PRACTICE QUESTIONS

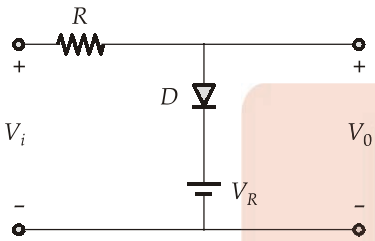
for SSC-JE : CBT-2

Basic Electronics

Electrical Engineering

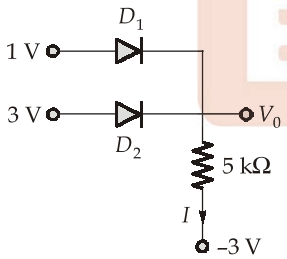
06 Basic Electronics

Q.1 In the circuit shown below the input V_i has positive and negative swings. V_o is the output.



(a) $V_o = 0$ for negative V_i
(b) $V_o = V_R$ for positive V_i
(c) $V_o = V_R$ for $V_i > V_R$
(d) $V_o = V_R$ for all V_i

Q.2 Consider the circuit shown in the figure below:



If diode D_1 and D_2 are made up of same material with the cut-in voltage $V_\gamma = 0.7$ V, then the value of current I is equal to

(a) 0.46 mA (b) 0.99 mA
(c) 0.59 mA (d) 1.06 mA

Q.3 The ratio of available power from the DC component of a full-wave rectified sinusoid to the available power of the rectified sinusoid is

(a) $8/\pi$ (b) 2
(c) $4/\pi$ (d) $8/\pi^2$

Q.4 A semiconductor material with impurities added is

(a) an extrinsic semiconductor
(b) an intrinsic semiconductor
(c) an *N*-type semiconductor
(d) a *P*-type semiconductor

Q.5 Boron and Indium are two commonly used trivalent impurities used for doping of semiconductors. Another is

(a) Arsenic (b) Phosphorus
(c) Aluminium (d) none of these

Q.6 The conductivity of a semiconductor crystal due to any current carrier is NOT proportional to

(a) mobility of the carrier
(b) effective density of states in the conduction band
(c) electronic charge
(d) surface states in the semiconductor

Q.7 The depletion region in a semiconductor *p-n* junction diode has

(a) Electrons and holes
(b) Positive and negative ions on either side
(c) Neither electrons nor ions
(d) No holes

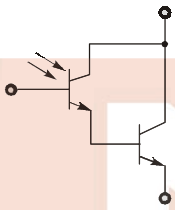
Q.8 The most common commercially available tunnel diodes are made from

(a) Silicon
(b) Gallium Arsenide
(c) Germanium
(d) any of the above

Q.9 The dynamic resistance of a semiconductor diode in forward biased is
(a) same as its static resistance
(b) much larger than its static resistance
(c) much smaller than its static resistance
(d) typically few ohms

Q.10 A tunnel diode
(a) is a current controllable device
(b) is a voltage controllable device
(c) has a cut-in voltage of 0.2 V
(d) none of these

Q.11 Recognise the device from the circuit symbol of figure

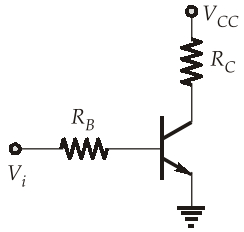


(a) Darlington
(b) Photo-transistor
(c) Photo-darlington
(d) none of these

Q.12 Which one of the following semiconductor junction diodes has a relatively much higher dopant concentration?
(a) Varactor
(b) Tunnel diode
(c) Zener diode
(d) Schottky barrier diode

Q.13 A solar cell is
(a) a thermal detector based on pyroelectric effect
(b) a quantum detector based on photo-conductive effect
(c) a quantum detector based on photovoltaic effect
(d) a quantum detector based on charge coupled concept

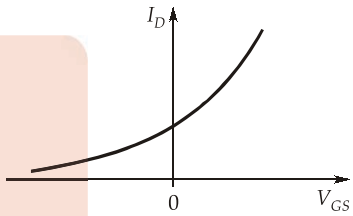
Q.14 In the transistor circuit shown, give the reason for collector to ground voltage to be V_{CC}.



(a) Collector emitter terminals shorted
(b) Collector resistance open circuit
(c) Input voltage V_i is negative
(d) Collector base terminal shorted.

Q.15 The efficiency of the solar cell depends upon
(a) incident light intensity
(b) the junction capacitance
(c) minority carrier lifetimes
(d) majority carrier lifetimes

Q.16 The variation of drain current with gate-to-source voltage (I_D – V_{GS}) of a MOSFET is shown in figure. The MOSFET is



(a) an n-channel depletion mode device
(b) an n-channel enhancement mode device
(c) an p-channel depletion mode device
(d) an p-channel enhancement mode device

Q.17 If a transistor is operating with both of its junctions forward biased, but with the collector base forward bias greater than the emitter - base forward bias, then it is operating in the
(a) forward active mode
(b) reverse saturation mode
(c) reverse active mode
(d) forward saturation mode

Q.18 For a *npn* bipolar transistor, what is the main stream of current in the base region
(a) Drift of holes
(b) Diffusion of holes
(c) Drift of electrons
(d) Diffusion of electrons

Q.19 *n-p-n* transistors are preferred over *p-n-p* transistors because they have
(a) high mobility of holes
(b) high mobility of electrons

(c) low mobility of holes
(d) higher mobility of electrons than the mobility of holes in *p-n-p* transistors

Q.20 Early effect in BJT refers to
(a) Avalanche breakdown
(b) Thermal runway
(c) Base narrowing
(d) Zener breakdown

Q.21 In a junction transistor, the collector cutoff current 'I_{CBO}' reduces considerably by doping the
(a) Emitter with high level of impurity
(b) Emitter with low level of impurity
(c) Collector with high level of impurity
(d) Collector with low level of impurity

Q.22 Two *p-n* junction diodes are connected back to back to make a transistor. Which one of the following is correct
(a) The current gain will high
(b) The current gain will moderate
(c) It can't be used as transistor due to large base width
(d) It can be used only for pnp transistor

Q.23 To avoid thermal runway in the design of an analog circuit, the operating point of BJT should be such that it satisfies the condition

(a) $V_{CE} = \frac{V_{CE}}{2}$ (b) $V_{CE} < \frac{V_{CC}}{2}$

(c) $V_{CE} > \frac{V_{CC}}{2}$ (d) $V_{CE} \le 0.75\ V_{CC}$

Q.24 Which of the following helps in reducing the switching time of a BJT?
(a) A resistor connected from base to ground.
(b) A resistor connected from emitter to ground.
(c) A capacitor connected from base to ground.
(d) A capacitor connected from emitter to ground.

Q.25 A bipolar junction transistor has a common base forward short circuit current gain of 0.99. Its common emitter forward short circuit current gain will be
(a) 50 (b) 99
(c) 100 (d) 200

Q.26 If $\alpha = 0.995$ $I_E = 10$ mA and $I_{co} = 0.5$ μA, then I_{CEO} will be
(a) 100 μA (b) 25 μA
(c) 10.1 mA (d) 10.5 mA

Q.27 If $(211)_x = (152)_8$, then the value of base 'x' is
(a) 3 (b) 5
(c) 7 (d) 9

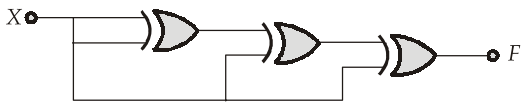
Q.28 The output of a logic gate is '1' when all its inputs are at logic '0'. Then the gate is either
(a) A NAND or an EX-OR gate
(b) A NOR or an EX-NOR gate
(c) An OR or an EX-NOR gate
(d) An AND or an EX-OR gate

Q.29 The minimized expression for the given *K* map (× : don't care) is

CD \ AB	00	01	11	10
00	0	0	1	1
01	0	×	×	1
11	×	×	1	×
10	1	0	1	1

(a) $A + \bar{B}C$ (b) $B + A\,C$
(c) $C + A\,B$ (d) $A\,B\,C$

Q.30 For the circuit shown below, output



(a) $F = 1$ (b) $F = 0$
(c) $F = X$ (d) $F = \bar{X}$

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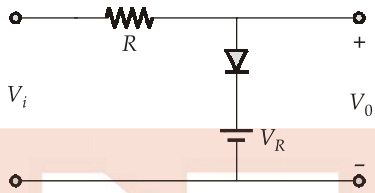
Answer Keys

1.	(c)	**2.**	(d)	**3.**	(d)	**4.**	(a)	**5.**	(c)	**6.**	(d)	**7.**	(b)
8.	(b)	**9.**	(c)	**10.**	(b)	**11.**	(c)	**12.**	(b)	**13.**	(c)	**14.**	(c)
15.	(a)	**16.**	(a)	**17.**	(b)	**18.**	(b)	**19.**	(d)	**20.**	(c)	**21.**	(a)
22.	(c)	**23.**	(b)	**24.**	(a)	**25.**	(b)	**26.**	(a)	**27.**	(c)	**28.**	(b)
29.	(a)	**30.**	(b)										

Detailed Solutions

1. (c)



Considering ideal diode :

for $V_i < V_R$, diode is OFF hence there is no current through R and $V_0 = V_i$.

For $V_i > V_R$, diode is ON hence

$$V_0 = V_R$$

(as diode will act as short circuit)

2. (d)

When D_2 is ON then the value of V_0 will be

$$V_0 = 3 - 0.7\ \text{V} = 2.3\ \text{V}$$

Hence, D_1 will be OFF.

Thus, the current,

$$I = \frac{2.3-(-3)}{5}\times 10^{-3}$$

$$= \frac{5.3}{5}\times 10^{-3} = 1.06\ \text{mA}$$

3. (d)

For full wave rectifier,

$$I_{dc} = \frac{2I_m}{\pi}$$

$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

$$\frac{P_{dc}}{P} = \frac{(I_{dc})^2 R}{(I_{rms})^2 R} = \frac{\left(\frac{2I_m}{\pi}\right)^2}{\left(\frac{I_m}{\sqrt{2}}\right)^2} = \frac{8}{\pi^2}$$

4. (a)

Semiconductor material with impurities is known as extrinsic semiconductor and without impurities (pure) - intrinsic.

5. (c)

Trivalent/Acceptor impurities - B, Al, Ga, In

Pentavalent / donar - P, As, Sb, Bi

6. (d)

Conductivity,

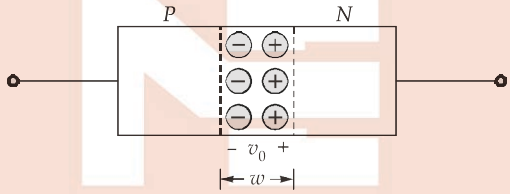
$$\sigma = nq\,\mu_n$$

μ_n : mobility of carrier

q : electron charge

n : effective density of states in conduction band

7. (b)



8. (b)

$\frac{I_p}{I_v}$ = 15 for GaAs = 7.5 for Ge = 2.5 for Si

This ratio must be high. Hence GaAs is preferred.

9. (c)

Dynamic resistance of diode, $r = \frac{\eta V_T}{I_f}\Omega$

$$r_{si} > r_{Ge}$$

Static resistance, $R_f = \frac{V}{I}$ (zero input signal)

Dynamic resistance, $r = \frac{\Delta V}{\Delta I}$ (with input signal)

static resistance > dynamic resistance.

10. (b)

Tunnel diode is voltage controlled device.

- Highly doped PN junction diode
- Fastest switch
- Negative resistance device

11. (c)

This is a darlington pair but illuminated by light so photo-darlington pair.

12. (b)

Doping in tunnel diode = $1 : 10^3$

zener diode : $1 : 10^5$

13. (c)

Solar cell based on photovoltaic effect.

14. (c)

As V_i is negative transistor is in cut-off.

15. (a)

Light intensity changes the short-circuit current, open-circuit voltage, fill factor, efficiency and impact of series and shunt resistance.

16. (a)

It is an *n*-channel depletion mode device.

17. (b)

	J_{EB}	J_{CB}	
1.	*RB*	*RB*	cutoff region
2.	*FB*	*FB*	saturation region
	If J_C voltage > J_E voltage = reverse saturation		
	J_C voltage < J_E voltage = forward saturation		
3.	*FB*	*RB*	Active region
4.	*RB*	*FB*	Reverse active region

18. (b)

Base current is mainly due to majority carriers of base.

19. (d)

In case of *n-p-n* transistor, the majority carriers in *E* and *C* region are electrons and they diffuse from *E* to *C*. However, in case of *p-n-p* transistor holes (majority carriers) diffuse from *E* to *C*. As electrons has higher mobility than holes. Therefore, *n-p-n* transistors are preferred over *p-n-p* transistors.

20. (c)

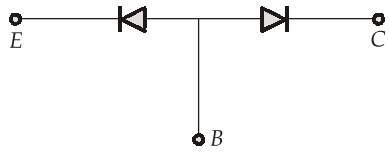
The decrease in effective base width with increase collector voltage is known as early effect.

21. (a)

$$\alpha = \frac{I_C - I_{CBO}}{I_E}$$

where α = current gain at *CB* transistor with emitter highly dopped, α increase, So $I_{CBO} \downarrow$.

22. (c)



23. (b)

To avoid thermal runaway,

$$V_{CE} < \frac{V_{CC}}{2}$$

24. (a)

Connecting a resistor from base of a transistor to ground/negative voltage helps in reducing the switching time of the transistor. When transistor saturate, there is stored charge in the base that must be removed before it turns off.

25. (b)

$$\alpha = 0.99$$
$$\beta = ?$$
$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.99}{1-0.99} = 99$$

26. (a)

$$I_{CEO} = \frac{I_{CBO}}{1-\alpha}$$
$$= \frac{I_{CO}}{1-\alpha} = \frac{0.5\,\mu A}{1-0.995} = 100\,\mu A$$

27. (c)

$$(211)_x = (152)_8$$

Converting to decimal

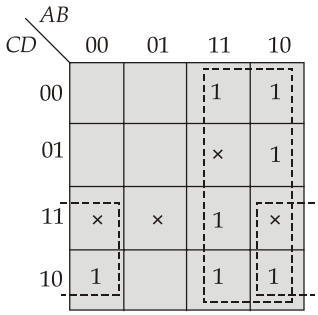
$$2x^2 + x + 1 = 8^2 \times 1 + 8 \times 5 + 2 = 106$$

on solving, $x = 7, -15/2$

28. (b)

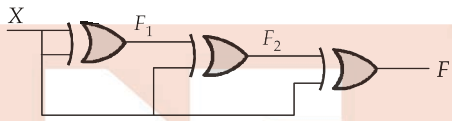
NOR			EX-NOR		
A	B	Y	A	B	Y
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	0	1	1	1

29. (a)



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

30. (b)



$F_1 = X \oplus X = 0$

$F_2 = 0 \oplus X = X$

$F = X \oplus X = 0$

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