that the light leaving the fish makes with the normal to the surface of the lake?

(A) 42° (B) 53° (C) 49° (D) 37°

Q.68 White light is incident at an angle to the surface of a triangular piece of glass. Which color of light deviates most from its original path after leaving the glass?

(A) red (B) orange (C) green (D) blue

EXERCISE - 4

Match the column–

Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **column I** have to be matched with statements (p, q, r, s) in **column II**.

Q.1 Match the following :

Column I	**Column II**
(A) Inverted crown-flint glass prism	(p) Deviation $\propto \frac{1}{\text{dispersive power}}$
(B) Achromatism	(q) Deviation without dispersion
(C) Hollow prism	(r) Absence of chromatic aberration
(D) Glass slab	(s) Dispersion without deviation

Q.2 Column II gives lens that can be use to correct the defect of vision given in column I, match them correctly.

Column I	**Column II**
(A) Myopia	(p) convex lens
(B) Hyperopia	(q) concave lens
(C) Astigmatism	(r) cylindrical lens
(D) Presbyopia	(s) bi-focal lens

ASSERTION & REASON TYPE

Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 5 choices (A), (B), (C), (D) and (E) out of which ONLY ONE is correct.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement -1 is True, Statement-2 is False.

(D) Statement -1 is False, Statement-2 is True. (E) Statement -1 is False, Statement-2 is False.

Q.3 **Statement 1 :** Refractive index of material of a prism depends on angle of prism A and angle of minimum deviation δ_m.

Statement 2 : Because $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin(A/2)}$

Q.4 **Statement 1 :** Optical fibres are used to transmit light without any appreciable loss in its intensity over distance of several kilometers.

Statement 2 : Optical fibres are very thick and all the light is passed through it without any loss.

Q.5 **Statement 1 :** When we seen an object, the image formed on the retina is real and inverted.
Statement 2 : If the magnification of a system is less than one, then the image formed in inverted.

Q.6 **Statement 1 :** A man wearing glasses of focal length + 1m cannot see beyond 1m.
Statement 2 : A convex lens forms a real image of a point object placed on its principal axis. If the upper half of the lens is painted black, the intensity of the image will decrease but the image will not be shifted upward or downward.

Q.7 **Statement 1:** Rainbow is an example of the dispersion of sunlight by the water droplets.
Statement 2 : Light of shorter wavelength is scattered much more than light of larger wavelength.

Q.8 **Statement 1 :** The focal length of a lens is dependent on the wavelength of light.
Statement 2 : The velocity of light changes with the medium.

Q.9 **Statement 1 :** The number of wavelengths in the visible region of the spectrum are infinite.
Statement 2 : Ray optics is valid, when characteristic dimensions are much larger than the wavelength of light.

Q.10 **Statement 1 :** Bird flying high up in air does not shadow on the earth ground.
Statement 2 : The size of bird is smaller than sun.

Q.11 **Statement 1 :** A star will appear to twinkle if seen from free space (say moon)
Statement 2 : An air bubble inside water behave like a convergent lens.

Q.12 **Statement 1 :**The twinkling of stars is due to the fact that refractive index of the earth's atmosphere fluctuates.
Statement 2 : In cold countries, the phenomenon of looming (i.e. ship appears in the sky) takes place, because refractive index of air decreases with height.

Q.13 **Statement 1 :** Critical angle is maximum for red colour in water-air system for visible light.
Statement 2 : Because $\sin\theta_C = 1/\mu$ and μ_r (refractive index of red colour) is minimum for visible light.

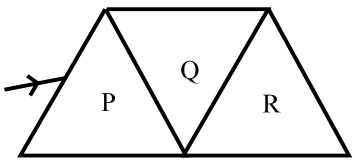
Q.14 **Statement 1 :** Deviation δ produced by a prism of refractive index μ and small angle A is given by $\delta = (\mu - 1)\, A$

Statement 2 : Because for a prism of refractive index μ and refraction angle A, $\mu = \dfrac{\sin\left(\dfrac{A+\delta}{2}\right)}{\sin\,(A/2)}$

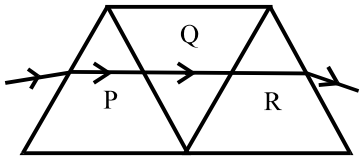
and for small θ, $\sin\theta \approx \theta$

Q.15 **Statement 1 :** Telescope is an optical instrument used to increase the visual angle of distance large objects.
Statement 2: Power of a lens is the capacity or ability of the lens to deviate the path of rays passing through it.

Q.16 **Statement 1 :** A given ray of light sufferes minimum deviation in an equilateral prism P. Additional prisms Q and R of identical shape and of same material as P are now added as shown in figure. The ray will now suffer same deviation as before.



Statement 2 : When a ray suffers minimum deviation, it becomes parallel to the base of prism. In above system the ray continues to be parallel to the base of prism Q and R (See figure)



EXERCISE - 5

PREVIOUS YEARS COMPETITION PROBLEMS

Q.1 Angle of deviation (δ) by a prism (refractive index = μ, and supposing the angle of prism A to be small) can be given by –

(A) $\delta = (\mu - 1)A$ (B) $\delta = (\mu + 1)A$ (C) $\delta = \frac{\sin(A+\delta)/2}{\sin(A/2)}$ (D) $\delta = \frac{\mu - 1}{\mu + 1}A$

Q.2 Light waves projected on oil surface show seven colours due to –
(A) Polarisation (B) Diffraction (C) Refraction (D) Interference

Q.3 If the refractive index of a material of equilateral prism is $\sqrt{3}$, then angle of minimum deviation of the prism is
(A) 30° (B) 45° (C) 60° (D) 75°

Q.4 The splitting of white light into several colours on passing through a glass prism is due to –
(A) refraction (B) reflection (C) interference (D) diffraction

Q.5 Rainbow is formed due to a combination of –
(A) Refraction and absorption (B) Dispersion and focussing
(C) Refraction and scattering (D) Dispersion and total internal reflection

Q.6 The image formed by an objective of a compound microscope is
(A) virtual and diminished (B) real and diminished (C) real and enlarged (D) virtual and enlarged

Q.7 A person using a lens as a simple microscope sees an –
(A) inverted virtual image (B) inverted real magnified image
(C) upright virtual image (D) upright real magnified image

Q.8 The astronomical telescope consists of objective and eye-piece. The focal length of the objective is –
(A) equal to that of the eye piece (B) greater than that of eye piece
(C) shorter than that of eye piece (D) five times shorter than that of the eye piece

Q.9 A doctor advises a patient to use spectacles with a convex lens of focal length 40 cm. in contact with a concave lens of focal length 25 cm. What is the power of the resultant combination –
(A) –6.5 D (B) –1.5 D (C) 6.5 D (D) 1.5 D

Q.10 An endoscope is employed by a physician to view the internal parts of a body organ. It is based on the principle of –
(A) refraction (B) reflection (C) total internal reflection (D) dispersion

Q.11 Myopia is due to –
(A) elongation of eye ball (B) irregular change in focal length
(C) shortening of eye ball (D) older age

Q.12 Blue colour of sky is due to phenomenon of –
(A) Reflection (B) Refraction (C) Scattering (D) Dispersion

Q.13 When light is passed through a prism, the colour which deviates least is –
(A) Red (B) Violet (C) Blue (D) Green

Q.14 The formation of rainbow is due to the phenomenon of –
(A) reflection (B) dispersion (C) refraction (D) interference

Q.15 A violet ray entering from medium 1 to medium 2 at certain angle just escapes from total internal reflection. Which of the following coloured radiation will be able to come to medium 2 under same condition to incidence–
(1) VIB (2) YOR (3) all except green (4) all

Q.16 Ability of the eye to see objects at all distances is called –
(A) Binocular vision (B) Myopia (C) Hypermetropia (D) Accommodation

Q.17 A person having the nearest distance of distinct vision of 32 cm. uses a reading lens of 8 cm. focal length. The magnification of his reading lens is –
(A) 5 (B) 4 (C) 3 (D) 2

Q.18 Rainbow is formed due to-
(A) Scattering & Refraction (B) Total internal reflection & dispersion
(C) Reflection only (D) Diffraction and dispersion

Q.19 A ray of light passing through a prism having $\mu = \sqrt{2}$ suffers minimum deviation. If angle of incident is double the angle of refraction within prism, than angle of prism is –
(A) 30° (B) 45° (C) 60° (D) 90°

Q.20 Which of the prism is used to see infrared spectrum of light –
(A) Rock salt (B) Nicol (C) Flint (D) Crown

Q.21 The far point of a myopic eye is 1.5 m. To correct this defect of the eye, the power of lens is –
(A) 0.66 D (B) – 0.66 D (C) + 1.5 D (D) – 1.5 D

Q.22 Which of the following statements is correct about rainbow ?
(A) In primary rainbow, red colour is on the outside and violet colour is on the inside.
(B) In primary rainbow, violet colour is on the outside and red colour is on the inside.
(C) Secondary rainbow is brighter than primary rainbow.
(D) In secondary rainbow, light wave suffers one total internal reflection before coming out.

Q.23 Sky appears to be red colour at the time of sunset. The reason is-
(1) Blue colour out sun rays is scattered away by the atmosphere
(2) As sun emits out only red colour in the morning
(3) White light is made to appear red by atmosphere (4) None of the above

EXERCISE - 6

PREVIOUS YEARS BOARD QUESTIONS

Q.1 What kind of lens is used in the spectacles of a person suffering from myopia (near-sightedness) ?

Q.2 State the reason for the following observations recorded from the surface of moon.
(i) Sky appears dark (ii) Rainbow is never formed.

Q.3 A 14-year old student is not able to see clearly the questions written on the blackboard placed at a distance of 5 m from him.
(a) Name the defect of vision he is suffering from.
(b) name the type of lens used to correct this defect.

Q.4 Explain the following terms used in relation to defects in vision and correction provided by them :
(a) myopia (b) Astigmatism (c) Bifocal lenses (d) Far sightedness.

Q.5 A ray of light incident on an equilateral glass prism shows minimum deviation of 30º. Calculate the speed of light through the glass prism.

ANSWER KEY

EXERCISE - 1

(1) No **(5)** Myopia. **(6)** Spherical aberration. **(7)** focal length 1.2m &power –0.83 D
(8) – 1.25 D **(9)** +2.67D **(10)** 4m **(15)** –1.25D (Dioptres)
(17) 2.67D **(19)** –2 dioptres **(24)** (D) **(25)** (B) **(26)** (A)
(27) (C) **(28)** (D) **(29)** (A) **(30)** (B) **(31)** (C)
(32) (C) **(33)** (C) **(34)** (B)

EXERCISE - 2

(1) convex **(2)** Violet **(3)** rainbow **(4)** cornea **(5)** iris **(6)** pupil
(7) retina **(8)** Rods **(9)** Cones **(10)** 25 cm. **(11)** near point **(12)** 25 cm to infinity
(13) presbyopia. **(14)** astigmatism. **(15)** colour blindness **(16)** seven
(17) dispersion **(18)** spectrum **(19)** accommodation of the eye. **(20)** near point
(21) myopia, hypermetropia , presbyopia. **(22)** dispersion.
(23) Scattering of light **(24)** 7 **(25)** 4×10^{-7} m **(26)** 7×10^{-7} m
(27) incidence, equal, parallel **(28)** False **(29)** True **(30)** True
(31) True **(32)** True **(33)** True **(34)** True **(35)** False

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11
A	B	D	C	C	C	B	C	B	D	A	D
Q	12	13	14	15	16	17	18	19	20	21	22
A	D	B	C	D	A	B	C	B	B	A	D
Q	23	24	25	26	27	28	29	30	31	32	33
A	C	D	B	C	B	D	A	C	C	A	C
Q	34	35	36	37	38	39	40	41	42	43	44
A	D	B	B	A	C	B	D	C	B	B,C	all
Q	45	46	47	48	49	50	51	52	53	54	55
A	A,B	B,C,D	C	A	A	B	C	B	A	A	C
Q	56	57	58	59	60	61	62	63	64	65	66
A	D	D	C	C	C	D	A	D	A	C	D
Q	67	68									
A	C	D									

EXERCISE - 4

(1) **(A) → s, (B) → r, p, (C) → q, (D) → q** **(2)** **(A) → q, (B) → p, (C) → r (D) → s**
(3) (E) **(4)** (C) **(5)** (C) **(6)** (B) **(7)** (B) **(8)** (A)
(9) (B) **(10)** (A) **(11)** (E) **(12)** (B) **(13)** (A) **(14)** (A)
(15) (B) **(16)** (A)

EXERCISE - 5

Q	1	2	3	4	5	6	7	8	9	10	11
A	A	D	C	A	D	C	C	B	B	C	A
Q	12	13	14	15	16	17	18	19	20	21	22
A	C	A	B	D	D	A	B	D	A	B	A
Q	23										
A	A										

EXERCISE - 6

(1) Concave lens. **(3)** (a) Short-sightedness (Myopia). (b) Concave lens. **(5)** $\frac{3 \times 10^8}{\sqrt{2}}$ ms^{-1}.