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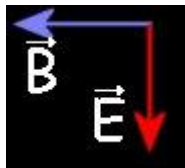
Unit 2 Electromagnetic Waves

Worksheet

1. Some neodymium–glass lasers can provide 100 TW of power in 1.0 ns pulses at a wavelength of 0.26 mm. How much energy is contained in a single pulse?

2. What is the radiation pressure 1.5 m away from a 500 W lightbulb? Assume that the surface on which the pressure is exerted faces the bulb and is perfectly absorbing and that the bulb radiates uniformly in all directions.

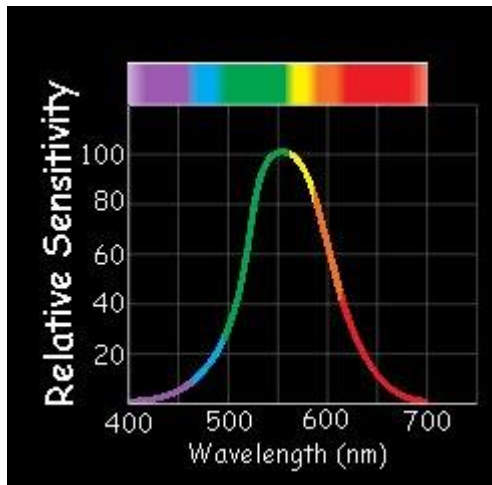
3. If the magnetic field of a light wave oscillates parallel to a y axis and is given by $B_y = B_m \sin(kz - \omega t)$, (a) in what direction does the wave travel and (b) parallel to which axis does the associated electric field oscillate?



4. If the electric and magnetic fields of an electromagnetic wave at a certain instant are in the directions shown in the diagram, what is the direction of the wave?

5. A certain helium – neon laser emits red light in a narrow band of wavelengths centered at 632.8 nm and with a “wavelength width” of 0.0100 nm. What is the corresponding “frequency width” for the emission?

6. Project Seafarer was an ambitious program to construct an enormous antenna, buried underground on a site about 10000 km^2 in area. Its purpose was to transmit signals to submarines while they were deeply submerged. If the effective wavelength were 1.0×10^4 Earth radii, what would be the (a) frequency and (b) period of the radiations emitted? Ordinarily, electromagnetic radiations do not penetrate very far into conductors such as seawater, and so normal signals cannot reach the submarines.



7. From the diagram, approximate the (a) smaller and (b) larger wavelength at which the eye of a standard observer has half the eye's maximum sensitivity. What are the (c) wavelength, (d) frequency, and (e) period of the light at which the eye is the most sensitive?

8. A plane electromagnetic wave traveling in the positive direction of an x axis in vacuum has components $E_x = E_y = 0$ and $E_z = (2.0 \text{ Vm}^{-1}) \cos[(\pi \times 10^{15} \text{ s}^{-1})(t - x/c)]$. (a) What is the amplitude of the magnetic field component? (b) Parallel to which axis does the magnetic field oscillate? (c) When the electric field component is in the positive direction of the z axis at a certain point P, what is the direction of the magnetic field component there?

9. 20. A distant galaxy is moving away from us at approximately $5 \times 10^7 \text{ ms}^{-1}$ and we approximate the speed of light as $c = 3 \times 10^8 \text{ ms}^{-1}$. (a) What is the resulting wavelength of the Hydrogen spectral line of $\lambda = 434 \text{ nm}$? (b) what would be the shift if the galaxy was moving towards earth?

10. A galaxy is moving away from the Earth at $2.6 \times 10^7 \text{ms}^{-1}$. Calculate the wavelength and frequency change of a 650 nm line in its spectrum. Take $c = 3 \times 10^8 \text{ms}^{-1}$.
