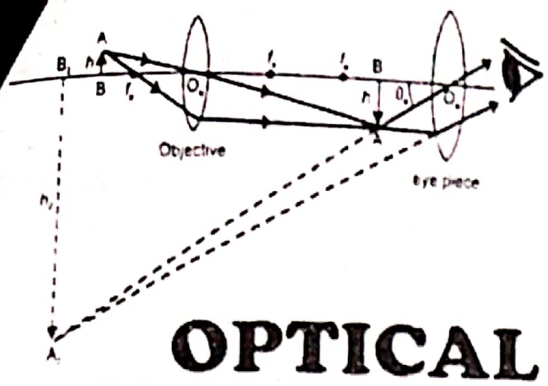


Chapter 10

OPTICAL INSTRUMENTS

KEY POINTS

Least Distance:

- Least distance of distinct vision is the minimum distance from the eye at which an object appear to be distinct.

Magnification:

- Magnification is the ratio of the size of the image to the size of the object, or the ratio of the distance of the image to the distance of the object from the lens or mirror.

$$M = \frac{q}{p} = \frac{I}{O}$$

Magnifying Power or Angular Magnification:

- Magnifying power or angular magnifying is defined as the ratio of the angles subtended by the image as seen through the optical device to that subtended by the object at the unaided eye.

$$M = \frac{\beta}{\alpha}$$

Resolving Power:

- Resolving power is the ability of an instrument to reveal the minor details of the object under examination.

$$R = \frac{D}{1.22\lambda}$$

Simple Microscope:

- Simple microscope is in fact a convex lens used to help the eye to see small objects distinctly. The magnifying power of a simple microscope is given by

$$M = \frac{d}{p} = 1 + \frac{d}{f}$$

Compound Microscope:

- Compound microscope consists of two convex lenses, an objective lens of very short focal length and eye piece of moderate focal length. The magnifying power of a compound microscope is given by

$$M = \frac{q}{p}\left(1 + \frac{d}{f_e}\right)$$

Telescope:

- Telescope is an optical instrument used to see distant objects. The magnifying power of the telescope is given by

$$M = \frac{f_o}{f_e}$$

Length of telescope = $L = f_o + f_e$

Spectrometer:

- Spectrometer is an optical device used to study spectra from different sources of light.

Parts of spectrometer

(1) Collimator
(2) Turn Table
(3) Telescope

Index of Refraction:

- Index of refraction is the ratio of speed of light in vacuum to the speed of light in the material. Mathematically $n = \frac{c}{v}$

Critical Angle:

- Critical angle is the angle of incidence in the denser medium for which the angle of refraction in the rare medium is equal to 90^o.

Total Internal Reflection:

- When the angle of incidence becomes greater than the critical angle of that material, the incident ray is reflected in the same material, which is called total internal reflection.

Cladding:

Cladding is a layer of lower refractive index (less density) over the central core of high refractive index (high density).

Multi Mode Step Index Fibre:

Multi mode step index fibre is an optical fibre which contains a layer of lower refractive index over the central core of high refractive index.

Multi Mode Graded Index Fibre:

Multi mode graded index fibre is an optical fibre in which the central core has high refractive index and its density gradually decreases towards its periphery.

TOPICAL MULTIPLE CHOICE QUESTIONS

Topic 10.1:

Least Distance of Distinct Vision

(1) **The minimum distance from the eye at which an object appears to be distinct is called**
(a) infinite point
(b) least distance of fuzzy vision
(c) least distance of distinct vision
(d) none of these

(2) **The least distance of distinct vision for the normal eye is**
(a) 25cm
(b) 2.5cm
(c) 15cm
(d) 20cm

(3) **The focal length of a normal eye-lens is about**
(a) 1mm
(b) 2cm
(c) 25cm
(d) 1m

(4) **Optical instruments are based on the principle of**
(a) diffraction and interference
(b) interference and dispersion
(c) reflection and refraction
(d) all of the above

(5) **The least distance of distinct vision**
(a) decreases with age
(b) increases with age
(c) no change
(d) none of these

Topic 10.2:

Magnifying Power and Resolving Power of Optical Instruments:

(6) **The ratio of the angles subtended by the image as seen through the optical device to that subtended by the object at the unaided eye is called**
(a) linear magnification
(b) least distance of distinct vision
(c) angular magnification
(d) near point

(7) **The power of lens is measured in**
(a) joule
(b) diopter
(c) watt
(d) meters

(8) **Unit of magnification**
(a) meter
(b) diopter
(c) cm
(d) no unit

(9) **To increase the resolving power of lens**
(a) increase λ and D
(b) increase λ and decrease D
(c) decrease λ and increase D
(d) decrease λ and D

(10) **The resolving power of diffraction grating is defined as**
(a) $\frac{\lambda}{\Delta\lambda}$
(b) $\frac{\Delta\lambda}{\lambda}$
(c) $\frac{\lambda_1-\lambda_2}{\lambda}$
(d) $\frac{\lambda_2-\lambda_1}{\Delta\lambda}$

(11) **The ratio of the size of the image to the size of object is called**
(a) magnification
(b)angular magnification
(c) classification
(d) linear classification

(12) **When an object is viewed at a shorter distance, the image on the retina of the eye is**
(a) smaller
(b) greater
(c) unchanged
(d) remain same

(13) The resolving power of an optical instrument can be expressed

(a) $R = \frac{1}{\alpha_{min}}$ (b) $R = \alpha_{max}$

(c) $R = \alpha_{res}$ (d) $R = \alpha$

(14) Raleigh showed that for light of wavelength λ through the lens of diameter D, the reciprocal of resolving power (1/R) is given by

(a) $R = \frac{1.22\lambda}{D}$ (b) $R = \frac{D}{1.22\lambda}$

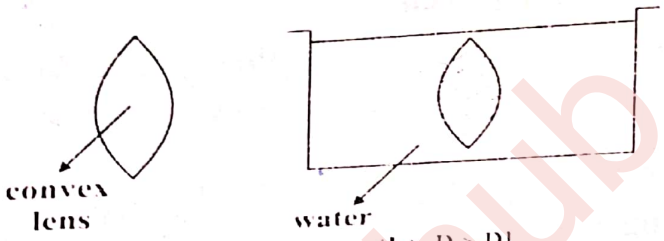
(c) $R = 1.22\lambda D$ (d) $R = \frac{1.22}{D\lambda}$

(15) Magnification of a lens is negative when the image is

(a) real and inverted (b) real and erected

(c) virtual and inverted (d) virtual and erect

(16) A convex lens is shown in the figure. This convex lens has a power "P" such that it is dipped into a beaker filled with water. How would this emersion will change the power of lens?



(a) $P_1 = P_2$ (b) $P_1 > P_2$

(c) $P_1 < P_2$ (d) $P_1 = 2P_2$

(17) When the image is real and inverted the magnification of the lens is

(a) positive (b) neutral

(c) negative (d) virtual

(18) The smaller value of α_{min} _____ is the resolving power.

(a) smaller (b) greater

(c) zero (d) none of these

(19) The minimum distance between an object and its real image in a convex lens is

(a) f (b) 2f

(c) 4f (d) 3f

(20) How will the image formed by a convex lens be affected, if the central portion of the lens is wrapped in black paper, as shown in the figure?

(a) no image will be formed

(b) full image will be formed but it is less bright

(c) full image will be formed but without the central portion

(d) two images will be formed. one due to each exposed half

Topic 10.3:

Simple Microscope

(21) The magnifying power of a simple microscope is

(a) $M = 1 + \frac{f}{d}$ (b) $M = 1 + \frac{d}{f}$

(c) $M = 1 + \frac{1}{f}$ (d) $M = 1 + df$

22) Watch makers uses

(a) convex lens (b) concave lens

(c) plano-concave lens (d) mirror

(13) The resolving power of an optical instr...

(a) $R = \frac{1}{\alpha_{min}}$ (b) $R = \alpha_{max}$

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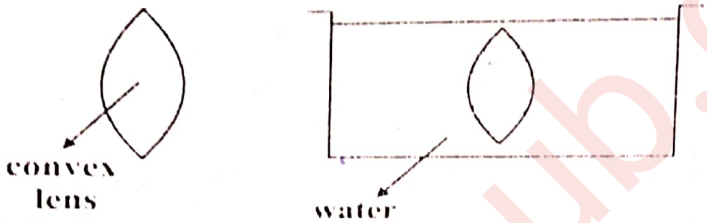

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22) Watch makers uses

(a) convex lens (b) concave lens

(c) plano-concave lens (d) mirror

(23) How should people wearing their spectacles work with a microscope?
(a) they should keep on wearing their spectacles
(b) they should take off their spectacles
(c) they may either put on their spectacles
(d) they cannt use the microscope at all

(24) If the image is at the least distance of the distinct vision then
(a) q = d
(b) q = 1/d
(c) 1/q = d
(d) qd = 1

(25) The image is formed at 2f when the object is placed
(a) behind 2f
(b) at f
(c) between f and 2f
(d) at 2f

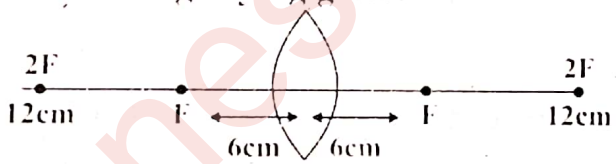
(26) If the object is 5mm high and image is 2cm high then the magnification is
(a) 4
(b) 1
(c) 2
(d) 10

(27) For a lens of high magnification the focal length should be
(a) large
(b) small
(c) of any size
(d) none of these

(28) If f = 5cm then the magnification of the simple microscope will be
(a) M = 4
(b) M = 6
(c) M = 5
(d) M = 2

(29) If the focal length of the convex lens is 10cm then its magnifying power is
(a) 4.3
(b) 3.5
(c) 9.5
(d) 11

(30) A convex lens is shown in the figure. At what distance an object must be placed so that convex lens become a magnifying glass?



(a) P=6cm
(b) 6cm<P<12cm
(c) P=12cm
(d) P<6cm

(31) When beam of white light falls perpendicularly on a plane of glass then the angle of refraction will be
(a) 90^0
(b) 60^0
(c) zero
(d) 180^0

Topic 10.4

Compound Microscope

(32) The focal length of the objective used in compound microscope
(a) large
(b) small
(c) same as eyepiece
(d) none of these

(33) The magnifying power of compound microscope

(a) $M = \frac{q}{p}(1 + df_e)$

(b) $M = \frac{q}{p}\left(1 + \frac{d}{f_e}\right)$

(c) $M = \frac{q}{p}\left(1 + \frac{f_e}{d}\right)$

(d) $M = \frac{p}{q}\left(1 + \frac{d}{f_e}\right)$

(34) **The image formed by the eyepiece of compound microscope is**
(a) real and inverted (b) real and erect
(c) virtual and erect (d) virtual and inverted

(35) **The resolving power of a compound microscope depends upon**
(a) the refractive index of the medium in which object is placed
(b) diameter of eyepiece
(c) width of objective lens
(d) nature of lens

(36) **The angular magnification of the compound microscope defined by**
(a) $\frac{\tan\theta_o}{\tan\theta_e}$ (b) $\frac{\tan\theta_e}{\tan\theta_o}$
(c) $\tan\theta_e \times \tan\theta_o$ (d) $\frac{1}{\tan\theta_e \times \tan\theta_o}$

(37) **For higher magnification which of the following instrument is used**
(a) optical fiber (b) compound microscope
(c) collimator (d) LED

(38) **The diverging lens of compound microscope is**
(a) eyepiece (b) objective
(c) eye (d) none of these

(39) **The magnifying power of compound microscope is given by the relation**
(a) $M_o - M_e$ (b) $M_o \times M_e$
(c) $M_o + M_e$ (d) M_o/M_e

(40) **The magnification of two lenses of compound microscope are 2 and 5 then magnifying power of microscope is**
(a) 7 (b) 3
(c) 10 (d) 20

(41) **The compound microscope is based on the principle of**
(a) reflection (b) refraction
(c) both a & b (d) none of these

Topic 10.5:

Astronomical Telescope

(42) **A fly is sitting on the objective of a telescope pointed towards the moon. What effect is expected in a photograph of the moon taken through the telescope?**
(a) the entire field of view is blocked
(b) there is an image of the fly on the photographs
(c) there is no effect at all
(d) there is a reduction in the intensity of the image

(43) **The final image seen from the astronomical telescope**
(a) real, erect and enlarge (b) real, inverted and enlarge
(c) virtual, inverted and enlarge (d) virtual, erect and enlarge

(44) **In astronomical telescope the image formed by eyepiece is**
(a) real (b) virtual
(c) neither real nor virtual (d) none of these

(45) **You are supplied with four convex lenses of focal lengths 100cm, 25cm, 3cm and 2cm. For designing of an astronomical telescope, you will use lenses of focal lengths.**
(a) 100cm and 25cm (b) 100cm and 3cm
(c) 25cm and 2cm (d) 100cm and 2cm

(46) The rays after refraction through the eye piece will become parallel and the final image appears to be formed at
(a) f (b) 2f
(c) between f and 2f (d) infinity

(47) The resolving power of an astronomical telescope depends on
(a) the focal length of the objective lens
(b) the least distance of distinct vision of the observer
(c) the focal length of the eyepiece
(d) the diameter of the objective lens

(48) For normal adjustment the distance between the objective and eye-piece of a telescope is
(a) $f_o + f_e$ (b) $f_o - f_e$
(c) $f_e - f_o$ (d) none of these

(49) In simple astronomical telescope the focal length of objective is
(a) less than eyepiece (b) greater than eye piece
(c) equal to eyepiece (d) none of these

(50) In astronomical telescope, if the focal lengths of objective and eye piece is 35 cm and 5cm respectively, then its length for normal adjustment is
(a) 40cm (b) 35cm
(c) 4.5cm (d) 3.5cm

(51) An astronomical telescope in normal adjustment has a converging eye-piece of focal length 5cm separated by 85cm from the objective lens of focal length "f_o"..Which one of the following pairs correctly gives the position of the image and the value of f_o?
(a) 90cm from the eye 80cm
(b) infinity 80cm
(c) infinity 90cm
(d) least distance of distinct vision 80cm

Topic 10.6:

Spectrometer

(52) An optical device used to study spectra from different sources of light is called
(a) micrometer (b) spectrometer
(c) collimator (d) telescope

(53) Spectrometer consists of
(a) four parts (b) three parts
(c) five parts (d) two parts

(54) In spectrometer the function of collimator is to produce
(a) parallel beam of light (b) converging beam of light
(c) diverging beam of light (d) all of these

(55) A fixed metallic tube with a convex lens at one end of the spectrometer is called
(a) telescope (b) microscope
(c) collimator (d) periscope

(56) The grating placed on the turn table which is capable of rotating about
(a) horizontal axis (b) vertical axis
(c) both a & b (d) in all direction

(57) A circular scale of the spectrometer, graduated in
(a) 180^0 (b) 90^0
(c) half degree (d) 360^0

Topic 10.7:

Speed of Light

(58) **Who was the first person to make attempt to measure the speed of light**

(a) Michelson (b) Galileo
(c) Einstein (d) Newton

(59) **The speed of light in materials other than vacuum is always**

(a) greater than c (b) less than c
(c) equal to c (d) none of these

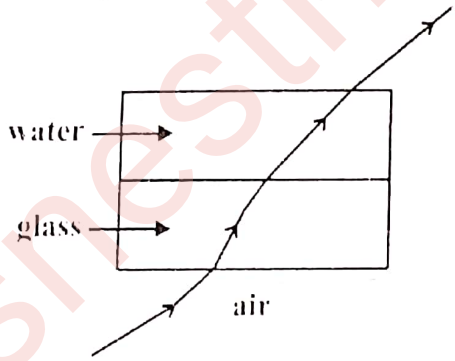
(60) **Michelson's formula for the speed of light is**

(a) $c = \frac{16f}{d}$ (b) $c = \frac{16d}{f}$
(c) $c = 16fd$ (d) $c = \frac{fd}{16}$

(61) **In Michelson's experiment the angle subtended by a side of the eight sided mirror is**

(a) $\frac{\pi}{8}$ (b) $\frac{\pi}{4}$
(c) $\frac{2\pi}{4}$ (d) $\frac{4\pi}{8}$

(62) **A ray of light enters into three different media one after the other air, glass, water as shown in the figure. If V_1 is it speed in air, V_2 in glass and V_3 in water then which of the following is true?**



(a) $V_1 < V_2 < V_3$ (b) $V_1 > V_2 > V_3$
(c) $V_1 > V_2 < V_3$ (d) $V_1 < V_2 > V_3$

(63) **The speed of light in air**

(a) very less than in vacuum (b) very greater than in vacuum
(c) nearly equal to in vacuum (d) zero

(64) **The speed of light in diamond is 1.5 x $10^8 ms^{-1}$ its refractive index w.r.t to air is**

(a) 1 (b) 3
(c) 1.5 (d) 2

Topic 10.8:

Introduction of Fibre Optics

(65) **Information carrying capacity of fibre optics is known as**

(a) semiconductor (b) band length
(c) bandwidth (d) laser

(66) **Photo phone was invented by**

(a) Graham Bell (b) Alexander Fleming
(c) Galileo (d) Abu Ali Sena

(67) **The practical use of services of optical fibre is**
(a) telecommunication (b) word processing
(c) image transmission and receiving equipment (d) all of these

(68) **Which light can travel faster through the optical fibre**
(a) infra red (b) ultraviolet
(c) visible (d) none of these

(69) **The component of the fibre optic communication system is**
(a) transmitter (b) an optical fibre
(c) receiver (d) all of these

(70) **The most common method of modulation is called**
(a) frequency modulation (b) fractional modulation
(c) digital modulation (d) all of these

(71) **Characteristic of optical fibre is**
(a) much thinner (b) light weight
(c) extremely wide bandwidth (d) all of these

(72) **The light source used as transmitter in communication system is**
(a) LED (b) LDR
(c) photo phone (d) insulator

(73) **Graham Bell was able to transmit a voice message via**
(a) microscope (b) periscope
(c) beam of light (d) telescope

(74) **The detector used in photo phone is made of**
(a) selenium (b) copper
(c) curie (d) aluminum

(75) **With respect to efficiency an optical fibre of diameter 6mm, can replace the bundle of**
(a) copper of 7.62cm (b) aluminum wire of 7.62cm
(c) copper of 6.72cm (d) aluminum wire of 6.34cm

Topic 10.9: Fibre Optic Principles

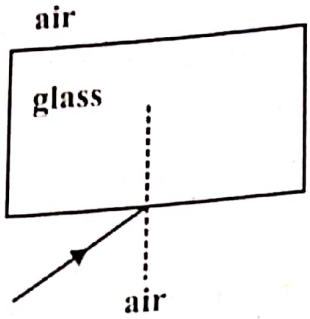
(76) **In fibre optics the signal that travel is**
(a) digital (b) analogue
(c) both a & b (d) none of these

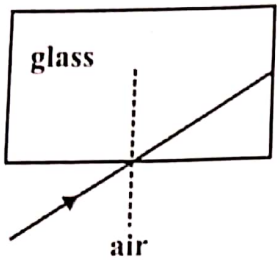
(77) **Snell's law is expressed as**
(a) $\sin\theta_c = \frac{1}{n_2 n_1}$ (b) $n_1 \sin\theta_1 = n_2 \sin\theta_2$
(c) $\frac{n_1 \sin\theta_1}{n_2 \sin\theta_2} = 0$ (d) $\frac{n_2 \sin\theta_2}{n_1 \sin\theta_1} = 0$

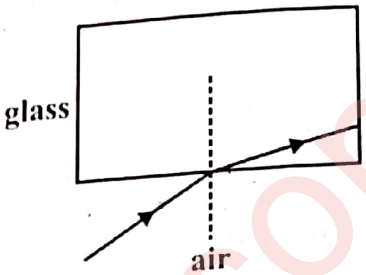
(78) **Optical fibres are of**
(a) 3 types (b) 2 types
(c) 4 types (d) 5 types

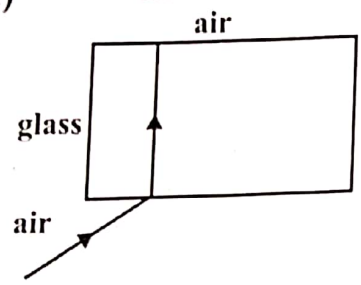
(79) **Cladding is the layer of lower refractive index over central core of**
(a) small refractive index (b) high refractive index
(c) zero refractive index (d) none of these

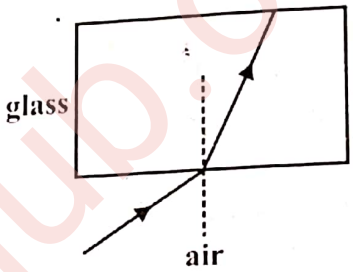
(80) A ray of light enters into a glass slab as shown in the figure from air. Which of the following is its possible path at the air-glass interface?



(a)


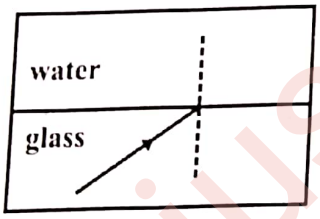
(b)


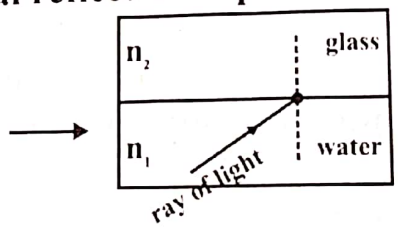
(c)


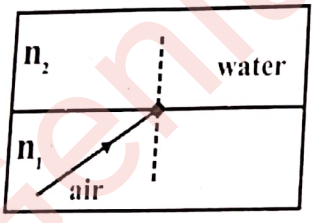
(d)


(81) When the light enters in the glass, there is no change in its
(a) velocity
(b) wavelength
(c) frequency
(d) direction

(82) In which of the following process total internal reflection is possible?

(a)


(b)


(c)


(d) all

(83) For the protection, the optical fibre is covered with
(a) glass jacket
(b) copper jacket
(c) plastic jacket
(d) rubber jacket

(84) When a ray passes through the denser medium to the rare medium the refracting
(a) bends towards the normal
(b) away from the normal
(c) along to the normal
(d) none of these

(85) Now a days, a new type of optical fibre is used in which the central core has
(a) high density
(b) low density
(c) low refractive index
(d) zero refractive index

(86) **To obey the phenomenon of total internal reflection, the angle of incidence of ray**
(a) should be greater than critical angle (b) should be less than critical angle
(c)should be equal to critical angle (d) should be zero

(87) **A ray which passes through the rigid rod(glass rod) and parallel to the axis of rigid body is called**
(a) reflected ray (b) axial ray
(c) no-axial ray (d) x-rays

(88) **The optical fibre whose density gradually decreases towards its periphery is called**
(a) single mode step index fibre (b) multimode graded index fibre
(c) multimode step index fibre (d) single graded step index fibre

Topic 10.10: Types of Optical Fibres

(89) **Single mode step index fibre has a very thin core of about _____ diameter.**
(a) 15μm (b) 5 μm
(c) 2 μm (d) 10 μm

(90) **In multi mode graded index fibre the core has the diameter which range from**
(a) 5 to 50 μm (b) 50 to 500 mm
(c) 50 to 1000 cm (d) 50 to 1000 μm

(91) **The number of phone calls carried by single mode index fibre are**
(a) 12000 (b) 15000
(c) 16000 (d) 14000

(92) **In mono mode step index fibre which source is used to send light through it**
(a) dichromatic (b) monochromatic
(c) polychromatic (d) none of these

(93) **Single mode step index fibre can handle**
(a) 10 T.V channels (b) 14 T.V channels
(c) 12 T.V channels (d) 16 T.V channels

(94) **Multi mode graded index fibre has core of relatively**
(a) high density (b) low density
(c) zero density (d) none of these

(95) **In multimode graded index fibre core and cladding has boundary**
(a) noticeably (b) no boundary
(c) no noticeably (d) none of these

(96) **Multimode step index fibre has a core of relatively larger diameter such as**
(a) 25μm (b) 100 μm
(c) 75 μm (d) 50 μm

Topic 10.11: Signal Transmission and Conversion to Sound

(97) **In newer fibre optic communication system repeaters are separated by a distance of**
(a) 20km (b) 30km
(c) 100km (d) 1000km

(98) **The light signals must be regenerated by a device called**
(a) generators (b) repeaters
(c) transmitter (d) transistors

(99) **The digital modulation is expressed in**
(a) bytes (b) bits
(c) codes (d) both a and b

(100) The typical wave length of light emitted by LED is

(a) 1.3μm (b) 2.4 μm

(c) 3.6 μm (d) 1.4μm

Topic 10.12:

Losses of Power

(101) The information received at one end of a fibre can be inaccurate due to _____ of light signals.

(a) dispersion (b) reflection

(c) refraction (d) interference

(102) The disadvantage of the step-index fibre can considerably be reduce by using a

(a) simple fibre (b)step index multi-mode fibre

(c) graded index fibre (d) none of these

(103) Using a graded index fibre, the time difference is reduced about is

(a) 1.3 ns per km (b) 1.2 ns per km

(c) 1.4 ns per km (d) 1 ns per km

(104) With a step-index fibre, the overall time difference may be about

(a) 33 ns km length of fiber (b) 93 ns km length of fiber

(c) 43 ns km length of fiber (d) 23 ns km length of fiber

(105) Loss of power in optical fibre results into

(a) inaccurate information at the services (b) poor reception of signals

(c) delay in time for reception of signals (d) all of these

(106) Due to dispersion effects, white light source is useful for

(a) long distance (b) short distance

(c) very long distance (d) a few kilometer

MULTIPLE CHOICE QUESTIONS

(From Past Papers 2012-2017)

(Federal Board)

(1) **An astronomical telescope having magnifying power of 5 consist of two min lenses 60 cm apart the focal length of the lenses is ___** (FDR 2012)

(a) 50cm, 10cm
(b) 10cm, 50cm
(c) 40cm, 20cm
(d) 30cm, 30cm

(2) **In a multimode step index fiber, density of the optical material decreases from ____.** (FDR 2013)

(a) Edges of core
(b) Core →edges
(c) Even
(d) Multiple

(3) **For incident angles equal to or greater than the critical angle, the glass – air boundary will act as a/an _____.** (FDR 2013)

(a) Mirror
(b) Glass
(c) Water
(d) Air

(4) **The near point of normal human eye is _____** (FDR 2014)

(a) 25m
(b) 250mm
(c) 2.5cm
(d) None of these

(5) **The speed of light in vacuum is** (FDR 2014)

(a) 3×10^{8} cm/sec
(b) 3×10^{10} cm/sec
(c) 3×10^{9} cm/sec
(d) None of these

(6) **The distance between the objective and eye- piece of telescope in normal adjustment is** (FDR 2015)

(a) $f_o + f_e$
(b) $\frac{f_o}{f_e}$
(c) $f_o - f_e$
(d) $\frac{f_e}{f_o}$

(7) Nowadays, a new types of optical fiber is being used in which the central core has high refractive index and its intensity gradually decreases towards its periphery. This type of optical fiber is called (FDR 2015)

(a) single mode step index fiber
(b) multimode step index fiber
(c) multimode graded index fiber
(d) double step index fiber

(8) A converging lens of focal length 'f' is used as a magnifying glass. What is its angular magnification when final image is formed at infinity? Where 'd' is the distance of near point. (FDR 2016)

(a) $\frac{d}{f}$
(b) $\frac{f}{d}$
(c) $1+\frac{d}{f}$
(d) $1+\frac{f}{d}$

(9) When light of wavelength 'λ' is incident on a lens of diameter 'D'. What is the correct expression for its resolving power? (FDR 2016)

(a) $\frac{D}{1.22\lambda}$
(b) $\frac{\lambda}{1.22D}$
(c) $\frac{1.22D}{\lambda}$
(d) $\frac{1.22\lambda}{D}$

(10) Magnification of magnifying glasses is given by: (FDR 2017)

(a) $f+p$
(b) $1+\left(\frac{d}{f}\right)$
(c) $1-\left(\frac{f}{d}\right)$
(d) $1+fd$

(11) Optically active substances are those substances which: (FDR 2017

(a) Produce Polarized light
(b) Produce double refraction
(c) Rotate the plane of polarization of polarized light
(d) Convert a place polarized light into circulatory polarized light

ANSWER KEYS

Multiple Choice Questions

1	c	21	b	41	c	61	b	81	c	101	a								
2	a	22	a	42	a	62	c	82	c	102	a								
3	a	23	a	43	a	63	c	83	a	103	a								
4	a	24	a	44	b	64	d	84	b	104	a								
5	a	25	a	45	a	65	c	85	a	105	d								
6	b	26	a	46	d	66	a	86	a	106	b								
7	b	27	b	47	d	67	b	87	b										
8	a	28	b	48	a	68	a	88	b										
9	b	29	b	49	b	69	d	89	b										
10	a	30	d	50	a	70	c	90	d										
11	a	31	c	51	b	71	d	91	d										
12	b	32	b	52	b	72	a	92	b										
13	a	33	b	53	b	73	c	93	b										
14	a	34	b	54	a	74	a	94	a										
15	d	35	b	55	c	75	a	95	c										
16	b	36	b	56	b	76	a	96	d										
17	a	37	b	57	c	77	b	97	c										
18	b	38	a	58	b	78	a	98	b										
19	c	39	b	59	b	79	b	99	d										
20	b	40	c	60	c	80	d	100	a										

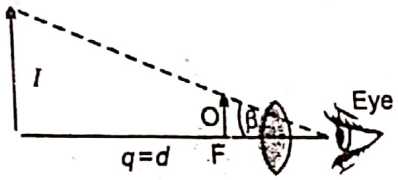
SHORT QUESTIONS
(From Textbook Exercise)

10.1 What do you understand by linear magnification and angular magnification? Explain how a convex lens is used as a magnifier?

Ans: **Linear Magnification:**
The ratio of size of image to the size of object is called linear magnification.
So, M = I/O

Angular Magnification:
The ratio of angle subtended by the image as seen through optical device to that subtended by the object at unaided eye. So, M = β/α

Convex lens as Magnifier:



(b)

When an object is placed with in the principle focus of a convex lens then a highly magnified, virtual and erect image is formed at the same side of the lens.

10.2 Explain the difference between angular magnification and resolving power of an optical instrument. What limits the magnification of an optical instrument?

Ans:

ANGULAR MAGNIFICATION	RESOLVING POWER
• Angular magnification simply increases the apparent size of the image of an object when seen through an optical device. • It can be made as large as we wish by using lenses of suitable focal lengths.	• The resolving power of an optical instrument is its ability to reveal the minor details of an object under examination. • It is the minimum angle between two point sources that allow the images to be resolved as two distinct spots of light rather than one.

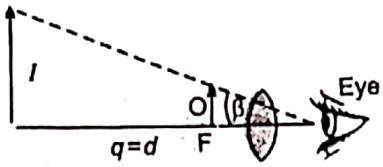
Limited magnification:
Due to spherical and chromatic aberration the magnification of an optical instrument is limited and details of the object cannot be seen clearly. The magnification alone is of no use unless we can see the details of the objects distinctly.

10.3 Why would it be advantageous to use blue light with a compound microscope
Ans: A wider objective and use of blue light of shorter wavelength produces less diffraction and increase its resolving power. Hence, it allows more details to be seen.

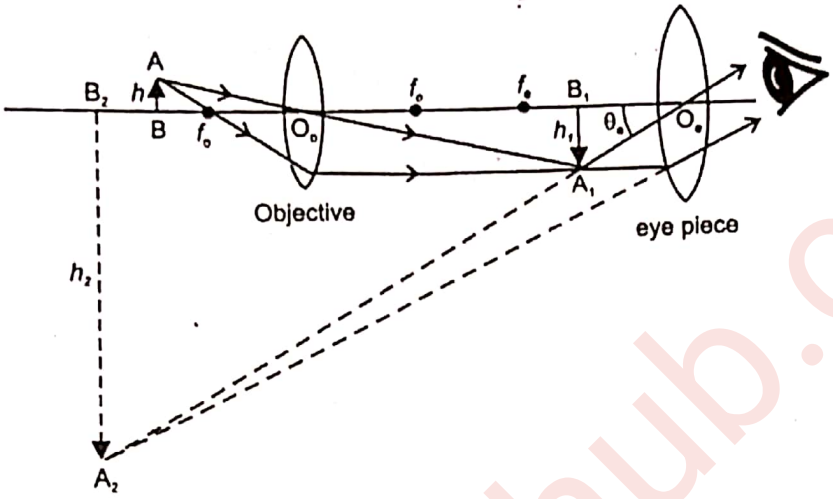
10.4 One can buy a cheap microscope for use by the children. The images seen in such a microscope have coloured edges. Why is this so?
In chromatic aberration, the lens behaves as a prism. When light passes through lens then all wave length are not focused at one point. Due to chromatic aberration of the lens the image seen in cheap microscopes have colored edges.

10.5 Describe with the help of diagrams, how (a) a single biconvex lens can be used as a magnifying glass. (b) biconvex lenses can be arranged to form a microscope.

Ans: **(a)** A biconvex lens can be used as a magnifying glass. The object is placed inside the focal point of the lens as shown in the fig.



(b) Two biconvex lenses are used to form a compound microscope as shown in the figure.



10.6 If a person was looking through a telescope at the full moon, how would the appearance of the moon be changed by covering half of the objective lens.

Ans: If the objective lens is half covered then there is no effect on the size of image but the brightness of the image is reduced. Because intensity of light depends upon diameter of the objective lens.

10.7 A magnifying glass gives a five times enlarged image at distance of 25cm from the lens. Find, by ray diagram, the focal length of the lens.

Ans: M = 5

d = 25 cm

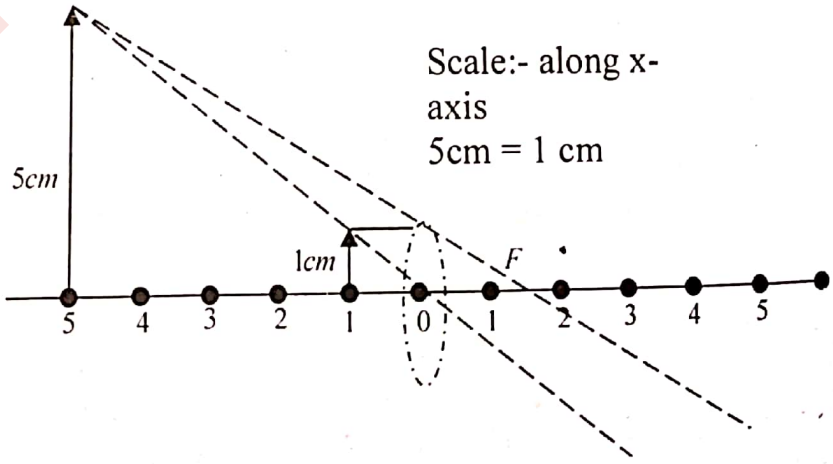
f = ?

$$M = 1 + \frac{d}{f}$$

$$5 = 1 + \frac{25}{f}$$

$$4 = \frac{25}{f}$$

f = 6.25 cm



0.8 Identify the correct answer.

(i) The resolving power of a compound microscope depends on:

(a) Length of the microscope

(b) The diameter of the objective lens.

(c) The diameter of the eye piece.

(d) The position of an observers eye with regard to the eye lens.

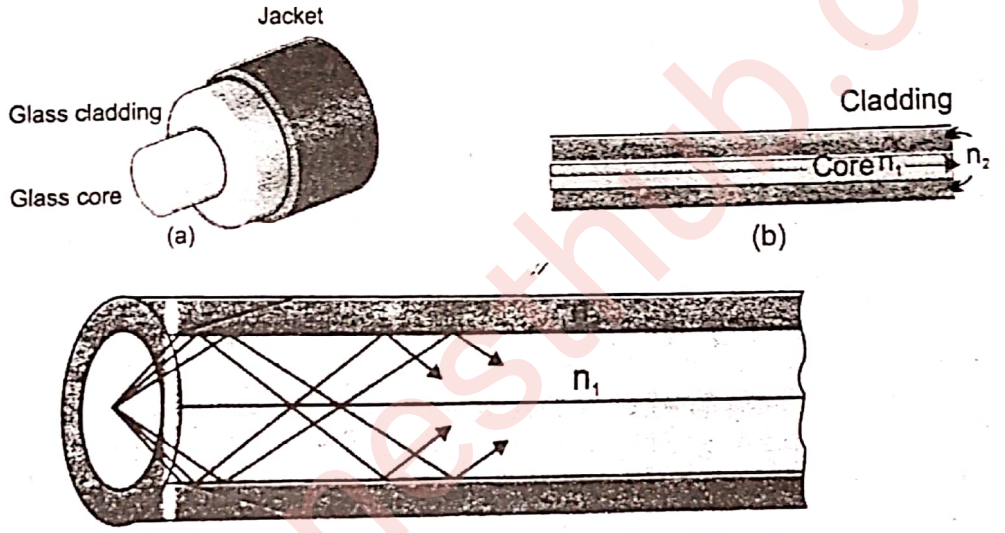
(ii) The resolving power of an astronomical telescope depends on:

(a) The focal length of the objective lens.
(b) The least distance of distinct vision of the observer.
(c) The focal length of the eye lens.
(d) The diameter of the objective lens.

Ans: (i) The statement 'b' is correct.
(ii) The statement 'd' is correct

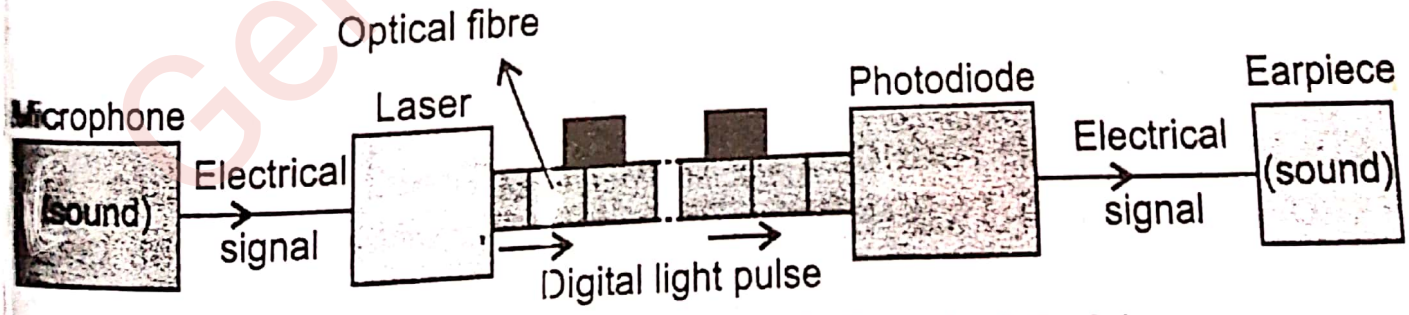
10.9 Draw sketches showing the different light paths through a single – mode and multimode fibre. Why is the single mode fibre preferred in telecommunication.

Ans: Single mode step index fibre has a very thin core of a about 5μm diameter and has relatively larger cladding (of glass or plastic) as shown in fig. It has a very thin core, a strong monochromatic light source i.e, a laser source has to be used to send light signals thought it. It can carry more than 14 TV channels or 14000 phone calls.
Multimode step index fibre has a core of relatively larger diameter such as 50 μ m. It is mostly used for carrying white light but due to dispersion effects, it is useful for a short distance only.



10.10 How the light signal is transmitted through the optical fibre?

Ans: The light signal is transmitted through optical fibre in the form of '1' and '0'. The digit '1' represents presence of light while digit '0' represent the absence of light. Usually light signal is produced by LASER or LED which travels through the fibre in digital form. It is received at other end with the help of a receiver which is generally a photodiode.



10.11 How the power is lost in optical fibre through dispersion? Explain.

Ans: When a light signal travels along fibres by multiple reflection, some light is absorbed due to impurities in the glass. Some of it is scattered by groups of atoms which are formed at places such as joints when fibres are joined together. Careful manufacturing can reduce the power loess by scattering and absorption.

SHORT QUESTIONS

(From past papers 2012-2017)

(Federal Board)

(1) Why would it be advantageous to use blue light with a compound microscope? **(FDR 2012)**

(2) Why would it be advantages to use blue to light for a compound microscope? **(FDR 2013)**

(3) In optical fiber system, how can the time difference of different dispersions be reduced? **(FDR 2013)**

(4) An astronomical telescope having magnifying power of 5 consists of two thin lenses 24 cm apart. Find the focal length of the lenses. **(FDR 2014)**

(5) Calculate the critical angle for an optical fiber having core of refractive index 1.50 and cladding of refractive index 1.48. **(FDR 2014)**

(6) What ate the problems faced by the astronomers while designing a telescope? Briefly describe their remedies. **(FDR 2015)**

7) What are the main components of spectrometer? Also write their function in brief. **(FDR 2016)**

8) A glass light pipe in air will totally internally reflect a light ray if its angle of incidence is at least 39^{o}. What is the minimum angle for total internal reflection if pipe is in water? (The refractive Index of water is 1.33) **(FDR 2017)**

) Define Near Point, Resolving Power and Continuous Refraction. **(FDR 2017)**