CHAPTER 11

Human Eye and The Colorful World

1. OBJECTIVE QUESTIONS

1. The human eye forms the image of an object at its
(a) cornea (b) iris
(c) pupil (d) retina

Ans : (d) retina

2. 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

Ans : (c) ciliary muscles

3. In the visible spectrum the colour having the shortest wavelength is
(a) Green (b) Red
(c) Violet (d) Blue

Ans : (c) Violet

4. Even in absolutely clear water, a diver cannot see very clearly because
(a) rays of lights get diffused
(b) velocity of light is reduced in water
(c) ray of light passing through the water makes it turbid.
(d) the focal length of the eye lens in water gets changed and the image is no longer focussed sharply on the retina.

Ans : (d) the focal length of the eye lens in water gets changed and the image is no longer focussed sharply on the retina.

The refractive indices of water and the cornea are so similar that the bending of light when it enters eye is negligible. The lens does not focus the image on retina but somewhere behind it. Due to this one cannot see clearly in absolutely clear water.

5. When ciliary muscales are relaxed, focal length of eye lens is
(a) maximum
(b) minimum
(c) Neither maximum nor minimum
(d) Cannot say

Ans : (a) maximum

When we are looking at distant objects, the ciliary muscles are relaxed and the eye lens becomes thin. Consequently, the focal length of the eye lens becomes maximum.

6. A person with a myopic eye cannot see object beyond $-1.2\,\text{m}$ distinctly. The power of the corrective lens used to restore proper vision is
(a) $-0.83\,\text{D}$ (b) $-0.92\,\text{D}$
(c) $+0.21\,\text{D}$ (d) $+0.91\,\text{D}$

Ans : (a) $-0.83\,\text{D}$

The corrective lens should form the image of far off object at the far point of the myopic person. So, by using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$= \frac{1}{-1.2} - \frac{1}{\infty} = -\frac{1}{1.2}$$

$$f = -1.2\,\text{m}$$

$$\text{Power of a lens, } P = -\frac{1}{1.2} = -0.83\,\text{D}$$

7. 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

Ans : (c) 25 cm

8. A person uses a lens of power $+3\,\text{D}$ to normalise vision. Near point of hyper-me-tropic eye is
(a) 1.66 m (b) 0.66 m
(c) 0.33 m (d) 1 m

Ans : (d) 1 m

Focal length of lens,

$$f = \frac{1}{P}$$

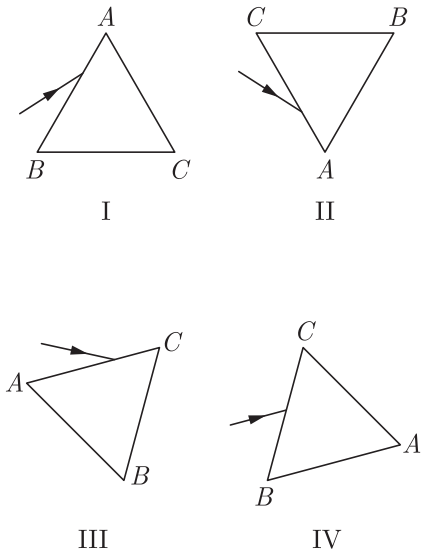
$$= \frac{1}{3} \times 100 = \frac{100}{3}\,\text{cm}$$

By lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{\frac{100}{3}} = \frac{1}{v} - \frac{1}{(-25)}$$

$$v = -100\,\text{cm} = -1\,\text{m}$$

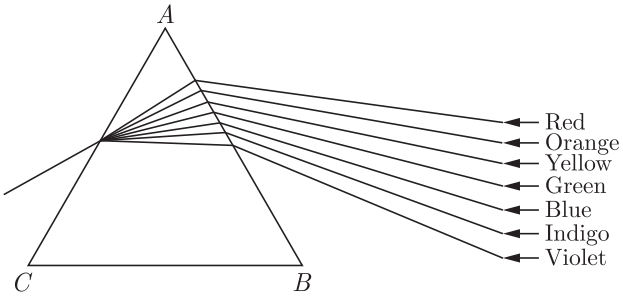
9. A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in figure. In which of the following cases, after dispersion, the sixth colour from the top corresponds to the colour of the sun?



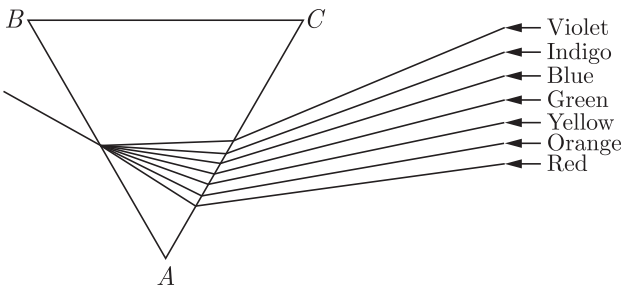
(a) (I) (b) (II)
(c) (III) (d) (IV)

Ans : (b) (II)

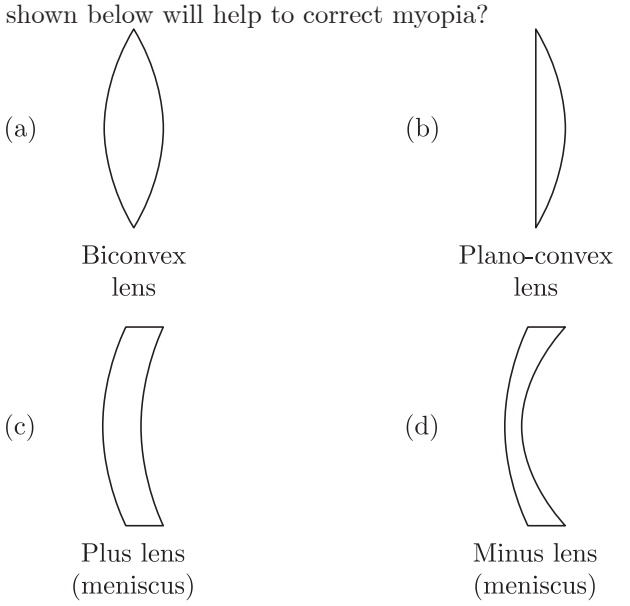
Generally, in case of a prism (II), the formation of spectrum is shown below



In the above figure, from top the sixth colour is Indigo. But we can see that from bottom the sixth colour is orange which is the colour of sun. So, we can obtain the correct situation by inverting the prism. Thus, the required orientations can be bound in case II.

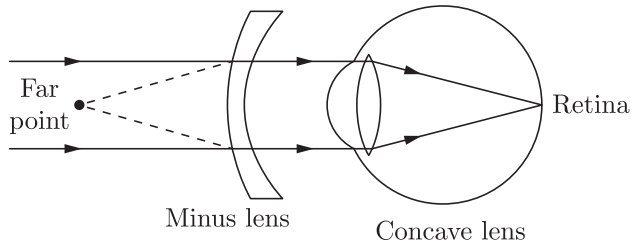


10. For a healthy eye, the rays of light entering the eye form a sharp image on retina. For a myopic eye, the rays from distant objects focus in front of the retina forming a blurred image. Which of the following lenses shown below will help to correct myopia?



Ans : (d)

Myopia can be corrected by using a concave lens or diverging lens of appropriate power. Here, lens 4 i.e. minus lens (meniscus) can be used to bring back the image on retina by diverging light rays intitally, thus, the defect is corrected.



11. A near sighted person wears eye glass of power 5.5 D for distant vision. His doctor prescribes a correction of +1D in near vision part of his bi-focals, which is measured relative to the main part of the lens. Then, the focal length of his near vision part of the lens is

(a) −18.18 cm (b) −20 cm
(c) −22.22 cm (d) +20.22 cm

Ans : (c) −22.22 cm

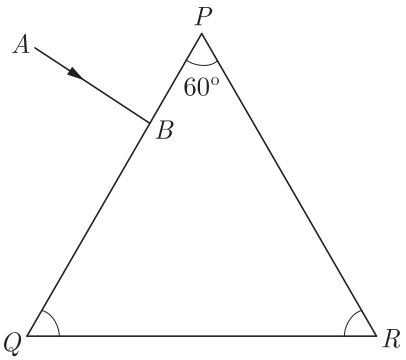
Power of lens after correction of +1D.

$$P_2 = P_1 + 1\text{D} = (-5.5 + 1)\text{D} = -4.5\,\text{D}$$

Focal length of near vision part of lens,

$$f_2 = \frac{1}{P_2} = \frac{100}{-4.5}\,\text{cm} = -22.22\,\text{cm}$$

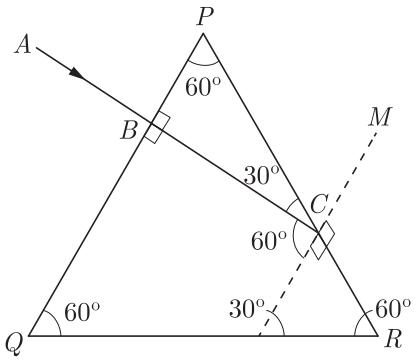
12. In given figure, a light ray AB is incident normally on one face PQ of an equilateral glass prism.
Find out the angles at faces PQ and PR.



(a) 60° (b) 30°
(c) 45° (d) 90°

Ans : (a) 60°

At face PQ, angle of incidence is 0° as ray AB falls normally on this face. This normally incident ray AB goes undeviated and strikes the face PR at point C. The angle of incidence, at point C with the normal MN is the angle NCB.
From the geometry of figure, it is clear that $\angle NCB$ is equal to 60°.



Therefore, angle of incidence at face PQ is 0° and angle of incidence at face PR is 60°

13. The following one is not a primary colour
(a) Yellow (b) Red
(c) Green (d) Blue

Ans : (a) Yellow

14. A thin prism P_1 with angle 4° and made from glass of refractive index 1.54 is combined with another prism P_2 made from glass of refractive index 1.92 to produce dispersion without deviation. Then, the angle of the prism P_2 is
(a) 2.3° (b) 4.3°
(c) 3.2° (d) 2.0°

Ans : (a) 2.3°

For a small-angled prism and for a small angle of incidence, deviation is given by

$$\delta = (n_g - 1)A$$

Where, n_g is refractive index of glass of prism

For prism $P_1 = \delta_1 = (n_{g_1} - 1)A_1$

For prism $P_2 = \delta_2 = (n_{g_2} - 1)A_2$

For no deviation, $\delta_1 = \delta_2$

$$(n_{g_1} - 1)A_1 = (n_{g_2} - 1)A_2$$

$$A_2 = \frac{(n_{g_1} - 1)}{(n_{g_2} - 1)}A_1$$

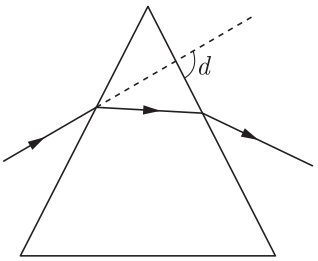
$$= \frac{(1.54 - 1)}{(1.92 - 1)} \times 4^\circ \qquad \begin{bmatrix} n_{g_1} = 1.54, \\ n_{g_2} = 1.92 \\ A_1 = 4^\circ \end{bmatrix}$$

$$A_2 = 2.3^\circ$$

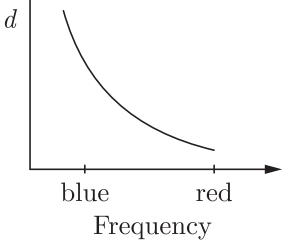
15. At the moment dew formation starts on a cool night, the air
(a) Must loose all water vapour
(b) Must remain unsaturated
(c) Must get mixed up with some ot
(d) Must become saturated

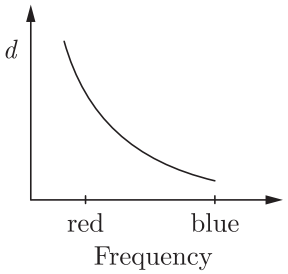
Ans : (d) Must become saturated

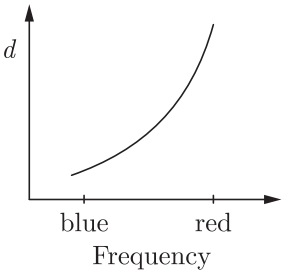
16. Light rays are deviated by a prism



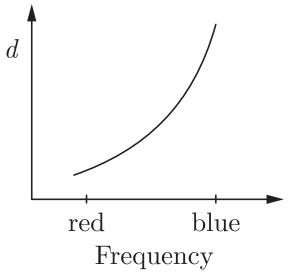
The deviation angle d is measured for light rays of different frequency, including blue light and red light. Which graph is correct?

(a)


(b)


(c)


(d)



Ans : (d)

When a white light passes through a prism, it disperses into its component colours i.e. VIBGYOR. Since, blue colour refracts the most, its angle of deviation would be greater than for red colour. Also, the frequency of blue colour is greater than that of the red colour.

17. A glass slab is placed over a page on which the word VIBGYOR is printed with each letter in corresponding colour. Then, which of the following is correct?

(a) The images of all the letters will be in the same place as that on paper

(b) Letter V is raised more

(c) Letter R is raised more

(d) None of the above

Ans : (b) Letter V is raised more

The image of all the letters are not in the same place as each colour have different wavelength. The letter V for violet is raised more because its wavelength is least.

18. 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

Ans : (b) Dispersion of sun light from water drops

19. Which amongst the given radiation is preferred for taking photographs in fog?

(a) Ordinary visible light (b) Infrared

(c) Microwave (d) X-rays

Ans : (b) Infrared

Infrared radiations are used for photography in fog, because they are not much scattered by mist or fog and can penetrate through fog, so photography can be done easily.

20. A near sighted person cannot see distinctly beyond 50 cm 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

Ans : (d) -2

21. 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

Ans : (b) Spherical aberration

22. A person cannot see objects clearly which are nearer than 75 cms from his eyes, the disease he suffering from is

(a) Astigmatism (b) Myopia

(c) Hypermetropia (d) Presbyopia

Ans : (c) Hypermetropia

23. 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

Ans : (d) Certain elements present in the sun interfere

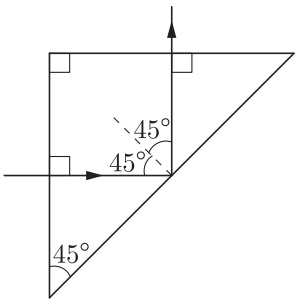
24. When a mirror is rotated an angle the reflected ray moves through double that angle, the instrument based on the above principle is

(a) Periscope (b) Odometer

(c) Refractometer (d) Sextant

Ans : (d) Sextant

25. A light ray is incident perpendicularly to one face of a 90° prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 45°, we conclude that the refractive index



(a) $n > \frac{1}{\sqrt{2}}$ (b) $n > \sqrt{2}$

(c) $n < \frac{1}{\sqrt{2}}$ (d) $n < \sqrt{2}$

Ans : (b) $n > \sqrt{2}$

The incident angle is 45° incident angle>critical angle, $i > i_c$

$\sin i > \sin i_c$ or $\sin 45 > \sin i_c$

$$\sin i_c = \frac{1}{n}$$

$$\sin 45^\circ > \frac{1}{n}$$

or $$\frac{1}{\sqrt{2}} > \frac{1}{n}$$

$$n > \sqrt{2}$$

26. The splitting of white light into several colours on passing through a glass prism is due to

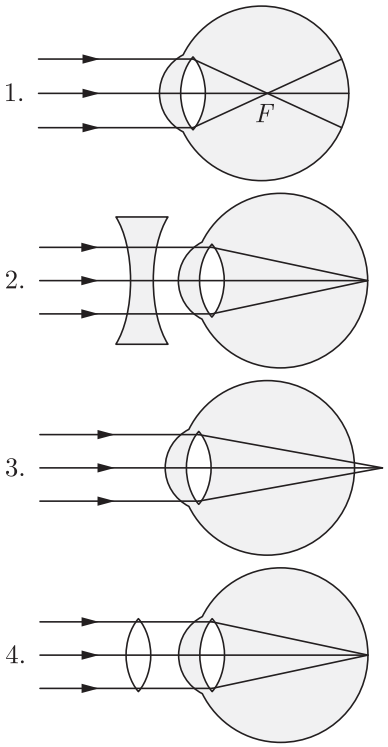
(a) refraction (b) reflection

(c) interference (d) diffraction

Ans : (a) refraction

Dispersion arises because of basic phenomenon refraction.

27.



Identify the wrong description of the above figures
(a) 1 represents far-sightedness
(b) 2 correction for short sightedness
(c) 3 represents far sightedness
(d) 4 correction for far-sightedness

Ans : (a) 1 represents far-sightedness

28. 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.

Ans : (a) Scattering due to dust particles and air molecules causes this phenomenon

29. The size of the pupil of the eye is adjusted by
(a) cornea (b) retina
(c) iris (d) blind spot

Ans : (c) iris

Iris is a dark muscular diaphragam that controls the size of the pupil.

30. 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.

Ans : (b) Deviated and dispersed

31. 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

Ans : (b) black

32. To get line spectrum, the substances are excited in their
(a) solid state (b) molecular state
(c) gaseous state (d) atomic state

Ans : (d) atomic state

33. 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

Ans : (c) 6×10^{14} cycles per second

2. FILL IN THE BLANK

1. The closest distance at which the eye can focus clearly is called the .....

Ans : Near point

2. For a normal eye, the range of vision is from .....

Ans : 25 cm to infinity

3. ..... regulates and controls the amount of light entering the eye.

Ans : Pupil

4. For young adult with normal vision, least distance of distinct vision = ...

Ans : 25 cm.

5. ..... is a dark muscular diaphragm that controls the size of the pupil

Ans : Iris

6. The splitting of white light into its component colours is called .....

Ans : Dispersion

7. The eye which suffers from myopia as well as from hypermetropia is said to suffer from .....

Ans : Presbyopia

8. The eye which cannot simultaneously see with the same distinctness all objects or lines making different inclinations is said to suffer from .....

Ans : Astigmatism.

9. The defect of the eye due to which a person is unable to distinguish between certain colours, known as .....

Ans : Colour blindness

10. The coloured diaphragm between the cornea and the lens is .....
Ans : Iris

11. The ability of the eye to focus both near and distant objects, by adjusting its focal length, is called the .....
Ans : Accommodation of the eye.

12. The smallest distance, at which the eye can see objects clearly without strain, is called the ..... of the eye.
Ans : Near point

13. Phenomenon of splitting of white light into its constituent colours is .....
Ans : dispersion

14. Light enters the eye through a thin membrane called as .....
Ans : cornea

15. The middle point of the iris has a hole, which is called .....
Ans : Pupil

16. The screen on which the image is formed by the lens system of the human eye is called .....
Ans : Retina

17. ..... is the ability of the eye to adjust its focal length.
Ans : Accommodation of eye

18. ..... is the inside surface of the rear part of the eyeball where the light entering the eye is focused.
Ans : Retina

19. .....causes the blue colour of sky and the reddening of the Sun at sunrise and sunset.
Ans : Scattering of light

20. Sunlight comprises ..... colours.
Ans : 7

3. TRUE/FALSE

1. Lens which is used for correcting the presbyopia defect of the eye is concave.
Ans : False

2. The sun is visible two minutes before the actual sunrise due to atmospheric refraction.
Ans : True

3. To see an object comfortably and distinctly, you must hold it at about 25 cm from the eyes.
Ans : True

4. The colour of the scattered light does not depend on the size of the scattering particles.
Ans : False

5. Hypermetropia is corrected by using a convex lens of suitable power.
Ans : True

6. The part of human eye that determines the colour of a person's eye is known as cornea.
Ans : False

7. The colour that deviates maximum while passing through a glass prism is violet.
Ans : True

8. Danger signal lights are red in colour.
Ans : True

9. Water droplets act as tiny prism in the formation of rainbow.
Ans : True

10. Te transparent spherical membrane covering the front of the eye is known as cornea.
Ans : True

11. The eye which can see near object clearly is said to suffer from hypermetropia.
Ans : False

12. The eye which cannot see distant objects clearly is said to suffer from myopia.
Ans : True

13. Colour blindness is a genetic disorder which occurs by inheritance.
Ans : True

14. The sun looks red at sunset because most of the blue light in sunrays is scattered leaving behind red yellow lights.
Ans : True

15. Clouds look white because water droplets of clouds scatter all colours of light equally.
Ans : True

16. A person suffering from myopia cannot see distant objects clearly.
Ans : True

17. The focal length of a given lens depends on the surrounding medium.
Ans : True

18. The angle between incident ray and emergent ray is called angle of deviation.
Ans : True

19. In Myopia the image of distant objects is focussed before the retina.

Ans : True

20. A dentist uses a convex mirror to view the inner parts of a patient's mouth.

Ans : False

21. the solar spectrum in general is an absorption spectrum.

Ans : True

4. MATCHING QUESTIONS

DIRECTION : 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.

1.

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

Ans : A-s, B-r, p, C-q, D-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)	Hyper-metropia	(q)	Concave lens
(C)	Astigmatism	(r)	Cylindrical lens
(D)	Presbyopia	(s)	Bi-focal lens

Ans : A-q, B-p, C-r, D-s

3.

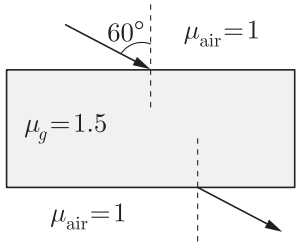
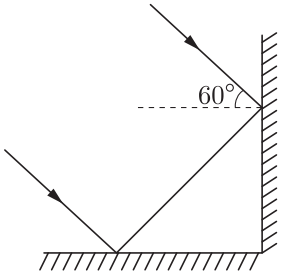
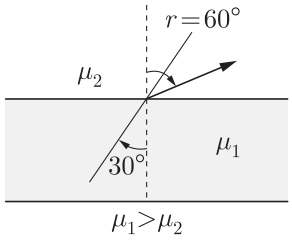
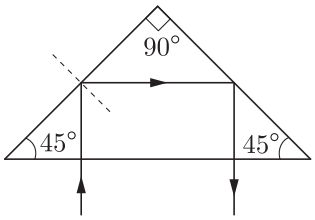
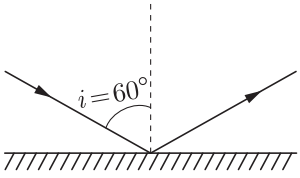
Column I		Column II	
(A)	Spectrometer	(p)	Refraction
(B)	Mirage	(q)	Deviation without dispersion
(C)	Hollow prism	(r)	To measure angle of prism
(D)	glass slab	(s)	To measure the dispersion

Column I		Column II	
		(t)	Dispersion without deviation

	A	B	C	D
(a)	s, r	r, p	q	q
(b)	s	p	q	r, t
(c)	p, q	s	r, s, t	q
(d)	q, s	q, r	s	s, t

Ans : (a) A-s, r, B-r, p, C-q, D-q

4. Angle of deviation is given in **Column-I** and ray diagram for angle of deviation in **Column -II**

Column I		Column II	
(A)	60°	(p)	
(B)	0°	(q)	
(C)	180°	(r)	
(D)	30°	(s)	
		(t)	

	A	B	C	D
(a)	t	p	q, s	r
(b)	r	t	q	r, t

	A	B	C	D
(c)	p, s	q	r, s, t	r
(d)	p	q, r	s	s, t

Ans : (a) A-t, B-p, C- q, s, D-r

A-t: The angle of deviation,

$$\delta = 180^\circ - 2i$$
$$= 180^\circ - 2 \times 60^\circ = 60^\circ$$

B-p: Glass slab produces no deviation and so $\delta = 0$.
C-q, s: Deviation in both the cases are 180°

D-r: $\delta = 60^\circ - 30^\circ = 30^\circ$

5. ASSERTION AND REASON

DIRECTION : In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.
(e) Both Assertion and Reason are false.

1. **Assertion :** Blue colour of sky appears due to scattering of blue colour.
Reason : Blue colour has shortest wave length in visible spectrum.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

During the day time, sky appears blue. This is because the size of the particles in the atmosphere is smaller than the wavelength of visible light, so they scatter the light of shorter wavelengths. The scatter blue light enters our eye.

2. **Assertion :** Hypermetropia is the defect of the eye in which only farther objects are seen.
Reason : Hypermetropia is corrected by using converging lens.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

3. **Assertion :** The focal length of the objective lens of the telescope is larger than that of eyepiece.
Reason : The resolving power of telescope increase when the aperture of objective lens is small.
Ans : (c) Assertion (A) is true but reason (R) is false.

The magnifying power of telescope is $m = \frac{f_0}{f_e}$. So, for high magnification, the focal length of objective lens should be larger than eyepiece.

Resolving power of a telescope $= \frac{d}{1.22\lambda}$. For high resolving power, diameter (d) of objective should be higher.

4. **Assertion :** The focal length of the mirror is f and distance of the object from the focus is u. The magnification of the mirror is $\frac{f}{u}$.
Reason : Magnification $= +\frac{\text{Size of image}}{\text{Size of object}}$
Ans : (d) Assertion (A) is false but reason (R) is true.

Magnification produced by mirror,

$$m = \frac{I}{O} = \frac{f}{f-u} = \frac{f}{x}.$$

Where, x is distance from focus.

and $$m = \frac{\text{Size of image (I)}}{\text{Size of object (O)}}$$

5. **Assertion :** Light from a distant object arriving at the eye lens may get converged at a point in front of the retina.
Reason : The eye is producing too much divergence in the incident beam.
Ans : (c) Assertion (A) is true but reason (R) is false.

The light from a distant object arriving at the eye lens may get converged at a point in front of the retina. This type of defect is called near-sightedness or myopia. This means that the eye is producing too much convergence in the incident beam.

6. **Assertion :** Thin prisms do not deviate light much.
Reason : Thin prism have small angle A and hence, $D_m = [(\mu - 1)A]$, where μ is the refractive index of prism w.r.t. medium 1.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

For thin prism, angle of prisms A is small.
For small A, D_{min} (minimum deviation) is also small.

So, $$\mu = \frac{\sin\left(\frac{A + D_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)} \quad ...(i)$$

$$\sin\left(\frac{A + D_{min}}{2}\right) \approx \frac{A + D_{min}}{2}$$
$(\sin\theta \approx \theta$ for small $\theta)$

and $$\sin\frac{A}{2} \approx \frac{A}{2}$$

Using above approximation, in equation (i)

$$\mu = \frac{A + D_{min}}{\frac{2}{A/2}}$$
$$D_{min} = (\mu - 1)A$$

Hence, it can be seen that if A is small, D_{min} is also small.

7. **Assertion :** Myopia is due to the increased converging power of the eye lens.
Reason : Myopia can be corrected by using spectacles made from concave lenses.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

In Myopia eye due to the increased converging power

of eye lens, the image of a far off object is formed in front of the retina.
Myopia can be corrected by using spectacles made from concave lens.

8. **Assertion :** The light of violet colour deviates the most and the light of red colour the least, while passing through a prism.
Reason : For a prism material, refractive index is highest for red light and lowest for the violet light.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

The light of violet colour deviates most and the light of red colour the least, while passing through a prism. For a prism material refractive index is highest for violet light and lowest for the red light.

9. **Assertion :** Myopia is the defect of the eye in which only nearer objects are seen by the eye.
Reason : The eye ball is elongated.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

10. **Assertion :** Secondary rainbow is fainter than primary rainbow.
Reason : Secondary rainbow formation is three step process and hence, the intensity of light is reduced at the second reflection inside the rain drop.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Primary rainbow is a result of three-step process.
1. Refraction at the first surface of raindrop.
2. Total internal reflection from the second surface of raindrop.
3. Again refraction from the first surface of raindrop from where the light finally emerges out. The intensity of light is reduced at the second reflection and hence, the secondary rainbow is fainter than the primary rainbow.

11. **Assertion :** The stars twinkle while the planet do not.
Reason : The stars are much bigger in size than the planets.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

As planets are of larger size than stars and much closer to the earth, planets can be considered as a collection of large number of point sized sources of light. The total variation in the amount of light entering our eye from all these individual point sized sources will average out to zero which nullify the twinkling effect of each other. Therefore, planets do not twinkle.

12. **Assertion :** There exists two angles of incidence for the same magnitude of deviation (except minimum deviation) by a prism kept in air.
Reason : In a prism kept in air, a ray is incident on first surface and emerges out of second surface. Now if another ray is incident on second surface (of prism) along the previous emergent ray, then this ray emerges out of first surface along the previous incident ray. This particle is called principle of reversibility of light.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

13. **Assertion :** A normal human eye can clearly see all the objects beyond certain minimum distance.
Reason : The human eye has capacity of adjusting the focal length of eye lens.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

14. **Assertion :** A white light on passing through prism splits into its component colours as such that the red light emerges nearest to the base of the prism.
Reason : Wavelength of red light is more than other component colours and hence, red light deviates least.
Ans : (d) Assertion (A) is false but reason (R) is true.

Dispersion takes place because the refractive index of medium for different wavelengths (colours) is different. The refractive index is inversely proportion to λ by Cauchy's expression as

$$\mu(\lambda) = r + \frac{d}{\lambda^2} + \frac{c}{\lambda^4}$$

Hence, deviation$(D) = (\mu - 1)A$
Since λ_{red} is more than other colours wavelength. So, deviation is least for red and it appears farthest from the base of the prism.

15. **Assertion :** A rainbow is sometimes seen in the sky in rainy season only when observer's back is towards the sun.
Reason : Internal reflection in the water droplets cause dispersion and the final rays are in backward direction.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

16. **Assertion :** Rainbow is an example of the dispersion of sunlight by the water droplets.
Reason : Light of shorter wavelength is scattered much more than light of larger wavelength.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

17. **Assertion :** When we see an object, the image formed On the retina is real and inverted.
Reason : If the magnification of a system is less than one, then the image formed is inverted.
Ans : (c) Assertion (A) is true but reason (R) is false.

The image formed on retina is real and inverted. If magnification is less than 1, then diminished images is formed not inverted.

18. **Assertion :** A normal human eye can clearly see all the objects beyond a certain minimum distance.
Reason : The human eye has the capacity to adjust

suitable the focal length of its lens to a certain extent.

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

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

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

20. **Assertion :** The optical instruments are used to increase the size of the image of the object.
Reason : The optical instruments are used increase the visual angle.

Ans : (d) Assertion (A) is false but reason (R) is true.

21. **Assertion :** The resolving power of a telescope is more if the diameter of the objective lens is more.
Reason : Objective lens of large diameter coileds more light.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

$RP \propto$ diameter of objective.

22. **Assertion :** The optical instruments are used to increase the size of the image of the object.
Reason : The optical instruments are used to increase the visual angle.

Ans : (d) Assertion (A) is false but reason (R) is true.

Optical instruments do not increase the size of the image of the object. It depends upon the distance between the object and objective lens.

23. **Assertion :** Danger signals are made of red colour.
Reason : Velocity of red light in air is maximum, so signals are visible even in dark.

Ans : (c) Assertion (A) is true but reason (R) is false.

24. **Assertion :** Sunlight reaches us without dispersion in the form of white light and not as its components.
Reason : Dispersion takes place due to variation of refractive index for different wavelength but in vacuum the speed of light is independent of wavelength and hence vacuum is a non-dispersive medium.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

In vacuum speed of light is independent of wavelength, Hence, no dispersion takes places in vacuum. Thus, vacuum is a non-dispersive medium in which all colours travel with the same speed.

25. **Assertion :** In case of rainbow, light at the inner surface of the water drop gets internally reflected.
Reason : The angle between the refracted ray and normal to the drop surface is greater than the critircal angle.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

The rainbow is formed when light at the inner surface of the water drop gets internally reflected if the angle between the refracted ray and normal to the drop surface is greater than the critical angle.

26. **Assertion :** The sky looks dark and black instead of blue in outer space.
Reason : No atmosphere containing air in the outer space to scatter sunlight.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).