Solutions to Homework Set #2

Problem 1.

My rest heart rate is 62 beats/min

$$f = 1Hz$$

The time interval between beats is

$$T = \frac{1}{f} = \frac{1}{1.03} = 0.97\,sec$$

Problem 2.

$$2\pi f = \sqrt{k/m} \Rightarrow (2\pi)^2 = k/m$$

$$m = \frac{K}{4\pi^2 f^2} = 0.317\,kg$$

Problem 3.

(a) 4

(b) $\frac{2\pi}{3} sec \left[4 cos 3\left(t + \frac{2\pi}{3}\right)\right]$

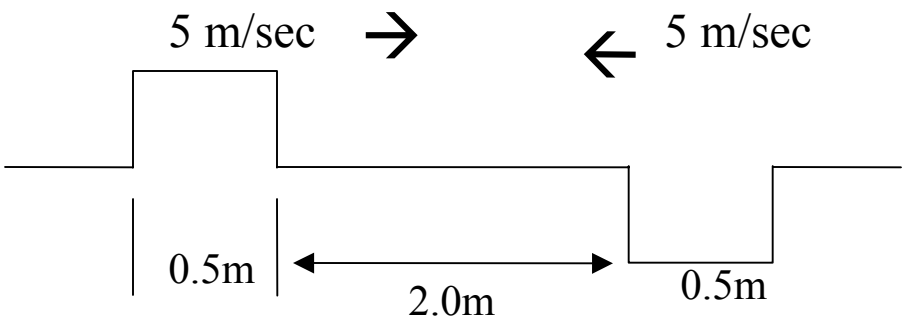
(c) Velocity $4 cos 3\left(t + \frac{2\pi}{3}\right) \Rightarrow \frac{dy}{dt} = -12 sin 3t \Rightarrow 12\ cm/sec$

(d) Speed $|v| = 12\ cm/sec$

(e) Acceleration $a = \frac{dv}{dt} = \frac{d^2 y}{dt^2} = -36 cos 3t \quad at \quad t = \frac{\pi}{2}, a \to 0\ cm/sec^2$

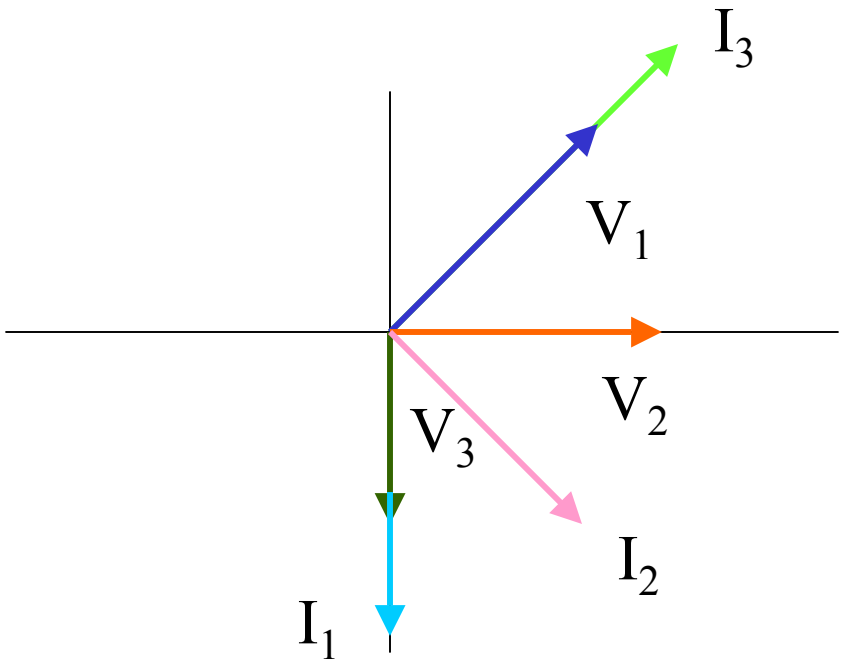
Problem 4.

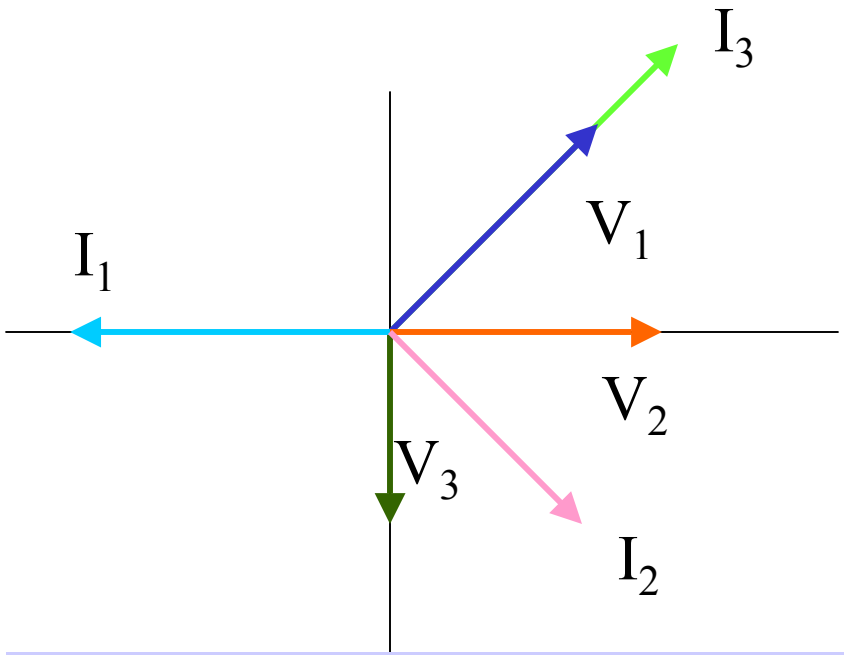
If the center of the pulses overlap, then the total we have total cancellation. The distance between centers is d=2.5 m. The relative velocity is 10 m/sec so,



$$t = \frac{d}{v} = \frac{2.5\,m}{10\,m/sec} = 0.25\,sec$$

Problem 5.





$\tilde{V}_1\angle 45^\circ$ *in phase with* $\tilde{I}_3\angle 45^\circ$

$\tilde{V}_3\angle -90^\circ$ *in phase with* $\tilde{I}_1\angle 270^\circ$

$$\angle\tilde{V}_1 - \angle\tilde{I}_1 = 45^\circ - 270^\circ = -225^\circ$$

$$\angle\tilde{V}_2 - \angle\tilde{I}_2 = 0^\circ - \left(-45^\circ\right) = 45^\circ$$

$$\angle\tilde{V}_3 - \angle\tilde{I}_3 = -90^\circ - 45^\circ = -135^\circ$$

Problem 6.

$$Z_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{1.43\times10^{-3}\,H/m}{8.89\times10^{-12}\,F/m}} = 12.7\,k\Omega$$

$$\beta = \omega\sqrt{LC} = 249\,rad$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi\cdot352\cdot10^{6}\,Hz\cdot8.89\cdot10^{-12}\,F} \sim 60\Omega$$

$$X_L = \omega L = 2\pi\cdot352\cdot10^{6}\,Hz\cdot1.43\cdot10^{-3}\,H \sim 3.2\,M\Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi\cdot60\,Hz\cdot1\cdot10^{-12}\,F} \sim 2.65\,G\Omega$$

$$X_L = \omega L = 2\pi\cdot60\,Hz\cdot1.0\cdot10^{-9}\,H \sim 0.4\,\mu\Omega$$