08/04/2020

*Note: for all EMR, v = speed of light $= 3.00 \times 10^8$ m/s

S30 Unit C: Universal Wave Equation Practice Problems

Name: Key!

Date: ____________

Show all work, including beginning formulas, units and significant digits. Answers are provided so you can check your work.

1. Determine the wavelength of the EMR emitted by a 60 Hz AC transmission line. **(5.0×10^6 m)**

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = (60 \text{ Hz})\lambda$

$\lambda = 5.0\times10^6 \text{ m}$

2. A cellular telephone operates on a frequency of 800 MHz. Determine the wavelength of the EM wave. **(0.375 m)**

Note: M = mega $= 10^6$ (on data sheet)

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = (800\times10^6 \text{ Hz})\lambda$

$\lambda = 0.375 \text{ m}$

3. Find the frequency of an AM band radio wave with a wavelength of 390 m. **(7.69×10^5 Hz)**

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = f(390 \text{ m})$

$f = 7.69\times10^5 \text{ Hz}$

4. Determine the wavelength (in Mm) of the EMR emitted by a 55 Hz AC transmission line. **(5.5 Mm)**

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = (55 \text{ Hz})\lambda$

$\lambda = 5454545 \text{ m}$

$= 5.5\times10^6 \text{ m} = 5.5 \text{ Mm}$

Recall: $\times10^6$ is Mega!

5. A cell phone operates on a frequency of 14 GHz. Determine the wavelength of the EM wave. **(0.021 m)**

G = giga $= 10^9$ (on data sheet)

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = (14\times10^9 \text{ Hz})\lambda$

$\lambda = 0.021 \text{ m}$

6. Find the frequency in MHz of an AM band radio wave with a wavelength of 3656 cm. **(8.206 MHz)**

c = centi $= 10^{-2}$ (on data sheet)

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = f(3656\times10^{-2} \text{ m})$

$f = 8.206 \text{ MHz}$

7. An FM radio station transmits at 92.5 MHz. Calculate the wavelength of these radio waves. **(3.24 m)**

$v = f\lambda$ $\quad 3\times10^8 \text{ m/s} = (92.5\times10^6 \text{ Hz})\lambda$

$\lambda = 3.24 \text{ m}$

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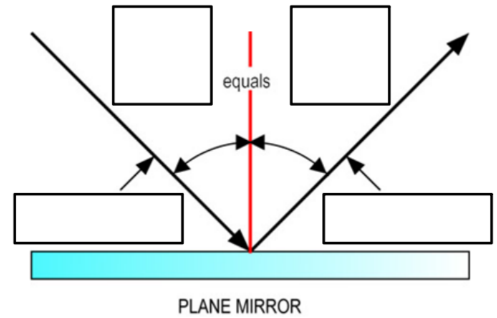
EMR Optics Summary

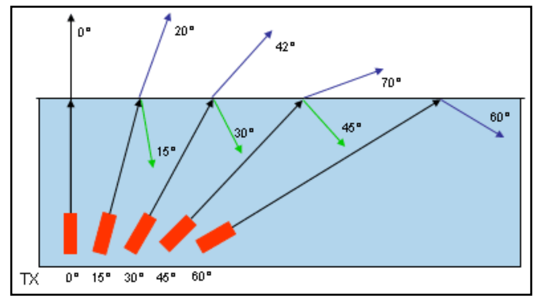
Reflection:



Angle of incidence = Angle of reflection

Normal = perpendicular to mirror

Total Internal Reflection:

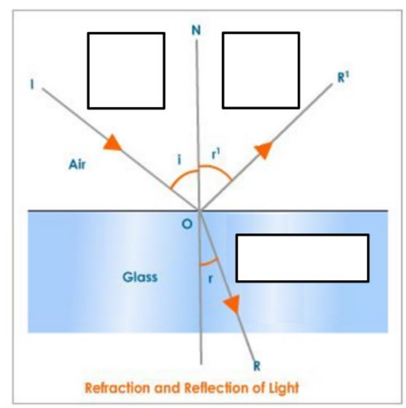


At a critical angle, no light rays are transmitted through the medium and are totally reflected back into the more dense medium.

Two applications of total internal reflection:

1. fibre optics 2. automatic windshield wipers

Refraction:



Materials all have refractive indexes. The higher the index, the more light bends. Light bends towards the normal when going into a more dense (higher index) material. Light bends away from the normal when going into a less dense (lower index) material.

Red light (big wavelength) refracts the least.

Violet light (short wavelength) refracts the most.

Diffraction:

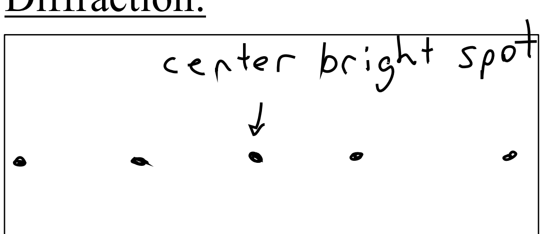


Diagram of interference pattern of a laser.

Light overlaps itself in diffraction, causing a set pattern of light and dark regions.

Polarization:

Some portions of a beam of EMR can be absorbed by a polarizing filter. One technology that use polarized light are polarized sunglasses. One technology that polarizes light is LCD screens.