Name: ______________________________ (please print)

Signature: ___________________________

ECE 2201 – Quiz #1
June 9, 2020

1. You may use one 8.5” x 11” crib sheet, or its equivalent. Do not communicate with anyone except Dr. Dave Shattuck while you are taking this quiz.
2. Show all work necessary to complete the problem. Use additional sheets of paper as needed. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit. Include this page with your printed name and signature, or include a different, separate page with your printed name and signature. Failure to do this will result in points being deducted.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. Do not use red ink. Do not use red pencil.
5. You will have 30 minutes to work on this quiz, plus additional time to print, scan and email your work. Email your completed quiz to Shattuck@uh.edu. It must be sent by the exact time announced in class, or points will be deducted.

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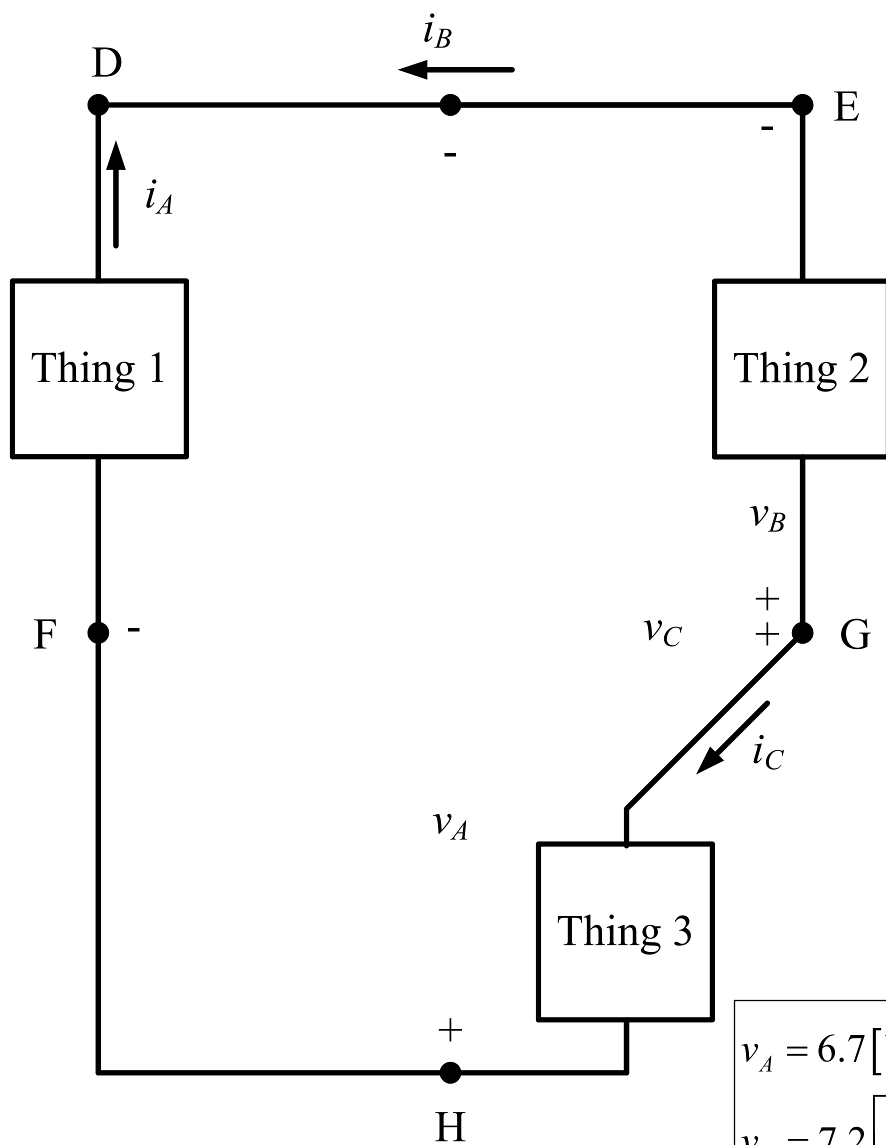
In the circuit shown, three things are connected together. The expressions for some of the voltages and currents are given.

a) Find the power absorbed by Thing 1 at $t = 4[\text{s}]$.
b) Find the energy delivered by Thing 1 during the fifth [second] after $t = 3[\text{s}]$.
c) Which end of Thing 3 is at a higher potential at $t = 1[\text{s}]$?
d) Assume that the current is made up of electrons. Which way are the electrons moving through Thing 2 at $t = 1[\text{s}]$? Explain your answer briefly, showing how you got your answer.



$$v_A = 6.7[\text{V}]e^{-t/5.4[\text{s}]} - 2.3[\text{V}]$$

$$v_C = 7.2\left[\frac{\text{V}}{\text{s}}\right]t - 9.3[\text{V}]$$

$$i_B = -4.2[\text{mA}]e^{-t/3.9[\text{s}]} + 2.9[\text{mA}]$$

Solution: a) For the power absorbed by Thing 1, we need the voltage across it, and the current through it. The voltage is v_A, and the current is i_B. The two are in the active sign relationship for Thing 1, so we can write

$$p_{ABS.BY.TH1} = -v_A i_B$$

Thus,

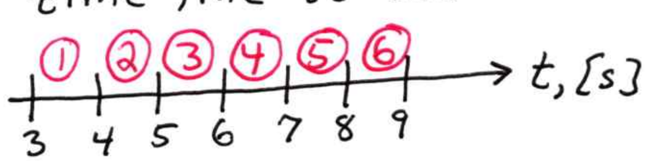
$$p_{ABS.BY.TH1}(4[s]) = -v_A(4[s])\, i_B(4[s])$$

$$= -\left(6.7[V]\, e^{-\frac{4[s]}{5.4[s]}} - 2.3[V]\right)\left(-4.2[mA]\, e^{-\frac{4[s]}{3.9[s]}} + 2.9[mA]\right)$$

$$= -(0.8943[V])((1.394)[mA])$$

$$\boxed{p_{ABS.BY.TH1}(4[s]) = -1.247[mW]}$$

b) We need to know which time period is the fifth [second] after $t = 3[s]$. We can draw a time line to see



that the fifth second is from 7[s] to 8[s].

$$p_{DEL.BY.TH1} = v_A i_B$$

see next page

b) continued.

$$w_{DEL.BY.TH1}(5^{th}) =$$

$$\int_{7\{s\}}^{8\{s\}} \left(6.7\{V\} e^{-t/5.4\{s\}} - 2.3\{V\}\right)\left(-4.2\{mA\} e^{-t/3.9\{s\}} + 2.9\{mA\}\right) dt$$

We can perform this integration on a calculator to obtain

$$\boxed{w_{DEL.BY.TH1}(5^{th}\{s\}) = -1.4363\{mJ\}}$$

c) The voltage across Thing 3 is v_C.

$$v_C(1\{s\}) = 7.2\{\tfrac{V}{s}\}\,1\{s\} - 9.3\{V\} = -2.1\{V\}$$

Since the voltage v_C, which is at G with respect to F, is negative then **F must be at a higher potential than G.**

d) The current through Thing 2 is i_B, which flows up through Thing 2.

$$i_B(1\{s\}) = -4.2\{mA\}\left(e^{-1/3.9}\right) + 2.9\{mA\}$$

$$i_B(1\{s\}) = -350\{\mu A\}$$

This means the actual polarity is opposite to the reference polarity of i_B. Since the actual polarity of the current is down through Thing 2, the electrons which have negative charges, **flow up through Thing 2**.