Name: KEY

Section:_____

EE322 Fall 2008 Exam 1: Part 1

Problem		Possible Points	Score
Part 1	1	25	
	2	25	
	3	25	
	4	25	
Part 2	5	10	
	6	20	
Total		130	

- You will have the first 60 minutes of the lab period to take Part 1 of the exam.
- For this portion of the exam, you are allowed to use 1 page, single-side of notes or whatever you want to write on it, and a calculator.
- You ***must show your work*** to get full credit for problems. Expect to lose points if you don't.
- Label your sketches (axes and functions) carefully. Expect to lose points if you don't.
- Some potentially useful equations:

$$\cos^2 x = \tfrac{1}{2}(1+\cos 2x)$$

$$\sin^2 x = \tfrac{1}{2}(1-\cos 2x)$$

$$\cos(x+y) = \cos x \cos y - \sin x \sin y$$

$$tri(t) = \begin{cases} 1-t, & t \geq 0 \\ 1+t, & t \leq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\text{sinc}(t) = \frac{\sin \pi t}{\pi t}$$

- If you finish Part 1 of the exam before it is called for, turn it in and pick up Part 2 (MATLAB).

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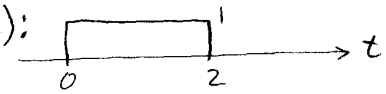
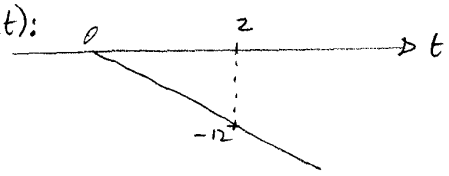
1. (25 pts) Continuous-time.

a. Graph $g(t) = -3ramp(2t)[u(t) - u(t-2)] + \delta(t+4)$.

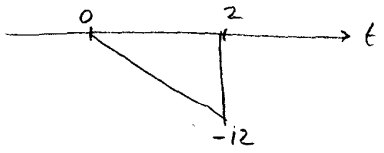
$u(t) - u(t-2)$:



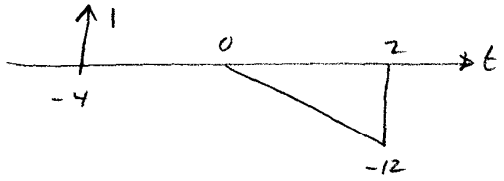
$-3ramp(2t)$:



$[u(t) - u(t-2)](-3ramp(2t))$:



$g(t)$:



b. Determine the odd and even parts of $h(t) = (1+t^2)\sin(\pi t)$.

$$h_e(t) = \frac{h(t) + h(-t)}{2} = \frac{(1+t^2)\sin\pi t + (1+(-t)^2)(\sin\pi(-t))}{2}$$

$\sin\pi(-t) = -\sin\pi t$

$$= \frac{\sin\pi t}{2} + \frac{t^2\sin\pi t}{2} + \frac{-\sin\pi t}{2} - \frac{t^2}{2}$$

$$\boxed{h_e(t) = 0}$$

$$h_o(t) = h(t) - h_e(t) = h(t)$$

$$\boxed{h_o(t) = (1+t^2)\sin(\pi t)}$$

c. Determine the fundamental period, if any, of $x(t) = 14\sin(400\pi t) - 6\cos(500\pi t)$

$2\pi 200t$ $\quad$ $2\pi 250t$

$f_1 = 200$ $\quad$ $f_2 = 250$

$T_1 = \frac{1}{200}$ $\quad$ $T_2 = \frac{1}{250}$

$$T_0 = LCM\left(\frac{1}{200}, \frac{1}{250}\right) = \frac{LCM\left(\frac{1000}{200}, \frac{1000}{250}\right)}{1000} = \frac{LCM(5,4)}{1000} = \frac{20}{1000}$$

$$\boxed{T_0 = 0.02 \text{ sec}}$$

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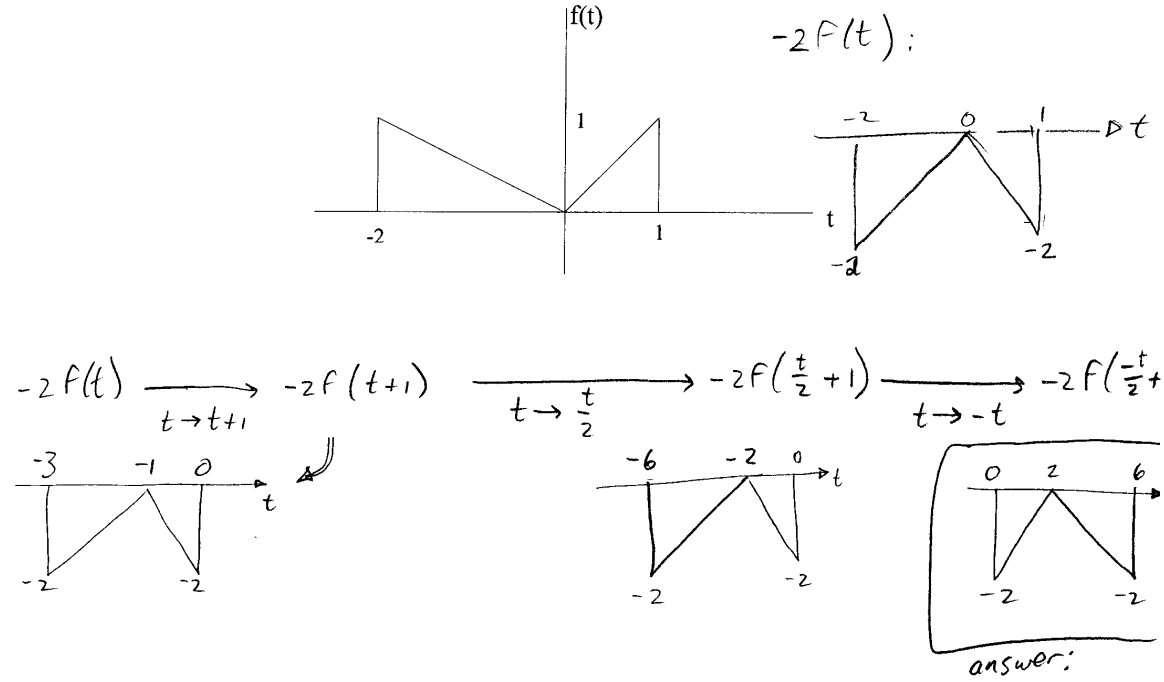
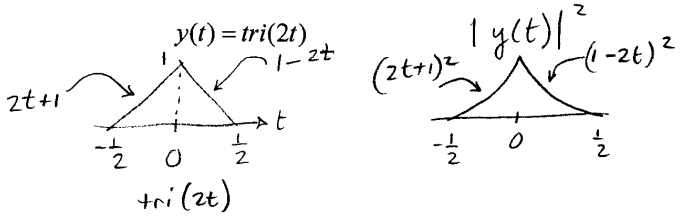
2. (25 pts) Continuous-time.

a. Given the signal below, graph $-2f\left(-\frac{t}{2}+1\right)$.



b. Calculate the energy or power associated with the following signals:



$$E_x = \int_{-\infty}^{\infty} |y(t)|^2 dt = 2\int_0^{1/2} (1-2t)^2 dt$$

$$= 2\int_0^{1/2} (1 - 4t + 4t^2) dt$$

$$= 2\left[t - 2t^2 + \frac{4t^3}{3}\Big|_0^{1/2}\right]$$

$$= 2\left(\frac{1}{2} - \frac{1}{2} + \frac{4}{3(8)}\right) = \boxed{\frac{1}{3}}$$

$z(t) = 2\sin(200\pi t)$.

Sinusoid - Pwr signal

$$\frac{A^2}{2} = \frac{4}{2} = \boxed{2}$$

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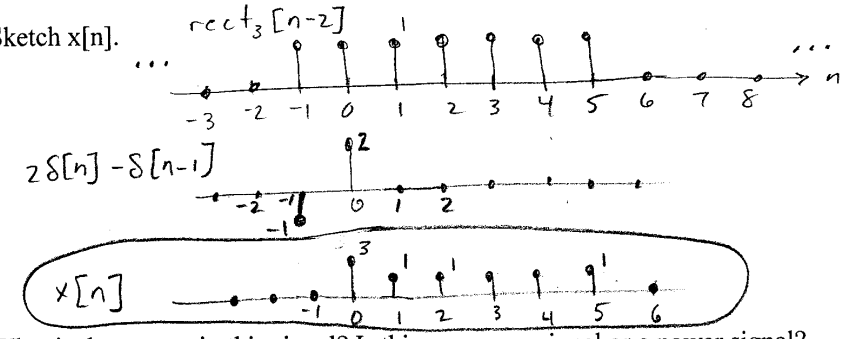
3. (25 pts) Discrete-time.

Suppose you are given the following discrete-time function:

$$x[n] = rect_3[n-2] + 2\delta[n] - \delta[n+1].$$

a. Sketch x[n].

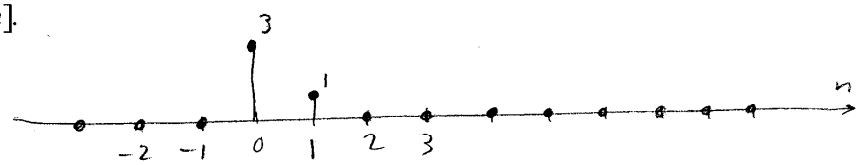


b. What is the energy in this signal? Is this an energy signal or a power signal?

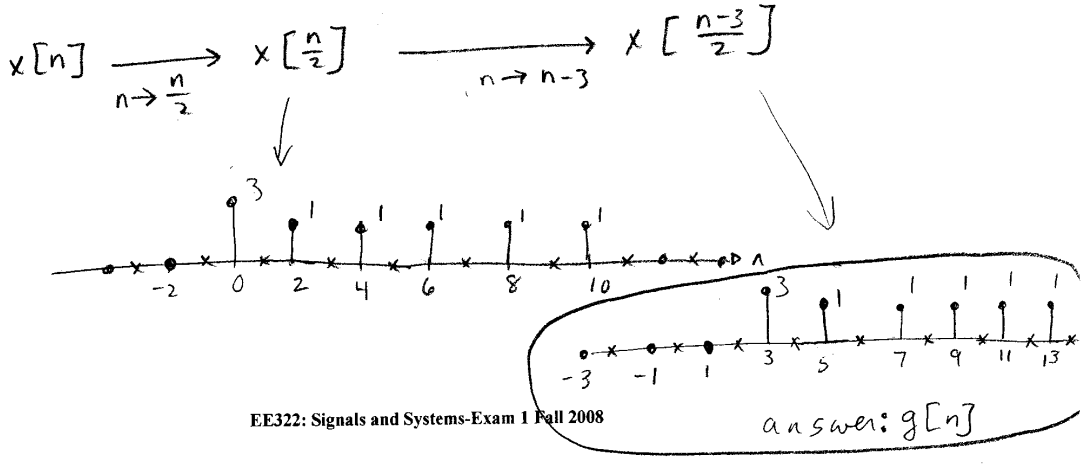
$E_x = 3^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 = \boxed{14}$ Energy signal

c. Plot y[n]=x[3n].

time compress by a factor of 3



d. Sketch $g[n] = x\left[\frac{n-3}{2}\right]$



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4. (25 pts) Discrete-time.

a. Determine the fundamental period of $y[n]=\cos\left(\frac{3\pi n}{2}\right)-1.5\sin\left(\frac{2\pi n}{3}+\frac{\pi}{7}\right)$

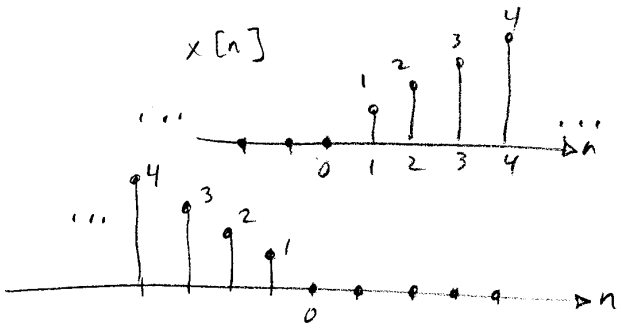
$= \cos\left(2\pi\frac{3}{4}n\right) - 1.5\sin\left(2\pi\frac{1}{3}n + \frac{\pi}{7}\right)$

N_1 N_2

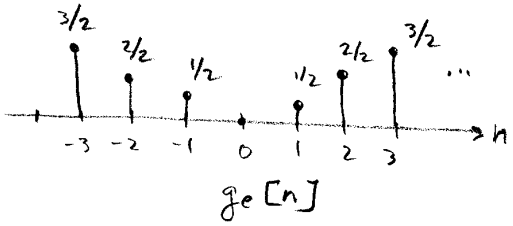
$LCM(N_1, N_2)$

$N_o =$ **12**

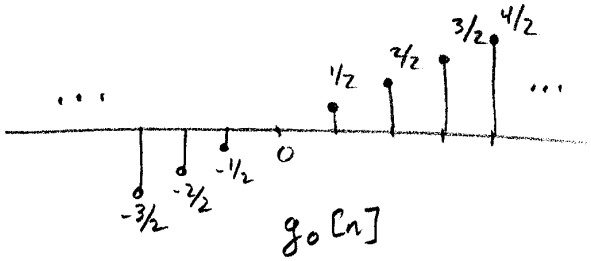
b. Find the even part of $x[n]=ramp[n]$.



$g_e[n] = \frac{x[n] + x[-n]}{2}$



$g_o[n] = g[n] - g_e[n]$:



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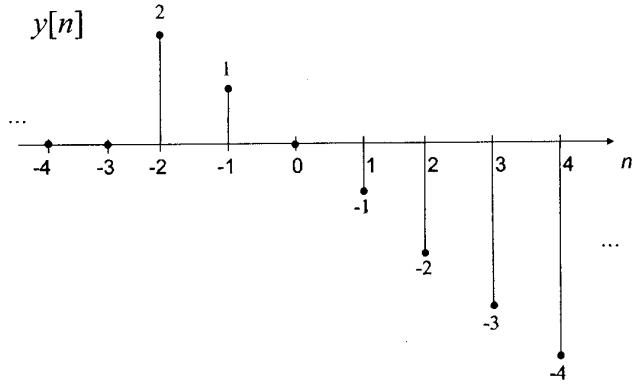
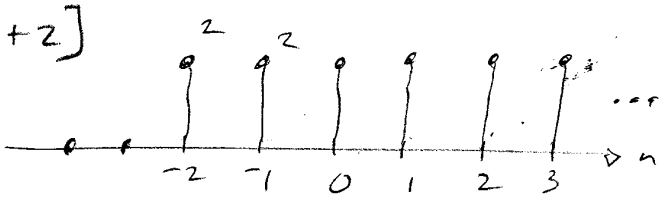
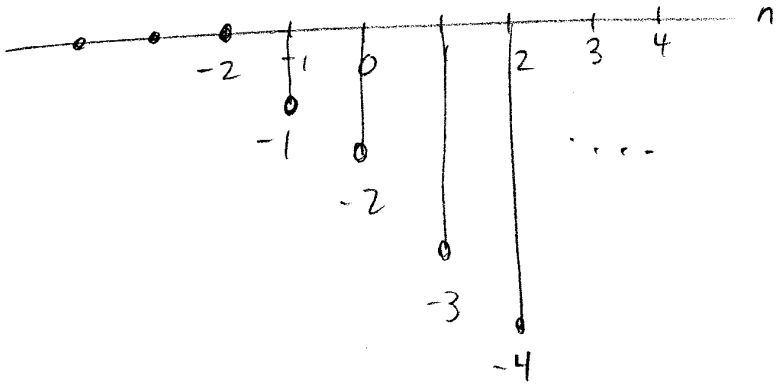
d. Write a mathematical expression for the function $y[n]$ shown in the figure below. Your answer should NOT include delta functions.



$2u[n+2]$



$-\text{ramp}[n+2]$



$$y[n] = 2u[n+2] - \text{ramp}[n+2]$$

Also possible: $2u[n+2] - 2u[n+1] + u[n+1] - u[n] - \text{ramp}[$

other answers may also be correct.

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