NPTEL MOOC on Introduction to Electromagnetism

Problem Set 7

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1. Of the following, which functional form does not represent a travelling wave, where the symbols have their usual meaning:
   (a) A $\exp[-k(x-ct)^2]$; A and k are constants
   (b) A $\exp[-ik(x-ct)]$; A and k are constants
   (c) A $\sin\left(\frac{\pi x}{L}\right)\exp(i\omega t)$; L and ω are constants
   (d) A $\left[\cos\left(\frac{\pi x}{L}\right)+i\sin\left(\frac{\pi x}{L}\right)\right]\exp(i\omega t)$; L and ω are constants

2. A long stretched string with tension 10N and mass per unit length of 0.05 kgm^{-1} is held at one end. When this end moves with displacement $y(t)=0.05\sin(50t)$m, how will the waves propagating on the string be described?

3. If the time-dependent electric field did not give rise to a magnetic field, will electromagnetic waves exist?

4. Solar energy falling normally per unit time per unit area on the earth's surface is about 1350 Wm^{-2}. Find the corresponding value of the electric field for the solar radiation assuming that the solar radiation comes in the form of plane electromagnetic waves.

5. If solar radiation of intensity 1350 Wm^{-2} falls on a perfectly reflecting mirror of size 0.3m×1.0m, how much force does it exert on the mirror?

6. A square pulse of height 5 mm and width 1 cm is travelling on a string with speed 15 ms^{-1}. This string is tied to another string where the wave speed is 10 ms^{-1}. What will be the size of the transmitted and reflected pulses?

7. Light is incident on a glass slab. What will be the percentage of light reflected from the air-glass interface?

8. If two oscillating dipoles are radiating at frequencies corresponding to red (wavelength 700nm) and green (wavelength 500nm), respectively, what will be the ratio of power emitted by them if their amplitude of oscillation is the same?