Q-1 - 9729478

The conductivity of a pure semiconductor is roughly proportional to $\frac{T^3}{2}e^{-\Delta E/2kT}where$(Delta)E`is the band gap.The band gap for germanium is 0.74eV at 4K and 0.67eV at 300K.By what factor does the conductivity of pure germanium increase as the temperature is raised form 4K to 300K?

SOLUTION:

Here $\delta = T(3/2)e^{-\Delta E/2KT}$

$$\therefore \frac{\sigma_2}{\sigma_1} = \left(\frac{T_2}{T_1}\right)^{3/2} \left(\frac{e^{-\Delta E_2/2KT_2}}{e^{-\Delta E_1/2KT_1}}\right.$$

$$= \left(\frac{300}{4}\right)^{3/2} \left(\frac{e^{-0.67/(2 \times 8.62 \times 10^{-5} \times 300)}}{e^{-0.74/(2 \times 8.62 \times 10^{-5} \times 4)}}\right.$$

$$= 10^{463}$$

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Q-2 - 19037873

Carbon, silicon and germanium atoms have four valence electrons each. Their valence and conduction bands are separated by energy band gaps represented by $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$, respectively.

Which one of the following relationship is true in their case?

(A) $(E_g)_c > (E_g)_{si}$

(B) $(E_g)_C = (E_g)_{Si}$

(C) $(E_g)_C < (E_g)_{Ge}$

(D) $(E_g)_C < (E_g)_{Si}$

CORRECT ANSWER: A

Q-3 - 11970751

The velence of the impurity atom that is to the be added to garmenium crystal so as to meke it a N-type semiconductor, is

(A) 6

(B) 5

(C) 4

(D) 3

CORRECT ANSWER: B

SOLUTION:

$$\underset{\text{impurity}}{Ge + \text{pentaevelent}} \rightarrow \underset{\text{semiconductor}}{N - type}$$

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Q-4 - 11046309

A group-14 element is to be converted into n-type semiconductor by doping it with a suitalbe impurity. To which group this impurity belong?

CORRECT ANSWER: N/A

SOLUTION:

n-type semiconductor means conduction due to the presence of excess of negatively charged electrons. Hence, to convert group 14 element into n-type semiconductor, it should be doped with group 15 element.

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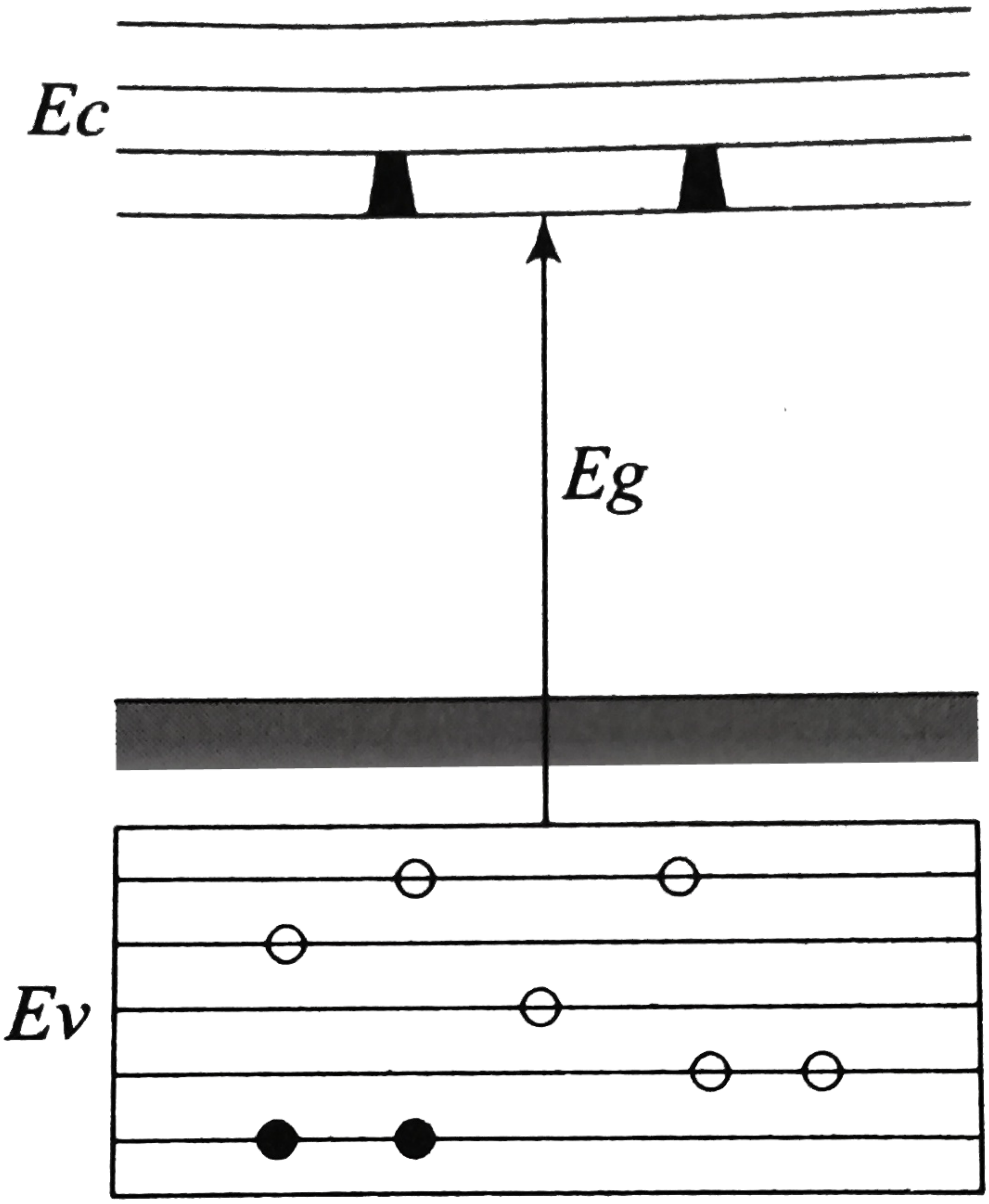
Q-5 - 11971078

In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is a/an



(A) p-type semiconductor

(B) insulator

(C) metal

(D) n type semiconductor

CORRECT ANSWER: A

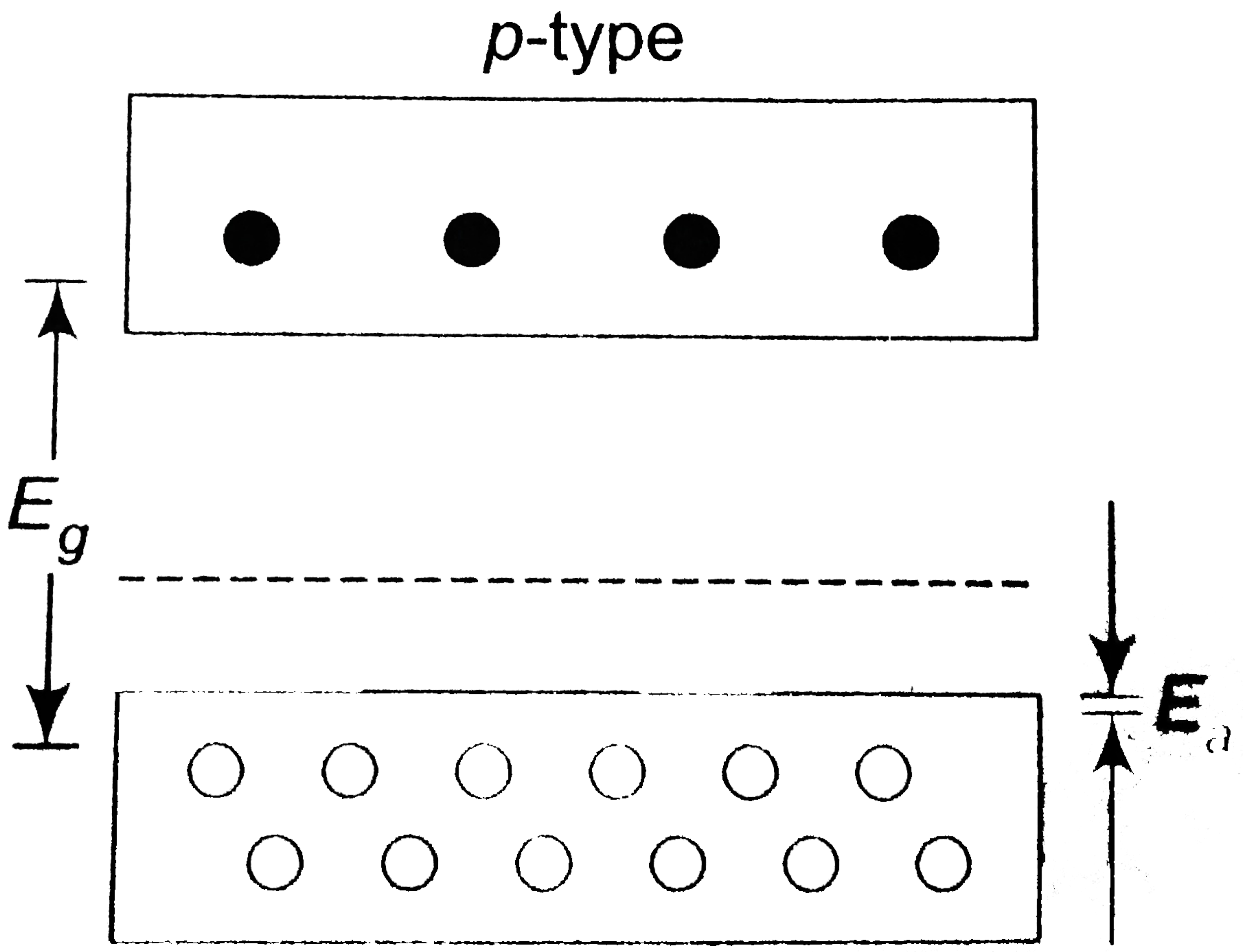
SOLUTION:

The given figure represents p-type semiconductor as described below

When one of the silicon atom (valence =4) has been replaced by an atom of aluminium (valence $=3$), the aluminium atom can bond covalently with only three

aluminium atom can bond covalently with only three

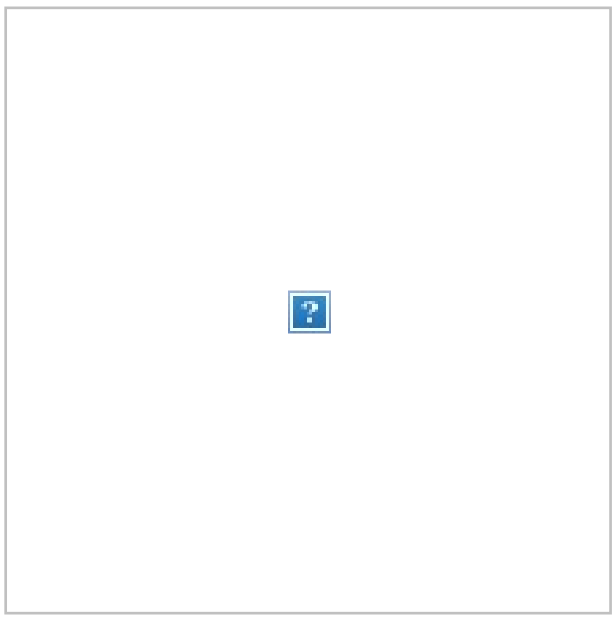
silicon atoms, so there is now a "missing" electron (a hole) in one alumiumium-silicon bond with a small expendicture of energy, an electron can be torn from a neigbouring silicon-silicon bond to fill this hole, thereby creating a hole in that bond. similarly, an electron from some other bond can be moved to fill the second hole. In this way, the hole can migrate through the lattice.

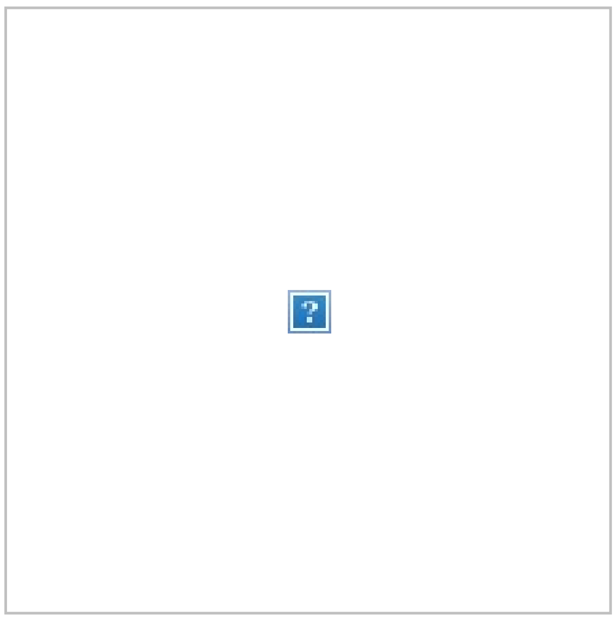


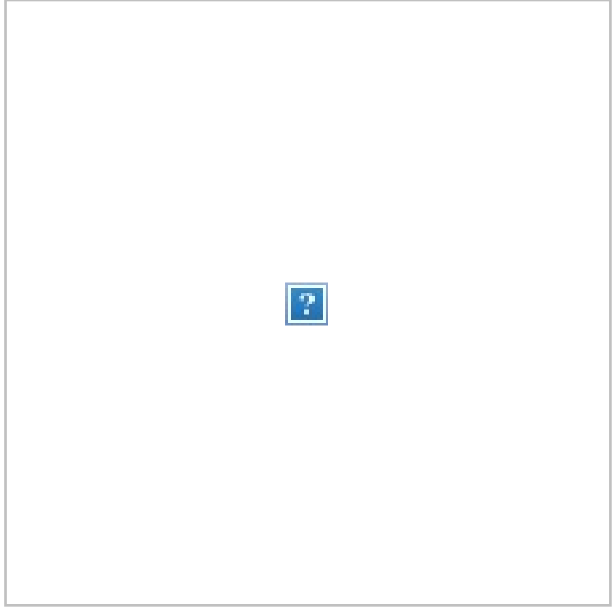
The alumunium atom is called an acceptor atom because it readily accetps an electron from a neighbouring bond that is from the valence band of silicon. As figure suggests, this electron occupies a localized acceptor satate that lies within the energy gap, at an average energy interval E_a above the top of the valence band. By adding acceptor atoms, it is possible to increase very greately the number of holes in the valence band.

Q-6 - 19037877

In the case of forward biasing of p-n junction, which one of the following figures correctly depicts the directioin of the flow of charge carriers?

(A) 

(B) 

(C) 

(D) None of these

CORRECT ANSWER: C

Q-7 - 14797426

In the given figure, which of the diodes are forward biased?

(A) ` (##DPP_PHY_57_E01_022_O01.png"

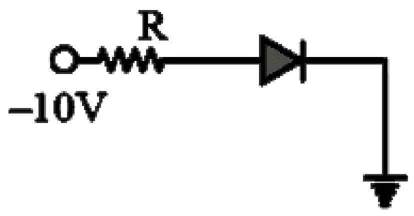
width="30%">

(B) ` (##DPP_PHY_57_E01_022_O02.png"

width="30%">

(C) ` (##DPP_PHY_57_E01_022_O03.png"

width="30%">

(4) 

(D)

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Q-8 - 14533234

For half wave rectifier if load resistance R_d is $2k\Omega$ and P-N junction resistance R_L is $2k\Omega$ determine rectification efficiency.

SOLUTION:

$$\eta_{HWA}$$

$$- 40.6\left(\frac{R_L}{R_d + R_L}\right)$$

$$= 40.6 \times \frac{2k\Omega}{(2+2)k\Omega}$$

$$= 26.3\ \%$$

.

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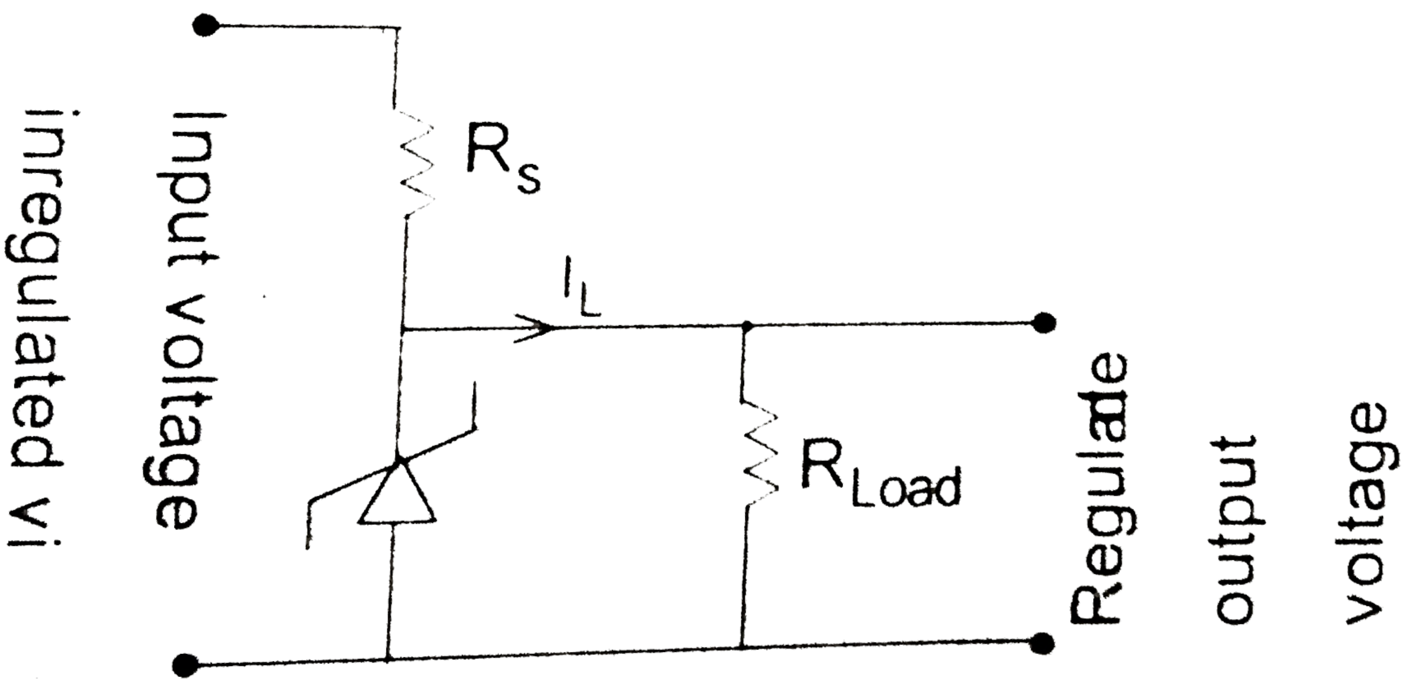
Q-9 - 14160399



in a zener diode (dc voltage regulator) circuit with $V_{\text{zener}} = 7.0$ V is used for regulation. Thhe load current is to be 4.0 mA and te unregulated input is 11.0 V. what should be te value of series resistor R_s if zener diode current is five times te load current

(A) 120Ω

(B) 167Ω

(C) 180Ω

(D) 200Ω

CORRECT ANSWER: B

SOLUTION:

$$i_{\text{zener}} = 5i_{load} = 20mA$$
$$\& i_{RS} = i_{\text{zener}} + i_{Load}$$
$$= 24mA$$

$$V_{Rs} + V_{\text{zener}} = 11$$

$V_{RS} + 7 = 11$,brgt $V_{RS} = 4V$

$$\therefore R_S = \frac{V_{Rs}}{i_{Rs}}$$
$$= \frac{4}{24 \times 10^{-3}}\Omega$$
$$= 167\Omega$$

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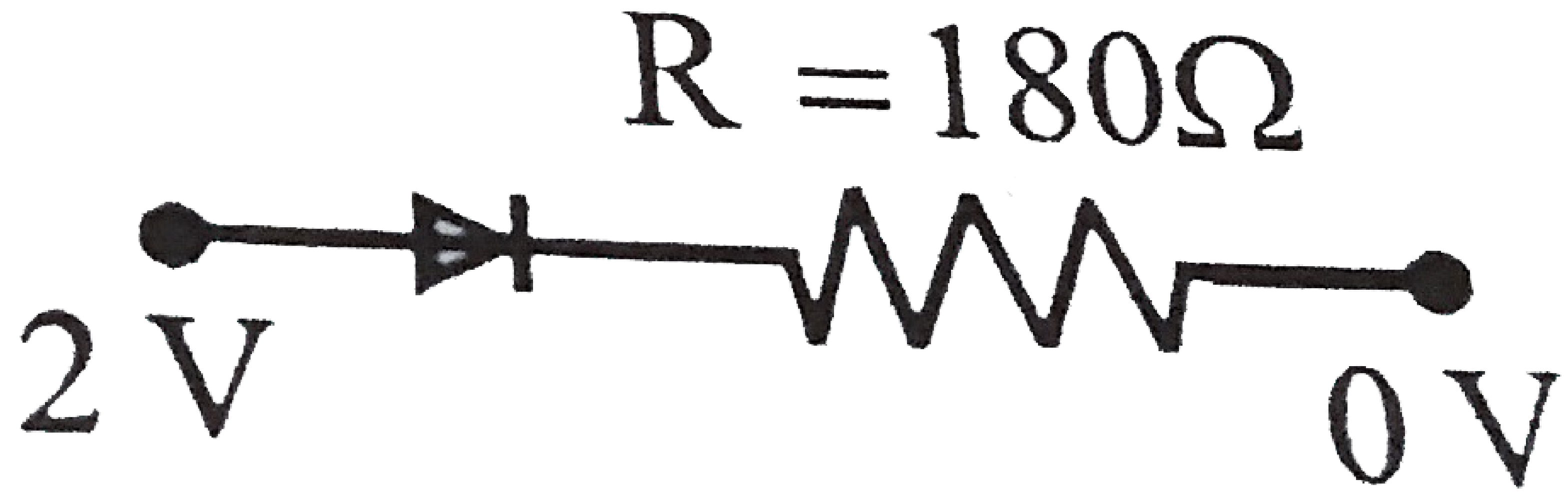
Q-10 - 14930875

Assuming that the silicon diode having resistance of 20Ω, the current through the diode is (knee voltage 0.7 V)



(A) 0 mA

(B) 10 mA

(C) 6.5 mA

(D) 13.5 mA

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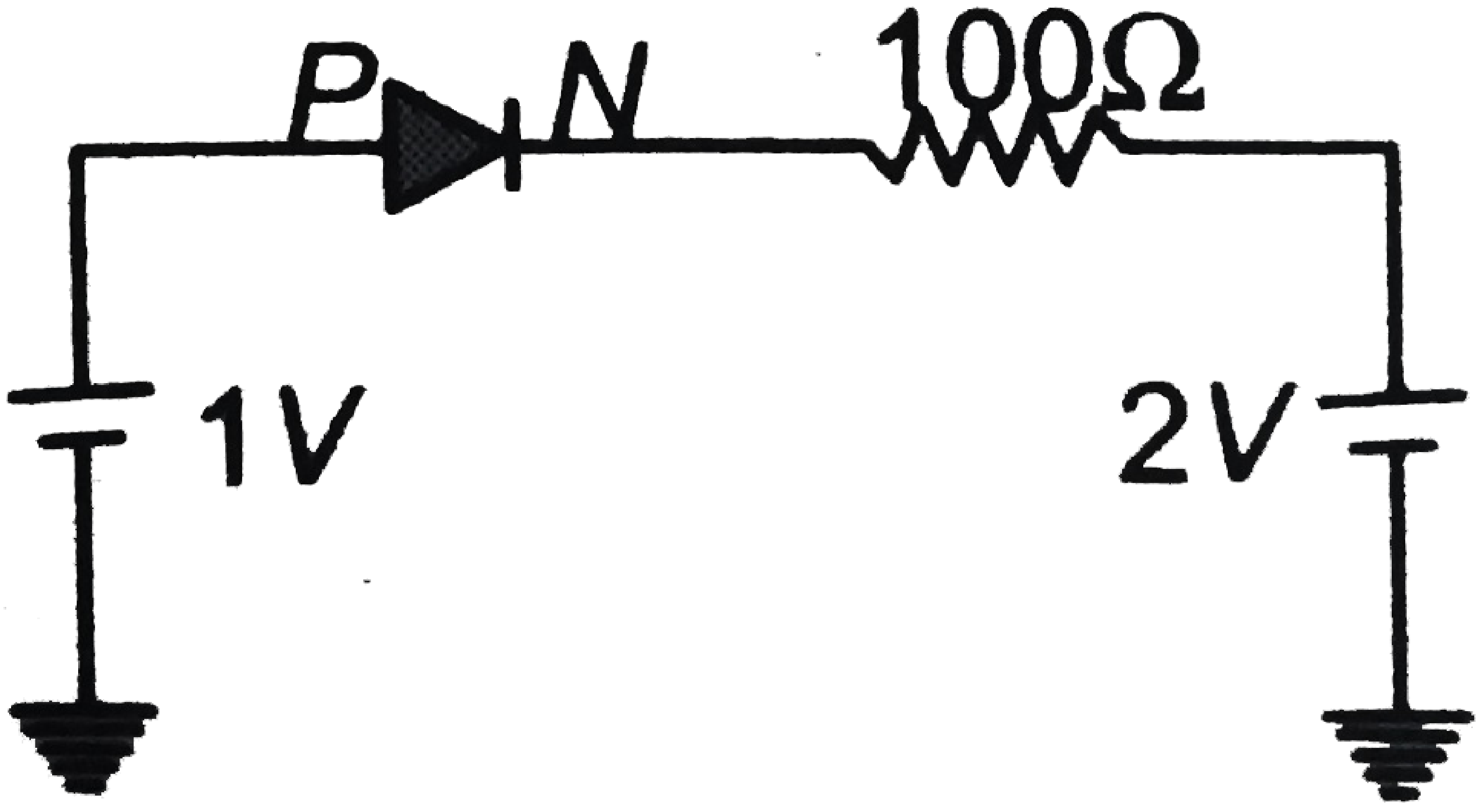
Q-11 - 11970855

The current through an ideal PN-junction shown in the following circuit diagram will be



(A) zero

(B) $1 mA$

(C) $10 mA$

(D) $30 mA$

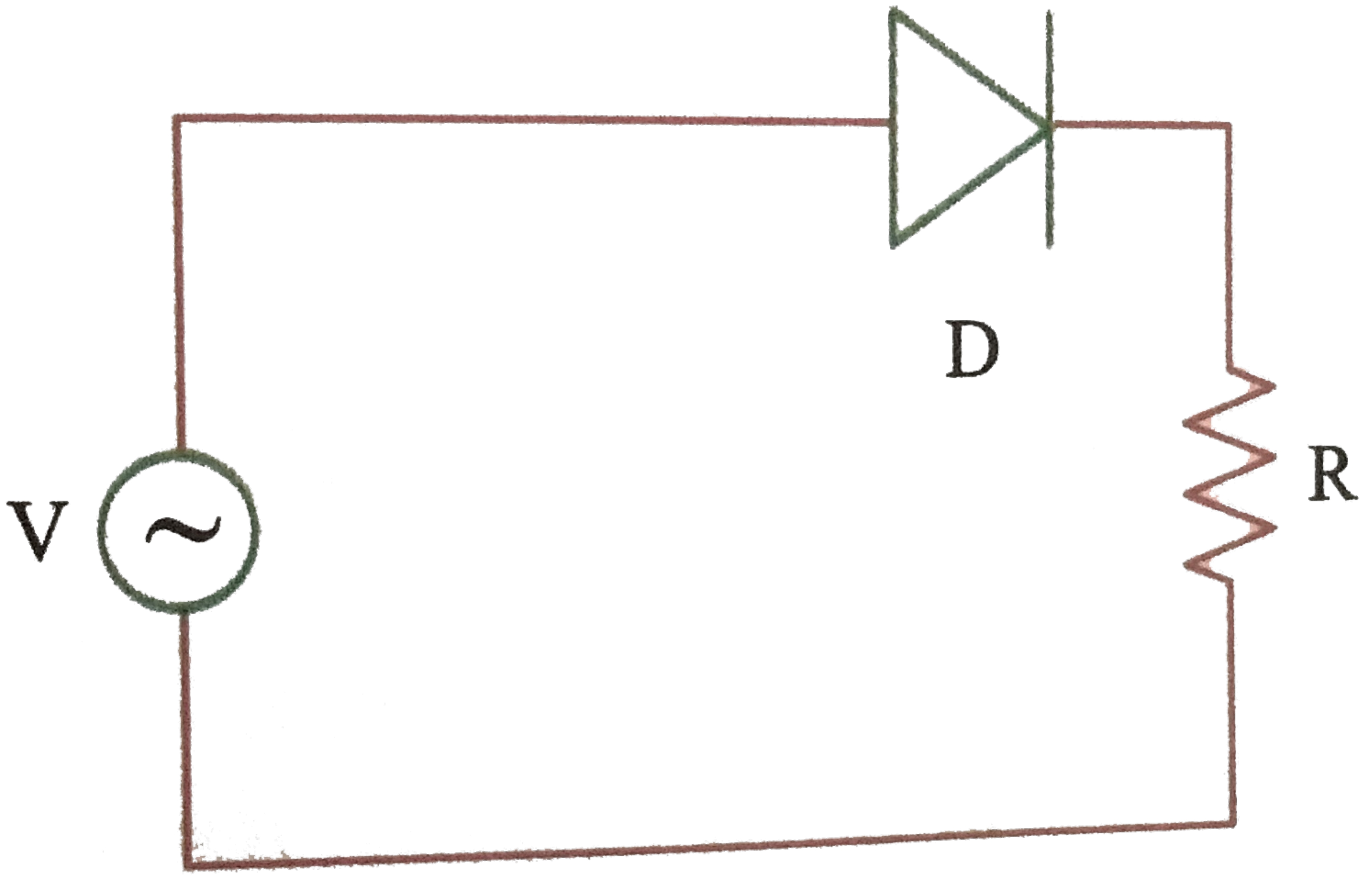
CORRECT ANSWER: A

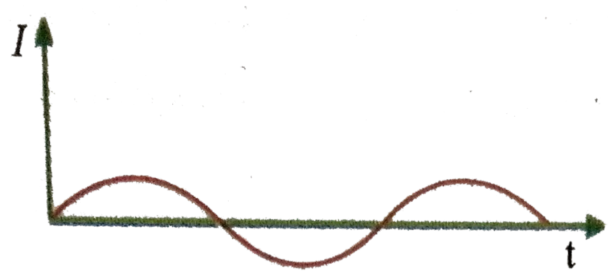
SOLUTION:

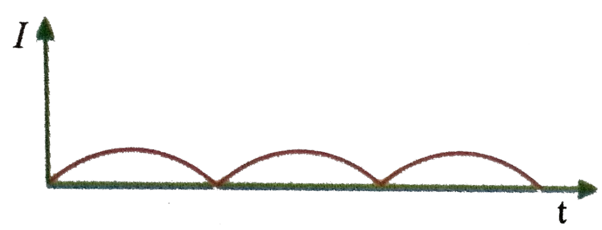
The diode is in reverse biasing so current through it is zero.

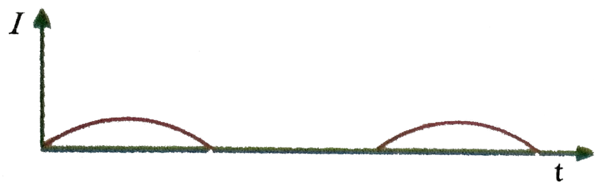
Q-12 - 13165687

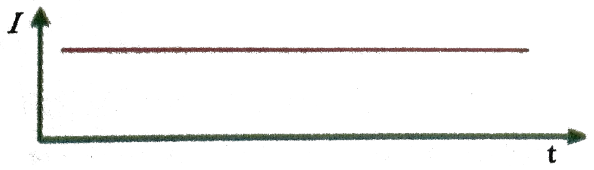
A $p-n$ junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit.



(A) 

(B) 

(C) 

(D) 

CORRECT ANSWER: C

SOLUTION:

Given figure is halfwave rectifier.

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Q-13 - 17816726

When the emitter current of a transistor is changed by 1 mA, its collector current changes by 0.990 mA. In the common base circuit, current gain for the transistor is

(A) 0.099

(B) 1.01

(C) 1.001

(D) 0.99

CORRECT ANSWER: D

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Q-14 - 13165662

The circuit gain of transistor in a common emitter circuit is 40. The ratio of emitter current to base current is.

(A) 40

(B) 41

(C) 42

(D) 43

CORRECT ANSWER: B

SOLUTION:

$\beta = \frac{I_C}{I_B}$ and
$\frac{I_E}{I_B} = \frac{I_C + I_B}{I_B} = \frac{I_C}{I_B}$
$+ 1 = \beta + 1$

.

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Q-15 - 11970899

The transfer ration of a transistor is 50. The input resistance of the transistor when used in the common -emitter configuration is $1k\Omega$. The peak value for an $A.\ C.$ input voltage of $0.01V$ peak is

(A) $100\mu A$

(B) $0.01mA$

(C) $0.25mA$

(D) $500\mu A$

CORRECT ANSWER: D

SOLUTION:

$\beta = 50, R_i = 1000\Omega,$
$V_i = 0.01V$

$\beta = \frac{i_c}{i_b}$ and
$ib = \frac{V_i}{R_i} = \frac{0.01}{10^3}$
$= 10^{-5}A$

Hence

$i_c = 50 \times 10^{-5}A$
$= 500\mu A$

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Q-16 - 12017379

For a transistor connected in common emitter mode, the voltage drop across the collector is 2V and beta is 50. If R_c is $2k\Omega$, the base current is $a \times 10^{-5} A$. What is the value of a ?

CORRECT ANSWER: B

SOLUTION:

Voltage drop across collector $= I_c R_c$

$$\therefore 2 = I_c \times (2 \times 10^3)$$

$$\text{or } I_c = 10^{-3} A$$

$$I_b = \frac{I_c}{\beta} = \frac{10^{-3}}{50} = 2$$

$$\times 10^{-5} A$$

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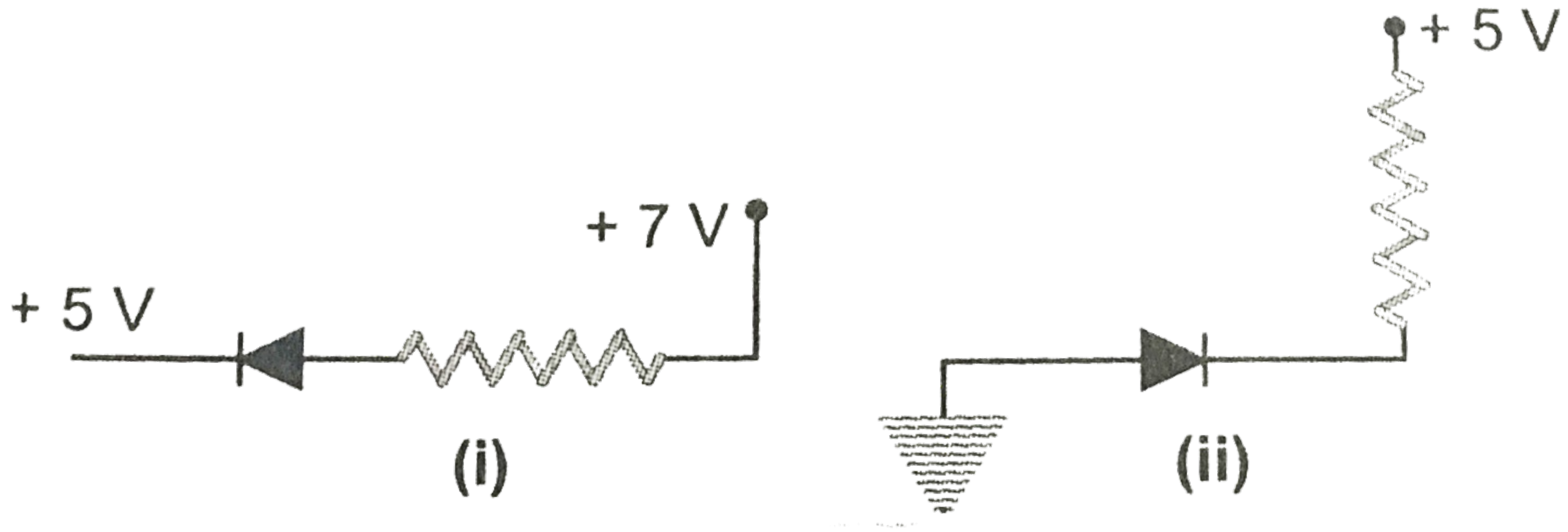
Q-17 - 12016909

In the following circuits, Fig., which one of the two diodes is forward biased and which is reverse biased.



SOLUTION:

(i) p-n junction is forward biased

(ii) p-n junction is reverse biased

Q-18 - 13157167

In a normal operation of a transistor,

(i) base-emitter junction is forward-biased

(ii) base-collector junction is forward-biased

(iii) base-emitter junction is reverse-baised

(iv) base-collector junction is reverse-biased

(A) (i), (ii)

(B) (i), (iv)

(C) (ii), (iii)

(D) (ii), (iv)

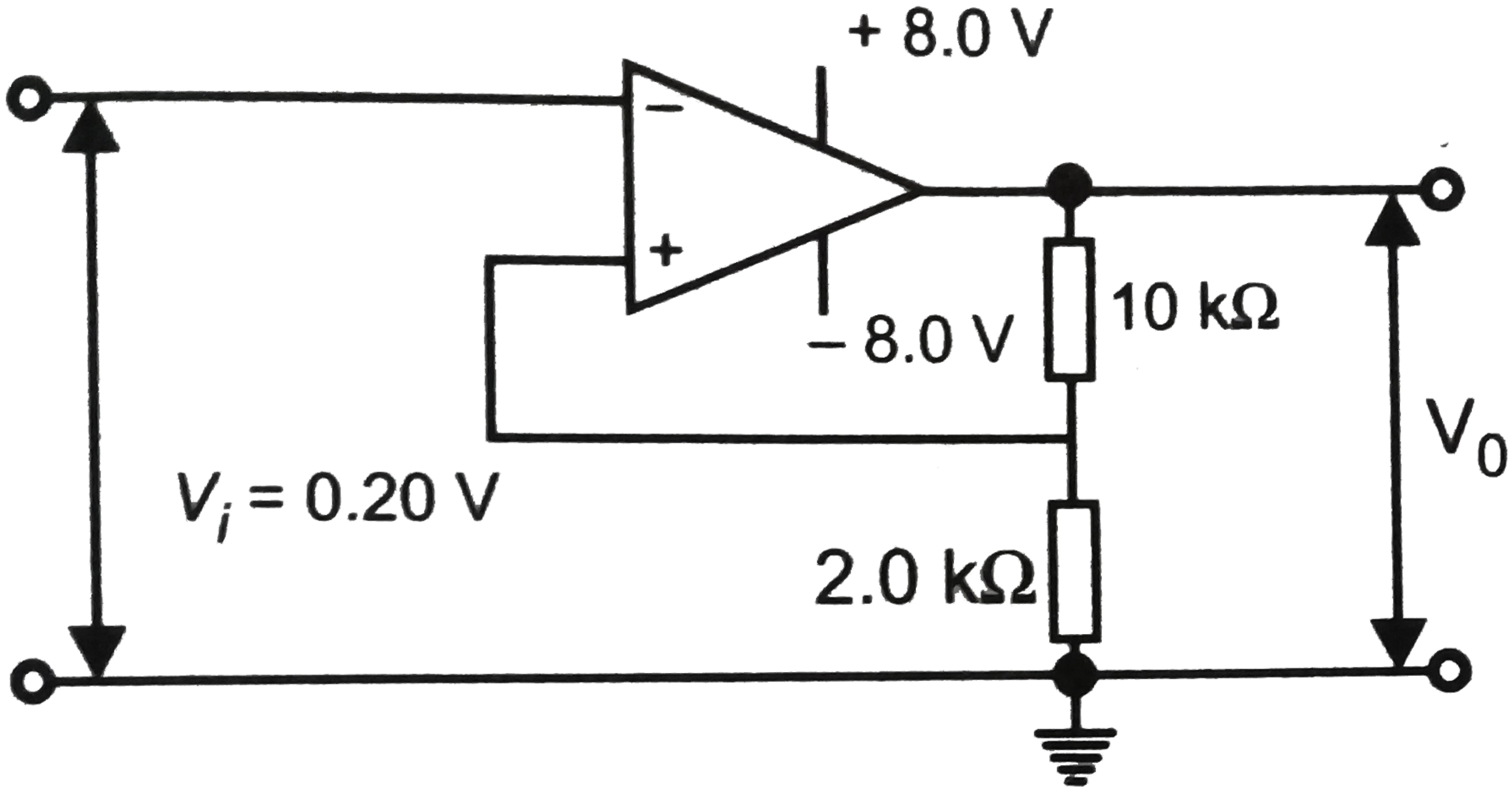
CORRECT ANSWER: B

SOLUTION:

NA

Q-19 - 11970998

An input voltage V_i of $0.20V$ is applied to an operational amplifier connected as shown in the diagram. What is the output voltage V_0?



(A) $0.20V$

(B) $1.2V$

(C) $0.80V$

(D) $8.0V$

CORRECT ANSWER: B

SOLUTION:

The circuit configuration is a non-in-venting amplifier.

The gain of the amlifier is given by the equation gain

$$= \frac{V_0}{V_1} = 1 + \frac{R_1}{R_2} = 1$$
$$+ \frac{10}{2} = 6$$

thus, the output voltage V_0 is

$$V_0 = 6V_i = 6(0.20)$$
$$= 1.2V$$

Q-20 - 11971175

Assertion: The logic gate NOT can be built using diode.

Reason: The output voltage and the input voltage of the diode have 180 phase difference.

(A) If both the assertion and reason are true and reason is a true explantion of the assertion.

(B) If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

(C) If the assertion is true but reason false

(D) If both the assertion and reason are false.

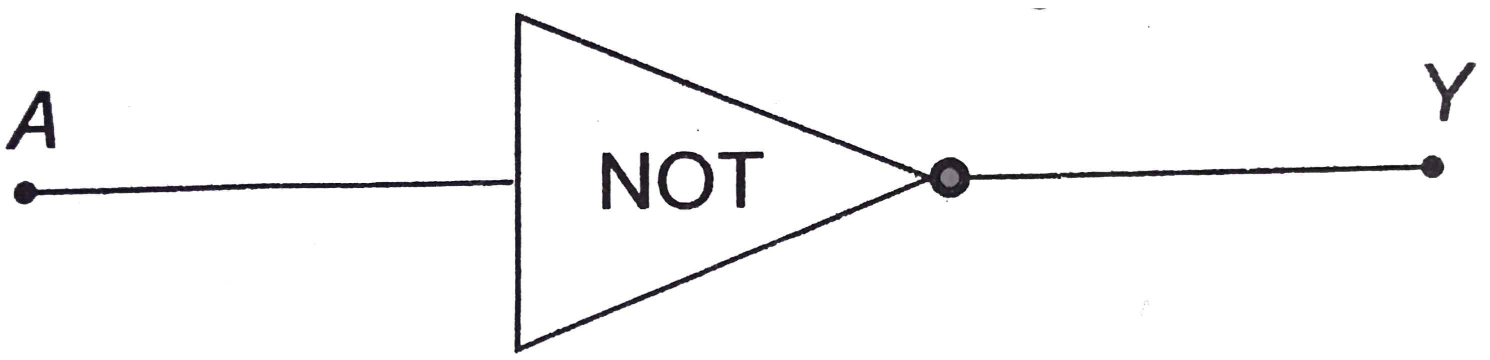
CORRECT ANSWER: D

SOLUTION:

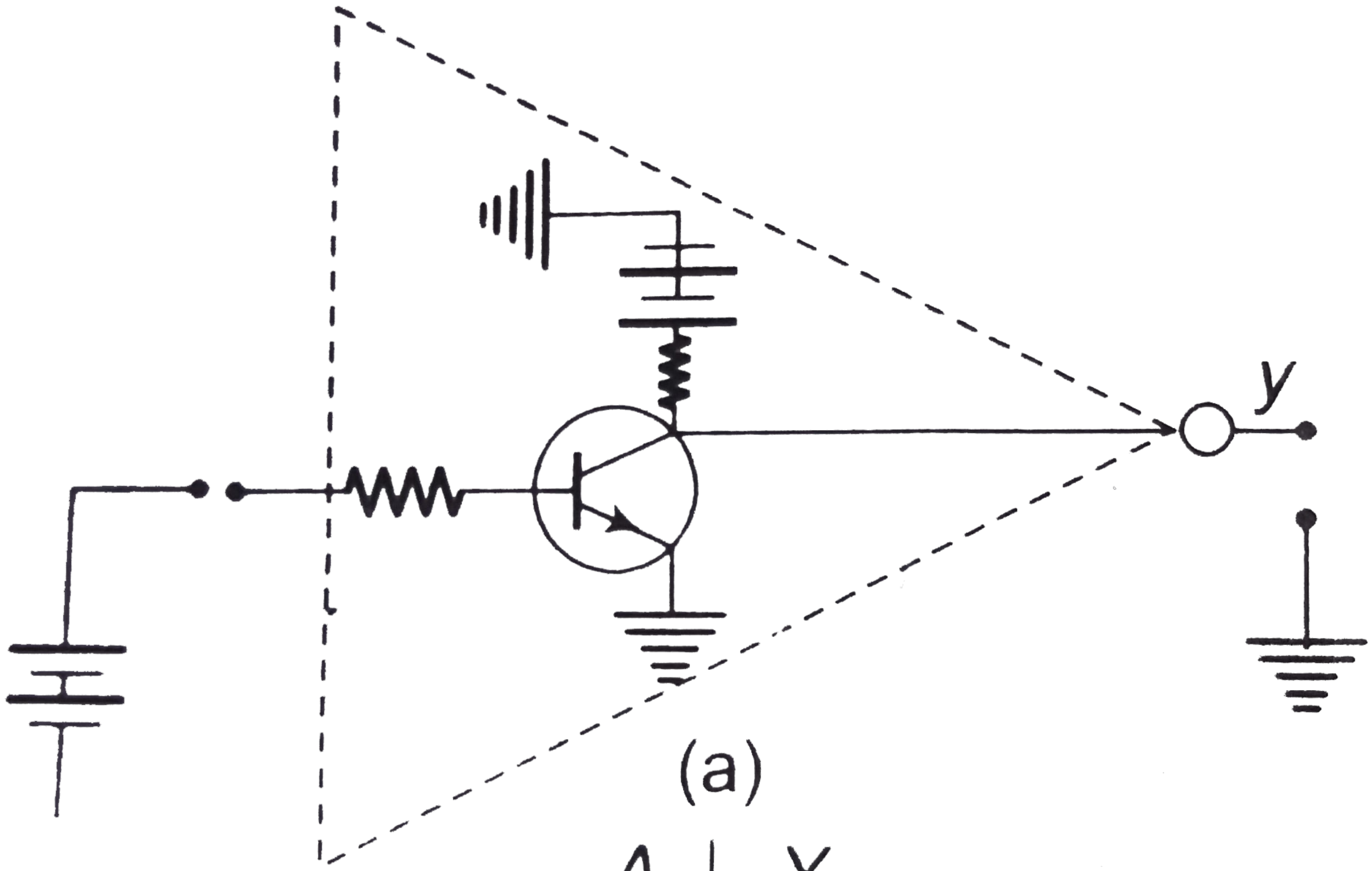
The NOT gate has only one input and one output. It combines the input A with the output Y, from Boolean expression

$\overline{A} = Y$

We cannot realise a NOT gate by using diodes.



Instead a transistor has to be used. An electric circuit and truth table for a NOT gate using a $n-p-n$ transistor is shown.



(a)

A	Y
0	1
1	0

(b)

Q-21 - 11970922

In the study of transistors as an amplifier, if $\alpha = I_c / I_c$ and $\beta = I_c / I_b$, where I_c, I_b and I_e are the collector, base and emitter currents, then

(A) $\beta = \dfrac{1-\alpha}{\alpha}$

(B) $\beta = \dfrac{\alpha}{1-\alpha}$

(C) $\beta = \dfrac{\alpha}{1+\alpha}$

(D) $\beta = \dfrac{1+\alpha}{\alpha}$

CORRECT ANSWER: B

SOLUTION:

As we know $i_E = i_C + i_B$

$$\Rightarrow \frac{i_e}{i_c} = 1 + \frac{i_b}{i_c}$$

$$\Rightarrow \frac{1}{\alpha} = 1 + \frac{1}{\beta} \Rightarrow$$

$$\Rightarrow \beta = \frac{\alpha}{1-\alpha}$$

.

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Q-22 - 13157168

Let I_E, I_C and I_B represent the emitter current, the collector current and the base current respectively in a transistor.then (i)I_C is slightly smaller than I_E

(ii) I_C is slightly greater than I_E

(iii) I_B is much smaller than I_E

(iv) I_B is much greater than I_E

(A) $(i), (ii)$

(B) (i),(iii)`

(C) $(ii), (iii)$

(D) $(ii), (iv)$

CORRECT ANSWER: B

SOLUTION:

NA

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Q-23 - 16266659

A common emitter amplifier is designed with NPN transistor $(\alpha = 0.99)$. The input impedance is $1K\Omega$ and load is $10K\Omega$. The voltage gain will be

(A) 9.9

(B) 99

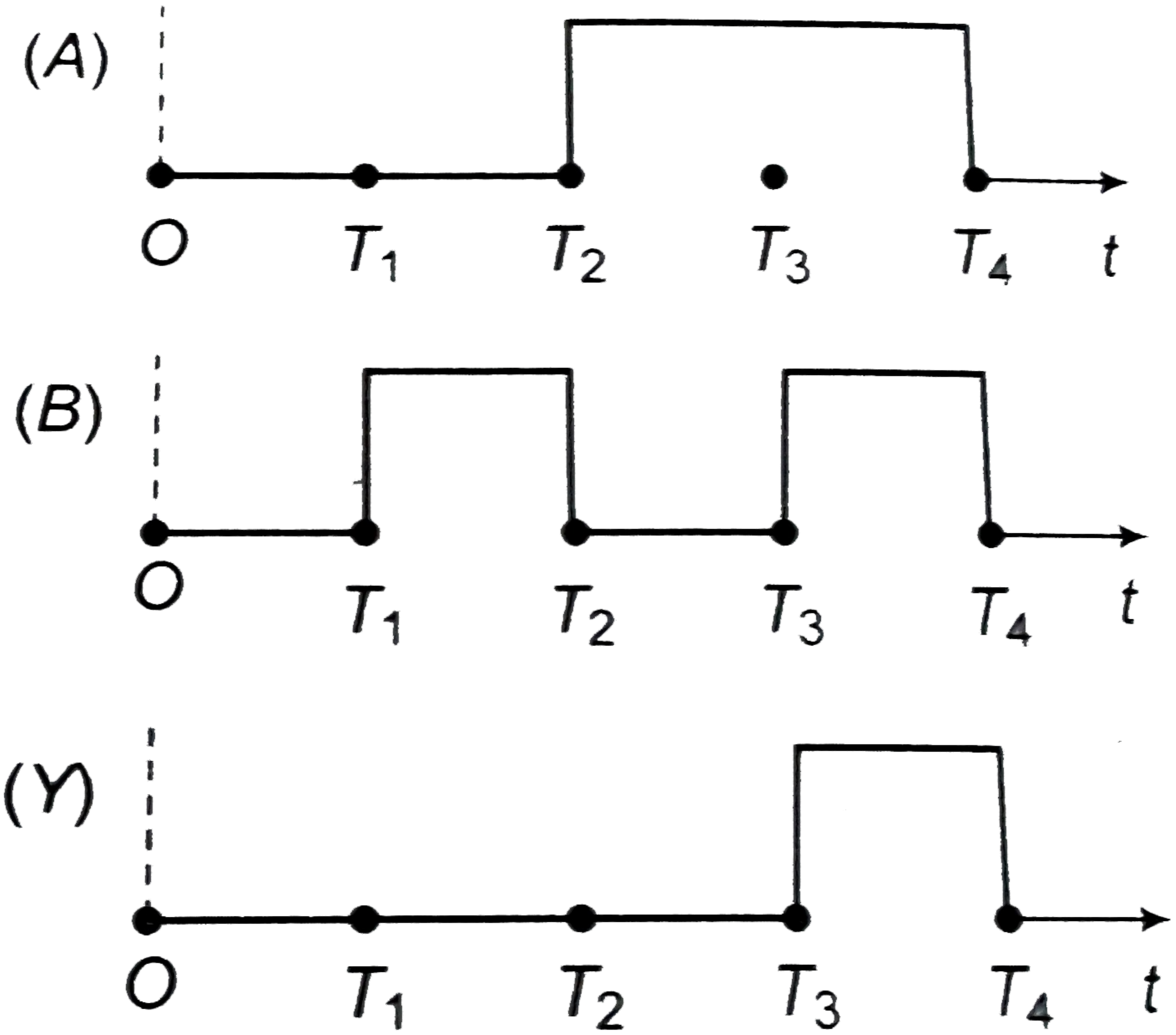
(C) 990

(D) 9900

CORRECT ANSWER: C

Q-24 - 13157209

The given figure shows the wave forms for two inputs A and B and that for the output Y of a logic circuit.the logic circuit is



(A) an AND gate

(B) an OR gate

(C) a $NAND$ gate

(D) an NOT gate

CORRECT ANSWER: A

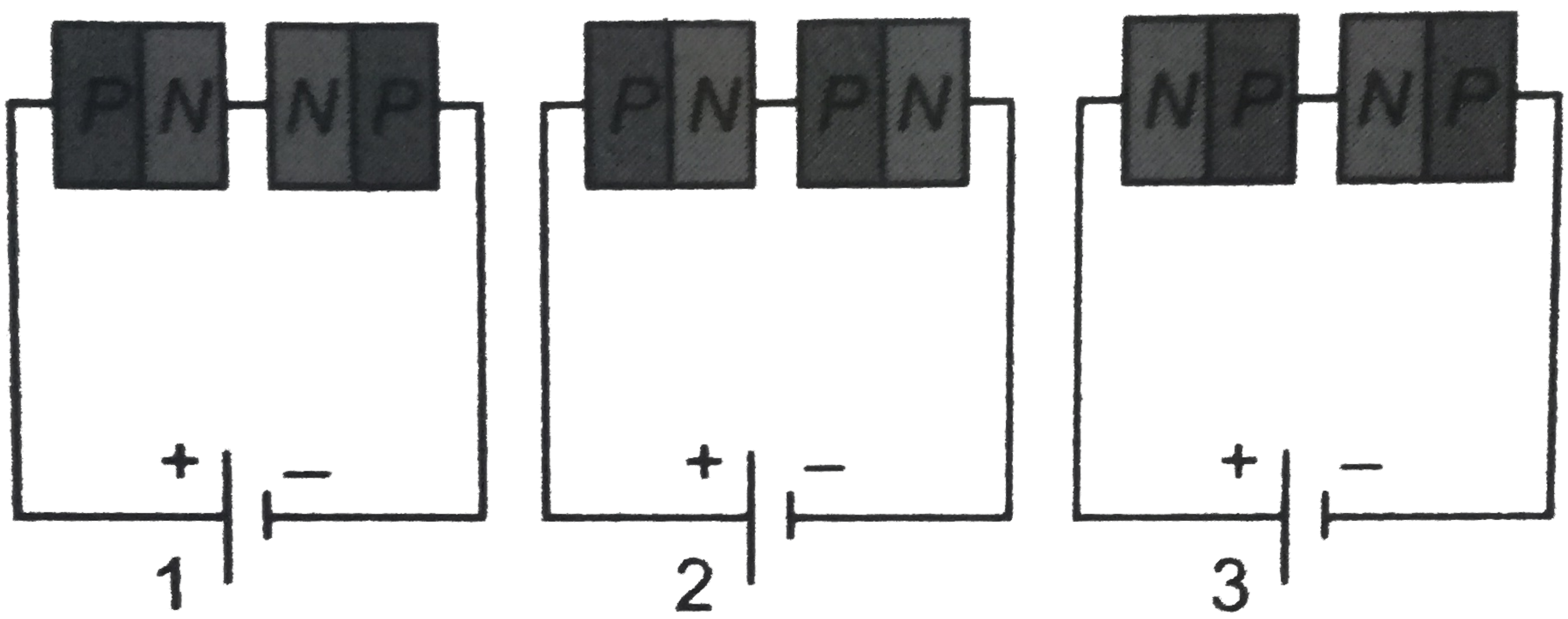
SOLUTION:

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

AND gete .

Q-25 - 11970779

Two PN-junction can be connected in series by three different methods as shown in the figure. If the potential difference in the junction is the same, then the correct connection will be



(A) In the circuit (1) and (2)

(B) In the circuit (2) and (3)

(C) In the circuit (1) and (3)

(D) Only in the circuit (1)

CORRECT ANSWER: B

SOLUTION:

Because in case $(1) N$ is connected with N. This is not a series combination of transistor.

Q-26 - 12297685

At what temperature(in kelvin) would the resistance of a copper wire be half its resistance at 0^{C}? Temperature coefficient of resistance of copper is $3.9 \times 10^{-3}. C^{-1}$.

SOLUTION:

Let at temperature t^C, $R_t = \frac{1}{2}R_0$

Then

$$\alpha = \frac{R_t - R_0}{R_0 \times t}$$

$$= \frac{(R_0/2) - R_0}{R \times t} =$$

$$- \frac{1}{2t}$$

or

$$t = -\frac{1}{2\alpha} =$$

$$- \frac{1}{2 \times 3.9 \times 10^{-3}} =$$

$$- 128.2^C$$

$$= 144.8K$$

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Q-27 - 11970895

In an NPN transistor the collector current is $10mA$. If 90 % of electrons reach collector, the emitter current (i_E) and base current (i_B) are given by

(A)
$i_E = -1mA, i_B = 9mA$

(B)
$i_E = 9mA, i_B = -1mA$

(C)
$i_E = 1mA, i_B = 11mA$

(D)
$i_E = 11mA, i_B = 1mA$

CORRECT ANSWER: D

SOLUTION:

$$i_C = \frac{90}{100} \times i_E$$

$$= \frac{\Delta i_c}{\Delta i_b} \Rightarrow \Delta i_c = \beta$$

$$\times \Delta i_b = 80 \times 250 \mu A$$

.

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Q-28 - 13165591

The output characterstics of an $n-p-n$ transistor represent, [I_C = Collector current, V_{CE} = potential difference between collector and emitter, I_B = Base current, V_{BB} = voltage given base , V_{BE} = the potential difference between base and emitter].

(A) change in I_C as I_B and V_{BB} are changed

(B) Changes in I_C with changes in $V_{CE}(I_B = cons\tan t)$.

(C) changes in I_B with changes in V_{CE}.

(D) Changes in I_C as V_{BE} is changed.

CORRECT ANSWER: B

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Q-29 - 12017401

Statement-1 : A transistor with common emitter mode has current gain 50. When base current is $5\mu A$, the emitter current is $0.255mA$

.

Statement-2 : $I_e = I_b + I_c$

and $\beta = I_c / I_b$

(A) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation of Statement-1.

(B) Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of Statement-1.

(C) Statement-1 is true, Statement-2 is false.

(D) Statement-1 is false, Statement-2 is true.

CORRECT ANSWER: A

SOLUTION:

Here, both statement-1 and statement-2 are correct and statement-2 is correct explanation of statement-1. As

$$I_e = I_b + I_c = I_b + \beta I_b$$

$$= I_b(\beta + 1)$$
$$= 5\mu A(50 + 1)$$

$$= 255\mu A = 0.255 mA$$

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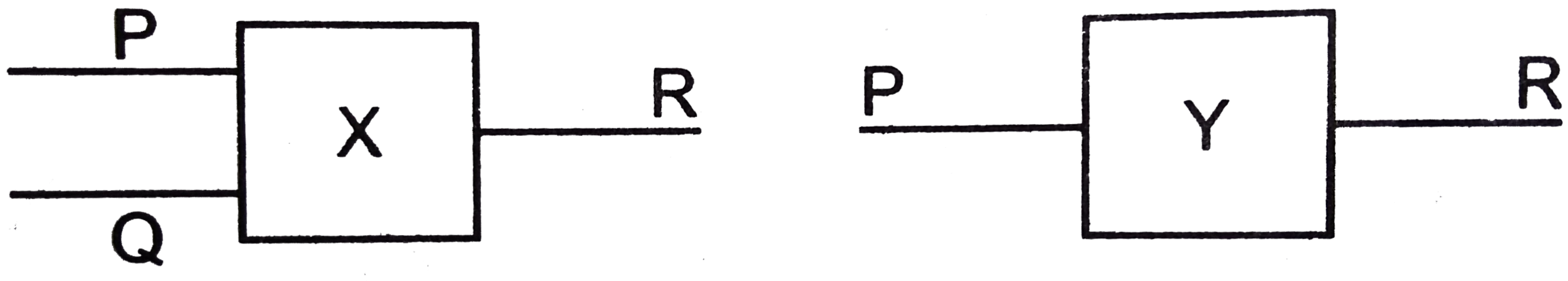
Q-30 - 11971009

Logic gates X and Y have the truth tables shown below



P	Q	R	P	R
0	0	0	0	1
1	0	0	1	0
0	1	0		
1	1	1		

When the output of X of connected to the input of Y, the resulting combination is equivalent to a single.

(A) NOTgate

(B) OR gate

(C) $NAND$ gate

(D) AND gate

CORRECT ANSWER: C

SOLUTION:

The truth table of the resulting logic circuit by connecting

X of Y is as follows

$$\begin{vmatrix} P & Q & R & R \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{vmatrix}$$

Hence, from the truth table, the combination is equivalent to a single $NAND$ gate. (ORX is an AND gate and Y is a NOT gate, thus the combination is $NOTAND$ gate, i.e., a $NAND$ gate)

Q-31 - 12017194

Determine the number density of donor atoms which have to be added to an intrinsic germanium semiconductor to produce an n-type semiconductor of conductivity $5\Omega^{-1}cm^{-1}$, given that the mobility of electron in n-type germanium is $3900cm^2V^{-1}s^{-1}$. Neglect the contribution of holes to conductivity.

SOLUTION:

Here,

$\sigma = 5\Omega^{-1}cm^{-1}, \mu_e$

$= 3900cm^2V^{-1}s^{-1},$

$n_e = ?$

We know, $\sigma = \frac{1}{\rho} = en_e\mu_e$

or

$n_e = \frac{\sigma}{e\mu_e}$

$= \frac{5}{(1.6 \times 10^{-19}) \times 3900}$

$= 8.012 \times 10^{15}cm^{-3}$

Since one donor atom, provides one free electron to the germanium semiconductor, therefore, the density of donor atoms $= 8.012 \times 10^{15}cm^{-3}$.

Q-32 - 12016777

A semiconductor has equal electron and hole concentration of $2 \times 10^8 m^{-3}$. On doping with a certain impurity, the hole concertraction increases to $4 \times 10^{10} m^{-3}$. (i) What type of semiconductor is obtained on doping? (ii) Calculate the new electron hole concentration of the semiconductor. (iii) How does the energy gap very with doping?

SOLUTION:

(i) Since on doping a semiconductor, the hole concentration $\left(n_p = 4 \times 10^{10} m^{-3}\right)$ becomes greater than electron concentration $\left(n_e = 2 \times 10^8 m^{-3}\right)$, so p-type semiconductor is formed on doping.

(ii) Here, $n_i = 2 \times 10^8 m^{-3}$,
$n_p = 4 \times 10^{10} m^{-3}, n_e$
$= ?$

$$n_e = \frac{n_i^2}{n_p}$$
$$= \frac{\left(2 \times 10^8\right)^2}{4 \times 10^{10}}$$
$$= 10^6 m^{-3}$$

(iii) Energy gap decreases with doping due to formation of acceptor energy levels just above the valence band in the energy gap region.

Q-33 - 12017217

The potential difference across the collector of a transistor, used in common emitter mode is $1.5V$, with the collector resistance of $3k\Omega$. Find (i) the emitter current and (ii) the base current, if d.c. gain of the transistor is 50.

SOLUTION:

$$I_c = \frac{V_{CE}}{R_L} = \frac{1.5}{3 \times 10^3}$$
$$= 0.50 \times 10^{-3} A$$
$$= 0.50 mA$$

$$I_b = \frac{I_c}{\beta} = \frac{0.50 mA}{50}$$
$$= 0.01 mA$$

$$I_e = I_c + I_b = 0.50$$
$$+ 0.01 = 0.51 mA$$

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Q-34 - 12017113

Zener diode is a specially desined p-n junction diode, in which both p-side and n-side of p-n junction are heavily doped. The zener diode is designed especially to operate in the reverse break down voltage region continuosly without being damaged? Zener diode is used to remove the fluctuations from the given voltage and thereby provides a voltage of constant magnitude (i.e., Zener diode is used as voltage regulator).

Read the above pragraph and answer the following question:

(i) What is the most important use of Zener diode?

(ii) What are the essential conditions for proper working of Zener diode?

(iii) What do you learn from the above atudy?

SOLUTION:

(i) The most important use of Zener diode is in making the constant voltage power supply.

(ii) The essential conditions for proper working of Zener diode are as follows:

The Zener diode must be reverse biased

The Zener diode must have voltage greater than Zener break down voltage.

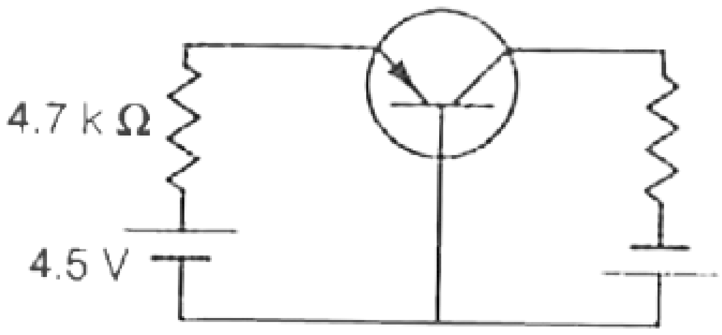
The Zener diode is to be used in a circuit where current is less than the maximum zener current, limited by power rating of the given Zener diode.

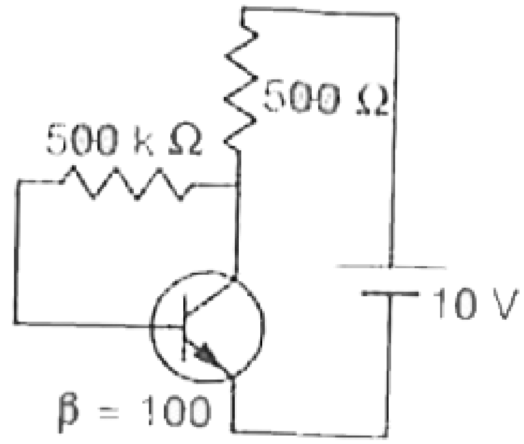
(iii) To be happy in life, one has to be like a Zener diode which evens out all fluctuation and displays a constant output. Ups and downs are part of life. One who evens them out is successful and happy.

Q-35 - 17088189

In the given circuit (Fig. 5.12) calculate the value of the collector current if its $I_{CD} = 10\mu A$ and $\alpha = 0.97$. Assume a voltage drop between base and emitter of 0.15 V

[Hint : $I_C = \alpha I_C + I_{CO}$]





CORRECT ANSWER: 0.91 MA

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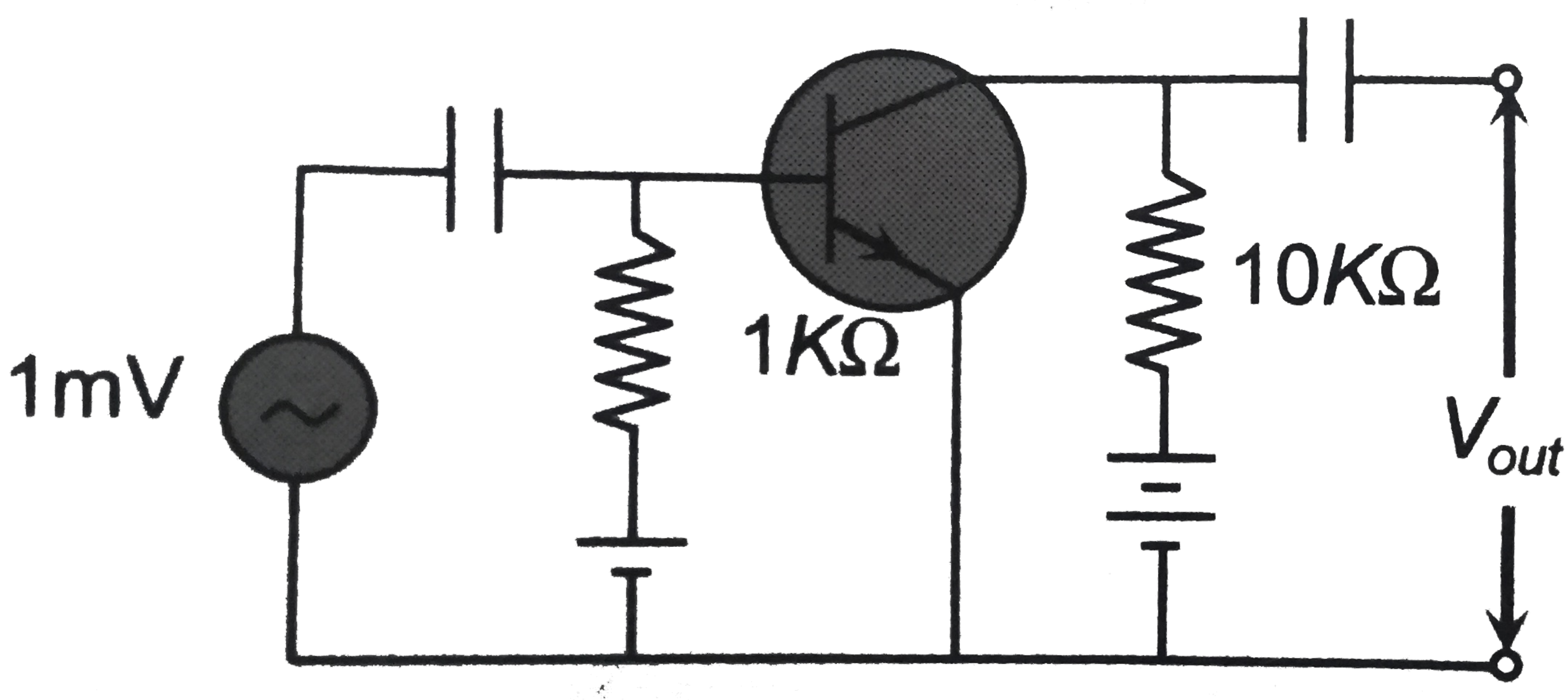
Q-36 - 11970925

In the following common emitter configuration an NPN transistor with current gain $\beta = 100$ is used. The output voltage of the amlifier will be



(A) $10mV$

(B) $0.1V$

(C) $1.0V$

(D) $10V$

CORRECT ANSWER: C

SOLUTION:

$$\text{Voltage gain} \frac{\text{Output voltage}}{\text{Input voltage}}$$

$$\Rightarrow V_{out} = V_{\text{in}} \times \text{Voltage gain}$$

$$\Rightarrow V_{out} = V_{\text{in}} \times \text{Current gain} \times \text{Resistance gain}$$

$$= V_{\text{in}} \times \beta \times \frac{R_L}{R_{BE}}$$

$$= 10^{-3} \times 100 \times \frac{10}{1}$$

$$= 1V$$

.

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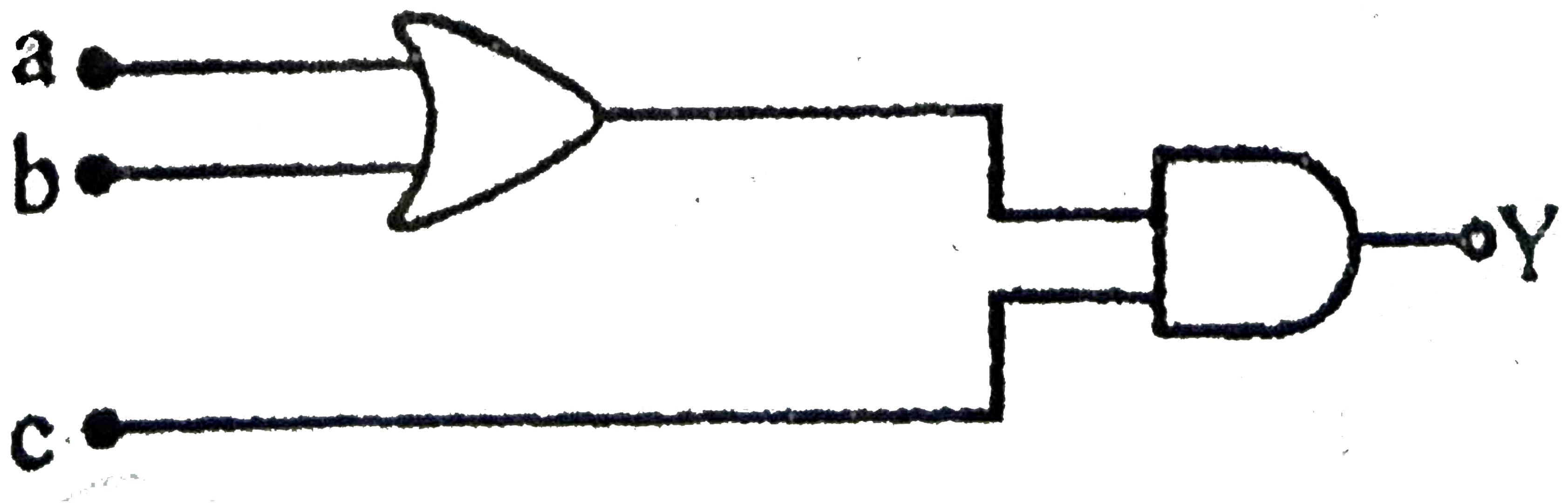
Q-37 - 14533942

To get an output of 1 form the circuit shown in figure the input must be :-



(A) $a=1, b=0, c=1$

(B) $a=1, b=1, c=0$

(C) $a=0, b=1, c=0$

(D) $a=0, b=0, c=1$

CORRECT ANSWER: A

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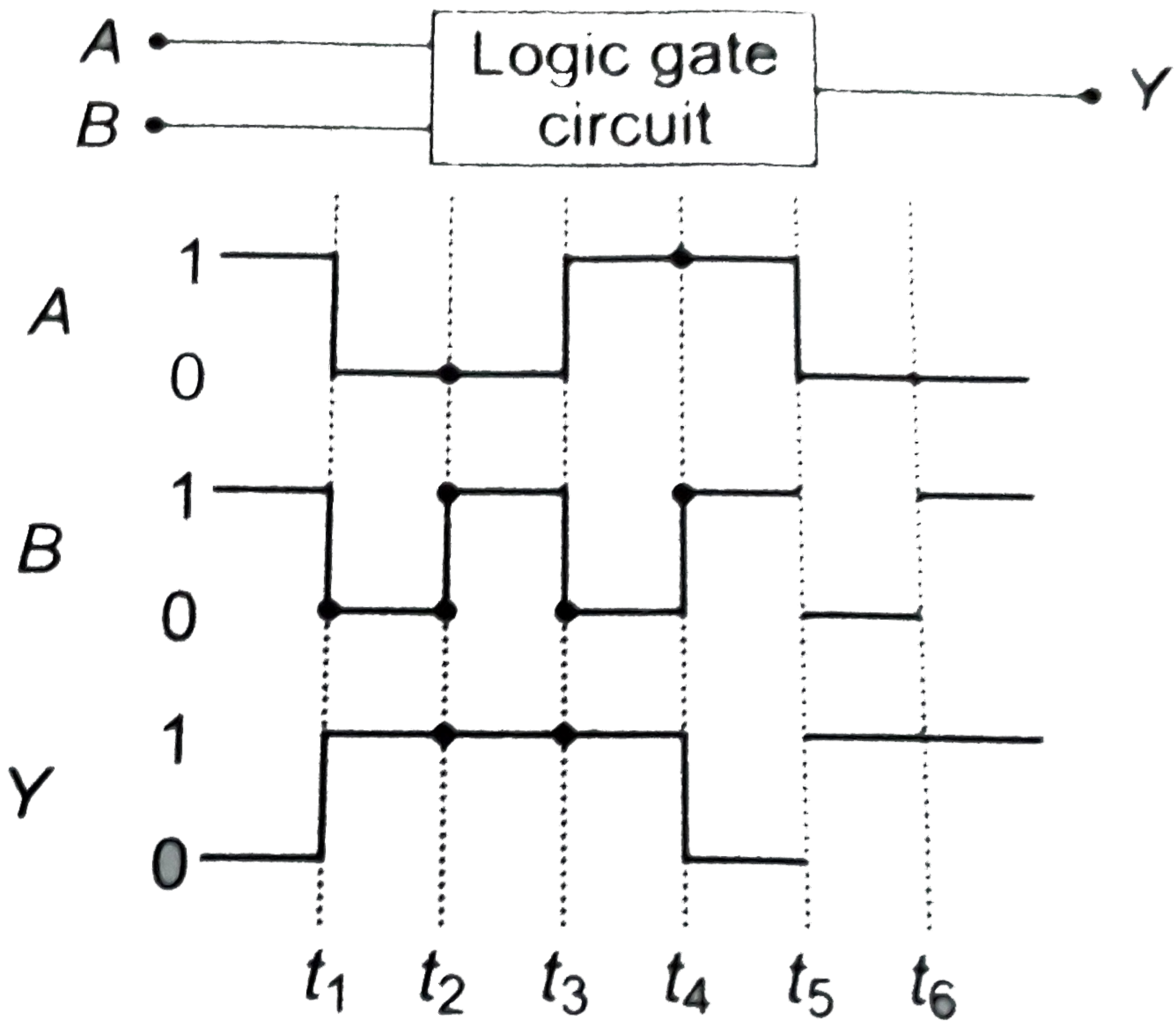
Q-38 - 13157210

The following figure shows a logic gate circuit with two inputs A and B and the output Y. The voltage waveforms of A, B and the output Y are as given



(A) NOR gate

(B) OR gate

(C) AND gate

(D) $NAND$ gate

CORRECT ANSWER: D

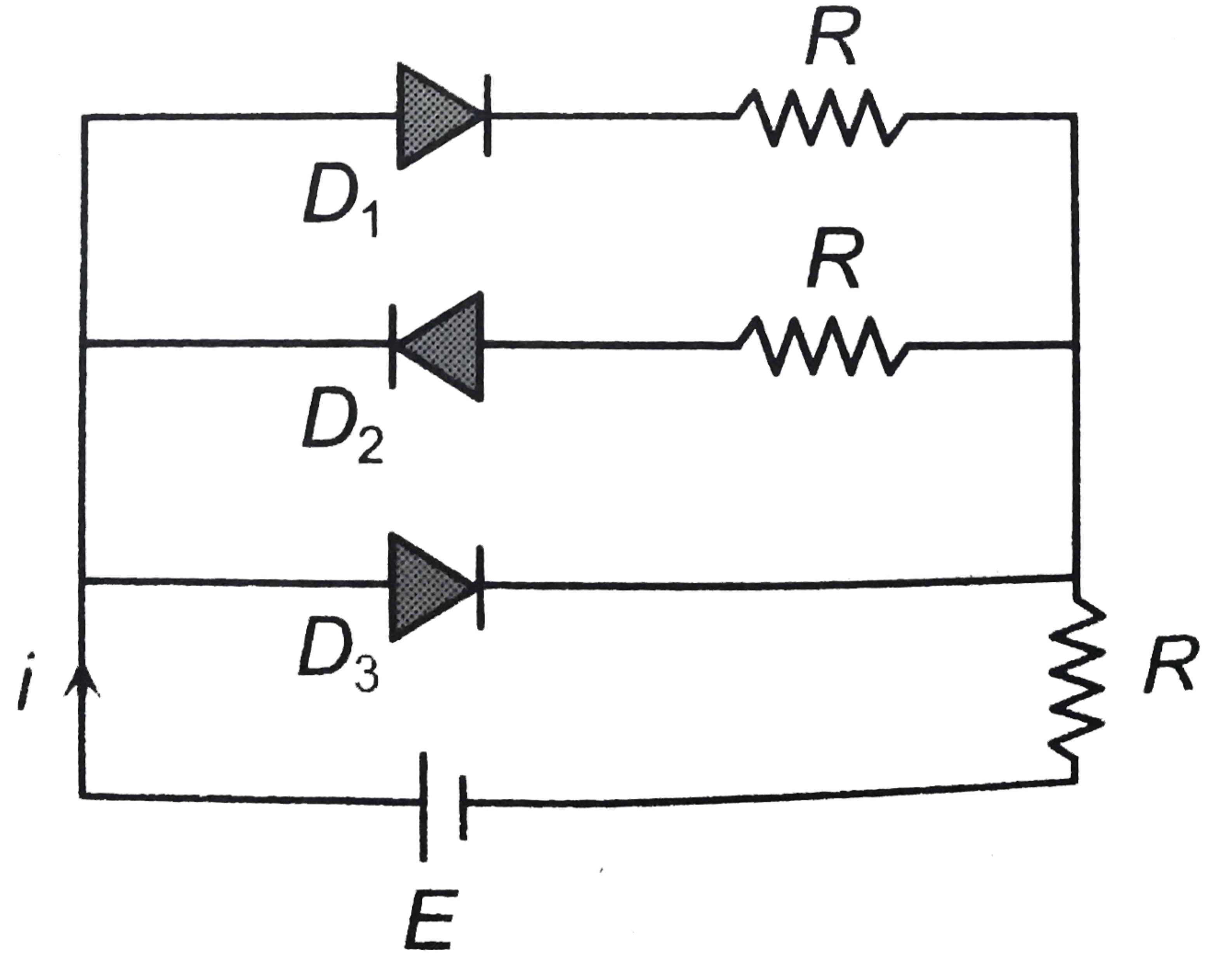
SOLUTION:

A	B	Y
1	1	0
0	0	1
0	1	1
1	0	1

$NAND$ gate

Q-39 - 11970878

In the following circuit of PN junction diodes D_1, D_2 and D_3 are ideal then i is



(A) E / R

(B) $E / 2R$

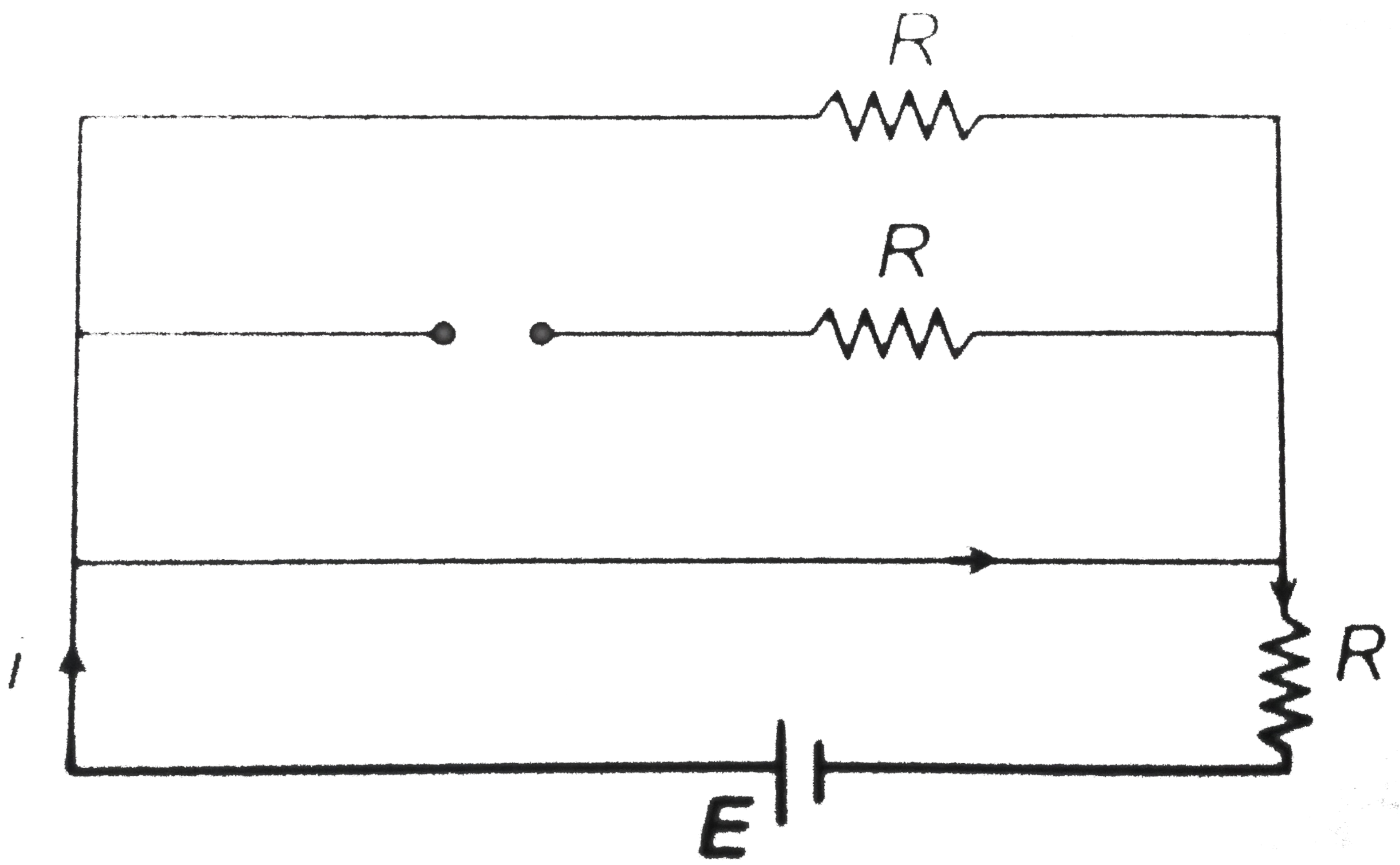
(C) $2E / 3R$

(D) Zero

CORRECT ANSWER: A

SOLUTION:

Diodes D_1 and D_3 are forward biased and D_2 is reverse biased on the circuit can be redrawn as follows.



$$\Rightarrow i = \frac{E}{R}$$

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Q-40 - 12016897

Pieces of copper and germanium are cooled from room temperature to 80K. What will be the effect on their resistance?

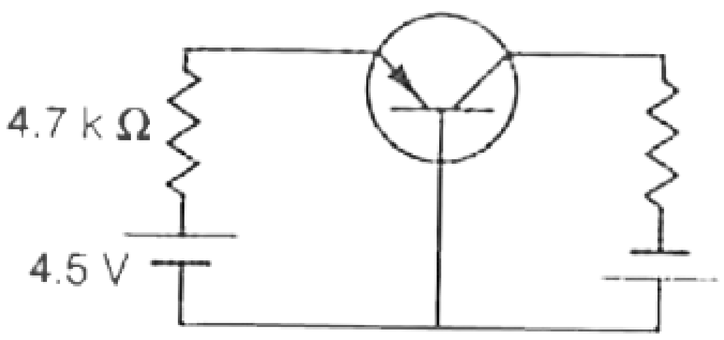
SOLUTION:

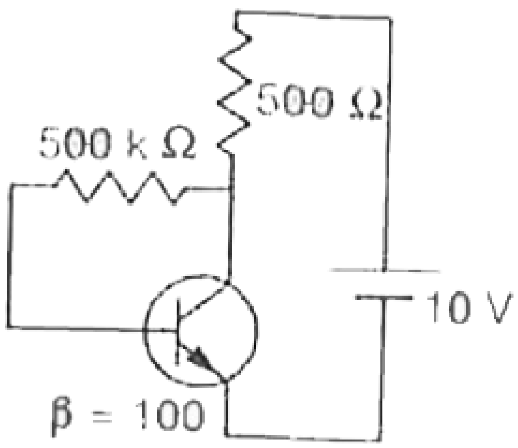
Resistance of Ge will increase and that of Cu will decrease.

Q-41 - 17088189

In the given circuit (Fig. 5.12) calculate the value of the collector current if its $I_{CD} = 10\mu A$ and $\alpha = 0.97$. Assume a voltage drop between base and emitter of 0.15 V

[Hint : $I_C = \alpha I_C + I_{CO}$]

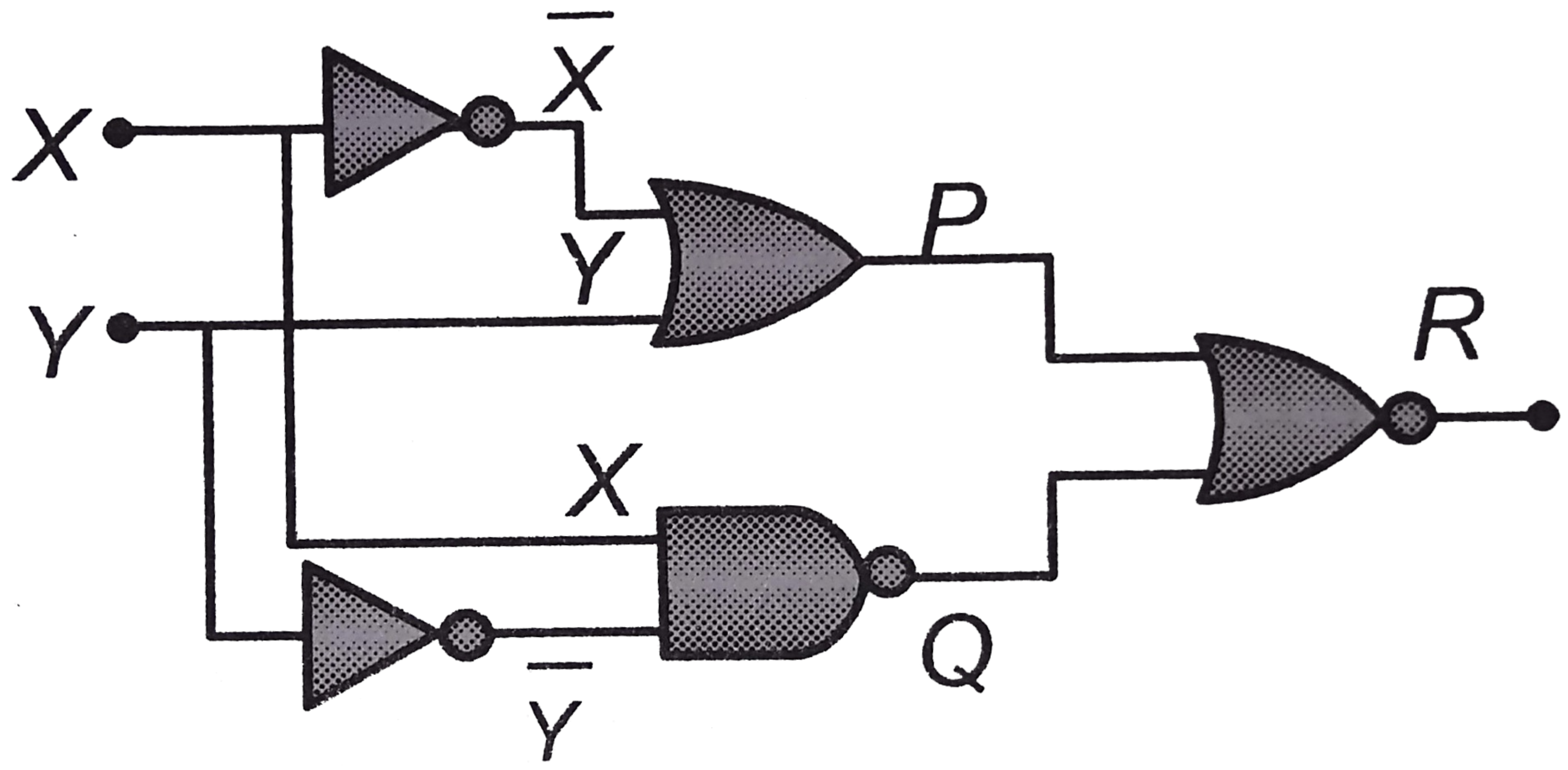




CORRECT ANSWER: 0.91 MA

Q-42 - 11970973

Figure gives a system of logic gates. From the study of truth table it can be found that no produce a high output (1) at R, we must have



(A) $X=0, Y=1$

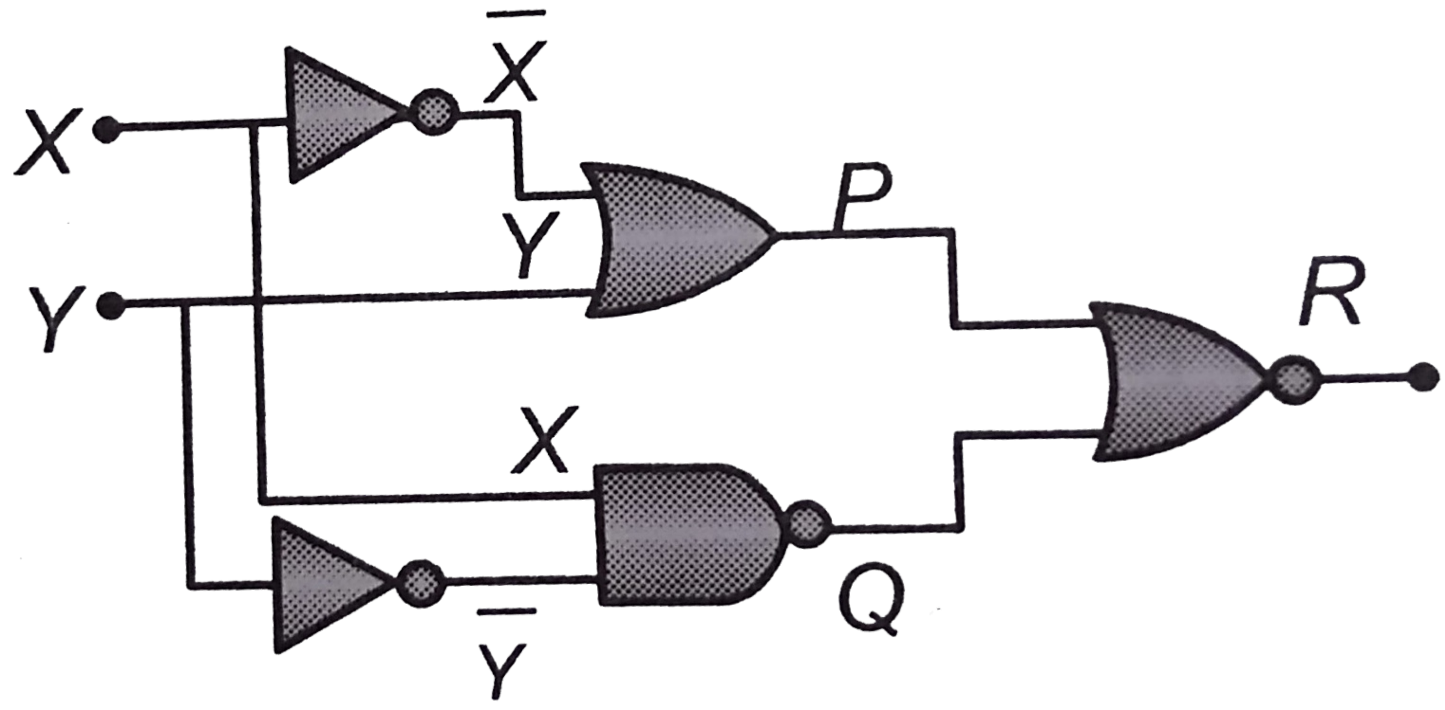
(B) $X=1, Y=1$

(C) $X=1, Y=0$

(D) $X=0, Y=0$

CORRECT ANSWER: C

SOLUTION:



The truth table can be written as

X	Y	$\overline{X}$	$\overline{Y}$	$P = \overline{X} + Y$	$Q = \overline{X\overline{Y}}$	$R = \overline{P + Q}$
0	1	1	0	1	1	0
1	1	0	0	1	1	0
1	0	0	1	0	0	1
0	0	1	1	1	1	0

Hence $X = 1, Y = 0$ gives output $R = 1$

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Q-43 - 9364290

The circuit shown in the figure determine the current through zener diode. (Given : zener diode break down voltage $Vz = 5.8V$) (A)

$7mA$ (B) $17mA$ (C) $10mA$ (D) $15mA$

Q-44 - 12017204

The width of depletion region in a P-N junction diode is 500 nm and an intense electric field of $5 \times 10^5 Vm^{-1}$ is also found to exit init. Determine the height of the potential barrier. Also calculate the kinetic energy which a conduction electron must have inorder to diffuse from the n-side to p-side.

SOLUTION:

$$V = Ed = (5 \times 10^5) \times (500 \times 10^{-9}) = 0.25V$$

Max. K.E. of an electron to cross the potential barrier

$$V = eV = 1.6 \times 10^{-19} \times 0.25J$$

$$= \frac{1.6 \times 10^{-19} \times 0.25}{1.6 \times 10^{-19}} eV$$
$$= 0.25eV$$

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Q-45 - 14930880

In common emitter amplifier, the current gain is 62. The collector resistance and input resistance are $5k\Omega$ an 500Ω respectively. If the input voltage is 0.01V, the output voltage is

(A) 0.62 V

(B) 6.2 V

(C) 62 V

(D) 620 V

Q-46 - 12017220

In a silicon transistor, base current is changed by $20\mu A$. This result in a change of $0.02V$ in base-emitter voltage and a change of $2mA$ in the collector current.

Find the input resistance, $\beta_{a.c.}$ and transconductance of the transistor.

The transistor is used as an amplifier with the load resistance $5k\Omega$. What is the voltage gain of the amplifier?

SOLUTION:

$$R_i = \frac{\Delta V_i}{\Delta I_b} = \frac{0.02V}{20\mu A}$$

$$= 1000\Omega = 1k\Omega$$

$$\beta_{a.c.} = \frac{\Delta I_c}{\Delta I_b} = \frac{2mA}{20\mu A}$$

$$= 100$$

$$g_m = \frac{\Delta I_c}{\Delta V_i} = \frac{2mA}{0.02V}$$

$$= \frac{2 \times 10^{-3}}{0.02} = 0.1$$

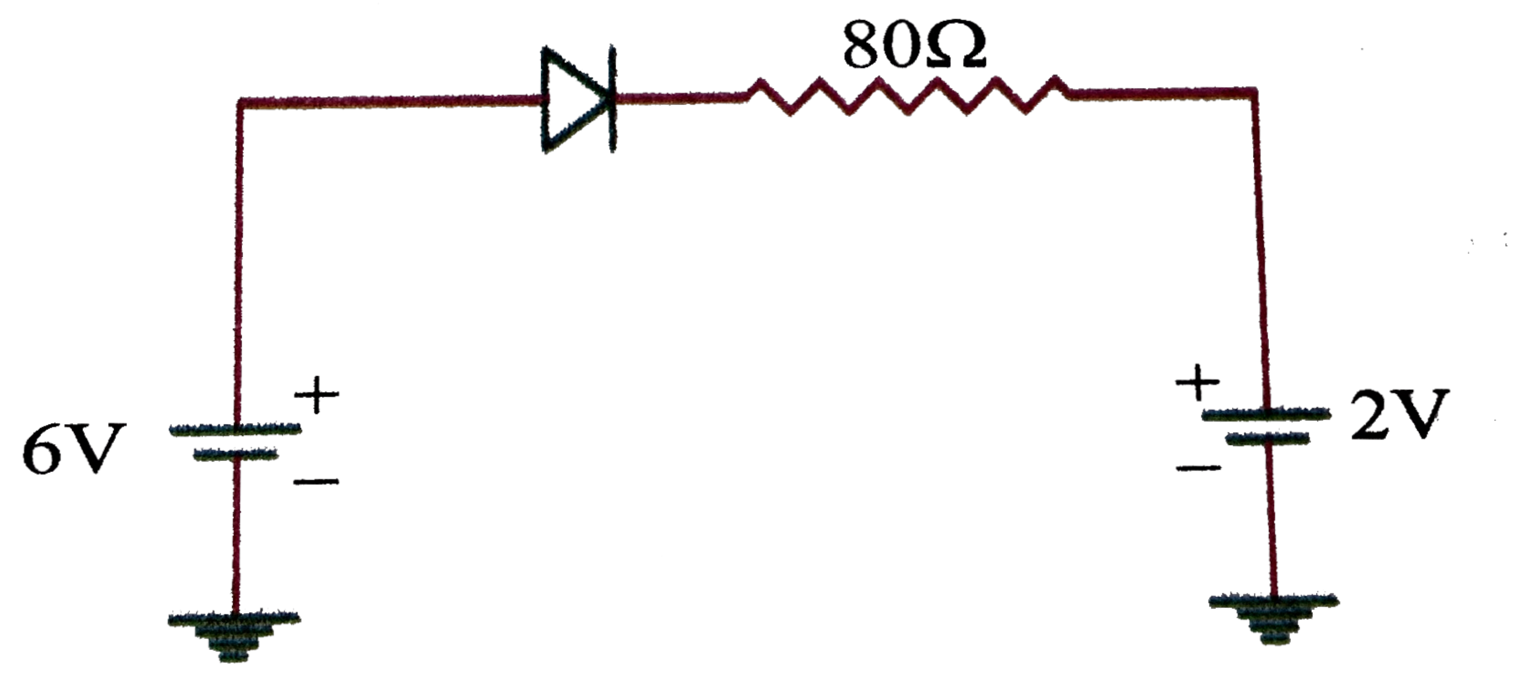
Ω^{-1}

$$A_V = \beta_{a.c.} \frac{R_0}{R_i} = 100$$

$$\times \frac{5k\Omega}{1k\Omega} = 500$$

Q-47 - 12930072

The resitance of the diode in forward bias condition is 20Ω and infinity in the reverse biased condition. The current in the circuit is



(A) $0.08A$

(B) $0.1A$

(C) $0.04A$

(D) zero

CORRECT ANSWER: C

SOLUTION:

$$i = \frac{V}{R}$$

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Q-48 - 9729431

The conduction band of a solid is partially filled at 0 K.will it be a conductor, a semiconductor or an insulator?

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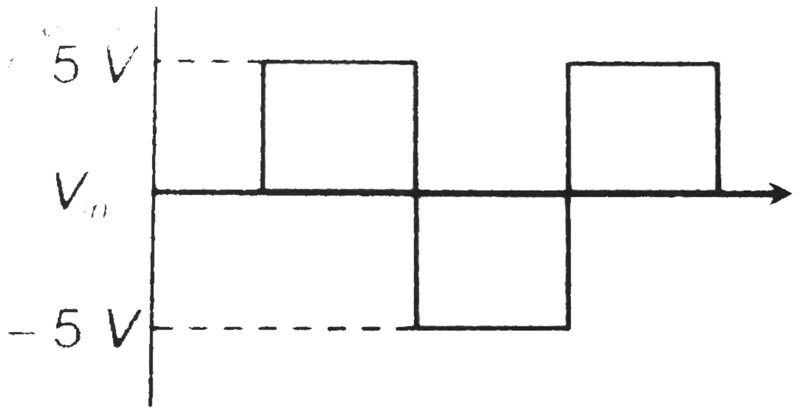
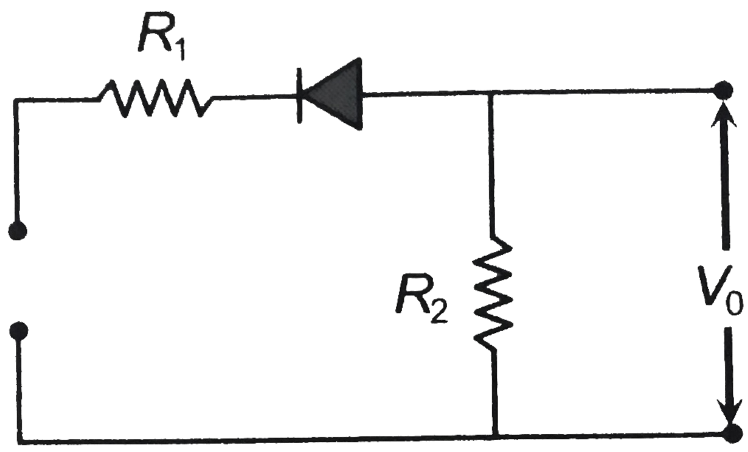
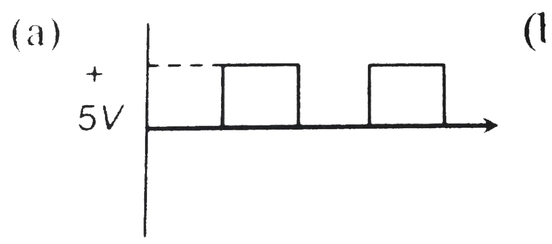
Q-49 - 11970879

A waveform shown when applied to the following circuit will produce which of the following output waveform? [Assuming ideal diode configuration and $R_1 = R_2$]

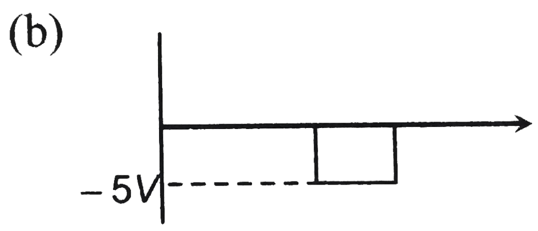




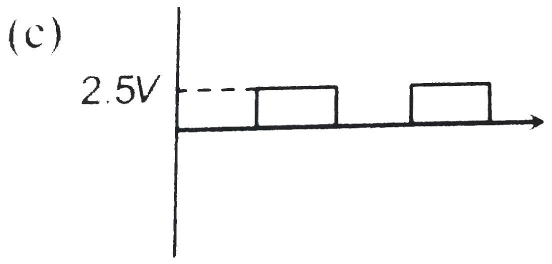
(A)



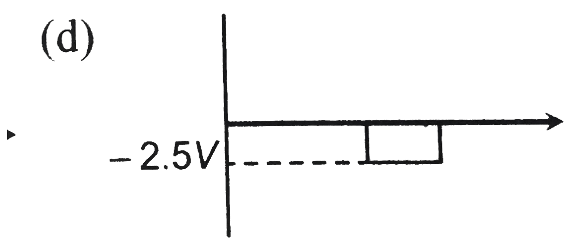
(B)



(C)



(D)



CORRECT ANSWER: D

SOLUTION:

The $P - N$ junction will conduct only when it is forward biased i.e., when $-5V$ is fed to it, so it will conduct only for $3rd$ quarter part of signal shown and when it conducts potential drop 5 volt will be across both the resistor, so output voltage across R_2 is $2.5V$.

$\therefore V_0 = -2.5V$

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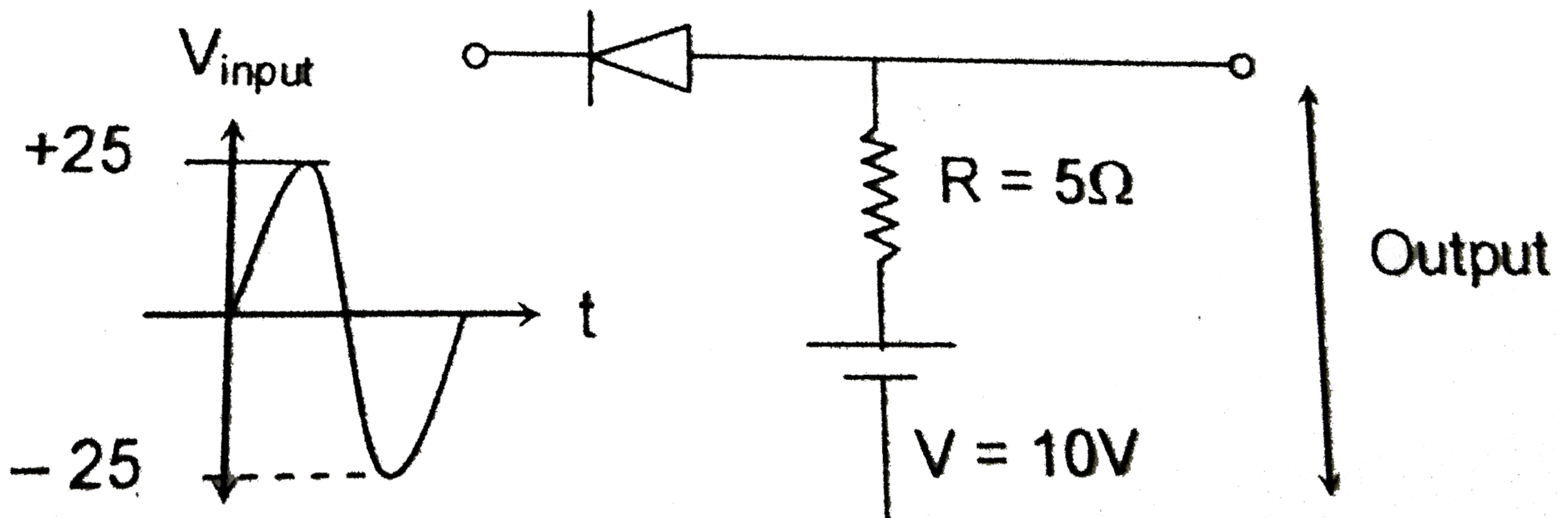
Q-50 - 14160179



(B) 10V, – 15V
(D) 25V, – 15V

An ideal diode is connected in a circuit with resistance $R = 5\Omega$ and $V = 10$ volt as shown in figure maximum and minimum value of output voltage. When no load applied is (assume diode to be ideal)

(A) 10V, -25 V

(B) 10V, -15 V

(C) 25V,-25V

(D) 25V, -15V

CORRECT ANSWER: A

SOLUTION:

Positive half cycle

$V_{\text{output}} = 10V$

For negative half cycle.

Potential difference across output $= -25V$

Q-51 - 13165717

Assume that the number of hole-electron pair in an intrinsic semiconductor is proportional to $e^{-\Delta E/2KT}$. Here ΔE = energy gap and $k = 8.62 \times 10^{-5} eV/\text{kelvin}$

The energy gap for silicon is $1.1 eV$. The ratio of electron hole pairs at$300K$ and $400K$ is :

(A) $e^{-5.31}$

(B) e^{-5}

(C) e

(D) e^{2}

CORRECT ANSWER: A

SOLUTION:

$$\frac{N_1}{N_2} = \frac{e^{-\Delta E/2KT_1}}{e^{-\Delta E/2KT_2}}$$

$$= e^{\frac{\Delta E}{2K}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

$$= \frac{1.1}{e^{2 \times 8.62 \times 10^{-5}}}\left(\frac{1}{400} - \frac{1}{300}\right)$$

.

Q-52 - 9729477

Let $(\Delta)E$denote the energy gap between the valence band and the conduction band.The population of conduction electrons (and of the holes)is roughly proportional to $e^{-\Delta E/2kT}$. Find the ratio of the concentration of conduction electrons in diamond to that in silicon at room tempareture 300K.$(\Delta E)$for silicon is 1.1 ev and for diamond is 6.0eV.How many conduction electrons are likely to be in one cubic meter of diamond ?

SOLUTION:

Give $n = e^{-\Delta \frac{E}{2} KT}$

$$\Delta E(Diamond) = 6eV$$

$$\Delta E(Si) = 1.1ev.$$

$$n_1 = e^{-\Delta \frac{E_1}{2} KT}$$

$$= \frac{-6}{e^2 \times 300 \times 8.62 \times 10^{-5}}$$

$$n_2 = \frac{e^{-\Delta E_2}}{2KT}$$

$$= \left(\frac{-11}{e^2} \times 300 \times 8.62 \times 10^{-5} \right)$$

$$\frac{n_1}{n_2} = \frac{4.14722 \times 10^{-51}}{5.7979 \times 10^{-10}}$$

$$= 7.15 \times 10^{-42}$$

Due to more ΔE, the conduction electrons per cubie metre in diamond is alomst zero.

Q-53 - 11971025

Assertion:The dominant mechanism for motion of charge carriers in forward and reverse biased silicon $P-N$ junction are drift in both forward and reverse biase.

Reason: In reverse biasing, no current flow through the junction.

(A) If both the assertion and reason are true and reason is a true explantion of the assertion.

(B) If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

(C) If the assertion is true but reason false

(D) If both the assertion and reason are false.

CORRECT ANSWER: D

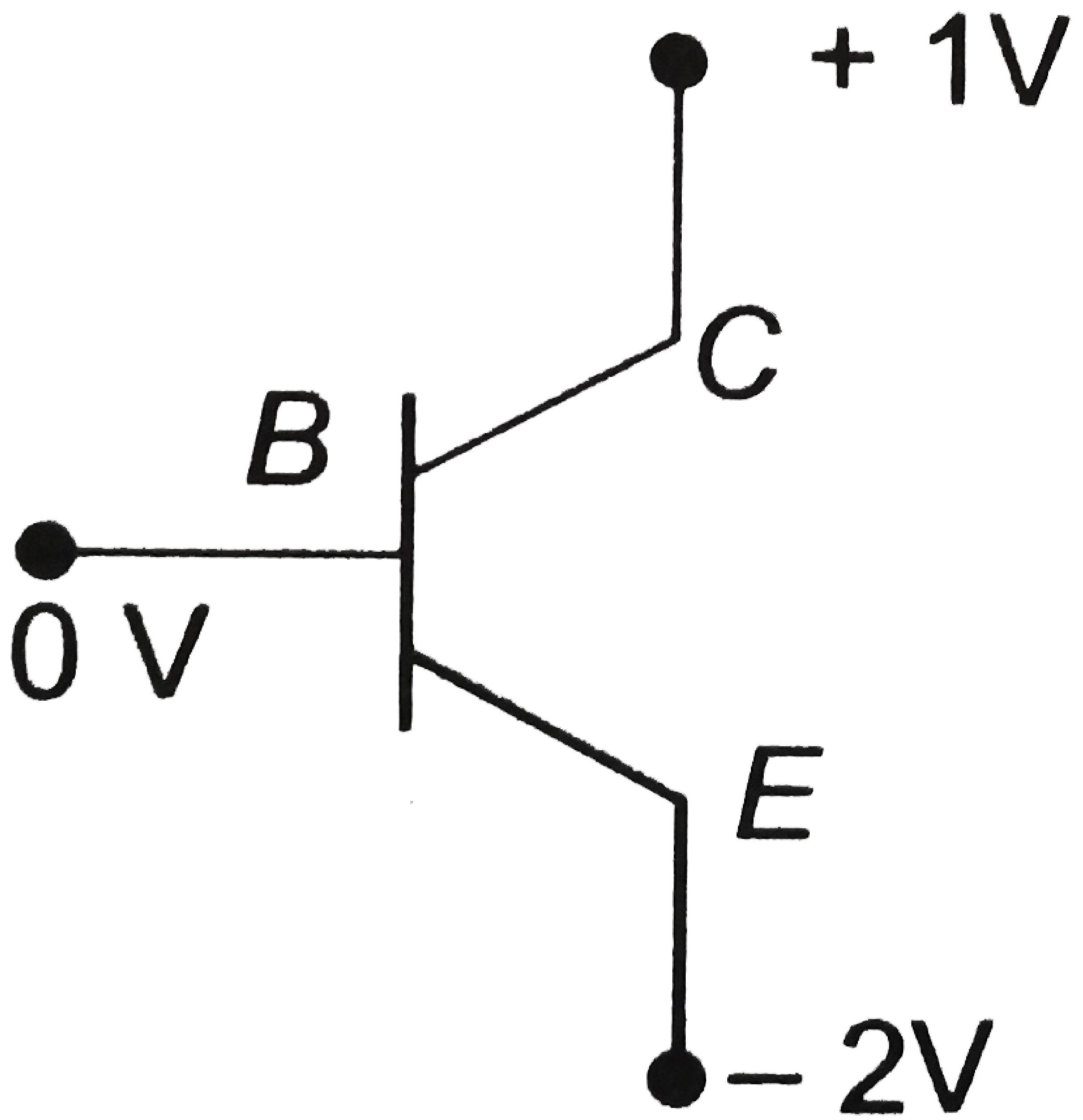
SOLUTION:

In PN-junction, the diffusion of majority carriers takes place when junction is forward biased and drifting of minority carriers takes place across the function, when reverse biased. The reverse biase opposes the majority carriers but makes the minority carriers to cross the PN -junction. thus the small current in μA flows during reverse biase.

Q-54 - 11971038

Assertion: When PN-junction is forward biased then motion of charge carriers at junction is due to diffusion. In reverse biasing. The cause of motion of charge is drifting.

Reason: In the following circuit emitter is reverse biased and collector is forward biased.



(A) If both the assertion and reason are true and reason is a true explantion of the assertion.

(B) If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

(C) If the assertion is true but reason false

(D) If both the assertion and reason are false.

CORRECT ANSWER: B

SOLUTION:

In forward biasing of PN junction current flows due to diffusion of majority charge carriers. While in reverse biasing current flows due to drifting of minority charge carriers.

The circuit given in the reason is a PNP transistor having emitter is more negative w.r.t. base so it is reverse biased and collector is more positive w.r.t. base so it is forward biased.

Q-55 - 11309653

Two electric bulbs rated

$25W, 220V$ and $100W$,
$220V$
are connected in series across a $220V$ voltage source . The

$25W$ and $100W$ bulbs now draw P_1 and P_2 powers ,

respectively.

(A) $P_1 = 16W$

(B) $P_1 = 4W$

(C) $P_2 = 16W$

(D) $P_2 = 4W$

CORRECT ANSWER: A::D

SOLUTION:

Let
$V = 200V$ and R_1
and R_2
be the resistance of the $25W$ and $100W$ bulbs.

$P_1 = 25 = V^2 / R_1$

$= \text{ or } R_1 = V^2$

$/ 25 \text{ and } R_2 = V^2$

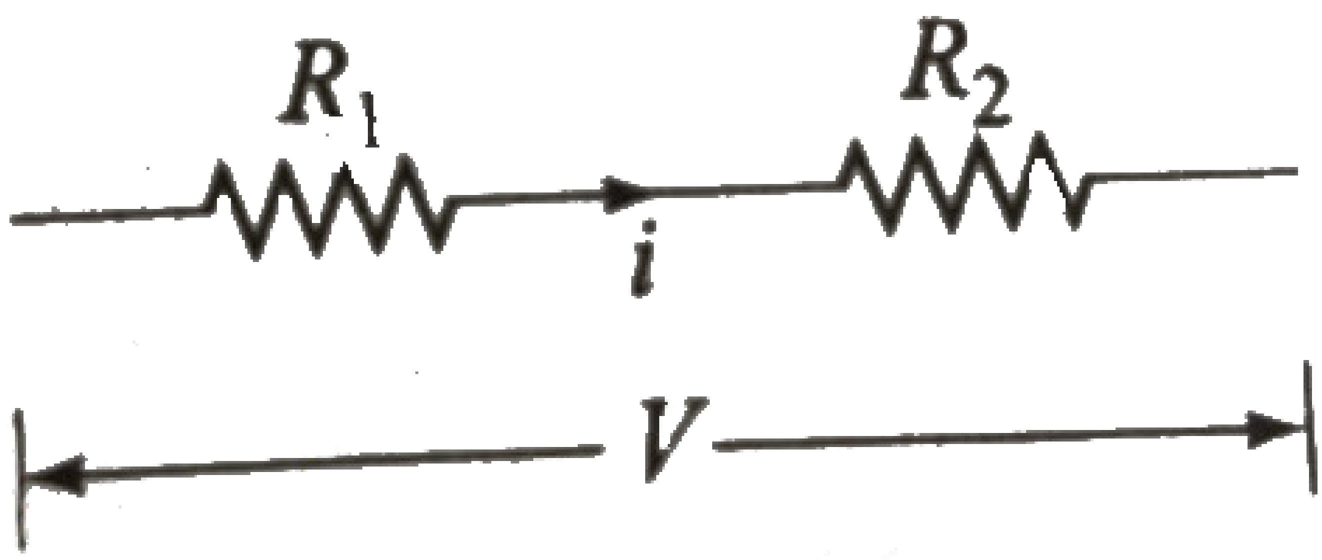
$/ 100$

When the bulbs are joined in series, the current is

$$I = \frac{V}{R_1 + R_2}$$

Power in the $25W$ bulb is $R_1 I^2$ and in the $100W$ bulb

is $R_2 I^2$.



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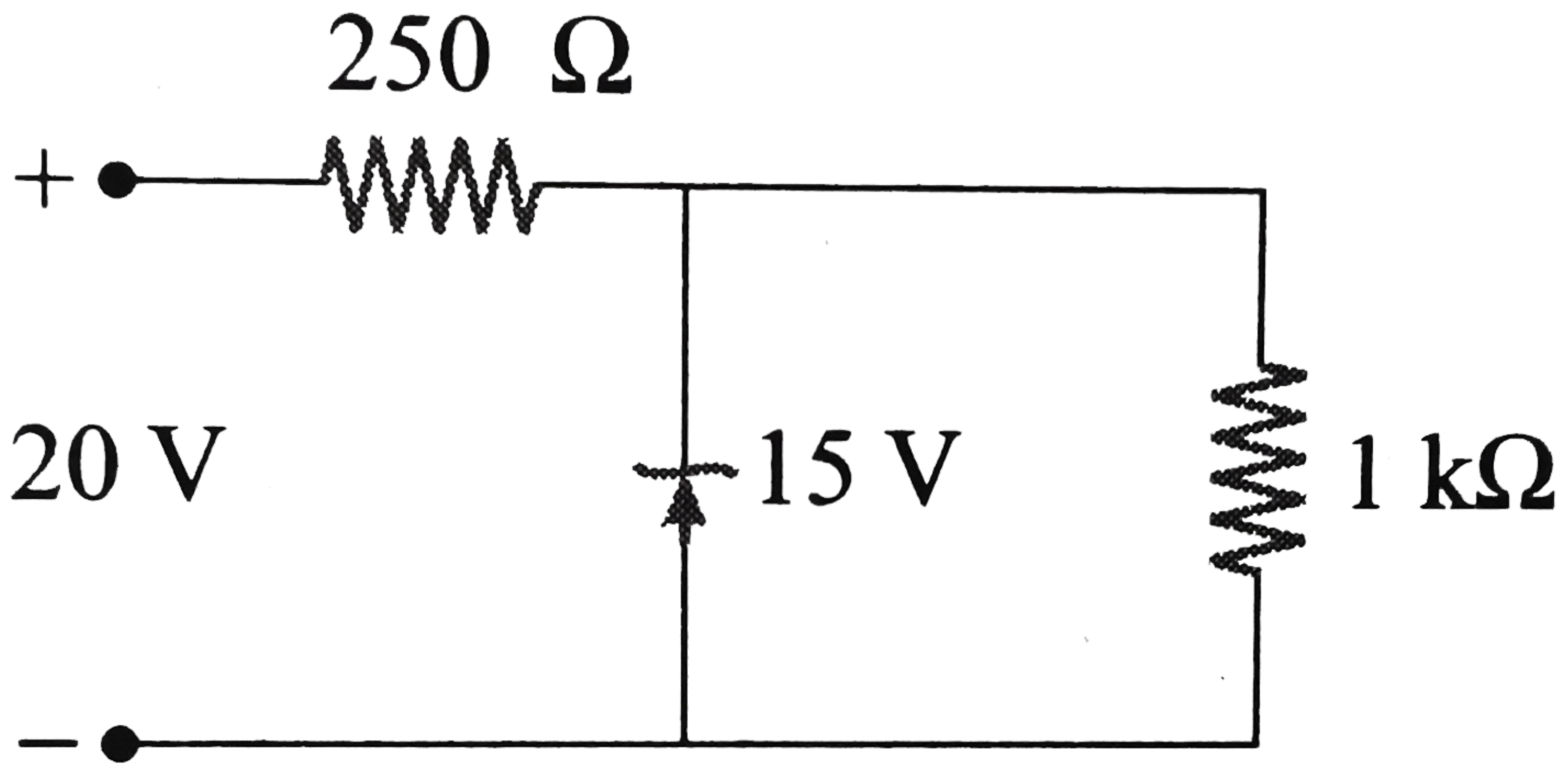
Q-56 - 11971097

A zener diode, having breakdown voltage equal to $15V$ is used in a voltage regulator circuit shown in the figure. The current through

the diode is



(A) $10mA$

(B) $15mA$

(C) $20mA$

(D) $5mA$

CORRECT ANSWER: D

SOLUTION:

For $I1k\Omega$

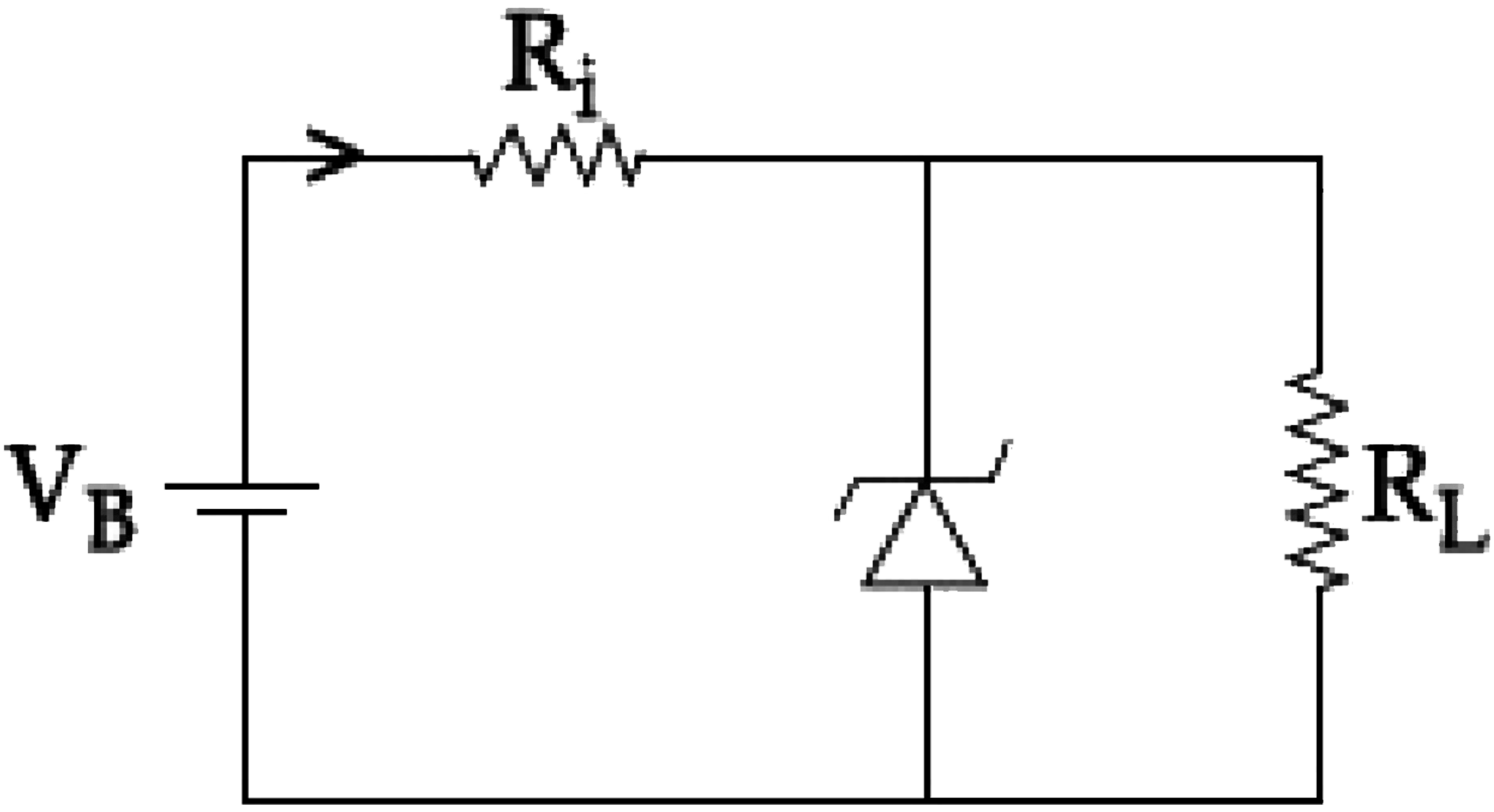
$$i_1 = \frac{15}{1} = 15mA$$

For $II250\Omega$

$$i_{250\,\Omega}=\frac{20-15}{250}$$
$$=\frac{5}{250}=\frac{20}{1000}$$
$$=20mA$$

$$\therefore i_{Zener}=20-15$$
$$=5mA$$

Q-57 - 9716891



the figure represents a voltage regulator circuit using a zener diode.

The breakdown voltage of the zener diode is 6 V and the load resistance is $R_L = 4k\Omega$ the series resistance of the circuit is

$R_i = 1kOMega$. if the battery voltage V_B varies from 8 V to 16 V,

what are the minimum and maximum values of the currect through

Zener diode?

(A) 0.5 mA, 6 mA

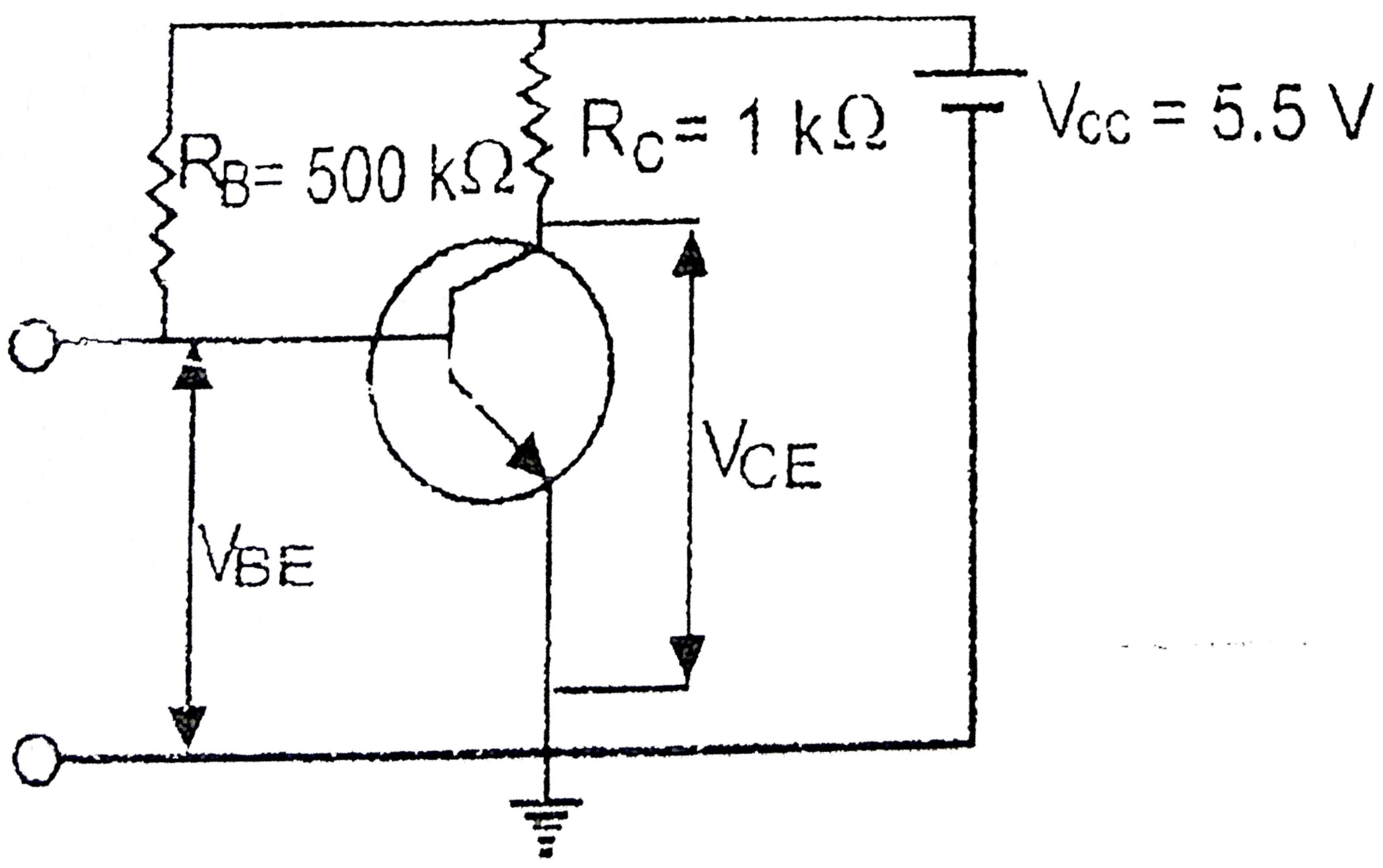
(B) 1 mA, 8.5 mA

(C) 0.5 mA, 8.5 mA

(D) 1.5 mA, 8.5 mA

CORRECT ANSWER: A

Q-58 - 14162323



(a) For given transistor circuit, the base current is $10\mu A$ and the collector current is 5.2 mA. Can this transistor circuit be used as an amplifier. Your answer must be supported with proper explanation.

(b). For a common emitter amplifier, current gain is 69. if the emitter current is 7 mA then calculate the base current and collector current.

CORRECT ANSWER: N/A

SOLUTION:

(a). To find the given circuit can be used as an amplifier,

we find V_{BE} and V_{CE}

$$V_{BE} = V_{CC} - 1 I_B R_B$$
$$= 5.5 - 10 \times 10^{-6}$$
$$\times 500 \times 10^3$$

$$= 0.5V$$

$$V_{CE} = V_C - 1 I_C R_C$$
$$= 5.5 - 5.2 \times 10^{-3}$$
$$\times 1 \times 10^3 = 0.3V$$

As both the emitter-base junction and collecter emitter

junction are forward bias (both have positive sign), it

can't be used as an amplifier,

Current gain $\beta = \dfrac{I_C}{I_B} = 69$ ..(i)

and $I_E = I_B + I_C = 7mA$ ..(ii)

From Eqs. (i) and (ii) we get

$$69 = \frac{I_C}{7 - I_C}$$

$\Rightarrow I_C = 6.9mA$

Substituting the value fo I_C in Eq. (ii), we obtain the value of $I_B = 0.1mA$.

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Q-59 - 12017221

The input resistance of a silicon transistor is 665Ω. Its base current is changed by $15\mu A$ which result in the change in collector current by $2mA$. This transistor is used as a common emitter amplifier with a load resistance of 5kOmega calculate current gain, $\beta_{a.c.}$, transconductance g_m and voltage gain A_v of the amplifier.

SOLUTION:

Here,

$R_i = 665\Omega, R_0 = 5k\Omega$

$= 5 \times 10^3\Omega$

$$\beta_{ac} = \frac{\Delta I_c}{\Delta I_b} = \frac{2mA}{15\mu A}$$

$$= \frac{2 \times 10^{-3} A}{15 \times 10^{-6} A}$$

$$= 133.3$$

$$R_i = \frac{\Delta V_{BE}}{\Delta I_b} \text{ or } \Delta V_{BE}$$

$$= R_i \times \Delta I_b = 665$$

$$\times 15 \times 10^{-6} V$$

$$g_m = \frac{\Delta I_c}{\Delta V_{BE}}$$

$$= \frac{2 \times 10^{-3}}{665 \times 15 \times 10^{-6}}$$

$$= 0.2\Omega_{-1}$$

$$A_V = \beta_{a.c.} \times \frac{R_0}{R_i}$$

$$= 133.3 \times \frac{5 \times 10^3}{665}$$

$$= 10^3$$

Q-60 - 9729484

The potential barrier of 250meV exists across the junction is 0.2volt.What minimm kinetic energy a hole should have to diffuse from the p-side to the n-side if (a)the junction is unbiased,(b)the junction is forward-biased at 0.1volt and the junction is reverse-biased at 0.1volt?

SOLUTION:

Potential barrier $= 0.2Vo <$

(a)

$KE = (potentiald$

$\Leftrightarrow erence) \times e$

$= 0.2eV$

(In unbiased condition.)

(b) In forword biasing

$KE + Ve = 0.2e$

$$\Rightarrow KE = 0.2e - 0.1e$$
$$= 0.1e$$

(d) In revers baising

$$KE + Ve = 0.2e$$
$$\Rightarrow KE = 0.2e + 0.1e$$
$$= 0.3e$$