2.1, 2.2, 2.9, 2.10, 2.14, 2.17.

P.-2.1 $x(t) = 3\cos(w_0 t - \pi/4)$

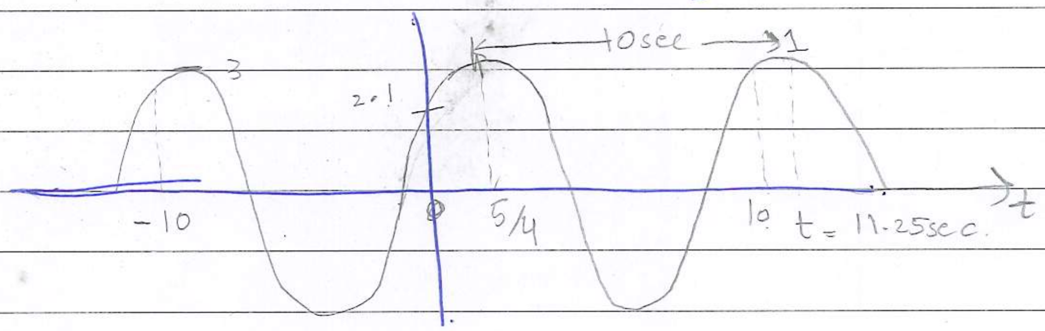
$w_0 = \pi/5$ $\quad -10 \leq t \leq 20$

Solution: $2\pi f = \pi/5 \Rightarrow f = \frac{1}{10} \Rightarrow T = 10sec$ (Pe

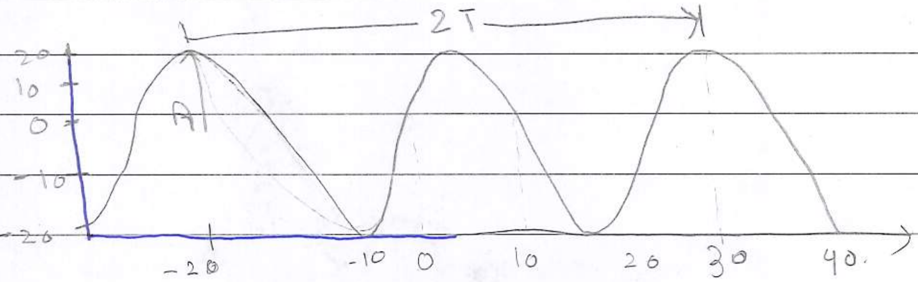
$\phi = -2\pi \frac{t_1}{T} \Rightarrow t_1 = \frac{-\phi}{2\pi} T = \frac{\pi/4}{2\pi} \times 10 = \frac{5}{4} = 1.25 sec$

at $t = 0$

$x(t) = 3\cos(-\pi/4) = \frac{3\sqrt{2}}{2} = 2.1$



P 2.2



Period: $2T = (30 - (-20))$ msec $= 50$ msec.

$\Rightarrow T = 25$ m sec.

Frequency: $w_0 = 2\pi/T = 2\pi\left(\frac{1}{2.5 \times 10^{-3}}\right) = 2\pi(40)$ rad

$f = 40 Hz$

Amplitude : $A = 20$.

Time-shift : $t_m = +5$ msec

Phase : $\phi = -\omega_0 t_m = -2\pi(40) \times 5 \times 10^{-3}$

$\phi = -2\pi(0.2) = -0.4\pi$

$x(t) = 20\cos(80\pi t - 0.4\pi)$

P2.4 :- $e^{j\theta} = 1 + j\theta + \frac{(j\theta)^2}{2!} + \frac{(j\theta)^3}{3!} + \frac{(j\theta)^4}{4!} + \frac{(j\theta)^5}{5!} + \cdots$

$= 1 + j\theta - \frac{\theta^2}{2!} - j\frac{\theta^3}{3!} + \frac{\theta^4}{4!} + j\frac{\theta^5}{5!} + \cdots$

separate the real and imaginary parts:

$$e^{j\theta} = \underbrace{\left(1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} + \cdots\right)}_{\cos\theta} + j\underbrace{\left(\theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - \cdots\right)}_{\sin\theta}$$

$\therefore$ $e^{j\theta} = \cos\theta + j\sin\theta$

which proves Euler's formula

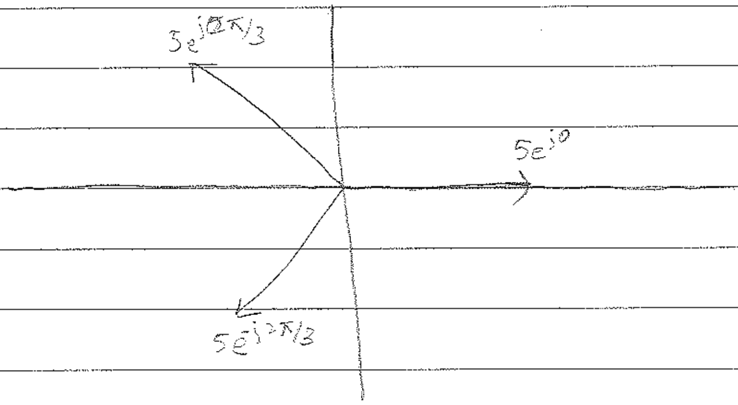
P 2-10: $x(t) = 5\cos(\omega t) + 5\cos(\omega t + 120^\circ) + 5\cos(\omega t - 120^\circ)$

Use Phasors:

$5\cos(\omega t) \longrightarrow 5e^{j0} = 5 + j0$

$5\cos(\omega t + 120^\circ) \longrightarrow 5e^{j2\pi/3} = -\frac{5}{2} + j\frac{5\sqrt{3}}{2}$

$5\cos(\omega t - 120^\circ) \longrightarrow 5e^{-j2\pi/3} = -5/2 - j\frac{5\sqrt{3}}{2}$.



Vector Sum:

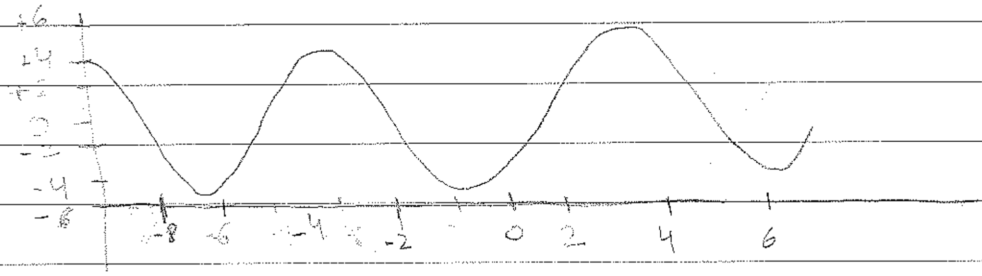
$5 + \left(-\frac{5}{2} + j\frac{5\sqrt{3}}{2}\right) + \left(-\frac{5}{2} - j\frac{5\sqrt{3}}{2}\right)$

$= \left(5 - \frac{5}{2} - \frac{5}{2}\right) + j\left(\frac{5\sqrt{3}}{2} - \frac{5\sqrt{3}}{2}\right) = 0$

Thus, $x(t) = 0$.

P 2.14:

positive peak at $t = -4$ msec, value $= 5$
negative peak at $t = 6$ msec



There are $1\frac{1}{2}$ periods from $t = -4$ms to $t = 6$ms

$$\left(1\tfrac{1}{2}\right)T = 10\text{msec.}$$

$$\Rightarrow T = \frac{20}{3}\text{ msec} = 6\tfrac{2}{3}\text{ msec}$$

$$\omega_0 = \frac{2\pi}{T} = 2\pi/(20/3000) = 300\pi \text{ rad/sec}$$

Phase: $\phi = -2\pi\left(\frac{t_1}{T}\right)$

$$= -2\pi\left(\frac{-4}{20/3}\right) = \frac{12\pi}{10} = 1.2\pi$$

$$\therefore x(t) = 5\cos(300\pi t + 1.2\pi)$$

For the complex notation $X = \text{Mag}\, e^{j\,\text{Phase}}$

$$X = 5e^{j1.2\pi}$$
$$x(t) = \text{Re}\{5e^{j1.2\pi}e^{j300\pi t}\}$$

P 17: $x(t) = 5\cos(\omega_0 t + 3\pi/2) + 4\cos(\omega_0 t + 2\pi/3) + 4\cos(\omega_0 t + \pi/3)$

(a) Express $x(t)$ in the form $x(t) = A\cos(\omega_0 t + \phi)$

$z_1 = 5e^{j3\pi/2} = 0 - 5j$

$z_2 = 4e^{j2\pi/3} = -2 + j\,3.46$

$z_3 = 4e^{j\pi/3} = 2 + j\,3.46$

$z = z_1 + z_2 + z_3 = 0 + j\,1.928 = 1.928e^{j\pi/2}$

$\therefore\ x(t) = 1.928\cos(\omega_0 t + \pi/2)$