COLLEGE OF ENGINEERING & TECHNOLOGY

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Course Title: Electronic Devices I
Course Code: EC 233

Cairo Branch

Sheet 1
Carriers in semiconductors

I. Indicate whether each of the following statements is true or false *(give reasons)*:

1- An intrinsic semiconductor behaves like an insulator at 0 K.

2- An extrinsic semiconductor has non-zero conductivity at 0 K.

3- Increasing the temperature of an intrinsic semiconductor causes that the concentration of electrons in the conduction band exceeds the number of holes in the valence band.

II. Choose the correct answer justifying your choice:

1- Doping Germanium with Arsenic (5 valence electrons) results in ……..

(a) n-type semiconductor (b) p-type semiconductor
(c) Intrinsic semiconductor (d) non-conducting material

2- Doping silicon with Gallium (3 valence electrons) results in ……..

(a) n-type semiconductor (b) p-type semiconductor
(c) Intrinsic semiconductor (d) non-conducting material

3- Doping silicon with phosphorous (5 vel. Elec.) results in ……..

(a) n- type semiconductor (b) p-type semiconductor
(c) Intrinsic semiconductor (d) non-conducting material

4- In an intrinsic semiconductor ……..

(a) There is no allowed energy levels between E_c and E_v.
(b) There is an allowed energy level which is little above E_v.
(c) There is an allowed energy level which is little below E_c.
(d) There is an allowed energy level which is near the middle between E_c and E_v

5- In an n-type semiconductor ……..

(a) There is no allowed energy levels between E_c and E_v.
(b) There is an allowed energy level which is little above E_v.
(c) There is an allowed energy level which is little below E_c.
(d) There is an allowed energy level which is near the middle between E_c and E_v.

6- In a p-type semiconductor ……..

(a) There is no allowed energy levels between E_c and E_v.
(b) There is an allowed energy level which is little above E_v.
(c) There is an allowed energy level which is little below E_c.
(d) There is an allowed energy level which is near the middle between E_c and E_v.

6- The electron and hole concentrations are equal to zero …….…….

(a) in an intrinsic semiconductor. (b) in an extrinsic semiconductor.
(c) in a semiconductor at 0 K temperature.
(d) in a semiconductor at very high temperature.

7- In an intrinsic semiconductor, if *n* and *p* are the electron and hole concentrations, …...

(a) *n* must be zero (b) *p* must be zero
(c) *n* and *p* must be equal (d) *n* and *p* must not be equal

8- In an n-type semiconductor, if *n* and *p* are the electron and hole concentrations, …...

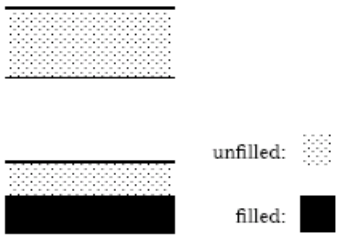
(a) *n* must be zero (b) *p* must be zero
(c) *n* is smaller than *p* (d) *n* is larger than *p*

9- In a p-type semiconductor, if *n* and *p* are the electron and hole concentrations, …...

(a) *n* must be zero (b) *p* must be zero
(c) *n* is smaller than *p* (d) *n* is larger than *p*

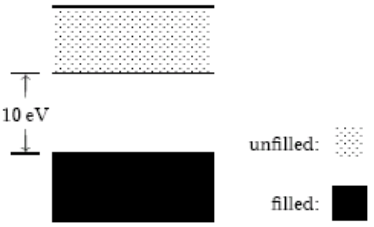
10- The energy level diagram shown applies to ……...

(a) a conductor
(b) an insulator
(c) a semiconductor
(d) an isolated atom



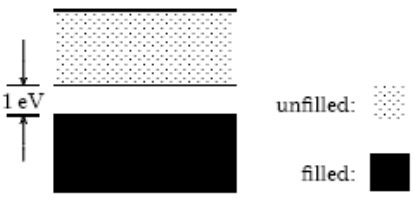
11- The energy level diagram shown applies to ……..

(a) a conductor
(b) an insulator
(c) a semiconductor
(d) an isolated atom

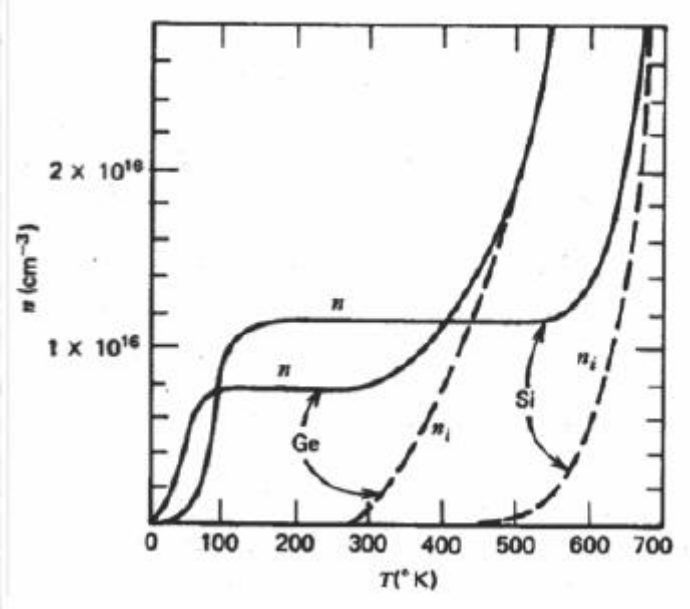


12- The energy level diagram shown applies to ……...

(a) a conductor
(b) an insulator
(c) a semiconductor
(d) an isolated atom



III. Answer the following questions on the given figure (Justify your answers):



a- Determine the total Carrier concentration for Silicon and Germanium at the different given temperature regions:100K, 200K, 300K, 400K and 500K.
b- Determine the doping concentration for Silicon and Germanium.
c- Which of the two materials have the greater energy gab?
d- Will any of the two materials return back to the intrinsic state at any given temperature?

Good Luck ☺