***Q:***

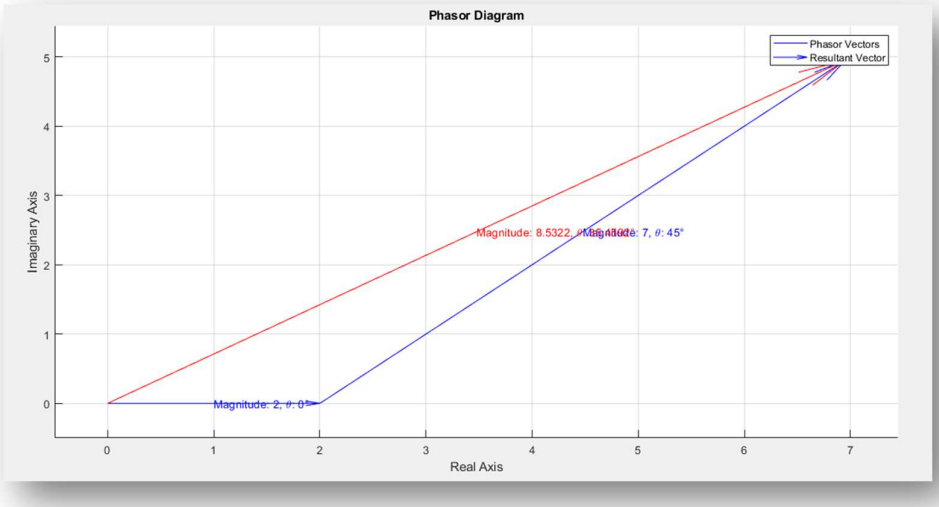
a) Show the following two harmonic waves in a phasor diagram

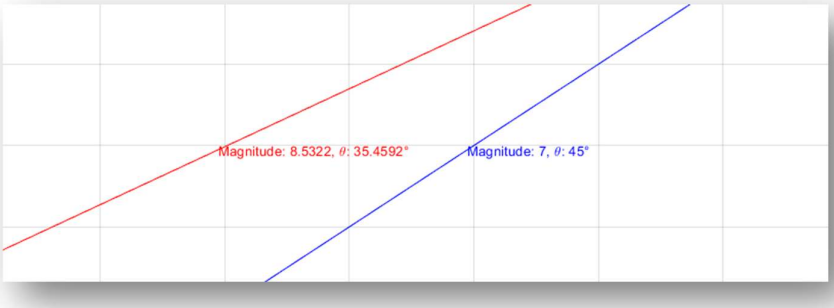
$$E_1 = 2\sin(\omega t)\,, E_2 = 7\sin\left(\omega t + \frac{\pi}{4}\right)$$

b) Obtain the mathematical relation of Briand wave.

***Sol:***

a)




b)

$$E_T = E_1 + E_2 = E_{o1}\sin(\omega t + a_1) + E_{o2}\sin(\omega t + a_2)$$

$$= (E_{o1}\cos(a_1) + E_{o2}\cos(a_2))\sin(\omega t) + (E_{o1}\sin(a_1) + E_{o2}\sin(a_2))\cos(\omega t)$$

$$= 2\sin(\omega t) + 7\sin\left(\omega t + \frac{\pi}{4}\right)$$

$$= \left(2\cos(0) + 7\cos\left(\frac{\pi}{4}\right)\right)\sin(\omega t) + \left(2\sin(0) + 7\sin\left(\frac{\pi}{4}\right)\right)\cos(\omega t)$$

$$= \left(2 + \frac{7\sqrt{2}}{2}\right)\sin(\omega t) + \frac{7\sqrt{2}}{2}\cos(\omega t)$$

$$E_T = E_o \sin(\omega t + a)$$

$$\begin{cases} |E_T| = \sqrt{\left(2 + \frac{7\sqrt{2}}{2}\right)^2 + \left(\frac{7\sqrt{2}}{2}\right)^2} = 8.53 \\ a = \arctan\left(\frac{\frac{7\sqrt{2}}{2}}{2 + \frac{7\sqrt{2}}{2}}\right) = 35.46 \end{cases}$$

Which is exactly the same as simulation 😊