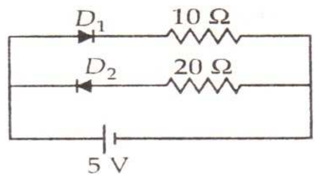
Electronic Devices

AIPMT

2012

1. **Two ideal diodes are connected to a battery as shown in the circuit. The current supplied by the battery is**



a) 0.75A b) zero c) 0.25 A d) 0.5 A

2. **In a CE transistor amplifier, the audio signal voltage across the collector resistance of 2kΩ is 2 V. If the base resistance is 1kΩ and the current amplification of the transistor is 100, the input signal voltage is**

a) 0.1 V b) 1.0V c) 1 mV d) 10 mV

3. **C and Si both have same lattice structure; having 4 bonding electrons in each. However, C is insulator where as Si is intrinsic semiconductor. This is because**

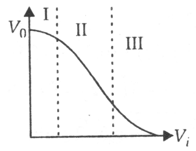
a) In case of C the valence band is not completely filled at absolute zero temperature

b) In case of C the conduction band is partly filled even at absolute zero temperature

c) The four bonding electrons in the case of C lie in the second orbit, whereas in the case of Si they lie in the third.

d) The four bonding electrons in the case of C lie in the third orbit, whereas for Si they lie in the fourth orbit

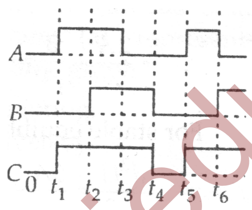
4. **Transfer characteristics [output voltage (V_0) vs input voltage (V_i) for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used**



a) In region III b) Both in region (I) and III

c) In region II d) In region I

5. **The figure shows a logic circuit with two inputs A and B and the output C. The voltage wave forms across A, B and C are as given. The logic circuit gate is**

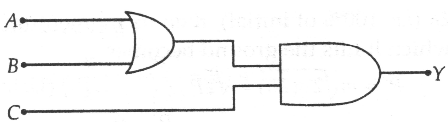


a) OR gate b) NOR gate c) AND gate d) NAND gate

6. **The input resistance of a silicon transistor is 100Ω. Base current is changed by 40μA which results in a change in collector currently by 2mA. This transistor is used as a common emitter amplifier with a load resistance of 4 k Ω. The voltage gain of the amplifier is**

a) 2000 b) 3000 c) 4000 d) 1000

7. **To get an output Y = 1 in given circuit which of the following input will be correct?**



A B C	A B C	A B C	A B C
a) 1 0 0	b) 1 0 1	c) 1 1 0	d) 0 1 0

2011

8. A transistor is operated in common emitter configuration at V_C = 2V such that a change in the base current from 100 μA to 300 μA produces a change in the collector current from 10 mA to 20 mA. The current gain is

a) 50 b) 75 c) 100 d) 25

9. In forward biasing of the p-n junction

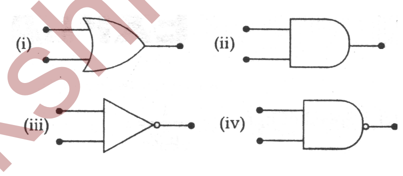
a) The positive terminal of the battery is connected to p-side and the depletion region becomes thick.

b) The positive terminal of the battery is connected to n-side and the depletion region becomes thin.

c) The positive terminal of the battery is connected to n-side and the depletion region becomes thick.

d) The positive terminal of the battery is connected to p-side and the depletion region becomes thin.

10. Symbolic representation of four logic gates are shown as



Pick out which ones are for AND, NAND and NOT gates, respectively

a)(ii), (iii) and (iv) b) (iii), (ii) and (i)

c) (iii), (ii) and (iv) d) (i), (iv) and (iii)

11. If a small amount of antimony is added to germanium crystal

a) It becomes a p-type semiconductor.

b) The antimony becomes an acceptor atom.

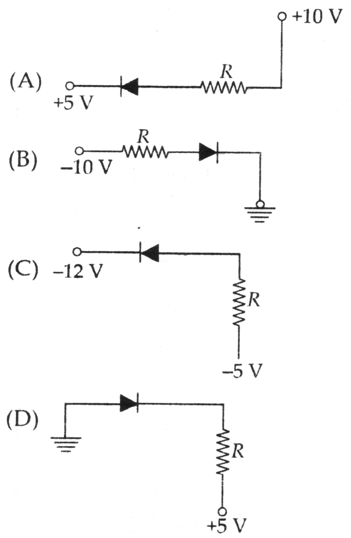
c) There will be more free electrons than holes in the semiconductor.

d) The resistance is increased.

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

a) 5 mA b) 10 mA c) 15 mA d) 20 mA

13. **In the following figure, the diode which are forward biased, are**



a) (A), (B) and (D) b) (C) only

c) (C) and (A) d) (B) and (D)

14. **Pure Si at 500 K has equal number of electron (n_e) and hole (n_h) concentrations of 1.5x $10^{16}m^{-3}$. Doping by indium increases n_h to 4.5x $10^{22}m^{-3}$. The doped semiconductor is of**

a) p-type having electron concentration n_e = 5x 10^9m^{-3}

b) n-type with electron concentration n_e = 5x $10^{22}m^{-3}$

c) p-type with electron concentration n_e = 2.5x $10^{10}m^{-3}$

d) n-type with electron concentration n_e = 2.5x $10^{23}m^{-3}$

2010

15. Which one of the following statement is false?

a) Pure Si doped with trivalent impurities gives a p-type semiconductor.

b) Majority carriers in a n-type semiconductor are holes.

c) Minority carriers in a p-type semiconductor are electrons.

d) The resistance of intrinsic semiconductor decreases with increase of temperature.

16. Which one of the following bonds produces a solid that reflects light in the visible region and whose electrical conductivity decreases with temperature and has high melting point?

a) Metallic bonding b) Van der Waal's bonding

c) Ionic bonding d) Covalent bonding

17. The device that can act as a complete electron circuit is

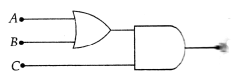
a) Junction Diode b) Integrated Circuit

c) Junction Transistor d) Zener Diode

18. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is

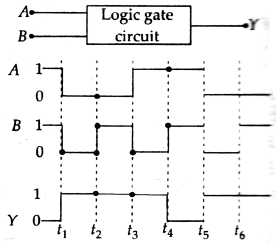
a) 500 b) 1000 c) 1250 d) 50

19. To get an output Y = 1 from the circuit shown below, the input must be



	A	B	C
a)	0	1	0
b)	0	0	1
c)	1	0	1
d)	1	0	0

20. **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 Y are as given**



The logic gate is

a) NOR gate b) OR gate

c) AND gate d) NAND gate

21. **For transistor action**

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

b) The base region must be very thin the lightly doped.

c) The emitter-base junction is forward biased and base-collector junction is reverse biased.

d) Both the emitter-base junctions as well as the base-collector junction are forward biased.

Which one of the following pairs of statements is correct?

a) (d) and (a) b) (a) and (b)

c) (b) and (c) d) (c) and (d)

Key

1. d	**2. d**	**3.c**	**4.b**	**5.a**	**6.a**	**7.b**
8. a	**9.d**	**10.d**	**11.c**	**12.a**	**13.c**	**14.a**
15. b	**16.a**	**17. b**	**18.c**	**19. c**	**20. D**	**21.c**

Solutions

1. (d)

In the given circuit the upper diode D_1 is forward biased and the lower diode D_2 is reverse biased. So, the current supplied by the battery is

$$I = \frac{5V}{10\Omega} = \frac{1}{2}A = 0.5A$$

2. (d)

Here, $R_c = 2k\Omega = 2 \times 10^3\ \Omega$

$V_0 = 2V$

$R_B = 1k\Omega = 1\times10^3\Omega$

$\beta = 100$

Output voltage, $V_0 = I_C R_C$

Or $I_C = \frac{V_0}{R_C} = \frac{2V}{2\times10^3\Omega} = 10^{-3}A = 1mA$

As $\beta = \frac{I_C}{I_B}$ or $I_B = \frac{I_C}{\beta}$

$$I_B = \frac{10^{-3}A}{100} = 10^{-5}A$$

Input voltage, $V_i = I_B R_B = (10^{-5} a)(1 \times 10^3 \ \Omega)$

$= 10^{-2} V = 10 \ mV$

3. (c)

The electronic configuration of carbon (^6c) is $1s^2 \ 2s^2 \ 2p^2$. The electronic configuration of silicon (^{14}Si) is $1s^2 \ 2s^2 \ 2p^6 \ 3s^2 \ 3p^2$.

Hence, the four bonding electrons of C and Si respectively lie in second and third orbit.

4. (b)

In the given graph

Region (I) – Cutoff region

Region (II) – Active region

Region (III) – Saturation region

Using transistor as a amplifier it is used in active region

5. (a)

The truth table of the given waveform is as shown in the table.

Timeinterval	Input A	Input B	Output C
O to t_1	0	0	0
t_1 to t_2	1	0	1
t_2 to t_3	1	1	1
t_3 to t_4	0	1	1
t_4 to t_5	0	0	0
t_5 to t_6	1	0	1
$> t_6$	0	1	1

The logic circuit is OR gate.

6. (a)

Here,

Input resistance, $R_i = 100\Omega$

Change in base current, $\Delta I_B = 40\mu A$

Change in collator current, $\Delta I_C = 2mA$

Load resistance, $R_L = 4k\Omega = 4\times10^3\Omega$

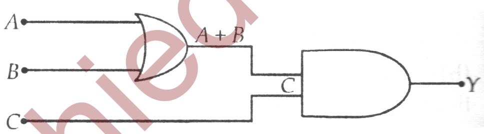
Current gain, $\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{2mA}{40\mu A}$

$$= \frac{2\times10^{-3}A}{40\times20^{-6}A} = 50$$

Voltage gain of the amplifier is

$$A_V = \beta\frac{R_L}{R_i} = 50\times\frac{4\times10^3}{100} = 2000$$

7. (b)



The Boolean expression of the given circuit is Y = (A+2).C

The truth table of the given inputs is as shown in the table.

Inputs			Output
A	B	C	Y=(A+2).C
1	0	0	0
1	0	1	1
1	1	0	0
0	1	0	0

From the above truth table it is clear that Y = 1, when A = 1, B = 0 and C = 1

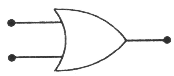
8. (a) Current gain, $\beta = \frac{\Delta I_C}{\Delta I_B}$

[Common emitter configuration]

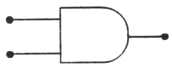
$$= \frac{(20-10)\,mA}{(300-100)\,\mu A} = \frac{10\times10^{-3}\,A}{200\times10^{-6}\,A} = 50$$

9. (d) In forward biasing, the positive terminal of the battery is connected to p-side and the negative terminal to n-side of p-n junction. The forward bias voltage opposes the potential barrier. Due to it, the depletion region becomes thin.

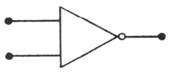
10. (d)

(i) 

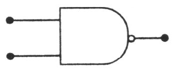
It represents logic symbol of OR gate.

(ii) 

It represents logic symbol of AND gate.

(iii) 

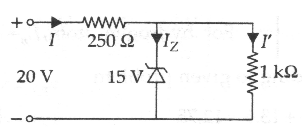
It represents the logic symbol of NOT gate.

(iv) 

It represents the logic symbol of NAND gate.

11. (c) When a small amount of antimony (pentavalent) is added to germanium (tetravalent) crystal and then crystal becomes n-type semiconductor. In n-type semiconductor electrons are the majority charge carriers and the holes are the minority charge carriers.

12. (a)



The voltage drop across 1 kΩ = V_Z = 15 V

The current through 1 kΩ is

$$I' = \frac{15V}{1\times10^{3}\Omega} = 15\times10^{-3} A = 15mA$$

The voltage drop across 250Ω = 20 V – 15 V = 5 V

The current through 250 Ω is

$$I = \frac{5V}{250\Omega} = 0.02A = 20\,mA$$

The current through the zener diode is

I_Z = I – I' = (20 – 15) mA = 5 mA

13. (c)

p-n junction is said to be forward biased when p side is at high potential than n side. It is for circuit (a) and (c).

14. (a)

P-type semiconductor is obtained when Si or Ge is doped with a trivalent impurity like aluminium (Al), boron (2), indium (In) etc,

Here, $n_i = 1.5 \text{ x } 10^{-16}$ m^{-3}

$n_h = 4.5 \text{ x } 10^{22}$ m^{-3}

As $n_e n_h = n_i^2$

$$n_e = \frac{n_i^2}{n_h} = \frac{\left(1.5\times10^{16} m^{-3}\right)^2}{4.5\times10^{22} m^{-3}} = 5\times10^{9} m^{-3}$$

15. (b) In a n-type semiconductors, electrons are majority carriers and holes are minority carriers.

In a p-type semiconductor holes are majority carriers and electrons are minority carriers

16. (a)

17. (b) The device that can act as a complete circuit is integrated circuit (Ic)

18. (c)

Voltage gain = 50

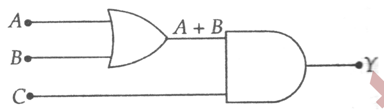
Input resistance, $R_i = 100\,\Omega$

Output resistance, $R_0 = 200\,\Omega$

Resistance gain = $\frac{R_0}{R_1} = \frac{200\Omega}{100\Omega} = 2$

Power gain = $\frac{(Voltage\ gain)^2}{Resistance\ gain} = \frac{50 \times 50}{2} = 1250$

19. (c)



The Boolean expression of the given circuit is

Y = (A+2) C

The truth table of the given input signals as shown in the table

A	B	C	A+B	Y=(A+2)C
0	1	0	1	0
0	0	1	0	0
1	0	1	1	1
1	0	0	1	0

From the truth table we conclude that output Y = 1, for the inputs A = 1, B = 0, C = 1

Hence option (c) is correct.

20. (d) It is clear from given logic circuit, that output Y is low when both the inputs are high, otherwise it is high. Thus logic circuit is NAND gate.

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

21. (c)

AIIMS

2011

1. Assertion: Transistor can be used as a switch.

Reason: Both linear and non-linear voltage bias dependence occurs in it.

2. For a common-emitter transistor, input current is 5 $\mu A, \beta = 100$ circuits is operated at load resistance of 10Ω, then voltage across collector emitter will be

a) 5 V b) 10 V c) 12.5 V d) 7.5 V

Solutions

1. Sol: (b)

The transistor can be used as a switch, amplifier and oscillator

2. Sol: (c)

Here, $I_B = 5\mu A = 5 \times 10^{-6}$A

$\beta = 100$

$R_L = 10k\Omega = 10\times10^3\Omega$

As $\beta = \frac{I_C}{I_B}$

Or $I_C = (100)(5x10^{-6}\ a) = 5\ x\ 10^{-4}$ A

The voltage across collector emitter is

$$V_{CE} = R_L I_C = \left(10\times10^3\Omega\right)\left(5\times10^{-4}A\right) = 5V$$