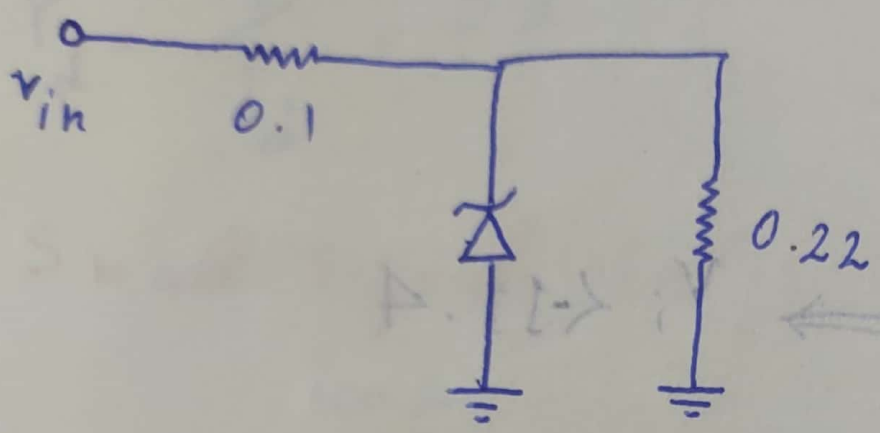
$V_{out} = 15$ $V_R = 2V$ $V_{in} = 310$ $f = 60Hz$ 1

$R_\ell = 150$ $C = ?$ $n = ?$ PIV

$$V_R = \frac{V_m - V_{DON}}{fRC} \Rightarrow 2 > \frac{15}{C \times 60 \times 150} \Rightarrow \underline{C > 83\,mf}$$

$$\frac{V_1}{V_2} = \frac{n_1}{n_2} \Rightarrow \frac{310}{15} = \frac{n_1}{n_2} \Rightarrow \begin{cases} n_1 = 62 \\ n_2 = 3 \end{cases}$$

$$PIV = 2V_m = 30V$$



$V_Z = 6.1$

$I_{Z_K} = 1\,mA$

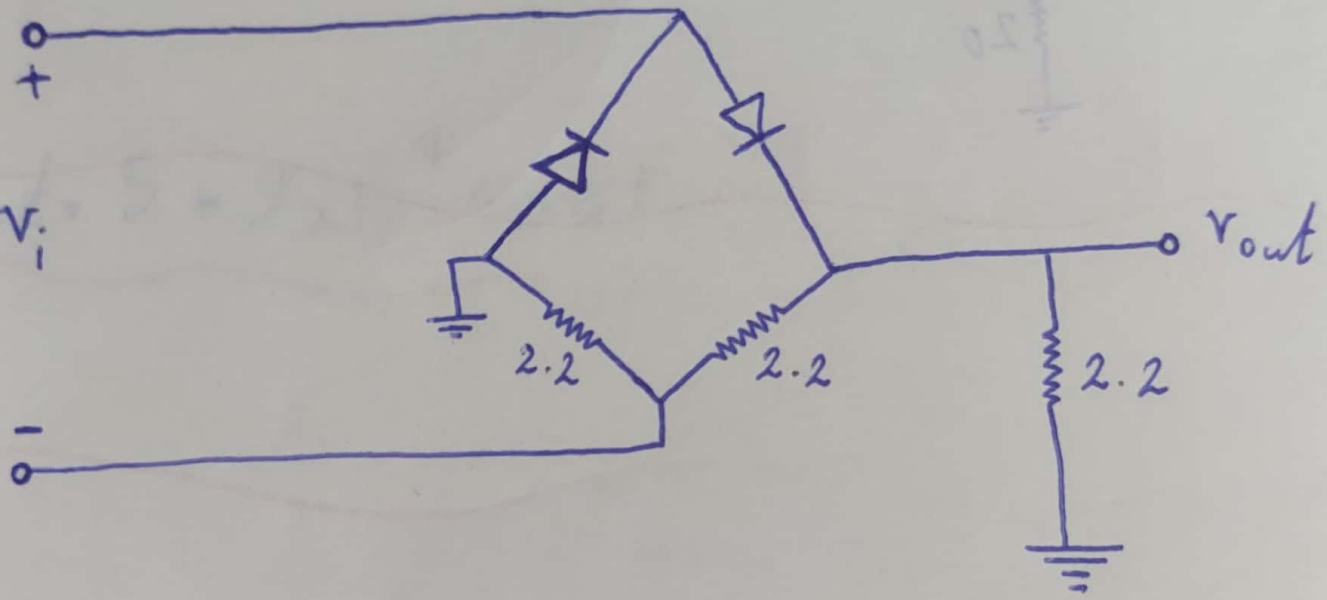
$P_{Z_{max}} = 500\,mW$

$$I_{Z_{max}} = \frac{500}{6.1} \simeq 82\,mA$$

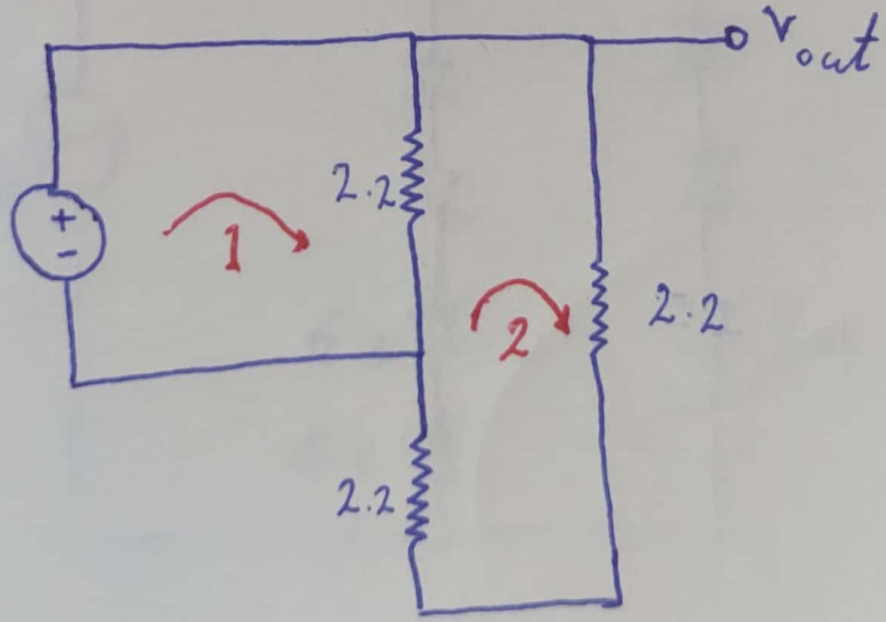
$$I_\ell = \frac{6.1}{0.22} = 27.7\,mA$$

$$I_{Z_{min}} = \frac{V_{in_{min}} - V_Z}{R_S} - I_\ell \longrightarrow V_{in_{min}} = 8.97V$$

$$I_{Z_{max}} = \frac{V_{in\,max} - V_Z}{R_S} - I_\ell \longrightarrow V_{in_{max}} = 17.07V$$

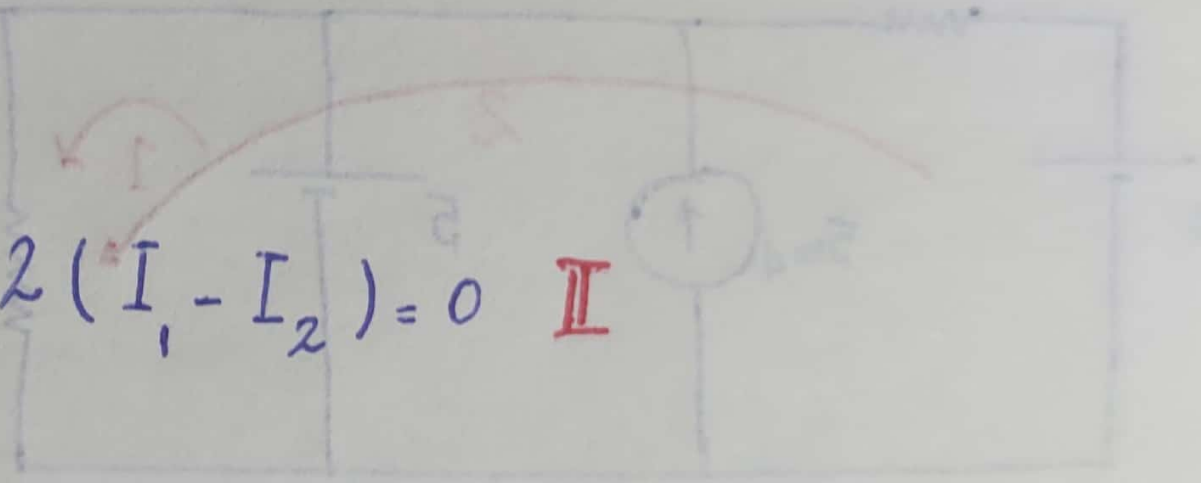


Positive period



KVl @2: $2.2\,I_2 + 2.2(I_2 - I_1) + 2.2\,I_2 = 0$

$I_1 = 3\,I_2$ I

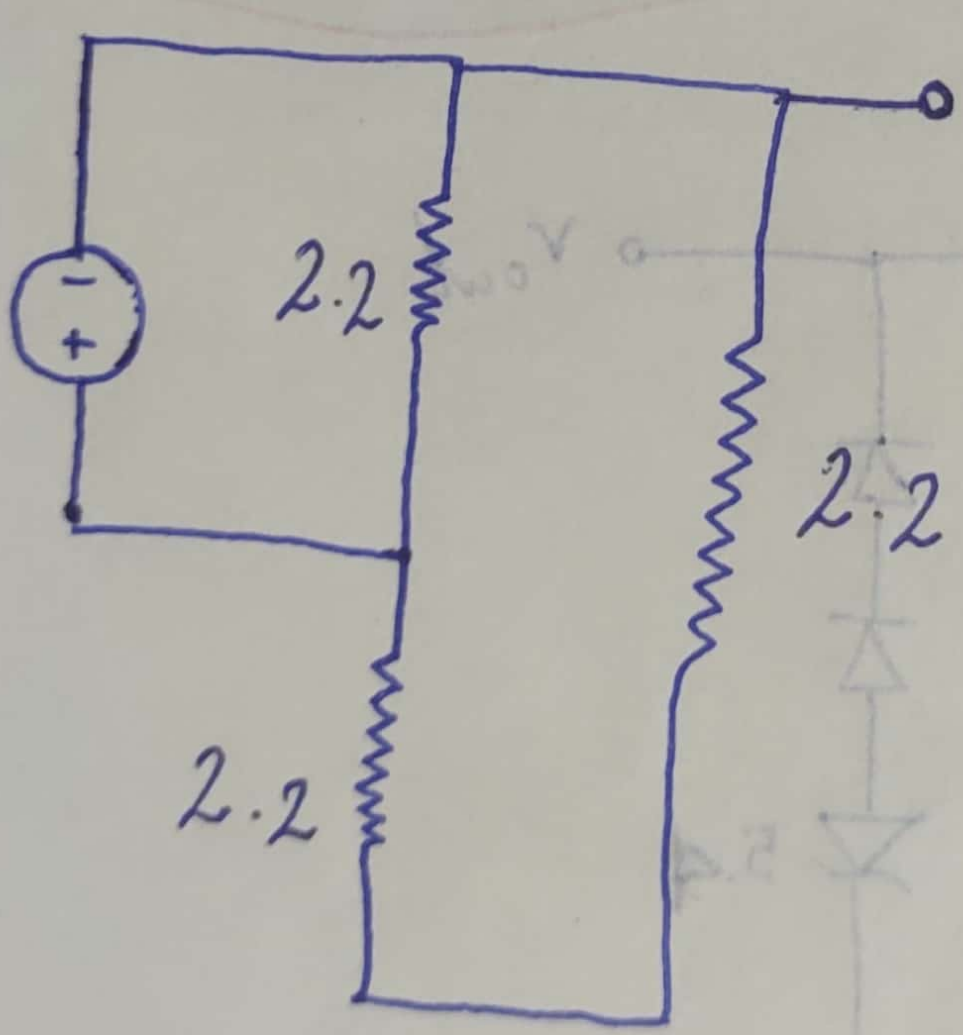


KVl @1: $-V + 2.2(I_1 - I_2) = 0$ II

I in II $V = 4.4\,I_2$

$V_{out} = 2.2\,I_2 \Longrightarrow V_{out} = V/2$

negative period



$$V_0 = -\frac{V_i}{2}$$

positive period

D_1 & D_3 ON

$V_o = 11.4$

$$I_{D_1} = \frac{V_i - 11.4}{500} > 0 \Longrightarrow V_i > 11.4$$

negative period

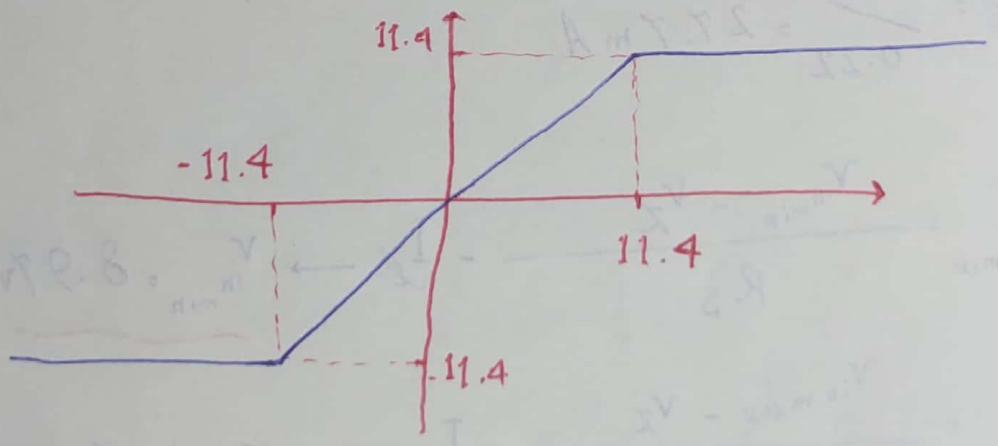
D_4 & D_3 ON

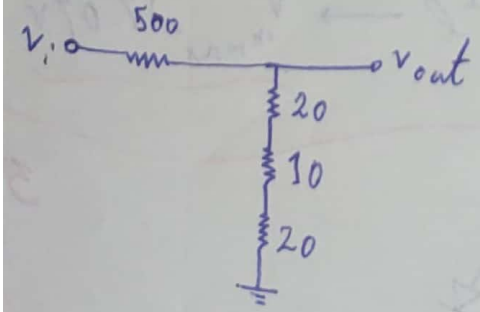
$V_o = -11.4$

$$I_{D_4} = \frac{-V_i - 11.4}{500} > 0 \Longrightarrow V_i < -11.4$$

$-11.4 < V_i < 11.4$ D_1 & D_2 & D_3 & D_4 OFF

$V_i = V_o$

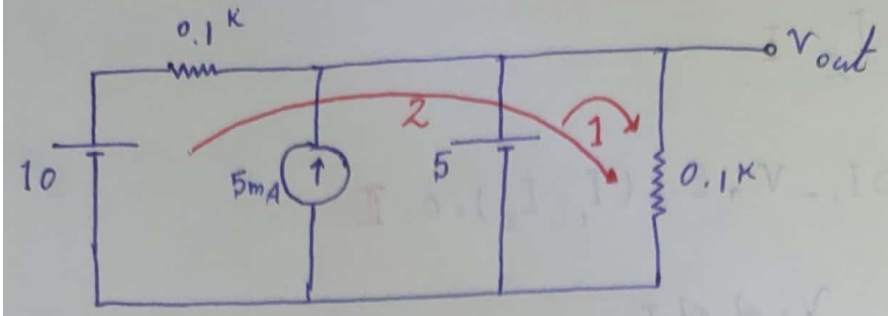




$V_{out} = 0.1 V_i$

(b

DC analysis:



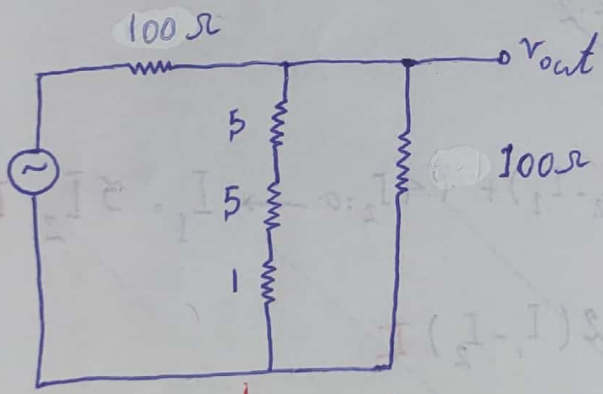
KVL @ 1 : $I_1 = 50\,mA$

KVL @ 2 : $-10 + 0.1\,I_2 + 5 = 0 \rightarrow I_2 = 50\,mA$

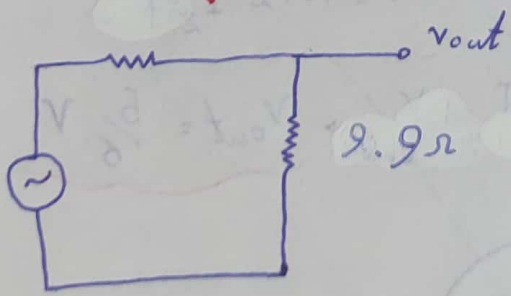
$I_d = 5\,mA$

$r_d = \frac{V_T}{I_d} = 5\,\Omega$

Small signal analysis:



100 Ω ↓ simple



$$V_{out} = \frac{9.9}{100+9.9} \times 0.01 \sin wt = 9 \times 10^{-4} \sin wt$$

$$V_{out} = 5 + 9 \times 10^{-4} \sin wt$$