Exam Electronics

Analysis tools of electrical circuits: Definitions, Thews and Theorems
[2526_I_INF_FISE_S01_CN_OAC]

CalcuThetors and documents are forbidden. Scoring scale is given as a guide
Answers exclusively on the subject. If you need more space, you can use the back of the pages.

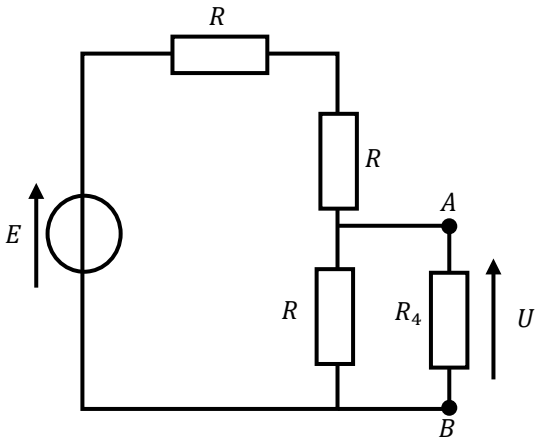
Exercise 1. Lecture questions (4.5 points – No negative score for the MCQ + 1 (bonus))

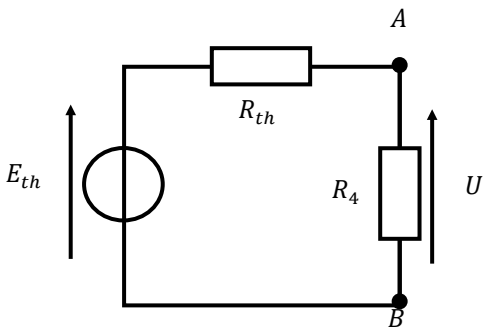
For each question, choose the correct answer:

Q1. The intensity of the current entering a resistor is higher than the intensity of the current exiting the same resistor.

a- TRUE b- FALSE

Q2. Consider the 2 following electrical circuits:





These 2 circuits are equivalents if and only if:

a- $E_{th} = E$ and $R_{th} = 2R$

b- $E_{th} = \frac{2E}{3}$ and $R_{th} = \frac{2}{3}.R$

c- $E_{th} = \frac{E}{3}$ and $E_{th} = \frac{2R}{3}$

d- $E_{th} = E$ and $R_{th} = \frac{2R}{3}$

Q3. The argument of the complex impedance of a dipole is:

a. The ratio between the RMS values of the current crossing the dipole and its voltage
b. The instantaneous value of the dipole voltage
c. The phase shift of the dipole voltage with respect to the current crossing it.
d. The phase at the origin

Q4. What is the unit of the product $L\omega$?

a. Siemens b. Hertz c. Ohms d. Unitless

Consider a resistor R, a capacitor with capacitance C and a self with inductance L. (Q5&6 + Bonus)

Q5. We associate the capacitor ant the resistor in parallel. What is the expression of the equivalent complex impedance $\underline{Z}$?

a. $\underline{Z} = \frac{R}{1+jRC\omega}$

b. $\underline{Z} = \frac{1}{R} + jC\omega$

c. $\underline{Z} = \frac{jRC\omega}{R+jC\omega}$

d. $\underline{Z} = \frac{1}{R} + C$

Q6. We associate the self and the capacitor in parallel. What is the expression of the equivalent complex impedance $\underline{Z}''$?

a. $\underline{Z}'' = \frac{jL\omega}{1-LC\omega^2}$

b. $\underline{Z}'' = \frac{1}{L} + \frac{1}{C}$

c. $\underline{Z}'' = \frac{1}{jL\omega} + jC\omega$

d. $\underline{Z}'' = \frac{1-LC\omega^2}{jC\omega}$

BONUS question: Regarding the dipole with complex impedance $\underline{Z}''$, what is the phase shift of the voltage between this dipole terminals with respect to the current crossing it? Justify your answer.



Exercise 2. Circuit in DC regime (7.5 points)

Consider the circuit below.

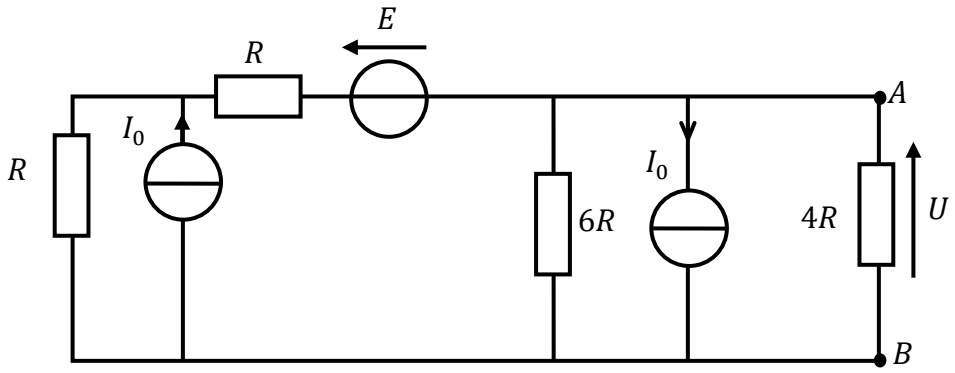


Figure 1

1. In this circuit, how many are there:
   a. Nodes? ☐ b. Branches? ☐ c. Loops? ☐

2. We wish to express the voltage U indicated in the diagram of figure 1. For example, we can reduce the circuit of figure 1 to a simpler circuit like that of figure 2 and then deduce U.
   Any other relevant method giving the expression of U, clearly explained, may also be used.

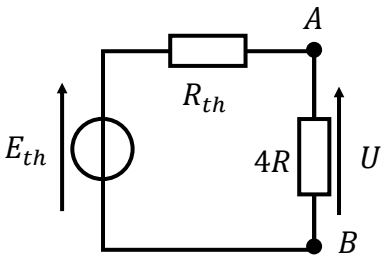


Figure 2

Exercise 3. Sinusoidal steady state (8 points – no negative scoring in the MCQ part)

Consider the following circuit where $v_e(t) = V_E.\sqrt{2}.\sin(\omega t)$:

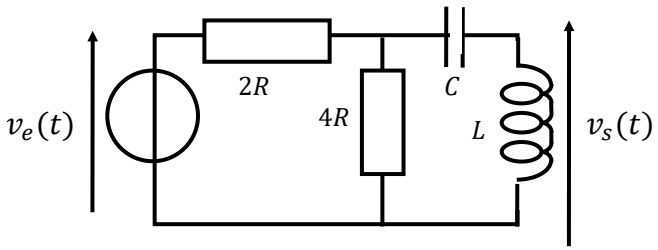


Figure 3

1. By convention, V_E is real, positive and unitless.
   a. TRUE
   b. FALSE

2. ω stands for?
   a. The frequency
   b. The pulsation
   c. The phase at the origin
   d. The period

We note $\underline{V_E}$, the complexe amplitude associated to $v_e(t)$.

3. What is the module of $\underline{V_E}$?
   a. V_E
   b. ω
   c. ωt
   d. 0

4. What is the argument of $\underline{V_E}$?
   a. V_E
   b. ω
   c. ωt
   d. 0

5. We wish to express the complex amplitude $\underline{V_S}$ associated to the voltage $v_s(t)$ indicated in the scheme in figure 3. we can reduce the circuit of figure 3 to a simpler circuit like that of figure 4 then deduce $\underline{V_S}$. $\underline{V_S}$ must be expressed in terms of $\underline{V_E}$, R, C, L and ω.

   Any other relevant method giving the expression of $\underline{V_S}$, **clearly explained**, may also be used.

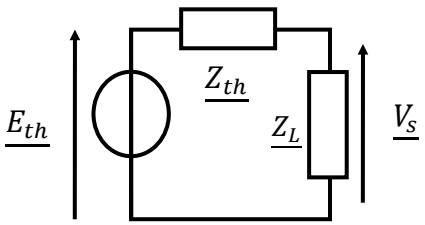


Figure 4