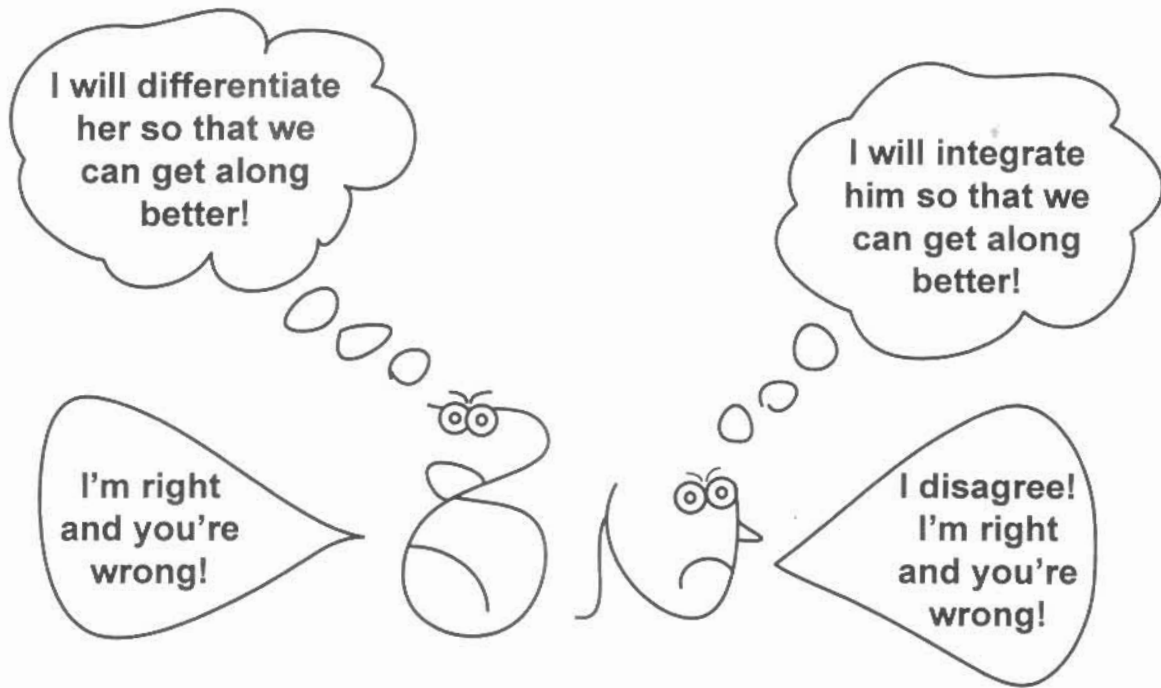


3/1/2006



*University of Portland  
School of Engineering*

**EE 262-Signals & Systems-3 cr. hrs.**

**Spring 2006**

**SOLUTIONS TO  
Midterm Exam # 1**

(Prepared by Professor A. S. Inan)

(Monday, February 27, 2006)

(Closed Book Exam, One formula sheet is allowed.)

(Total Time: 55 mins.)

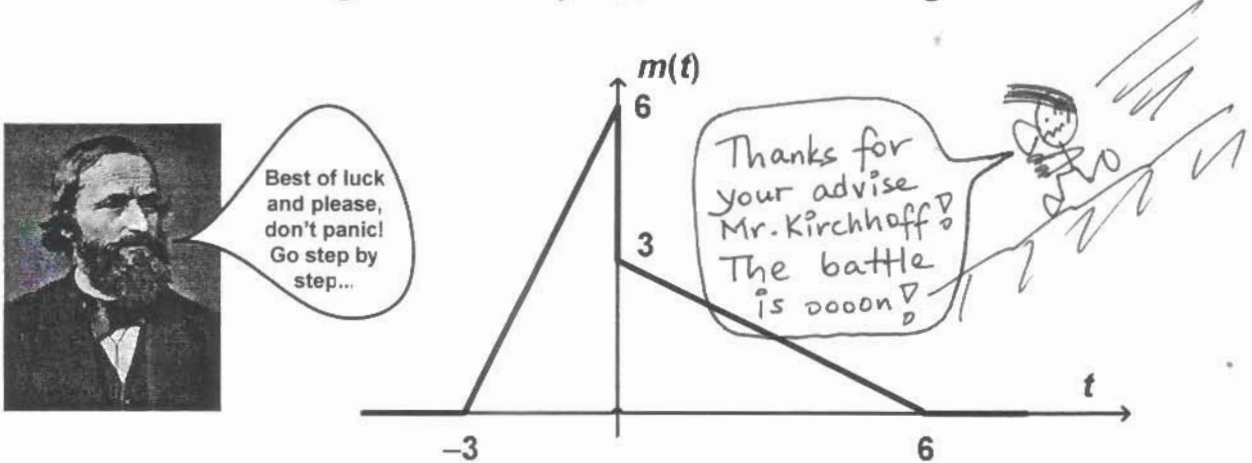
Name: SOLUTIONS ! ☺

Signature: [Handwritten Signature] ☺

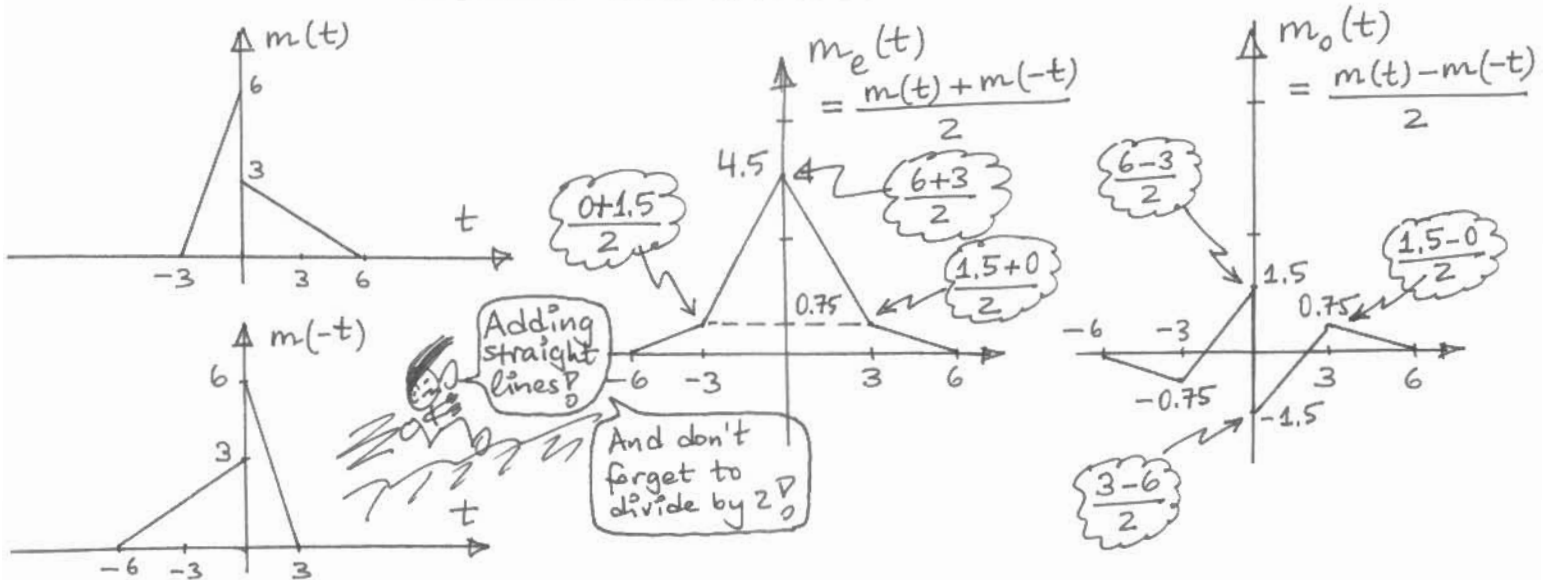


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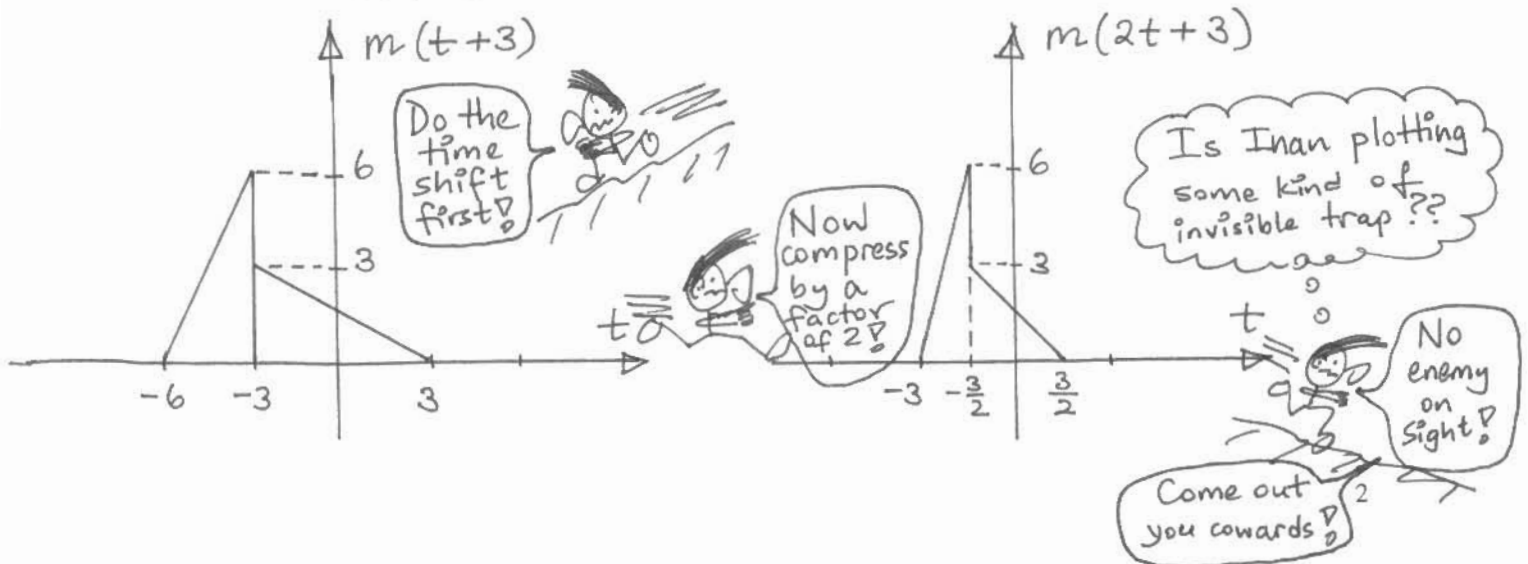
(1) (10 mins., Total: 30 points) **A continuous-time signal.** Consider the continuous-time signal denoted by  $m(t)$  as shown in the figure below.



(a) (10 points) Sketch the even and odd parts of  $m(t)$ . Provide all the pertinent values on your sketch.



(b) (10 points) Sketch  $m(2t+3)$ .



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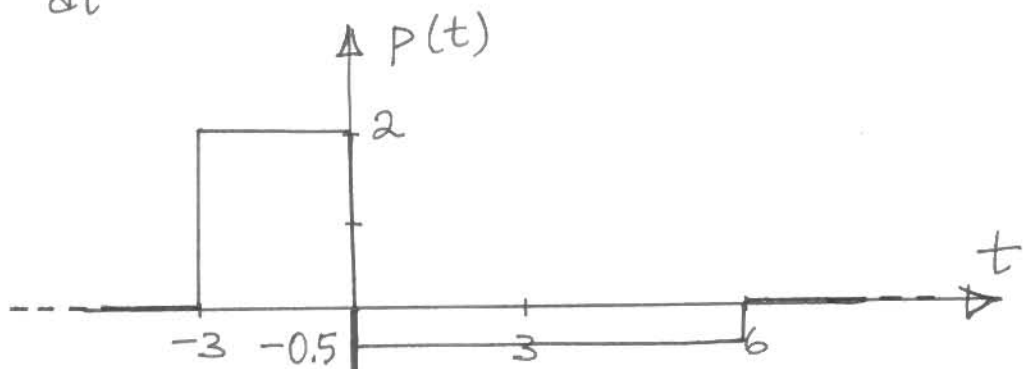
What?  
You chickens,  
fight like  
a man!

(c) (10 points) Find the function  $p(t) = dm(t)/dt$  and sketch  $p(t)$  versus  $t$ . Provide all the pertinent values on your sketch.

$$m(t) = 2r(t+3) - 3u(t) - \frac{5}{2}r(t) + \frac{1}{2}r(t-6)$$

d/dt

$$p(t) = \frac{dm(t)}{dt} = 2u(t+3) - 3\delta(t) - \frac{5}{2}u(t) + \frac{1}{2}u(t-6)$$



Derivative of  
a jump point  
results in an  
impulse?

I knew Inan was  
up to something...  
However, I will fight  
till the end!



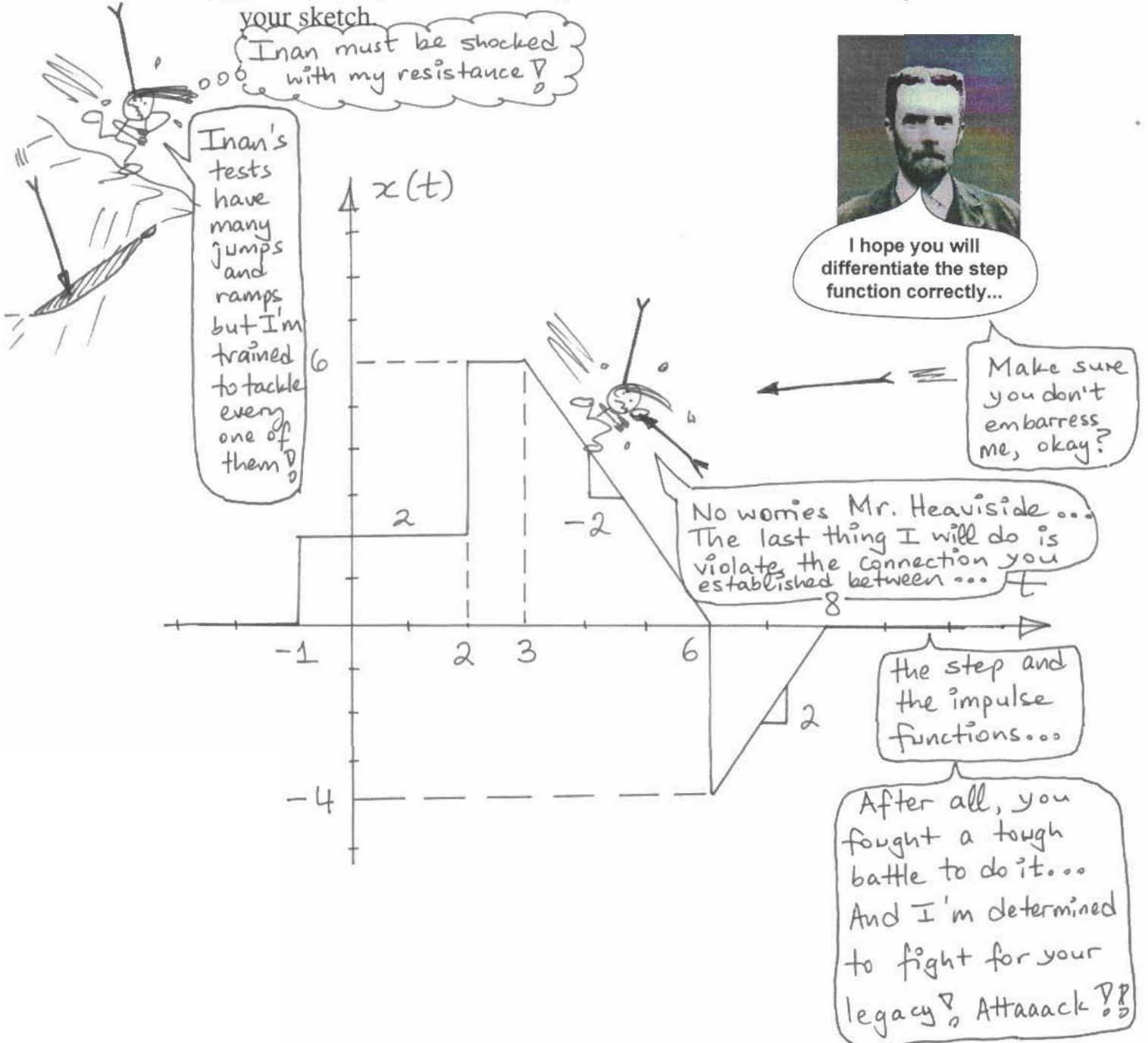
Come out  
and I will  
duel you  
one by one!

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(2) (15 mins., Total: 25 points) **Impulse, step, and ramp functions.** A continuous-time signal is given by

$$x(t) = 2u(t+1) + 4u(t-2) - 2r(t-3) + 4r(t-6) - 4u(t-6) - 2r(t-8)$$

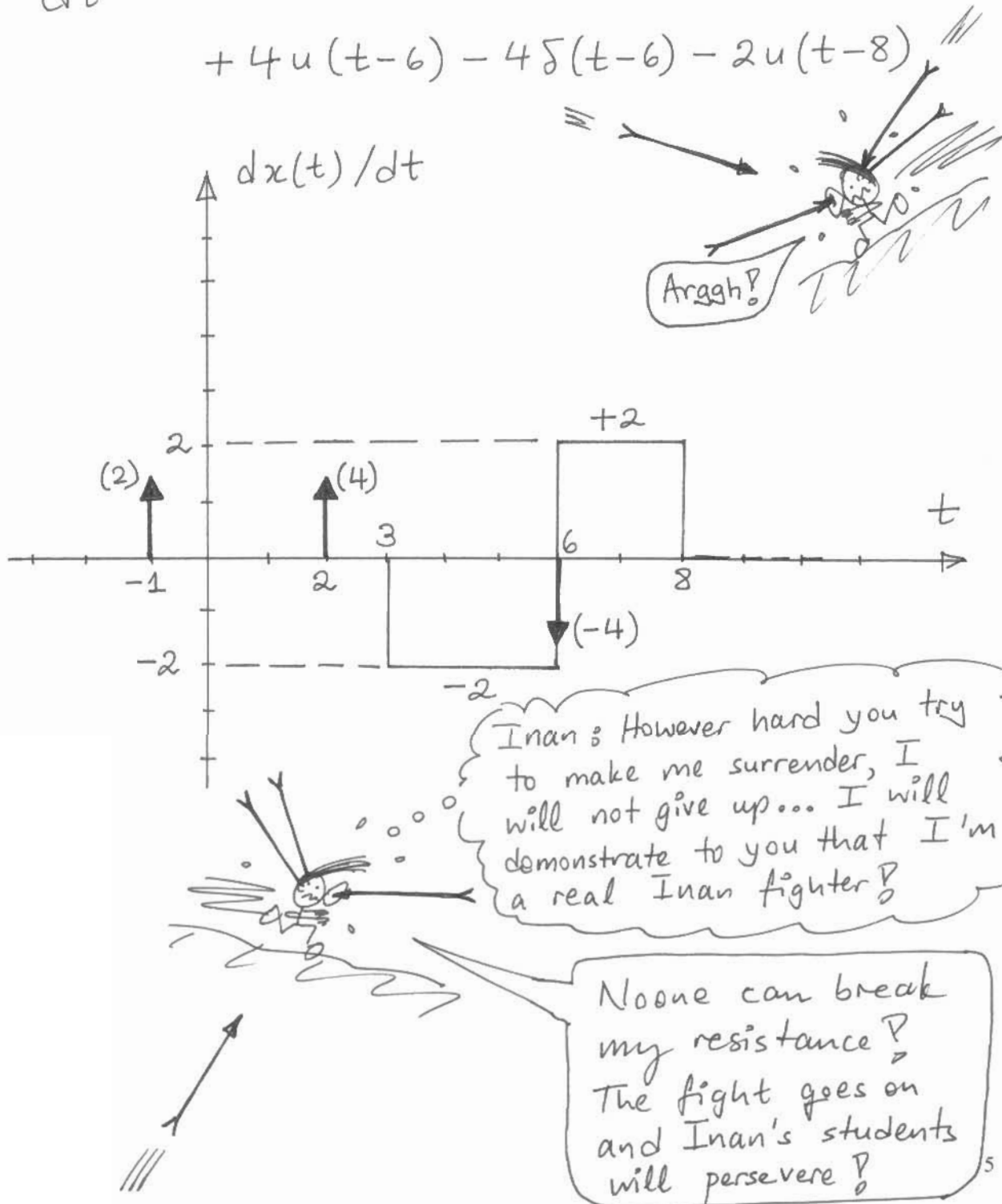
(a) (12.5 points) Sketch this signal. Provide all the necessary values on your sketch



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(b)(12.5 points) Using  $x(t)$  given in part (a), sketch the derivative signal,  $dx/dt$ . Provide all the appropriate values on your sketch.

$$\frac{dx(t)}{dt} = 2\delta(t+1) + 4\delta(t-2) - 2u(t-3) + 4u(t-6) - 4\delta(t-6) - 2u(t-8)$$



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(3) (10 mins., 20 points) **Convolution integral.** Find the convolution integral  $y(t) = x(t) * h(t)$  where the continuous-time signals  $x(t)$  and  $h(t)$  are given by  $x(t) = [u(3+t) - u(t-3)]$  and  $h(t) = \delta(t-2) + \delta(t+2)$  respectively. Provide the complete mathematical expression for the function  $y(t)$  and sketch it as a function of  $t$ .

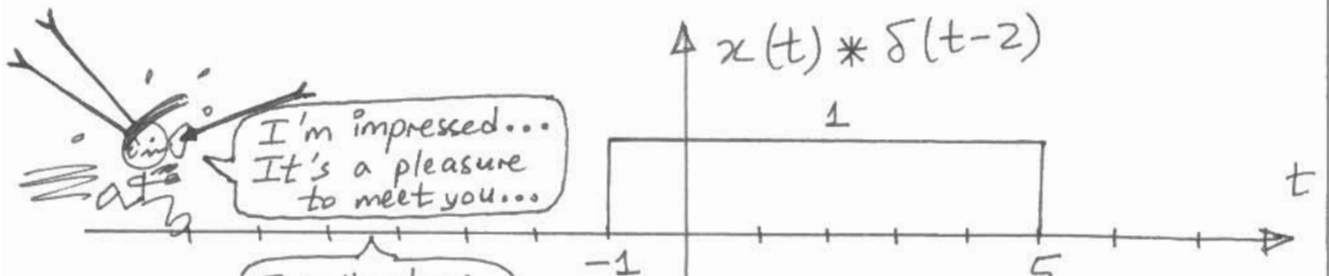
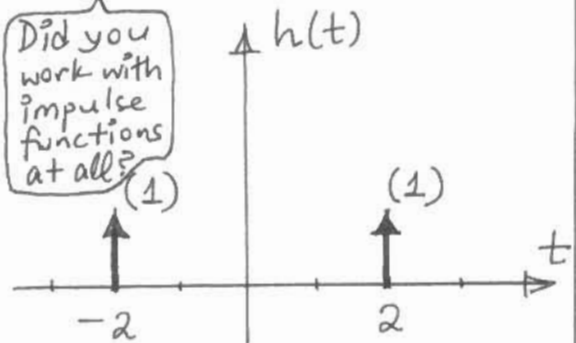
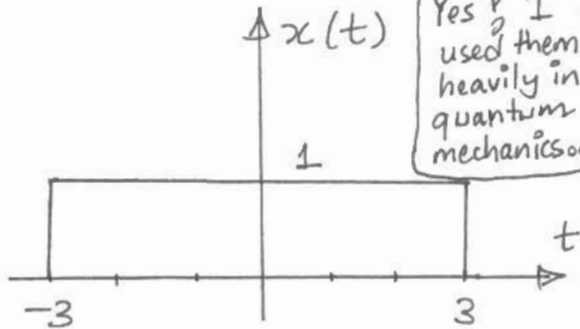


Hi! My name is Paul Adrien Maurice Dirac. Did you know that sometimes the impulse function is also called the Dirac delta function?

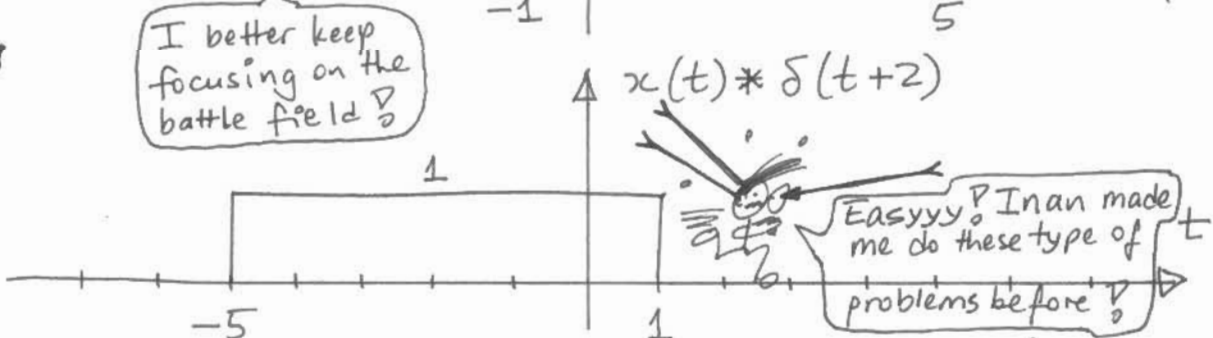
Hi Mr. Dirac. What a coincidence?

Yes I used them heavily in quantum mechanics...

Did you work with impulse functions at all?

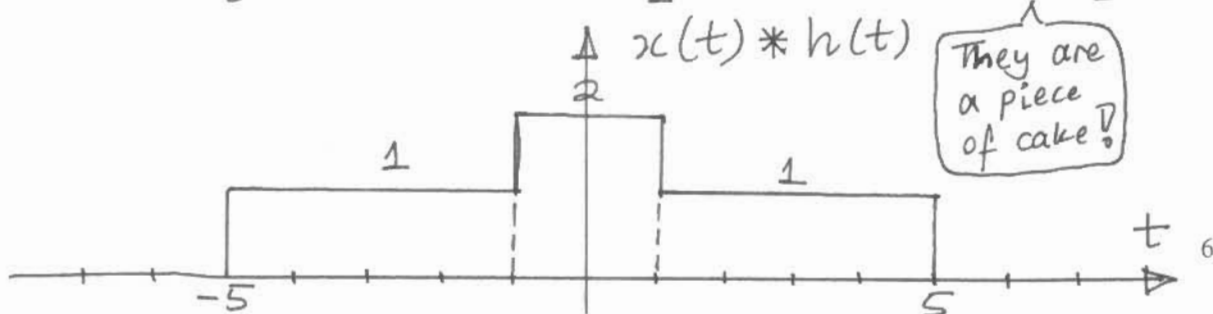


I'm impressed... It's a pleasure to meet you...



I better keep focusing on the battle field!

Easy! I can make me do these type of problems before!



They are a piece of cake!

$$y(t) = u(t+5) + u(t+1) - u(t-1) - u(t-5)$$

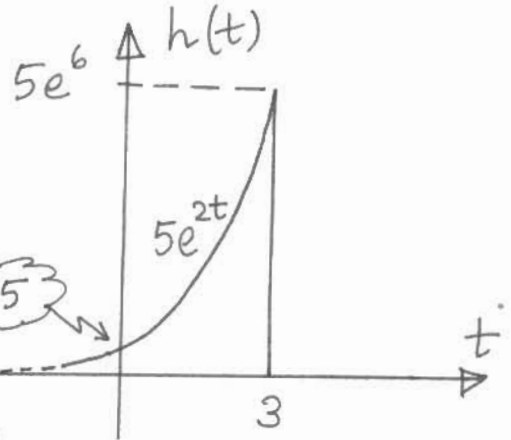
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(4) (15 mins., Total: 25 points) LTI system. The impulse response of a Linear Time-Invariant (LTI) system is given by  $h(t) = 5e^{2t}u(3-t)$ .



Keep up the good work and never ever give up!! Quick!!

I won't! And thanks for standing by my side and for all your support!



(a) (5 points) Is this system memory-less? (Provide brief justification for your answer.)

By the way: Thanks for the two laws you discovered,

No, since  $h(t) \neq k\delta(t)$ .

You will pay for my memory Inan... \*G\*F\*

they helped me tremendously in Inan's electric circuits course!

(b) (5 points) Is this system causal? (Justification.)

No, since  $h(t) \neq 0$  for  $t < 0$ .

However, I'm memoryless because of Inan!

It's the courses I took from Inan that destroyed my memory!

(c) (5 points) Is this system stable? (Justification.)

Yes, since  $\int_{-\infty}^{\infty} |h(t)| dt = \int_{-\infty}^3 5e^{2t} dt$

$= \frac{5}{2} e^{2t} \Big|_{-\infty}^3 = \frac{5e^6}{2} < \infty$

Inan should not exist!

I used to be a stable person before I started taking Inan courses!

Not anymore...

Destroy Inan! Delete Inan!  
 Destroying Inan does not violate  
 the conservation of ~~energy~~ <sup>matter</sup> principle PP

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(d) (10 points) Find and sketch the unit-step response of this system.  
 (Don't forget to sketch it! Provide appropriate values on your sketch.)

This is why I can  
 battle Inan's tests!

The unit step response  $g(t)$  can be  
 found from the impulse response as

$$g(t) = \int_{-\infty}^t h(\tau) d\tau$$

$$= \begin{cases} \int_{-\infty}^t 5e^{2\tau} d\tau = \frac{5}{2}e^{2t} & \text{for } t < 3 \\ \int_{-\infty}^3 5e^{2\tau} d\tau = \frac{5e^6}{2} & \text{for } t > 3 \end{cases}$$

or  $g(t) = \frac{5}{2}e^{2t}u(3-t) + \frac{5e^6}{2}u(t-3)$

