King Saud University

College of Applied Medical Sciences

Biomedical Technology

BMT 336

Sample Exam

Q1. Define the following:

1. Law of Reflection:
2. Law of Refraction “Snell’s law”:
3. Aperture stop (AS) :
4. Field stop (FS) :

Answer:

Law of Reflection: When a ray of light is reflected at an interface dividing two optical media, the reflected ray remains within the plane of incidence, and the angle of reflection equals the angle of incident. The plane of incident is the plane containing the incident ray and the surface normal at the point of incidence.

Law of Refraction “Snell’s law”: When a ray of light is refracted at an interface dividing two transparent media, the transmitted ray remains within the plane of incidence and the sine of the angle of refraction, is directly proportional to the sine of the angle of the incidence.

Aperture stop (AS): The real element in an optical system that limits the size of the cone of rays accepted by the system from an axial object point.

Field stop (FS) : The real element that limits the angular field of view formed by an optical system.

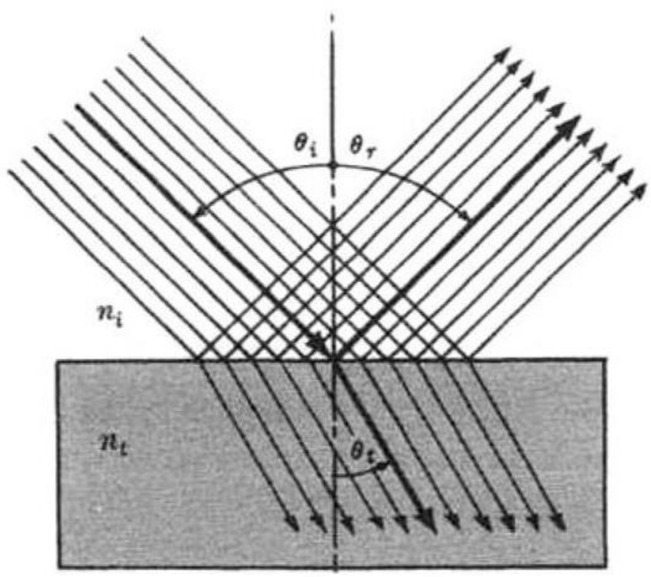
Q2: A beam of collimated light (i.e. having parallel rays) traveling in air makes an angle of 30 ° to the normal to a glass plate. If the index of the glass is 3/2, determine the direction of the transmitted beam within the plate.

Answer:

Snell's law:

$$nt\ sin\theta t = ni\ sin\theta i$$

The law gives us the relationship between the incident and transmitted angles.



Here for air $n\, ni = 1$,

$\theta i = 30^{o}$;

nt = 3/2

Hence $(1) \sin 30^{o} = \frac{3}{2} \sin \theta t$

sin 30º= ½

So, $\sin \theta t$ = 0.333

$\sin \theta t = 19.5^{\text{o}}$ is the angle made with the normal

Q3: Suppose that an object positioned 10 inches to the left of a positive lens is imaged 30 inches to the right of the lens. Where will the image appear if the object is now moved so that it is 2.5 inches from the lens?

Completely describe the image in both instances.

Answer:

The focal length of the lens can be obtained from the thin lens equation:

$\frac{1}{f} = \frac{1}{d1} + \frac{1}{d2}$

Where d1 and d2 are object distance and image distance, respectively.

$$\frac{1}{10} + \frac{1}{30} = \frac{1}{f}$$

F = +7.5

Also,

$$Mt = -\, d2/d1$$

Mt = -3

And so this image is a real, inverted and magnified image

For the second situation:

d1 = 2.5

$$\frac{1}{d2} + \frac{1}{d1} = \frac{1}{7.5}$$

d2 = - 3.75

in this situation the image is virtual, erect and located 3.75 from the front lense.

Mt = +1.5

Q4. Light having a free space wavelength of λ= 500nm passes from vacuum into diamond (n=2.4). Under ordinary circumstances the frequency is unaltered as light traverses different substances.

Assuming this to be the case, compute the wave's speed and wavelength in the diamond.

Answer:

Since $n = \frac{c}{v}$

$\boldsymbol{v = c/n}$

$$\boldsymbol{v = \frac{3 \times 10^8}{2.4}}$$

$\boldsymbol{wavelength = 1.25 \times 10^8}$ **m/s**

And $\boldsymbol{n = \frac{c}{v} = \frac{(\lambda 0\ v0)}{\lambda\ v} = \lambda 0/\lambda}$

$\boldsymbol{\lambda = 208\ nm}$