APPLIED PHYSCIS

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Note: Attempt all Questions.

Q1: What is the difference between Reflection and Refraction?

ANS). Difference Between Reflection and Refraction of Light in Tabular Form

BASIS OF COMPARISON	REFLECTION	REFRACTION
Description	**Reflection is the bouncing back of light when it strikes a smooth surface.**	**Refraction is the bending of light when it travels from one medium to another.**
Nature of Surface	**Generally, occurs on shinny surfaces that only allow rebounding of light without permitting penetration through it.**	**Occurs in transparent surfaces that allow bending of the ray to a different medium.**
Types/Forms	**There are generally two forms of reflections, that is, Regular reflection (Specular reflection) and Diffused reflection.**	**There is a single form of refraction.**
Occurrence	**Generally, occurs in mirrors.**	**Generally, occurs in lenses.**
Behavior of Light	**In this process light bounces back and returns back in the same direction.**	**In this process light changes path i.e. travels from one medium to another.**
Speed of Light	**When a light ray strikes the boundary of a different medium (shinny surface) the speed of light ray does not vary.**	**The speed of light varies with the medium in which the ray undergoes bending.**
Medium of Light Propagation	**The medium in which light propagates remains the same.**	**The medium of propagation gets changed.**

Angle of Reflection and Angle of Incidence	**The angle of reflection and angle of incidence are same in case of reflection.**	**The angle of reflection and angle of incidence are not same in refraction.**
First Law	**The incident ray, the reflected ray and the normal all lie in the same plane.**	**The incident ray, the refracted ray and normal at the point of incidence all lie in the same plane.**
Second Law	**The angle of reflection is always equal to the angle of incidence.**	**The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media.**

B). What is meant of Critical angle?

ANS). When light ray travelling in denser medium is incident on the rarer medium at an angle of incidence such that the refracted ray grazes out through the interface boundary ($\angle r$=900) then the angle of incidence is called critical angle *ic*. *sin ic*=μ1.

Let us consider two different media. The critical angle is that of θ_{cric} θ_{cric} which gives a value of exactly 90 degrees. If these values are substituted in the Snell's Law equation, we will get a generic equation that will be used to predict the critical angle.

Therefore,

The critical angle = the inverse function of the sine of (\frac {refraction index}{incident index}) (*incident index refractories*)

The equation is:]

\theta_{cric} = \sin^{-1\frac{n_r} {n_i} $\theta_{cric}=\sin^{-1} n_i n_r$

Where,

The Formula for Critical Angle

\theta_{cric}θ_{cric}	**The critical angle.**

n_rn_r	**Refraction index.**
n_in_i	**Incident index.**

C). **What is the main function of angle of incidence?**

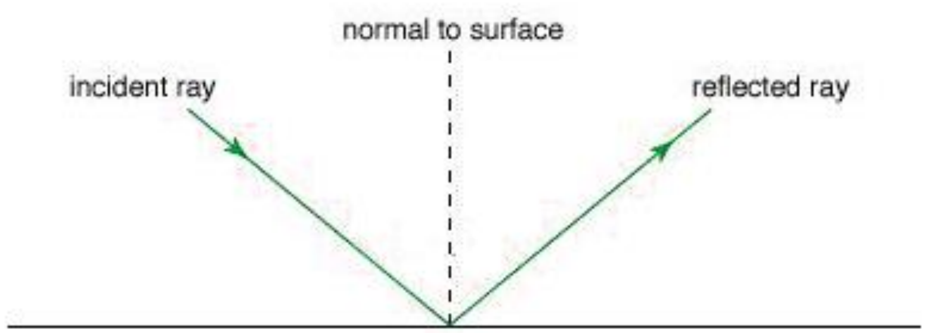
ANS). In optics, angle of incidence can be defined as the angle between a ray incident on a surface and the line perpendicular to the surface at the point of incidence (called as normal). To understand the angle of incidence, we have to first look into the concept of reflection of light. We all know that when a ray of light hits a polished surface like a mirror it is reflected back.

The incident ray and reflected ray form two angles at the point of incidence:

1). The angle formed between the normal and the incident ray at the point of incidence is called the angle of incidence**.**

2). Similarly, the angle formed between the normal and the reflected ray at the point of incidence is called the angle of reflection**.**

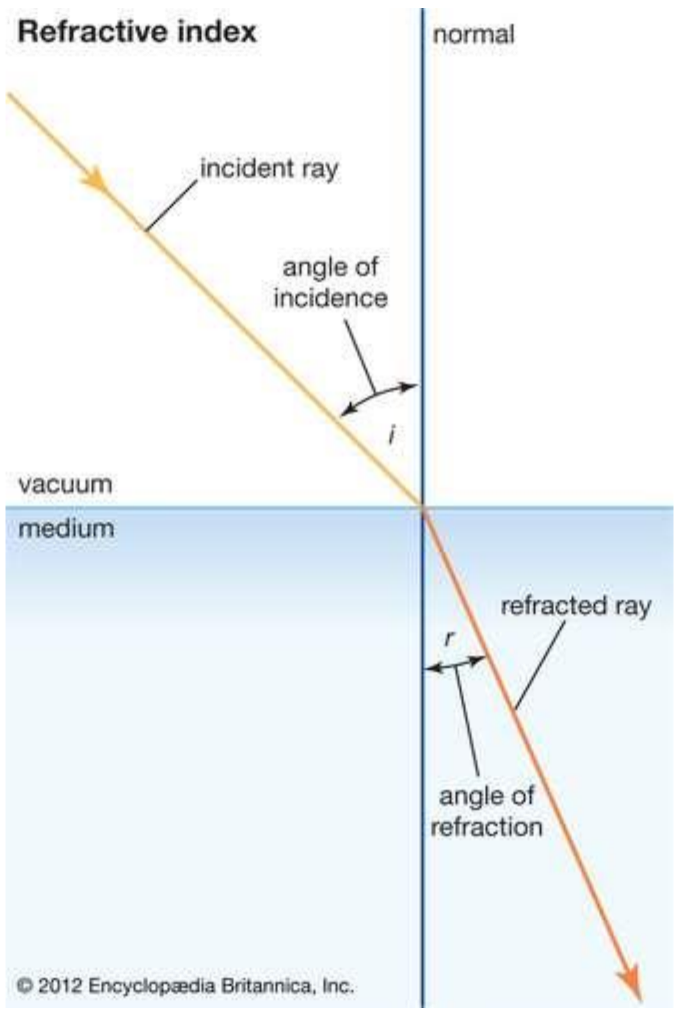
Angle of incidence is equal to the reflected angle through the law of reflection. The angle of incidence and the angle of reflection is always equal and they are both on the same plane along with the normal.



Angle of Incidence Formula

D). What is meant by Index of refraction?

ANS). **Refractive index**, also called **index of refraction**, measure of the bending of a ray of light when passing from one medium into another. If *I* is the angle of incidence of a ray in vacuum (angle between the incoming ray and the perpendicular to the surface of a medium, called the normal) and *r* is the angle of refraction (angle between the ray in the medium and the normal), the refractive index *n* is defined as the ratio of the sine of the angle of incidence to the sine of the angle of refraction; i.e., $n = \sin I / \sin r$. Refractive index is also equal to the velocity of light *c* of a given wavelength in empty space divided by its velocity *v* in a substance, or $n = c/v$.



refractive index

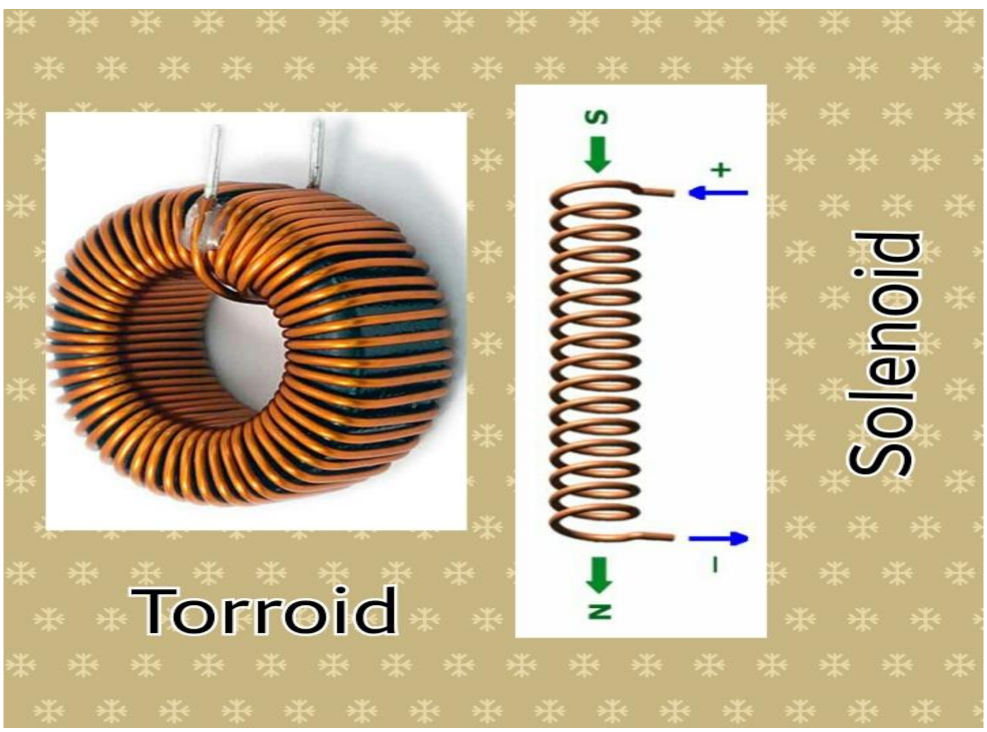
Some typical refractive indices for yellow light (wavelength equal to 589 nanometers [10^{-9} meter]) are the following: air, 1.0003; water, 1.333; crown glass, 1.517; dense flint glass, 1.655; and diamond, 2.417. The variation of refractive index with wavelength is the source of chromatic

aberration in lenses. The refractive index of X-rays is slightly less than 1.0, which means that an X-ray entering a piece of glass from air will be bent away from the normal, unlike a ray of light, which will be bent toward the normal. The equation $n = c/v$ in this case indicates, correctly, that the velocity of X-rays in glass and in other materials is greater than its velocity in empty space.

Q2).

A). **Explain the difference between Solenoid and toroid's?**

ANS). The main difference between solenoid and toroid is that the solenoid is considered as the straight coil and the toroid is the bent solenoid which is having ring or doughnut shape. In toroid due to the ring shape the magnetic field is much stronger than solenoid at Its center.

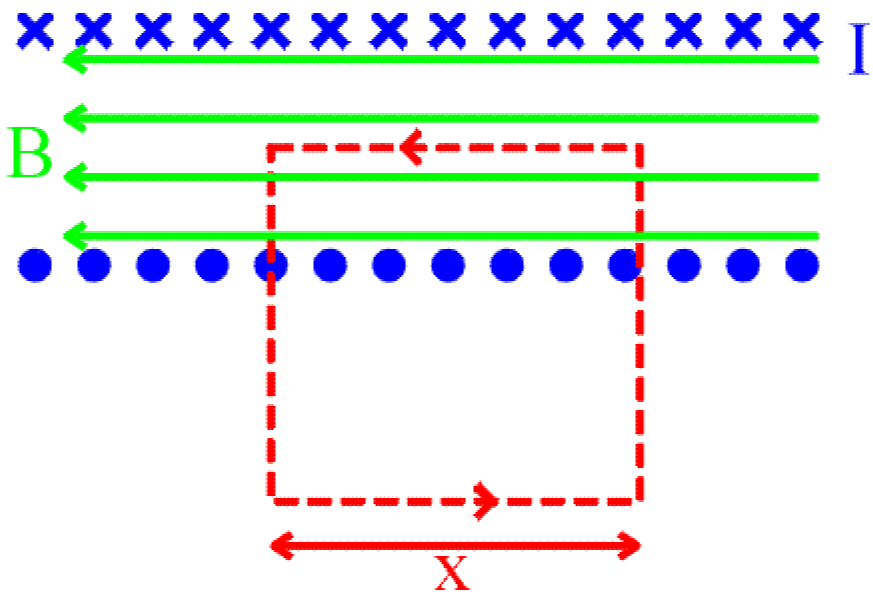


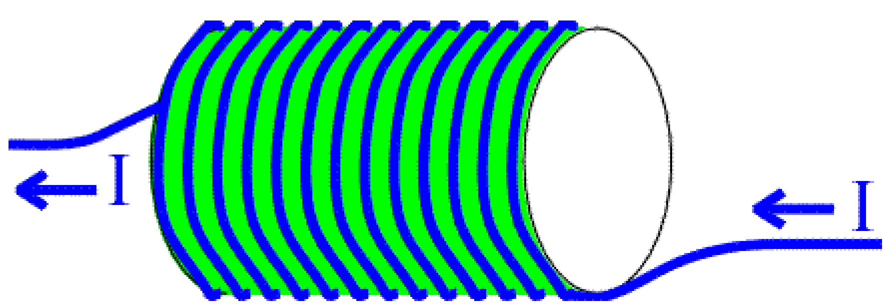
B). **Explain the Magnetic field of solenoids?**

ANS). A solenoid is a coil of wire designed to create a strong magnetic field inside the coil. By wrapping the same wire many times around, a cylinder, the magnetic field due to the wires can become quite strong. The number of turns ***N*** refers to the number of loops the solenoid has. More loops will bring about a stronger magnetic field. The formula for the field inside the solenoid is

$$B = \mu_0 I\, N / L$$

This formula can be accepted on faith; or it can be derived using Ampere's law as follows. Look at a cross section of the solenoid.





The blue crosses represent the current traveling into the page, while the blue dots represent the currents coming out of the page. Ampere's law (left) for the red path can be written as.

$$\sum_i B_i \,\Delta L_i \cos\theta_i = \mu_0 I \quad \Rightarrow \quad B\cdot x = \mu_0\left(\frac{N}{L}x\right)I$$

where the number of loops enclose by the path is (***N/L***) ***x.*** Only the upper portion of the path contributed to the sum because the magnetic field is zero outside, and because the vertical paths are perpendicular to the magnetic field. By dividing ***x*** out of both sides of the last equation, one finds:

$$B = \mu_0 \left(\frac{N}{L} \right) I$$

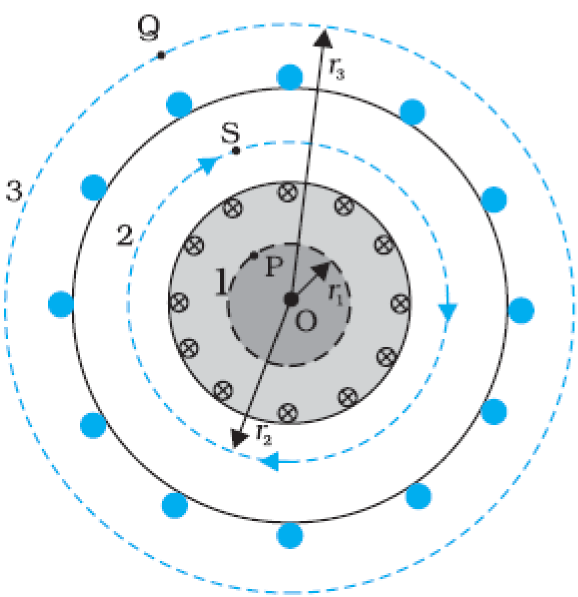
The magnetic field inside a solenoid is proportional to both the applied current and the number of turns per unit length. There is no dependence on the diameter of the solenoid, and the field strength doesn't depend on the position inside the solenoid, i.e., the field inside is constant.

C). Explain the Magnetic field of Toroid's?

ANS). **TOROID - DEFINITION**

If a solenoid is bent in a circular shape and the ends are joined, we get a toroid. Alternatively, one can start with a nonconducting ring and wind a conducting wire closely on it. The magnetic field in such a toroid can be obtained using Ampere's Law.

MAGNETIC FIELD DUE TO A TOROID - EXAMPLE

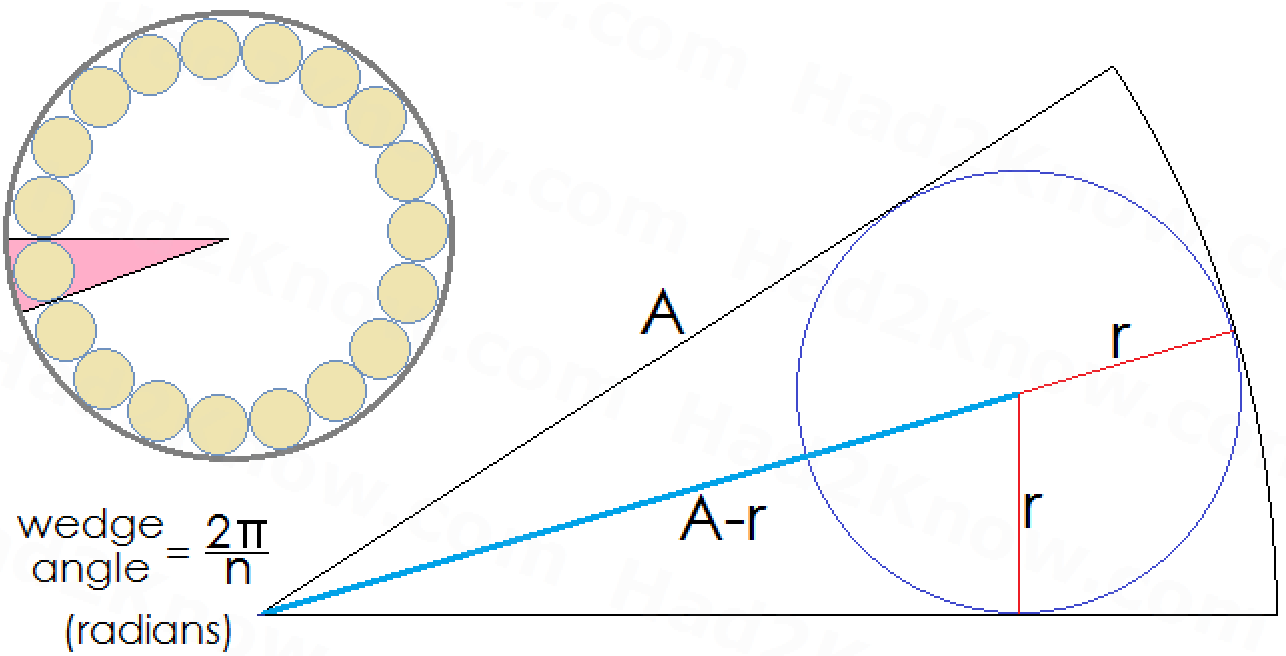


The magnetic field in the open space inside (point P) and exterior to the toroid (point Q) is zero. The field *B* inside the toroid is constant in magnitude for the ideal toroid of closely wound turns. The direction of the magnetic field inside is clockwise as per the right-hand thumb rule for circular loops. Three circular Amperian loops 1, 2 and 3 are shown by dashed lines. By symmetry, the magnetic field should be tangential to each of them and constant in magnitude for a given loop.

Example: The number of turns per unit length in a toroid is 103 and current

flowing in it is $4\pi1$ ampere, then the magnetic induction produced in it, is :
Magnetic field in a toroid $B=\mu0ni$
Given $n=103$ and $i=4\pi1A$
We know that $\mu0=4\pi\times10-7T/A$
$B=4\pi\times10-7\times103\times4\pi1=10-4T$

NUMBER OF TURNS IN A TOROIDAL COIL - FORMULA



The figure below shows a cross-sectional view of the inner radius of a toroid inductor and wire. The inner radius of the torus is A, **the radius of the wire is** r, **and the maximum number of loops is** n.
The equation that relates A, r, **and** n **is:**
$sin(n\pi)=A-rr$ **in radians**

$n=$**arcsin**$A-rr\pi$