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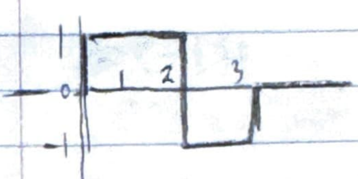
1.1-1, 1.1-4, 1.1-6(a,b)

1.1-1 Find energies in signals.
Comment on effect on energy sign change, time shifting, or doubling of the signal.
Effect on energy if signal if multiplied by K.

a) 

$$\int_{t=-\infty}^{t=\infty} |x(t)|^2 dt = \int_0^3 (1)^2 dt = \boxed{3}$$

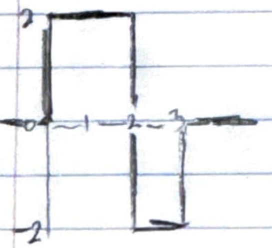
b) 

$$\int_{-t=\infty}^{t=\infty} |x(t)|^2 dt = \int_0^3 (1)^2 dt = \boxed{3}$$

c) 

Time Shifted

$$\int_{-\infty}^{t=\infty} |x(t)|^2 dt = \int_3^6 (1)^2 dt = 6-3 = \boxed{3}$$

d) 

$$\int_{t=-\infty}^{t=\infty} |2x(t)|^2 dt = \int_0^3 4 \, dt = \left[4t\right]_0^3 = \boxed{12}$$

They all satisfy $x(t) \to 0$ as $|t| \to \infty$

If multiplied by K instead of 2, then we'd always have

$$\int_0^3 |k\,x(t)|^2 dt = \left[k^2 t\right]_0^3 = \boxed{3k^2}$$

- Sign change: Does nothing. Obviously due to the absolute value.
- Time Shift: Also does nothing, as the upper and lower integral bounds both change to compensate.
- Doubling: Had the effect of quadrupling the regular amount.
- Multiply by K: multiplies regular amount by the obvious k^2.

1.1-4 We're doing something similar, but $x(t)$ is different and $x(t)$ does not go to 0 as $|t| \to \infty$. We need the signal power instead using

$$P_x = \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 dt \qquad x(t) = t^3$$

Our signal is periodic! So we can just take the average across one interval!

$$P_x = \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 dt \qquad x_{rms} = \sqrt{P_x}$$

$$P_x = \frac{1}{4} \int_{-2}^{2} t^6 dt = \boxed{\frac{64}{7}} \qquad x_{rms} = \boxed{\frac{8}{\sqrt{7}}}$$

a) Absolute value cancels, so it will be the same.

$$\boxed{P_x = \frac{64}{7} \qquad x_{rms} = \frac{8}{\sqrt{7}}}$$

b) $P_x = \frac{1}{4} \int_{-2}^{2} 4t^6 dt = \boxed{\frac{256}{7}}$ $\qquad x_{rms} = \boxed{\frac{16}{\sqrt{7}}}$

c) $P_x = \frac{1}{4} \int_{-2}^{2} c^2 t^6 dt = \boxed{\frac{64c^2}{7}}$ $\qquad x_{rms} = \boxed{\frac{8c}{\sqrt{7}}}$

Similar to the previous problem, we see a quadrupling of P_x and doubling of x_{rms} due to the root. Introducing C just gives c^2 and c in P_x and x_{rms} respectively.

1.1-6(a,b) a ⇒ $5 + 10\cos(100t + \pi/3)$
b ⇒ $10\cos(100t + \pi/3) + 16\sin(150t + \pi/5)$
Those are absolutely vile. Let's start with (a)

Okay sike, we have tricks
up our sleeve.

a) we can use the special case here.

$$x(t) = 5 + 10\cos\left(100t + \frac{\pi}{3}\right)$$

$$P_x = 5^2 + \frac{10^2}{2} = \boxed{75} \qquad x_{rms} = \boxed{\sqrt{75}}$$

b) $$x(t) = 10\cos\left(100t + \frac{\pi}{3}\right) + 16\sin(150t + \pi/5)$$

$$P_x = \frac{1}{2}(10^2 + 16^2) = \boxed{178} \qquad x_{rms} = \boxed{\sqrt{178}}$$