Name: _____ (please print)

Signature: _____

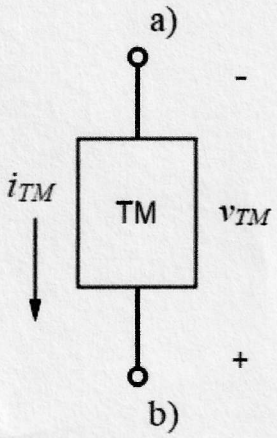
ECE 2201 – Quiz #1
September 15, 2021

- This quiz is closed book, closed notes. You may not work with another person or try to obtain the answer to the quiz online.
- Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
- Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
- If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
- Do not use red ink. Do not use red pencil.
- You will have 30 minutes to work on this quiz.

_____/25

Room for extra work

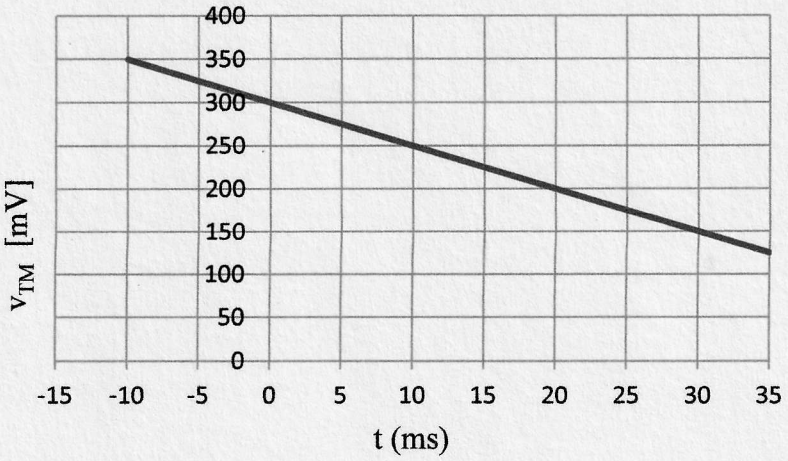
An exciting new discovery has led to the development of the TrombettaMax, a device shown in the diagram and labeled 'TM'. The voltage v_{TM} and current i_{TM} for the TrombettaMax are plotted in the graphs below. Reference polarities are shown in the figure.

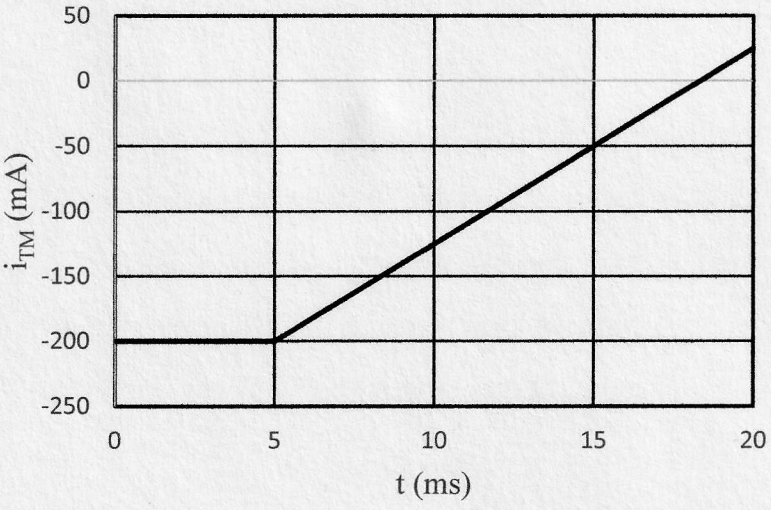


a) Find an expression for the power delivered by the TrombettaMax from 5 to 15 [ms]. Your expression will be a function of time. **Include units in all terms of this expression.** There is no need to simply the algebra - any valid expression will do.

b) Find the energy absorbed by the TrombettaMax from 5 to 15 [ms]. For full credit, you need to arrive at a numerical answer.

c) If the charge carriers are positive, state whether they are gaining or losing energy at t = 20 [ms]. In a few words, explain how you know this.





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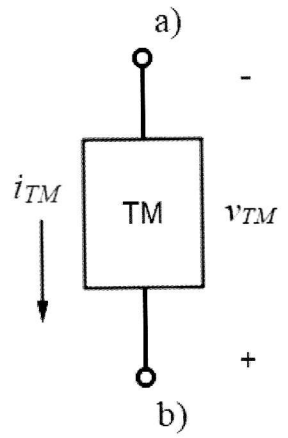
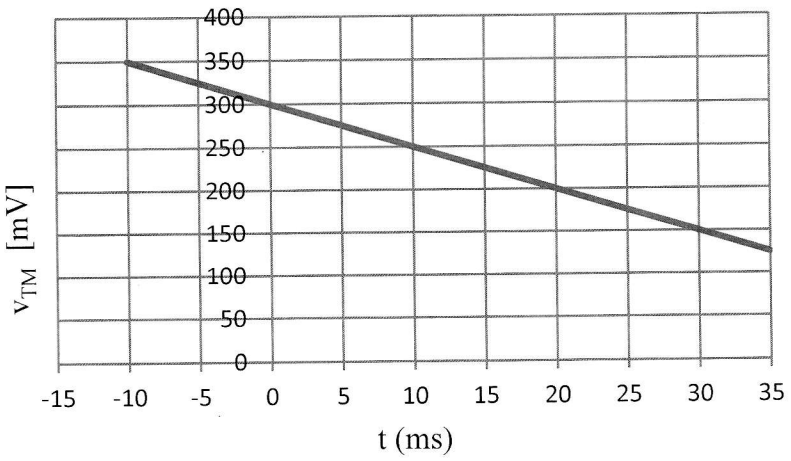




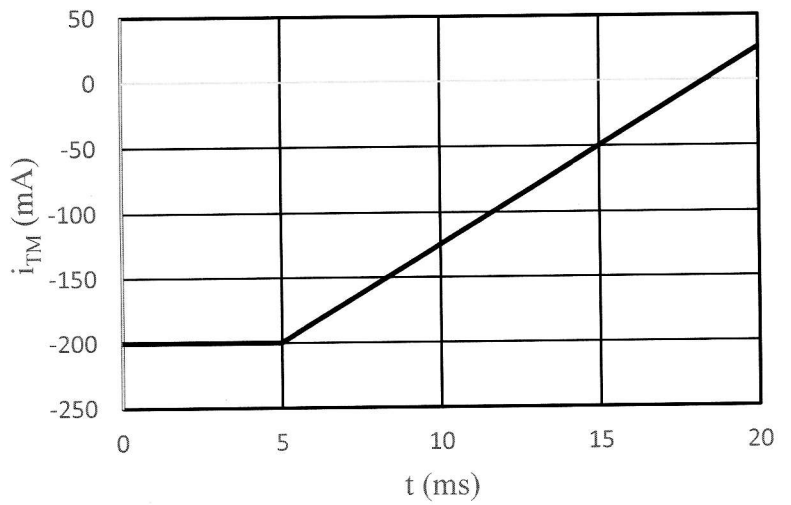
$v_{TM}(t) = m_V t + b_V$

$t = 0 \Rightarrow v_{TM} = 300\ [mV]$

$\Rightarrow b_V = 300\ [mV]$

$m_V = \frac{-150}{30}\left[\frac{mV}{ms}\right] = -5\left[\frac{mV}{ms}\right]$

$\therefore v_{TM}(t) = -5\left[\frac{mV}{ms}\right] t + 300\ [mV]$



For $t \geq 5$ [ms]

$i_{TM}(t) = m_A t + b_A$

$m_A = \frac{150}{10}\left[\frac{mA}{ms}\right] = 15\left[\frac{mA}{ms}\right]$

$t = 5$ [ms] $\Rightarrow i_{TM} = -200$ [mA]

$\Rightarrow -200\ [mA] = 15\left[\frac{mA}{ms}\right](5\ (ms)) + b_A$

$\Rightarrow b_A = -275\ [mA]$

$\therefore i_{TM}(t) = 15\left[\frac{mA}{ms}\right] t - 275\ [mA]$

Room for extra work

a) $P_{del\ by\ TH} = v_{TH} \cdot i_{TH}$

$= (-5\left[\frac{mV}{ms}\right]t + 300\,[mV]) \cdot (15\left[\frac{mA}{ms}\right]t - 275\,[mA])$

b) $w_{abs\ by\ TH} = -\int_{5\,[ms]}^{15\,[ms]} v_{TH} \cdot i_{TH}\, dt$

$= -\int_{5[ms]}^{15[ms]} (-5t + 300)(15t - 275)\, dt$

- With v_{TH} in [mV], i_{TH} in [mA], and t in [ms], w will have units $[mV] \cdot [mA] \cdot [ms] = [nJ] = [10^{-9}\,J]$
- A good calculator comes in handy here. Mine says...

$w_{abs\ by\ TH} = 318750\ [nJ] = 0.318750\ [mJ]$