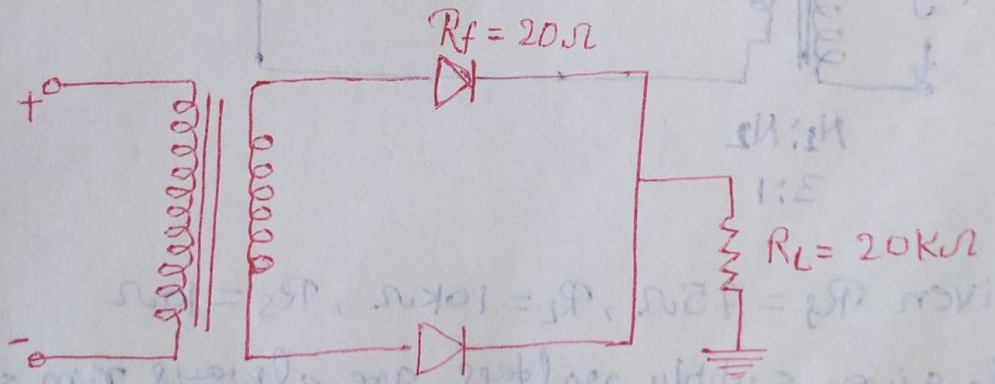
Q. A centre-tapped is shown below. The voltage across half of the secondary winding is $V_S = 200 \sin \omega t$. Find I_m, I_{dc}, I_{rms}, ripple factor and PIV.



Soln- $V_S = 200 \sin \omega t$

$\therefore V_m = 200$

$$I_m = \frac{V_m}{R_f + R_L} = \frac{200\ V}{(0.02+20)K\Omega} = 9.99\ mA$$

$$I_{dc} = \frac{2I_m}{\pi} = \frac{2 \times 9.99}{\pi} = 6.35\ mA$$

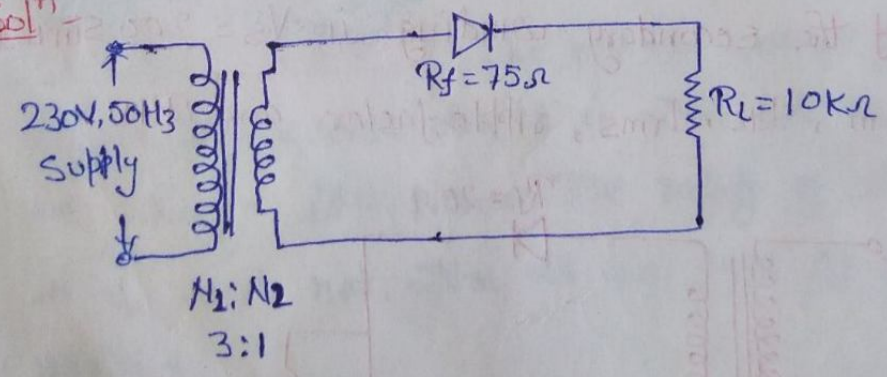
$$I_{rms} = \frac{I_m}{\sqrt{2}} = 7.06\ mA$$

$$\text{Ripple factor} = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1} = \sqrt{(1.11)^2 - 1} = 0.48$$

$$PIV = 2V_m = 2 \times 200 = 400V$$

Q. A half wave rectifier circuit is supplied from a 230V, 50Hz supply with a step down ratio of 3:1 to a resistive load of 10kΩ. The diode forward resistance is 75Ω while transformer secondary resistance is 10Ω. Calculate maximum, average, RMS value of current, D.C. output voltage, efficiency of rectification and ripple factor.

Sol^n



Given $R_f = 75\Omega$, $R_L = 10K\Omega$, $R_s = 10\Omega$

The given supply voltage are always r.m.s. value

$$V_{P(RMS)} = 230V, \quad \frac{N_2}{N_1} = \frac{1}{3}$$

$$\because \frac{V_S}{V_P} = \frac{N_2}{N_1} \Rightarrow V_S = \frac{1}{3} \times 230 \Rightarrow V_{S(RMS)} = 76.67V$$

$\therefore V_m = \sqrt{2} V_s = \sqrt{2} \times 76.67 = 108.423\,V$

$I_m = \frac{V_m}{R_s + R_f + R_L} = \frac{108.423}{10+75+10\times10^3} = 10.75\,mA$

$I_{dc} \simeq I_{av} = \frac{I_m}{\pi} = \frac{10.75}{\pi} = 3.422\,mA$

$I_{rms} = \frac{I_m}{2} = \frac{10.75}{2} = 5.375\,mA$

dc output voltage, $V_{dc} = I_{dc} \cdot R_L = 3.422 \times 10 = 34.22\,V$

$P_{dc} = V_{dc} \cdot I_{dc} = 34.22 \times 3.422 \times 10^{-3} = 0.1171\,W$

$P_{ac} = I_{rms}^2 [R_s + R_f + R_L)$

$= (5.375)^2 [10+75+10\times10^3]$

$= 0.2913\,W$

$\%\eta = \frac{P_{dc}}{P_{ac}} \times 100 = \frac{0.1171}{0.2913} \times 100 = 40.19\%$

Ripple factor,

$\gamma = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1} = \sqrt{\left(\frac{5.375}{3.422}\right)^2 - 1}$

$= 1.21$