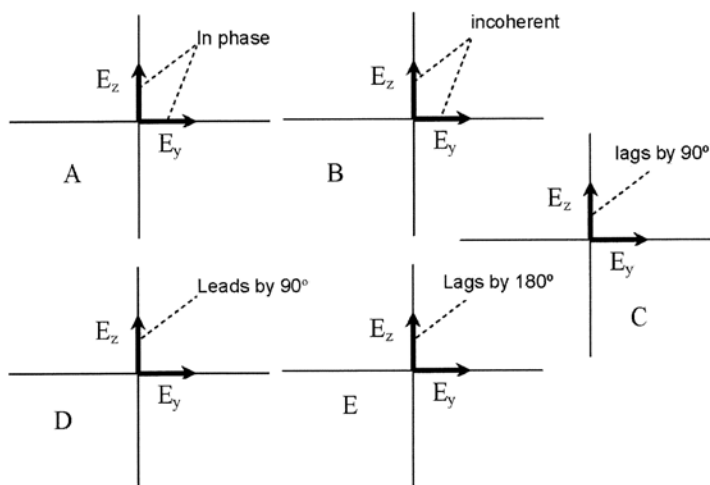1. (a) The diagrams below represent the polarization states of light. In each case the wave is traveling along the x-axis in the positive x direction.

(i) Which diagram represents linear polarized light at 45°?

(ii) Which diagram represents left circular light? Explain.

(iii) Which diagram represents un-polarized light?

(b) Consider the following expression for a harmonic wave travelling in the positive x direction,

$$\Psi(x, t) = A \sin k(x - vt).$$

Identify each of the parameters in the above expression, and show that this wave is a solution of the differential wave equation,

$$\frac{\partial^2 \Psi}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 \Psi}{\partial t^2}.$$

(c) Consider the following two harmonic waves:

$$E_1 = 2 \cos \omega t$$

and

$$E_2 = 7 \cos(\pi/4 - \omega t).$$

(i) Show each of these waves in a phasor diagram.

(ii) In the same diagram, show the wave that results from the addition of these two harmonic waves.

(iii) Determine the mathematical expression for the resultant wave. What sort of wave is the resultant? Use the expression you derived to justify your answer.