- RAY OPTICS NOTES 2

66) Define angle of deviation.

The angle between the emergent ray RS and the direction of the incident ray PQ is called the *angle of deviation*, δ

67) Obtain an expression for the refractive index of the prism with neat diagram

68) Derive an expression for angle of deviation for small angled prism

69) How will the angle of minimum deviation of prism change when

i) Refractive index of the material of prism change ii) Prism is placed in water instead of air

iii) Instead of red light blue light is used? Justify your answer

70) How will you relate angle of refraction with refracting angle of prism at the angle of minimum deviation?

r= A/2

71) Define dispersion of light

The phenomenon of splitting of white light into constituent colours when white light passes through prism is called the dispersion of light.

72) What is a spectrum?

The pattern of colour components of light is called the spectrum of light.

violet, **i**ndigo, **b**lue, **g**reen, **y**ellow, **o**range and **r**ed (VIBGYOR). Increasing order of wavelength.

73) Why does dispersion take place?

The cause of dispersion is that different colour of light has different refractive index, different speedof light inside the prism and different deviation.

74) Which colour of refract more?Why?

Red light. n = sin i/ sinr; $n_{red} < n_{blue}$; r is more for red.

75) Whcih colour of light deviates more? Why?

Violet deviates more than red.

According to Cauchy's formula.

$$\mu\alpha\frac{1}{\lambda^2} cauchy's\ formula$$

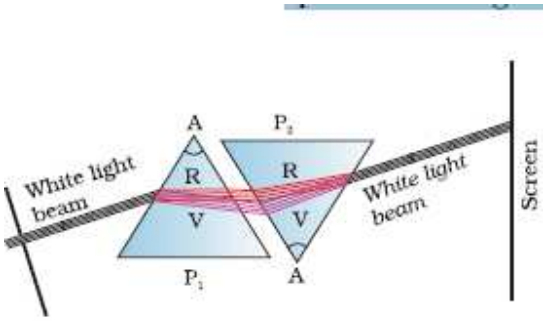
$$n_r < n_V ; and\ \lambda_V < \lambda_R$$

$$\delta_V > \delta_R$$

NOTE:

Inside the prism, velocity of red light is less than velocity of blue light since $v \alpha \lambda$

76) Explain Recombination of white light with diagram



He put another similar prism,but in an inverted position, and let the emergent beam from the first prism fall on the second prism . The resulting emergent beam was found to be white light. The explanation was clear— the first prism splits the white light into its component colours, while the inverted prism recombines them to give white light. Thus, white light itself consists of light of different colours, which are separated by the prism. It must be understood here that a ray of light,
as defined mathematically, does not exist. An actual ray is really a beam of many rays of light. Each ray splits into component colours when it enters the glass prism. When those coloured rays come out on the other side, they again produce a white beam.

77) Why don't you prefer thick convex or concave lens?
Thick lenses could be assumed as made of many prisms, therefore, thick lenses show *chromatic aberration* due to dispersion of light. (chromatic aberration means different coloured object forms image at different point near focus)

78) What are non dispersive and dispersive medium?
In vacuum, of course, the speed of light is independent of wavelength. Thus, vacuum (or air approximately) is a non-dispersive medium in which all colours travel with the same speed. This also follows from the fact that sunlight reaches us in the form of white light and not as its components. Glass is a dispersive medium.

79) What is the ratio of speed of red light of λ = 600nm to blue light of λ = 400nm in air?
The ratio of speed of red light of λ = 600nm to blue light of λ = 400nm in air is 1:1 since the speed of light is independent of wavelength

80) Explain the principle in the formation of rainbow
The rainbow is an example of the dispersion of sunlight by the water drops in the atmosphere. This is a phenomenon due to combined effect of dispersion, refraction and reflection of sunlight by spherical water droplets of rain.

81) What are the conditions for observing a rainbow?
The conditions for observing a rainbow are that the sun should be shining in one part of the sky (say near western horizon) while it is raining in the opposite part of the sky (say eastern horizon). An observer can therefore see a rainbow only when his back is towards the sun

82) Why rainbow can not be formed in moon?
No water droplet on moon

83) Explain the formation of primary rainbow with diagram
Refer page no 333 to 335 with diagram 9.27 b

84) Explain the secondary rainbow with diagram
Refer page 335 with diagram 9.27 C

85) State Rayleigh scattering?
The amount of scattering is inversely proportional to the fourth power of the wavelength. This is known as Rayleigh scattering

86) Why does sky appears blue during day time?
The amount of scattering is inversely proportional to the fourth power of the wavelength. This is known as Rayleigh scattering
Since blue has a shorter wavelength than red and is scattered much more strongly. In fact, violet gets scattered even more than blue, having a shorter wavelength. But since our eyes are more sensitive to blue than violet, we see the sky blue Hence, the bluish colour predominates in a clear sky,

87) Under what condition Rayleigh scattering is i) valid ii) not valid?
If the relative size of the wavelength of light λ, and the scatterer (of typical size, say, *a*) then for $a << \lambda$, one has Rayleigh scattering which is proportional to $(1/\lambda)4$. Rayleigh scattering is valid.
If $a >> \lambda$, i.e., large scattering objects (for example, raindrops, large dust or ice particles) this is not true ie not

88) Why does cloud containing water droplet appear white?
For $a >> \lambda$, i.e., large scattering objects (for example, raindrops, large dust or ice particles) this is not true; **all wavelengths are scattered nearly equally**. Thus, clouds which have droplets of water with $a >> \lambda$ are generally white.

89) Why does sun appear reddish during sun rise and sun set?
The amount of scattering is inversely proportional to the fourth power of the wavelength. This is known as Rayleigh scattering
At sunset or sunrise, the sun's rays have to pass through a larger distance in the atmosphere . Most of the blue and other shorter wavelengths are removed by scattering. Red has longer wavelength and is least scattered. The least scattered light reaching our eyes, therefore, the sun looks reddish. This explains the reddish appearance of the sun and full moon near the horizon.

OPTICAL INSTRUMENT

90) **Draw a ray diagram to get final image at LDDV or near point in simple microscope and derive an expression for the magnifying power of simple microscope**
91) Which colour of light blue or red has greater magnifying power? Why?
MP= 1+ (D/f). $\lambda_B < \lambda_R$, $n_B > n_R$, $f_B < F_R$ .So MP for blue is greater than red.
92) **Draw a ray diagram to get final image at infinity in simple microscope and give an expression for the magnifying power of simple microscope**
93) Why do you prefer simple microscope when final image is formed at infinity than at near point?

The viewing is more comfortable and the difference in magnification is usually small. So simple microscope when final image is formed at infinity is preferred.

94) Draw a ray diagram to get final image at LDDV or near point in compound microscope and derive an expression for the magnifying power of compound microscope

95) Draw a ray diagram to get final image at infinity or normal adjustment method in compound microscope and give an expression for the magnifying power of compound microscope

96) How will you increase the magnifying power of compound microscope?

By decreasing focal length of objective and eyepiece MP can be increased

$$\text{MP} = \frac{L}{f_0} * \frac{D}{f_e}$$

factors such as illumination of the object, contribute to the quality and visibility of the image

97) Why do you prefer multi component lenses are used in compound microscope?

In modern microscopes, multi component lenses are used for both the objective and the eyepiece to improve image quality by minimising various optical aberrations (defects) in lenses.

98) **Draw a ray diagram to get final image at LDDV or near point in Astronomical refracting telescope and derive an expression for the magnifying power**

95) Draw a ray diagram to get final image at infinity or normal adjustment method in Astronomical refracting telescope and derive an expression for the magnifying power

96) How will you increase the magnifying power of telescope ?

By increasing focal length of objective and focal length of eye piece .MP can be increased

MP =fo/fe

96) **Draw a ray diagram to get final image in Astronomical reflecting telescope and give an expression for the magnifying power**

97) Give advantages of reflecting type telescope over refracting type

Reflecting Telescope	Refracting Telescope
1. There is no chromatic aberration since there is no refraction	There is chromatic aberration due to refraction by lens
2. Resolving power can be increased by choosing large aperture parabolic mirror (Objective)	Resolving power cannot be increased to a great extent because it is difficult to make large aperture lens because it is difficult to grind
3. The weight of the large aperture spherical mirror its less, thus can be held easily	Weight of large aperture spherical lens is high, thus it is difficult to hold
4. Spherical or parabolic mirror are used as objectives	Convex lenses are used as objective
5. Spherical aberration can be minimized by using parbolic mirror	Spherical aberration can be reduced by making the ray passing closer to principles axes

98) Give one limitation of reflecting over refracting type telescope

One obvious problem with reflecting telescope is that the objective mirror focuses light inside the telescope tube. One must have an eye piece and the observer right there, obstructing some light, thus decreasing intensity of light.

99) Why do you prefer large aperture objective in telescope?

Light gathering power is increased and resolving power can be increased.

100) consider a telescope whose objective has a focal length of 100 cm and the eyepiece a focal length of 1 cm. Let us consider a pair of stars of actual separation 1′ (one minute of arc). What is the separation when it is viewed through telescope?

ANS: The magnifying power of this telescope is m = 100/1 = 100.

The stars appear as though they are separated by an angle of $100 \times 1' = 100' = 1.67^{o}$

101) what is the difference between terrestrial and astronomical telescope in construction and nature of image formed?

Terrestrial telescopes have, in addition, a pair of inverting lenses to make the final image erect.