EPITA / InfoS3 November 2018

NAME: ..... Firstname: ..... Group: .....

Electronics Midterm

The calculators and the extra-documents are not allowed. The marking scale is given as a rough guide.

Answer only on the exam sheet. If much space is needed, write on the back.

Exercise 1. Questions from class (MCQ without negative points – 5 points)

Q1. Material doping increases the conductivity of the semi-conductor.

a- TRUE

b- FALSE

Q2. The two kinds of doping are denoted by the letters P and N. What are they corresponding to?

a- To the kind of ions injected in the semi-conductor.

b- These are the initials of the electronics engineers who discovered the semi-conductors.

c- To the polarity of the excess charge carriers.

d- None of the above.

Q3. We use the Silicium, which has 4 electrons in its valence band, as semi-conductor. If it is doped with Phosphorus, which has 5 electrons in its valence band, which kind of doping is realized?

a- P-Doping

b- N-Doping

c- NP-Doping

d- No doping

Q4. A semi-conductor, which has a N-doping, is such that:

a- its crystal structure lacks some electrons.

b- its crystal structure has too many electrons.

Q5. What is the roughest model of the diode:

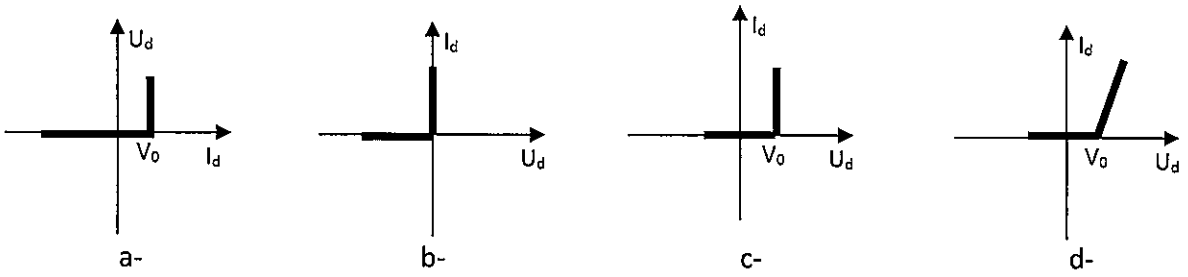
a- The ideal model

b- The threshold model

c- The real model

d- The three models are equivalent

Q6. Which characteristic corresponds to the current/voltage characteristic of the threshold model of the diode:



Q7. When a diode is turned off, it behaves as:

a- A null resistance

b- An open switch

c- An ideal voltage generator

d- A self

Q8. The dynamical resistance of a diode:

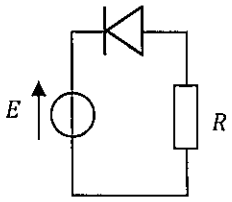
a- has unit in Siemens.

b- is the equivalent dipole of the diode when it is turned on.

c- is usually very low.

d- is usually huge.

Q9. Consider the following circuit. The diode D is ideal:



What is the value of the voltage of terminals of D if $E = 10V$, $R = 100\Omega$?

a- $0\ V$

b- $10\ V$

c- $1\ kV$

d- $0{,}1\ V$

Consider the following circuit:

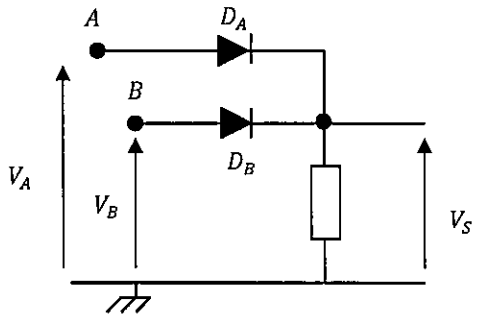
Q10. Which kind of logic gates does this circuit realize?

a- AND

b- OR

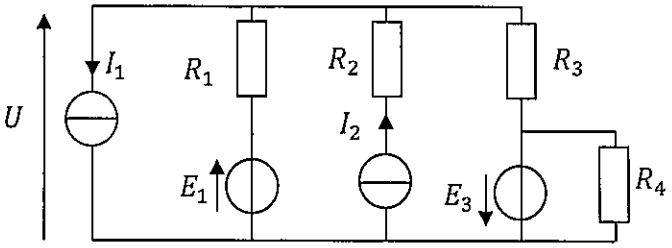
c- NAND

d- NOR

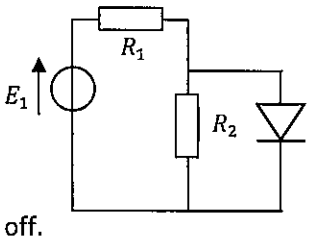


Exercise 2. SUP Review (4 points)

Consider the following circuit, where E_1, E_3, I_1, I_2 and R_i are known. The generators are independent. Determine the voltage U. You can choose any method that you prefer.



Exercise 3. Diodes (5 points)



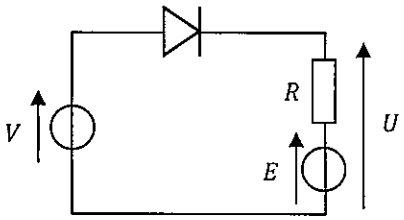
Consider the following circuit. The diode is modelled with its threshold model with $V_0 = 0{,}7V$. For the following questions, you will use a contradiction reasoning.

1. If $R_1 = 10k\Omega$, $R_2 = 10\Omega$ and $E = 10V$, prove that the diode is turned off. What is then the intensity of the current flowing through R_2?

2. If $R_1 = 50\Omega$, $R_2 = 100\Omega$ and $E = 10V$, prove that the diode is turned on. Determine then the intensity of the current flowing through it.

Exercise 4. Transfer characteristic (6 points)

Consider the following circuit:



We want to draw the characteristic $U = f(V)$.

The diode is modelled by its threshold model and its threshold voltage is denoted V_0.

1. Give the expression of U if the diode is turned on.

2. Give the expression of U if the diode is turned off.

3. For which values of V is the diode turned off?

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

5. Consider now that the voltage generator V generates a sinusoidal voltage $v(t) = V.\sqrt{2}.\sin(\omega t)$. Are given $V.\sqrt{2} = 30\ V$, $E = 15\ V$ and $V_0 = 0{,}6\ V$. Draw the curve $u(t)$.