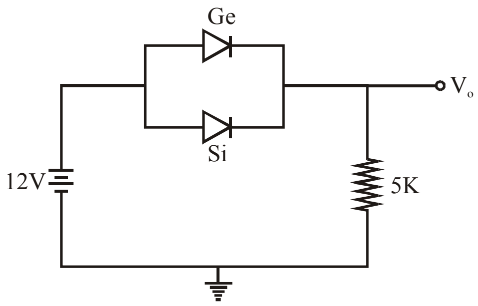
SEMICONDUCTOR

1. Ge and Si diodes start conducting at 0.3 V and 0.7 V respectively. In the following figure if Ge diode connection are reversed, the value of V_o changes by : (assume that the Ge diode has large breakdown voltage)



(1) 0.6 V (2) 0.8 V
(3) 0.4 V (4) 0.2 V

2. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an n-type semiconductor, the density of electrons is $10^{19} m^{-3}$ and their mobility is $1.6\ m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n-type semiconductor contribution of holes is ignored) is close to:

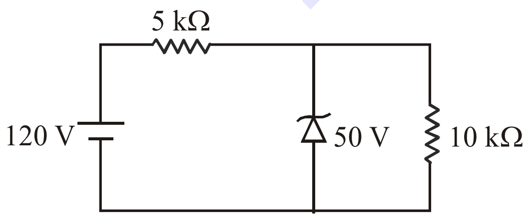
(1) 2Ωm

(2) 0.4Ωm

(3) 4Ωm

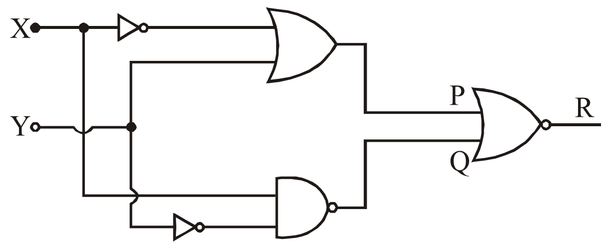
(4) 0.2Ωm

3. For the circuit shown below, the current through the Zener diode is :



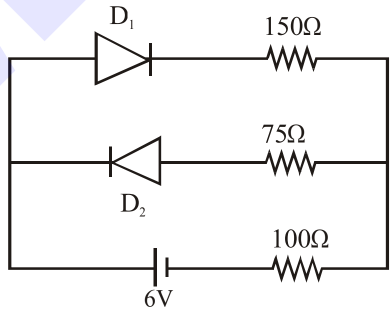
(1) 5 mA
(2) Zero
(3) 14 mA
(4) 9 mA

4. To get output '1' at R, for the given logic gate circuit the input values must be :



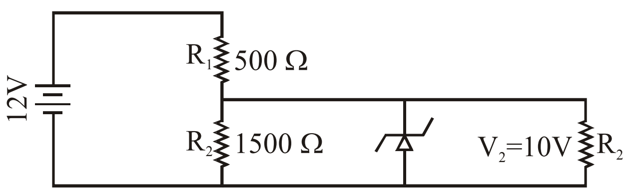
(1) X = 0, Y = 1
(2) X =1 , Y = 1
(3) X = 0, Y = 0
(4) X = 1, Y = 0

5. The circuit shown below contains two ideal diodes, each with a forward resistance of 50Ω. If the battery voltage is 6 V, the current through the 100 Ω resistance (in Amperes) is :-



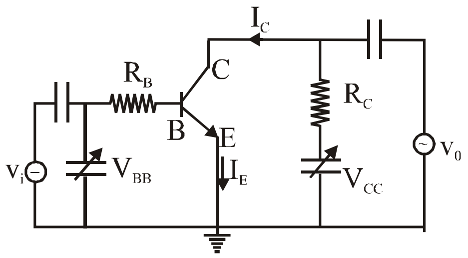
(1) 0.027 (2) 0.020
(3) 0.030 (4) 0.036

6. In the given circuit the current through Zener Diode is close to :



(1) 6.0 mA (2) 4.0 mA
(3) 6.7 mA (4) 0.0 mA

7.



In the figure, given that V_{BB} supply can vary from 0 to 5.0 V, V_{CC} = 5V, β_{dc} = 200, R_B = 100 kΩ, R_C=1 kΩ and V_{BE}=1.0 V, The minimum base current and the input voltage at which the transistor will go to saturation, will be, respectively :

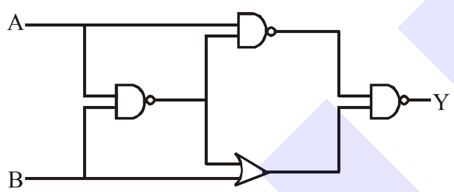
(1) 20μA and 3.5V

(2) 25μA and 3.5V

(3) 25μA and 2.8V

(4) 20μA and 2.8V

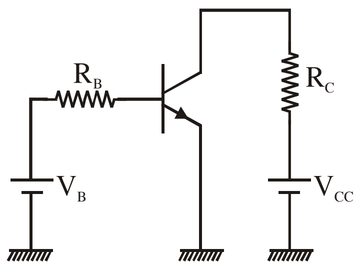
8. The output of the given logic circuit is :



(1) $\bar{A}B$ (2) $A\bar{B}$

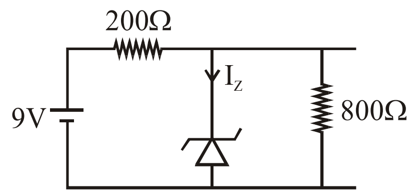
(3) $AB+\overline{AB}$ (4) $A\bar{B}+\bar{A}B$

9. A common emitter amplifier circuit, built using an npn transistor, is shown in the figure. Its dc current gain is 250, R_C = 1kΩ and V_{CC} = 10 V. What is the minimum base current for V_{CE} to reach saturation ?



(1) 100 μA (2) 7 μA (3) 40 μA (4) 10 μA

10. The reverse breakdown voltage of a Zener diode is 5.6 V in the given circuit.

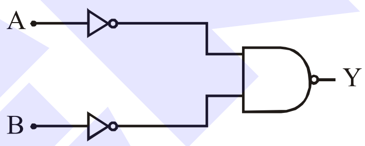


The current I_Z through the Zener is :

(1) 7 mA (2) 17 mA

(3) 10 mA (4) 15mA

11. The logic gate equivalent to the given logic circuit is :-



(1) OR (2) AND

(3) NOR (4) NAND

12. An NPN transistor is used in common emitter configuration as an amplifier with 1 kΩ load resistance. Signal voltage of 10 mV is applied across the base-emitter. This produces a 3 mA change in the collector current and 15μA change in the base current of the amplifier. The input resistance and voltage gain are :

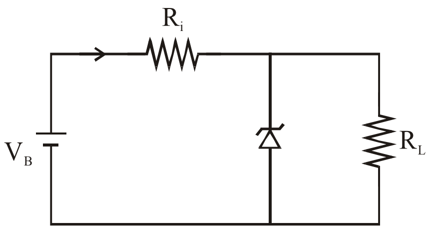
(1) 0.33 kΩ, 1.5

(2) 0.67 kΩ, 200

(3) 0.33 kΩ, 300

(4) 0.67 kΩ, 300

13. The figure represents a voltage regulator circuit using a Zener diode. The breakdown voltage of the Zener diode is 6V and the load resistance is $R_L = 4\ k\Omega$. The series resistance of the circuit is $R_i = 1\ k\Omega$. If the battery voltage V_B varies from 8V to 16V, what are the minimum and maximum values of the current through Zener diode ?

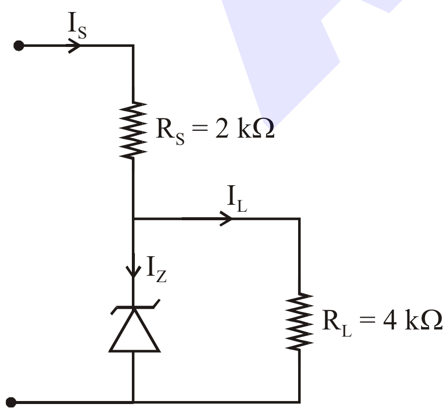


(1) 0.5 mA ; 6 mA (2) 0.5 mA ; 8.5 mA
(3) 1.5 mA ; 8.5 mA (4) 1 mA ; 8.5 mA

14. An npn transistor operates as a common emitter amplifier, with a power gain of 60 dB. The input circuit resistance is 100Ω and the output load resistance is 10 kΩ. The common emitter current gain β is :

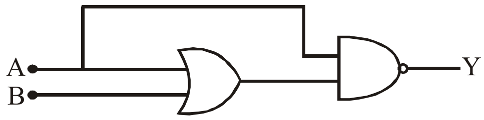
(1) 60 (2) 10^4 (3) 6×10^2 (4) 10^2

15. Figure shown a DC voltage regulator circuit, with a Zener diode of breakdown voltage = 6V. If the unregulated input voltage varies between 10 V to 16 V, then what is the maximum Zener current ?



(1) 2.5 mA (2) 3.5 mA
(3) 7.5 mA (4) 1.5 mA

16. The truth table for the circuit given in the fig. is:



(1)

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

(2)

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

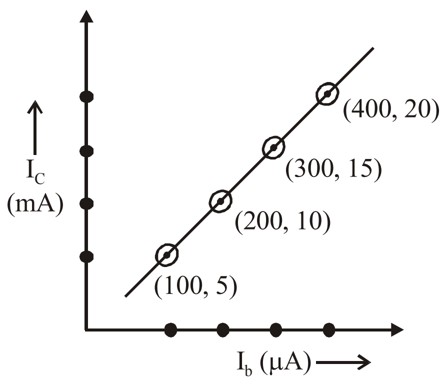
(3)

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

(4)

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

17. The transfer characteristic curve of a transistor, having input and output resistance 100 Ω and 100 kΩ respectively, is shown in the figure. The Voltage and Power gain, are respectively:



(1) 5×10^4, 5×10^5
(2) 5×10^4, 5×10^6
(3) 5×10^4, 2.5×10^6
(4) 2.5×10^4, 2.5×10^6

SOLUTION

1. Ans. (3)

Initially Ge & Si are both forward biased so current will effectivily pass through Ge diode with a drop of 0.3 V

if "Ge" is revesed then current will flow through "Si" diode hence an effective drop of (0.7 – 0.3) = 0.4 V is observed.

2. Ans. (2)

$j = \sigma E = nev_d$

$\sigma = ne\dfrac{v_d}{E}$

$= ne\mu$

$\dfrac{1}{\sigma} = \rho = \dfrac{1}{n_e e\mu_e}$

$= \dfrac{1}{10^{19} \times 1.6 \times 10^{-19} \times 1.6}$

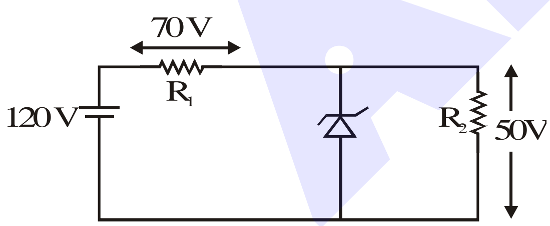
$= 0.4\ \Omega m$

3. Ans. (4)

Assuming zener diode doesnot undergo breakdown, current in circuit $= \dfrac{120}{15000} = 8\text{mA}$

$\therefore$ Voltage drop across diode = 80 V > 50 V.

The diode undergo breakdown.



Current is $R_1 = \dfrac{70}{5000} = 14\text{mA}$

Current is $R_2 = \dfrac{50}{10000} = 5\text{mA}$

$\therefore$ Current through diode = 9mA

4. Ans. (4)

$p = \overline{x} + y$

$Q = \overline{\overline{y}.x} = y + \overline{x}$

$O/P = \overline{P + Q}$

To make O/P

P + Q must be 'O'

SO, $y = 0$

$x = 1$

5. Ans. (2)

$I = \dfrac{6}{300} = 0.002$ (D_2 is in reverse bias)

6. Ans. (4)

Since voltage across zener diode must be less than 10V therefore it will not work in breakdown region, & its resistance will be infinite & current through it = 0

$\therefore$ correct answer is (4)

7. Ans (2)

At saturation, $V_{CE} = 0$

$V_{CE} = V_{CC} - I_C R_C$

$\Rightarrow I_C = \dfrac{V_{CC}}{R_C} = 5 \times 10^{-3}$ A

Given

$\beta_{dc} = \dfrac{I_C}{I_B}$

$I_B = \dfrac{5 \times 10^{-3}}{200}$

$I_B = 25\ \mu A$

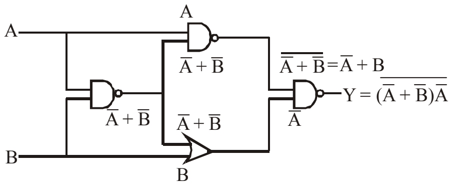
At input side

$V_{BB} = I_B R_B + V_{BE}$

$= (25mA)(100k\Omega) + 1V$

$V_{BB} = 3.5$ V

8. Ans. (2)



$$Y = \overline{\left(\overline{A}+\overline{B}\right)\overline{A}}$$

$$= \overline{\overline{A}+\overline{A}B}$$

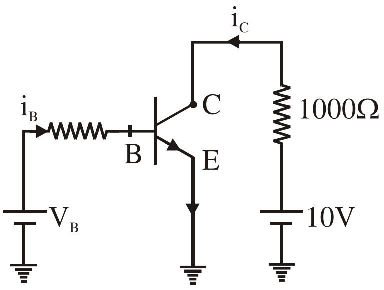
$$= A\left(\overline{\overline{A}B}\right)$$

$$= A\left(A+\overline{B}\right)$$

$$= A + A\overline{B} \quad = A\overline{B}$$

9. Ans. (3)

Sol.



At saturation state, V_{CE} becomes zero

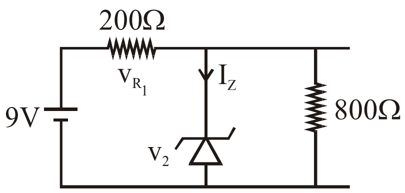
$$\Rightarrow i_C = \frac{10V}{1000\Omega} = 10mA$$

now current gain factor $\beta = \frac{i_C}{i_B}$

$$\Rightarrow i_B = \frac{10mA}{250} = 40\mu A$$

10. Ans. (3)

Sol.



$9 = V_Z + V_{R_1}$

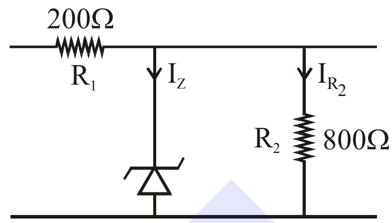
$V_Z = 5.6$ V

$V_{R_1} = 9 - 5.6$

$V_{R_1} = 3.4$

$$I_{R_1} = \frac{V_{R_1}}{R} = \frac{3.4}{200}$$

$I_{R_1} = 17$ mA



$V_z = V_{R_2} = I_{R_2}(R_2)$

$$\frac{5.6}{800} = I_{R_2}$$

$I_{R_2} = 7mA$

$I_z = (17 - 7)$ mA

= 10 mA

11. Ans. (1)

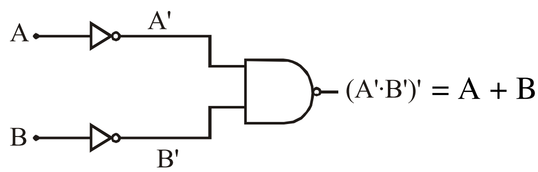
Sol. Method 1

Truth table can be formed as

A	B	Equivalent
0	0	0
0	1	1
1	0	1
1	1	1

Hence the Equivalent is "OR" gate.

Method 2



(OR GATE)

12. Ans. (4)

Sol. input current = 15×10^{-6}

output current = 3×10^{-3}

resistance output = 1000

$V_{input} = 10 \times 10^{-3}$

Now $V_{input} = r_{input} \times i_{input}$

$10 \times 10^{-3} = r_{input} \times 15 \times 10^{-6}$

$$r_{input} = \frac{2000}{3} = 0.67\ K\Omega.$$

$$\text{voltage gain} = \frac{V_{output}}{V_{input}} = \frac{1000 \times 3 \times 10^{-3}}{10 \times 10^{-3}} = 300$$

Option (4)

13. Ans. (2)

Sol. At $V_B = 8V$

$$i_L = \frac{6 \times 10^{-3}}{4} = 1.5 \times 10^{-3}\ A$$

$$i_R = \frac{8 - 6 \times 10^{-3}}{1} = 2 \times 10^{-3}\ A$$

$\therefore i_{zener\ diode} = i_R - i_{load}$

$= 0.5 \times 10^{-3}$ A

At $V_B = 16$ V

$i_L = 1.5 \times 10^{-3}$ A

$$i_R = \frac{(16 - 6) \times 10^{-3}}{1} = 10 \times 10^{-3}\ A$$

$\therefore i_{zener\ diode} = i_R - i_L$

$= 8.5 \times 10^{-3}$ A

14. Ans. (4)

Sol. $A_v \times \beta = P_{gain}$

$$60 = 10 \log_{10}\left(\frac{P}{P_0}\right)$$

$$P = 10^6 = \beta^2 \times \frac{R_{out}}{R_{in}}$$

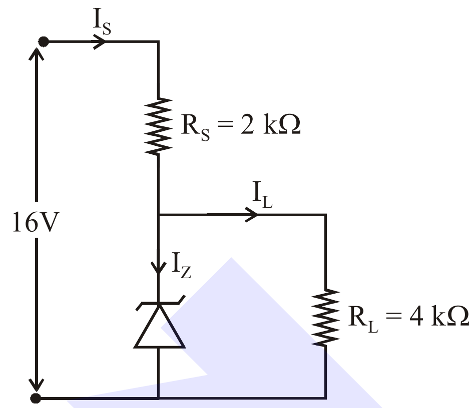
$$= \beta^2 \times \frac{10^4}{100}$$

$\beta^2 = 10^4$

$\beta = 100$

15. Ans. (2)

Sol. Maximum current will flow from zener if input voltage is maximum.



When zener diode works in breakdown state, voltage across the zener will remain same.

$\therefore V_{across\ 4k\Omega} = 6V$

$\therefore$ Current through 4KΩ = $\frac{6}{4000}$ A = $\frac{6}{4}$ mA

Since input voltage = 16V

$\therefore$ Potential difference across 2KΩ = 10V

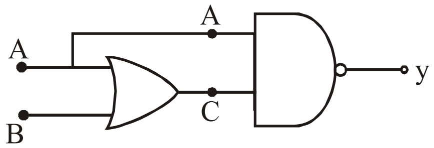
$\therefore$ Current through 2kΩ = $\frac{10}{2000}$ = 5mA

$\therefore$ Current through zener diode

$= (I_S - I_L) = 3.5$ mA

16. Ans. (1)

Sol.



C = A + B

and y = $\overline{A.C}$

A	B	C = (A + B)	A.C.	y = $\overline{A.C}$
0	0	0	0	1
0	1	1	0	1
1	0	1	1	0
1	1	1	1	0

17. Ans. (3)

Sol. $V_{gain} = \left(\frac{\Delta I_C}{\Delta I_B}\right)\frac{R_{out}}{R_{in}}$

$= \left(\frac{5\times10^{-3}}{100\times10^{-6}}\right) \times 10^3$

$= \frac{1}{20}\times10^6 = 5 \times 10^4$

$P_{gain} = \left(\frac{\Delta I_C}{\Delta I_b}\right)(V_{gain})$

$= \left(\frac{5\times10^{-3}}{100\times10^{-6}}\right)(5\times10^4)$

$= 2.5 \times 10^6$