



What is light?

Short answer: The colours we can see with our eyes.

Look at a light bulb, what colour is it?

white.

Where are the colours?

White light is seeing all of the colours at once.

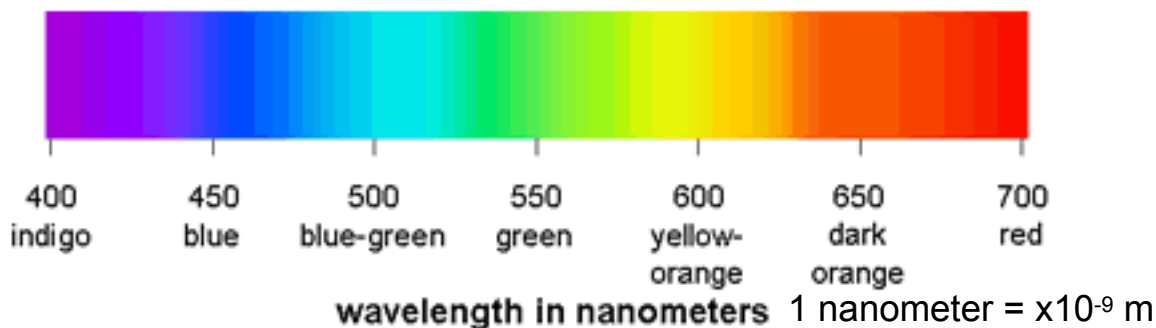


Why is something blue?

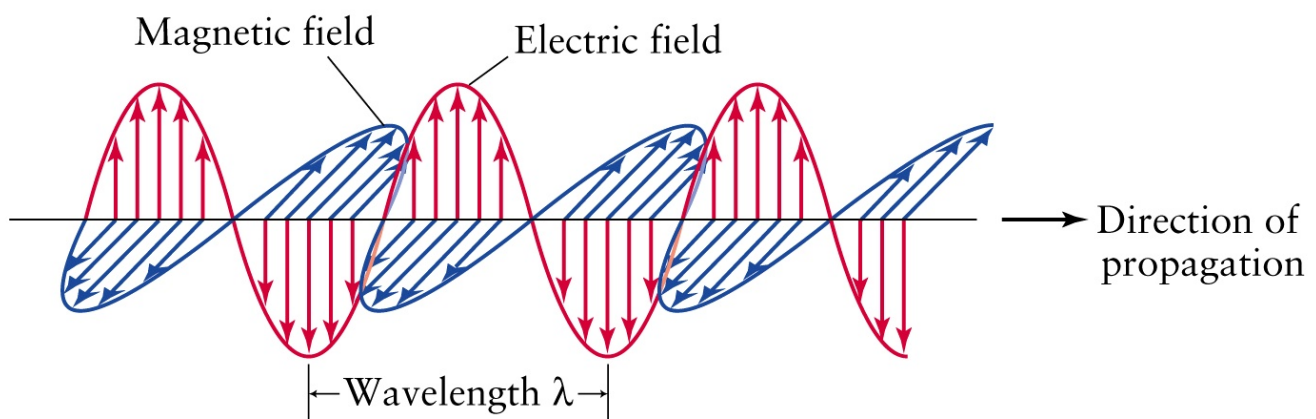
That object absorbs all colours and reflects blue.

Is white a colour? Is black a colour?

- Light is a type of wave called an electromagnetic wave.
- It has many of the same wave properties we discussed in grade 11:
 - > amplitude
 - > wavelength
 - > frequency
 - > speed
- It obeys the wave equation: $v = f\lambda$



- Electromagnetic waves "look" different.
- They are a moving electric and magnetic field.



- We will keep it simple and use the properties of transverse waves in our discussion of light.

What colour is the Sun?



What are some types of radiation?

x-rays, radio waves, infrared, ultraviolet, gamma rays, microwaves, and light.

- All of these forms of radiation form what is called the **Electromagnet Spectrum**.
- They are all an interaction of magnetic and electric fields and travel at the same speed in a perfect vacuum. $c = 3.00 \times 10^8 \text{ m/s}$

The Electromagnetic Spectrum

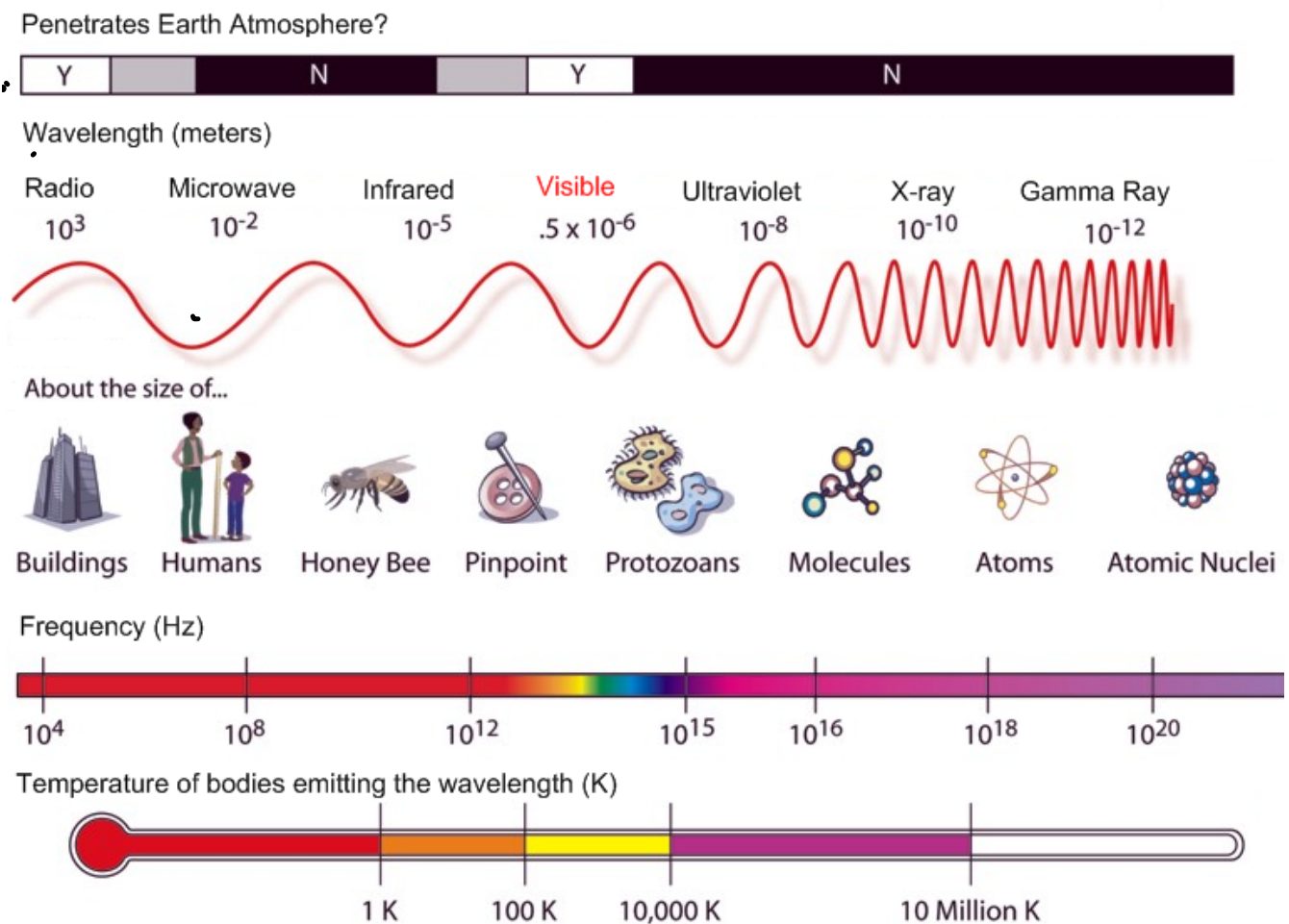


Table 1 The Electromagnetic Spectrum

Classification	Range	Applications
radio waves	$\lambda > 30 \text{ cm}$ $f < 1.0 \times 10^9 \text{ Hz}$	AM and FM radio; television
microwaves	$30 \text{ cm} > \lambda > 1 \text{ mm}$ $1.0 \times 10^9 \text{ Hz} < f < 3.0 \times 10^{11} \text{ Hz}$	radar; atomic and molecular research; aircraft navigation; microwave ovens
infrared (IR) waves	$1 \text{ mm} > \lambda > 700 \text{ nm}$ $3.0 \times 10^{11} \text{ Hz} < f < 4.3 \times 10^{14} \text{ Hz}$	molecular vibrational spectra; infrared photography; physical therapy
visible light	$700 \text{ nm (red)} > \lambda > 400 \text{ nm (violet)}$ $4.3 \times 10^{14} \text{ Hz} < f < 7.5 \times 10^{14} \text{ Hz}$	visible-light photography; optical microscopy; optical astronomy
ultraviolet (UV) light	$400 \text{ nm} > \lambda > 60 \text{ nm}$ $7.5 \times 10^{14} \text{ Hz} < f < 5.0 \times 10^{15} \text{ Hz}$	sterilization of medical instruments; identification of fluorescent minerals
X rays	$60 \text{ nm} > \lambda > 10^{-4} \text{ nm}$ $5.0 \times 10^{15} \text{ Hz} < f < 3.0 \times 10^{21} \text{ Hz}$	medical examination of bones, teeth, and vital organs; treatment for types of cancer
gamma rays	$0.1 \text{ nm} > \lambda > 10^{-5} \text{ nm}$ $3.0 \times 10^{18} \text{ Hz} < f < 3.0 \times 10^{22} \text{ Hz}$	examination of thick materials for structural flaws; treatment of types of cancer; food irradiation

WAVE SPEED EQUATION

$$c = f\lambda$$

speed of light = frequency \times wavelength

PROBLEM

The AM radio band extends from 5.4×10^5 Hz to 1.7×10^6 Hz. What are the longest and shortest wavelengths in this frequency range?

SOLUTION

Given: $f_1 = 5.4 \times 10^5$ Hz $f_2 = 1.7 \times 10^6$ Hz $c = 3.00 \times 10^8$ m/s

Unknown: $\lambda_1 = ?$ $\lambda_2 = ?$

Use the wave speed equation on this page to find the wavelengths:

$$c = f\lambda \quad \lambda = \frac{c}{f}$$

$$\lambda_1 = \frac{3.00 \times 10^8 \text{ m/s}}{5.4 \times 10^5 \text{ Hz}}$$

$$\lambda_1 = 5.6 \times 10^2 \text{ m}$$

$$\lambda_2 = \frac{3.00 \times 10^8 \text{ m/s}}{1.7 \times 10^6 \text{ Hz}}$$

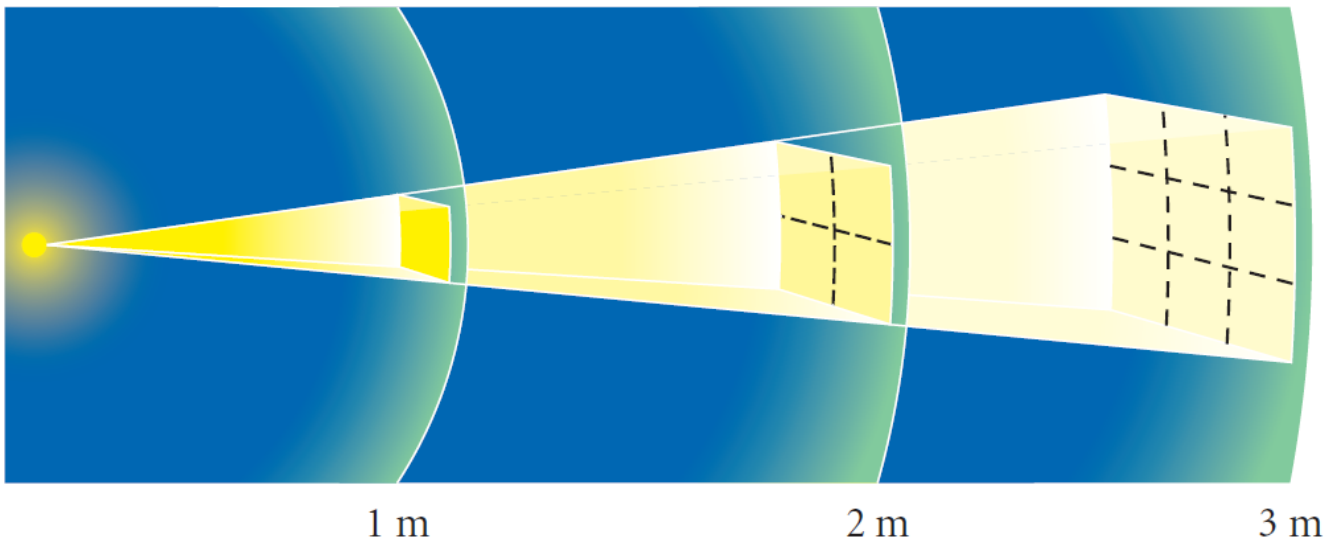
$$\lambda_2 = 1.8 \times 10^2 \text{ m}$$

CALCULATOR SOLUTION

Although the calculator solutions are 555.5555556 m and 176.470588 m, both answers must be rounded to two digits because the frequencies have only two significant figures.

Read Holt: Pages 446-450.

Light obeys the Inverse Square Law



Read about it in Holt: Page 450.

1. Describe the meaning of luminous flux.
2. Why is it called the "inverse square law"?
3. When purchasing a digital projector should you only look at the wattage of the unit? Explain.
4. Does the higher the wattage mean the brighter the bulb? Provide details to support your answer.

EM Radiation Review

Grade: 12
Subject: Science 122
Date: Sept. 2014

1 What type of wave does light travel as?

- A Longitudinal
- B Transverse
- C Pressure
- D Electromagnetic

2 All parts of the electromagnetic spectrum travel at the same speed in a perfect vacuum.

True

False

3 What part of the EM spectrum does light fall into?

A Microwave

B Visible

C Ultra Violet

D Gamma

4 Most of the EM radiation emitted by the Sun is in the coloured part of the spectrum.

Yes

No

5 What is the term for the rate of the creation of visible light by an object.

A Lumens

B Luminous Flux

C Brightness

D Illuminance

6 Which one is EM radiation with the most energy?

A x-rays

B microwaves

C ultraviolet

D infrared

7 A person is 3m from a light source. He then moves to a point 12m from the source. By what factor as the illuminance been reduced?

A 16

B 9

C 8

D 4

8 Is black a colour.

Yes

No

Attachments

microwaves_en.jnlp