(1)

$$v = \mathbf{E} \times \mathbf{B}$$

(2-3)

high index of refraction $\iff$ more aligned with normal

---

(4)

Example 0.1:

What inductance must be connected to a 18 pF capacitor in an oscillator capable of generating 600 nm (i.e., visible) electromagnetic waves? Comment on your answer.

Relating frequency and wavelength of EM wave:

$$\boxed{c = f\lambda}.$$

Frequency of oscillation of current in LC circuit:

$$\boxed{f = T^{-1} = \frac{1}{2\pi\sqrt{LC}}}.$$

Thus:

$$2\pi\sqrt{LC} = \frac{\lambda}{c}.$$

Note: $c = 3 \times 10^8\ m/s$.

My mistake was forgetting that $T = \frac{1}{f}$.

---

(5)

Example 0.2:

What is the intensity of a traveling plane electromagnetic wave if Bm is 4.8 104 T?

"Intensity" = Average of the Poynting vector:

$$I = \langle S \rangle = \frac{1}{2\mu_0} E_0 B_0$$

Note: $\mu_0 = 1.26 \times 10^{-6}\ H/m$.

---

(6)

Power is given by:

$$\boxed{P = \frac{E}{\Delta t}}.$$

Not needed for this problem, but energy of a photon is given by:

$$\begin{aligned} E &= hf \\ &= h\frac{c}{\lambda}. \end{aligned}$$

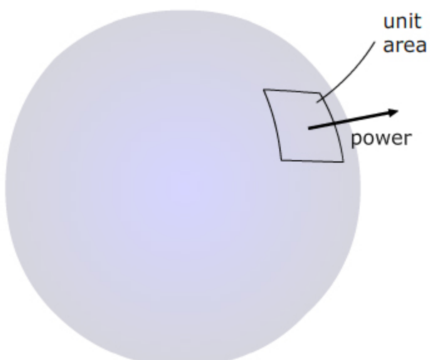
Note: $h = 6.626 \times 10^{-34}\ J \cdot s$

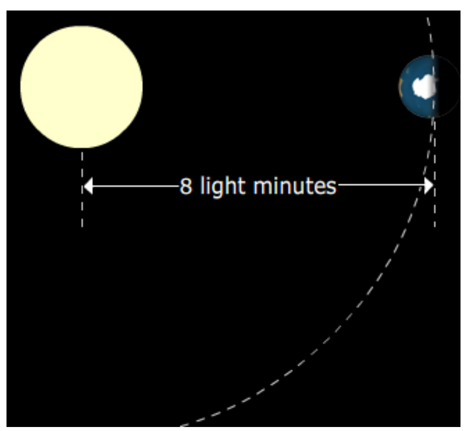
---

(7)

Imagine a source of power is radiating waves isotropically, which means equally in all directions. At a distance r, all of the radiated power is radiated through a sphere with area $4r^2$. So the intensity at r from the source is:

$$\boxed{I = \frac{P}{A} = \frac{P}{4\pi r^2}}.$$





(Source)

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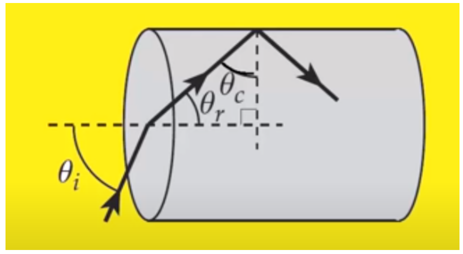
(11)

Critical angle is the angle of incidence that provides an angle of refraction of 90-degrees:

$$\boxed{\theta_{crit} = \sin^{-1}\left(\frac{n_2}{n_1}\right)}.$$

Note: be careful about where the ray is originating from when assigning n_2 and n_1.

(12)



θ_c represents the critical angle where any transmitted light is parallel to the surface ($\theta_t = 90$). Effectively, this means that all light is reflected:

$$\theta_c = \sin^{-1}\left(\frac{n_{outside}}{n_{inside}}\right).$$

From the right angle, we easily see:

$$\theta_r = 90 - \theta_c.$$

Finally, we find θ_i with Snell's Law:

$$\theta_i = \sin^{-1}\left(\frac{n_{inside}\sin\theta_r}{n_{outside}}\right).$$