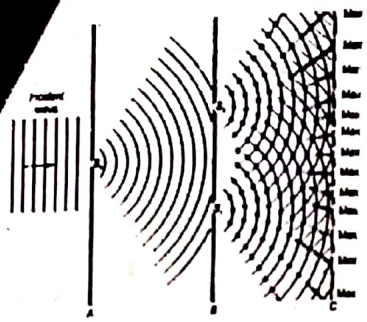

Chapter 9

PHYSICAL OPTICS

KEY POINTS

Wavefront:

- A surface passing through all the points undergoing a similar disturbance (i.e., having the same phase) at a given instant is called a wave front.

Spherical wave front:

When the disturbance is propagated out in all directions from a point source, the wavefronts in this case are spherical.

Plane wave front:

A small part of spherical or cylindrical wave front at very large distance from source of light

Rays:

- Radial lines leaving the point source in all directions are called rays. It represent the direction of propagation of light.

Wavelength:

- The distance between two consecutive wavefronts is called wavelength.

Huygen's Principle:

- Huygen's principle is that all the points on a primary wave front can be considered as the source for the production of secondary wavelets.
- Position of new wave front of all secondary wavelets is tangent envelope to all of them.
- There is an infinite number of wave fronts possible.

Interference:

- When two or more waves overlap each other there is a resultant wave. This phenomenon is called interference.

Conditions for interference of light:

(1) Monochromatic (Having single wave length)

(2) Coherence (Having constant phase difference)

Constructive Interference:

- When two waves, traveling in the same medium overlap and the amplitude of the resultant wave is greater than either of individual waves, it is called constructive interference.

Destructive Interference:

- In case of destructive interference, the amplitude of the resulting wave is less than either of the individual waves.

Young's Double Slit Experiment:

- In Young's double slit experiment.

i. For bright fringe, path difference is $d\ Sin\theta = m\lambda$

ii. For dark fringe, $dSin\theta = \left(m+\frac{1}{2}\right)\lambda$

iii. The distance between two adjacent bright or dark fringes.

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$$\Delta y = \frac{\lambda}{d}$$

Newton's Rings:

- Newton's rings are circular fringes formed due to interference in a thin air film enclosed between a convex lens and a flat glass plate.

Apparatus for Newton's Ring:

(1) Extended source of monochromatic light
(2) Semi silvered glass plate (beam splitter)
(3) Plano convex lens of large focal length
(4) Flat glass plate
(5) Microscope

Interference In Different Types Of The Films:

Thin film of refracting medium having thickness comparable to the wavelength of light rays e.g.

(1) Oil film on water
(2) Soap film
(3) Air film

Michelson's Interferometer:

- Michelson's interferometer is an instrument that is capable of measuring distance with extremely high precision.
- If mirror is moved through distance L , then m fringes pass before eye.

$$L = m\lambda / 2$$

Diffraction:

- Bending of light around obstacles is due to diffraction of light.
- For a diffraction gratings.

nth order maxima: $d \sin\theta = n\lambda$

X-rays Diffraction:

- Diffraction of X-rays by crystals using Bragg's equation

$2d \sin\theta = n\lambda$ where n is the order of reflection

Polarization:

- Polarization of light proves that light consists of transverse electromagnetic waves.

Diffraction Grating:

Diffraction grating is a multi-slit arrangement of parallel and equally spaced slits.

- Distance between two slits is called *grating element*.

$d = 1/N$

where 'N' is the number of lines in one unit length.

- Grating equation is given as

$d \sin\theta = m\lambda$

where 'm' is called the *order of diffraction* pattern

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TOPICAL MULTIPLE CHOICE QUESTIONS

Topic 9.1:

Wavefronts

(1) **The wave nature of light was proposed by**
(a) Newton (b) Joule
(c) Maxwell (d) Huygen

(2) **Electromagnetic wave nature of light was proposed by**
(a) Hertz (b) Maxwell
(c) Einstein (d) Huygen

(3) **Small segments of a large spherical wavefronts approximately**
(a) a circular wavefront (b) cylindrical wavefront
(c) plane wavefront (d) spherical wavefront

(4) **Such a surface on which all the points have the same phase of vibration is called**
(a) crest (b) trough
(c) wavelength (d) wavefront

(5) **A line normal to the wavefront, showing the direction of propagation of light is called**
(a) beam of light (b) ray of light
(c) both a and b (d) none of these

(6) **To convert spherical wavefronts into plane wavefronts**
(a) a concave lens is placed in front of source
(b) a convex lens is placed in front of source
(c) source is placed at the principle focus of convex lens
(d) all of these

(7) **Which one of the following properties of light does not change with the nature of medium**
(a) velocity (b) wavelength
(c) amplitude (d) frequency

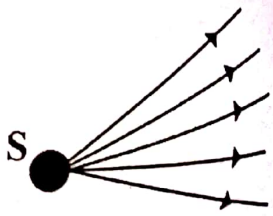
(8) **Blue colour of the sky is due to**
(a) dispersion (b) scattering
(c) interference (d) polarization

(9) **Young's experiment performed for the first time in_____ proved wave nature of light**
(a) 1981 (b) 1801
(c) 1765 (d) 1678

(10) **Wave nature of light is conformed by phenomena**
(a) Polarization (b) Interference
(c) Diffraction (d) All of these

(11) **Light reaches the earth in the form of**
(a) spherical wavefront (b) plane wavefront
(c) both A and B (d) none of these

(12) **A source of light "S" is shown in the figure. What is true?**
(a) spherical wavefront are present near source
(b) plane wavefront will be formed at large distance from source
(c) rays are parallel only in case of plane wavefronts
(d) all of these



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Topic 9.2:

Huygen's Principle

(13) **Huygen's principle enables us to determine the**
(a) frequency and wavelength of new wavefront (b) shape and location of new wavefront
(c) amplitude and location of new wavefront (d) shape and size of new wavefront

(14) **According to Huygen's principle, every point of a wavefront may be considered as a source of**
(a) primary wavelets (b) secondary wavelets
(c) source wavelets (d) none of these

(15) **According to Huygen's principle, the new wavefront at time t + Δt is a**
(a) secant envelope to all secondary wavelets (b) tangent envelope to all secondary wavelets
(c) tangent envelope to all primary wavelets (d) secant envelope to all primary wavelets

(16) **The phase difference between two successive wave front of light is**
(a) $\frac{\pi}{2}$ (b) π
(c) 2π (d) zero

(17) **The electromagnetic wave theory was proposed by**
(a) Hertz (b) Maxwell
(c) Einstein (d) Huygen

(18) **The distance traveled by the light between primary wavefront to a secondary wavefront is given by**
(a) $\frac{c}{\Delta t}$ (b) $c\Delta t$
(c) $\frac{\Delta t}{c}$ (d) $\frac{c\Delta t}{t}$

(19) **Wavelet of light moves in**
(a) Backward direction (b) Forward direction
(c) All directions (d) Any direction

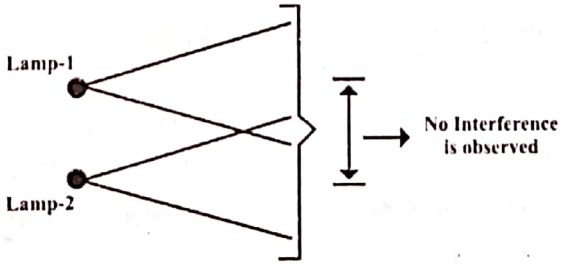
Topic 9.3:

Interference of Light Waves

(20) **The sources are said to be coherent if they have**
(a) constant phase difference (b) very less distance apart
(c) monochromatic (d) both a & c

(21) **Can two head light of a car produce interference**
(a) yes (b) no
(c) partially produce (d) both a & c

(22) **Two lamps of same colour are place close to each other. The light coming from both the lamps reach a screen where no interference pattern is observed. Why is it so?**



(a) beams of light are not monochromatic
(b) beams of light does not have same frequency
(c) beams does not have same speed
(d) beams are not coherent means a constant phase difference

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(23) **To observe the phenomenon of interference**
(a) light should be monochromatic (b) light must be coherent
(c) the sources should close to each other (d) all of these

(24) **If two light waves are not coherent then which of the phenomenon cannot be take place**
(a) diffraction (b) interference
(c) polarization (d) all of these

(25) **The two different flashlights will not produce an interference pattern, because**
(a) light beams are not coming from the coherent sources
(b) light beams are coming from the coherent sources
(c) light beams are not coming from the transmitted light sources
(d) light beams are coming from the transmitted light sources

(26) **If the waves interfere constructively then the amplitude of the resultant wave will be**
(a) greater then either of individual wave (b) Less then either of individual wave
(c) equal to either of individual wave (d) none of these

(27) **A screen is illuminated by white light coming from the two sources. One cant observe interference because**
(a) beams are not monochromatic
(b) as sources are different phase difference changes
(c) beams are coherent
(d) both A and B

Topic 9.4:

Young's Double Slit Experiment

(28) **In Young's double slit experiment, the distance between two adjacent bright or dark fringes**
(a) $\frac{d}{L\lambda}$ (b) $\frac{d\lambda}{L}$
(c) $\frac{dL}{\lambda}$ (d) $\frac{L\lambda}{d}$

(29) **The process which was/were taking place in YDSE is/are**
(a) interference (b) diffraction
(c) both A and B (d) none of these

(30) **In Young's double slit experiment, fringe spacing will be maximum if we use**
(a) yellow light (b) red light
(c) green light (d) blue light

(31) **Maxima is termed as**
(a) bright fringe (b) monochromatic light
(c) white light (d) dark fringe

(32) **What happen to the fringe spacing, when the experiment is performed in water instead of air**
(a) enlarge (b) shrink
(c) disappear (d) no effect

33) **The condition for the constructive interference of two coherent beams is obtained, the path difference will be**
(a) integral multiple of $\frac{\lambda}{2}$ (b) integral multiple of λ
(c) even integral multiple of λ (d) odd integral multiple of $\frac{\lambda}{2}$

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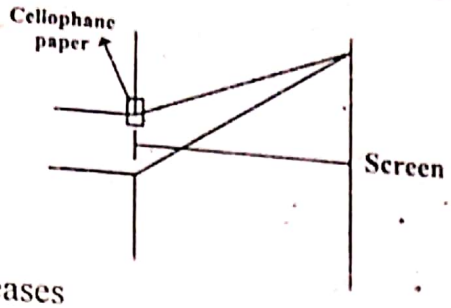
(34) **A YDSE arrangement is shown in the figure in which one of the slits is covered with a cellophane paper. What happens to the intensity of dark & bright fringes on screen?**



(a) intensity of both decreases
(b) intensity of both increases
(c) brighter becomes less bright but dark becomes less dark
(d) all of these

(35) **In Young's double slit experiment, the condition for bright fringe is expressed as**

(a) $d\sin\theta = \left(m - \frac{1}{2}\right)\lambda$
(b) $d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$
(c) $2d\sin\theta = m\lambda$
(d) $d\sin\theta = m\lambda$

(36) **Two interfering beams have intensities as 9I and 4I. What will be the ratio at corresponding intensities of constructive and destructive interference?**

(a) 3:2
(b) 5:1
(c) 25:1
(d) 1:2

(37) **In Young's double slit experiment, if the distance between the slits and screen is halved and the distance between the slits is doubled then the fringe spacing is**

(a) half
(b) double
(c) four times
(d) one fourth

(38) **In young's double slit experiment if blue light is used instead of red light then fringe spacing.**

(a) increases
(b) decreases
(c) remain same
(d) none of these

Topic 9.5:

Interference in Thin Films

(39) **The speed of light in vacuum depends upon the**

(a) frequency
(b) wavelength
(c) nature of the medium
(d) none of these

(40) **The colours appears in the thin films is due to the**

(a) interference
(b) dispersion
(c) polarization
(d) scattering

(41) **The sky during sunset seems red due to**

(a) scattering
(b) dispersion
(c) polarization
(d) interference

(42) **In interference of thin films the path difference depends upon the**

(a) angle of incidence
(b) angle of reflection
(c) angle of deviation
(d) angle of refraction

(43) **Whenever light changes its medium the quantity remains same is**

(a) speed
(b) wavelength
(c) frequency
(d) all of these

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(44) **Whenever the white light passed though the prism, the light**
(a) dispersed (b) deviate
(c) polarized (d) interfere

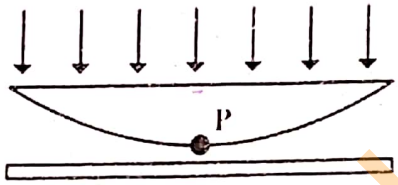
(45) **An oil film spreading over a wet footpath shows colour due to**
(a) dispersion of light waves (b) Diffraction of light waves
(c) interference of light waves (d) polarization

(46) **When a ray of light enters from rare medium to denser medium its wavelength**
(a) increases (b) decreases
(c) remain same (d) none

Topic 9.6:

Newton's Ring

(47) **A Plano-convex lens is placed on the glass slab the way as shown in the figure. If the light is transmitted at point of contact "P". Then what is true?**



(a) centre becomes bright (b) no phase change occurs
(c) centre remains dark (d) both A and B

(48) **In Newton's Ring, at the point of contact of the lens and the glass plate, the thickness of the film is**
(a) very large (b) very thin
(c) almost zero (d) continually changes

(49) **Newton's rings are formed due to**
(a) Diffraction (b) Interference
(c) Polarization (d) Dispersion

(50) **The path difference $\frac{\lambda}{2}$ means the phase change of**
(a) 90° (b) 60°
(c) 180° (d) 45°

(51) **In the figure of Q.47 if light is reflected back at point of contact then centre becomes**
(a) dark (b) bright
(c) may be bright or dark (d) no interference is observed

Topic 9.7:

Michelson Interferometer

(52) **Michelson measured the length of standard meter in terms of wavelength of**
(a) sodium light (b) red cadmium light
(c) platinum light (d) cesium light

(53) **Which instrument is used to view the fringes in Michelson interferometer**
(a) compound microscope (b) interferometer
(c) spectrometer (d) telescope

(54) **Michelson's formula for the displacement L is**
(a) $L = m\frac{\lambda}{2}$ (b) $\lambda L = \frac{m}{2}$
(c) $L = 2m\lambda$ (d) $\lambda L = 2m$

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(55) **Michelson's interferometer can also be used to find the**
(a) wavelength of light
(b) frequency of light
(c) velocity of light
(d) velocity of sound

(56) **Michelson's interferometer was devised in**
(a) 1864
(b) 1687
(c) 1881
(d) 1786

(57) **In a Michelson interferometer by moving the mirror through a distance of $\frac{\lambda}{4}$, the path difference changes by**
(a) $\frac{\lambda}{4}$
(b) $\frac{\lambda}{2}$
(c) λ
(d) zero

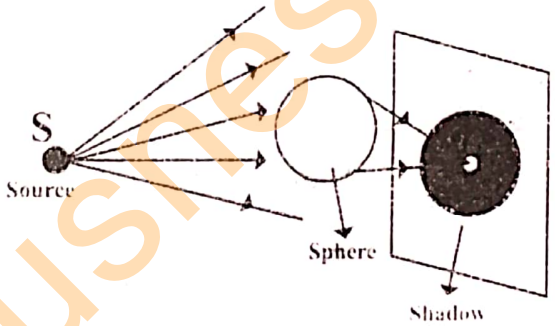
(58) **Michelson shows that the standard meter was equivalent to _____ of wavelength of red cadmium light**
(a) 15553163.5
(b) 16553153.5
(c) 1653163.5
(d) 1553163.5

(59) **Michelson's Interferometer is an instrument that can be used to measure**
(a) distance with extremely low precision
(b) distance with extremely high precision
(c) both a and b
(d) none

Topic 9.8 & 9.9:

Diffraction of Light & Diffraction Due to Narrow Slit

(60) **A sphere is placed in front of the light source as shown in the figure. The light then falls on a screen. The centre of screen is bright due to**



(a) interference
(b) dispersion
(c) scattering
(d) diffraction

(61) **Diffraction is a characteristics of**
(a) particle
(b) wave
(c) both a and b
(d) none of these

(62) **We can't see through the corners yet can hear. This is due to**
(a) greater wavelength of sound
(b) smaller wavelength of light
(c) diffraction of sound
(d) all of these

(63) **Diffraction is a property of**
(a) interference
(b) wave
(c) reflection
(d) polarization

(64) **In diffraction the phenomenon is found to be prominent when the wavelength of light is large as compared with the**
(a) aperture of the slit
(b) size of the slit
(c) number of the slits
(d) all of these

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(65) In diffraction pattern due to narrow slits the equation for the first minimum is

(a) $\frac{d}{2}\sin\theta = \lambda$ (b) $\frac{d}{2}\sin\theta = \frac{\lambda}{2}$

(c) $d\sin\theta = \frac{\lambda}{2}$ (d) $\frac{d}{2}\sin\theta = \frac{2}{3}\lambda$

(66) When the light passes through the pinhole opening, then the spreading of light is due to

(a) interference (b) diffraction

(c) polarization (d) scattering

(67) Which of the following waves can be diffracted

(a) sound waves (b) light waves

(c) water waves (d) all of these

Topic 9.10:

Diffraction Grating

(68) The optical instrument with a regular pattern, which splits light into several beams is called

(a) slit (b) pinhole camera

(c) grating (d) grating element

(69) The distance between two adjacent lines or slits is called

(a) slit (b) grating

(c) grating element (d) narrow slit

(70) A typical diffraction grating has about

(a) 400 to 5000 lines per meter (b) 400 to 5000 lines per centimeter

(c) 400 to 5000 lines per cubic meter (d) 400 to 5000 lines per millimeter

(71) The relation of grating element can be expressed as

(a) $d = \frac{length\ of\ grating\ element}{distance\ \ between\ the\ slits}$

(b) $d = \frac{length\ of\ grating\ element}{number\ of\ lines\ rules\ on\ it}$

(c) $d = \frac{number\ of\ lines\ ruled\ on\ it}{length\ of\ grating\ element}$

(d) $d = (length\ of\ grating\ element) \times (number\ of\ lines\ ruled\ on\ it)$

(72) On a compact disc the width of each fine ruling is about

(a) 0.5mm (b) 0.5cm

(c) 0.5μm (d) 0.5 dm

(73) When θ = 0, along the direction of normal to the grating, the path difference between the rays coming out from the slits of grating will be

(a) minimum (b) maximum

(c) zero (d) none of these

(74) If a diffraction grating has 1000 lines per mm. Its grating element will be

(a) $1\times10^{-3}\,cm$ (b) $1\times10^{-5}\,cm$

(c) $1\times10^{-5}\,mm$ (d) $1\times10^{-4}\,cm$

(75) In diffraction grating the path difference for constructive interference should be

(a) $\frac{\lambda}{2}$ (b) $\frac{\lambda}{4}$

(c) λ (d) $\frac{\lambda}{8}$

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(76) A diffraction grating used to make a diffraction pattern for yellow light and then for red light. The distance between the red spots will be _____ that for yellow light.
(a) less than (b) greater than
(c) disappear (d) no change

(77) To get more orders of spectra using a diffraction grating, the wavelength should be
(a) decrease (b) increase
(c) remain same (d) none of these

(78) To get orders of spectra using a diffraction grating, we can use the relation
(a) $n = \frac{\sin\theta}{\lambda}$ (b) $n = \frac{\sin\theta}{\lambda}$
(c) $n = \frac{\sin\theta}{d\lambda}$ (d) $n = \frac{d\sin\theta}{\lambda}$

Topic 9.11:

Diffraction of X-rays by Crystals

(79) X-rays is a type of electromagnetic radiation of much shorter wavelength of the order of
(a) 10^{-10}m (b) 10^{-19}m
(c) 10^{-20}m (d) 10^{-12}m

(80) Bragg's equation is expressed as
(a) $\frac{d}{2}\ \text{Sin}\ \theta = n\lambda$ (b) $d\ \text{Sin}\ \theta = n\lambda$
(c) $2d\ \text{Sin}\ \theta = n\lambda$ (d) $2d\ \text{Sin}\ \theta = \frac{n\lambda}{2}$

(81) The study of atomic structure of crystals by X-rays was initiated in
(a) 1914 (b) 1901
(c) 1811 (d) 1931

(82) Diffraction of x-rays by crystal shows that
(a) the intensity of light is high (b) x-ray has shorter wavelength
(c) x-rays has greater frequency (d) both b & c

(83) X-rays are very useful in determine the structure of
(a) hemoglobin (b) double helix structure of DNA
(c) both a & b (d) pulse rate

(84) Which colour suffers the maximum deviation in prism
(a) yellow (b) blue
(c) orange (d) green

(85) Diffraction effects were discovered in
(a) 1901 (b) 1801
(c) 1918 (d) 1810

Topic 9.12:

Polarization

(86) The phenomenon of polarization is done by
(a) selective absorption (b) refraction through crystals
(c) scattering through particles (d) all of these

(87) Polarizer are made by special substances called
(a) dichroic substances (b) super conductor
(c) organic substances (d) none of these

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(88) Which one of the following proves that light waves are transverse in nature
(a) interference (b) diffraction
(c) polarization (d) reflection

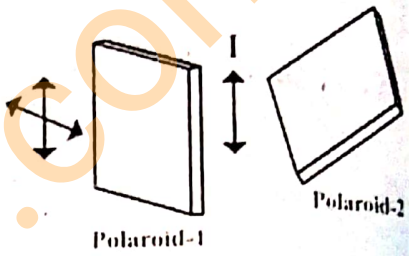
(89) Longitudinal waves do not exhibit
(a) refraction (b) reflection
(c) diffraction (d) polarization

(90) Confining the light into one plane of vibration is called
(a) interference (b) diffraction
(c) dispersion (d) polarization

(91) The plane of polarization is rotated many degrees when thickness of such crystals is
(a) 1 mm (b) less than 1mm
(c) a few mm (d) order of $1A^0$

(92) Light passes through Polaroid-1 and its intensity becomes "I". How its intensity varies when this light passes through Polaroid-2 oriented at $\theta=45^\circ$

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



(93) The organic substance which show optical rotation when they are in solution
(a) tartaric acid (b) sugar
(c) alcohol (d) both a & b

(94) Light glare can be reduce by using
(a) polaroid (b) un-polarized glass
(c) both a & b (d) analyzer

(95) Glare produces when light reflects from water snow and rough road surfaces when their angle of incidence is
(a) small (b) large
(c) very large (d) none of these

(96) Light reflected from smooth surface of water is partially polarized
(a) perpendicular to the surface (b) parallel to the surface
(c) along the surface (d) in opposite direction to the surface

(97) The frequency of excitation when a Polaroid is given a complete rotation. Placed in front of plane polarized light rotated with a frequency "f" is
(a) f (b) $2f$
(c) $4f$ (d) $\frac{f}{2}$

(98) Commercially polarizing material is called
(a) glass (b) polaroid
(c) analyzer (d) prism

(99) A Polaroid glass _____ of light produced at a road surface.
(a) increases glare (b) decreases glare
(c) no glare (d) very intense glare

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MULTIPLE CHOICE QUESTIONS

(From Past Papers 2012-2017)

(Federal Board)

(1) **In case of X-ray diffraction by crystal the wavelength can be found by using the equation_____** (FDR 2012)

(a) $d \sin \theta = n\lambda$
(b) $2d \sin\theta = n\lambda$
(c) $2d\cos\theta = n\lambda$
(d) $d \cos \theta = n\lambda$

(2) **In a diffraction grating, distance between the two adjacent slits in called _____.** (FDR 2013)

(a) Grating element
(b) Normal to grating
(c) Fringes
(d) Diffraction

(3) **To determine the inter planer space, equation used is _____.** (FDR 2013)

(a) $d \sin\theta = n\lambda$
(b) $2d \sin\theta = n\lambda$
(c) $\frac{d \sin\theta}{2} = n\lambda$
(d) $\sin\theta = n\lambda$

(4) **Colors seen on oily water surface are due to the _____** (FDR 2014)

(a) interference of light
(b) Diffraction of light
(c) Polarization
(d) Refraction of light

(5) **The technique used to study the structure of hemoglobin is _____** (FDR 2014)

(a) X-rays diffraction
(b) Newton's rings
(c) Polarization
(d) Interface

(6) **_____ of light proves that light consists of transverse electromagnetic waves** (FDR 2015)

(a) interference
(b) diffraction
(c) polarization
(d) dispersion

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ANSWER KEYS

(Topical Multiple Choice Questions)

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

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SHORT QUESTIONS

(From Textbook Exercise)

9.1. Under what conditions two or more sources of light behave as coherent sources?

Ans: Two or more sources are said to be coherent if light coming from these sources have same frequency and have constant phase difference.

9.2. How is the distance between interface fringes affected by the separation between the slits of Young's experiment? Can fringes disappear?

Ans: We know that fringe width is given by

$$\Delta y = \frac{L\lambda}{d}$$

Where "d" separation between slits. Therefore $\Delta y \propto \frac{1}{d}$. This relation shows that if separation between the slits increases then fringe width decreases. If separation between slits is very large then the fringes may disappear.

9.3. Can visible light produce interference fringes? Explain.

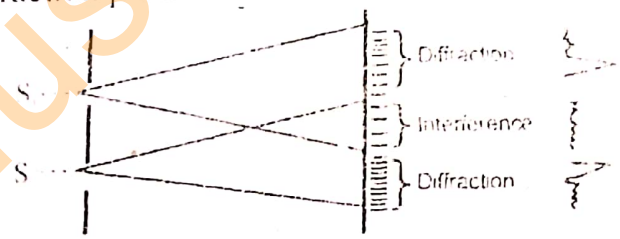
Ans: Yes, visible light can produce interference.
If white light is used for interference then we can see colours on both side of central maxima on the screen. But the pattern will not be well defined due to overlapping of colours.

9.4. In the Young's experiment, one of the slits is covered with blue filter and other with red filter. What would be the pattern of light intensity on the screen?

Ans: Blue filter gives blue light and red filter gives red light. For interference the two waves must have same frequency. As in the case one light is red and the other is blue therefore no interference will take place. We shall observe two Coloured images on the screen with constant intensity.

9.5. Explain whether the Young's experiment is an experiment for studying interference or diffraction effects of light.

Ans: Young's experiment is an experiment for study the interference of light although light also diffracts while pass through the slits. But interference phenomenon is more prominent then diffraction phenomenon.



9.6. An oil film spreading over a wet footpath shows colours. Explain how does it happen?

Ans: If white light is incident on a film, of irregular thickness at all possible angles, we should consider the interference pattern due to each spectral colour separated. It is quite possible that at a certain place on the film, its thickness and the angle of incidence of light are such that the condition of destructive interference of one colour is being satisfied. Hence that pattern of the film will show the remaining constituent colour of the white light due to constructive interference.

9.7. Could you obtain Newton's rings with transmitted light? If yes, would the pattern be different from the obtained with reflected light?

Ans: We can obtain Newton's ring with transmitted light but the pattern will be exactly opposite from that obtained with reflected light. In case of reflected light the central spot appears dark and in the case of transmitted light central spot appears white.

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9.8. In the white light spectrum obtained with a diffraction grating, the third order image of a wave length coincides with the fourth order image of a second wavelength. Calculate the ratio of the two wavelengths.

Ans: For first wavelength $d \sin\theta = 3\lambda_1$

For second cave length $d \sin\theta = 4\lambda_2$

As the two orders coincides therefore

$3\lambda_1 = 4\lambda_2$

$\frac{\lambda_1}{\lambda_2} = \frac{4}{3}$

Thus ratio is

$\Rightarrow 4:3$

9.9. How would you manage to get more orders of spectra using a diffraction grating?

Ans: We know that for diffraction grating.

$d \sin\theta = m\lambda$

$$m = \frac{d \sin\theta}{\lambda}$$

Where 'm' is order of diffraction.

1) This shows that order of spectra can be increased by increasing the valued d (grating element)

As $d = \frac{1}{N}$, Therefore, d can be increased by decreasing number of lines (N) on the grating.

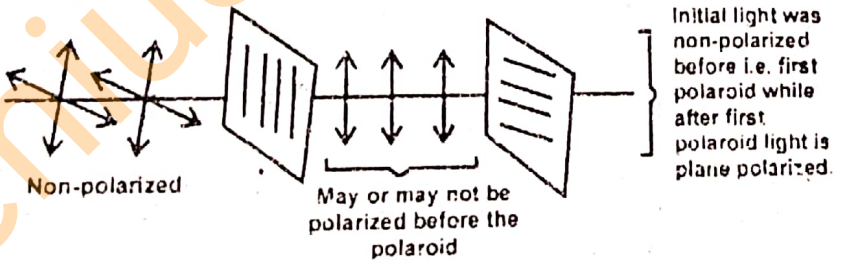
2) Using the light of shorter wavelength.

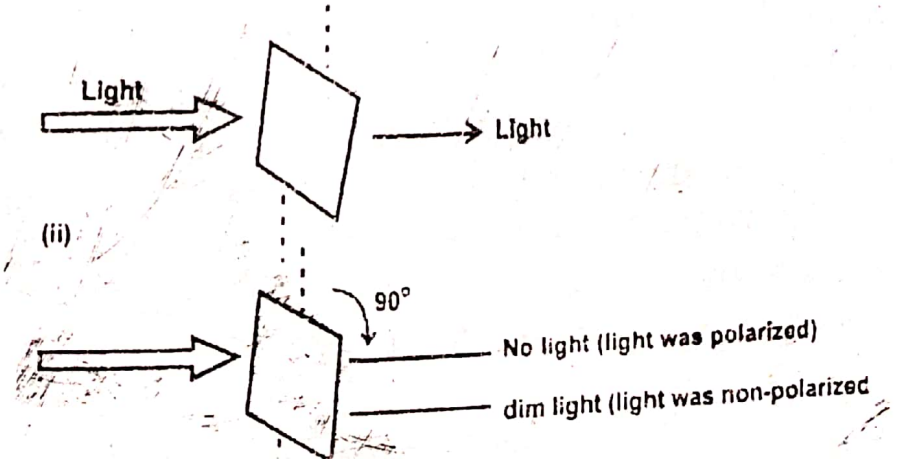
9.10. Why the Polaroid sunglasses are better than ordinary sunglasses?

Ans: Polaroid sunglasses are better then ordinary sun glasses because they reduce the glare of light through reflected from water glass, snow and rough road is partially polarized and produces glare. therefore the glare is reduced by the polaroid.

9.11. How would you distinguish between unpolarized and plan polarized lights?

Ans: Ordinary light (unpolarized light) has a number of planes of vibrations on the other hand in polarized light, vibration are confined in one plane only. The unpolarized and polarized light can be distinguished by using a polarized light, the light would be stopped at some particular orientation





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(29) Sketch out three differences between interference and diffraction of light.(FDR 2017)

Ans:

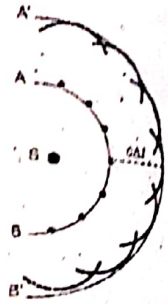
DIFFERENCE B/W INTERFERENCE AND DIFFRACTION	
INTERFERENCE	**DIFFRACTION**
1. Interference is the result of interaction of waves coming from two wavefronts.	1. Diffraction is the result of interaction of waves coming from different parts of same wavefront.
2. Interference maxima are of same width and brightness.	2. Diffraction maxima are not of same width and brightness.
3. Interference minima are perfectly dark.	3. Diffraction minima are not perfectly dark.

(30) Slate Huygens's principle. Also distinguish between a wave-front and a wavelet by graphical sketch. (Graph paper is not required) (FDR 2017)

Ans: Huygen's principle enables us to determine the shape and location of the new wavefront at a later time $t+\Delta t$. This principle consists of two parts:

Every point of a wavefront may be considered as a source of secondary wavelets which spread out in forward direction with a speed equal to the speed of propagation of the wave.

The new position of the wavefront after a certain interval of time can be found by constructing a surface touches all the secondary wavelets.



SHORT QUESTIONS

(From past papers 2012-2017)

(Federal Board)

(1) An oil film spreading over a wet footpath shows colours. Explain how it happens. **(FDR 2012)**

(2) In "Newton's rings" at the point of contact of the lens and the glass plate, the spot is dark. Why? **(FDR 2012)**

(3) What are the coherent sources of light? **(FDR 2014)**

(4) In a double slit experiment the second order maximum occurs at $\theta=0.25^{o}$. The wavelength is 650 nm. Determine the slit separation. **(FDR 2014)**

(5) Why are natural crystal used for X-ray diffraction instead of diffraction grating? **(FDR 2015)**

(6) State Huygens's principle. Also draw figure. **(FDR 2015)**

(7) An oil film spreading over a wet footpath show colors. Briefly describe how it does happen? **(FDR 2015)**

(8) How is the distance between the interference fringes affected by the separation between the slits of Young's arrangement? Can interference fringes disappear? **(FDR 2016)**

(9) In the Young's slit arrangement, one of the slits is covered with blue filter and other with red filter. What would be the pattern of light intensity on the screen? Explain. **(FDR 2016)**

(10) Sketch out three differences between interference and diffraction of light. **(FDR 2017)**

(11) Slate Huygens's principle. Also distinguish between a wave-front and a wavelet by graphical sketch. (Graph paper is not required) **(FDR 2017)**

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