University of Victoria
Midterm Examination #1
Summer 2013

2.5/30

Course Name:	**ELEC 260**
Course Title:	**Continuous-Time Signals and Systems**
Section(s):	**A01, A02**
CRN(s):	**30265 (A01), 30266 (A02)**
Instructor:	**Michael Adams**
Duration:	**50 minutes**

Name: [redacted]

Student Number: V00[redacted]

This examination paper has **8 pages**, all of which are numbered.

Students must count the number of pages in this examination paper before beginning to write, and report any discrepancy immediately to the invigilator.

All questions are **to be answered on the examination paper** in the space provided.

Total Marks: 30

This examination is **closed book**.

The use of a crib sheet is **not** permitted.

The use of a calculator is **not** permitted.

Show all of your work!
Clearly define any new quantities (e.g., variables, functions, etc.) that you introduce in your solutions.

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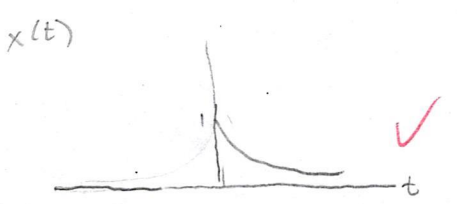
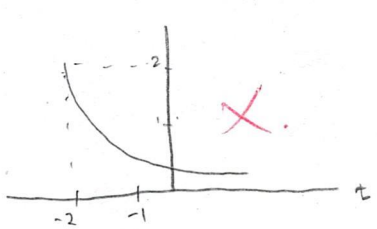
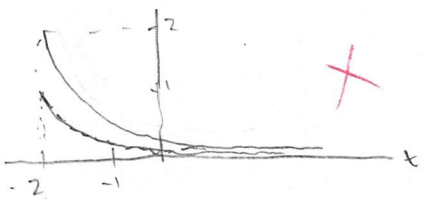
Do not write on this page unless instructed to do so.

PROBLEM 1. Using graphical methods (i.e., the method used during the lectures), compute the convolution $x(t) * h(t)$, where $x(t) = e^{-t}u(t)$ and $h(t) = e^{-2t+2}u(t-1)$. For each separate case in your solution, you must state the the convolution result and the corresponding range of t. Each convolution result may be stated in the form of an integral, but the integral must be simplified as much as possible without integrating. In addition, for each separate case, you must show the fully-labelled graph from which your answer is derived. In the preceding sentence, the words "fully labelled" imply (amongst other things) that the equation of each curve on a graph must be labelled with its equation. You cannot use the commutative property of convolution in your solution. That is, you must compute directly compute $x(t) * h(t)$. You cannot instead compute $h(t) * x(t)$. **[7 marks]**

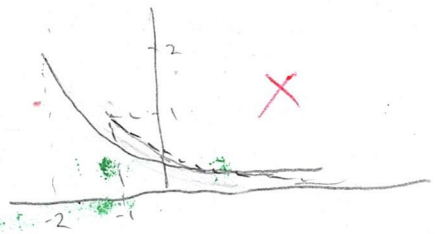




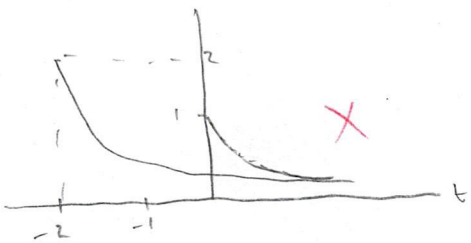
convolution $x(t) * h(t)$



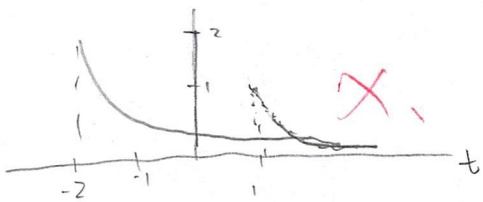
$$\int_{-2}^{\infty} e^{-2t+2}u(t+1) + \int_{-2}^{8} e^{-t+2}u(t)$$



$$\int_{-2}^{\infty} e^{-2t+2}u(t-1) + \int_{-1}^{\infty} e^{-t+1}u(t)$$



$$\int_{-2}^{\infty} e^{-2t+2}u(t-1) + \int_{0}^{\infty} e^{-t}u(t)$$



$$\int_{-2}^{\infty} e^{-2t+2}u(t-1) + \int_{1}^{\infty} e^{-t-1}u(t)$$

1

PROBLEM 2. Using the MATLAB programming language, write a function called `moreMarksPlease` that takes a single real parameter x and returns the real value y, where

$$y = \begin{cases} \sum_{k=0}^{100} \cos(k^2 x) & \text{if } x \neq 0 \\ 0 & \text{otherwise.} \end{cases}$$

Be sure to use correct syntax in your answer, since syntax clearly matters here. **[2 marks]**

```
Function [y] = moreMarksPlease
if (x == 0)
    y = 0;
else
    for (k=0, k<100, k++)
    y = cos(k^2x);
    end
end
end
```

0

PROBLEM 3. Consider the function f of the real variable t given by $f(t) = \dfrac{-1}{(3jt-3)^7}$. Compute a fully simplified expression for $\arg f(t)$. **[5 marks]**

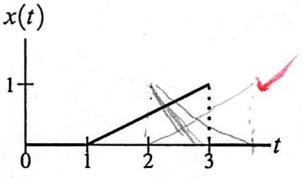
$\arg f(t) = \arg\left(\dfrac{-1}{(3jt-3)^7}\right)$

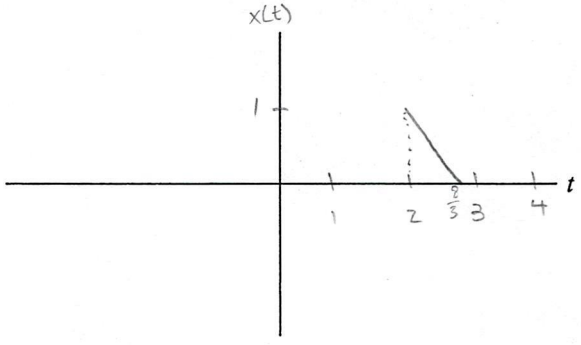
$= 3\sqrt[7]{-t+1}$

0

PROBLEM 4.

Suppose that we have the signal $x(t)$ shown in the graph to the right. Using the axes provided below, plot and fully label a graph of $y(t) = x(-3t-1)$. Show all of your work. **[2 marks]**





show process

2.5

PROBLEM 5. Consider the function $y(t)$ given by

$$y(t) = \int_{t-13}^{t+\pi} \tau\delta(\tau)d\tau + \int_{-\infty}^{\infty} \tau e^{-|\tau-1|}\delta(\tau-1)d\tau + \int_{-\infty}^{t} \delta(\tau+3)d\tau.$$

Find a fully simplified expression for $y(t)$. **[5 marks]**

$= \int_{t-13}^{t+\pi} \tau\, d\tau + \int_{-\infty}^{\infty} \tau e^{-|\tau-1|}\delta(\tau-(1))\,d\tau + \int_{-\infty}^{t} \delta(\tau+3)\,d\tau$

$= \frac{\tau^2}{2}\Big|_{t-13}^{t+\pi} + \int_{-\infty}^{\infty} (1)e^{-(1-1)}\,dt + 0$

$= \frac{(t+\pi)^2}{2} - \frac{(t-13)^2}{2} +$

$= \frac{t^2 + 2\pi t + \pi^2 - t^2 + 26t - 169}{2}$ X

$y(t) = \frac{(2\pi + 26)t + \pi^2 - 169}{2}$

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PROBLEM 6. Suppose that we have a system $\mathcal{H}$ with input $x(t)$ and output $y(t)$.

(A) Clearly state, in mathematical terms, the condition that must be satisfied in order for the system $\mathcal{H}$ to be time invariant. Be sure to define all quantities such as variables, functions, and constants. Otherwise, you will receive zero marks. Be careful with the notation that you choose to employ. If, for example, you confuse arrows and equal signs in your solution, you will probably receive zero marks. **[2 marks]**

$x(t) \rightarrow \boxed{\mathcal{H}} \rightarrow y(t)$

$x(t) \rightarrow y(t)$

$x_1(t) \rightarrow y_1(t)$

$x_2(t) \rightarrow y_2(t)$.

$x(t-t_0) \rightarrow y(t)$ X

$x_1(t-t_0) \rightarrow y_1(t)$

$x_2(t-t_0) \rightarrow y_2(t)$

$y_3(t) = a x_1(t) + b x_2(t)$

0/2

(B) Suppose now that the system $\mathcal{H}$ is characterized by the equation $y(t) = x(-t)$. Using the condition stated in part (a), determine whether this system is time invariant. **[2 marks]**

$y_1(t) = x_1(-t)$

$y_2(t) = x_2(-t)$

$y_3 = a x_1(-t) + b x_2(-t)$

$= a x_1(-t-t_0) + b x_2(-t-t_0)$

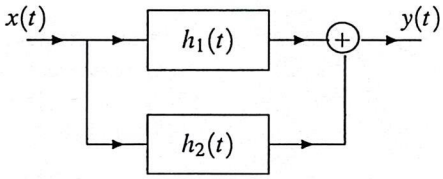
X

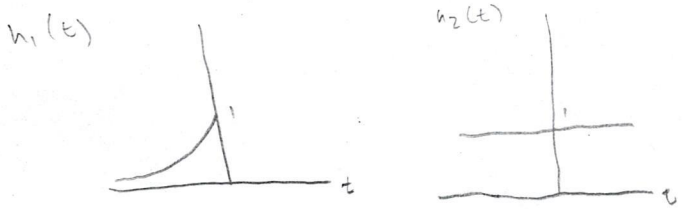
0/2

$\therefore$ system is time invariant

PROBLEM 7.

Consider a system with input $x(t)$, output $y(t)$, and impulse response $h(t)$ that consists of the interconnection of two LTI systems with impulse responses $h_1(t) = e^{-t}u(t)$ and $h_2(t) = 1$, as shown in the diagram. Determine if the system with input $x(t)$ and output $y(t)$ is BIBO stable. Do not skip any steps. Show all of your work. **[5 marks]**





both $h_1(t)$ and $h_2(t)$ are BIBO stable

therefore system where $x(t) \rightarrow y(t)$

through $h_1(t)$ or $h_2(t)$ is BIBO stable

✓

0/5

END