PHYSICS

BOOKS - NEW JYOTHI PHYSICS (TAMIL ENGLISH)

SEMICONDUCTOR ELECTRONICS : MATERIALS , DEVICES AND SIMPLE CIRCUITS

Solved Problems

1. C, Si and Ge have same lattice structure . Why is C an insulator while Si and Ge are intrinsic semiconductors ?

2. Suppose a pure Si crystal has 5×10^{22} atoms m^{-3} . It is doped by 1 ppm concentration of pentavalent . As . Calculate the number of electrons and holes . Given that $n_i = 1.5 \times 10^{16} m^{-3}$.

3. A semiconductor is known to have an electron concentration of $8 \times 10^{13} cm^{-3}$ and a hole concentration of $5 \times 10^{12} cm^{-3}$.

a . Is the semiconductor n- type of p-type ?

b. What is the resistitivity of the simple , if the electron mobility is 23,000 $cm^2 V^{-1} s^{-1}$ and hole mobility is $100 cm^2 V^{-1} s^{-1}$? Take charge on electron , $e = 1.6 \times 10^{-19}$ C .

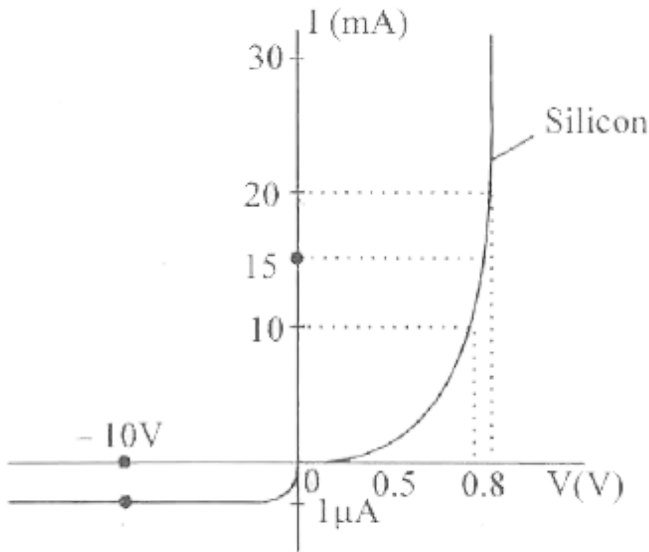**4.** Can we take one slab of p-type semiconductor and physically join it to another n-type semiconductor to get p-n junction ?

5. The V-I characteristic of a silicon diode is shown in the figure . Calculate the resistance of the diode at (a) $I_D = 15mA$ and (b)

$$V_D = -10V$$

6. In a Zener regulated power supply , a Zener

diode with $V_Z = 6.0$ V 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_S ?

7. The current in the forward bias is known to be more (-mA) than the current in the reverse bias $(\sim \mu A)$. What is the reaction then to operate the photodiodes in reverse bias ?
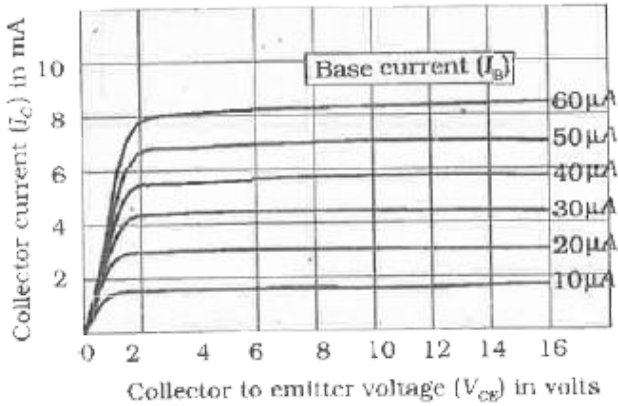
8. Why are Si and GaAs preferred materials for solar cells ?

9. From the output characteristics shown in Figure , calculate the values of β_{ac} and β_{dc} of the transistor when V_{CE} is 10 V and $I_C = 4.0$

mA .

The graph shows Collector current (I_C) in mA on the vertical axis and Collector to emitter voltage (V_{CE}) in volts on the horizontal axis, with curves for Base current (I_B) labeled 60μA, 50μA, 40μA, 30μA, 20μA, 10μA.

10. In Fig (a) , the V_{BB} supply can be varied from 0 V to 5.0 V . The Si transistor has $\beta_{dc} = 250$ and $R_B = 100k\Omega$, $R_C = 1k\Omega$, $V_{CC} = 5.0V$.

Assume that when the transistor is saturated , $V_{CE} = 0V$ and $V_{BE} = 0.8V$. Calculate (a) the minimum base current , for which the transistor will reach saturation .

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11. For a CE transistor amplifier , the audio signal voltage across the collector resistance of 2.0 $k\Omega$ is 2.0 V . Suppose the current amplification factor of the transistor is 100 . What should be the value of R_R in series with

V_{BB} supply of 2.0V if the dc base current has to be 10 times the signal current . Also calculate then de drop across the collector resistance . Take VBE=0.6V

12. Calculate the emitter current in a transistor for which $\beta = 50$, base current $I_B = 25\mu A$.

13. For a common emitter amplifier , current gain is 70 . If the emitter is 8.8 mA , calculate the collector and base current . Also calculate current gain , when transistor is worked on common base amplifier .

14. What is the change in the collector current , in a transistor of a.c. current gain 150, for a $100\mu A$ change in base current ?

15. For a transistor connected in common emitter mode , the voltage drop across the collector is 2 V and β is 50 . Find base current if R_C is 2K .

16. Justify the output waveform (Y) of the OR gate for the following inputs A and B given in the figure below .

17. Take A and B input waveforms similar to that in Ex. Sketch the output waveform obtained from AND gate .

18. Sketch the output Y from a NAND gate having inputs A and B given below .

1. In an n-type silicon , which of the following statements is true ?

   A. a. Electron are majority carriers and trivalent atoms are the dopants

   B. b. Electrons are minority carriers and pentavalent atoms are the dopants

C. c. Holes are minority carriers and pentavalent atoms are the dopants .

D. d. Holes are majority carriers and trivalent atoms are the dopants .

Answer: C

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2. How do you classify p-type semiconductors ?

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3. Carbon, silicon and germanium have four valence electrons 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 is true ?

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. $\left(E_g\right)_C = \left(E_g\right)_{Si} = \left(E_g\right)_{Ge}$

Answer: C

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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 differences

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 these.

Answer: C

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6. Which of the following statements are incorrect?

A. Base , emitter and collector regions should have similar size and doping concentrations

B. The base region must be very thin and lightly doped .

C. The emitter junction is forward biased and collector junction is reversed biased.

D. Both the emitter junction as well as the

   collector junction are forward biased.

Answer: B::C

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7. For a transistor amplifier , the voltage gain

A. remains constant for all frequencies.

B. is high at high and low frequencies and

   constant in the middle frequency range .

C. is low at high and low frequencies and

constant at mid frequencies .

D. None of these.

Answer: C

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8. 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 ?

9. For a CE- transistor amplifier , the audio signal voltage across the collected resistance of $2k\Omega$ is 2 V . Suppose the current amplification factor of the transistor is 100 , find the input signal voltage and base current , if the base is $1k\Omega$.

10. Two amplifiers are connected one after the other in series (cascaded) . The first amplifier has a voltage gain of 10 and the second has a voltage gain of 20 . If the input signal is 0.01 volt, calculate the output are signal.

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11. A p-n photodiode is fabricated from a semiconductor with hand gap of 2.8 eV . Can it detect a wavelength of 6000 n m ?

12. 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 of 600 K and that at 300 K ? Assume that the temperature dependence of intrinsic carrier concentration n_i is given by

n_(i)=n_(0) exp ((-E_(g))/(k_T)), where n_(0) is a constant and k_=8.62xx10^(-5)eV//K.

13. You are given the two circuits as shown in fig. show that circuit (a) acts as OR gate while the circuit (b) acts as AND gate .
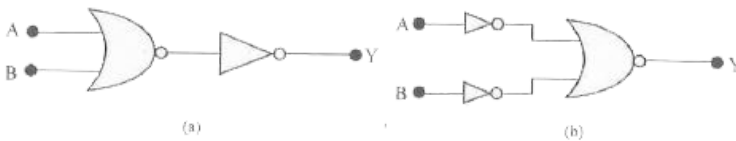
14. Write the truth table for a NAND gate connected as given in figure below .
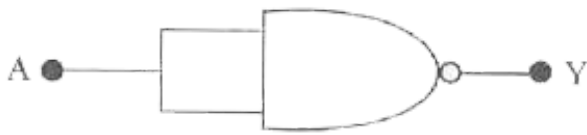
Hence identify the exact logic operation carried out by this circuit .

15. You are given two circuits as shown in fig. which consist of NAND gates . Identify the logic operation carried out by the two circuits .
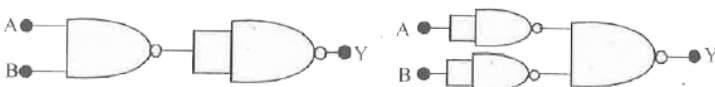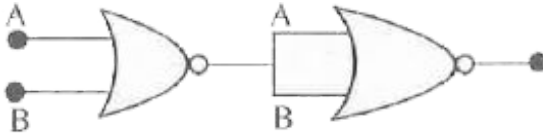
16. Write the truth table for circuit given in figure below consisting of NOR gates and identify the logic operation (OR , AND , NOT) which this circuit is performing . (Hint : A = 0 , B = 1 , then A and B inputs of second NOR gate will be 0 and hence Y = 1 . Similarly work out the values of Y for other combination of A and B . Compare with the truth table of OR , AND ,

NOT gates and first the correct one .)

17. Write the truth table for the circuits gives

in figure consisting of NOR gates only .

Identify the logic operations (OR , AND , NOT)

performed by the two circuits .

(a)   (b)
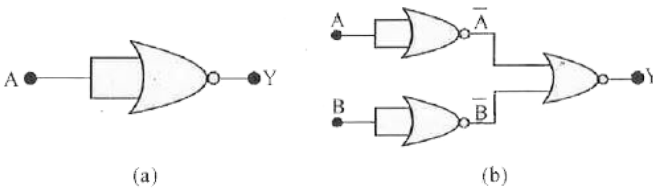
1. A semiconductor has the electron concentration $0.45 \times 10^{12} m^{-3}$ and hole concentration $5 \times 10^{29} m^{-3}$. Find its conductivity. Given electron mobility $= 0.135 m^2 V^{-1} s^{-1}$ and hole mobility $= 0.048 m^2 V^{-1} s^{-1}$, $e = 1.6 \times 10^{-19} C$

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2. Two amplifiers are connected as shown in the figure . Find $V(o)$ if $G(1) = 20, G_2 = 10$ and $V_{in} = 50mVV_2 = 10V$ for each diode

Amplifier 1 G_1 Amplifier 2 G_2

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3. In a silicon transistor a change of 7.89 mA in the emitter current produces a change of 7.8 mA in the collector current . What is the change in the base current necessary to

produce an equivalent change in the collector current ?

4. Convert the following decimal numbers into binary numbers .

A. 97

B. 138

C. 782

D. 635

Answer:

5. Convert the following binary numbers into decimal numbers.
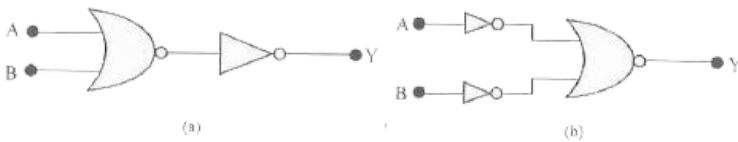
A. 110011

B. 10011

C. 0.111

D. 0.101

Answer:

6. Write the truth table for the circuits gives in figure consisting of NOR gates only . Identify the logic operations (OR , AND , NOT) performed by the two circuits .
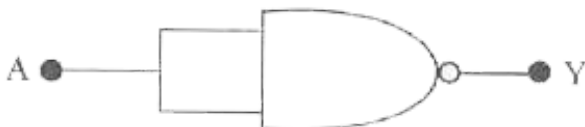

(a)   (b)
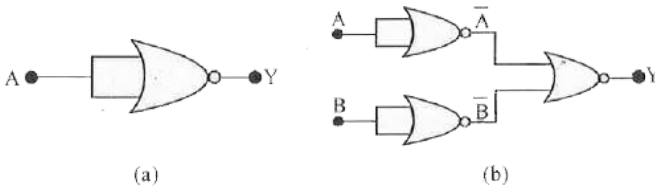
7. You are given the two circuits as shown in fig. show that circuit (a) acts as OR gate while the circuit (b) acts as AND gate .

8. Write the truth table for a NAND gate connected as given in figure below .

Hence identify the exact logic operation carried out by this circuit .

Evaluation Questions And Answer

1. The energy gap of diamond is 6 eV .

a . What does it mean ?

b. What is the value of energy gap in the case of copper ?

c. On the basis of energy gap , explain how substances are classified.

2. When impurity (atom) is added to an intrinsic semiconductor , then it becomes extrinsic semiconductors .
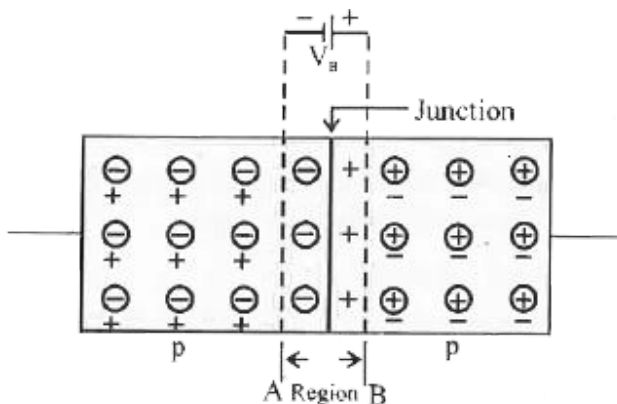
What is the above process called ?

b. What is the advantage of doing so ?

c. Distinguish between intrinsic semiconductor and extrinsic semiconductor.

3. Fig shows a p-n junction diode.

a. What does V_B denote ?

b. Name the region AB.

4. What is the value of conductivity of a semiconductor at absolute zero ?

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5. Can a transistor amplifier generate power ?

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6. Give some properties of a semiconductor.

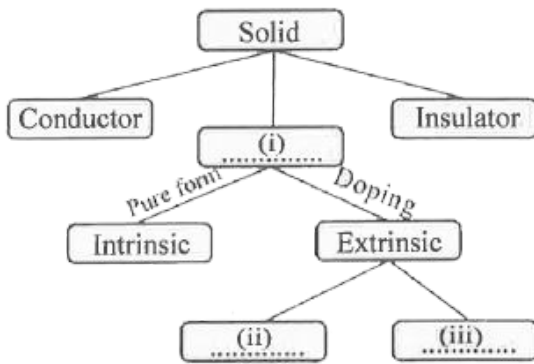▶ **Watch Video Solution**

7. What is a Zener diode ?

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8. What are the characteristics of a hole ?

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9. Copy and complete the following block diagram .

Solid
- Conductor
- (i) ....
  - Pure form → Intrinsic
  - Doping → Extrinsic
    - (ii) ....
    - (iii) ....
- Insulator

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10. What is meant by forbidden energy gap ?

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11. What do you mean by fermi energy ?

12. What is depletion region in p-n junction ?

13. What will happen if both , emitter and collector of a transistor are reverse biased ?

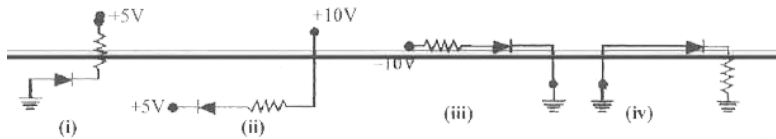**14.** How does conductivity of a semiconductor increase ?
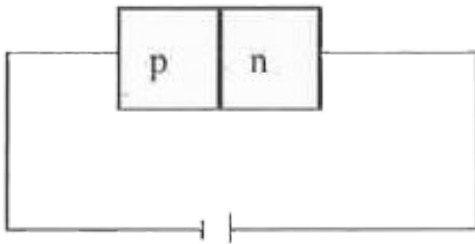
15.

The forward bias of a diode is wrongly given above .

a. Redraw the above circuit correctly .

b. Draw the graph of current I with voltage V

in forward bias .

c. Classify the following circuit diagram into

forward bias , reverse bias , unbias

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16. Classify the following into conductors ,
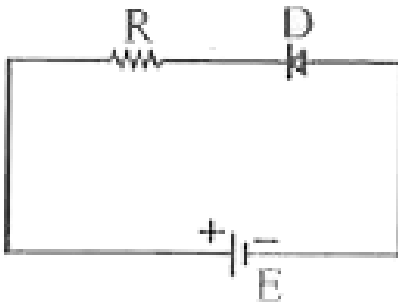
insulators and semi conductors .

GaAs , InP , Ni, Calcite , Graphite

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17. The magnitude of potential barrier of germanium is about 0.3 V .

a What does it mean . , b . What is the value of potential barrier for silicon ?

18.

a. What type of biasting is used here ?

b. What happens to the depletion region ?

c. Will the diode conduct or not ?

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19. Why is a NOT gate known as an inverter ?

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20.

a. What type of biasting is used here ?

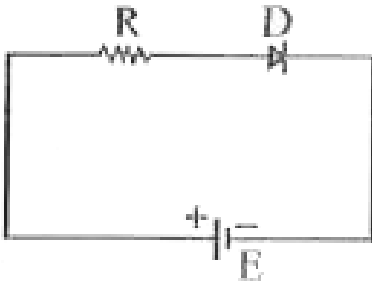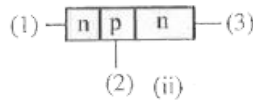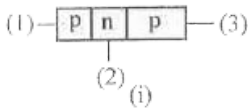b. What happens to the depletion region ?

c. Will the diode conduct or not ?

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21.

The above figures represent a p-n-p transistor

and an n-p-n transistor.

a. Draw the circuit symbols of p-n-p transistor and n-p-n transistor .

b. Write the names of the terminals (1) , (2) and (3) .

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22. In the normal working of a transistor , the emitter is forward biased and collector is reverse biased.

a. Comment on the above statement .

b. Can we exchange emitter and collector of a transistor ?

c. Base region of a transistor is made very thin and lightly doped. Why ?

d. "Eventhough the collector - base is reverse biased, the current flow takes place with out experiencing much high resistance" , Give your explanation.

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23. A transistor is being used as a common emitter amplifier .

a What is the phase relationship between the output and input voltages ?

b. Define voltage gain of an amplifier.

c. Define the transconductance of a transistor .

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24. How does the conductivity of a semiconductor change with rise in

temperature ? Explain.

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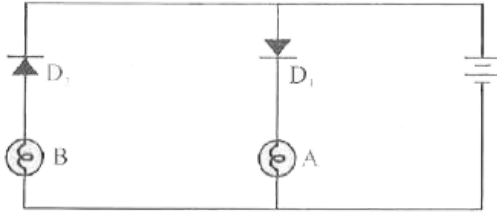**25.** Why are Ge and Si semiconductors ?

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26. Why is a common emitter amplifier preferred over a common base amplifier ?

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27.

a . What do you observe when the circuit is closed ?

b. What will happen when the polarity of cell is reserved ? Why ?

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28. What are the different transistor configurations ?

29. Which configuration is widely used in circuits ?

30. What is the name of the device in which AC is converted into DC ?

31. What is the name of the device in which DC is converted into AC ?

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32. How can you keep the LC oscillation undamped ?

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33. What the different gains in a transistor ?

34. What is dark current ?

35. Transistor Radio does not work satisfactorily when used inside a railway carriage .

a . Justify your answer .

b . What happens in a transistor when both the emitter and collector are reverse biased ?

c. What is this condition known as ?

d. Under what condition a transistor works as an open switch ?

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36. Fill in the blanks with appropriate words given below .

[Base , collector , emitter , base-collector junction, collector - emitter junction , emitter base junction]

Structurally a bipolar junction transistor

consists of emitter , base and (i) Out of these regions (ii) is the most heavily doped. For proper functioning of a transistor. (iii) is forward biased and (iv) is reverse biased.

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37. A car stereo working at stabilized voltage supply of 9V DC and has a Zener diode of 9V , 0.25 W . But the voltage supply inside the car is 12 V DC .

The boy approached you to get help .

a. Which mode of bias will you suggest to connect Zener diode as voltage regulator ?

b. Draw a circuit diagram of voltage regulation to help the boy .

c . Which device is essential for circuit diagram ? Find the value of that device .

[Hint . Current through the load , $I_L = 0$]

38. State whether true or false and justify .

a Zener diodes are used under forward bias.

b. In n-p-n transistor , current conduction is primarily due to electrons .

c. Transistor amplifiers do not strictly obey law of conservation of energy since output power is greater than input power .

d. In a transistor amplifier all the frequency will have exactly equal gain .

39. In both p and n type semiconductors , actually electrons are flowing . What difference

do you observe in the motion of electron in these two semiconductors ?

40. A greenhouse has an electronic system (block diagram is given below) which automatically switches ON a heater if the air temperature in the greenhouse drops too low . A manual switch is included so that the automatic system can be switched off .

(Hint , The temperature sensor gives a logic -I

output when the air temperature is normal and logic 0 when it is too cold)
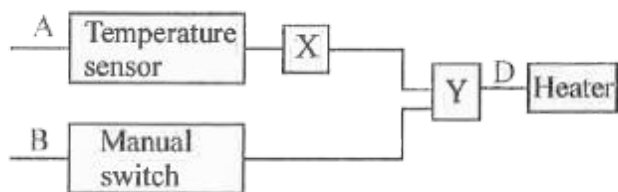
a. What is meant by 1 and 0 in digital circuit ?

b. Name the logic gate X . Why is it used ?

c. Name the logic gate Y.

d. Construct a truth table of this electronic system by taking A and B as inputs and D as output

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41. The behaviour of the control unit of an automatic gas cooker is given below .

Gas	Cooking time	Warning light
OFF	OFF	ON
OFF	ON	ON
ON	OFF	ON
ON	ON	OFF

Cooking time is different by different dishes .

Hence cooking time must be adjusted properly

. This control unit can be constructed by using

logic gates .

a . What is meant by logic gates ?

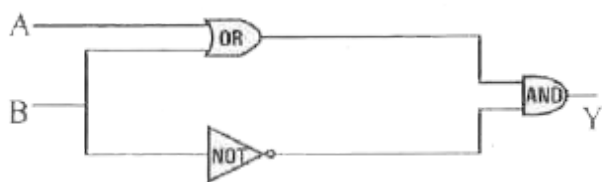b . Which gate is suitable for the above control

unit ?

c. Construct a simple circuit diagram of

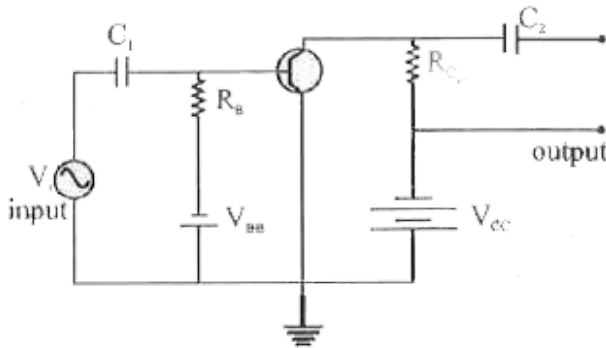control unit (Using symbol of logic gate and block diagram of others)

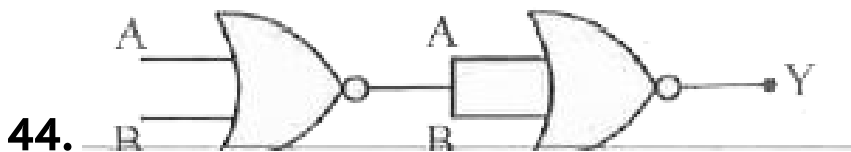**42.** Construct a truth table for the following logic circuit

43. Correct the following CE amplifier circuit .

44.

a. Name the gates in the combination .

b. Identify the logic operation of the whole

gate .

c. Give the truth table .

45. Crystalline substances have a sharp melting point . Why ?

46. Why are NAND and NOR gate called universal gate ?

47. Why do crystalline state most stable ?

Continuous Evaluation Assignment

1. On the basis of band theory , explain the difference between conductor , insulator and semiconductor.

2. Discuss the structure and properties of

a. intrinsic semiconductor

3. Discuss some of the applications of p-n

junction diode .

4. Explain analogue and digital signals .

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5. Discuss various types of logic gates.

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6. Write a note on IC fabrication .

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7. Mention some practical applications of logic gates .
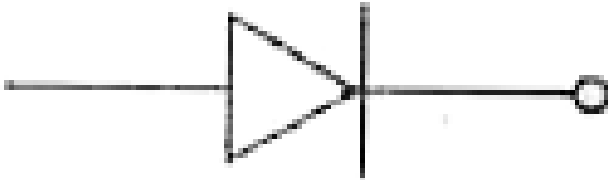
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Previous Year Questions

1. We are familiar with the semi conductors Silicon and Germanium .

a. With a necessary schematic diagram , briefly explain the characteristics of an intrinsic semiconductor.

b. Draw the energy bands of a n-type semiconductor.

c The following figure represents a

d . Draw a typically illuminated P-n junctions solar cell.

e. LED convert............ energy to light.

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2. A. Draw the circuit diagram of transistor as an amplifier in common emitter configuration .

B. Obtain the expression for the voltage gain .

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3. A. What do you mean by barrier potential of a diode ?

B. With the help of a diagram explain the working of a full wave rectifier .

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1. A pure semiconductor has equal electron and hole concentration of $10^{16} m^{-3}$. Doping by indium increases n_h to $5 \times 10^{22} m^{-3}$. Then the value of n_e in the doped semiconductor is

   A. a. $10^6 / m^3$

   B. b. $10^{22} / m^3$

   C. c. $2 \times 10^6 / m^3$

   D. d. $2 \times 10^9 / m^3$

Answer: D

2. The collector supply voltage is 6 V and the voltage drop across a resistor of 600Ω in the collector circuit is 0.6 V , in a transistor connected in common emitter mode . If the current gain is 20 , the base current is
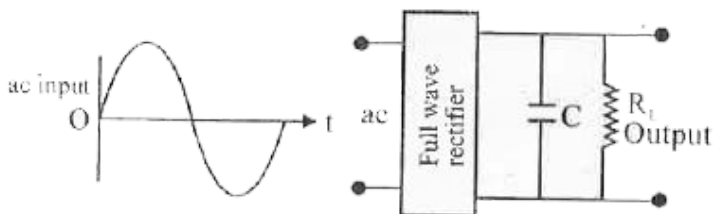
A. 0.25 mA

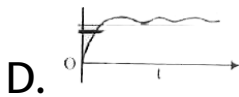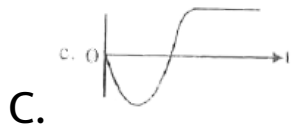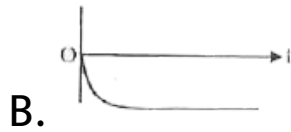B. 0.05 m A
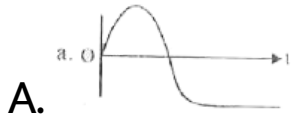
C. 0.02 m A

D. 0.07 m A

Answer: B

3. A full - wave rectifier circuit with an ac input

is shown.

The output voltage across R_L is represented as

A.

B.

C.

D.

Answer: D

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4. When the voltage drop across a p-n junction diode is increased from 0.65 V to 0.70 V , the change in the diode current is 5 mA . The dynamic resistance of the diode is

    A. A) 20Ω

    B. B) 50Ω

    C. C)10Ω

    D. D) 80Ω

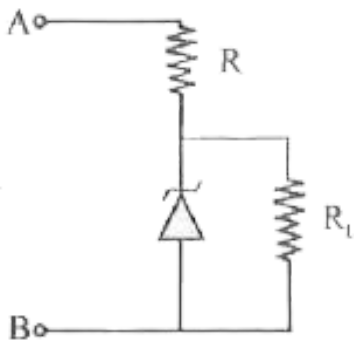**Answer: C**

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5. If the voltage between the terminals A and B

is 17 V and Zener breakdown voltage is 9 V ,

then the potential across R is

A. A) 6 V

B. B) 8 V

C. C) 9 V

D. D) 17 V

Answer: B

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6. GaAs (with a band gap = 1.5 eV) as a L.E.D can emit

A. blue light

B. green light

C. ultraviolet rays

D. infrared rays

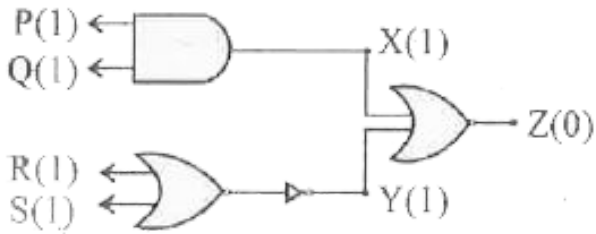▶ **Watch Video Solution**

7. The circuit diagram shows a logic combination with the states of outputs X , Y and Z given for inputs P , Q , R and S all at state 1 . When inputs P and R change to state 0 with inputs Q and S still at 1 , the states of

outputs X , Y and Z changes to

P(1) ←
Q(1) ←
X(1)
Z(0)
R(1) ←
S(1) ←
Y(1)

A. 1, 0 , 0

B. 1 , 1 , 1

C. 0 , 1 , 0

D. 0,0,1

Answer: C

8. In a common emitter transistor amplifier , the output resistance is $500k\Omega$ and the current gain β = 49 . If the power gain of the amplifier is 5×10^6 , the input resistance is
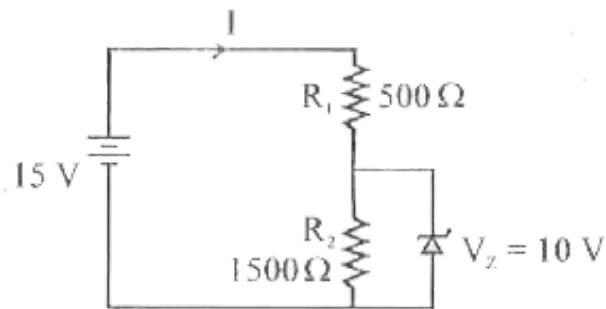
A. a) 325Ω

B. b) 165Ω

C. c) 198Ω

D. d) 240Ω

Answer: D

9. In the circuit given , the current through the

zener diode is

A. a) 10 m A

B. b) 6.67 m A

C. c) 5 m A

D. d) 3.33 m A

Answer: D

10. A transistor oscillator is (i) an amplifier with positive feedback (ii) an amplifier with reduced gain (iii) the one in which dc supply energy is converted into ac output energy . Then

A. A) all (i) , (ii) and (iii) are correct

B. B) only (i) and (ii) are correct

C. C) only (i) and (iii) are correct

D. D) only (ii) and (iii) are correct

Answer: C

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11. A semiconductor with a band gap of 2.5 eV is used to fabricate a p-n photodiode . It can detect a signal of wavelength

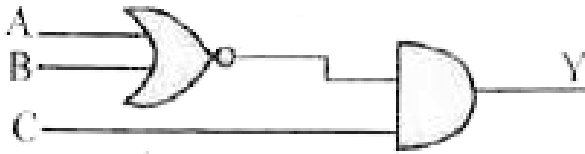A. 4000 nm

B. 6000 Å

C. 6000 nm

D. 4000 Å

Answer: D

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12. In the circuit given A , B and C are inputs

and Y is the output

The output Y is

A. high for all the high inputs

B. high for all the low inputs

C. high when A = 1 , B =1 , C= 0

D. low for all low inputs

Answer: D

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13. In the given circuits for ideal diode , the current through the battery is
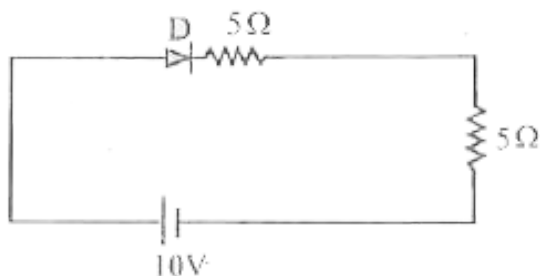
A. 0.5 A

B. 1.5 A

C. 1.0 A

D. 2 A

Answer: C

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14. The logic gates giving output '1' for the inputs of '1' and '0' are

    A. AND and OR

    B. OR and NOR

    C. NAND and OR

    D. AND and NOR

Answer: D

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15. Identify the mismatch of the following :

a. Photo diode	-	optical signal
b. LED	-	spontaneous emission
c. Diode laser	-	stimulated emission
d. Solar cell	-	electrical energy into light
e. Photo conducting cell	-	photo detector

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16. If a PN junction diode of depletion layer width W and barrier height V_0 is forward biased , then

A. W increases , V_0 decreases

B. W decreases V_0 increases

C. both W and V_0 increase

D. both W and V_0 decreases

Answer: D

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17. The heavily and lightly doped regions of a

bipolar junction transistor are respectively

A. base and emitter

B. base and collector

C. collector and base

D. emitter and base

Answer: D

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18. The device used for detecting optical signal
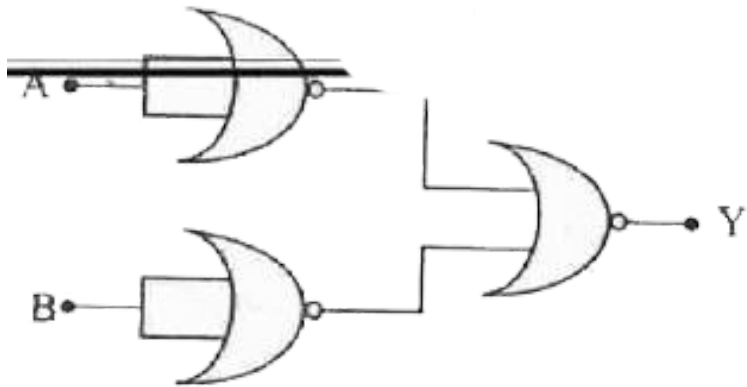
is

A. zener diode

B. photodiode

C. junction diode

D. optical diode

Answer: B

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19.

The logical operation carried out by the above

circuit is

A. OR

B. NOT

C. AND

D. NOR

Answer: C

20. In CE transistor amplifier , if the base current is increased by 20 μ A , the collector current changes from 4 mA to 5 mA . The current amplification factor of the transistor is
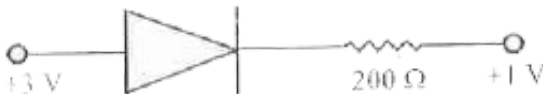
A. 200

B. 50

C. 125

D. 250

Answer: B

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21. If an ideal junction diode is connected as shown , then the value of the current iis

A. $0.013A$

B. $0.02A$

C. $0.01A$

D. $0.1A$

Answer: C

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22. Identify the mismatched pair from the following

a.	Zener diode	:	voltage regulator
b.	germanium doped with phosphorous	:	n-type semiconductor
c.	semiconductor	:	band gap > 3 eV
d.	pn junction diode	:	rectifier
e.	silicon doped with aluminium	:	p-type semiconductor

23. In a common emitter configuration a transistor has $\beta = 50$ and input resistance $1k\Omega$. If the peak value of a.c. input is 0.01 V , then the peak value of collector current is
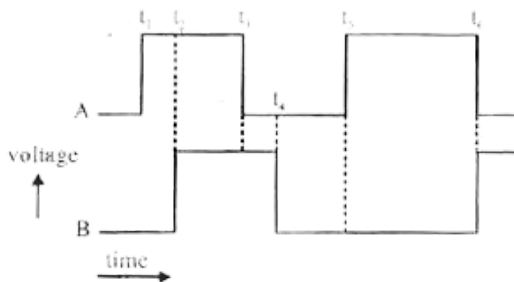
A. $0.01\mu A$

B. $500\mu A$

C. $100\mu A$

D. $0.5\mu A$

Answer: B

24. The wave forms A and B given below are given as input to a NAND gate . Then its logic output y is

A. for t_1 to t_2 , y = 0

B. for t_2 to t_3 , y = 1

C. for t_3 to t_4 , y = 1

D. for t_4 to t_5 , y 0

Answer: C

25. The output of an AND gate is connected to both the inputs of a NOR gate , then this circuit will act as a

A. OR gate

B. NOR gate

C. AND gate

D. NAND gate

Answer: D

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26. In p-type semiconductor , the acceptor

level lies

A. near the conduction band

B. halfway between conduction and valence

bands

C. within conduction band

D. near the valence band

Answer: D

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27. If the feedback voltage is increased in a negative feedback amplifier , then

A. a. both gain and distortion decreases

B. b. the distortion increases

C. c. the gain decreases and distortion increases

D. d. the gain increases

Answer: A

28. The inputs A , B and C to be given in order to get an output Y = 1 from the following circuit are

A. A) 0 , 1 , 0

B. B) 1 , 0 , 0

C. C) 1 , 0 , 1

D. D) 0 , 0 , 1

Answer: D

29. The collector resistance and the input resistance of a CE amplifier are respectively $10k\Omega$ and $2k\Omega$. If β of the transistor is 49 , the voltage gain of the amplifier is

   A. A) 125

   B. B) 150

   C. C) 175

D. D) 245

Answer: D

30. The light emitting diode (LED) is

A. A) a heavily doped p-n junction with no external bias

B. B) a heavily doped p-n junction with reverse bias

C. C) a heavily doped p-n junction with

forward bias

D. D) a lightly doped p-n junction with no

external bias

Answer: C

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31. Identify the wrong statement

A. a. In conductors , the valence and conduction bands overlap

B. b. Substances with energy gap of the order of 10 eV are insulators

C. c. The resistivity of semiconductors is lower than metals

D. d. The conductivity of metals is high

Answer: C

32. Identify the wrong statement with reference to a solar cell

A. a. It is a p-n junction diode with no external bias

B. b. It uses materials of high optical absorption

C. c. It uses materials with band gap 5 eV

D. d. It converts light energy into electrical energy

Answer: C

33. The minimum number of NAND gates used
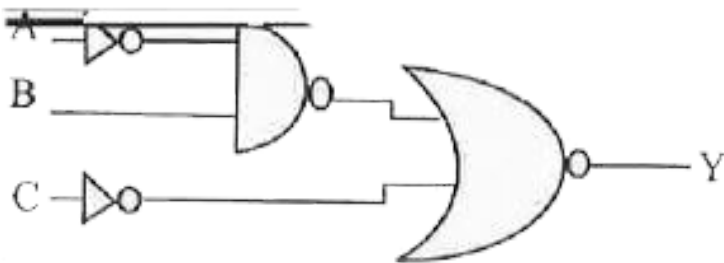to construct an OR gate is

A. A) 4

B. B) 6

C. C) 5

D. D) 3

Answer: D

34. For which one of the following input combinations , the given logic circuit gives the output Y = 1 ?

A. a) A = 0 , B = 0 , C = 0

B.

C. b) A = 0 , B = 1 , C = 1

D. c) A =0 , B =1 , C = 0

Answer: B

35. In a semiconductor $\dfrac{2}{3}$ rd of the total current is carried by electrons and remaining $\dfrac{1}{3}$ rd by the holes . If at this temperature , the drift velocity of electrons is 3 times that of

holes , the ratio of number density of electrons to that of holes is

A. a) $\dfrac{3}{2}$

B. b) $\dfrac{2}{3}$

C. c) $\dfrac{5}{3}$

D. d) $\dfrac{3}{5}$

Answer: B

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36. In an PNP transistor , 10^{10} holes enter the emitter in 10^{-6} s . If 2 % of holes is lost in the base , then the current amplification factor is

A. a. 49

B. b. 19

C. c. 29

D. d. 39

Answer: A

37. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 600 nm is incident on it . The energy band gap (in eV) for the semiconductor is

A. a. 1.50

B. b. 0.75

C. c. 2.06

D. d. 0.90

Answer: C

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