PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

SEMICONDUCTOR ELECTRONICS

Example

1. An ideal diode and a 5 ω reistor are connected in series with a 15 V power supply

as shown in figure below. Calculate the current that flows through the diode.

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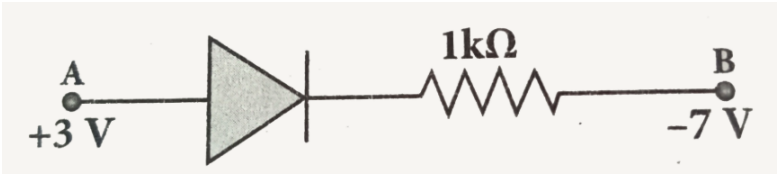
2. Consider an ideal juction diode. Find the value of current flowing through AB is



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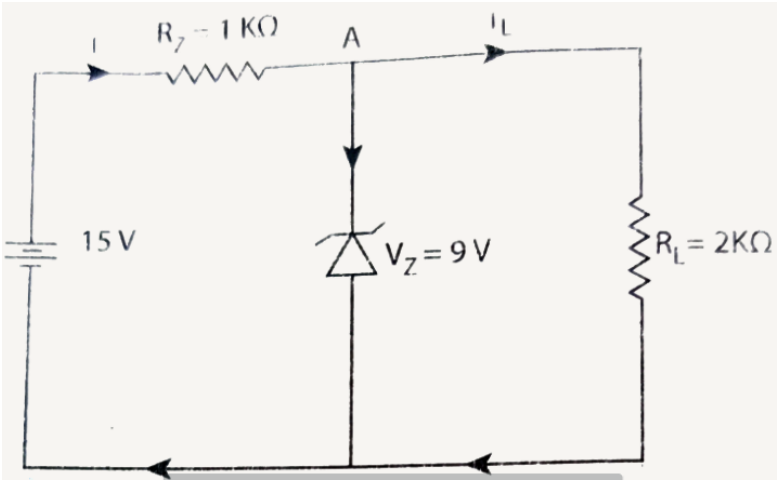
3. Find the current through the Zener diode When the load resitence is 2 K Ω.Use diode approximation.



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4. Determine the Wavelength of light emitted from LED which is made up of GaAsP semiconductor whose forbidden energy gap is 1.875 eV.Mention the colour of the light emitted.

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5. In a transistor connected in the common base configuartion, $\alpha = 0.95, I_E = 1mA$ .Calculate the value of I_C and I_B.

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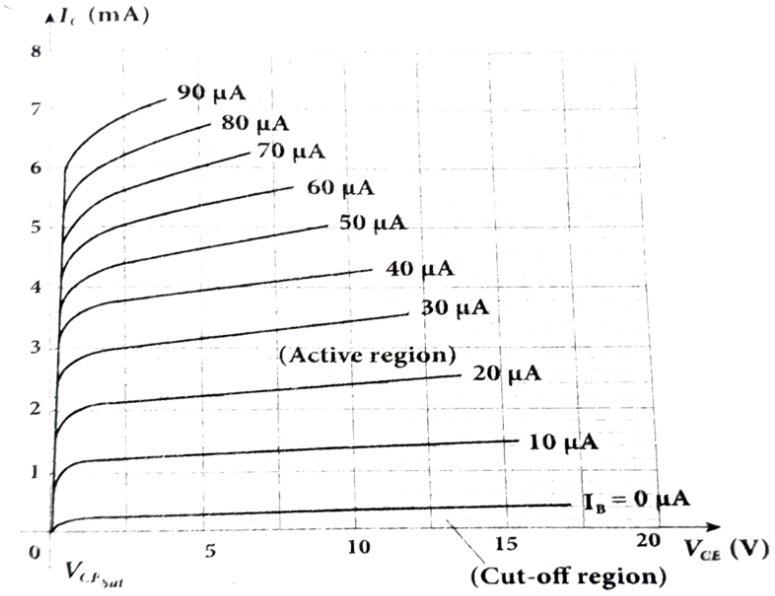
6. The output characteristics of a transistor connected in common emitter mode is shown in the figure. Determine the value of I_C when V_CE=15 V. Also determine the value of $I_C$when V_CE is changed to 10 V.



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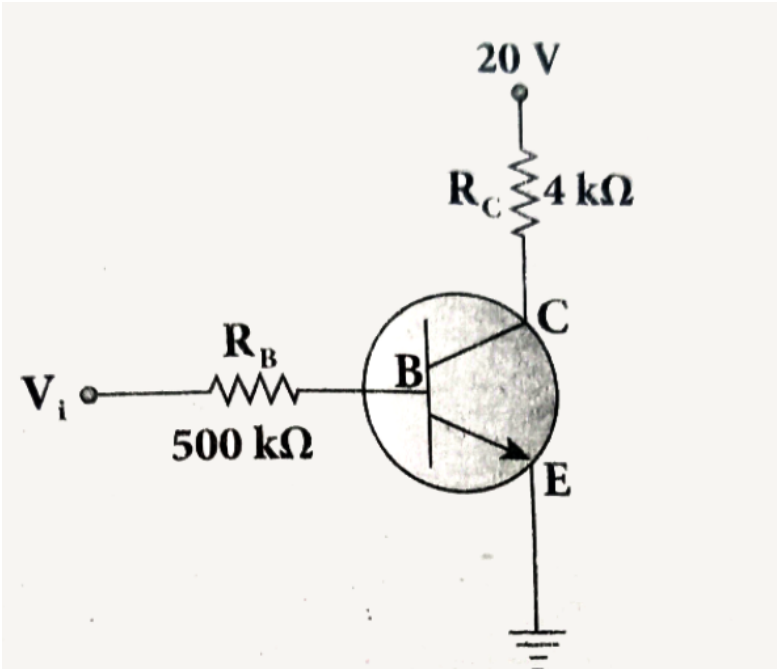
7. In the circuit shown in the figure , the input voltage V_i is 20 V, V_BE=0V and V_CE=0V. What are the value of I_B, I_C, β?



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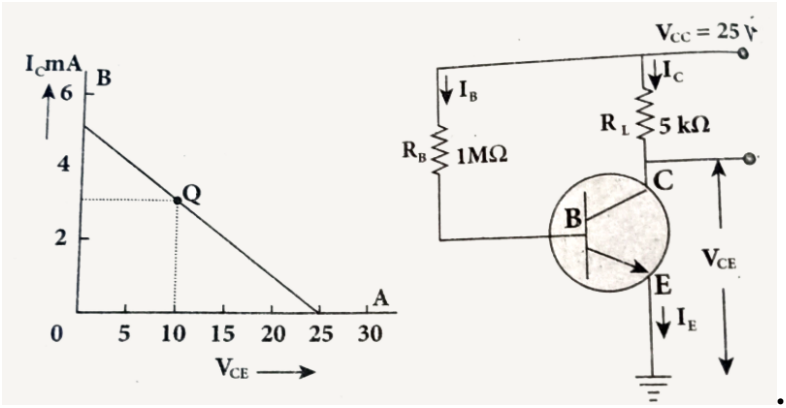
8. The current gain of a common emitter transiter circuit shown in figure is



. Draw the dc load line and mark the Q point on it .

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9. Calculate the range of the variable capacitor that is to be used in a tuned-collector oscillator which has a fixed inductance of 150 p H.The frequency band is from 500 KHz to 1500KHz.

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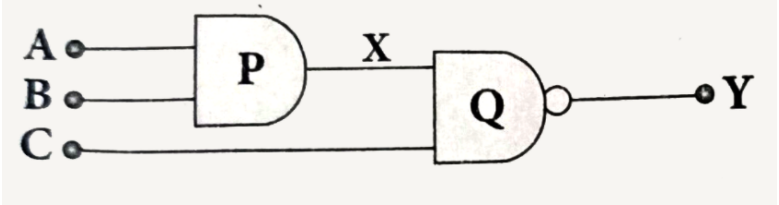
10. What is the output Y in the following circuit , When all the three inputs A,B, and C

are first 0 and then 1?



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11. In the combination of the following gates, wirte the Boolen eqquation for the outputs Y in terms of inputs A and B.

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12. Simplify the Boolean identify

AC+ABC=AC

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Textual Evaluation Solved Multiple Choice Questions

1. The barrier potential of a silicon diode is approximately.

A. 0.7 V

B. 0.3 V

C. 2.0 V

D. 2.2 V

Answer: a

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2. Doping a semiconductor results in

A. The decrease in mobile charge carriers

B. The change in chemical properties

C. The change in the crystal structure

D. The breaking of the covalent bond

Answer: c

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3. A forward biased diode is treated as

A. An open switch with infinite resistance

B. A closed switch with a voltage drop of OV

C. A closed switch in series with a battery voltage of 0.7V

D. A closed switch in series with a small resistance and a battery.

Answer: d

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4. If a half-wave rectified voltage is fed to a load resistor , which part of a cycle the load current will fl ow ?

A. $0^0 - 90^0$

B. $90^0 - 180^0$

C. $0^0 - 180^0$

D. $0^0 - 360^0$

Answer: c

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5. The primary use of a zener diode is

A. Rectifier

B. Amplifier

C. Oscillator

D. Voltage regular

Answer: d

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6. The principle in which a solar cell operates

A. Diffusion

B. Recombination

C. Photovoltaic action

D. Carrier flow

Answer: c

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7. The light emitted in a LED is due to

A. Recombination of charge carriers

B. Reflection of light due to lens action

C. Amplification of light falling at the junction

D. Recombination of charge carriers

Answer: a

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8. When a transistor is fully switch on , it is said to be

A. Sorted

B. Saturated

C. Cut-off

D. Open

Answer: b

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9. The specific characteristic of a common emitter amplifier is

A. High input resistance

B. Low power gain

C. Signal phase reversal

D. Low current gain

Answer: c

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10. To obtain sustained oscillation in an oscillator

A. Feedback should be positive

B. Feedback factor must be unity

C. Phase shift must be 0 or 2π

D. All the above

Answer: d

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11. If the input to the NOT gate is A = 1011, its output is

A. 0100

B. 1000

C. 1100

D. 0011

Answer: a

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12. The electrical series circuit in digital form is

A. AND

B. OR

C. NOR

D. NAND

Answer: a

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13. Which of the following represents symport?

A. 

B. 

C. 

D. 

Answer: a

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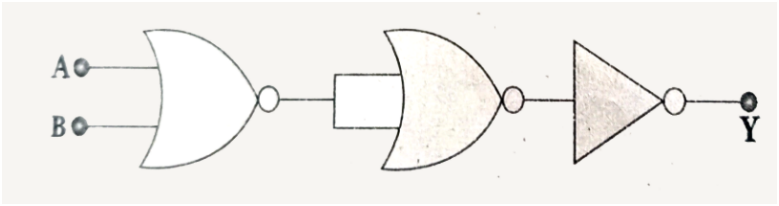
14. The given electrical network is equivalent to



A. AND gate

B. OR gate

C. NOT gate

D. NOR gate

Answer: c

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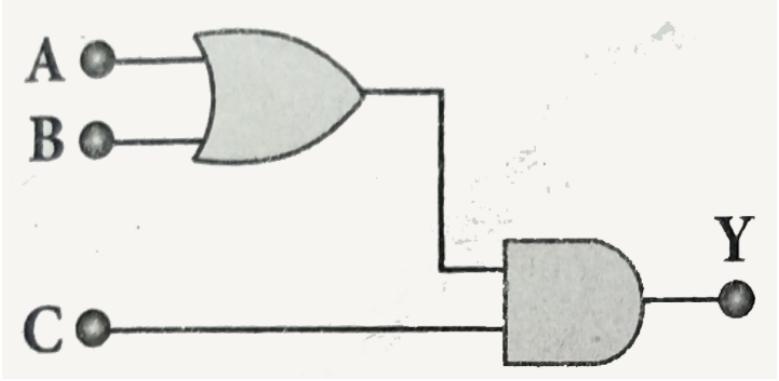
15. The output of the following circuit is I when the input ABC is



A. 101

B. 100

C. 110

D. 010

Answer: a

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Textual Evaluation Solved Short Answer Questions

1. Define electron motion in a semiconductor.

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2. Distinguish between intrinsic and extrinsic semiconductors.

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3. What do you mean by doping ?

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4. How electron -hole pairs are created in a semiconductor material ?

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5. A diode is called as a unidirectional device. Explain.

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6. What do you mean by leakage current in a diode ?

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7. Draw the output waveform of a full wave rectifier.

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8. Distinguish between avalanche and zener breakdown.

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9. Discuss the biasing polarities in an NPN and PNP transistors.

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10. Explain the current flow in a NPN transistor

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11. What is the phase relationship between the AC input and output voltages in a common emitter amplifier ? What is the reason for the phase reversal ?

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12. Explain the need for a feedback circuit in a transistor oscillator.

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13. Given circuit symbol , logical operation , truth table , and Boolean expression of AND , OR , NOT , NAND , NOR , and EX - OR gates

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14. State De Morgan's first and second theorems.

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Textual Evaluation Solved Long Answer Questions

1. Elucidate the formation of a N-type and P-type semiconductors.

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2. Explain the formation of PN junction diode. Discuss its V-I characteristics.

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3. Draw the circuit diagram of a half wave rectifier and explain its working.

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4. Explain the construction and working of a full wave rectifier.

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5. What is a LED? Give the principle of operation with a diagram.

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6. Write notes on Photodiode.

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7. Explain the working principle of a solar cell. Mention its applications.

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8. Sketch the static characteristics of a common emitter transistor and bring out the essence of input and output characteristics.

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9. Describe the function of a transistor as an amplifier with the neat circuit diagram. Sketch the input and output wave form.

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10. Transistor functions as a switch. Explain.

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11. State Boolean laws.Elucidate how they are used to simplify Boolean expressions with suitable example,

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12. State and prove De Morgan's Frist and second theorems.

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Textual Evaluation Solved Numerical Problems

1. The given circuit has two ideal diodes connected as shown in figure below. Calculate the current flowing through the resistance R_1

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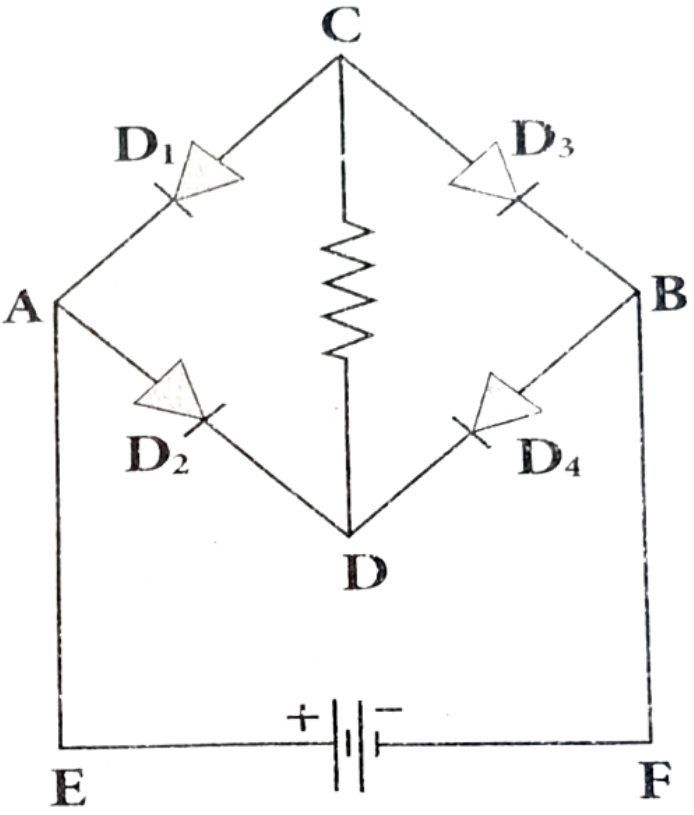
2. Four silicon diodes and a 10 Ω resistor are connected as shown in figure below .Each diode has a resistence of 1Ω Find the current

flows through the 10 Ω.



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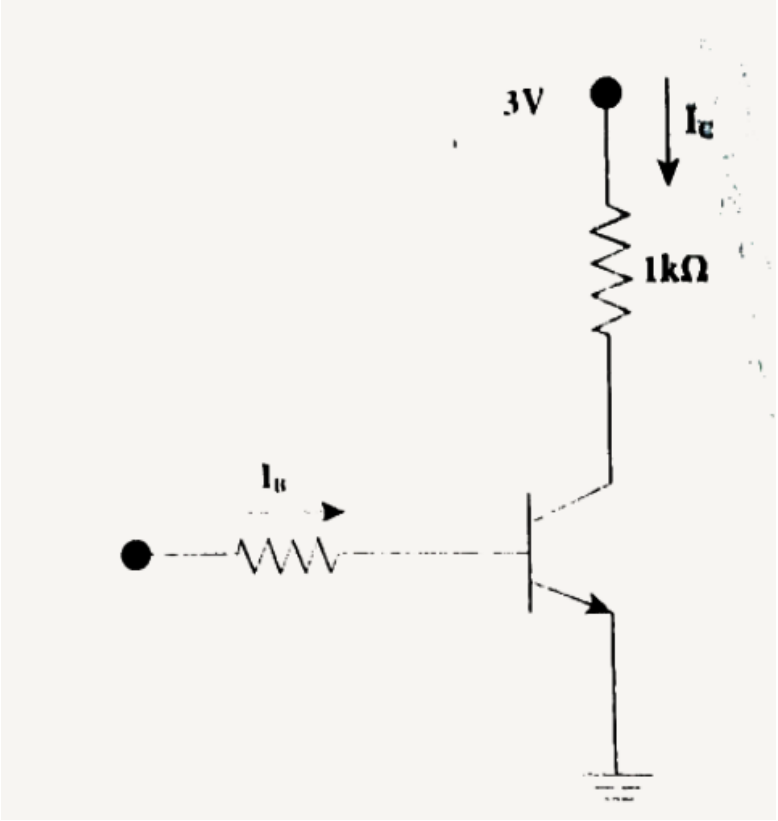
3. Assuming $V_Cesat = 0.2V$ =0.2 and $\beta = 50$,Find the minium base current (I_B) required to drive transitor given in the figure to saturation.



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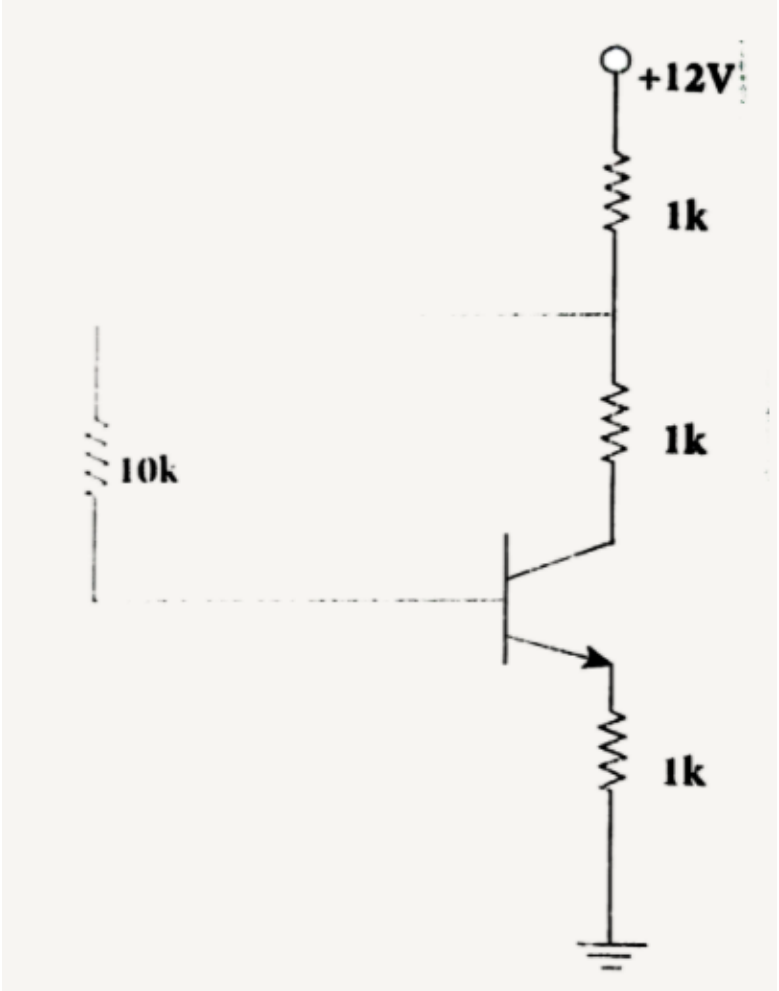
4. A transistor having α=0.99 and V_BE=0.7V, is given in the circuit. Find the value of the

collector current.



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5. In the circuit shown in the figure , the BJT has a current gain $(\beta)$of 50. For an emitter-base voltage V_EB=600 mV, calculate the emitter- collector volatge V_EC(in volts). 

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Additional Question M C Q

1. The probability of electrons to be found in the conduction band of an intrinsic

semiconductor at a finite temperature

A. increase exponentially with increasing band gap

B. decrease exponentially with increasing band gap

C. decreases with increasing temperature

D. is independent of the temperature and the band gap

Answer: b

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2. The electrical conductivity of a semiconductor increase when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in eV for the semiconductor is

A. 0.9

B. 0.7

C. 0.5

D. 1.1

Answer: c

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3. Which of the following statements is not true?

A. The resistance of intrinsic semiconductor decreases with increase of temperature.

B. Doping pure Si with trivalent impurities gives p-type semiconductors.

C. The majority carriers in n-type semiconductors and holes

D. A p-n junction can act as a semiconductor diode.

Answer: c

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4. Holes are charge carrier in

A. intrinsic semiconductors

B. ionic solids

C. p-type semiconductor

D. metals

Answer: a

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5. A transistor is used in the common emitter mode as an amplifier. Then

A. the base-emitter junction is forward-biased

B. the base-emitter junction is reverse -biased

C. the input signal is connected in series with the voltage applied to blast the base-emitter junction

D. the input signal is connected in series with the voltage applied to bias the base-collector junction.

Answer: c

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6. The energy band gap is maximum in

A. metals

B. superconductors

C. insulators

D. semiconductors

Answer: c

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7. At absolute zero, Si acts as

A. non-metal

B. metal

C. insulator

D. none of these

Answer: c

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8. A piece of copper and another of germanium are cooled from room temperature to 77 K. The resistance of

A. each of these decreases

B. copper strip increases and that of germanium decreases

C. copper strip decreases and that of germanium increases

D. each of these increases

Answer: c

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9. In the middle of the depletion layer of reverse biased p-n junction, the

A. electric field is zero

B. potential is zero

C. potential is maximum

D. electric field is maximum

Answer: a

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10. A full wave rectifier is operating at 50 Hz, 220v the fundamental frequency of ripple will be -

A. 50 Hz

B. 25 Hz

C. 100 Hz

D. 70.7 Hz

Answer: c

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11. The part of a transistor, which is heavily doped to produce a large number of majority carriers is called

A. emitter

B. base

C. collector

D. any one out of emitter, base and collector

Answer: a

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12. when NPN transistor is used as an amplifier then .....

A. electrons move from base to collector

B. boles move from emitter to base

C. electrons move from collector to base

D. holes move from base to emitter

Answer: a

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13. In a common-base amplifier, the phase difference between the input signal voltage and the output voltage (across collector and base) is

A. 0

B. $\pi/4$

C. $\pi/2$

D. π

Answer: a

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14. In a common-base mode of a transistor, the collector current is 5.488 mA for an emitter current of 5.60 A. The value of the base current amplification factor (β) will be

A. 49

B. 50

C. 51

D. 48

Answer: a

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15. Match the following

1.	J.J. Thomson	(a)	Atomic model for hydrogen atom
2.	Rutherford	(b)	Theoretical atom model
3.	Geiger and Marsden	(c)	Nucleus
4.	Neils Bohr	(d)	Scattering of alpha particles

A. OR gate

B. NOR gate

C. AND gate

D. NAND gate

Answer: a

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16. In a fcc lattice structure, what is the effective number of atoms?

A. 4

B. 3

C. 2

D. 1

Answer: a

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17. Monoclinic crystal lattice has dimensions

A. $\alpha = \beta = \gamma$

B. $\alpha = \beta = 90^\circ, \gamma \neq 90^\circ$

C. $\alpha \neq \beta \neq \gamma$

D. none of these

Answer: b

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18. In insulators

A. valence band is partially filled

B. conduction band is partially filled with electrons

C. conduction band is filled with electrons and valence band is empty

D. conduction band is empty and valence band is completely filled with electrons

Answer: d

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19. The valence band and conduction band of a solid overlap at low temperature, the solid may be

A. a metal

B. a semiconductor

C. an insulator

D. none of these

Answer: a

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20. If germanium is dopped with arsenic, that will result in

A. n-type semiconductor

B. p-type semiconductor

C. intrinsic semiconductor

D. none of these

Answer: a

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21. n-type semiconductor is

A. positive charged

B. negatively charged

C. neutral

D. positive or negative depending upon doping material

Answer: d

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22. To a germanium crystal equal number of aluminium and indium atoms are added. Then

A. it remains an intrinsic semiconductor

B. it becomes an n-type semiconductor

C. it becomes a p-type semiconductor

D. it becomes an insulator

Answer: c

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23. The dominant contribution to current comes from holes in case of

A. metals

B. intrinsic semiconductors

C. p-type extrinsic semiconductors

D. n-type extrinsic semiconductors

Answer: c

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24. For a heavily doped n-type semiconductor, fermi-level lies

A. a little below the conduction band

B. a little above the valence band

C. a little inside the valence band

D. at the centre of the band gap

Answer: a

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25. The coordination number for a bcc crystal is

A. 4

B. 8

C. 12

D. 6

Answer: b

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26. If the forward voltage in a diode is increased the width of the depletion region

A. increases

B. decreases

C. fluctuates

D. no change

Answer: b

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27. In order to rectify an alternating current one uses a

A. thermocouple

B. diode

C. triode

D. transistor

Answer: b

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28. Why is there sudden increase in current in Zener diode?

A. due to rupture of bonds

B. resistance of depletion layer becomes less

C. due to high doping

D. none of the above

Answer: a

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29. In a transistor

A. there is 1 p -n junction

B. there are 2 p-n junction

C. there are 3 p -n junction

D. none of the above

Answer: b

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30. Let i_e, i_e and i_b represent emitter current, collector current and the base current of a transistor,

A. $i_c > i_e$

B. $i_b > i_c$

C. $i_b < i_c$

D. $i_e > i_e$

Answer: d

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31. In common - emitter amplifier the ratio $\frac{I_C}{I_E}$

0.98. The current gain will be

A. 4.9

B. 7.8

C. 49

D. 78

Answer: c

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32. The gate for which output is high, if atleast one input is low?

A. NAND

B. NOR

C. AND

D. OR

Answer: a

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33. An oscillator is nothing but an amplifier with

A. positive feedback

B. large gain

C. no feedback

D. negative feedback

Answer: a

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34. Crystalline solid are

A. anisotropic

B. isotropic

C. amorphous

D. none of these

Answer: a

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35. Which among the following is an amorphous solid ?

A. Glass

B. Diamond

C. Salt

D. Sugar

Answer: a

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36. Energy required to break one band in DNA is

A. $\approx 1eV$

B. $\approx 0.1eV$

C. $\approx 0.01eV$

D. $\approx 2.1eV$

Answer: a

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37. An intrinsic semiconductor, at the absolute zero temperature, behaves like a/an

A. insulator

B. superconductor

C. n-type semiconductor

D. p-type semiconductor

Answer: a

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38. In a semiconducting material the mobilities of electrons and holes are, μ_e and μ_h respectively. Which of the following is true?

A. $\mu_e > \mu_h$

B. $\mu_e < \mu_h$

C. $\mu_e = \mu_h$

D. $\mu_e < 0, \mu_h > 0$

Answer: a

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39. In a pure semiconductor crystal, if current flows due to breakage of crystal bonds, then the semiconductor is called

A. acceptor

B. donor

C. intrinsic semiconductor

D. extrinsic semiconductor

Answer: c

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40. Which of the following, when added as an impurity into the silicon, produces n-type semiconductor?

A. phosphorous

B. aluminium

C. magnesium

D. both (b) and (c)

Answer: a

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41. In n-type semiconductors, majority charge carriers are

A. holes

B. protons

C. neutrons

D. electrons

Answer: d

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42. In p-type semiconductor,

A. major current carrier are electrons

B. major carrier are mobile negative ions

C. major carrier are mobile holes

D. the number of mobile holes exceeds the number of acceptor atoms

Answer: c

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43. The potential barrier in the depletion layer is due to

A. ions

B. holes

C. electrons

D. forbidden band

Answer: a

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44. When a p-n diode is reverse biased, then

A. no current flows

B. the depletion region is increased

C. the depletion region is reduced

D. the height of the potential barrier is reduced

Answer: b

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45. If an p-n diode is reverse biased, then the resistance measured by an ohm meter, will be

A. zero

B. low

C. high

D. infinite

Answer: c

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46. Diode is used as an a

A. oscillator

B. amplifier

C. rectifier

D. modulator

Answer: c

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47. A full wave rectifier is operating at 50 Hz, 220v the fundamental frequency of ripple will be -

A. 25 Hz

B. 50 Hz

C. 70.7 Hz

D. 100 Hz

Answer: b

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48. Zener diode acts as a/an

A. oscillator

B. regulator

C. rectifier

D. filter

Answer: b

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49. A transistor is a/an

A. chip

B. insulator

C. semiconductor

D. metal

Answer: c

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50. The minimum potential difference between the base and emitter required to switch a silicon transistor ON is approximately.

A. IV

B. 3V

C. 5V

D. 4.2 V

Answer: a

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51. when NPN transistor is used as an amplifier then .....

A. holes moves from emitter

B. electrons move from base to collector

C. holes move from base to emitter

D. electrons move from collector to base

Answer: b

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52. The current gain for a transistor working as common base amplifier is 0.96. If the emitter current is 7.2 mA, then the base current is

A. 0.29 mA

B. 0.35 mA

C. 0.39 mA

D. 0.43 mA

Answer: a

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53. Consider an n-p-n transistor amplifier in common - emitter configuration. The current gain of the transistor is 100. If the collector

current changes by 1 mA, what will be the change in emitter current?

A. 1.1 mA

B. 1.01 mA

C. 0.01 mA

D. 10 mA

Answer: b

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54. An amplifier has voltage gain A = 1000 . The voltage gain in dB is ..... .

A. 30 dB

B. 60dB

C. 3 dB

D. 20 dB

Answer: b

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55. Boolean algerbra is essentially based on

A. logic

B. truth

C. numbers

D. symbol

Answer: a

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56. The number (0) zero is required for

A. transistor

B. abacus

C. computer

D. calculator

Answer: c

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57. Which of the following logic gates in a universal gate?

A. OR

B. NOT

C. AND

D. NAND

Answer: d

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58. Which of the following is the weakest kind of the bonding in solids?

A. Ionic

B. Metallic

C. Van der Waals

D. Covalent

Answer: c

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59. he cations and anions are arranged in alternate form in

A. metallic crystal

B. ionic crystal

C. covalent crystal

D. semiconductor crystal

Answer: b

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60. Diamond is very hard because

A. it is covalent solid

B. it has large cohesive energy

C. high melting point

D. insoluble in all solvents

Answer: b

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61. Calculate the number of atoms per unit cell of bcc type.

A. 9

B. 4

C. 2

D. 1

Answer: c

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62. At absolute zero, Si acts as

A. non metal

B. metal

C. insulator

D. none of these

Answer: c

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63. Which of the following, when added as an impurity into the silicon, produces n-type semiconductor?

A. B

B. AL

C. P

D. Mg

Answer: c

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64. Only P is a pentavalent impurity atom,its doping with germanium produces a p-types semi-conductor

A. indium

B. phosphorus

C. arsenic

D. antimony

Answer: a

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65. When arsenic is added as an impurity to silicon, the resulting material is

A. n-type conductor

B. n-type semiconductor

C. P-type semiconductor

D. none of these

Answer: b

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66. In a p-type semiconductor, the majority carriers of current are

A. protons

B. electrons

C. holes

D. neutrons

Answer: c

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67. The depletion layer in the p-n junction region is caused by

A. drift of holes

B. diffusion of charge carriers

C. migration of impurity ions

D. drift of electrons

Answer: b

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68. In the depletion region of an unbiased p-n junction diode, there are

A. holes

B. mobile ions

C. electrons

D. immobile ions

Answer: d

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69. In forward bias the width of potential barrier in a p-n diode

A. remain constant

B. decreases

C. increases

D. first (a) then (b)

Answer: b

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70. Reverse bias applied to a junction diode

A. lowers the potential barrier

B. raises the potential barrier

C. increases the majority carrier current

D. increases the minority carrier curtom

Answer: b

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71. Barrier potential of a p-njunction diode does not depend on

A. diode design

B. temperature

C. forward bias

D. doping density

Answer: a

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72. The peak voltage in the output of a half wave diode rectifier fed with a sinusoidal signal without filter is 10 V. The d.c component of the output voltage is

A. $\frac{10}{\sqrt{2}}$V

B. $\frac{10}{\pi}$V

C. 10 V

D. $\frac{20}{\pi}$V

Answer: b

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73. A p-n diode can be used as

A. condenser

B. regulator

C. amplifier

D. rectifier

Answer: d

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74. Zener diode is used for

A. amplification

B. rectification

C. stabilisation

D. producing oscillations in an oscillator

Answer: c

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75. when NPN transistor is used as an amplifier then .....

A. electrons move from collector to base

B. electrons move from collector to base

C. electrons move from base to collector

D. electrons move from emitter to base

Answer: c

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76. The correct relationship between the two current gains α and β in a transistor is

A. $\alpha = \frac{\beta}{1+\beta}$

B. $\alpha = \frac{1+\beta}{\beta}$

C. $\beta = \frac{\alpha}{1+\alpha}$

D. $\beta = \frac{\alpha}{\alpha-1}$

Answer: a

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77. The correct relation for α, β for a transistor is

A. $\beta = \frac{1-\alpha}{\alpha}$

B. $\beta = \frac{\alpha}{1-\alpha}$

C. $\alpha = \frac{\beta - 1}{\beta}$

D. $\alpha\beta = 1$

Answer: b

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78. In common - emitter amplifier the ratio $\frac{I_C}{I_E}$ 0.98. The current gain will be

A. 49

B. 98

C. 4.9

D. 25.5

Answer: a

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79. Radio waves of constant amplitude can be generated with

A. FET

B. filter

C. rectifier

D. oscillator

Answer: d

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80. An oscillator is an amplifier with

A. a large gain

B. negative feedback

C. positive feedback

D. no feedback

Answer: c

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81. The output of OR gate is 1

A. if both inputs are zero

B. if either or both inputs are 1

C. only if both inputs are 1

D. if either input is zero

Answer: b

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82. The device which easily closes or opens an electric circuit is called as_____.

A. junction diode

B. integrated circuit

C. junction transistor

D. zener diode

Answer: b

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83. At absolute zero temperature, a semiconductor acts as a/an

A. dielectric

B. conductor

C. insulator

D. none of these

Answer: c

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84. At which temperature, a pure semiconductor behave slightly as a conductor?

A. low temperature

B. room temperature

C. high temperature

D. both (a) and (b)

Answer: b

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85. In germanium crystal, the forbidden energy gap in joule is

A. 1.6×10^{-19}

B. zero

C. 1.12×10^{-19}

D. 1.76×10^{-19}

Answer: c

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86. In a p-type semiconductor, germanium is doped with

A. gallium

B. boron

C. aluminium

D. all of these

Answer: d

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87. The major carrier of current in a p-type semiconductor will be

A. neutrons

B. protons

C. electrons

D. holes

Answer: d

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88. Rectification is the process of conversion of

A. a.c into d.c

B. low a.c into high a.c

C. d.c into a.c

D. low d.c into high d.c

Answer: a

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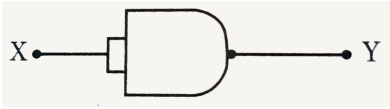
89. Which type of gate is represented by the given figure?



A. NAND

B. NOT

C. AND

D. OR

Answer: b

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90. Which of the following gates can be served as a building block for any digital circuit

A. OR

B. NOT

C. AND

D. NAND

Answer: d

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Additional Question Short Answer Questions

1. What are passive and active components.

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2. Define energy band.

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3. What is forbidden energy gap?

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4. What are intrinsic semiconductor?

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5. What are extrinsic semiconductor?

Watch Video Solution

6. What are holes?

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7. What is meant by biasing and bias voltage?

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8. Define forward bias.

Watch Video Solution

9. Explain knee voltage.

Watch Video Solution

10. What is a Rectification?

Watch Video Solution

11. Define - Efficiency of rectifier.

Watch Video Solution

12. What is meant by zener effect?

Watch Video Solution

13. What is a Zener diode ?

Watch Video Solution

14. Write down the applications of zener diode.

Watch Video Solution

15. What is peak inverse voltage (PIV)?

Watch Video Solution

16. What are Optoelectronic devices?

Watch Video Solution

17. Write down the applications of LED's?

Watch Video Solution

18. Write down the applications of photodiodes?

Watch Video Solution

19. Write down the applications of solar cell.

Watch Video Solution

20. What is a solar cell.

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21. Mention the application of a oscillators.

Watch Video Solution

22. Write down concept of Barkhausen conditions for sustained oscillations.

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Additional Question Long Answer Questions

1. Explain the classification of materials.

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2. Explain zener diode as votltage regulator .

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3. Write down the concept in details of Integrated Chips (IC's)

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Additional Question Numerical Problems

1. If the energy of a photon of sodium light $(\lambda = 589nm)$ equals the band gap of a semiconductor, calculate the minimum energy required to create hole-electron pair.

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2. In an P.N.P transistor circuit, the collector current is 10 mA. If 90% of the electrons emitted reach the collector.

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3. In the circuit, the value of β is 100. find I_B, V_{CE}, V_{BE} and V_{BC}, when I_C=1.5mA. The transistor is in active, cut off or saturation state?

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4. A transistor has $\alpha = 0.95$.If the emitter curent is 10 mA,What is (a) the collector current ,(b)the base current and (c)gainβ?

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5. For a BJT , the common- base current gain $\alpha = 0.98$ and the collector base junction reverse bias saturation $I_{CO} = 0.6\mu A$. This BJT is connected in the commone emitter mode and operated in the active region with a base drive current $I_B = 20\mu A$. The collector current I_C for this of operating is .

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6. An NPN BJT having reverse saturation currents $I_S = 10^{-15}$ A is biased in the forwared active region withV_BE=700mV and the current gain (β)may vary from 50 to 150 due to manufacturing variation. What is the maximum emitter currents(inμA).

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