NAME : .....FIRST NAME :..... GROUP :.....

Mid-term exam: Electronics

Calculators and documents are not allowed. The number of points per question is indicative.
Answers to be written on this document only.

Exercise 1. Lecture questions (without negative points – 5 points)

Q1. Doping decreases the conductivity of the semi-conductor

a- True b- False

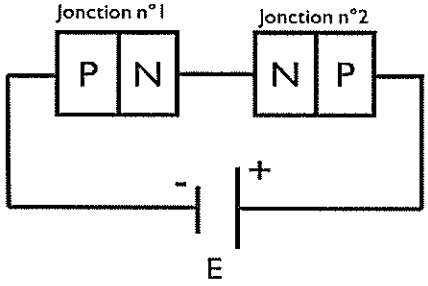
Q2. We use a piece of silicium with 4 electrons of the valence band. If we dope it with the phosphor which has 5 electrons of the valence band, which type of doping we obtain:

a- P doping
b- N doping
c- NP doping
d- No doping

Q3. With an electric excitation, an insulator material can become a semi-conductor :

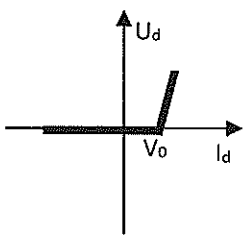
a- True
b- False
c- Only if the material has electrons of the condictivity band

Q4. We consider the following circuit, where E>the threshold voltage. Choose the correct answer :

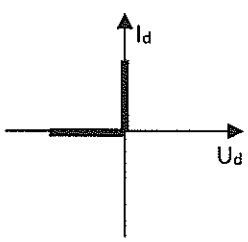


a- The circuit is closed b- The circuit is open

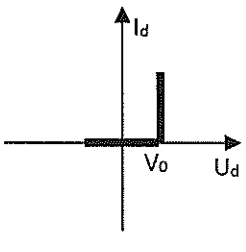
Q5. Which of these characteristics corresponds to the one of the 'ideal' model ?



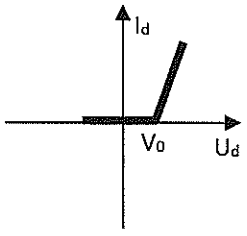
a-



b-



c-



d-

Q6. Which model allows to represent precisely the diode:

a- The ideal model

b- The threshold model

c- The real model

d- The three models are equivalent

Q7. $I_D = I_S(e^{\frac{V_D}{nV_T}} - 1)$ reprents the courant I_D flowing through a diode function of V_D the voltage across it. Passive sign convention is used. I_S corresponds to the reverse current which is:

a- Very high (~10 Amperes)

b- Very low (~10^{-9} Amperes)

Q8. An intrinsic semi-conductor is :

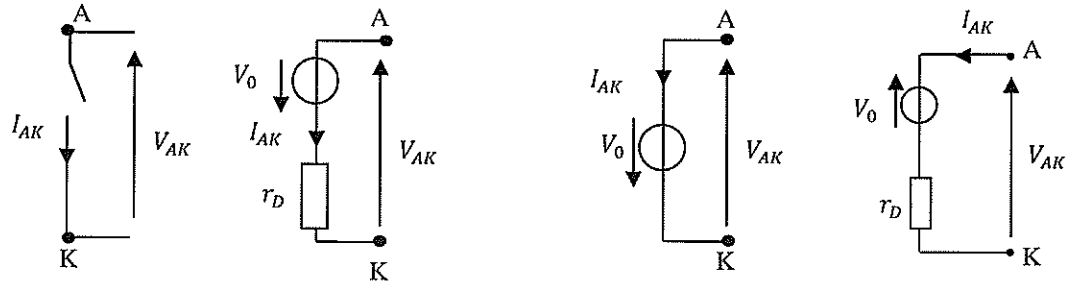
a- Disorderly cristal

b- A cristal doped with pentalent atoms

c- A christal doped with trivalent atoms

d- A pure cristal

Q9. Using the real model, when the diode is OFF, it is replaced by which electrical circuit ? (A : Anode and K : Cathode).



a- b- c- d-

Q10. We consider the following circuit:

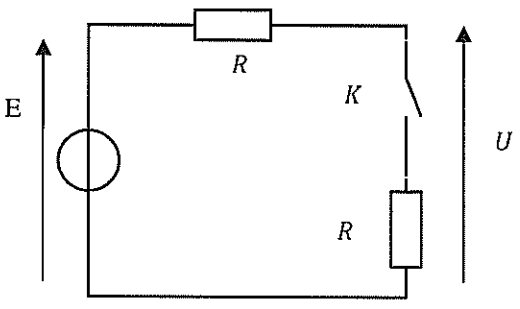
What is th voltage U if the switch K is closed?

a- $U = 0$

b- $U = \frac{E}{2}$

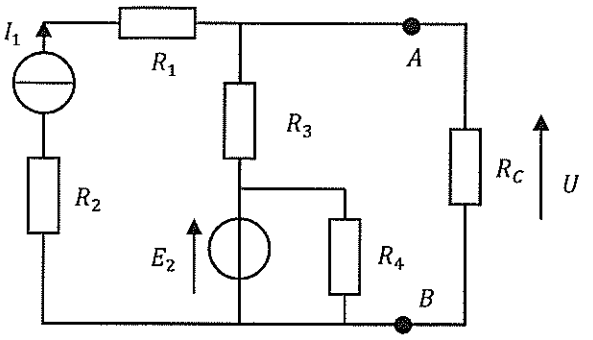
c- $U = E$

d- $U = -E$



Exercise 2. SUP Review (5 points)

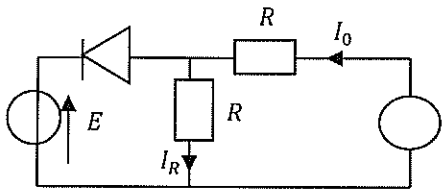
We consider the following circuit.



Using your preferred method, give the expression of the voltage U. Express your result as a fraction (not as a 'fraction of fractions'!)

Exercise 3. Forward/reverse bias (5 points)

We consider the following circuit.



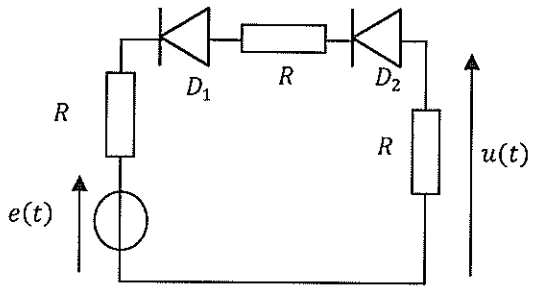
We model the diode using the model with threshold voltage with $V_0 = 0{,}7V$.

1. If $R = 1k\Omega$, $I_0 = 10mA$ and $E = 5V$, determine the state of the diode and draw the equivalent circuit. Give then the intensity of the current I_R going through the resistor.

2. If $\mathrm{R} = 10\Omega$, $\mathrm{I_0} = 10\mathrm{mA}$ and $\mathrm{E} = 5\mathrm{V}$, determine the state of the diode. Give then the intensity of the current I_R going through the resistor.

Exercise 4. Transfer characteristic (6 points)

We consider the following circuit.



We want to determine and plot $u(t)$. We give :

$$e(t) = E_0 \sin(\omega t)\,, R = 100\ \Omega$$

with $E_0 = 30V$ et $\omega = 2\pi \times 50 rad/s$

The diodes are assumed to be 'ideal'.

1. Show that the 2 diodes can be simultaneously ON. Express $u(t)$ and precise for which value of $e(t)$.

2. Show that the 2 diodes can be simultaneously OFF. Express $u(t)$ and precise for which value of $e(t)$.

3. Plot the transfer characteristic of this circuit ($u = f(e)$).

4. Plot $u(t)$.