



PHYSICS

NCERT - NCERT PHYSICS(ENGLISH)

SEMICONDUCTOR ELECTRONICS MATERIALS DEVICES AND SIMPLE CIRCUITS

Solved Examples

1. C, Si and Ge have same lattice structure. Why

is C insulator,

while Si and Ge intrinsic semiconductors ?



2. Suppose a pure Si-crystal has $5 imes 10^{28} {
m atoms} m^{-3}$. It is doped by 1 ppm concentration of pentavalent As. Calculate the number of electrons and holes. Give that $n_i=1.5 imes 10^{16}m^{-3}$.





3. Can we take one slab of p - type semiconductor and physically join it to another n - type semiconductor to

get p - n junction?

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4. The V - I characteristic of a silicon diode is shown in the Fig. Calculate the resistance of the diode at



5. In a zener regulated power supply a zener

diode with

 $V_z=6.0V$ is used for regualtion. The load

current is to eb 4.0 mA and the

unregulated input is 10.0 V . What should be

the value of series resistor R?



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6. The current in the forward bias is known to

be more (in mA)

than the current in the reverse bias (in μA).

What is the reason then to operate

the photodiodes in reverse bias?





7. Why are Si and GaAs are preferred materials

for solar cells?

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8. Justify the output wavefrom (y) of the OR

gate for input and as gives in Fig.



9. The following Fig. shows the input waveforms (A,B) and the output waveform (y) of a gate. Identify the gate and write its truth

table.



10. Sketch the output Y from NAND gate
having input A A and B given below, Fig.
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1. In a *n*-type semiconductor, which of the following statement is true?

A. Electrons are majority carriers and

trivalent atoms are the dopants.

B. Electrons are minority carriers and

pentavalent atoms are the dopants.

C. Holes are minority carriers and

pentavalent atoms are the dopants.

D. Holes are majority carriers and trivalent

atoms are the dopants.

Answer:

2. Which of the statements given in above

example is true for p - type semiconductors ?

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3. Carbon, silicon and germanium have four valence elcectrons each . These are characterised by valence and conduction bands separated by energy band - gap respectively equal to $(E_g)_c (E_g)_{si}$ and $(E_g)_{Ge}$. Which of the following statements ture ?

$$\begin{split} &\mathsf{A.} \, \big(E_g \big)_{Si} < \big(E_g \big)_{Ge} < \big(E_g \big)_C \\ &\mathsf{B.} \, \big(E_g \big)_C < \big(E_g \big)_{Ge} > \big(E_g \big)_{Si} \\ &\mathsf{C.} \, \big(E_g \big)_C > \big(E_g \big)_{Si} > \big(E_g \big)_{Ge} \\ &\mathsf{D.} \, \big(E_g \big)_C = \big(E_g \big)_{Si} = \big(E_g \big)_{Ge} \end{split}$$

Answer:

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4. In an unbiased p-n junction, holes diffuse from the p-region to n-region because

A. free electrons in the n-region attract

them.

B. they move across the junction by the

potential difference.

C. hole concentration in p-region is more

as compared to n-region.

D. All the above.

Answer: C

5. When a forward bias is applied to a p -n junction. It

A. raises the potential barrier.

B. reduces the majority carrier current to

zero.

C. lowers the potential barrier.

D. None of the above.

Answer:

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6. In half - wave rectification, what is the output frequency, if the input frequency is 50 Hz ? What is the output

frequency of a full - wave rectifier

for the same input frequency ?

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7. A p-n photodiode is fabricated from a semiconductor with band - gap of 2.8 eV . Can it detect a wavelength of 6000nm?



8. The number of silicon atoms per $m^3 is5 \times 10^{28}$. This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and $5 \times 10^{20} perm^3$ atoms of indium. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} m^{-3}$. Is the material n-type or p-type?

9. In an intrinsic semiconductor the energy gap $E_g is 1.2 eV$. Its hole mobility is much smaller than electron mobility and independent of temperature. What is the ratio between conductivity at 600K and 300K? Assume that temperature dependence intrinstic concentration n_i is given by $n_i = n_0 \expigg(rac{-E_g}{2k_{ au}}igg)$, where n_0 is a constant

and $k_{\,=} 8.62 imes 10^{\,-5} eV\,/\,K.$

10. In a p-n junction diode, the currect I can expressed as $I = I_0 \exp \Bigl(rac{eV}{2k_BT} - 1 \Bigr)$ where I_0 is called the reverse saturation current, V is the voltage across the diode and is positive for forward bias and negative for reverse bias, and I is the current through the diode, K_B is the Boltzmann constant $\left(8.6 imes10^{-5}eV/K
ight)$ and T is the absolute temperature. If for a given diode $I_o = 5 \times 10^{-12} A$ and T = 300 K, then

(a) What will be the forward current at a formward voltage of 0.6V ?

(b) What will be the increase in the current if the voltage across the diode is increased to 0.7V ?

(c) What is the dynamic resistance?

(d) What will be current if reverse bias voltage

changes from 1V to 2V?

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11. You are given the two circuits as shown in Fig. and . Show that circuit acts as OR gate

while the circuit acts as AND gate.



12. Write the truth table for a NAND gate as given in Fig.9. Hence identify the exact logic

operation carried out by this circuit.



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13. You are given two circuits as shown in following figure. The logic operation carried out by the two circuit are respectively :-





14. Write the truth table for circuit given in Fig.below consisting of NOR gates and identify the logic operation (OR, AND and NOT) which this circuit is performing.



15. Write the truth table for the circuit given in Fig., consisting of NOR gates only. Identify the logic operations (OR, AND, NOT) performed by two circuits.



