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EE : ELECTRICAL ENGINEERING

TEST No. - 11 | ANALOG ELECTRONICS

Read the following instructions carefully

1. This question paper contains 33 MCQ's & NAQ's. Bifurcation of the questions are given below:

Subjectwise Test Pattern

Questions	Question Type	No. of Questions	Marks	Total Marks	Negative Marking
1 to 9	Multiple Choice Ques.	9	1	9	0.33
10 to 16	Numerical Answer Type Ques.	7	1	7	None
17 to 25	Multiple Choice Ques.	9	2	18	0.66
26 to 33	Numerical Answer Type Ques.	8	2	16	None
Total Questions : 33		**Total Marks : 50**		**Total Duration : 90 min**	

2. Choose the closest numerical answer among the choices given.

Multiple Choice Questions : Q.1 to Q.9 carry 1 mark each

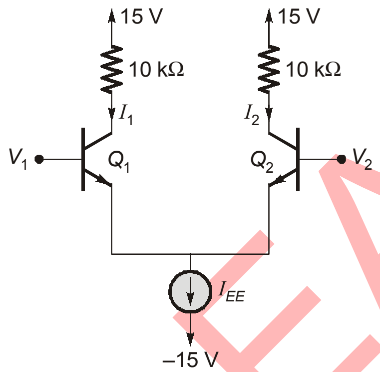
Q.1 An ideal trans-conductance amplifier has the following characteristic

(a) input impedance = ∞, output impedance = ∞
(b) input impedance = 0, output impedance = 0
(c) input impedance = ∞, output impedance = 0
(d) input impedance = 0, output impedance = ∞

1. (a)

In a trans-conductance amplifier input is voltage and output is current so input impedance is ∞ and output impedance is ∞

Q.2 Consider the circuit shown below



If both the BJT Q_1 and Q_2 are identical $V_1 = V_2 + 0.3$ V then $\frac{I_2}{I_1}$ is (V_T = 25 mV)

(a) 109097
(b) 6.144×10^{-6}
(c) 9.16×10^{-3}
(d) 109.097

2. (b)

Given that both the transistor are identical

So,
$$I_1 = I_0 \exp\left(\frac{V_{BE1}}{V_T}\right)$$

$$I_2 = I_0 \exp\left(\frac{V_{BE2}}{V_T}\right)$$

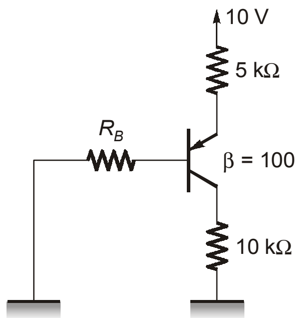
So,
$$V_{BE1} = V_1 - V_E$$
$$V_{BE2} = V_2 - V_E$$

$$\frac{I_2}{I_1} = \frac{\exp\left(\frac{V_{BE2}}{V_T}\right)}{\exp\left(\frac{V_{BE1}}{V_T}\right)} = \exp\frac{(V_{BE2} - V_{BE1})}{V_T}$$

$$= \exp\left(\frac{V_2 - V_1}{V_T}\right)$$

$$\frac{I_2}{I_1} = \exp\left(\frac{-0.3}{V_T}\right) = 6.144 \times 10^{-6}$$

Q.3 Consider the BJT circuit shown below



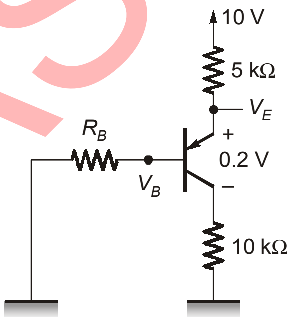
The value of R_B such that the BJT remains in active regions

(a) $R_B \geq 924.06$ kΩ (b) $R_B \leq 914$ kΩ

(c) $R_B \geq 1015$ kΩ (d) $R_B \leq 1015$ kΩ

3. (a)

Let the device is at edge of saturation



So, $V_{CE} = -0.2$ V

and $I_C = \alpha I_E$,

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

Now we apply kVL

$$10\text{ V} = 5000\, I_E + 0.2 + I_C(10000)$$

$\Rightarrow$ $I_E = 0.657$ mA

So, $V_E = 10 - I_E(5000) = 6.71$ V

So, $V_B = V_E - 0.7\text{ V} = 6.011$ V

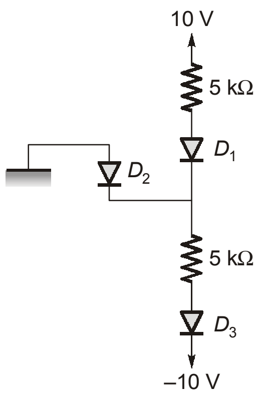
Now, $$R_B = \frac{V_B}{I_B} \Rightarrow \frac{(\beta+1)V_B}{I_E} = 924.06\text{ k}\Omega$$

So at edge of saturation $R_B = 924.06$ kΩ

If we want device to work in active region then I_B should decrease so R_B should increase

So, for $R_B \geq 924.06$ kΩ the device will go in active region.

Q.4 Consider the circuit shown below



If D_1, D_2 and D_3 are ideal then which of these diode are off

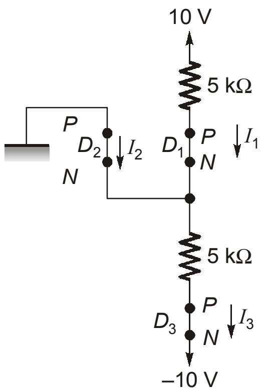
(a) D_1 (b) D_2

(c) D_3 (d) all diode are off

4. (b)

Since, we assume that all diode are on, and diode are ideal so they are replaced by short circuit and then according to direction of current we will find the actual answer.

So,



So we get that, $I_1 = 2$ mA

and $I_3 = 2$ mA

So, $I_2 = 0$

Since $I_2 = 0$

So D_2 is off and I_1 and I_3 flow from P to N terminal of diode, so D_1 and D_3 are an and D_2 is off.

Q.5 An amplifier has open loop gain of 10, and input impedance of 1 kΩ and output impedance of 100 Ω. If negative feedback with feedback factor of 0.99 is connected to the amplifier in a voltage series feedback mode. The new input and output impedance are.

(a) 91.74 Ω, 1.09 kΩ
(b) 91.7 Ω, 9.17 Ω
(c) 10.9 kΩ, 1.09 kΩ
(d) 10.9 kΩ, 9.17 Ω

5. (d)

Open loop gain, $A = 10$

$\beta = 0.99$

and $R_{in} = 1$ kΩ

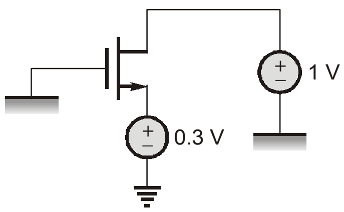
$R_0 = 100\ \Omega$

In voltage series feedback input impedance increase and output impedance decrease

So, $R_{in}' = R_{in}(1 + A\beta) = 10.9$ kΩ

$$R_0' = \frac{R_0}{(1+A\beta)} = 9.17\ \Omega$$

Q.6 In the figure shown below, if |Vth| = 0.4 V, the transistor is operating in



(a) Linear region
(b) Saturation region
(c) cutoff region
(d) Cannot be determined

6. (c)

Since the device is NMOS $V_{th} = 0.4$

and $V_S = 0.3$ V,

$V_D = 1$ V,

$V_G = 0$

For cut off $V_{GS} < |V_{th}|$

Since, $V_{GS} = -0.3$ V

So, device is in cutoff

Q.7 Consider two amplifiers A_1 and A_2. The rise time for first stage is 0.3 ms and for the second stage is 0.4 msec. If the two systems are connected in cascade form with each other then the rise time of the combined system will be

(a) 0.5 msec (b) 0.55 msec
(c) 0.4 msec (d) 0.3 msec

7. (b)

$$\frac{1}{f_H} = 1.1\sqrt{\frac{1}{f_{H_1}^2} + \frac{1}{f_{H_2}^2}}$$

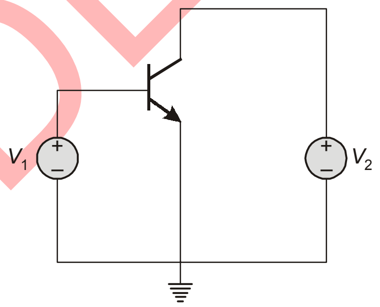
For cascade connection,

$$\frac{0.35}{f_H} = 1.1\sqrt{\left(\frac{0.35}{f_{H_1}}\right)^2 + \left(\frac{0.35}{f_{H_2}}\right)^2}$$

$$t_r = 1.1\sqrt{t_{r_1}^2 + t_{r_2}^2}$$

$$= 1.1\sqrt{(0.3)^2 + (0.4)^2} = 0.55 \text{ msec}$$

Q.8 The transistor in the circuit shown below is biased to operate in



(a) Active Region for $V_1 > V_2$; $V_1, V_2 < 0$
(b) Active Region for $V_1 < V_2$; $V_1, V_2 > 0$
(c) Saturation Region for $V_1 > V_2$; $V_1, V_2 > 0$
(d) Saturation Region for $V_1 < V_2$; $V_1, V_2 < 0$

8. (b)

For active region

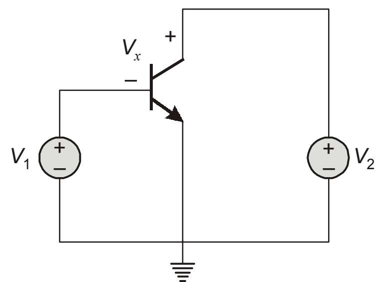
$V_1 + V_x = V_2$

$V_B > V_E$ and $V_C > V_B$

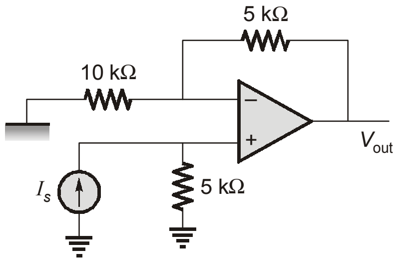
i.e. $V_{BE} > 0$, and $V_{CB} > 0$

$V_1 > 0$, and $V_{CE} - V_{BE} > 0$

$V_2 > V_1$



Q.9 The nature of feedback in the opamp circuit shown is



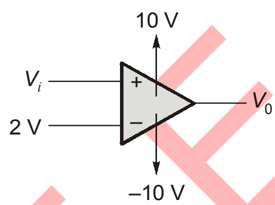
(a) Current – Current feedback (b) Voltage – Voltage feedback
(c) Current – voltage feedback (d) Voltage – Current feedback

9. (b)

Input to the opamp at non-inverting terminal cannot be current as it will not sense current, so input is voltage and feedback is also voltage. So it is a voltage – voltage feedback

Numerical Answer Type Questions : Q. 10 to Q. 16 carry 1 mark each

Q.10 Input to the opamp is $V_i = 10 \sin \omega t$. The opamp is connected as shown below

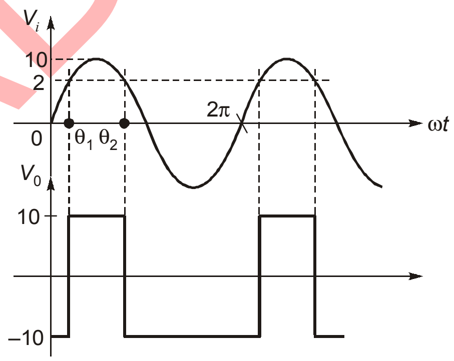


The average value of V_0 is ________ V .

10. −1.28 (−1.30 to −1.20)

Since input is a sine wave

$$V_0 = 10 \text{ V when } V_i > 2 \text{ V}$$
$$V_0 = -10 \text{ V when } V_i < 2 \text{ V}$$



V_0 is periodic wave with period 2π and it is 10 V when $\theta_1 \le \omega t \le \theta_2$ else it is −10

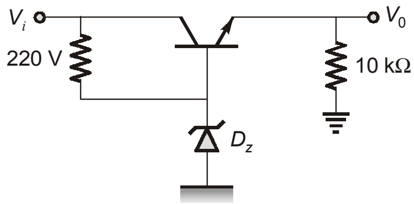
$$\text{So average } V_0 = \frac{(\theta_2 - \theta_1)10 - (2\pi - (\theta_2 - \theta_1))10}{2\pi}$$

Since $\theta_1 = \sin^{-1}\left(\frac{2}{10}\right) = 0.201$ radian

$$\theta_2 = \pi - \theta_1 = 2.94 \text{ radians}$$

So, average $V_0 = -1.28$ V

Q.11 Consider the circuit shown below,



The β = 100 in forward active mode and β = 10 in reverse active mode, D_z is an ideal zener diode with V_Z = 10 V and forward voltage drop equal to 0.7 V. If V_i = 20 V then V_0 is _______ V.

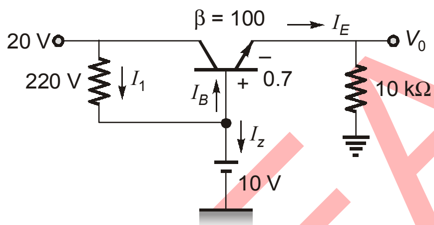
11. **9.3 (9.1 to 9.4)**

Since $V_i = 20$ V,

$V_Z = 10$ V

Let us assume that BJT is in forward active and zener diode is in breakdown mode

So circuit is



So, $V_0 = 9.3$ V,

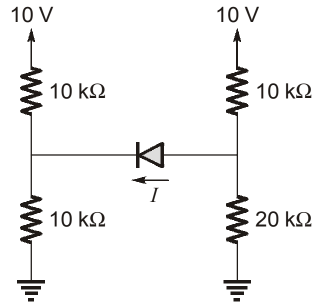
$I_E = 0.93$ A

and $I_B = 9.2\ \mu$A

Sine $I_1 = \dfrac{20-10}{220} = 45.45$ mA

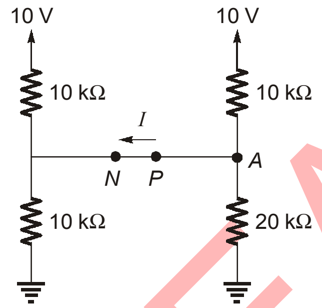
Since $I_1 > I_B$ so, I_Z will be positive. So the zener will be in breakdown and our assumption in corner.

Q.12 Consider the circuit shown below, if the diode is ideal then value of I is __________ mA



12. 0.1425 (0.13 to 0.15)

Let us assume that diode is on and since diode is ideal so it is replaced by short circuit so



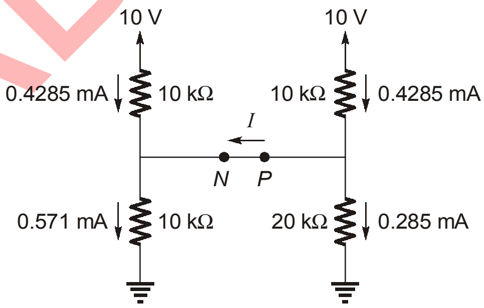
applying nodal analysis at node A we get (let voltage at node A is V)

$$\frac{V}{20} + \frac{V}{10} = \frac{10-V}{10} + \frac{10-V}{10}$$

$$\Rightarrow \quad 3\,V = 40 - 7\,V$$

$$\Rightarrow \quad V = \left(\frac{40}{7}V\right)$$

Now redrawing the circuit



So, $\quad I = 0.1425\text{ mA}$

Q.13 The open loop gain of a voltage amplifier is 100 and bandwidth is 100 Hz. If negative feedback with feedback factor β = 0.1 is applied in the amplifier then the bandwidth of closed loop amplifier will be _______ Hz.

13. 1100 (1090 – 1110)

Given that

$$\text{open loop gain } A = 100$$
$$\text{Bandwidth} = 100 \text{ Hz}$$
$$\beta = 0.1$$

Since negative feedback is applied

So new bandwidth will be

$$100(1 + A\beta) = 1100 \text{ Hz}$$

Q.14 Bandwidth of a 3-stage tuned amplifier with each stage having bandwidth of 10 MHz is ________ MHz.

14. 5 (4.5 to 5.5)

$$\text{Bandwidth} = 10 \text{ MHz}\left(2^{1/3} - 1\right)^{1/2}$$
$$\simeq 5 \text{ MHz}$$

Q.15 A bipolar junction transistor is in active region with collection current of 10 mA. Assuming β = 50 and V_T = 26 mV, the value of input resistance (r_π) of transistor in common emiiter configuration is _________ Ω.

15. 130 (128 – 132)

Given that

$$\beta = 50,$$
$$I_C = 10 \text{ mA},$$
$$V_T = 26 \text{ mV}$$

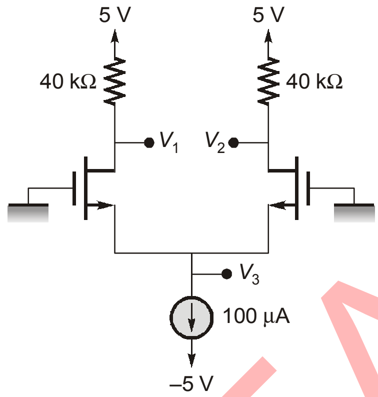
$$r_\pi = \frac{\beta}{g_m} = \left(\frac{\beta}{I_C}.V_T\right) = 130\,\Omega$$

Q.16 In the following circuit, transistor Q_1 and Q_2 has following parameter

$$\left(\frac{W}{L}\right)_1 = \left(\frac{W}{L}\right)_2 = 20$$

$$V_{th1} = V_{th2} = 1\text{ V}$$

$$\mu n C_{ox}\left(\frac{\omega}{L}\right)_1 = \mu n C_{ox}\left(\frac{\omega}{L}\right)_2 = 100\ \mu\text{A/A}^2$$



Value of $V_1 + V_2$ is ________ V

16. **6 (5.8 to 6.2)**

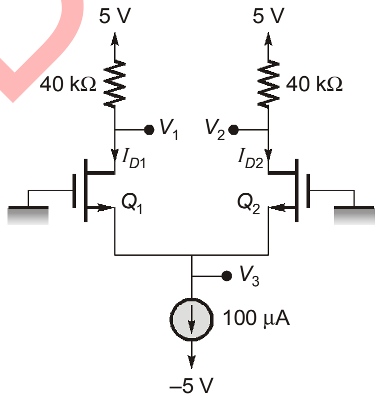
Since both the transistor are identical and V_{GS} of device is some so drain current I_{D1} will be same as that of I_{D2}

and since $\quad I_{D1} = I_{D2}$

and $\quad I_{D1} + I_{D2} = 100\ \mu\text{A}$

$\Rightarrow \quad I_{D1} = 50\ \mu\text{A},$

$I_{D2} = 50\ \mu\text{A},$



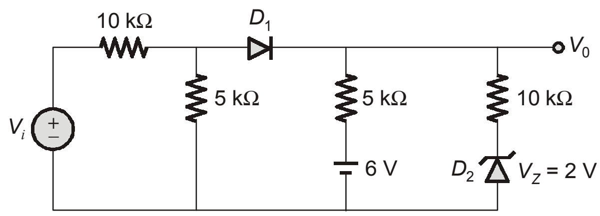
So, $\quad V_1 = V_2 = 5 - (40\text{ k}\Omega \times I_D)$

$= 3\text{ V}$

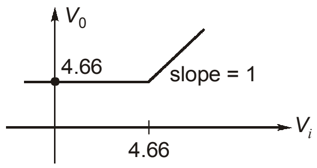
So, $\quad V_1 + V_2 = 6\text{ V}$

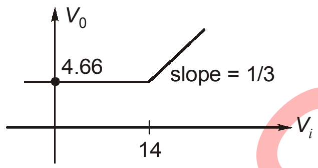
Multiple Choice Questions : Q.17 to Q.25 carry 2 marks each

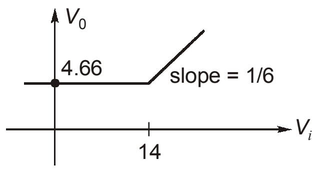
Q.17 Consider the circuit shown below

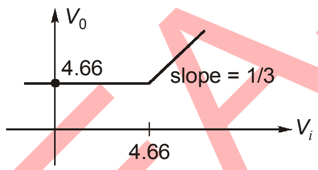


If D_1 is an ideal diode and D_z is an ideal zener diode with $V_Z = 2$ V then the transfer characteristic will be

(a)


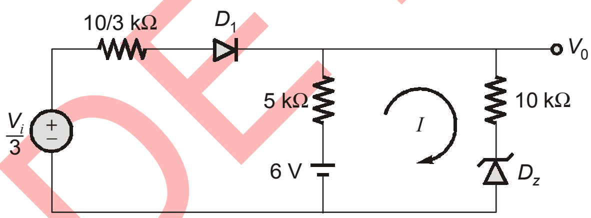
(b)


(c)


(d)


17. (c)

The circuit given in the question can be redrawn as



When V_i is small D_1 is off and D_Z is breakdown region due to 6 V battery, so

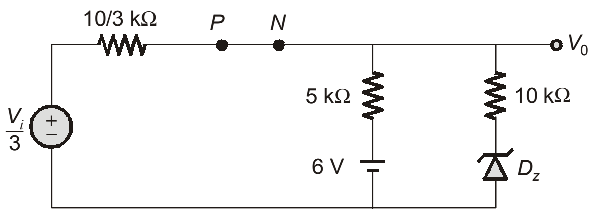
$$I = \frac{6-2}{15} = \frac{4}{15} \text{ mA}$$

$$V_0 = 4.66 \text{ V}$$

Now when $\frac{V_i}{3} = 4.66$ V then D_1 will turn on

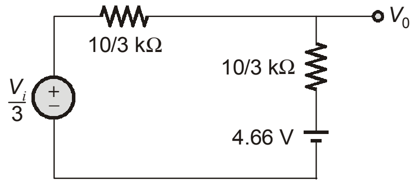
So D_1 turn as when $\quad V_i = 14$ V

and circuit will become

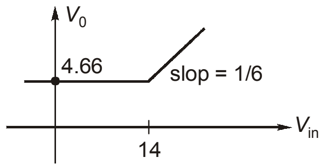


The circuit can be redrawn as

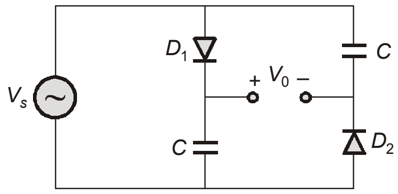
[Since zener diode is reverse biased so $V_z = 2$ V]



So,
$$V_0 = \left[\left(\frac{V_i/3 - 4.66}{2}\right) + 4.66\right]$$



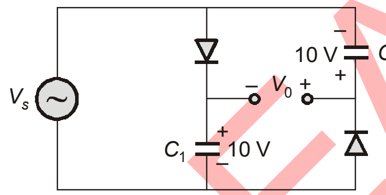
Q.18 Consider the circuit shown below, if input signal is $V_s = 10 \sin \omega t$. The diodes are ideal then average value of V_0 at steady state is



(a) 0 V
(b) 10 V
(c) 20 V
(d) 40 V

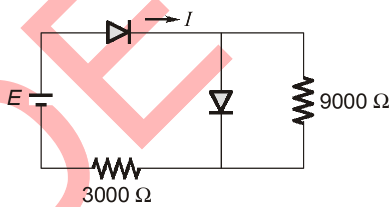
18. **(a)**

Since input is a sinusoid wave
D_1 will turn as when input is positive
D_2 will turn as when input is negative
D_1 will charge C_1 with voltage 10 V
D_2 will charge C_2 with voltage 10 V



So, $\quad V_0 = 0$

Q.19 Consider the circuit shown below. The diodes in the circuit have forward voltage drop of 0.7 V.

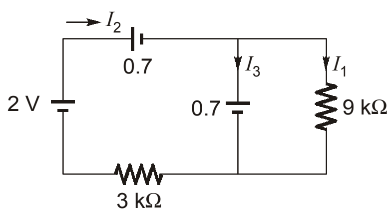


If $E = 2$ V then value of I is

(a) 0.077 mA
(b) 0.108 mA
(c) 0.2 mA
(d) 0.13 mA

19. **(c)**

Given that $E = 2$ V and each diode has a drop of 0.7 V, let each diode is on



So, $$I_1 = \frac{0.7}{9\text{ k}\Omega} = 0.077 \text{ mA}$$

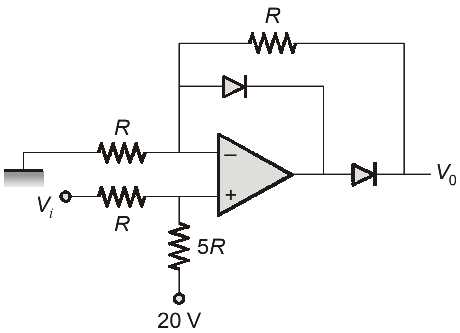
$$I_2 = \frac{2-1.4}{3} = 0.2 \text{ mA}$$

Since, $\quad I_3 = 0.123$ mA

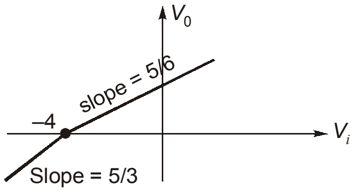
Since I_1 and I_3 are positive assumption that both diode are on is correct and

$$I = I_2 = 0.2 \text{ mA}$$

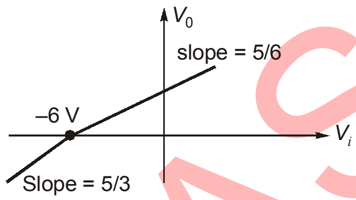
Q.20 The transfer characteristic for precision rectifier circuit shown below is (assume op-amp and diodes are ideal and voltmeter is used to measure output voltage)



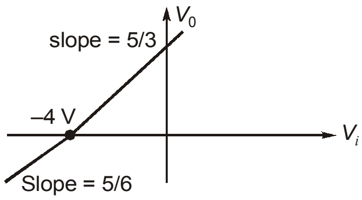
(a)



(b)

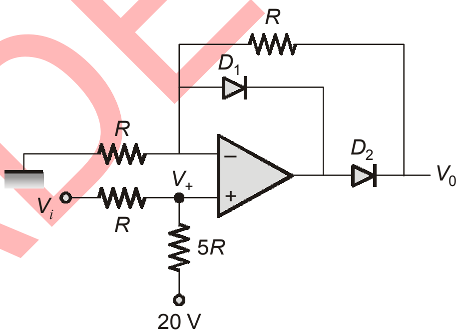


(c)



(d) None

20. (c)

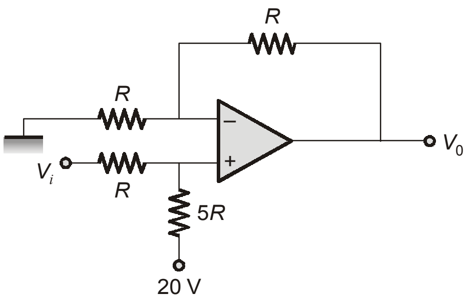


$$V_+ = \left(\frac{5}{6}V_i + \frac{20}{6}\right)$$

$\Rightarrow$ V_+ is positive when $V_i \geq -4$ V, V_+ is negative when $V_i < -4$ V.

When V_+ is positive then D_1 is off and D_2 is on

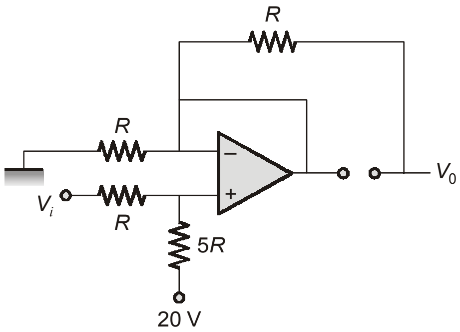
So,



$$V_0 = 2V_+ = \left(\frac{5}{3}V_i + \frac{20}{3}\right)$$

When V_+ is negative then D_1 is on and D_2 is off

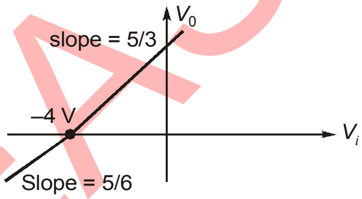
So,



Since no current will flow in output branch and opamp is in negative feedback

So, $$V_+ = V_-$$

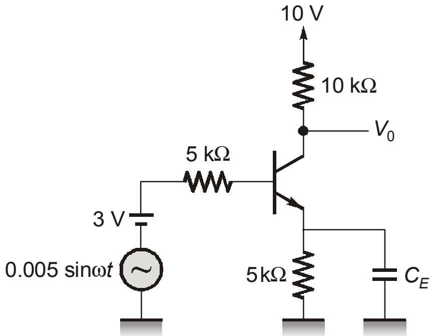
and $$V_0 = V_+ = \frac{5V_i}{6} + \frac{20}{6}$$



So, when V_+ is positive $V_0 = 2V_+$

V_+ is negative $V_0 = V_+$

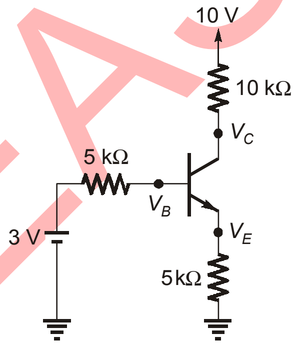
Q.21 Consider the circuit shown below, $\beta = \infty$, $V_{BE} = 0.7$ V, $V_{CEsat} = 0.2$ V. The early effect is neglected then V_0 is ($V_T = 26$ mV)



(a) $3.1 - 0.289 \sin \omega t$
(b) $3.1 - 0.88 \sin \omega t$
(c) $5.9 - 0.289 \sin \omega t$
(d) $5.4 - 0.88 \sin \omega t$

21. (d)

First of all we need to solve the circuit at dc



since $\beta = \infty$,

$I_B = 0$,

$V_B = 3$ V

and $V_E = 2.3$ V

and $I_E = 0.46$ mA

also, $I_E = I_C = 0.46$ mA

$V_C = 10 - 10000\, I_C$

$V_C = 5.4$ V

Now
$$r_\pi = \frac{\beta}{g_m} = \infty$$

$$g_m = \frac{I_C}{V_T} = 0.01769 \text{ A/V}$$

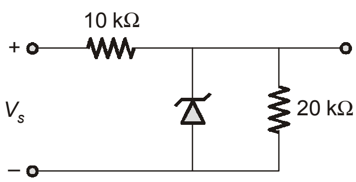
Since small signal input is $0.005 \sin \omega t$. The effect will be seen at collector with a gain of $-g_m R_C$ (since early effect is neglected)

$\Rightarrow$ gain is $(-0.01769 \times 10000) = -176.9$

So, $V_C = dc + ac$

$= (5.4 - 0.88 \sin \omega t)$

Q.22 Consider the circuit shown below, if the zener diode has $V_z = 10$ V, $r_z = 20\ \Omega$, $I_{zk} = 1$ mA and V_s is unregulated supply $V_s = 30$ V then value of V_0 is



(a) 9.916 V
(b) 10 V
(c) 10.136 V
(d) 10.029 V

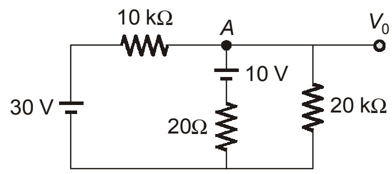
22. (d)

Zener diode has $V_z = 10$ V,

$r_z = 20\ \Omega$

and $V_s = 30$ V

So, the circuit can be redrawn as



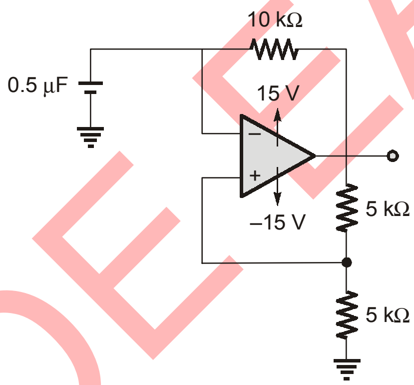
Applying KCL at node A we get

$$\frac{V_0}{20000} + \frac{V_0 - 10}{20} + \frac{V_0 - 30}{10000} = 0$$

$$V_0 + 1000\,(V_0 - 10) + 2V_0 - 60 = 0$$

$$\Rightarrow \quad V_0 = 10.029\text{ V}$$

Q.23 The saturation voltage of ideal op-amp shown below is ± 15 V. The output voltage V_0 of the following circuit in steady state is



(a) rectangular wave of $f = 182$ Hz
(b) square wave of $f = 182$ Hz
(c) square wave of $f = 91$ Hz
(d) rectangular wave of $f = 91$ Hz

23. (d)

Circuit is an stable multivibration

Since $\beta = 0.5$

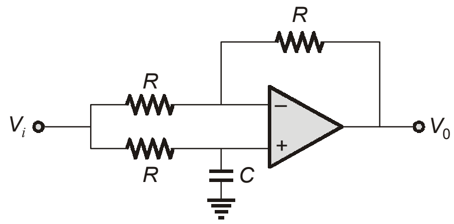
T = Time period of signal

$$= 2\tau ln\left(\frac{1+\beta}{1-\beta}\right) = 2 \times 10\text{ k}\Omega \times 0.5\ \mu f \times ln\,(3)$$

$$= 0.010986\text{ sec}$$

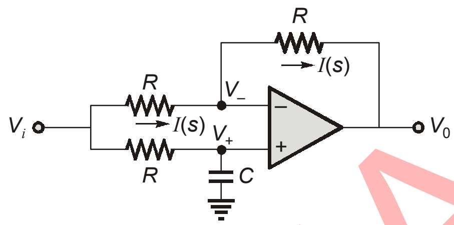
and frequency = 91 Hz

Q.24 Consider an opamp circuit shown below, if opamp is ideal and input V_i = 10 sin 5000 t then the maximum amplitude of output is



(a) 5 (b) 20
(c) 40 (d) 10

24. (d)



$$V_+ = \left(\frac{V_i(s)}{Rsc+1}\right)$$

Since the opamp is in negative feedback

So, $$V_+ = V- = \frac{V_i(s)}{Rsc+1}$$

So, $$I(s) = \frac{V_i(s) - V_-}{R}$$

$$= \frac{V_i(s) - \dfrac{V_i(s)}{sRC+1}}{R}$$

$$I(s) = \frac{sCV_i(s)}{RsC+1}$$

and $$V_0(s) = V_- - I(s)\,R$$

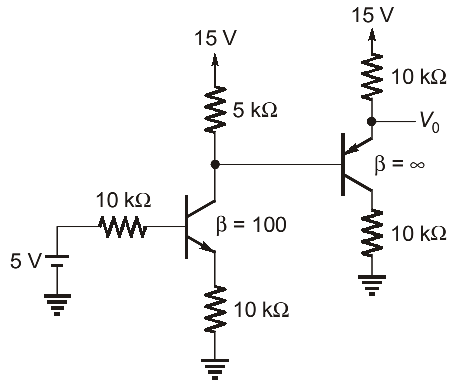
$$V_0(s) = \left(\frac{V_i}{RsC+1} - \frac{sCV_i(s)R}{RsC+1}\right)$$

$$V_0(s) = \left(\frac{1-sRC}{1+sRC}\right)V_i(s)$$

$$\frac{V_0(s)}{V_i(s)} = \left(\frac{1-sRC}{1+sRC}\right) = \text{All pass filter with gain} = 1$$

Since input is 10 sin ωt output will be 10 sin $(\omega t - \phi)$ [since gain of all pass filter is 1]

Q.25 Consider the circuit shown below

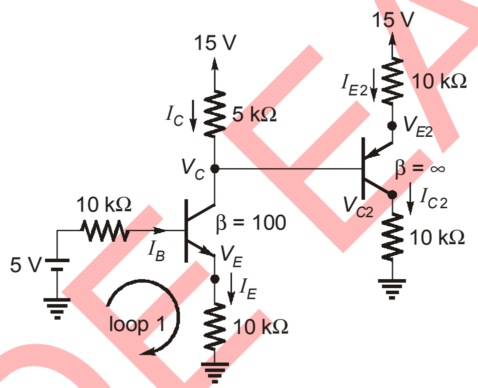


The value of V_0 is

(a) 15.59 V (b) 13.59 V

(c) 11.59 V (d) 9.59 V

25. (b)



Suppose that the devices are in forward active mode of operation.

In loop, $5 = I_B(10000) + 0.7 + I_E(10000)$

$\Rightarrow$ $I_B = 4.2\ \mu A,$

$I_C = 0.421$ mA

$I_E = 0.425$ mA

$V_E = 4.2$ V

and $V_C = 12.89$ V

So $V_{CE} = 8.69$ V

So Q_1 is in forward active mode

$V_{E2} = V_C + 0.7 = 13.59$ V

So, $I_{E2} = I_{C2} = 0.14$ mA

$V_{C2} = 1.4$ V

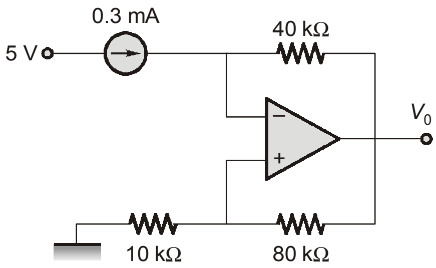
So, $V_{EC2} = 12.19$ V

So Q_2 is also in forward active mode

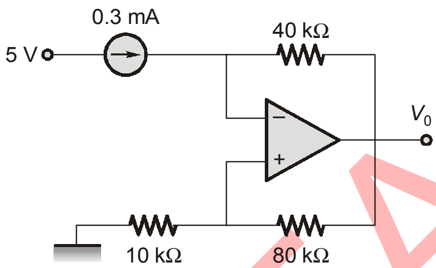
So, $V_0 = 13.59$ V

Numerical Answer Type Questions : Q. 26 to Q. 33 carry 2 marks each

Q.26 The value of V_0 in the circuit, shown in figure is ________ V.



26. –13.5 (–14 to –13)



So, $$V_+ = \frac{V_0}{9}$$

and $$V_+ = V_- = \frac{V_0}{9}$$ (since opamp is in negative feedback)

Current through 40 kΩ will be 0.3 mA since no current will enter opamp

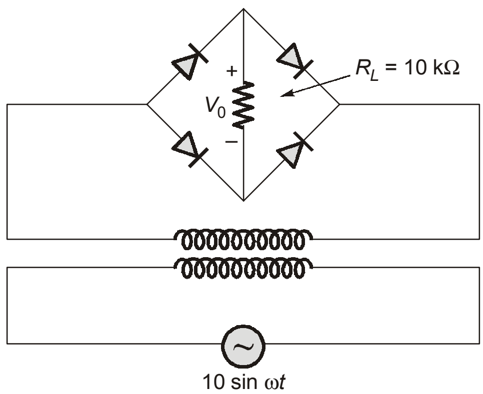
So, $$\frac{V_- - V_0}{40\text{ k}\Omega} = 0.3\text{ mA}$$

$$\frac{V_0}{9} - V_0 = 12$$

$$\frac{-8V_0}{9} = 12$$

$$V_0 = -13.5\text{ V}$$

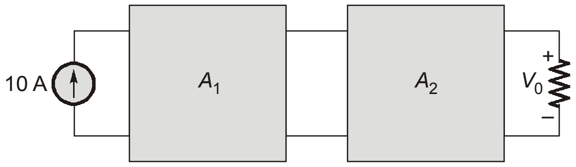
Q.27 In the given circuit the diodes are ideal, then the average value of V_0 is _______ V.



27. (0)

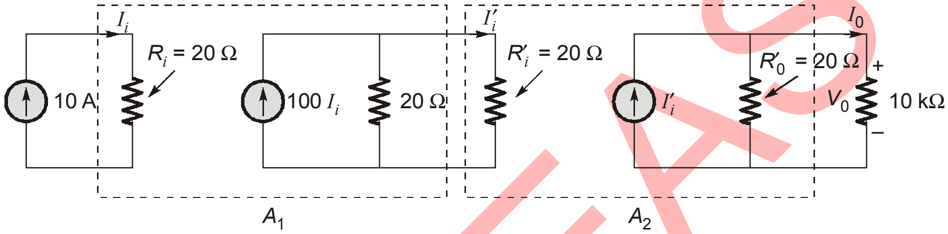
The value of V_0 will be zero when input 10 sin ωt is positive then all diode are on and $V_0 = 0$ and when input is negative then all diode are off and $V_0 = 0$

Q.28 A cascade connection of two current amplifier A_1 and A_2 is shown in the figure. The gain of first amplifier is 100 and second amplifier is 1 and input impedance of each amplifier is 20 Ω and output impedance is also 20 Ω. If input current source is an ideal source then value of V_0 is ________ kV.



28. 9.98 (9.00 to 10.00)

Redrawing the circuit, with each amplifier shown with input impedance and current gain



Since $\qquad I_i = 10\text{ A},$

$$I_i' = \frac{100\,I_i}{2}$$

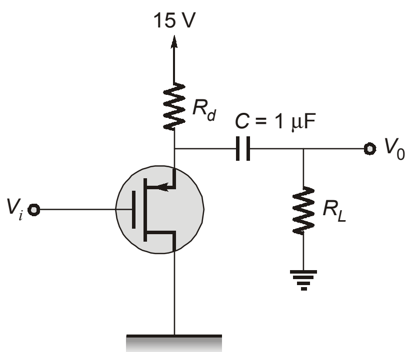
and $\qquad I_0 = \left(\frac{20}{10000+20}\right) I_i'$

$$V_0 = 10000\,I_0$$

putting all the values we get

$$V_0 = 9.98\text{ kV}$$

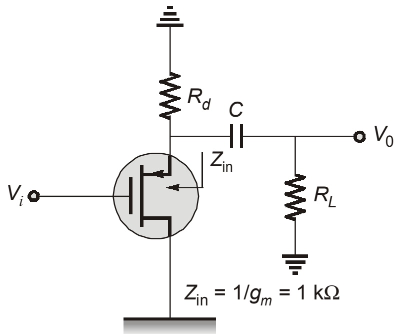
Q.29 Consider the circuit shown below



The PMOS common drain amplifier is designed as shown in the figure, if g_m = 1 mA/V and body effect and channel length modulation are neglected. The lower cut off frequency of the circuit is _______ Hz. ($R_d = R_L$ = 10 kΩ)

29. 14.61 (14.00 to 15.00)

To find the lower cut off frequency we need to find resistance seen by capacitance $C = 1/\mu F$.



So resistance seen by C is $((Z_{in} \,||\, R_d) + R_L)$

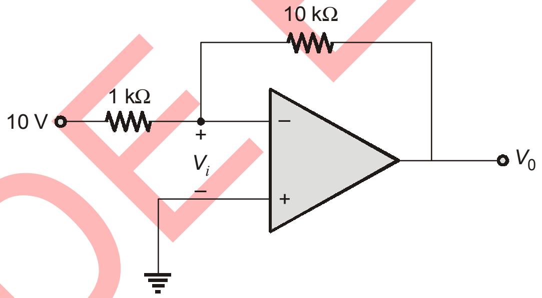
$$R = 10.90\text{ k}\Omega$$

So,
$$\omega_c = \frac{1}{RC} = 91.74\text{ rad/sec}$$

$$f_c = \frac{\omega_c}{2\pi} = 14.60\text{ Hz}$$

Q.30 Ideally the opamp has infinite open loop gain and due to this property we apply virtual short concept in opamp in negative feedback.

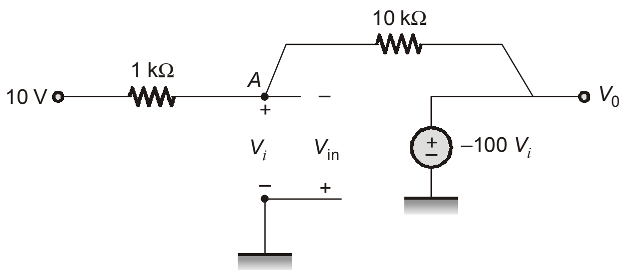
Suppose the opamp in the circuit has open loop gain equal to 100 then the value of V_i is ________ V.



30. 0.9009 (0.8000 to 1.0000)

Since gain of opamp is not infinity so virtual short concept cannot be applied. Here open loop gain is 100 but still input impedance is infinity and output impedance is zero.

So the circuit can be redrawn as



KCL at node A

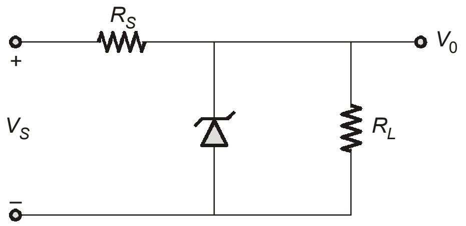
$$\frac{10 - V_i}{1000} = \frac{V_i - (-100V_i)}{10000}$$

$$100 - 10\ V_i = V_i + 100\ V_i$$

$$100 = 111\ V_i$$

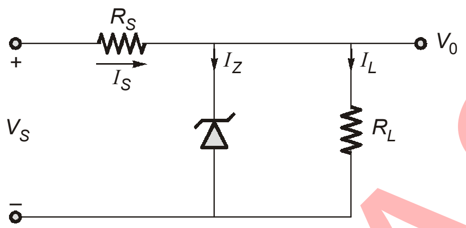
$$\Rightarrow \quad V_i = 0.9009\text{ V}$$

Q.31 Consider the voltage regulation circuit shown below



If the input supply V_s is unregulated supply and V_s vary between 20 V and 30 V. The zener diode has knee current of 2 mA and V_z = 15 V, R_L = 3 kΩ. Then maximum value of R_s that can be applied is ________ Ω.

31. 714 (710 to 720)



⇒ $$I_s = I_z + I_L$$

Since we want to find maximum value of R_s so we want minimum value of I_s.

$$I_{s\,min} = I_{z\,min} + I_{L\,min}$$

$$I_{z\,min} = 2 \text{ mA}$$

$$I_{L\,min} = \frac{V_L}{R_{L\max}} = \frac{15}{3} = 5 \text{ mA}$$

So, $$I_{s\,min} = 7 \text{ mA}$$

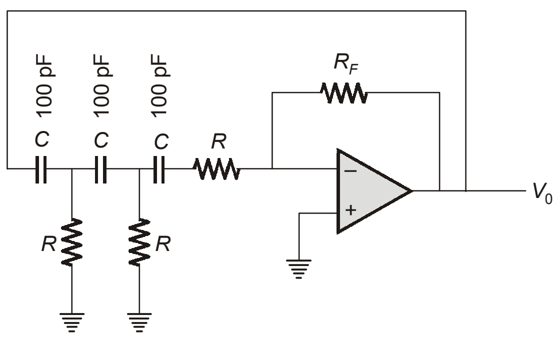
Since $$I_s = \frac{V_s - V_z}{R_s}$$

$$I_{S\min} = \frac{V_{s\min} - V_z}{R_{s\max}}$$

$$R_{s\,max} = \frac{V_{s\min} - V_z}{I_{s\min}}$$

$$R_{s\,max} = \frac{5}{7} \text{ k}\Omega$$

Q.32 Consider the phase shift oscillator as shown in the figure below.



If the frequency of oscillations of the circuit is 100 kHz, then the value of the resistance R will be _____ kΩ.

32. 6.5 (6.0 to 7.0)

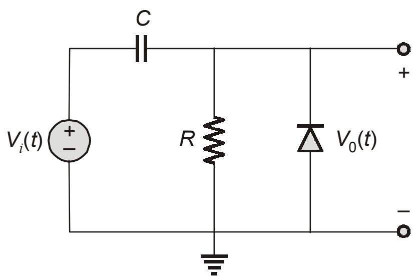
$$f = \frac{1}{2\pi RC\sqrt{6}}$$

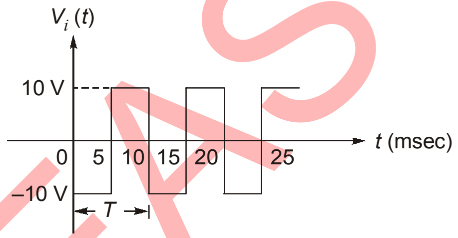
$$R = \frac{1}{2\pi\sqrt{6}\cdot Cf}$$

$$= \frac{1}{2\pi\sqrt{6}\cdot 100\times 10^{-12}\times 100\times 10^{3}}$$

$$= \frac{1}{2\pi\sqrt{6}}\times 10^{2}\times 10^{3} = 6.5\ \text{k}\Omega$$

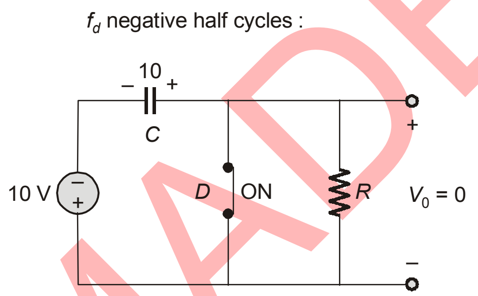
Q.33 For the circuit shown below, if $V_i(t)$ is the input voltage of the circuit, then the value of output voltage i.e. $V_0(t)$ at t = 16 msec is ________ volts.

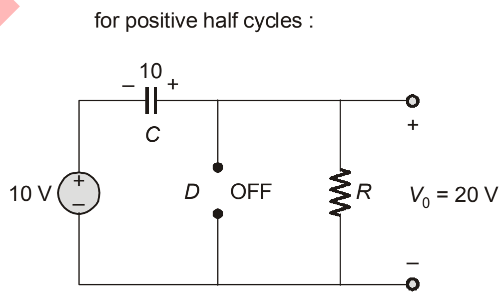


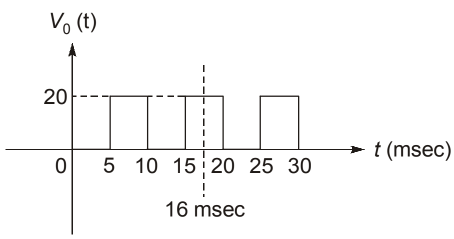


(Assume the time constant $RC >> T$ and the diode is ideal)

33. 20 (19 to 21)







$$V_0(t)|_{t=16\text{ msec}} = 20\text{V}$$

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