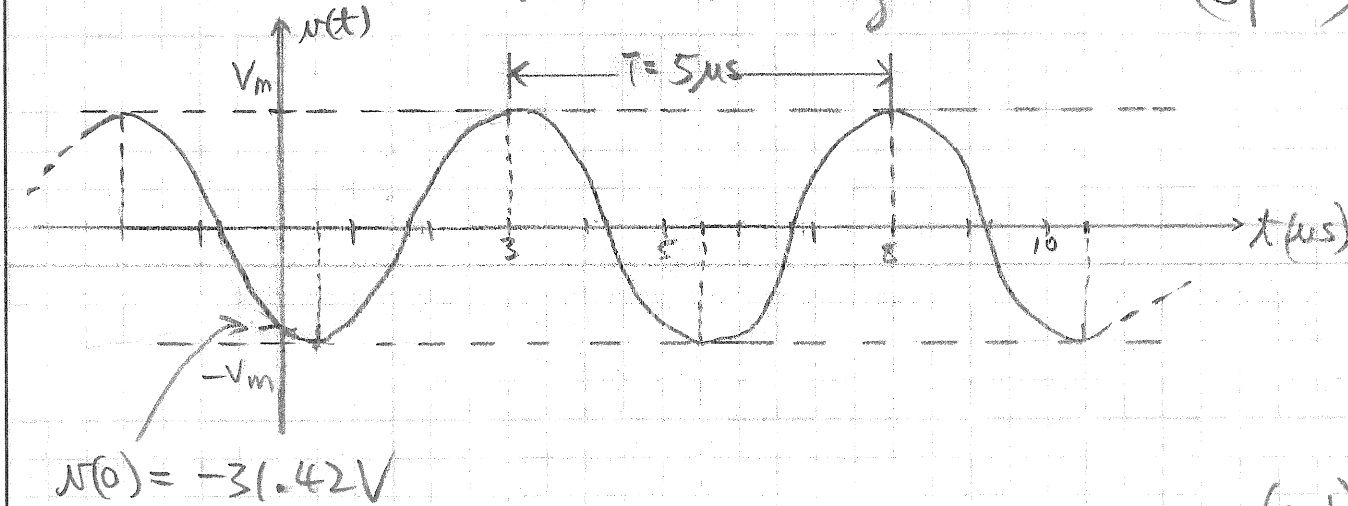
P1. $v(t) = V_m \cos(2\pi f t + \phi)$ V

Given: • $T = 5\mu s$

• At $t = 0$, $v(0) = -31.42V$

• 1st peak (after $t=0$) at $t = 3\mu s$.

(a) Sketch and label the signal (8pts.)



(b) $f = \frac{1}{T} = \frac{1}{5\mu s} = 2 \times 10^5$ Hz or 200 kHz (2pts)

(c) If ϕ is positive, the signal has been shifted <u>left</u> (1pt)

(d) The original, unshifted, signal was:

$$v(t') = V_m \cos(2\pi f t') \text{ V}.$$

After a shift of T_s to the left, $t' = t + T_s$.

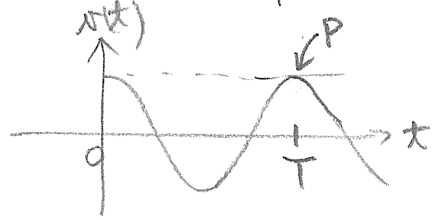
The shifted signal is:

$$v(t) = V_m \cos[2\pi f (t + T_s)]$$

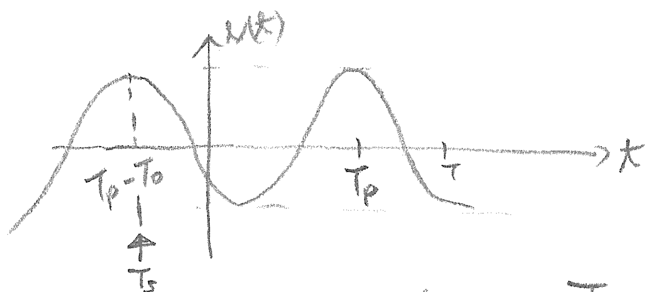
$$= V_m \cos[2\pi f t + 2\pi f T_s] \quad \text{(i)}$$

P1(d) The time shift causes the signal to shift left:

If the signal was not shifted,
there would be peaks at $t=0$ and $t=T$



Because of the time shift, the Peak P
is now closer to $t=0$



(3 pts)

The amount shifted, T_s, is given by

$$T_s = T_p - T_0 \qquad (\text{recall } T_p = 3\,\mu s)$$

$$= 3 - 5$$

$$T_s = -2\,\mu s.$$

(2 pts)

From Eq 5-21,

$$\phi = -2\pi \frac{T_s}{T} = -2\pi \frac{-2}{5}$$

$$= 0.8\pi \text{ rad}$$

$$\phi = 144^\circ$$

(2 pts)

P1(e) $v(t) = V_m \cos\left(2\pi(200000)t + 144^\circ\right)$ V

$v(0) = V_m \cos(144^\circ)$ V $= -31.42$V

(2pt.)

$\therefore$ $V_m = \underline{38.84\text{ V}}$ //

(P.2) $v_1(t) = -10\cos(\omega t + 50°)\ V$

$v_2(t) = 12\sin(\omega t - 10°)\ V$

(a) $v_1(t) = -10\cos(\omega t + 50°)$

$= 10\cos(\omega t - 130°)$ or $10\cos(\omega t + 230°)$

$\therefore \vec{V}_1 = 10\angle -130°$ or $10\angle 230°\ V$ (6 pts)

Note: the magnitude term of the phasor $V_m\angle\phi$ must be positive

$v_2(t) = 12\sin(\omega t - 10°)$

$= 12\cos(\omega t - 10° - 90°)$

$= 12\cos(\omega t - 100°)$

$\therefore \vec{V}_2 = 12\angle -100°$ (or $12\angle 260°$) V (6 pts)

(b) From (a)

$\vec{V}_1$ has an angle of $-130°$ (or $230°$)

$\vec{V}_2$ has an angle of $-100°$ (or $260°$)

$\therefore$ the angle between $\vec{V}_1$ & $\vec{V}_2$ is $30°$ (2 pts)

P. 2 (cont'd)

(c)

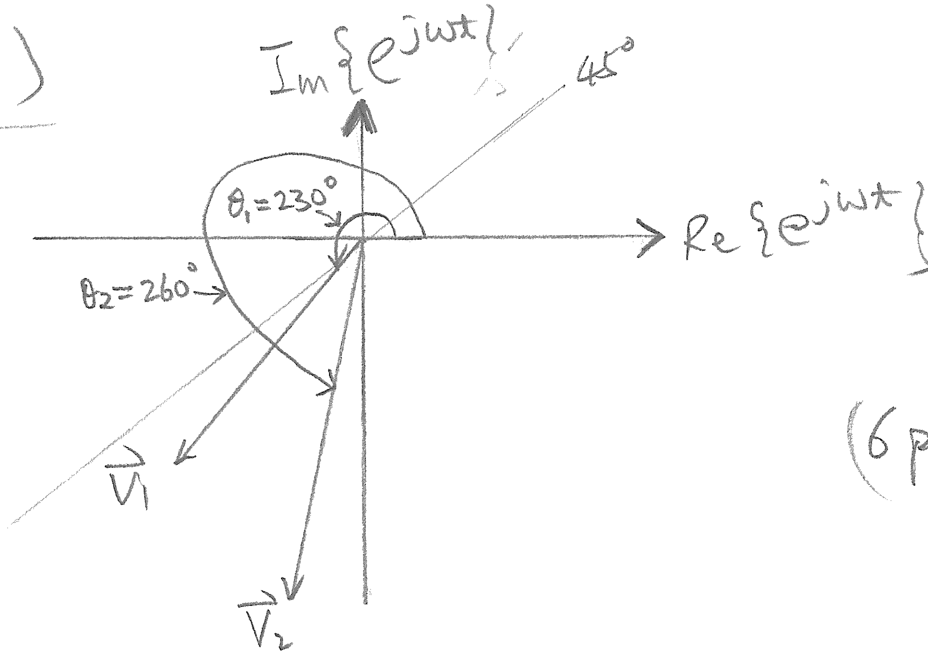


Fig. 2c

(6 pts.)

(d) From Fig. 2c,

$v_2(t)$ is leading $v_1(t)$ (by $30°$) (1 pt.)

(P.3.) (15pts)

$$4i + 8\int i\,dt - 3\frac{di}{dt} = 50\cos(4t + 75°)$$

In phasor Domain:

$$4\vec{I} + \frac{8\vec{I}}{j\omega} - 3j\omega\vec{I} = 50\angle 75° \quad \text{(8pts)}$$

Since $\omega = 4$ rads^{-1}

therefore

$$\vec{I}(4 - j2 - j12) = 50\angle 75° \quad \text{(3pts)}$$

$$\vec{I} = \frac{50\angle 75°}{4 - j14} = \frac{50\angle 75°}{14.56\angle -74.05°}$$

$$= 3.434\angle 149.05° \ \text{A} \quad \text{(2pts)}$$

In time domain, the steady-state current is:

$$i(t) = 3.434\cos(4t + 149.05°)\ \text{A} \quad \text{(2pts)}$$