



## Electronics Exam - Diodes

[SI-S4-ELEC-1-DIO]

Calculators 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 : MCQ (3 points – No negative score)

**Q1.** Which model gives the most precise representation of a diode:

- |   |   |
|---|---|
| a- Ideal model (Switch)                   | c- Real model (Voltage source with internal resistance) |
| b- Threshold model (ideal voltage source) | d- The three models are equivalent                      |

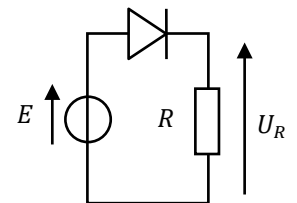
**Q2.** When a diode operates in reverse mode, it behaves like:

- |                            |                              |
|----------------------------|------------------------------|
| a- A wire                  | c- An open switch            |
| b- An ideal voltage source | d- None of the answers above |

Consider the diagram on the opposite where the diode is considered ideal (Q3&4):

**Q3.** What is the value of the voltage  $U_R$  between resistor  $R$  terminals if  $E = 10V$ ,  $R = 100\Omega$ .

- |         |          |
|---------|----------|
| a- 0 V  | c- 1 kV  |
| b- 10 V | d- 0,1 V |



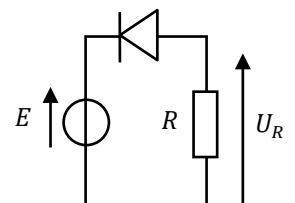
**Q4.** What is the value of the voltage  $V_{AK}$  between diode terminals if  $E = 10V$ ,  $R = 1k\Omega$ .

- |         |          |
|---------|----------|
| a- 0 V  | c- 1 kV  |
| b- 10 V | d- 0,1 V |

Consider the diagram on the opposite, where the threshold model is used to model the diode, (Voltage source  $V_0 = 0,7 V$ ) (Q5&6):

**Q5.** What is the value of the voltage  $U_R$  between resistor  $R$  terminals if  $E = 10V$ ,  $R = 100\Omega$ .

- |           |          |
|-----------|----------|
| a- 0 V    | c- 9,3 V |
| b- 10,7 V | d- 0,7 V |



**Q6.** What is the value of the voltage  $V_{AK}$  between diode terminals if  $E = 10V$ ,  $R = 1k\Omega$ .

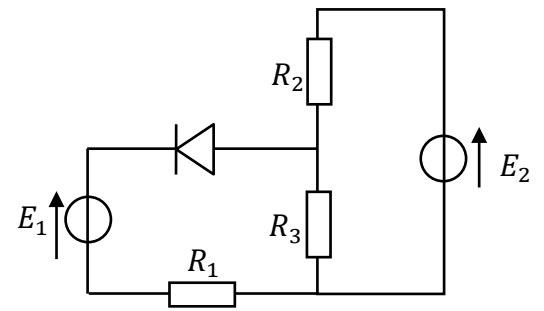
- |           |            |
|-----------|------------|
| a- -0,7 V | c- -10,7 V |
| b- -10 V  | d- -9,3 V  |

**Exercise 2 : Diodes (5 points)**

Consider the diagram on the opposite where  $R_1 = 2k\Omega$ ,  $R_2 = R_3 = 1k\Omega$ ,  $E_1 = 5V$ ,  $E_2 = 20V$ . We choose the ideal model for the diode (switch model).

Using a reasoning by the absurd, show that the diode operates in direct mode.

Determine then the current crossing the diode.

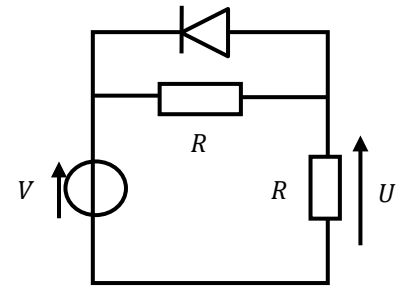


**Exercise 3 : Transfer pattern (6 points)**

Consider the diagram on the opposite where  $V \in \mathbb{R}$ .

We would like to plot the transfer pattern  $U = f(V)$ .

The diode model is the threshold model (ideal source voltage  $V_0$ ).



1. Give the expression of  $U$  when the diode operates in direct mode.

2. Give the expression of  $U$  when the diode operates in reverse mode.

3. For which values of  $V$  the diode operates in reverse mode?

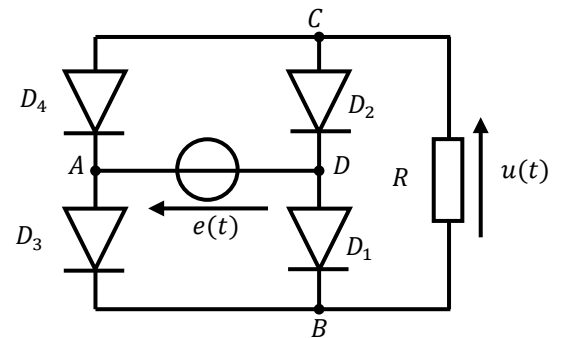
4. Plot  $U = f(V)$ .

**Exercise 4 : full wave rectifier (6 points+1point Bonus)**

Consider the diagram on the opposite:

$e(t)$  is a alternating voltage source. We use, as a first approach, the ideal model for all the diodes.

- a) During the positive alternation ( $e(t) > 0$ ), which diode(s) operate(s) in direct mode? Justify clearly your answer.

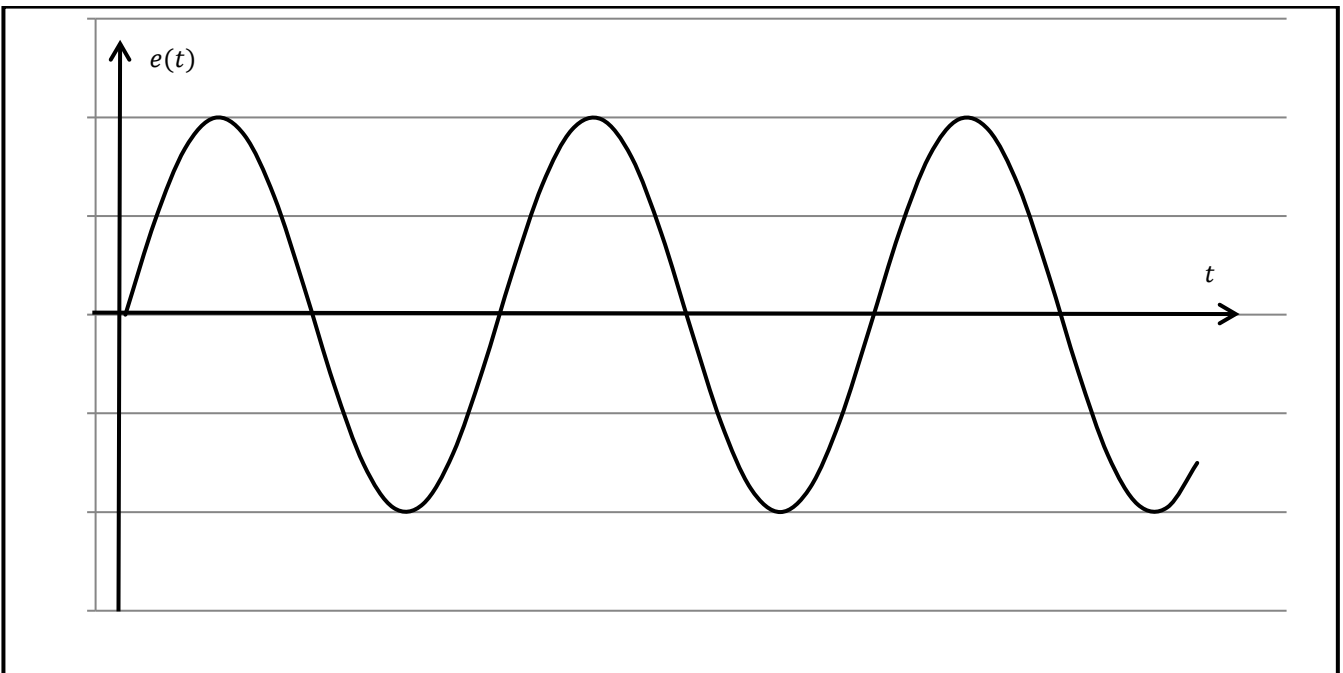


- b) What is the expression of  $u$  when  $e(t) > 0$  ?

- c) During the negative alternation ( $e(t) < 0$ ), which diode(s) operate(s) in direct mode? Justify your answer.

- d) What is the expression of  $u$  when  $e(t) < 0$  ?

- e) Plot  $u(t)$  in the figure below



BONUS : We use henceforth the threshold model (ideal voltage source  $V_0$ ) for all the diodes. Plot the curve of  $u(t)$ , **justifying your answer**. We suppose that  $E_M$  (the peak value of the voltage  $e(t)$ ) verifies  $E_M > 2 \cdot V_0$ .

