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ANS (1) we have

$L_y' = L' \sin\theta' = (1m) \sin 30 = .5m$

$L_x' = L' \cos\theta' = (1) \cos 30 = .866$

As length contraction is only is in x-x' direction hence $L_y = L_y' = .5m$

$$L_x = L_x' \sqrt{1-\left(\frac{v^2}{c^2}\right)}$$

$$= (.866)\sqrt{1-\left(\frac{v^2}{c^2}\right)}$$

$$\tan\theta = \frac{L_y}{L_x}$$

$$\tan 45^\circ = 1 = \frac{.5m}{(.866)\sqrt{1-\left(\frac{v^2}{c^2}\right)}}$$

ANS (2)

$\vec{V'} = 3\hat{i} + 4\hat{j} + 12\hat{k}$

$V_x' = 3 \quad V_y' = 4 \quad V_z' = 12$

$v = .8c$

$$V_x = \frac{V_x' + v}{1 + \frac{v V_x'}{c^2}} = 2.4 \times 10^8 \, m/s$$

Similarly $V_y = 2.4 \, m/s$, $V_z = 7.2 \, m/s$

Therefore, $\bar{V}$ in the laboratory frame is

$$V = V_x\hat{i} + V_y\hat{j} + V_z\hat{k}$$

$$= (2.4\times10^8)\hat{i} + (2.4)\hat{j} + (7.2)\hat{k}$$

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ANS(3) $KE = (m - m_0)c^2$

& RHS $= 1 + \frac{(m-m_0)c^2}{m_0c^2}$

$= 1 + \frac{mc^2}{m_0c^2} - \frac{m_0c^2}{m_0c^2}$

$= 1 + \frac{m_0}{m_0\sqrt{1-\frac{v^2}{c^2}}} - 1 = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$

ANS(4) $P = \frac{m_0 v}{\sqrt{1-\frac{v^2}{c^2}}}$

$p^2 = \frac{m_0^2 v^2}{1-\frac{v^2}{c^2}}$

RHS $= \sqrt{1 + \frac{m_0^2 v^2}{1-\frac{v^2}{c^2}}\left(\frac{1}{m^2c^2}\right)} = \sqrt{1 + \frac{v^2}{c^2 - v^2}}$

$= \sqrt{\frac{c^2 - v^2 + v^2}{c^2 - v^2}} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$

ANS(5) $\frac{I_1}{I_2} = \frac{81}{1}$

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{81}{1}} = \sqrt{\frac{9}{1}}$

$\alpha_1 = 9\alpha_2$

$\frac{I_{max}}{I_{min}} = \frac{(\alpha_1+\alpha_2)^2}{(\alpha_1-\alpha_2)^2} = \frac{(9a_2+a_2)^2}{(9a_2-a_2)^2} = \left(\frac{100}{64}\right)$

$\therefore$ $I_{max} : I_{min} = 25:16$

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Ans (6): Resultant intensity at a point due to two waves of amplitude α_1 & α_2

$$I = \alpha_1^2 + \alpha_2^2 + 2\alpha_1\alpha_2 \cos\delta$$

$$I_{max} = (\alpha_1+\alpha_2)^2 \qquad I_{min} = (\alpha_1-\alpha_2)^2$$

$$\alpha = \frac{\alpha_1^2}{\alpha_2^2} = \frac{I_1}{I_2}$$

$$\therefore \frac{I_{max} - I_{min}}{I_{max} + I_{min}} = \frac{(\alpha_1+\alpha_2)^2 - (\alpha_1-\alpha_2)^2}{(\alpha_1+\alpha_2)^2 + (\alpha_1-\alpha_2)^2}$$

$$= \frac{4\alpha_1\alpha_2}{2\alpha_1^2 + 2\alpha_2^2} = \frac{2\alpha_1\alpha_2}{\alpha_1^2+\alpha_2^2}$$

$$= \frac{2\sqrt{\alpha}}{1+\alpha}$$

Ans (7) As fringe width $\bar{x} = \frac{D\lambda}{d}$

$\bar{x} = 0.0135$ & $D = 50+50 = 100$

$d = 2a(\mu-1)\alpha$ & $a = 50$; $\mu = 1.5$

$$\therefore \alpha = \frac{180-179}{2} = \left(\frac{1}{2}\right)^{\circ} = \left(\frac{\pi}{360}\right) \text{rad}$$

$$d = 2 \times 50 \times (1.5-1) \times \frac{\pi}{360} = .436 \text{ cm.}$$

$$\therefore \lambda = \frac{.0135 \times .436}{100}$$

$$= 5890 \text{ Å}$$

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ANS 8 The Condition for Constructive interference of light reflected from a film

$\cancel{2\mu t \cos r = (2n-1)\frac{\lambda}{2}}$

$\mu = 1.33 \quad t = 5\times10^{-5} \quad r = 0 \quad \cos r = 1$

$\therefore \quad 2\times1.33\times(5\times10^{-5}) = (2n-1)\frac{\lambda}{2}$

$$\lambda = \cancel{\frac{2\times2\times1.33\times(5\times10^{-5})}{(2n-1)}}$$

$$= \frac{26600}{(2n-1)} \text{ Å}$$

$n = 1, 2, 3, 4.$

$\lambda = 26600\text{ Å},\ 8867\text{ Å},\ 5320\text{ Å}$ ——

ANS 9

$t = t_1 + t_2$

$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{4n\lambda}{D_n^2}$$

$\therefore \quad R_1 = R_2 = 100\text{ Cm} \quad \lambda = 6\times10^{-5}\text{ Cm}$

$$r_n^2 = \frac{n\lambda R_1 R_2}{R_1+R_2}$$

$$\therefore \quad r_{20} - r_{10} = \sqrt{\frac{\lambda R_1 R_2}{R_1+R_2}}\left[\sqrt{20}-\sqrt{10}\right]$$

$$= \underline{.0717\text{ Cm}}$$

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ANS (10) (a) Bi-Prism: A bi-prism is a device to obtain two coherent sources to produce sustain interference. It is a combination of two prism of very small refracting angles placed base to base. Actually it is placed base to base, it is ~~cast~~ constructed as a single prism with one of its angle is 179° and other two about 30' each

(b) Angular fringe width is defined as the angular separation b/w consecutive bright or dark fringes and denoted by θ

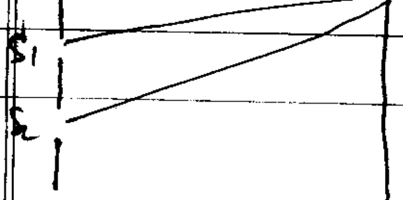
$$\text{Angle} = \frac{\text{Arc}}{\text{Radius}}$$

$$\theta = \theta_{n+1} - \theta_n = \frac{x_{n+1}}{D} - \frac{x_n}{D} = \frac{\bar{x}}{D}$$

$$\theta = \frac{D\lambda/d}{D}$$

$$\boxed{\theta = \frac{\lambda}{d}} \text{ radians.}$$

(c) The diffrence b/w optical path of two rays, which are in constant phase diff. with each other reuniting at a perticular point is known as path diffrence



path diffrence $= S_2P - S_1P$

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~~Interference~~	~~Diffraction~~
* The region of min. intensity are usually almost perfect dark	not perfectly dark
* All maxima are of same intensity	of varying intensity.
* Interference fringes may or may not be of same width	are not of the same width.

(e) As $\sin\theta = \pm \frac{\lambda}{a}$

$a =$ slit width

If a is large, then for a given wave-length of light, $\sin\theta$ & θ are very small then this means maxima & minima are very close to central maximum.

If slot width is narrow diffraction minima and maxima are quite distinct and clear.

(f) Increasing slot width: The central peak will become more sharper but fringe spacing remain unchanged, Hence less interference maxima fall within the central diffraction medium.

Increasing the distance b/w slits:
fringes become closer together but the envelope of the pattern remains unchanged Hence more interference maxima fall within the central envelope.

(8) Single slit | Double-Slit

* Intensity pattern is

$I = I_0 \left(\frac{\sin\alpha}{\alpha}\right)^2$ | $I = 4I_0 \left(\frac{\sin\alpha}{\alpha}\right)^2 \cos^2\beta$

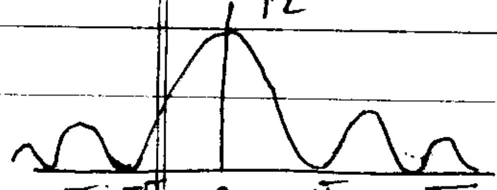
$\alpha = \frac{\pi e \sin\theta}{\lambda}$ | $\beta = \frac{\pi(e+d)\sin\theta}{\lambda}$

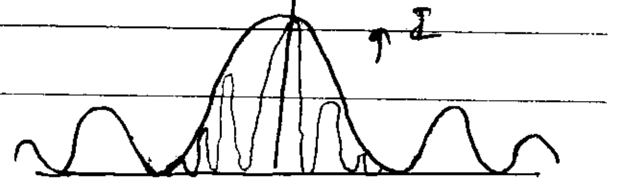
central max $= I_0$ | Central max $= 4I_0$

* A central bright max with secondary max. and minima of gradully decreasing intensity. | equally spacing interference max & minima with central max.

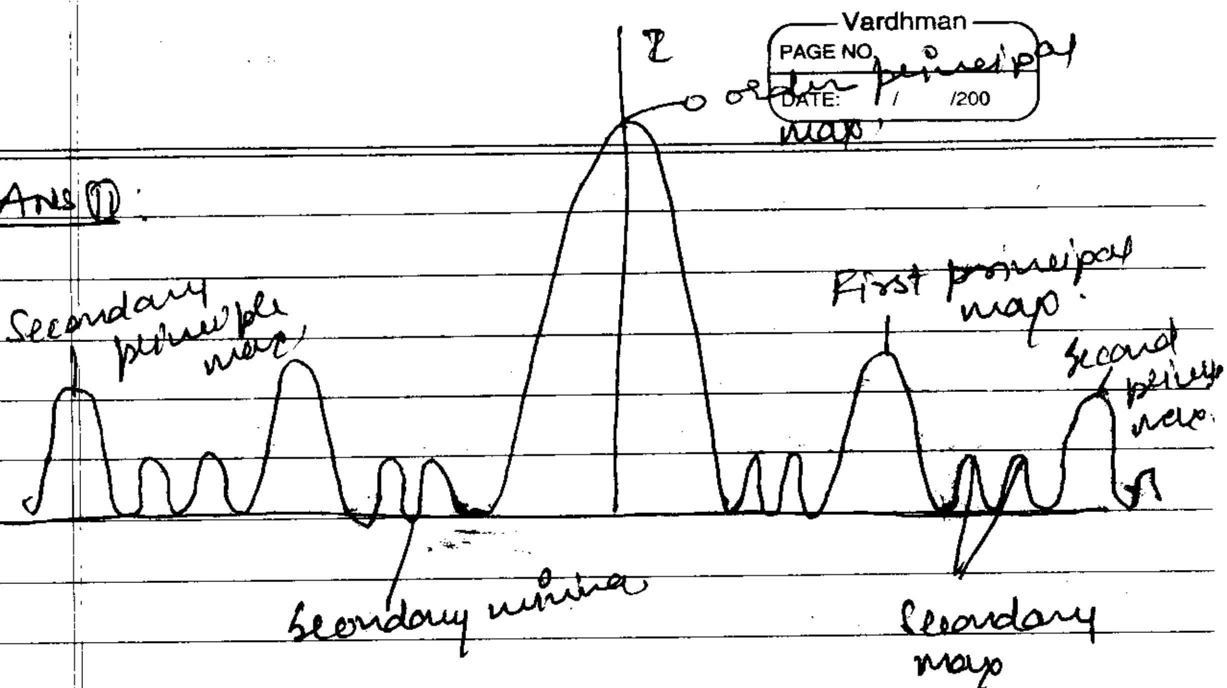
* on increasing slit width max and minima will come closer | on increasing slit width central peak will become sharper but fringe spacing remains unchanged.

* Pattern is





ANS (11):



ANS (12) Dispersive power → is the rate of change of the angle of diffraction with wavelength of light.

as grating equation is

$(a+d) \sin\theta = n\lambda$

$(a+d) \cos\theta \, d\theta = n d\lambda$

$$\boxed{\frac{d\theta}{d\lambda} = \frac{n}{(a+d)\cos\theta}}$$

ANS (13)

(a) Acceptance angle → maximum angle may be defined as the maximum angle that a light ray can have relative to the axis of the fiber and propagates down the fiber.

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This is denoted as θ_m

$$\theta_m = \sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right)$$

(b) Fractional Refractive Index change → defined as the ratio of the difference b/w the refractive indices of the core & the cladding to the refractive index of the core. it is denoted as

$$\boxed{\Delta = \frac{n_1 - n_2}{n_1}}$$

(c) Numerical Aperature: defined as the sine of the acceptance angle

$$NA = \sin\theta_m = \sqrt{n_1^2 - n_2^2}$$

$$\boxed{NA = n_1\sqrt{2\Delta}}$$

(d) Attenuation constt. → This is also power loss and it is the ratio of output power to input power.

$$\text{Loss} = \frac{P_{out}}{P_{in}}$$

it is denoted by α ~~const~~ and in $\left(\frac{1}{Km}\right)$

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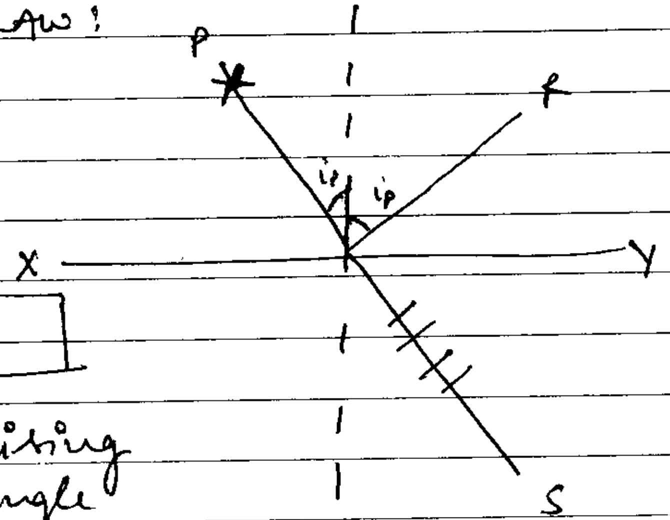
ANS (14) Single mode	Multimode
* Sustain only one mode of propagation	various modes are supported
* generally exited by diode laser	usually by LED
* free from intermodal dispersion	Suffer intermodal dispersion.
* Used for very long haul Communication	Used for LAN or small data transfer.
* Have higher bandwidth	lower
* V number is < 2.405	V number is > 2.405

ANS (15) The process of achieving the larger number of atoms in the higher energy levels then the lower energy level is known as the population inversion.

Ruby laser - Optical Pumping
He-Ne - Electric discharge
Chemical reaction - CO_2 Laser.

ANS (16) BREWSTER LAW :



$$\boxed{\mu = \tan i_p}$$

i_p = polarising angle

μ = refractive index of the medium.

ANS (17) A line equally inclined to the three edges meeting at one of the blunt corners of crystal or any line parallel to it's direction is optical axis

it is a direction not a line

The crystal is always symmetrical around it.