جامعة المستقبل

كلية التقنيات الصحية والطبية

قسم تقنيات البصريات

Second Stage 2024-2025

REFRACTIVE ERRORS 1

Lecture Title

Light

Lecture Number: 1 / course 1

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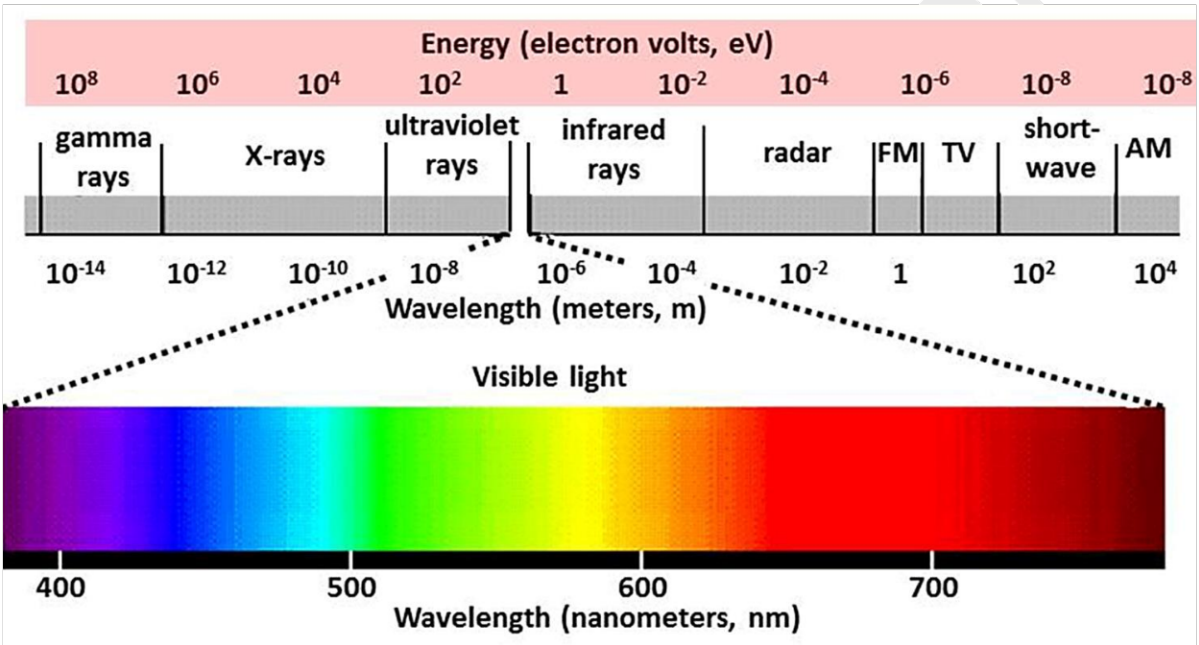
OPTOMETRIST

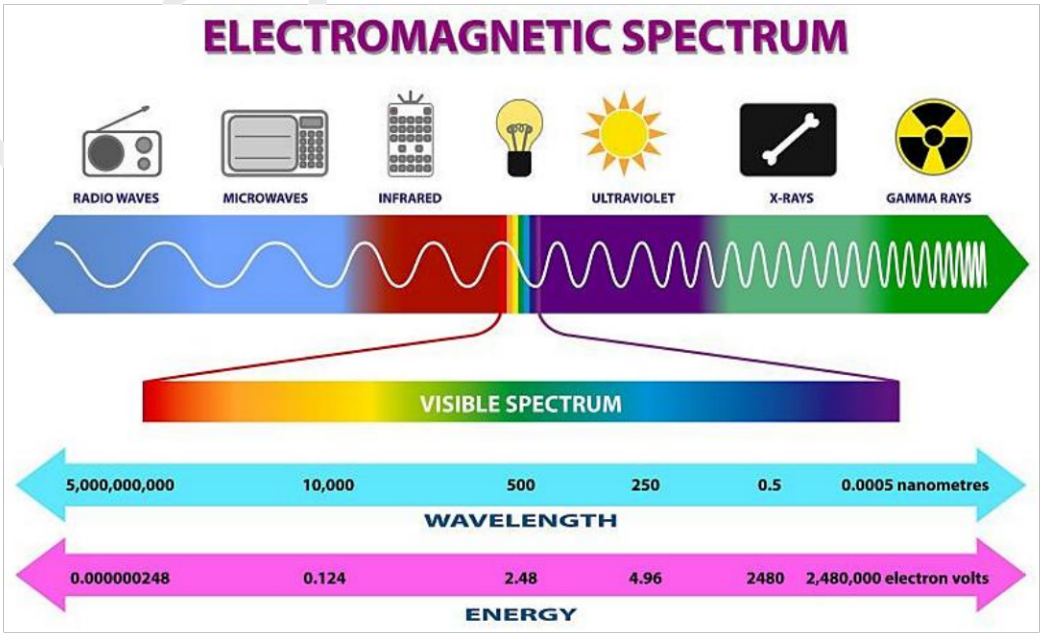
Light

Light is a form of electromagnetic radiation that is visible to the human eye. It is one of the fundamental ways energy is transferred through space.

Electromagnetic Radiation الإشعاع الكهرومغناطيسي

- **Light is part of the electromagnetic spectrum, which includes other forms of radiation such as radio waves, microwaves, infrared, ultraviolet, X-rays, and gamma rays.**





Speed of Light سرعة الضوء

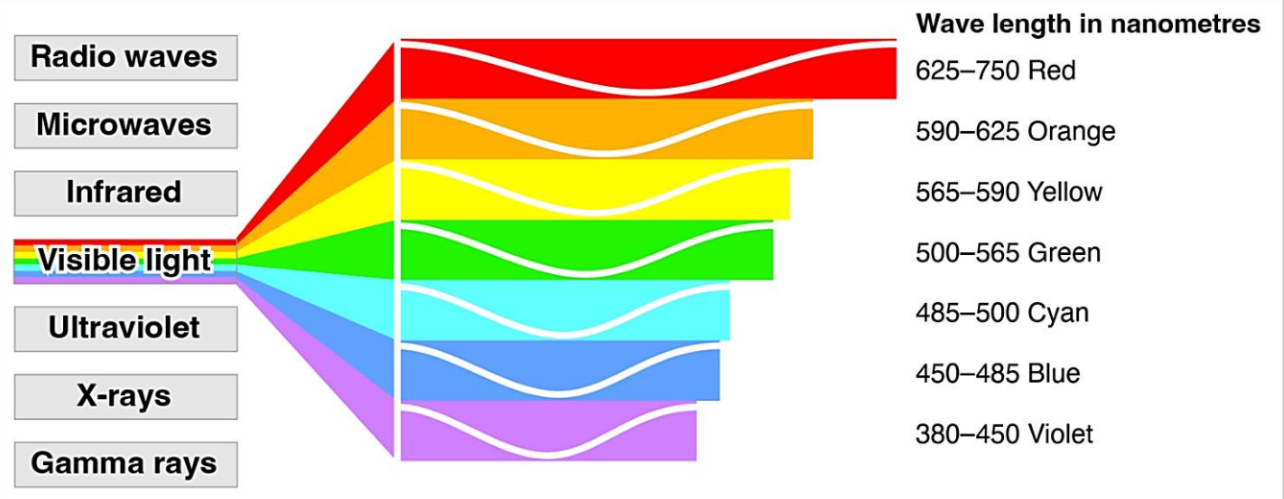
- In a vacuum, light travels at a constant speed of approximately 3×10^8 m/s.
- The speed of light changes when it passes through different media (like water or glass), slowing down as it enters denser materials.

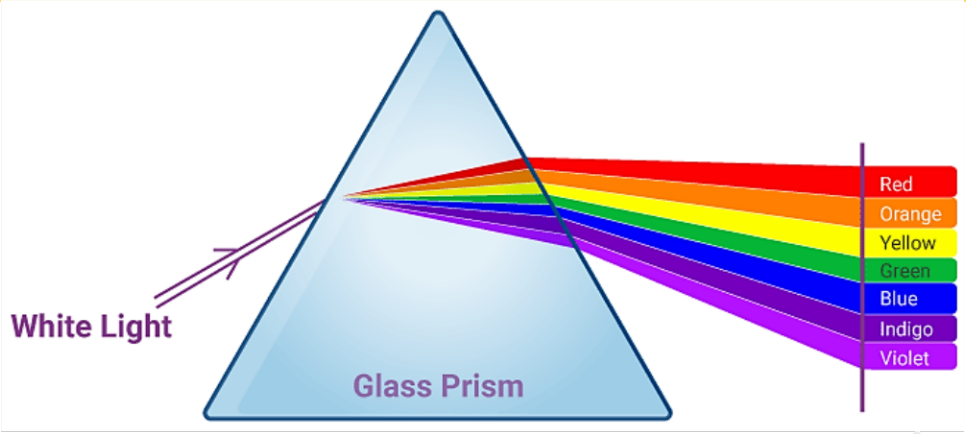
Interaction with Matter التفاعل مع المادة

- When light interacts with matter, it can be absorbed, reflected, refracted, or transmitted depending on the material's properties and the light's wavelength.
- The color we perceive in objects is due to the wavelengths of light that are reflected from the object to our eyes, with other wavelengths being absorbed.

Visible Spectrum الطيف المرئي

- The part of the electromagnetic spectrum that is visible to the human eye is known as the visible spectrum, ranging from approximately 400 nanometers (violet) to 700 nanometers (red).
- Different wavelengths within this range correspond to different colors, from violet to red.





Importance of Light أهمية الضوء

- **Light is essential for vision, allowing us to see the world around us.**
- **It plays a crucial role in processes like photosynthesis, which is vital for life on Earth.**
- **Light is also used in various technologies, including communication, medicine, and energy.**

Behaviour of Light سلوك الضوء

Light rays can travel in different directions or the same direction. Types of light rays include:

- **parallel light rays: Light travels from an object into our eyes by moving in straight lines. These lines are called light rays.**

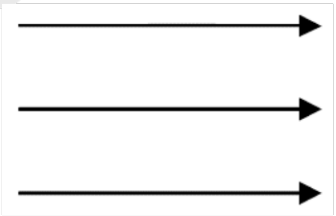


Figure 1: Parallel light rays

- **convergent light rays: Convergent light rays will meet at a focal point.**

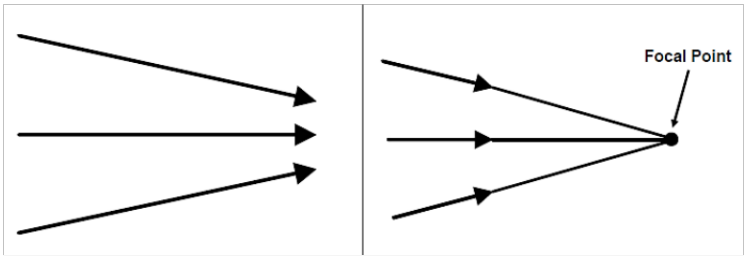


Figure 2: Convergent light rays converge to a focal point

- **divergent light rays: Divergent light rays come from an object less than 6 m from the eye.**

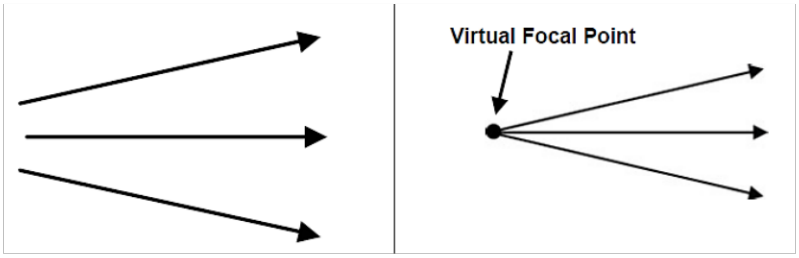


Figure 3: *Divergent light rays*

Optical Medium الوسط البصري

Light rays can travel through any transparent (clear) material. A transparent material that lets light travel through it is called an optical medium.

An optical medium can be a:

- **gas (like air)**
- **liquid (like water)**
- **solid (like glass or clear plastic)**

Refractive Index معامل الانكسار

Every optical medium has a specific refractive index. It is the ratio of the speed of light in a vacuum to that in a second medium of greater density

Light travels faster in a medium that has a low refractive index (like air), and slower in a medium that has a high refractive index (like glass).

$$refractive\ index = \frac{speed\ of\ light\ in\ air}{speed\ of\ light\ in\ medium}$$

Examples of refractive index are:

Air = 1

Water = 1.333

Crown glass = 1.52

Flint glass = 1.62

Diamond = 2.42

Aqueous humour = 1.336

Cornea = 1.376

Crystalline lens = 1.386 – 1.406

Reflection الانعكاس

light ray will bounce off a surface when it reaches a smooth reflecting surface, such as a mirror.

***Law of reflection*: angle of incidence = angle of reflection**

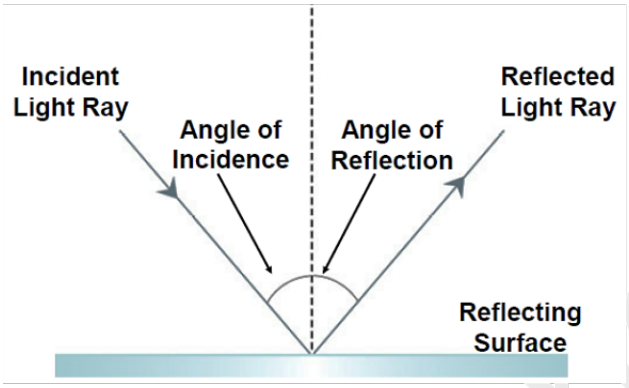


Figure 4: Reflection

Refraction الانكسار

When a light ray travels from a medium with a lower refractive index into a medium with a higher refractive index, the light ray is bent towards the normal.

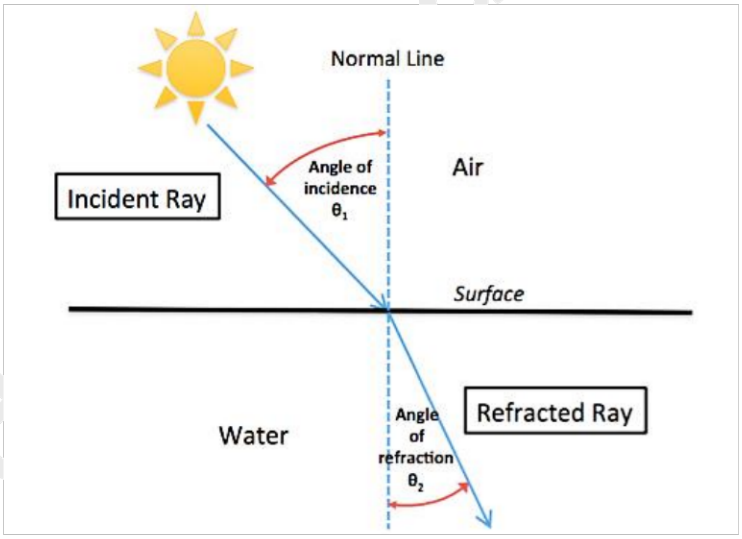


Figure 5: Refraction

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ **snell's law**

When a light ray travels from a medium with a higher refractive index (high density) into a medium with a lower refractive index (low density), the light ray is bent away from the normal. "VICE VERSA"

1. Definitions and Concepts (Short Answer)

a) **Define the term electromagnetic radiation and explain where light fits within the electromagnetic spectrum.**
b) **What is the speed of light in a vacuum, and how does it change when light passes through a medium such as glass or water?**
c) **Explain the difference between parallel, convergent, and divergent light rays. Provide examples of where each type might be encountered in daily life.**
d) **What is the refractive index? List the refractive index for air, water, and the cornea.**

2. Problem-Solving (Calculations)

a) **A light ray travels from air into water. If the angle of incidence in the air is 30°, calculate the angle of refraction in the water.**
b) **b. Consider a light ray traveling from crown glass to air. If the angle of incidence in the glass is 45°, calculate the angle of refraction in the air.**

3. Reflection and Refraction (Essay)

Write a short essay (300-500 words) on how reflection and refraction of light are used in designing optical instruments, such as eyeglasses, cameras, or microscopes. Discuss the importance of understanding these concepts in the field of optometry.