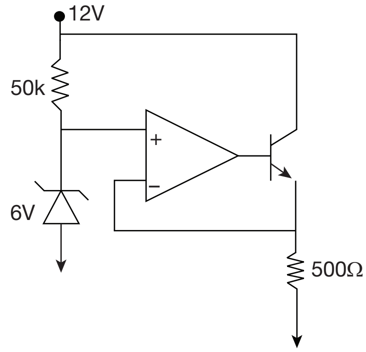
Analog and Digital Electronics Test I

Number of Questions: 25 **Section Marks: 25**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. In below circuit Op-Amp is ideal. If $\beta = 50$, the total current supplied by the 12V.



(A) 12.12 mA (B) 11.88 mA
(C) 12 mA (D) 11.6 mA

2. Match List-I with List-II where List-I contains oscillator and List-II has characteristic

List-I	List-II	
(p) clapp oscillator	(1)	RC oscillator for audio frequency applications
(q) colpittes oscillator	(2)	RF oscillator: Two inductances and one capacitance as the reactance network.
(r) Hartley oscillator	(3)	LC oscillator for RF frequency: Three capacitances and one inductance in the resistance network.
(s) wein bridge oscillator	(4)	RF oscillator: Two capacitance and one inductance as the reactance network.

(A) $p-1, q-2, r-3, s-4$
(B) $p-4, q-3, r-2, s-1$
(C) $p-3, q-4, r-2, s-1$
(D) $p-3, q-2, r-1, s-4$

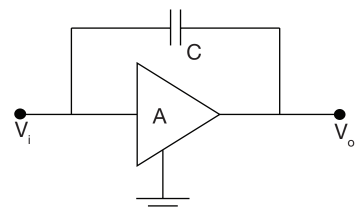
3. A power amplifier delivers 10W output at 50% of collector efficiency. If the maximum allowable junction temperature is 125°C, then maximum thermal resistance q_{jc} that can be tolerated [$\therefore$ ambient temperature = 25°C]

(A) 20° C/W (B) 5° C/W
(C) 10° C/W (D) 40° C/W

4. In class *B* push-pull operation the power delivered to the load $R_L = 10\ \Omega$ is $P_{ac} = 20$W. Then peak load current is

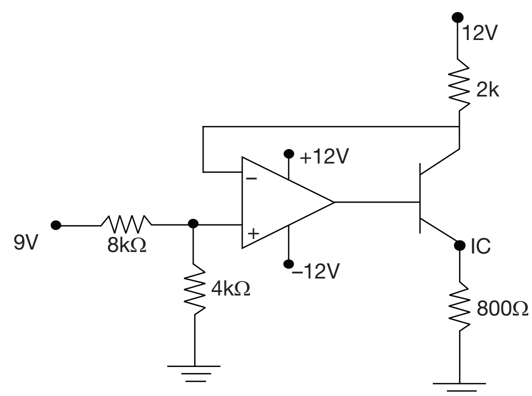
(A) $\sqrt{2}$A (B) 2A
(C) 1A (D) 0.5A

5. An amplifier of gain *A* is bridge by a capacitance *C* as shown in below circuit, then the effective input capacitance is



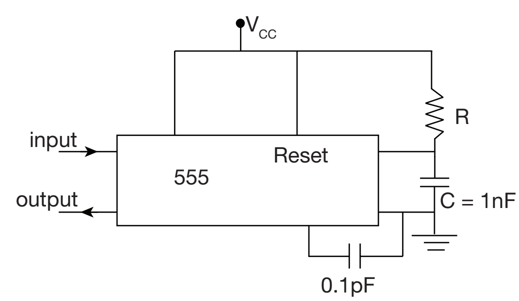
(A) C/A
(B) AC
(C) $C(1 + A)$
(D) $C(1 - A)$

6. In below circuit, find I_C if $\beta = 50$



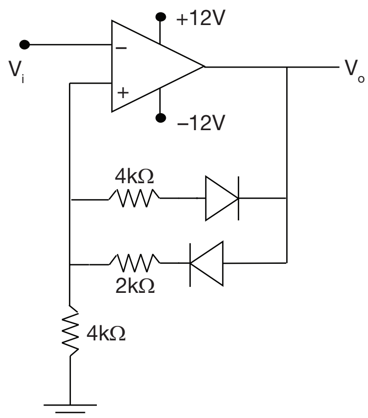
(A) 4.5 mA (B) 1.5 mA
(C) 4.41 mA (D) 3 mA

7. Given circuit is to be used as a divided by 2 network. The frequency of the input trigger signal is 4 kHz. If the value of capacitor is1 nF then value of *R* is



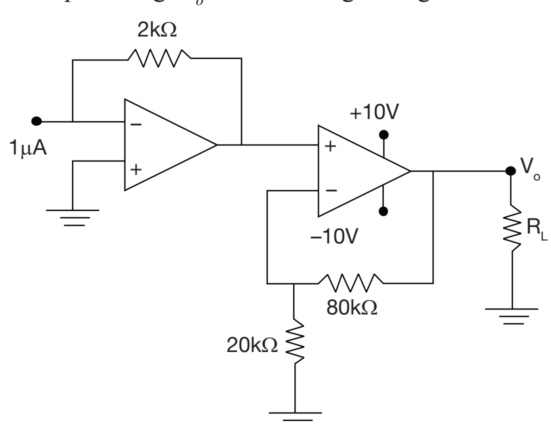
(A) 39 kΩ (B) 120 kΩ
(C) 140 kΩ (D) 272 kΩ

8. Hysteresis loop width of below Schmitt trigger is [diodes and Op-Amps are ideal]



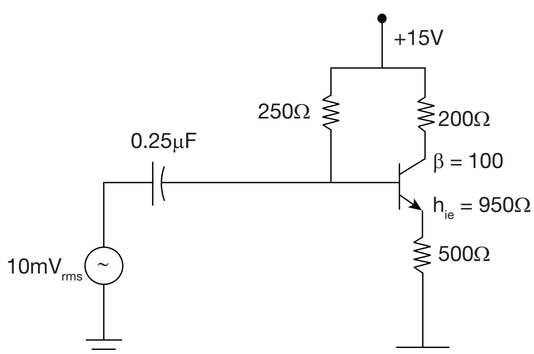
(A) 2V (B) 8V
(C) –6V (D) 14V

9. The output voltage V_o of the below given figure



(A) 0.1 mV (B) 1 mV
(C) 10 mV (D) 10V

10. Find the voltage gain of below circuit?

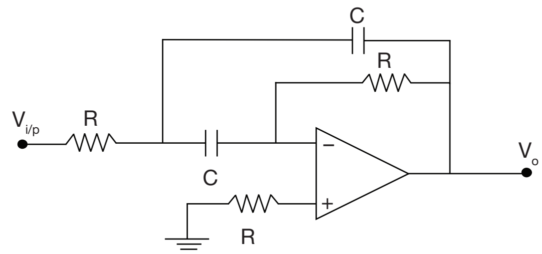


(A) 28.17 (B) 217.4
(C) 505 (D) 150.3

11. An amplifier with open loop voltage gain $A_V = 800 \pm 50$ is available. It is required to have an amplifier whose gain varies by not more than ±0.5%. Find reverse transmission factor β of the feedback network.

(A) 1.43% (B) 2.5%
(C) 4% (D) 3.7%

12. Below network represents a



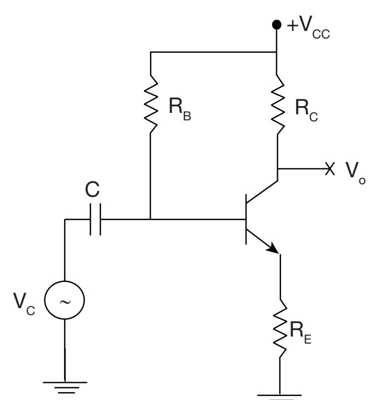
(A) Low pass filter
(B) High pass filter
(C) Band pass filter
(D) Band stop filter

13. Match List-I with List-II where List-I contains type of feedback and List-II have input impedance ($Z_{i/p}$) and output impedance ($Z_{o/p}$)

List-I	List-II
(p) current series	(1) $Z_{i/p}$ increases and $Z_{o/p}$ decreases
(q) current shunt	(2) $Z_{i/p}$ increases and $Z_{o/p}$ increases
(r) voltage series	(3) $Z_{i/p}$ decreases and $Z_{o/p}$ decreases
(s) voltage shunt	(4) $Z_{i/p}$ decreases and $Z_{o/p}$ increases

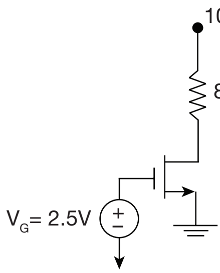
(A) p–2, q–4, r–1, s–3
(B) p–4, q–2, r–3, s–1
(C) p–3, q–1, r–2, s–4
(D) p–2, q–3, r–4, s–1

14. Below circuit configuration indicates which type of feedback connection?



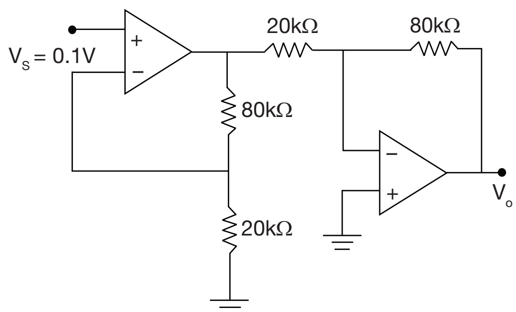
(A) voltage series feedback
(B) voltage shunt feedback
(C) current series feedback
(D) current shunt feedback

15. For FET shown in below figure has V_{TN} = 1.5V, k_n = 2 mA/V^2. The FET is in saturation and I_D = 1mA then small signal voltage gain A_V is



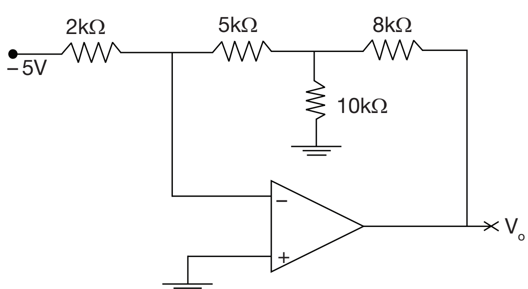
(A) –64 (B) –32
(C) 16 (D) 48

16. Find out output voltage (V_o), assume that the op-Amps in below circuit are ideal



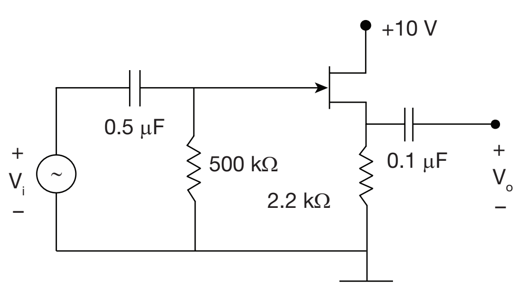
(A) 2 V (B) 0.5 V
(C) –0.5 V (D) –2 V

17. Output voltage of below circuit is



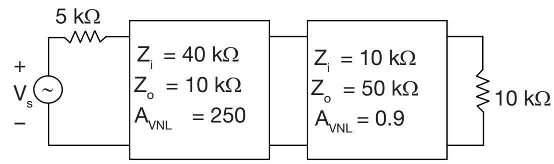
(A) –40.5 V (B) 12.5 V
(C) 42.5 V (D) 35 V

18. A dc analysis of the source follower network has V_{GSQ} = –2.5 V and I_{DQ} = 2.36 mA. Then find voltage gain A_V? [I_{DSS} = 12 mA, V_P =–5 V, Y_{OS} = 74 µs]



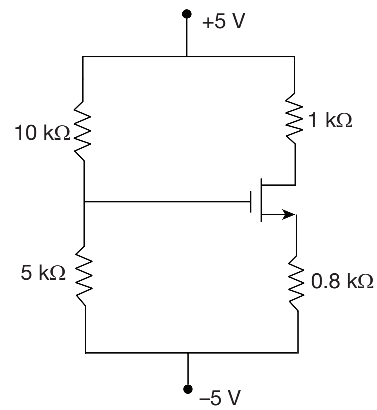
(A) 0.48 (B) 0.84
(C) 0.24 (D) 1.2

19. Find total current gain for the system



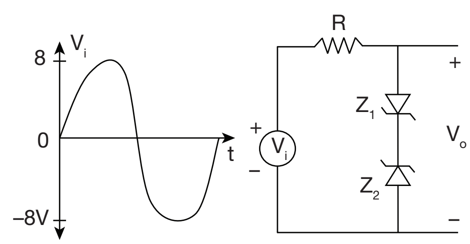
(A) –497.5 (B) 277.7
(C) –208 (D) 187

20. In below circuit the transistor parameters are V_{Th} = –1.2V and K_n = 0.8 mA/V² then find drain current

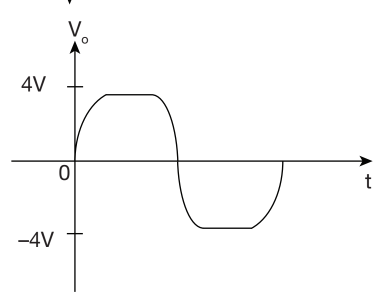


(A) 1.27 mA (B) 1.75 mA
(C) 1.55 mA (D) 1.97 mA

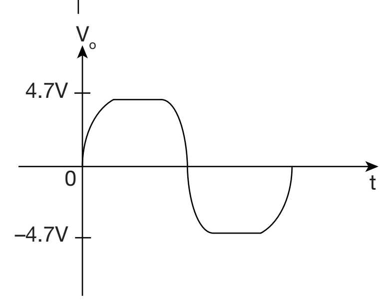
21. In below shown circuit zener voltage V_{Z_1} = 4V and V_{Z_2} = 4V, $V\gamma$ = 0.7V, then output voltage V_o is



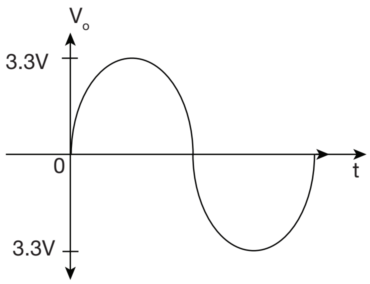
(A)



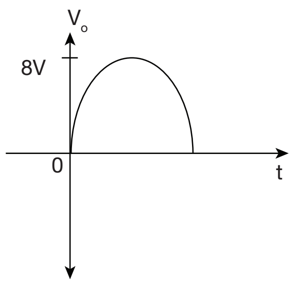
(B)



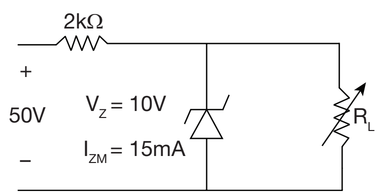
(C)



(D)

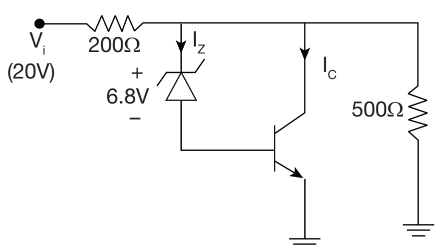


22. Find the range of R_L in below circuit



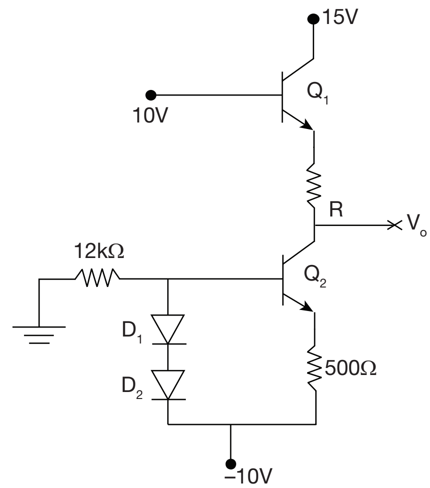
(A) 533 Ω < R_L < 1 kΩ
(B) 2 kΩ < R_L < 4 kΩ
(C) 800 Ω < R_L < 2 kΩ
(D) 500 Ω < R_L < 2 kΩ

23. Determine collector current for the below shown shunt regulator? Consider β is very high.



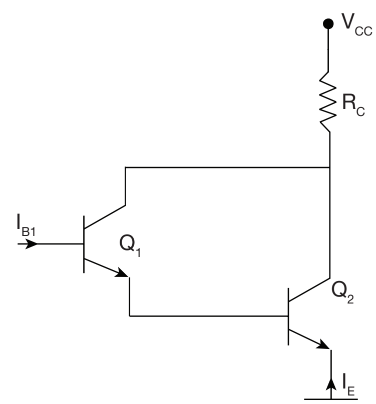
(A) 3.75 mA (B) 62 mA
(C) 58.25 mA (D) 25 mA

24. Calculate the value of R for V_o to become 3V. [$V_{BE} = V_D = 0.7$ and β is large]



(A) 2.25 kΩ (B) 4.5 kΩ
(C) 6 kΩ (D) None of the above

25. For the circuit below shown, $\alpha_1 = 0.96, \alpha_2 = 0.98$, V_{CC} = 15V, R_C = 250 Ω and I_E = –120mA, calculate I_B?



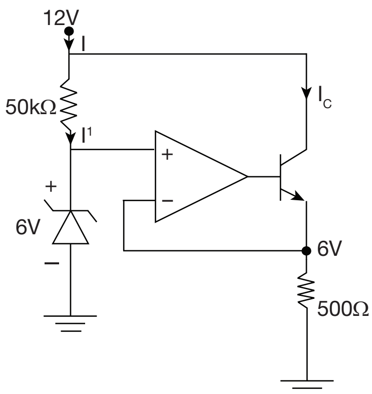
(A) –86 μA (B) 2.4 mA
(C) –2.4 mA (D) 96 μA

Answer Keys

1. B	**2.** C	**3.** C	**4.** B	**5.** D	**6.** C	**7.** D	**8.** D	**9.** C	**10.** B
11. A	**12.** C	**13.** A	**14.** C	**15.** B	**16.** D	**17.** C	**18.** B	**19.** A	**20.** B
21. B	**22.** D	**23.** C	**24.** B	**25.** D					

HINTS AND EXPLANATIONS

1.



$I = I^1 + I_C$

$I_E = \dfrac{6}{500} = 12 \text{ mA}$

$I_C = \alpha\, I_E = \dfrac{\beta}{1+\beta} I_E = \dfrac{50}{51} \times 12 \times 10^{-3} = 11.76\,\text{mA}$

$I^1 = \dfrac{12-6}{50}\text{mA} = \dfrac{6}{50}\text{mA} = 0.12\,\text{mA}$

$I = I_C + I^1 = 11.88 \text{ mA}$

Choice (B)

2. Choice (C)

3. $P = 10\text{W}$, $\eta = 50\%$, $T_a = 25^\circ\text{C}$, $T_i = 125^\circ\text{C}$

$\theta_{jc}\, P_D = T_j - T_a$

$\theta_{jc} = \dfrac{100}{10} = 10^\circ \text{ C/W}$ Choice (C)

4. $P_{ac} = I_{ac}^2 R_L \Rightarrow 20 = I^2_{AC}(10)$

$\Rightarrow\ I_{ac} = \sqrt{2}$

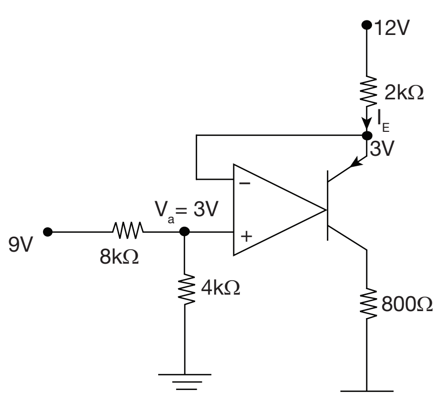
$\Rightarrow\ I_m = \sqrt{2}\ I_{ac} = 2$ Choice (B)

5. Assuming voltage amplifier with zero input current

$Q_i = C(V_i - AV_i)$

$\Rightarrow\ \dfrac{Q_i}{V_i} = C_{eq} = C(1-A)$ Choice (D)

6.



$V_a = \dfrac{9 \times 4}{12} = 3\text{V}$

$I_E = \left(\dfrac{12-3}{2}\right)\text{mA} = 4.5 \text{ mA}$

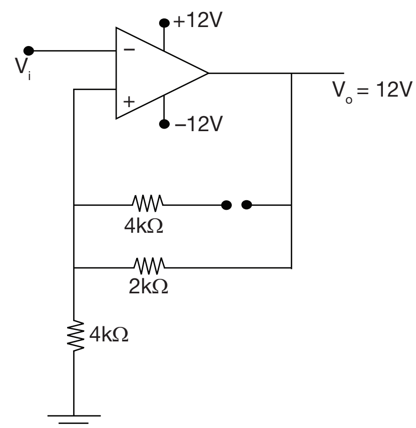
$I_C = \alpha\, I_E = \dfrac{\beta}{1+\beta} I_E = \dfrac{50}{51} \times 4.5 = 4.41\,\text{mA}$ Choice (C)

7. $t_p = 1.2T$

$= \dfrac{1.2}{4} \times 10^{-3} = 1.1 \text{ RC}$

$\dfrac{1.2 \times 10^{-3}}{4 \times 1.1 \times 10^{-9}} = R = 272 \text{ k}\Omega$ Choice (D)

8.



If $V_o = +12\text{V}$ then

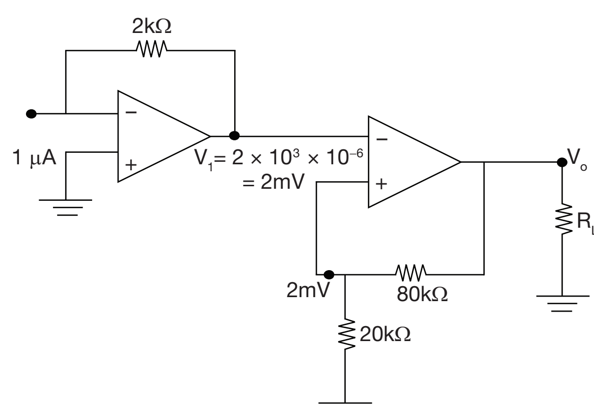
$V_1 = \dfrac{12 \times 4}{6} = 8\text{V}$

If $V_o = -12\text{V}$ then

$V_2 = \dfrac{-12 \times 4}{8} = -6\text{V}$

$V_H = V_1 - V_2 = 14\text{V}$ Choice (D)

9.



$\dfrac{V_o \times 20}{100} = 2 \times 10^{-3}$; $V_o = 10\text{mV}$ Choice (C)

10. $A_v = \dfrac{R_e}{r_e}$

$r_e = \dfrac{V_T}{I_E}$

$I_E = \dfrac{15 - 0.7 \times 100}{250 + 101 \times 500} = 28.17 \text{ mv}$

$r_e = \dfrac{26}{28.19} = 0.92\Omega$

$A_V = \dfrac{200}{0.92} = 217.4$ Choice (B)

11. $A_V = 800 \pm 50$

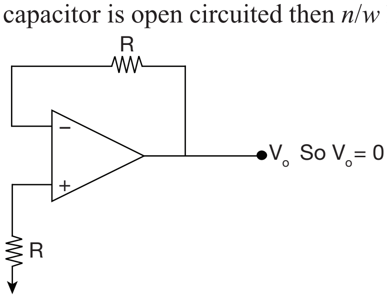
$\dfrac{\partial A_F}{A_F} = \pm 0.5\%$

$\dfrac{\partial A_F}{A_F} = \dfrac{\partial A}{A}\left(\dfrac{1}{1+\beta A}\right)$

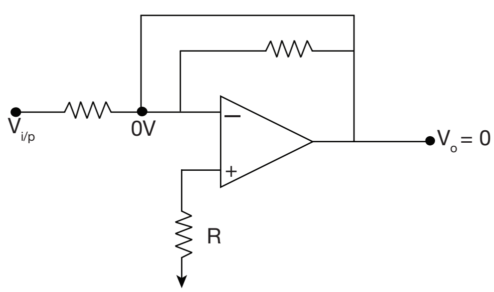
$\Rightarrow \dfrac{0.5}{100} = \dfrac{50}{800}\left(\dfrac{1}{1+\beta(800)}\right)$

$\Rightarrow$ β = 1.43%. Choice (A)

12. If $f \to 0$, capacitor is open circuited then n/w looks like



If $f \to \infty$, capacitors will short circuited then n/w looks like



So it represents a band pass filter Choice (C)

13. Choice (A)

14. The current through R_E results in a feedback voltage that opposes the source signal applied, so that V_o is reduced. It has current series feedback connection. Choice (C)

15. $A_V = -g_m R_D$

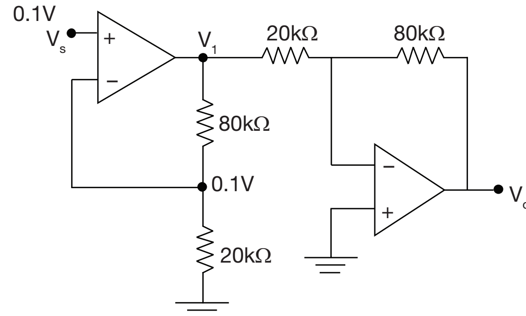
$\Rightarrow g_m = 2k(V_{GS} - V_{Th})$

$\Rightarrow V_{GS} = 2.5\text{V}$

$\Rightarrow g_m = 2 \times 2 \times 10^{-3} [2.5 - 1.5] = 4\text{ms}$

$A_V = -4 \times 10^{-3} \times 8 \times 10^3 = -32$ Choice (B)

16.

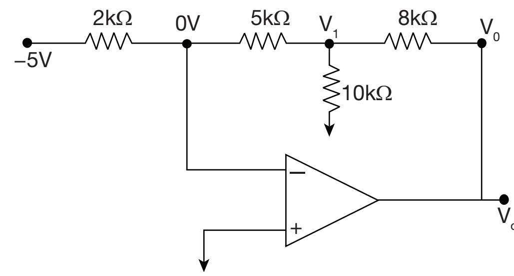


$0.1\text{V} = \dfrac{V_1 \times 20}{80 + 20}$

$V_1 = 0.5\text{V}$

$\Rightarrow V_0 = \dfrac{-R_F}{R_1} \times V_1 = -2\text{V}$ Choice (D)

17.



KCL at Node 0V is $\dfrac{0-(-5)}{2} + \dfrac{0 - V_1}{5} = 0$

$\dfrac{25}{2} = V_1$

$\Rightarrow$ KCL at Node V_1 is $\dfrac{V_1 - 0}{5} + \dfrac{V_1}{10} + \dfrac{V_1 - V_0}{8} = 0$

$\Rightarrow V_1\left[\dfrac{1}{5} + \dfrac{1}{10} + \dfrac{1}{8}\right] = \dfrac{V_0}{8}$

$\Rightarrow V_o = 42.5\text{V}$ Choice (C)

18. $g_m = \dfrac{2I_{DSS}}{|V_P|}\left[1 - \dfrac{V_{GSQ}}{V_P}\right]$

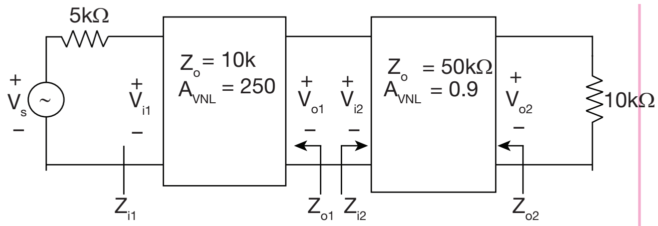
$= \dfrac{2 \times 12}{5}\left[1 - \dfrac{(-2.5)}{(-5)}\right] = 2.4 \text{ ms}$

$A_V = \dfrac{g_m R_s}{1 + g_m R_s} = \dfrac{2.4 \times 10^{-3} \times 2.2 \times 10^3}{1 + 2.4 \times 10^{-3} \times 2.2 \times 10^3}$

$= \dfrac{5.28}{6.28} = 0.84.$ Choice (B)

19. $A_{V_1} = \dfrac{V_{o_1}}{V_{i_1}} = \dfrac{Z_{i_2}}{Z_{i_2} + Z_{o_1}} A_{VNL1} = \dfrac{10 \times 10^3 \times 250}{(10+10) \times 10^3} = 125$

$A_{V_2} = \dfrac{R_L}{R_L + Z_{o_2}} A_{VNL2} = \dfrac{10^4}{10^4 + 50} \times 0.9 = 0.99$



$$A_{V_T} = A_{V_1}.A_{V_2} = 124.37$$

$$A_{i_T} = -A_{V_T}\frac{Z_i}{R_L}$$

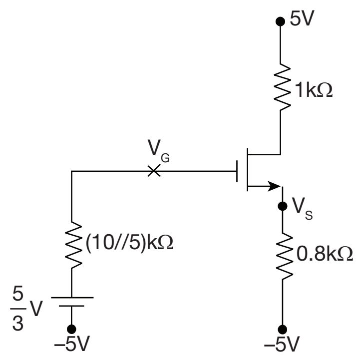
$$= 124.37 \times \frac{40}{10} = -497.5$$ Choice (A)

20. $V_{th} = \frac{5\times 5}{15} = \frac{5}{3}\text{V}$

$$5 + V_G = \frac{5}{3}$$

$$V_G = \frac{-10}{3}\text{V}$$

$$V_{GS} = V_G - V_S$$



$$I_D = \frac{V_S+5}{0.8\,\text{k}\Omega} = k_n\left[C_{GS(on)} - V_T\right]^2$$

$$\frac{(V_S+5)}{0.8} = 0.8\left[\frac{-10}{3} - V_S + 1.2\right]^2$$

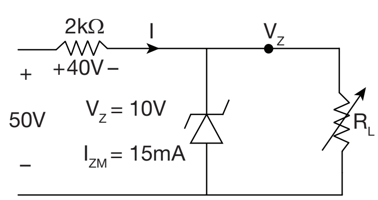
$\Rightarrow$ $V_S = -3.6$

$\Rightarrow$ $I_D = \frac{(-3.6+5)10}{8}\text{mA}$

$= 1.75$ mA Choice (B)

21. For $|V_i| \le 4.7$V, $V_o = V_i$ Choice (B)

22. To determine the value of R_L that will turn on zener diode



$$V_Z = \frac{50\times R_L}{R_L + 2K} = 10$$

$$R_{L\min} = 500\ \Omega$$

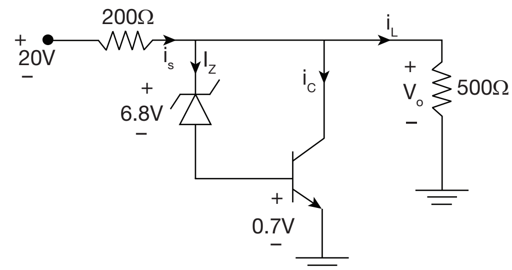
$$I = \frac{40}{2\text{k}\Omega} = 20\text{mA}$$

$$I_{L\min} = I - I_{ZM} = 5\text{ mA}$$

$$R_{L\max} = \frac{V_z}{I_{L\min}} = \frac{10\times 10^3}{5} = 2\,\text{k}\Omega$$

$\Rightarrow$ R_L range is $500\ \Omega < R_L < 2\ k\Omega$ Choice (D)

23.



$\Rightarrow$ $V_o = 6.8 + 0.7 = 7.5$V

$$i_L = \frac{7.5}{500} = 3.75\,\text{mA}$$

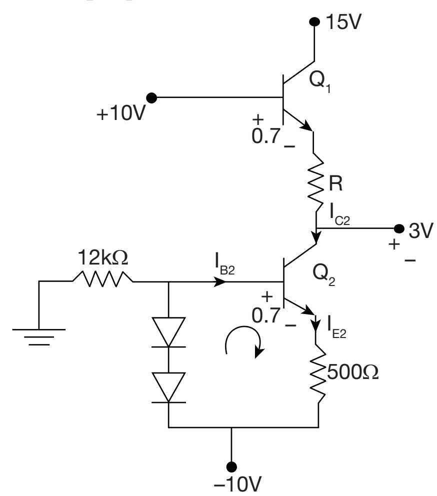
$$i_S = \frac{20-7.5}{200} = \frac{12.5}{200} = 62\,\text{mA}$$

as I_z is very small (β is very high)

$i_C \simeq i_S - i_L$

$\simeq 58.25$ mA Choice (C)

24. Write *KVL* loop equation



$\Rightarrow$ $0.7 + 0.7 - 0.7 - I_{E_2}\,500 = 0$

$\Rightarrow$ $I_{E_2} = 1.4\,\text{mA}$

$\Rightarrow$ $I_{C_1} \approx I_{E_2} = I_{C_2}$ [β is large]

$\Rightarrow$ write *KVL* equation

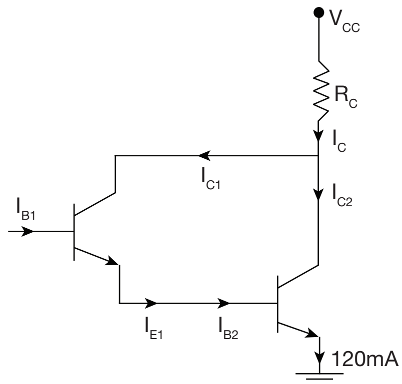
$10 = 0.7 + I_{C_2}\ R + 3$

$$\Rightarrow R = \frac{10 - 3.7}{1.4} \text{k}\Omega$$

$$= 4.5 \text{ k}\Omega$$

Choice (B)

25.



$$\beta_1 = \frac{\propto_1}{1 - \propto_1} = 24$$

$$\beta_2 = \frac{\propto_2}{1 - \propto_2} = 49$$

$$I_{B_2} = \frac{I_E}{(1 + \beta_2)} = \frac{120\text{mA}}{50}$$

$$= 2.4 \text{ mA} = I_{E_1}$$

$$\Rightarrow \quad I_{B_1} = \frac{I_{E_1}}{1 + \beta_1} = \frac{2.4\text{mA}}{25} = 96\mu\text{A}$$

Choice (D)