Saaif Ahmed
Signals & Systems

HW 2

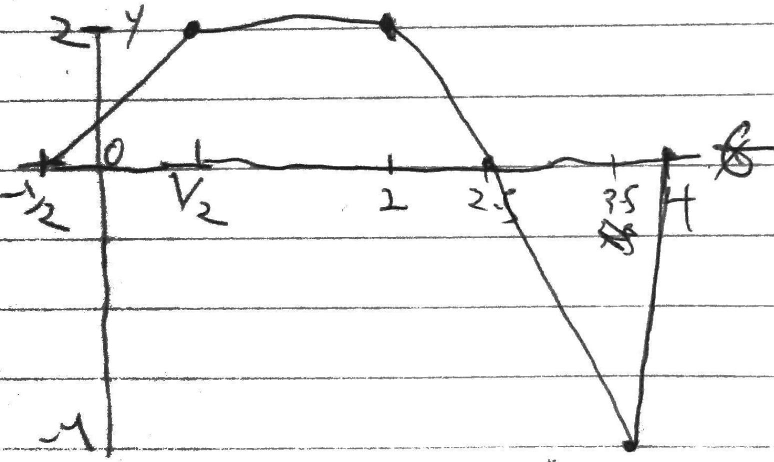
1 A) : $v(t) \rightarrow v(2t-1)$

shift by 1 $\rightarrow$ ~~0→1, 2→3, 5→6, 6→7, 8→9, 9→10~~

everything to the left 1

new X = -1, 1, 4, 5, 7, 8

scale period by 2 = $-\frac{1}{2}, \frac{1}{2}, 2, 2.5, 3.5, 4$



y = mx + b
y = 2x + b
1 = 2 1/2 + 1

2t + 1
2
-4t + 10

y = mx + b
y = 4x + b
2 = 8 + b

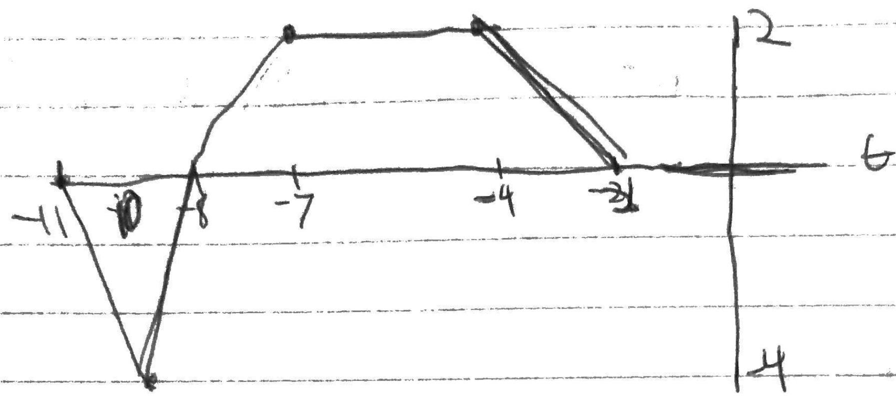
8t - 32

~~$v(2t-1) = 2t(g(t+\frac{1}{2})) + 2g(t-\frac{1}{2}) + \ldots$~~

$$\boxed{v(2t-1) = 2t(g(t+\tfrac{1}{2})) + 2g(t-\tfrac{1}{2}) + -4t\,g((t-2)/1.5) + 8t(g((t-3.5)2))}$$

B) $v(t+2)$

shift by 2 then flip

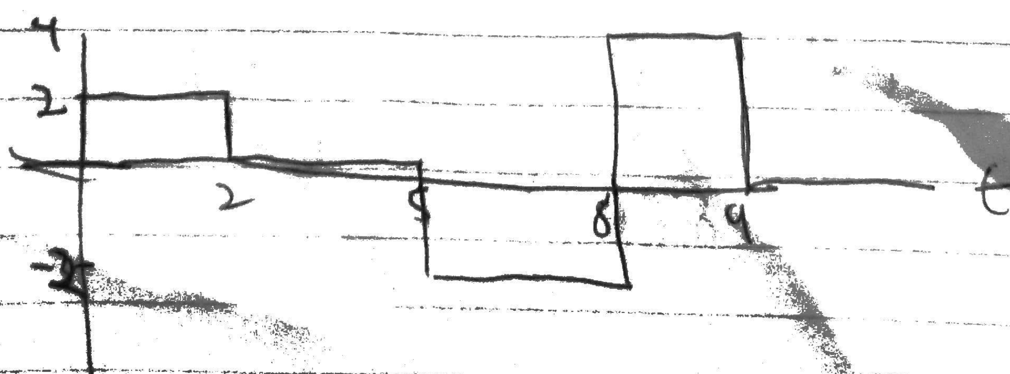


slopes: $1t$, 2, $-2t$, $4t$

$$\boxed{v(-t+2) = 1t\left(g\left(\frac{t}{2}+\frac{2}{2}\right)\right) + 2g\left(t/(3)+\frac{7}{3}\right) + -2t\left(g\left(\frac{t}{3}+\frac{10}{3}\right)\right) + 4t\left(g\left(t/1+\frac{4}{1}\right)\right)}$$

2. slope; 1, 0, -2, 4

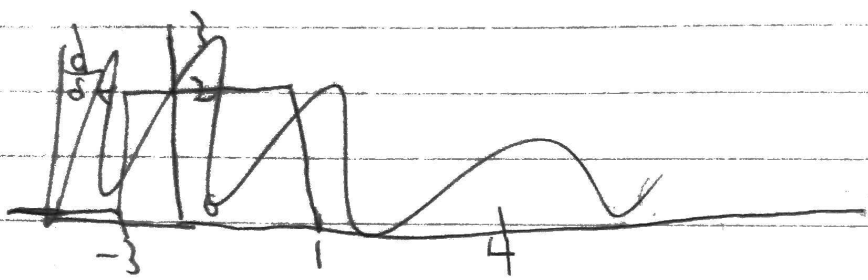
d/dt 1

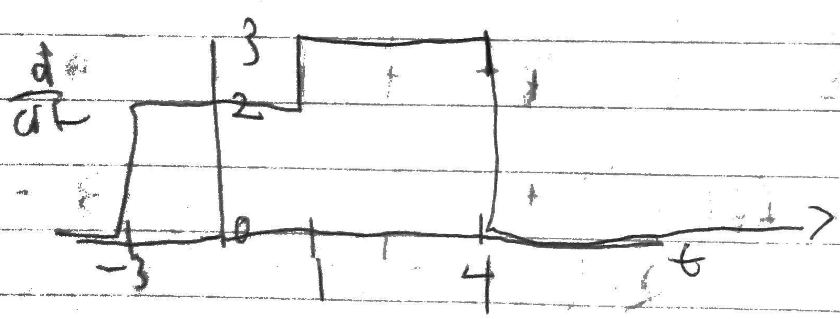


3: A) $2t+2 \to 2(t+1)$
$3t-5 \to 3(t-\frac{5}{3})$

$$f(t) = 2(t+1)\big(u(t+3) - u(t-1)\big) + 3(t-\tfrac{5}{3})\big(u(t-1) - u(t-4)\big)$$

B) slopes: 2, 3, 0





4 A) $((-1)^4 - 2(-1)^2 - 3(-1) + 1)\delta(t-1)$
$1 - 2 + 3 + 1\ \delta(t-1)$
$= 3\delta(t-1)$

B) $((2)^4 - 2(2)^2 - 3(2) + 1)\ \delta(t+2)$
$16 - 8 - 6 + 1\ \delta(t+2)$
$= 3\delta(t+2)$

c) $\int_{-\infty}^{\infty} f(t)\,\delta(t-t_0) = f(t_0)$

$= (-1)^4 - 2(-1)^2 - 3(-1) + 1)$

$= 3$

D) property of delta function $\int_{-\infty}^{\infty} \delta(t) = 1$

thus $f(t)$ scales it

$\int_{-1}^{3} \to$ encompas $(-1, 0)$

$= 3$

e) property of delta function $\int_a^b \delta(t) = \begin{cases} 1 & a \le t \le b \\ 0 & \text{otherwise} \end{cases}$

thus $\int_2^5 = \boxed{0}$

F) $t_0 = -2$, $\tau \le -5$, in range

$\cos\left(-\frac{2\pi}{3}\right) = -\frac{1}{2}$

$= -\frac{1}{2}$

g) $t_0 = -2$, $\tau \ge 1$ not in range

$= 0$

h) $t_0 = 0$, $\tau \ge 0$, in range

$\cos(0) = 1$

$= 1$

5. $v(t) = r(t) - r(t-2) - 2r(t-5) + 6r(t-8)$

6. A) $x_1(t) = e^{-2x(t)}$

$x_2(t) = e^{-2x_2(t)}$

$y_1(t) + y_2(t) = e^{-2x(t)} \cdot 2$

$y_1(x(t) + x(t)) = (e^{-2x(t)})^2$

[non-linear]

B) additivity:

$x(t) + x(t) = x(t-3)\cos(t+1) + x(t-3)\cos(t+1)$

$y(x(t) + x(t)) = (x(t-3) + x(t-3))(\cos(t+1))$

additivity checks

$ax(t) = ax(t-3)\cos(t+1)$

$a(y(x(t))) = a(x(t-3)\cos(t+1))$

homogeneity checks $\boxed{\text{linear}}$

7. A) $x_1(t) = e^{-2x(t-T)}$

$y(t-t) = e^{-2x(t-T)}$

time invariant

B) $x[t] = x(t-T-3)\cos(-T+1+t)$

$y(t-t) = x(t-T-3)\cos(-T+1+t)$

time invariant

c) $y(t) = x^2(t) + 1$

$x_1(t) = x(t-T)$

$y_1(t) = x_1^2(t) + 1 = x^2(t-T) + 1$

$y(t-T) = x^2(t-T) + 1$

time invariant

8 A) $e^{2t}(x(t))^2 = e^{2t} \cdot \underbrace{x(t) \cdot x(t)}_{\text{present}}$

[Both causal and memoryless]

B) $x(\underbrace{2t+10}_{\text{future}})$ -> [memory]

c) $\int_{-\infty}^{2t} x(\tau)\, d\tau$

2t -> increase band to future

$-\infty$ -> depends on past

[memory]

9 A) not BIBO stable

$\frac{x(t)}{x(t-1)}$ -> at $t=1$ unstable and only there

[not BIBO stable]

B: BIBO Stable

bounded [$\int_{-\infty}^{t} x(\tau)\cos(\pi\tau)\,d\tau$]

multiplier bounded

oscillates

Bounded and $x(\tau)$ just scales $\cos(\pi\tau)$ which is bounded

$\boxed{\text{BIBO stable}}$