

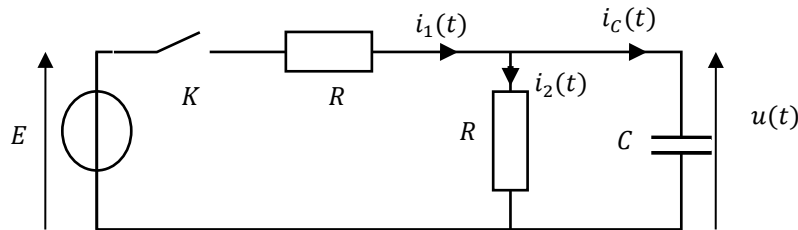


## Partial Electronic

*Calculators and documents are not allowed. The scale is indicative.  
Answers exclusively on the subject. If you run out of space, you can use  
the back of the pages.*

### Exercise 1. MCQ (9 points – no negative point)

Consider the circuit below. The switch is opened and the capacitor is discharged.



1. There is continuity of current in the capacitor.

a. TRUE

b. FALSE

2. At  $t = 0$ , we close the switch  $K$ . Complete the following table. You will express your answers based on  $E$  and  $R$ .

	$i_1$	$i_2$	$u$
$t = 0^+$			
$t \rightarrow \infty$			

Once steady state is established, the switch is opened.

3. We then consider  $t' = 0$ . Complete the following table. You will express your answers based on  $E$  and  $R$ .

	$i_1$	$i_2$	$u$
$t' = 0^+$			

4. What is the unit of the product  $C\omega$ ?

- a. Siemens                      b. Hertz                      c. Amps                      d. Ohms

Consider a sinusoidal voltage  $u(t) = U \cdot \sqrt{2} \cdot \sin(\omega t + \varphi)$ . Note  $\underline{U}$ , the complex amplitude associated with  $u(t)$ .

5. What can we say about  $U$ ?

- a. It is expressed in Ampere                      c. It represents the maximum value of  $u(t)$   
b. It has no unity                      d. It is expressed in Volt

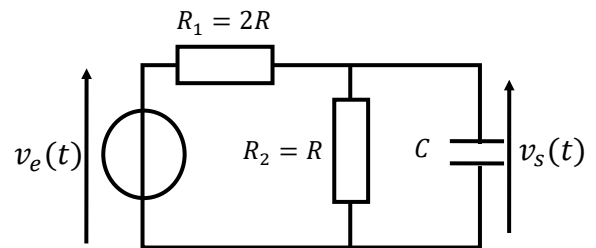
6. What is the module of  $\underline{U}$ ?

- a.  $\varphi$                       c.  $U$   
b.  $\omega$                       d.  $\omega t + \varphi$

Consider the filter opposite, where  $v_e(t) = V_E \cdot \sqrt{2} \cdot \sin(\omega t)$ . (Questions 7 to 10):

7. What is the complex impedance  $\underline{Z}_{eq}$  of the dipole equivalent to the combination of  $R_2$  and  $C$ ?

- a.  $\underline{Z}_{eq} = \frac{jRC\omega}{R+jC\omega}$                       c.  $\underline{Z}_{eq} = \frac{jC\omega}{1+jRC\omega}$   
b.  $\underline{Z}_{eq} = \frac{R}{1+jRC\omega}$                       d.  $\underline{Z}_{eq} = \frac{RC}{R+C}$



8. The complex amplitude of the voltage  $v_s$  is given by:

- a.  $\underline{V}_S = \frac{1}{3-2jRC\omega} V_E$                       c.  $\underline{V}_S = \frac{1}{3R+jC\omega} V_E$   
b.  $\underline{V}_S = \frac{V_E \sin(\omega t)}{3+2jRC\omega}$                       d.  $\underline{V}_S = \frac{1}{3+2jRC\omega} V_E$

9. What type of filter is it?

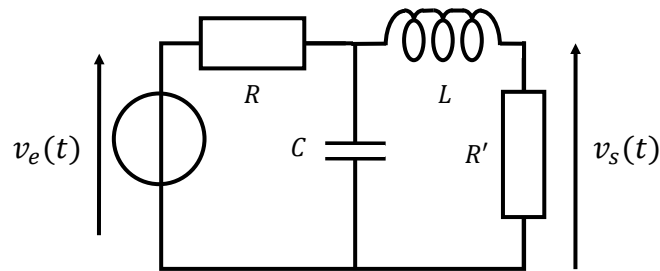
- a. High Pass                      c. Low Pass  
b. Band Pass                      d. Band Stop

10. What filter do you get if you replace  $R_2$  with a coil?

- a. Low Pass                      c. Band Stop  
b. Band Pass                      d. High Pass

**Exercise 2.** Forced sinusoidal regime: Study of a filter (11 points)

Consider the following circuit, where  $R' = R$  :

**Figure 1**1. Qualitative study:

- a. Give an equivalent diagram in very low frequency (VLF) of this filter. From this deduce the limit of the voltage  $v_s$  of this filter in VLF.

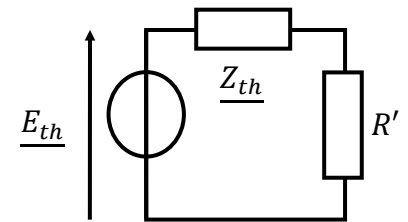
- b. Give an equivalent diagram in very high frequency (VHF) of this filter. From this deduce the limit of the voltage  $v_s$  of this filter in VHF.

- c. Conclude on the nature and order of this filter.

- d. What type of filter do you get if you invert the coil and capacitor? Justify your answer.

2. Quantitative study:

- a. Determine  $\underline{E_{th}}$  and  $\underline{Z_{th}}$  so that the previous circuit (Figure 1) is equivalent to this one below. Detail your reasoning.



**Figure 2**

- b. Using the diagram in Figure 2, express the complex amplitude  $\underline{V}_S$  associated with the voltage  $v_s(t)$  as a function of  $\underline{E}_{th}$  and  $\underline{Z}_{th}$  then, as a function of  $R, L, C, \omega$  and  $\underline{V}_E$ . From this deduce the transfer function  $T(\omega)$  of the filter, as well as its amplification  $A(\omega)$ .

