

*University of Portland  
School of Engineering*

**EE 262-Signals & systems-3 cr. hrs.**  
**Spring 2009**

**Midterm Exam # 1**

(Prepared by Professor A. S. Inan)

(Friday, February 13, 2009)

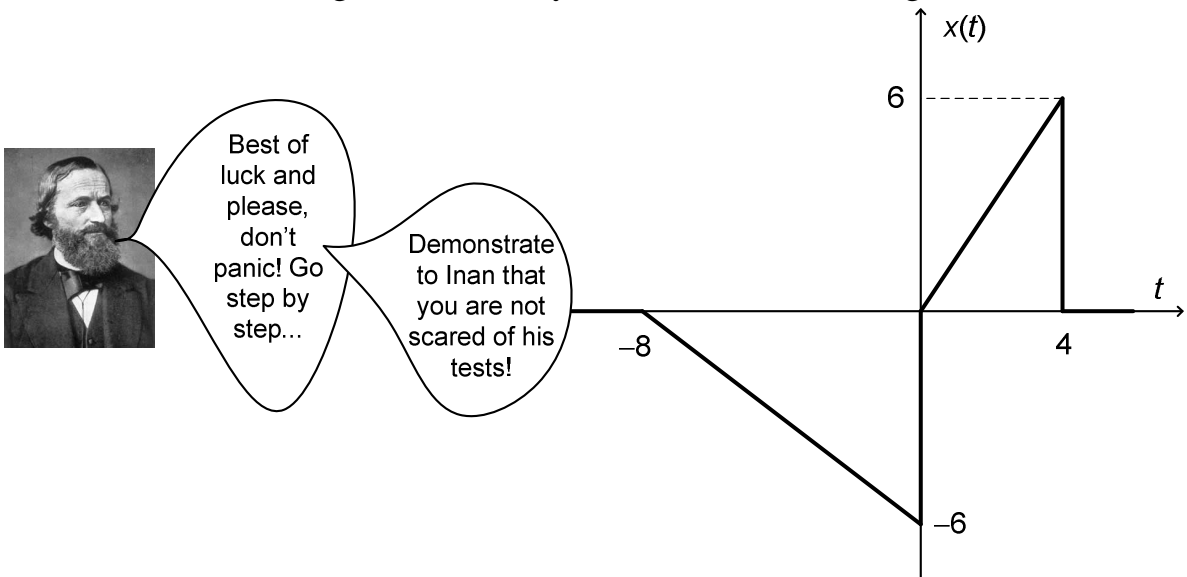
(Closed Book Exam, One formula sheet allowed.)

(Total Time: 55 mins.)

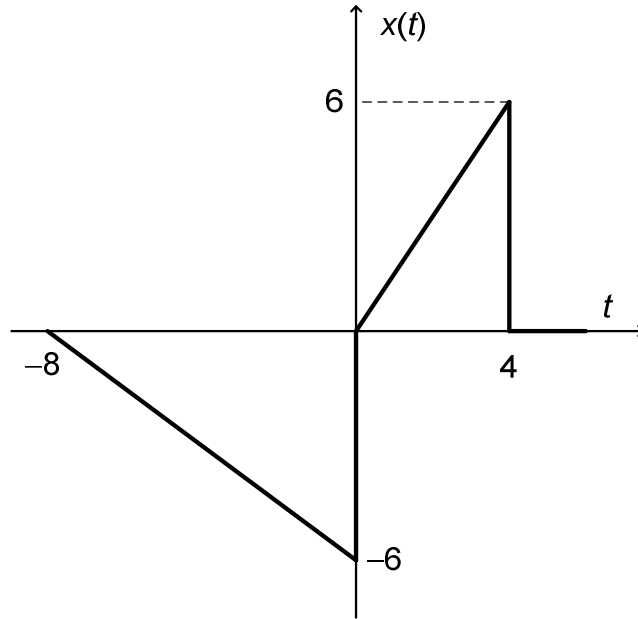
**Name:** \_\_\_\_\_ 😊

**Signature:** \_\_\_\_\_ 😊

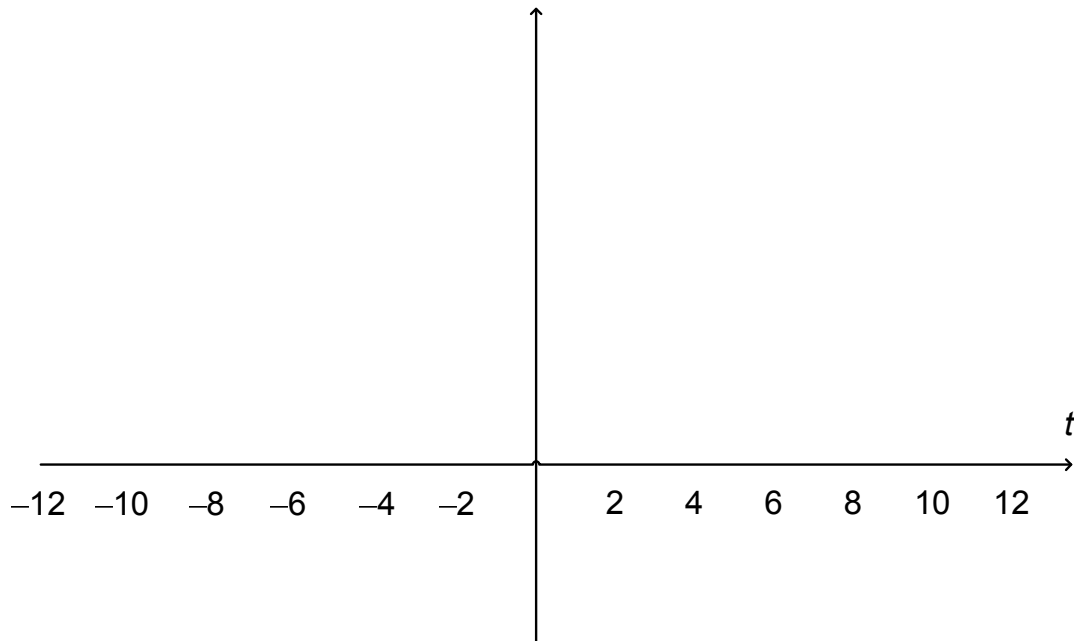
(1) (10 mins., Total: 30 points) **A continuous-time signal.** Consider the continuous-time signal denoted by  $x(t)$  as shown in the figure below.

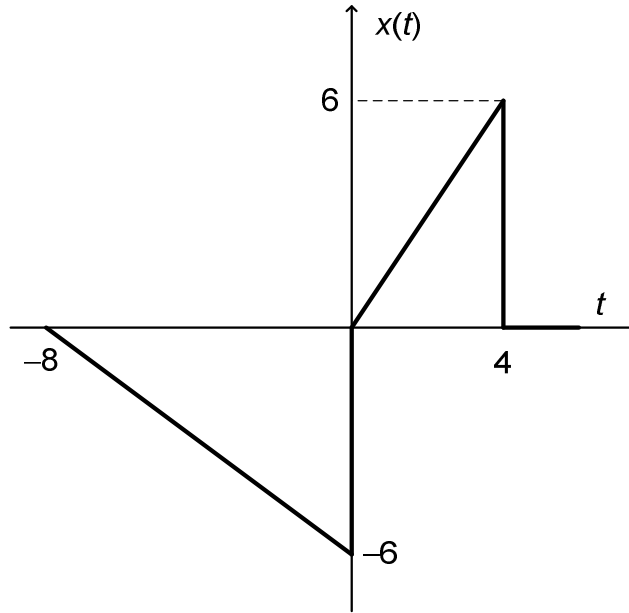


(a) (10 points) Sketch the even and odd parts of  $x(t)$ . Provide all the pertinent values on your sketch.

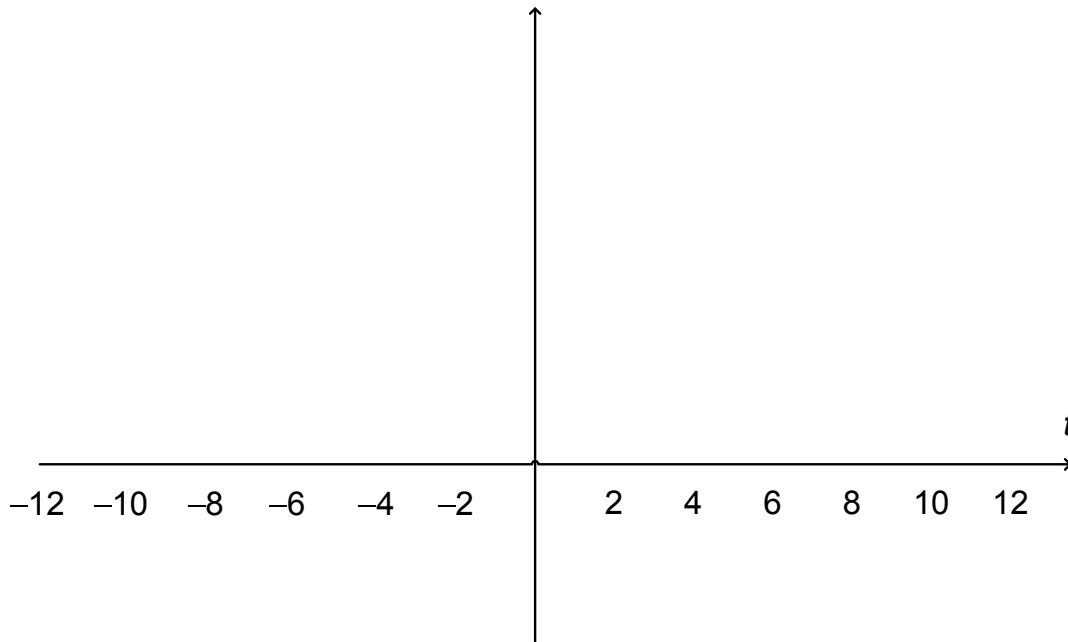


(b) (10 points) Sketch  $2x(t/3-2)/3$ .





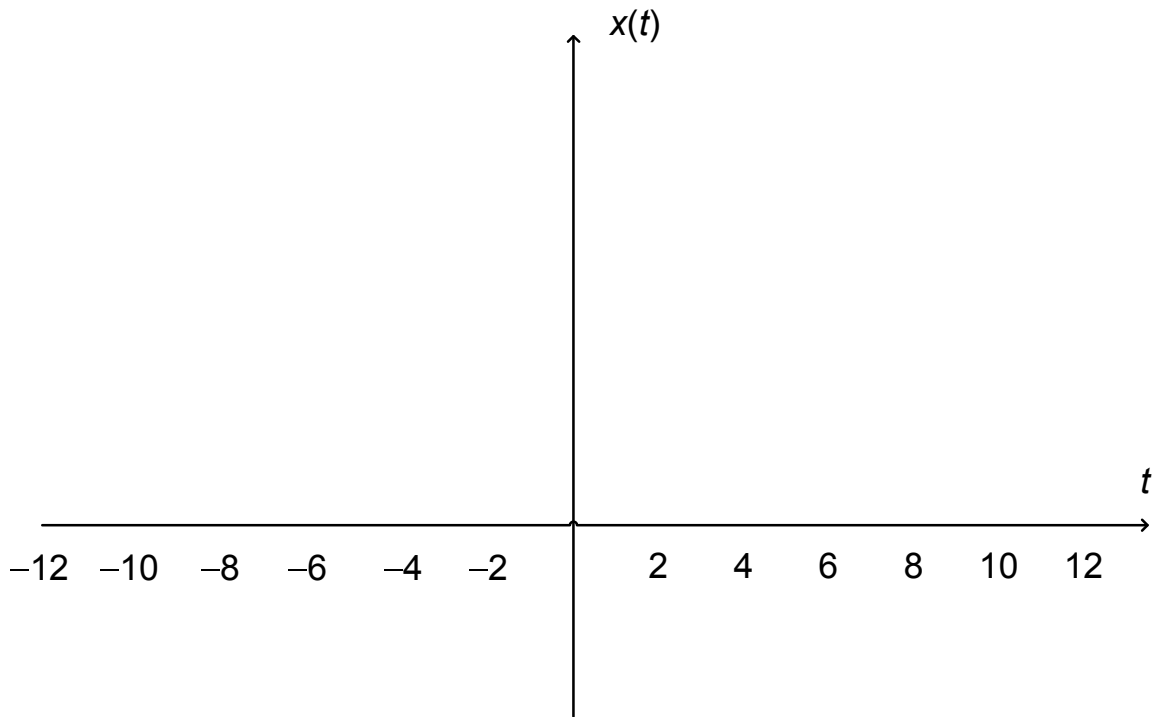
(c) (10 points) Find the mathematical expression for the function  $y(t) = dx(t)/dt$  and sketch  $y(t)$  versus  $t$ . Provide all the pertinent values on your sketch.



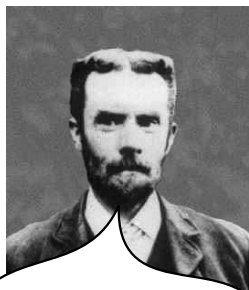
(2) (15 mins., Total: 25 points) **Impulse, step, and ramp functions.** A continuous-time signal is given by

$$x(t) = -2u(t+4) - (3/2)r(t+4) + (11/2)r(t) - 4u(t-3) - 4r(t-3) + 7u(t-6) - 3r(t-6) + 3r(t-9)$$

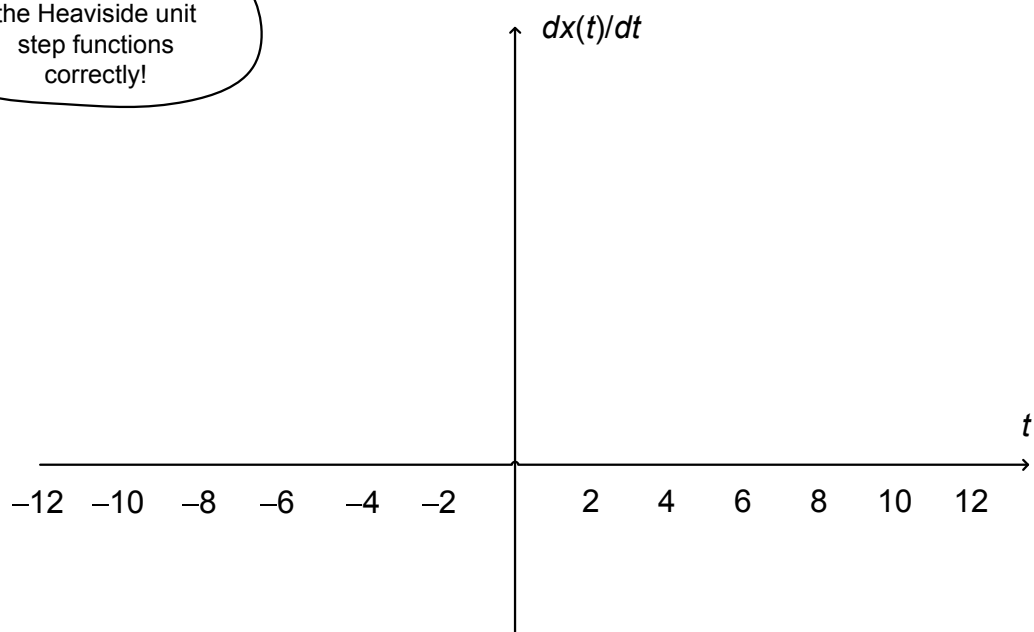
(a) (12.5 points) Sketch this signal. Provide all the necessary values on your sketch.



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



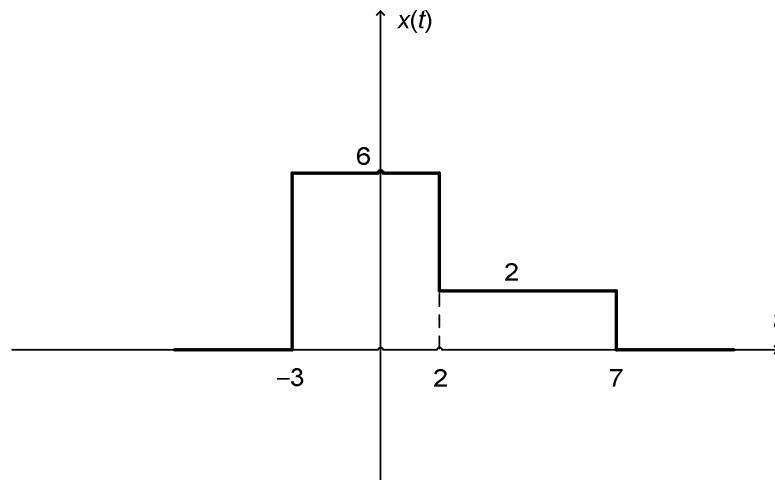
Please, differentiate the Heaviside unit step functions correctly!



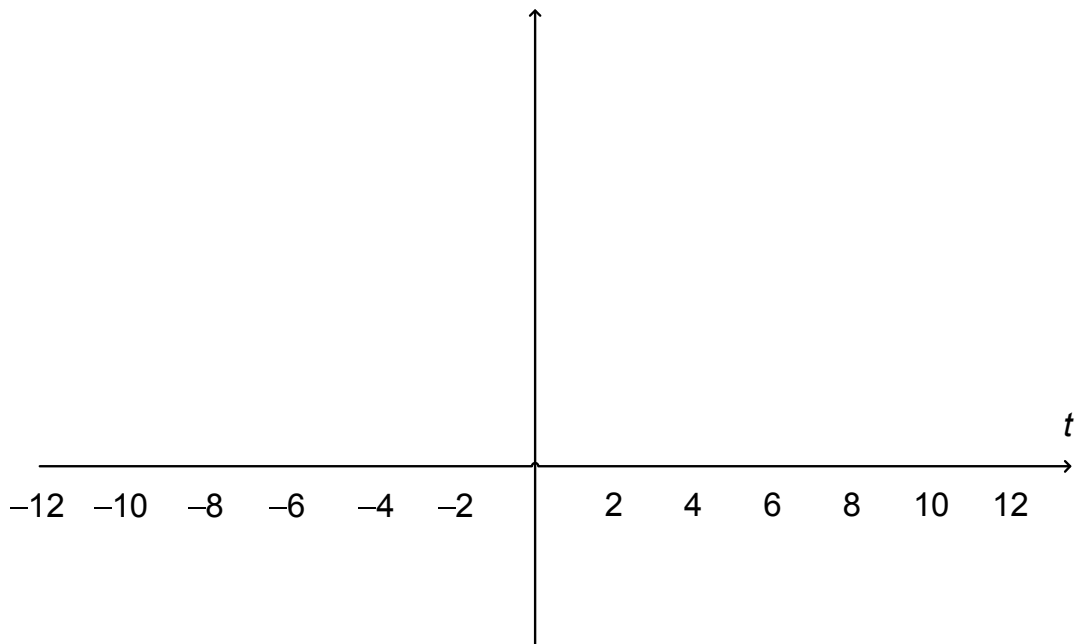
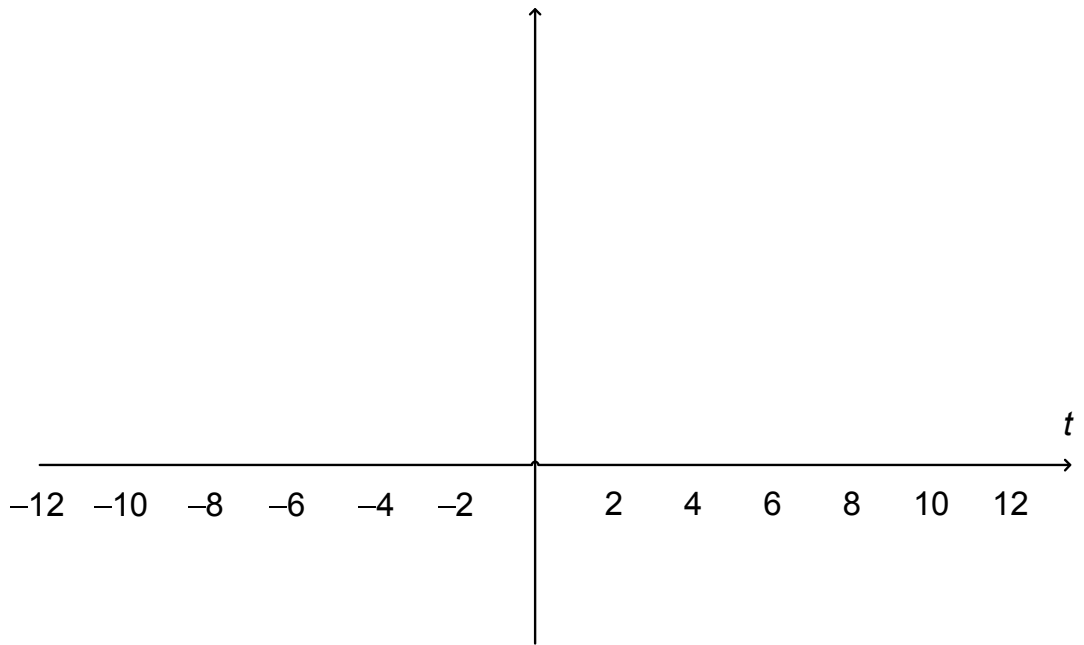


Hi! My name is Paul Adrien Maurice Dirac. You look familiar, what is your name?

Hi! My name is the Unit Impulse Function... However, sometimes, they also call me the Dirac delta function, I wonder why?

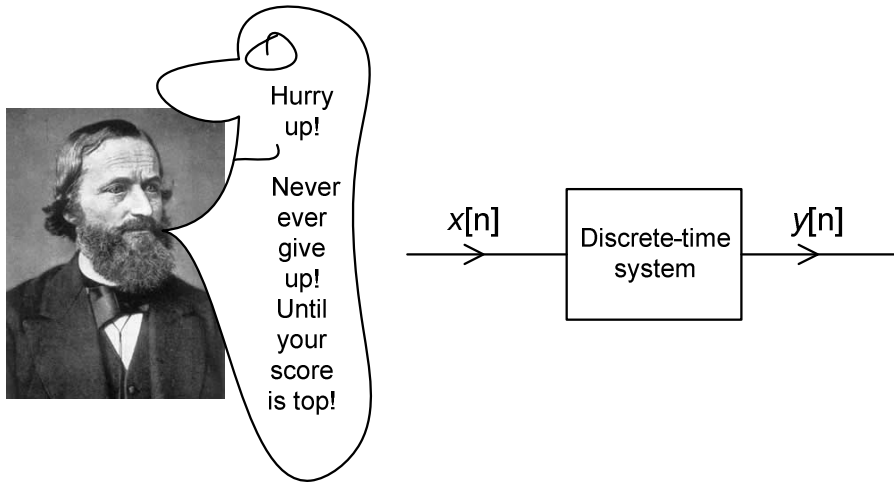


(3) (10 mins., 25 points) **Convolution integral.** Find the complete mathematical expression for the signal  $y(t)$  and sketch it if  $y(t)$  is given by the convolution integral  $y(t) = x(t) * h(t)$ , if the signal  $x(t)$  is given as shown above and the signal  $h(t)$  is given as follows:  $h(t) = \delta(t - 3) - 2\delta(t + 2)$ .





(4) (15 mins., Total: 20 points) **Properties of a discrete-time system.** The input  $x[n]$  and the output  $y[n]$  relationship of a discrete-time system is given by  $y[n] = (n - 2)x[2 - n]$ .



(a) (4 points) Is this system memory-less? (Provide a clearly stated justification for your answer.)

(b) (4 points) Is this system causal? (Justification required!)

(c) (4 points) Is this system BIBO stable? (Justification required!)

(d) (4 points) Is this system linear? (Justification required!)

(e) (4 points) Is this system time invariant? (Justification required!)