PHYSICS

NCERT - NCERT PHYSICS(HINGLISH)

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 ?

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

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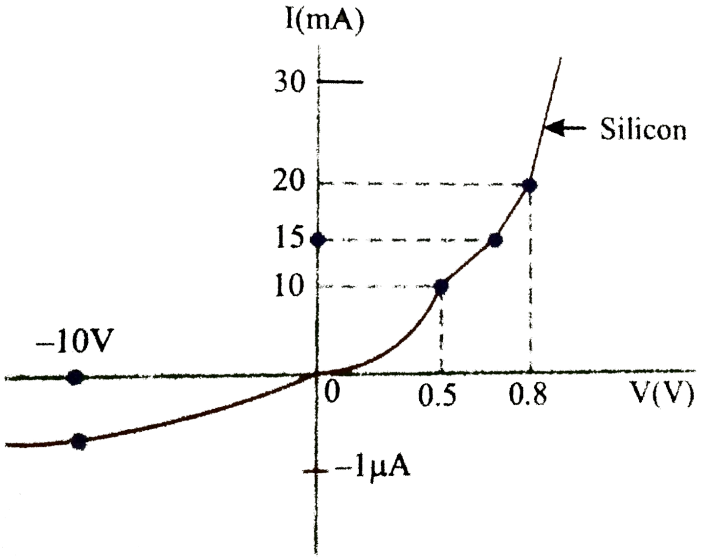
4. The $V - I$ characteristic of a silicon diode is shown in the Fig. Calculate the resistance of the diode at

(a) $I_D = 15mA$ and

(b) $V_D = -10V$.



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5. In a zener regulated power supply a zener diode with

$V_z = 6.0V$ is used for regulation. The load current is to be 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?

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7. Why are Si and GaAs are preferred materials for solar cells?

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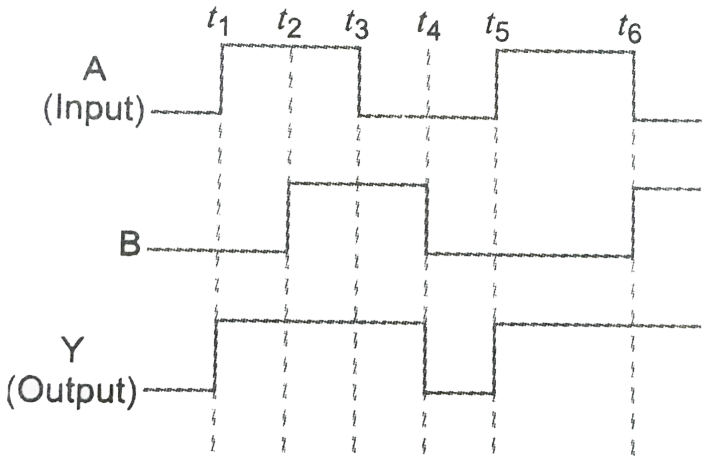
8. Justify the output waveform (y) of the OR gate for input and as gives in Fig.



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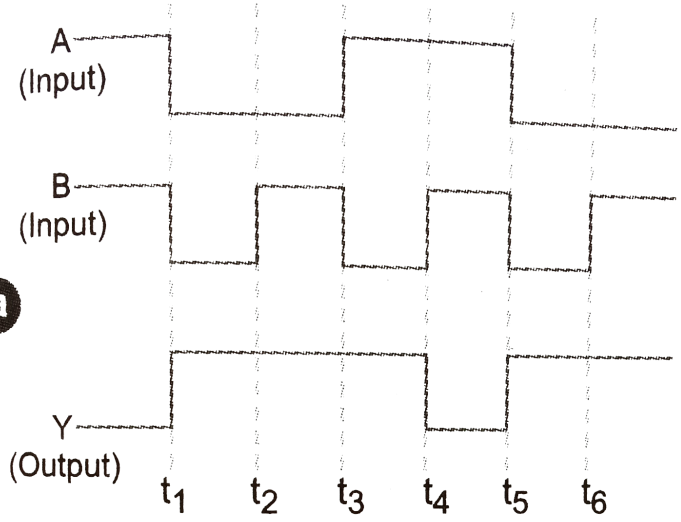
9. The following Fig. shows the input waveforms (A,B) and the output waveform (y) of a gate. Identify the gate and write its truth

table.

a



b

	A	B	$y = \overline{A \cdot B}$
At $t < t_1$	1	1	0
For t_1 to t_2	0	0	1
For t_2 to t_3	0	1	1
For t_3 to t_4	1	0	1
For t_4 to t_5	1	1	0
For t_5 to t_6	0	0	1

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10. Sketch the output Y from NAND gate having input A A and B given below, Fig.

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Exercise

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:

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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 ?

A. $(E_g)_{Si} < (E_g)_{Ge} < (E_g)_C$

B. $(E_g)_C < (E_g)_{Ge} > (E_g)_{Si}$

C. $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

D. $(E_g)_C = (E_g)_{Si} = (E_g)_{Ge}$

Answer:

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4. In an unbiased p-n junction electrons diffuse from n-region to p-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

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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?

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8. The number of silicon atoms per $m^3 is 5 \times 10^{28}$. This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and $5 \times 10^{20} per m^3$ 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?

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9. In an intrinsic semiconductor the energy gap $E_g is 1.2eV$. 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 $n_i = n_0 \exp\left(\frac{-E_g}{2k_T}\right)$, where n_0 is a constant and $k = 8.62 \times 10^{-5} eV/K$.

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10. In a $p-n$ junction diode, the current I can expressed as $I=I_0\exp\left(\frac{eV}{2k_BT}-1\right)$ 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 $\left(8.6\times10^{-5}eV/K\right)$ and T is the absolute temperature. If for a given diode $I_o=5\times10^{-12}A$ and $T=300K$, then

(a) What will be the forward current at a forward 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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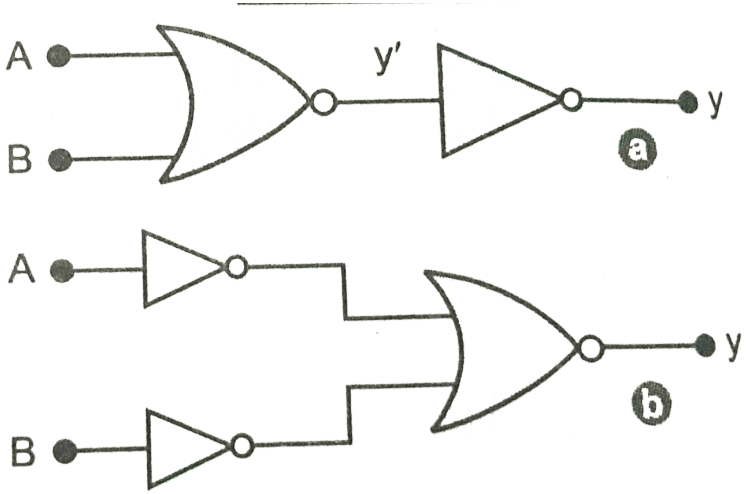
11. You are given the two circuits as shown in Fig. and . Show that circuit acts as OR gate

while the circuit acts as AND gate.



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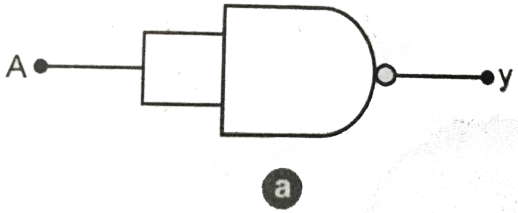
12. Write the truth table for a NAND gate as given in Fig.9. Hence identify the exact logic

operation carried out by this circuit.



A	B
1	0
0	1

b

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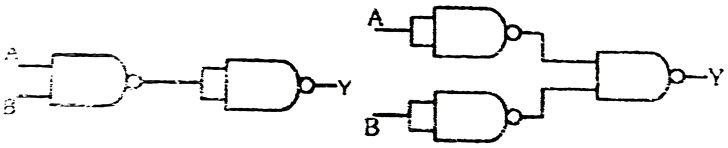
13. You are given two circuits as shown in following figure. The logic operation carried out by the two circuit are respectively :-



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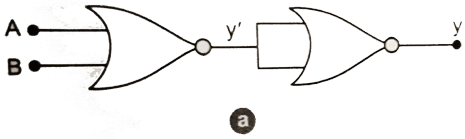
14. Write the truth table for circuit given in Fig. below consisting of NOR gates and identify the logic operation (OR, AND and NOT) which this circuit is performing.



(a)

(b)

A	B	y'	y
0	0	1	0
1	0	0	1
0	1	0	1
1	1	0	1

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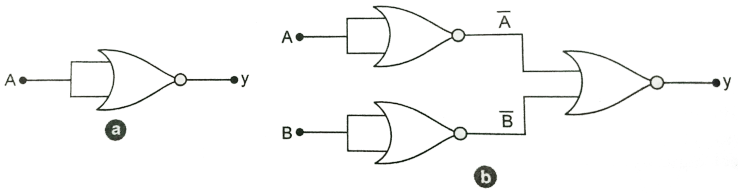
15. Write the truth table for the circuit given in Fig., consisting of NOR gates only. Identify the logic operations (OR, AND, NOT) performed by two circuits.



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