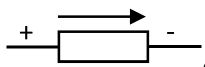
Second Test of Introduction to Electrical Technology. Professor: Danilo Rairán. Oct/02/2018

Name:____ Code: _______________ Group:_________

- The symbol "#" is equal to the last digit of your code plus one.
- The grade of each item will be assigned **if and only if** the item is perfect.

1. Given an electrical element: 

, where $v(t) = \frac{\#}{10}\frac{di(t)}{dt}$, and the electric charge in Eq. 1. **a**) Compute the rank of time satisfying $i(t_?) > \#\ A$, **b**) compute $v(t)$, **c**) compute and plot the electric power $p(t)$, **d**) Find when the power is greater, lower or equal to zero.

2. Given the circuit in Fig. 1, demonstrate the power balance, **a**) before the switch operation, **b**) after the switch operation.

3. Given the circuit in Fig. 2: **a**) Compute the voltage in all nodes if the reference is given by Eq. 2, **b**) If $v_B = 1.5 * \# * v_C = 2.7 * \# * v_D = 4.1 * \#$, plot the Electric Potential Diagram, including v_{ad}, **c**) Compute v_{db} using at least two different paths, and using stairs-elevator or the Electric Potential Diagram.

Eq. 1) $$q(t) = \begin{cases} 5 * 10^{-4}\ C,\ t < -1\ ms \\ 500t^2\ (C), -1\ ms \le t < 1\ ms \\ (\# + 0.5)t - \# * 10^{-3}\ \ (C),\ 1\ ms \le t < 2\ ms \\ -500t^2 + 3t + (\# - 3)10^{-3}\ (C),\ 2\ ms \le t < 3\ ms \\ (\# + 1.5)10^{-3}\ (C),\ t \ge 3\ ms \end{cases}$$

Eq. 2) $$v_{ref} = \begin{cases} a,\ if\ \# = 1,2,9 \\ b,\ if\ \# = 3,4,10 \\ c,\ if\ \# = 5,6 \\ d,\ if\ \# = 7,8 \end{cases}$$

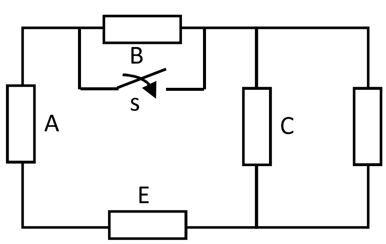


Fig. 1.

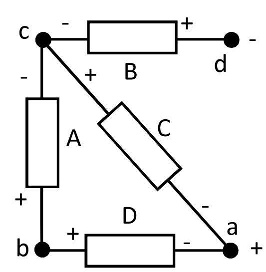


Fig. 2.

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a = 0,6	a = 0,8	a = 0.5
b = 0,5	b = 0,8	b = 0,6
a = 0,4		c = 0,6
d = 0,2		
/1,7	/1,6	/1,7

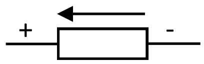
Great Total: /5,0

Second Test. Introduction to Technology in Electricity. Code: _____________________ Group: _______

Danilo Rairán, Apr/10/2018

Note: # is equal to the last digit of your code plus one.

The points in each item will be assigned ***if and only if*** *the answer and the process are perfect.*

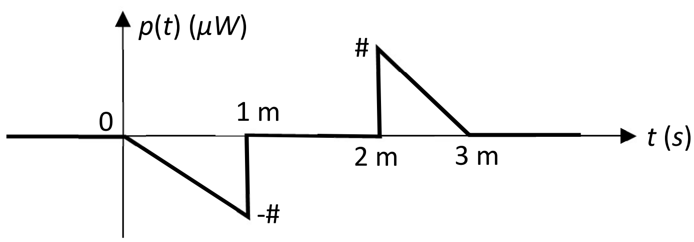
1. Given an electrical element:  answer each question, as follows:

a. Plot $q(t)$ using Matlab. (0.8 *points*)

$$q(t) = \begin{cases} 0\,C, & t < 0 \\ 500t^2\ (C), & 0 \le t < 1\,ms \\ (\# + 0.5)t - \#10^{-3}\ (C), & 1\,ms \le t < 2\,ms \\ -500t^2 + 3t + (\# - 3)10^{-3}\ (C), & 2\,ms \le t < 3\,ms \\ (\# + 1.5)10^{-3}\ (C), & t \ge 3\,ms \end{cases}$$

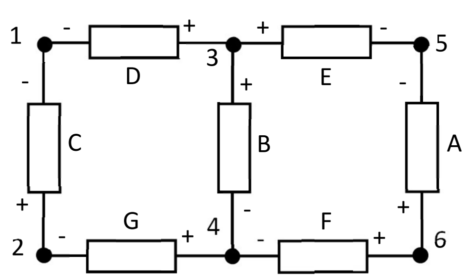
b. Compute $i(t)$ given $q(t)$, by hand (*0.5 points*)

c. Compute the equation for $p(t)$ according to the following graph (*0.5 points*)



d. Compute the voltage $v(t)$ given the previous data (*1.0 points*)

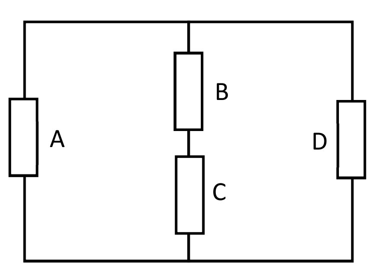
2. Calculate the indicated voltages…



a. v_A = □ v_B = ?, v_C = □, v_D = □, v_E = □, v_F = □, v_G = □ in terms of the voltages in the other elements (*0.6 points*)

b. v_{63} = □, v_{54} = □, v_{32} = □, v_{41} = □, v_{52} = □, v_{61} = □, v_{25} = □, v_{16} = □, v_{45} = □, v_{15} = □ in terms of the voltage in the elements (*0.6 points*)

3. Randomly choose polarity and current sense in the circuit, then demonstrate the power balance. (*1 point*)



Introduction to Electricity, Prof. Danilo Rairán, Jun/17/2021, second test

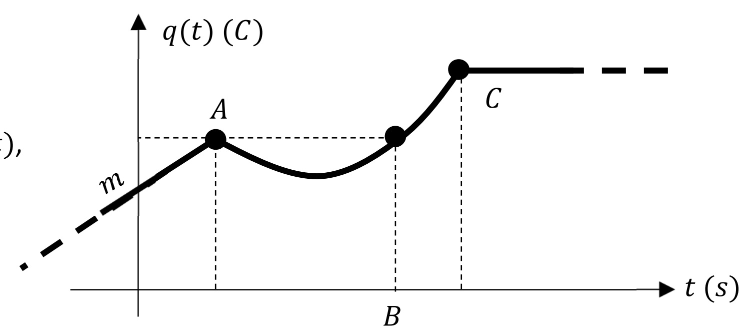
Name: ____ Code: _________________

Group: ____________________   # = a number given by the professor during the test

1. The function $i(t) = (t - \#)^2 * (t + \#)^2\ (A)$ is not a parabola but given that the best knowledge we have so far to analyze it is a second order polynomial, then compute a parabola that approximates the function $i(t)$ as close as possible. Explain the procedure of approximation.

2. If $m = \# \times 10^{-3}$, $A = (\# \times 10^{-3}, \# \times 10^{-6})$, $B = 2 * \# \times 10^{-3}$, $C = (2.5 * \# \times 10^{-3}, 2 * \# \times 10^{-6})$

   a) compute an equation to describe $q(t)$, **b**) compute $i(t)$, **c**) plot $i(t)$.



3. Given the equation for $i(t)$ answer the following questions: **a**) $i(4m) = ?$, **b**) $t = ?\ if\ i = 11\ mA$, **c**) $t = ?\ if\ i = 8\ mA$.

$$i(t) = \begin{cases} (-1.5 + \#/7)t - 5m(-1.5 + \#/7) + 10m\ (A), t < 5\ ms \\ -120t^2 + \frac{12}{5}t + 1m\ (A), \quad 5ms < t < 15ms \\ (0.5 + \#/7)t - 15m(0.5 + \#/7) + 10m\ (A), t > 15\ ms \end{cases}$$

4. It is well known that the price of a house changes as the electric charge in a circuit. That price increased (25+#) millions per year, until it reaches (500 + 25*#) millions. Changes in the politics to curve that tendency makes that price to be (540 + 10*#) millions in three years, and another three years later it is (490 + 10*#) millions. Finally, the price continues decreasing linearly until (450 + 5*#) millions in two years.

   a) Make a plot describing the price of a house. **b**) Compute the equation, use scientific notation.

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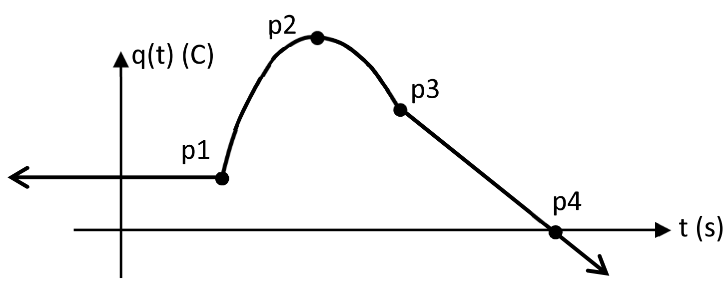
1. 1.0/5	2. a) 0.7/5	3. a) 0.4/5	4. a) 0.6/5
	b) 0.5/5	b) 0.4/5	b) 0.9/5
	c) 0.3/5	c) 0.2/5	

Second Test, Introduction to Electricity, October 17, 2019, Danilo Rairán, Group: ______________

Name: ____ Code: ______________________

x = last digit of your code plus one

1. Half million cats were devastating the mice population. Nobody knew what was happening until the authorities decided to hire you to make a model. They new that a year ago there were ***x*** billions mice, and just two months ago there were ***x***/3 billions. Everything changes today because the government decided to call a flautist to take all the cats to another country. If you can predict that the mice population will increase to ***x***/4 billions in two months and that they will recover their initial population in six months, a) make a model to describe the mice population from 17/Oct/2018 to 17/Oct/2020; b) could an electric current or electric charge behaves like this mice population? Why?
2. If p1 = (1.5m,***x***), p2 = (3.4m,2.5***x***), p3 = (5.3m,2***x***), p4 = (7.2m,0) in the graph, a) compute q(t), b) compute i(t), c) plot i(t),



3. If q(t) is given by the following equation, a) q(-2.73m) = ?, b) $t_?$ If q($t_?$)=0.98m***x***,

$$q(t) = \begin{cases} 500t^2 + t + (0.5m + 1m\boldsymbol{x})\ (C), & t < -1\ ms \\ -\boldsymbol{x}t\ (C), -1\ ms \le t < 1\ ms \\ 500t^2 + t + (-1.5m - 1m\boldsymbol{x})\ (C), t \ge 1\ ms \end{cases}$$

____

1 a	/15	2 a	/8	3 a	/5
b	/0	b	/6	b	/12
		c	/4		

Introduction to Electricity, Prof. Danilo Rairán, Jun/23/2020

Name: ____ Code: _______________________

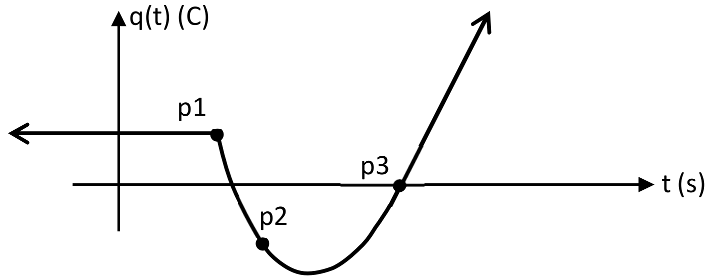
Group: _______________

\# = a number given by the professor during the test

1. Data points in the following table do not describe a parabola, but the best we can do now is to define a parabola that sort of describe them. Compute a parabola that matches the best way possible those points.

t (s)	2#x10^{-6}	3#x10^{-6}	4#x10^{-6}	5#x10^{-6}	6#x10^{-6}	7#x10^{-6}	8#x10^{-6}
i (A)	1x10^{-3}	0.809x10^{-3}	0.309x10^{-3}	-0.309x10^{-3}	-0.809x10^{-3}	-1x10^{-3}	-0.809x10^{-3}

2. If p1 = (1.5m,**#**), p2 = (3.4m,-1.5**#**), p3 = (6.3m,0) in the graph, **a**) compute q(t), **b**) compute i(t), **c**) plot i(t), knowing that the slope of the line matches the slope of the parabola at p3.



3. A monarch butterfly travels crossing countries in a trip that last three generations each round. A biologist estimates that the total amount at the end of the first generation is #10^7 butterflies. That number is 1.2*#10^7 at the end of the second generation, and again #10^7 at the end of the third generation. However, things where not that good for them after that, they start to decrease 1% every year. If there are baby butterflies every 6 weeks, **a**) make a mathematical model to describe the monarch population including the biologist estimations and another three generations of butterflies after that. **b**) could an electric current or electric charge behave like the monarch population? Why?

4. Given the equation for $q(t)$ answer following questions. **a**) $q(4\mu) =?$ **b**) $t =?$ If $q = 0\ C$, **c**) $t =?$ if $\# \times 10^{-3}\ C < q < 2\# \times 10^{-3}\ C$.

$$q(t) = \begin{cases} (10^3 t + 10^{-3})\#\ \ (C), t < 1\ \mu s \\ \left(\frac{5}{4}10^3 t + \frac{3}{4}10^{-3}\right)\#\ \ (C), 1\ \mu s \le t < 5\ \mu s \\ \left(\frac{-7}{2}10^3 t + \frac{49}{2}10^{-3}\right)\#\ \ (C), t \ge 5\ \mu s \end{cases}$$

1) 0.6/5	→ 15 minutes	6:29 – 6:44
2) a) 1/5 b) 0.4/5 c) 0.4/5	→ 35 minutes	6:52 – 7:27
3) a) 1.5/5 b) 0/5	→ 40 minutes	7:33 – 8:13
4) a) 0.3/5 b) 0.3/5 c) 0.5	→ 20 minutes	8:20 – 8:40

Segundo parcial, Introducción a la Electricidad, **24 de octubre de 2022**, Profesor: Danilo Rairán

Nombre: ____ Código:____________________ Grupo: ___________

 # = último dígito del código + 1

1. Dados los datos en la tabla, y presentando todo el procedimiento:
   a. encuentre una línea que aproxime todos los datos, luego haga una aproximación parabólica,
   b. grafique, tanto los datos de la tabla como las dos aproximaciones en una misma gráfica.

t (s)	-2m	-1m	0	1m	2m	3m	4m	5m
q(t) (C)	-5#	0	1#	4#	15#	40#	85#	156#

2. Dada la ecuación para $i(t)$, presente todo el procedimiento para calcular:
a. $t =?$ si $i = 12\ mA$,
b. $t =?$ si $i = 5\ mA$.

$$i(t) = \begin{cases} (-1.5 + \#/7)t - 5m(-1.5 + \#/7) + 10m\ (A), t < 5\ ms \\ -120t^2 + \frac{12}{5}t + 1m\ (A), \quad 5ms < t < 15ms \\ (0.5 + \#/7)t - 15m(0.5 + \#/7) + 10m\ (A), t > 15\ ms \end{cases}$$

3. La carga eléctrica en un conductor se divide en tres partes y se comporta como el número de estudiantes en una universidad. Primero, decrece a razón de $4k(1 + \#/5)$ por cada año. Luego, por cambios difíciles de explicar, se sabe que si bien el número en cinco años será el mismo de hoy, crecerá 50% dos años más adelante, cuando será $50k(1 + \#/5)$. Por último, y de ahí en adelante, el número es invariante.

   a. Haga una gráfica para describir el número de estudiantes.
   b. Calcule su ecuación.
   c. Calcule y grafique el equivalente a la corriente, $i(t)$.

Nota por punto:
1. a. 1.0 **2. a**. 0.8 **3**. **a**. 0.5
b. 0.5 **b**. 0.8 **b**. 0.8
c. 0.6

Tiempo estimado:
1. 30 minutos, **2.** 40 minutos, **3.** 40 minutos

Si utiliza Matlab, escriba todo el código en la hoja de solución.

Introduction to Electricity, Prof. Danilo Rairán, Nov/26/2020

Name: ____ Code: _________________

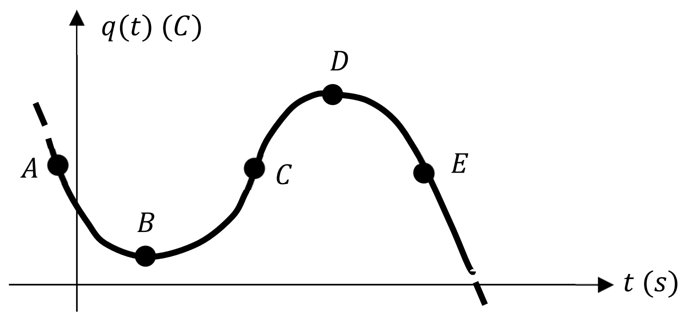
Group: ___________________ # = a number given by the professor during the test

1. Data points in the following table do not describe a parabola, but the best we can do in this moment is to define a parabola that sort of describe them. Compute the equation of a parabola that matches those points as better as possible.

$t\ (s)$	0	$0{,}03e-5$	$0{,}06e-5$	$0{,}09e-5$	$0{,}12e-5$	$0{,}15e-5$	$0{,}18e-5$
$i\ (A)$	0	$\# * 0{,}28e-8$	$\# * 0{,}46e-8$	$\# * 0{,}48e-8$	$\# * 0{,}34e-8$	$\# * 0{,}07e-8$	$-\# * 0{,}22e-8$

2. If $A = (-2m, 8\mu)$, $B = (1m, 6\mu - \#\mu/7)$, $C = (4m, 8\mu)$, $D = (6m, 10\mu + \#\mu/7)$, $E = (8m, 8\mu)$

a) compute an equation to describe $q(t)$, **b**) compute $i(t)$, **c**) plot $i(t)$.



3. Given the equation for $i(t)$ answer the following questions: **a**) $i(4m) =?$, **b**) $t =?\ if\ i = 11\ mA$, **c**) $t = ?\ if\ i = 8\ mA$.

$$i(t) = \begin{cases} (-1.5 + \#/7)t - 5m(-1.5 + \#/7) + 10m\ (A), t < 5\ ms \\ -120t^2 + \frac{12}{5}t + 1m\ (A), \quad 5ms < t < 15ms \\ (0.5 + \#/7)t - 15m(0.5 + \#/7) + 10m\ (A), t > 15\ ms \end{cases}$$

4. The electric charge in one point of a circuit changes as the amount of honey in a beehive. The beehive is full at the end of fall, then decreases 20% during winter. Contrary with it is expected, it decreases during spring till 60% of the maximum, then at the end of summer it is 70%, when usually starts to grow linearly to be again 100% at the end of fall.

a) Make a plot describing the amount of honey in the beehive. **b**) Compute the equation.

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1. 1.0/5 2. a) 0.7/5 3. a) 0.4/5 4. a) 0.6/5

b) 0.5/5 b) 0.4/5 b) 0.9/5

c) 0.3/5 c) 0.2/5

Introduction to Electricity, Prof. Danilo Rairán, Jan/27/2022, second test

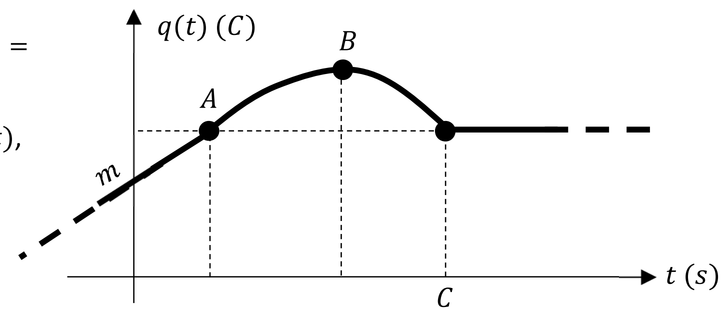
Name: ____ Code: _________________

Group: ____________________ # = a number given by the professor during the test

1. The function $i(t) = (t - \#)(t + \#)t\ (A)$ is not a parabola but given that the best knowledge we have so far to analyze it is a second order polynomial, then compute a parabola that approximates the function $i(t)$ for $t \geq 0\ s$. Explain the procedure of approximation.

2. If $m = \# \times 10^{-3}$, $A = (\# \times 10^{-3}, \# \times 10^{-6})$, $B = (2.5\# \times 10^{-3}, 2\# \times 10^{-6})$, $C = 4\# \times 10^{-3}$,

   a) compute an equation to describe $q(t)$, **b**) compute $i(t)$, **c**) plot $i(t)$.



3. Given the equation for $i(t)$ answer the following questions: **a**) $i(0.5\#m) =?$, **b**) $t =?\ if\ i = 1.5\#\ \mu A$, **c**) $t =?\ if\ i = 0.5\#\ \mu A$.

$$i(t) = \begin{cases} (t - \#m)^2 + 2\#\mu \quad (A) \quad , \quad t < \#\,ms \\ -1mt + 3\#\mu \quad (A) \quad , \quad \#\,ms < t < 2\#\,ms \\ (t - 2\#m)^2 + \#\mu \quad (A) \quad , \quad t > 2\#\,ms \end{cases}$$

4. The number of transistors in a computer change similarly to the electric current in a circuit. It was $25 + 10\#$ millions in 2016, it grew to $50 + 10\#$ millions in 2018 and reached an outstanding value of $100 + 10\#$ millions in 2020. However, it was not possible to continue that tendency of growing, instead, the number of transistors in a computer has been constantly increasing $20 + 10\#$ million transistors per year.

   a) Make a plot describing the number of transistors in a computer. **b**) Compute the equation, use scientific notation.

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1. 1.0/5	2. a) 0.7/5	3. a) 0.4/5	4. a) 0.6/5
	b) 0.5/5	b) 0.4/5	b) 0.9/5
	c) 0.3/5	c) 0.2/5	