Announcements

- MCAT Physics session here in Olin 268 tonight, 7:00-8:00 pm
- Physics alumni panel Thursday, Feb. 26 at 7:00 pm in the Hildreth-Mirza Great Room

Lecture 9 — Concept Test 1

A wave on a string is described by the equation

$$y(z,t) = 8\cos(2z + 4t),$$

where distance is in meters and time is in seconds.

(a) What is the wavelength of this wave?

1. $8\,\text{m}$
2. $2\,\text{m}$
3. $4\,\text{m}$
4. $\pi/4\,\text{m}$
5. $\pi\,\text{m}$
6. $\pi/2\,\text{m}$

(b) What is the propagation direction of this wave?

1. $+x$
2. $-x$
3. $+y$
4. $-y$
5. $+z$
6. $-z$

Lecture 9 — Concept Test 2

Generate a traveling wave by oscillating the end of a slinky with a frequency of $2\,\text{Hz}$. The resulting wavelength is $60\,\text{cm}$. If we now increase the frequency to $4\,\text{Hz}$ with the same slinky, what is the new wavelength for the wave?

1. 0
2. $15\,\text{cm}$
3. $30\,\text{cm}$
4. $60\,\text{cm}$
5. $120\,\text{cm}$
6. not enough information

Maxwell's Equations of Electricity and Magnetism

- Gauss's law for electricity: $\oint \vec{E} \cdot d\vec{A} = q_{\text{enc}}/\epsilon_0$
- Gauss's law for magnetism: $\oint \vec{B} \cdot d\vec{A} = 0$
- Faraday's law: $\oint \vec{E} \cdot d\vec{\ell} = -\dfrac{d\Phi_B}{dt}$
- Ampere-Maxwell law: $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{\text{enc}} + \mu_0\epsilon_0 \dfrac{d\Phi_E}{dt}$

Maxwell's Equations in Vacuum (no q or I)

- $\oint \vec{E} \cdot d\vec{A} = 0$
- $\oint \vec{B} \cdot d\vec{A} = 0$
- $\oint \vec{E} \cdot d\vec{\ell} = -\dfrac{d\Phi_B}{dt}$
- $\oint \vec{B} \cdot d\vec{\ell} = \mu_0\epsilon_0 \dfrac{d\Phi_E}{dt}$

Lecture 9 — Concept Test 3

Suppose the electric field in an EM wave is described by the equation

$$\vec{E} = E_0 \cos(kz - \omega t)\, \hat{\imath}.$$

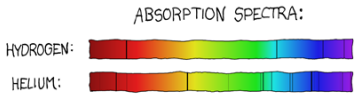
Which of the following could represent the magnetic field for this EM wave?

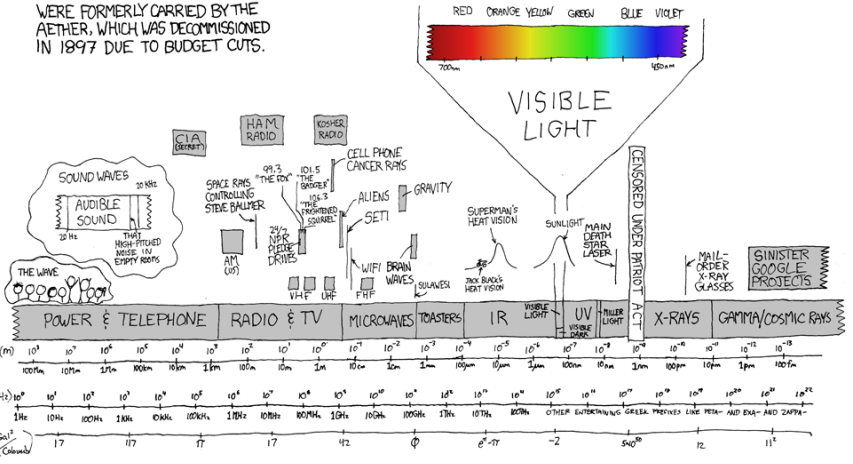
1. $\vec{B} = -\dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{\jmath}$
2. $\vec{B} = \dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{\jmath}$
3. $\vec{B} = -\dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{\imath}$
4. $\vec{B} = \dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{\imath}$
5. $\vec{B} = -\dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{k}$
6. $\vec{B} = \dfrac{E_0}{c} \cos(kz - \omega t)\, \hat{k}$

xkcd.com/273

THE ELECTROMAGNETIC SPECTRUM

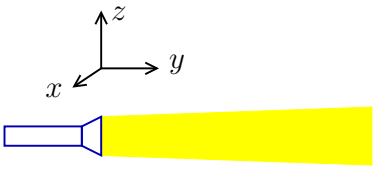
THESE WAVES TRAVEL THROUGH THE ELECTROMAGNETIC FIELD. THEY WERE FORMERLY CARRIED BY THE AETHER, WHICH WAS DECOMMISSIONED IN 1897 DUE TO BUDGET CUTS.





Lecture 9 — Concept Test 4

Consider a beam of light that is propagating along the y-axis and polarized along the z-axis. The light enters a diffuse vapor cloud.



(a) Along which axis do the electrons in the vapor cloud oscillate?

1. $\pm x$
2. $\pm y$
3. $\pm z$

(b) Along which axes can the re-radiated light propagate?

1. $\pm x$ and $\pm y$
2. $\pm x$ and $\pm z$
3. $\pm y$ and $\pm z$