Formulas from the Lesson on Light

1. Law of Reflection

Formula:

$$\theta_i = \theta_r$$

Where:

- θ_i = Angle of incidence
- θ_r = Angle of reflection

Example:
A light ray strikes a mirror at an angle of 30°. What will be the angle of reflection?
Solution:
Using the law of reflection:

$$\theta_r = \theta_i = 30°$$

So, the angle of reflection is **30°**.

2. Distance of Image in a Plane Mirror

Formula:

$$d_o = d_i$$

Where:

- d_o = Distance of the object from the mirror
- d_i = Distance of the image behind the mirror

Example:
If a person stands **2 meters** in front of a plane mirror, where is the image located?
Solution:

$$d_i = d_o = 2 \text{ meters}$$

So, the image is formed **2 meters behind** the mirror.

3. Speed of Light

Formula:

$$c = 3.0 \times 10^8 \text{ m/s}$$

Where:

- c = Speed of light in vacuum or air

Speed of light in different media:

- **Vacuum/Air:** $3.0 \times 10^8 m/s$
- **Water:** $2.25 \times 10^8 m/s$
- **Glass:** $2.0 \times 10^8 m/s$

Example:
If light takes **2 × 10⁻⁹ seconds** to travel through a 60 cm glass slab, what is the speed of light in the glass?
Solution:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{0.60}{2 \times 10^{-9}} = 3.0 \times 10^8 \text{ m/s}$$

So, the speed of light in glass is ** $3.0 \times 10^8 m/s$**.

4. Refractive Index

Formula:

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

Where:

- n = Refractive index
- c = Speed of light in vacuum
- v = Speed of light in the medium

Example:
The speed of light in water is ** $2.25 \times 10^8 m/s$. What is the refractive index of water?**
****Solution:**

$$n = \frac{3.0 \times 10^8}{2.25 \times 10^8} = 1.33$$

So, the refractive index of water is **1.33**.

5. Relation Between Wavelength, Frequency, and Speed of Light

Formula:

$$c = \lambda f$$

Where:

- c = Speed of light
- λ = Wavelength of light (in meters)
- f = Frequency of light (in Hertz)

Example:
If the frequency of red light is ** 4.3×10^{14} Hz**, what is its wavelength?
Solution:

$$\lambda = \frac{c}{f} = \frac{3.0 \times 10^8}{4.3 \times 10^{14}}$$

$$= 7.0 \times 10^{-7} \text{ m} = 700 \text{ nm}$$

So, the wavelength of red light is **700 nm**.

6. Lateral Inversion (Image Reversal)

Formula:

M = -1

Where:

- M = Magnification (negative sign indicates inversion)

Example:
The word **"AMBULANCE"** is written in reverse on the front of an ambulance so that it appears correctly in a rear-view mirror.

7. Colour Subtraction

Formula:

$$\text{White light} - \text{absorbed colour} = \text{reflected colour}$$

Example:
If a cloth absorbs **red** and reflects **blue and green**, what colour does it appear?
Solution:

$$\text{White} - \text{Red} = \text{Cyan}(\text{Blue} + \text{Green})$$

So, the cloth appears **cyan**.

8. Image Distance in a Plane Mirror

Formula:

$$h_i = h_o$$

Where:

- h_i = Height of the image
- h_o = Height of the object

Example:
If a person is **1.6 meters** tall, what is the height of their image in a plane mirror?
Solution:

$$h_i = h_o = 1.6 \text{ m}$$

So, the image height is **1.6 meters**.

9. Multiple Reflections

Formula for Number of Images Formed by Two Mirrors at an Angle \theta :

$$N = \frac{360^\circ}{\theta} - 1$$

Example:
Two mirrors are placed at an angle of **90°**. How many images will be formed?
Solution:

$$N = \frac{360^\circ}{90^\circ} - 1 = 4 - 1 = 3$$

So, **3 images** will be formed.

10. Magnification Formula

Formula:

$$M = \frac{\text{Height of image}(h_i)}{\text{Height of object}(h_o)}$$

$$M = \frac{\text{Image Distance}(d_i)}{\text{Object Distance}(d_o)}$$

Example:
If an object **10 cm** tall is placed **20 cm** in front of a plane mirror, what is the size of its image?
Solution:

$$M = \frac{h_i}{h_o} = 1 \Rightarrow h_i = 10 \text{ cm}$$

So, the image height is **10 cm**.

Final Notes

These formulas are essential for solving problems related to light, reflection, and image formation. Let me know if you need more practice questions! 🚀