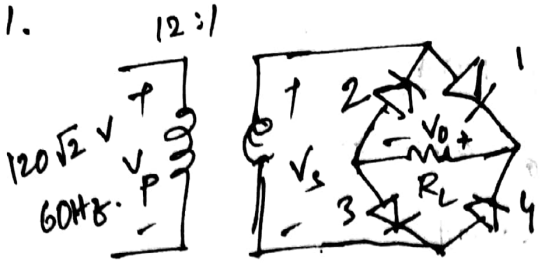
1.



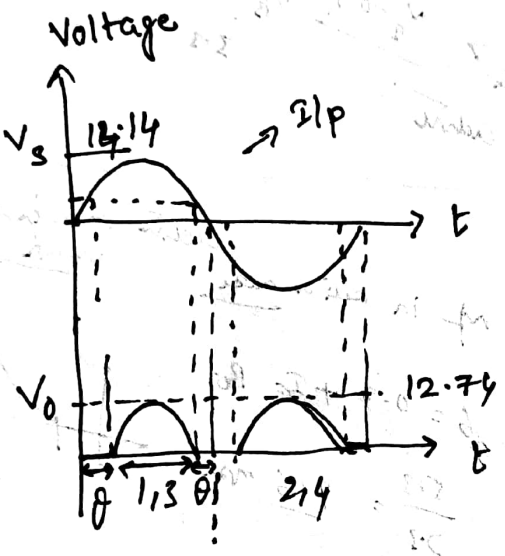
$D_1 = 0.7 V$

$V_p = 120\sqrt{2}\ V$

$V_s = \frac{1}{12}(120\sqrt{2}) = 10\sqrt{2} = 14.14\ V$

$V_0 = 14.14 - 1.4 = 12.74\ V$

peak value of voltage across the load.



each diode

$\sin\theta = \frac{V_D}{V_s}$ ⇒ $\theta = \sin^{-1}\left(\frac{V_D}{V_s}\right) = 2.84°$

Diode conduction angle = $\frac{180 - (2.84 \times 2)}{360°}$

(% of conduction)

= 48.4 %

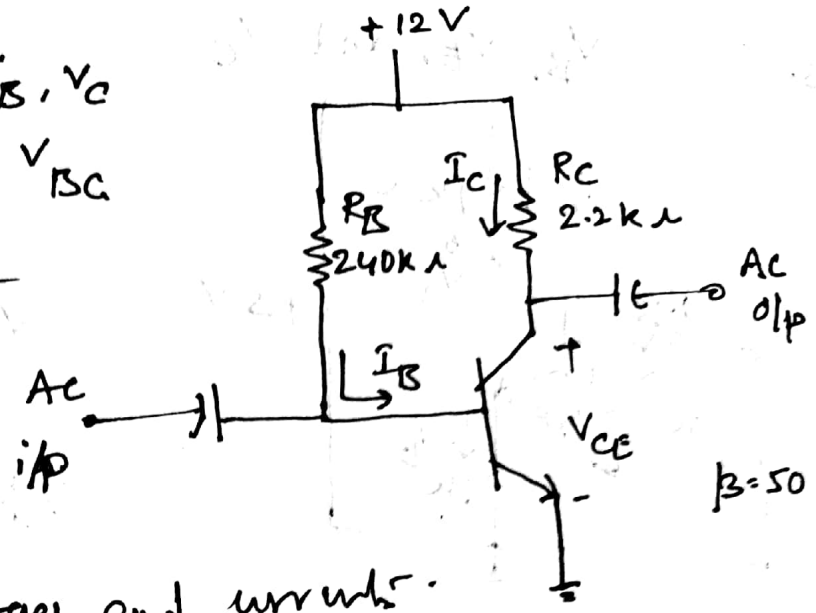
avg voltage across the load = $\frac{2}{\pi}(V_0)$

$V_{dc} = 8.1\ V$

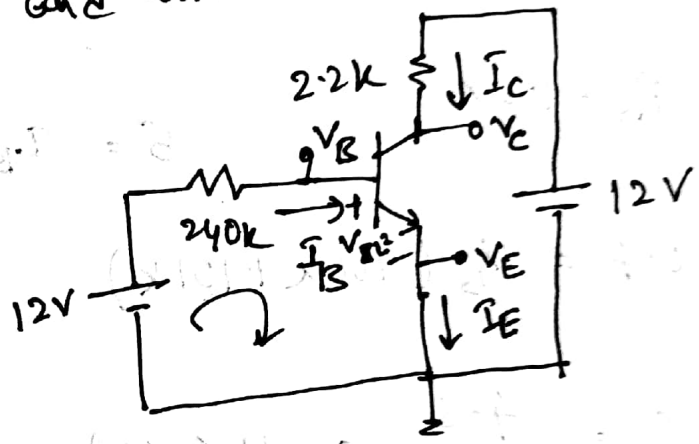
avg current across the load (1k) ⇒ $I = \frac{V_{dc}}{R}$

$= 8.1\ mA$

2. I_B, I_C, V_{CE}, V_B, V_C and V_{BC}



Capacitors have no role in this circuit since we are interested in DC voltages and currents.



$V_E = 0$ (grounded)

at $12 = 240k \cdot I_B + 0.7V$

$$I_B = \frac{12 - 0.7}{240k} = 47\mu A$$

$$I_C = \beta I_B = 2.35\,mA$$

$$I_E = I_C + I_B$$

$$I_E = 2.4\,mA$$

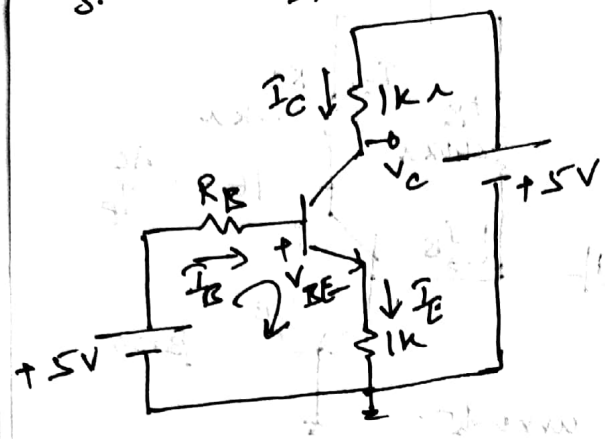
$$12 = I_C(2.2k) + V_C$$

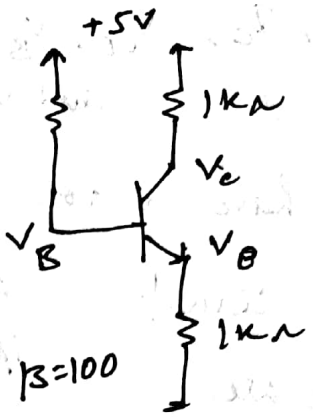
$$V_C = 12 - 2.35 \times 2k = 12 - 5.17 = 6.83\,V$$

$$V_B = V_{BE} = 0.7V$$

$$V_{BC} = 0.7 - 6.83 = -6.13V$$

8. V_B, V_E, and V_C





i) $R_B = 100\,K$

$5 = I_B R_B + V_{BE} + I_E(1K)$

$5 - 0.7 = I_B (100K + 101K)$

$I_E = (\beta+1) I_B$

$I_B = \frac{4.3}{201\,K} = 21.4\,\mu A$

$I_E = 101\, I_B$

$I_E = 2.16\,mA$

$I_C = 2.14\,mA$

$V_B = 5 - R_B I_B$

$V_B = 5 - 2.14 = 2.86\,V$

$V_C = 5 - 2.14 = 2.86\,V$

$V_E = 2.16\,m \times 1K = 2.16\,V$

(ii) $R_B = 10\,K$

$I_B = \frac{4.3}{111\,K} = 38.7\,\mu A$

$V_B = 5 - 10 \times 38.7 \times 10^{-3}$

$I_E = 3.91\,mA$

$I_C = 3.87\,mA$

$V_B = 4.613\,V$

$V_C = 5 - 3.87 = 1.13V$

$V_C - V_B \Rightarrow -3.5 \rightarrow$ Not in Active region.

Consider transistor in sat. $V_{CE\,sat} = 0.2V$

$4.3 = I_B R_B + I_E R_E$

$I_E = I_C + I_B$

$V_C = V_E + V_{CE\,sat}$

$I_C = I_E - I_B$

$V_C = I_E R_E + 0.2V$

$5 = I_C R_C + V_C$

$5 = I_C R_C + I_E R_E + 0.2V$

$4.8 = I_C R_C + I_E R_E$

$4.8 = I_E R_C - I_B R_C + I_E R_E$

$4.8 = I_E (R_C + R_E) - I_B R_C$

$R_C = 1K \quad R_E = 1K \quad R_B = 10K$

$4.8 = I_E (2K) - I_B 1K$

$2 \times 4.3 = I_B\, 10K \times 2 + I_E\, 1K \times 2$

$8.6 = 20K\, I_B + 2K\, I_E$

$4.8 = +1K\, I_B - 2K\, I_E$

$I_B = \dfrac{8.6 - 4.8}{21K} = 180.9\,\mu A.$

$I_E = \dfrac{4.8 + I_B(1K)}{2K} = 2.49\,mA$

$I_C = I_E - I_B = 2.31\,mA$

$V_E = I_E R_E = 2.49\,V$

$V_C = 2.69V$

$V_B = V_{BE} + V_E = 0.7 + 2.49$

$V_B = 3.19V$