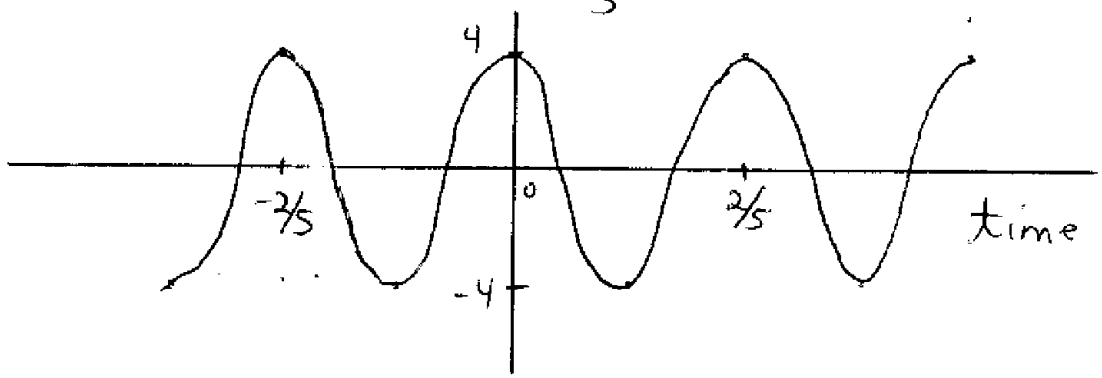
1. a) $x(t) = 4\cos(5\pi t)$

periodic with period $T = \frac{2\pi}{5\pi} = \frac{2}{5}$ sec

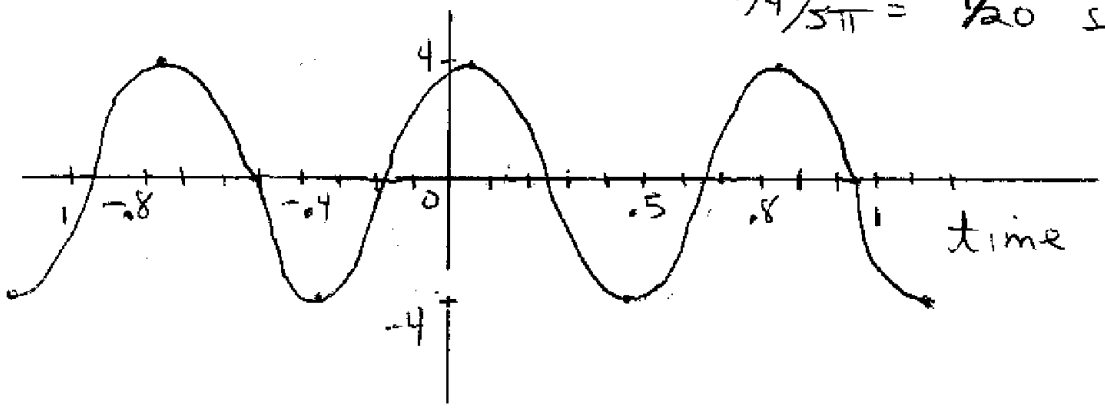
To sketch: $A = 4$, $T = \frac{2}{5}$, $\theta = 0$



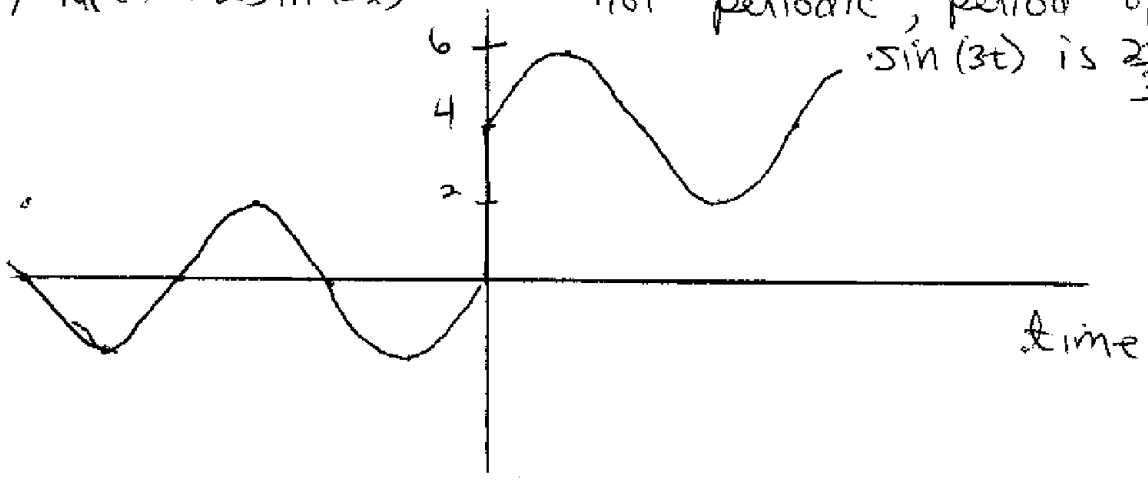
b) $x(t) = 4\cos(5\pi t - \pi/4)$

periodic with period $T = 2/5$ sec

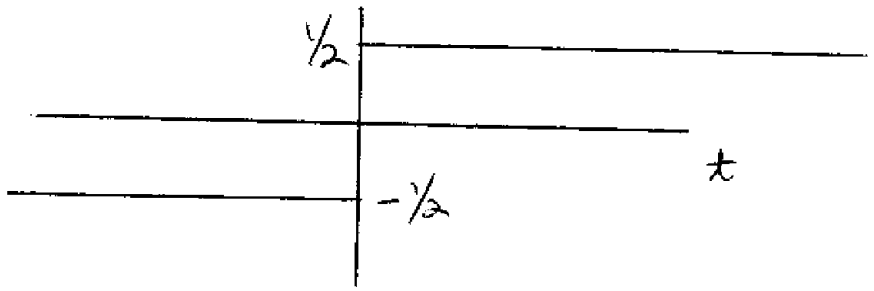
to sketch: $A = 4$, $T = 2/5$, $\theta = \pi/4$ so peak is at $\pi/4 / 5\pi = 1/20$ sec



c) $x(t) = 4u(t) + 2\sin(3t)$ not periodic, period of $\sin(3t)$ is $\frac{2\pi}{3}$



d) $x(t) = u(t) - \frac{1}{2}$, not periodic



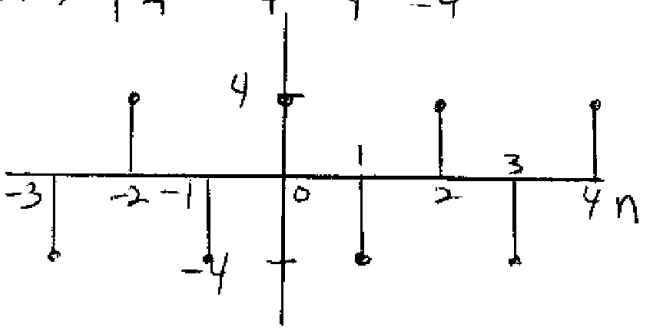
e) $x[n] = 4\cos(\pi n)$

periodic if $\Omega = \frac{2\pi q}{r}$ for some integers q or

In this case $\Omega = \pi$ so $q = 1, r = 2$ work.

so, this is periodic

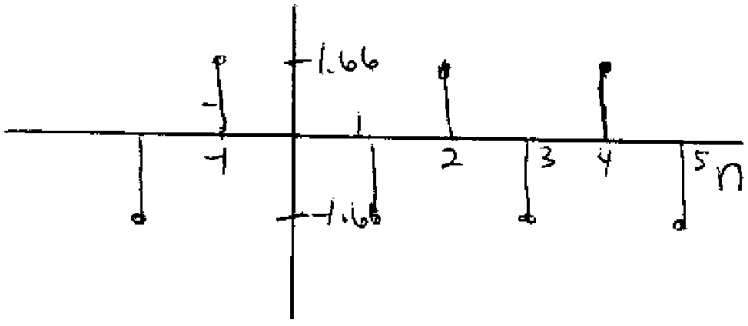
n	0	1	2	3
$4\cos(n\pi)$	4	-4	4	-4



repeats every other value

f) $x[n] = 4\cos(\pi n - 2)$, periodic, repeats every other value of n

n	-1	0	1	2	3
$4\cos(n\pi - 2)$	1.66	-1.66	1.66	-1.66	1.66

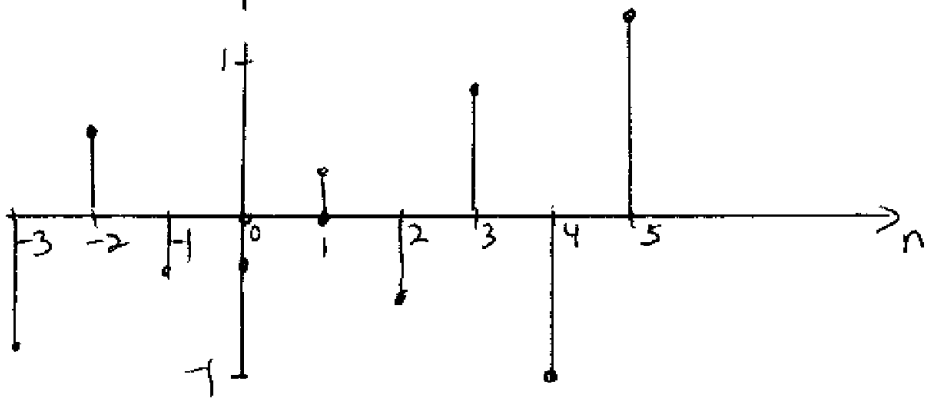


g) $x[n] = 2\sin(3n)$

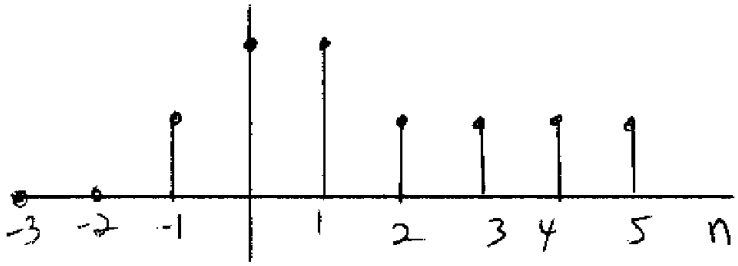
$\Omega = 3 \neq \frac{2\pi q}{r}$ for q, r integers

so not periodic

n	-1	0	1	2	3	4	5
$2\sin(3n)$	-.28	0	.28	-.56	.82	-1.07	1.3



h) $x[n] = u[n] + \beta_3[n]$



2. a) $x(t) = \cos(4t) + 2\sin(8t)$

$T_1 = \frac{2\pi}{4}$ $\quad$ $T_2 = \frac{2\pi}{8}$

$\frac{T_1}{T_2} = \frac{\pi/2}{\pi/4} = \frac{2}{1} \Rightarrow$ periodic with period $T_1 = \frac{\pi}{2}$ sec

b) $x(t) = 3\cos(4t) + \sin(\pi t)$

$T_1 = \frac{2\pi}{4}$ $\quad$ $T_2 = \frac{2\pi}{\pi} = 2$

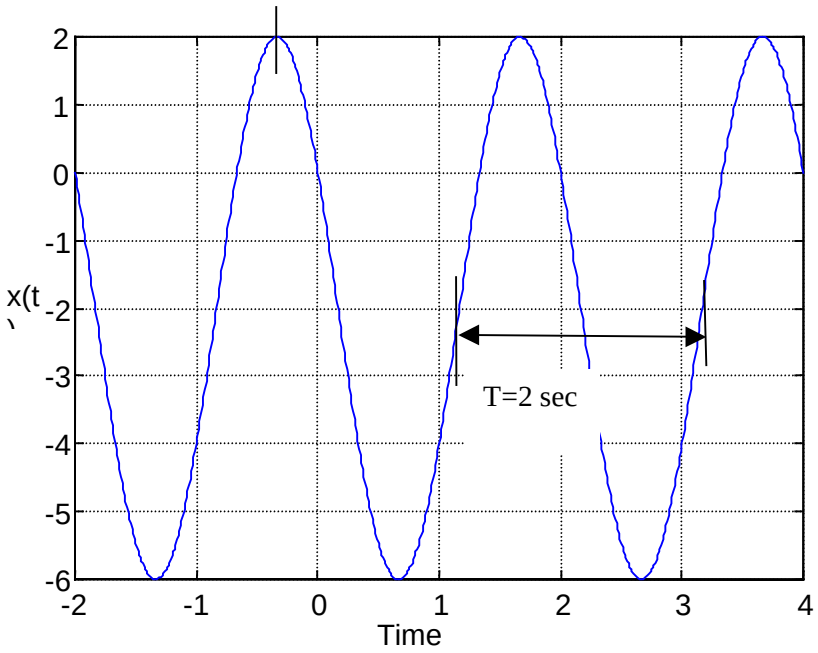
$\frac{T_1}{T_2} = \frac{\pi/2}{2} = \frac{\pi}{4} \neq \frac{q}{p}$ so not periodic

c) $x(t) = \cos(3\pi t) + 2\cos(4\pi t)$

$T_1 = \frac{2\pi}{3\pi} = \frac{2}{3}$ $\quad$ $T_2 = \frac{2\pi}{4\pi} = \frac{1}{2}$

$\frac{T_1}{T_2} = \frac{2/3}{1/2} = \frac{4}{3} \Rightarrow$ periodic with period $T = 2$ sec.

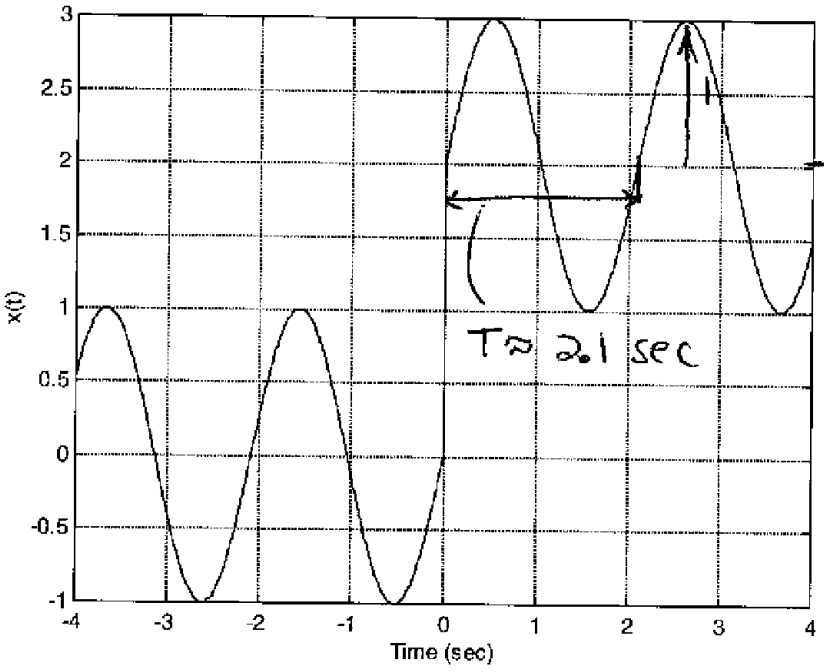
3. Give an expression for x(t).



offset is -2
amplitude is 8/2 = 4
frequency is $2\pi / 2 = \pi$rad / sec
shift is 0.35 sec to the left

$x(t) = -2 + 4\cos(\pi(t+0.35)) = -2 + 4\cos(\pi t+0.35\pi)$

4.



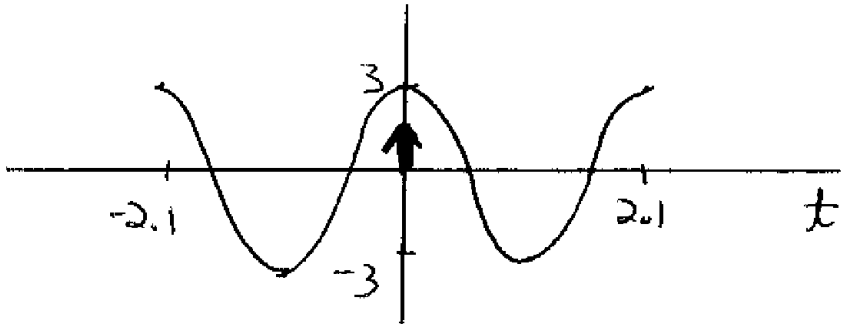
a) Give an expression for x(t).
b) Plot dx/dt.

a) from plot, $x(t) = 2u(t) + \sin(\omega t)$ (phase = 0)

$$\omega = \frac{2\pi}{T} = 3 \text{ rad/sec}$$

$$x(t) = 2u(t) + \sin(3t)$$

b) $\frac{dx}{dt} = 2\delta(t) + 3\cos(3t)$



5 a) not periodic since $u(t)$ shifts cos up for $t \geq 0$

b) $\Omega = 0.5\pi = \frac{2\pi q}{r}$, works for $q=1, r=4$

$\Rightarrow$ periodic (period is $N=4$)

c) $T_1 = \frac{2\pi}{3\pi} = \frac{2}{3}$, $T_2 = \frac{2\pi}{4\pi} = \frac{1}{2}$

$\frac{T_1}{T_2} = \frac{2/3}{1/2} = \frac{4}{3}$ = ratio of integers

$\Rightarrow$ periodic with period $3T_1 = 2$ sec

d) $\Omega = 20 = \frac{2\pi q}{r}$ does not work for integers q & r

$\Rightarrow$ not periodic

e) $T_1 = \frac{2\pi}{2\omega_1}$, $T_2 = \frac{2\pi}{3\omega_1}$

$\frac{T_1}{T_2} = \frac{\pi/\omega_1}{2\pi/3\omega_1} = \frac{3}{2}$ periodic with

period $2T_1 = \frac{2\pi}{\omega_1}$

f) $T_1 = \frac{2\pi}{3\pi} = \frac{2}{3}$, $T_2 = \frac{\pi}{8\pi} = \frac{1}{4}$

$\frac{T_1}{T_2} = \frac{2/3}{1/4} = \frac{8}{3}$ $\Rightarrow$ ratio of integers

$\Rightarrow$ periodic with period $= 3T_1 = 2$ sec

g) $T_1 = \frac{2\pi}{3\pi} = \frac{2}{3}$, $T_2 = \frac{2\pi}{10} = \frac{\pi}{5}$

$\frac{T_1}{T_2} = \frac{2/3}{\pi/5} = \frac{10}{3\pi}$ not a ratio of integers $\Rightarrow$ not periodic

h) $\Omega = 2\pi(8) = 16\pi = \frac{2\pi r}{q}$

works for $q=1$ & $r=8$ $\rightarrow$ periodic

note: $x[n] = 10\cos(16\pi n) = 10$ for all n (i.e. period = 1)

i) $\Omega = 8 \neq \frac{2\pi r}{q}$ for any integers r & q

$\Rightarrow$ not periodic