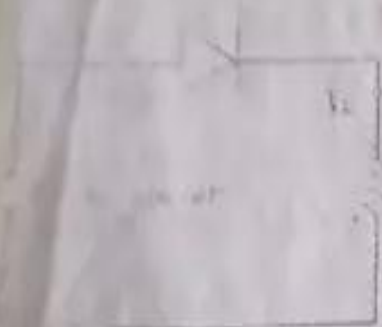


المسألة: حساب القدرة

المعطيات: $V_m = 115 \text{ V}$, $R = 20 \Omega$



$$V_m = 115 \text{ V}$$

$$V_{dc} = \frac{V_m}{\pi} = \frac{115}{\pi} = 36.6 \text{ V}$$

$$I_{dc} = I_{average} = \frac{V_m}{\pi R} = \frac{V_{dc}}{R} = \frac{36.6}{20} = 1.83 \text{ A}$$

$$V_{rms} = \frac{V_m}{2} = \frac{115}{2} = 57.5 \text{ V}$$

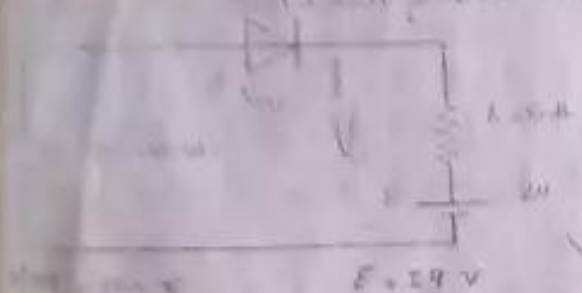
$$I_{rms} = \frac{V_m}{2R} = \frac{V_{rms}}{R} = \frac{57.5}{20} = 2.87 \text{ A}$$

القدرة الحقيقية المستهلكة في الحمل

$$P_{ac} = V_{rms} \times I_{rms}$$

$$= 57.5 \times 2.87 = 165.31 \text{ W}$$

Ex. A single phase half wave rectifier circuit is shown in figure. The input voltage is $V_s = 110 \sin \omega t$ V. The load resistance is $R = 10 \Omega$. The source resistance is $R_s = 0.5 \Omega$. The DC voltage is $E = 19$ V.



Source resistance $R_s = 0.5 \Omega$

$$V_s = \frac{110}{\sqrt{2}} = \frac{110}{1.414} = 77.7 \text{ V}$$

$$V_m \sin \alpha = E$$

$$\sin \alpha = \frac{E}{V_m}$$

$$\alpha = \sin^{-1} \left\{ \frac{19}{77.7} \right\} = 0.248 \text{ or } 14.2^\circ$$

$$\pi - \alpha = 180^\circ - 14.2^\circ = 165.8^\circ$$

$$\pi - \alpha = 165.8^\circ - 14.2^\circ = 151.6^\circ$$

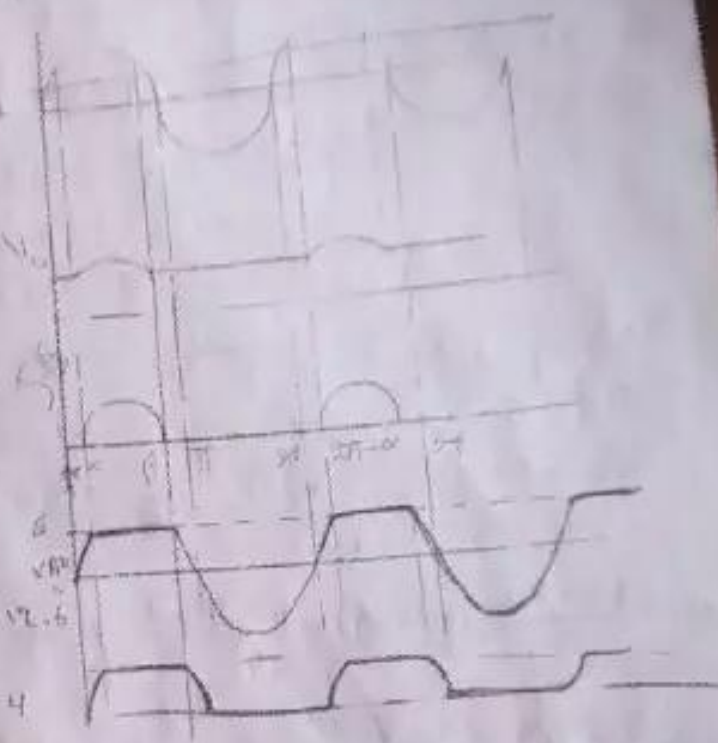
$$I_{dc} = \frac{1}{2\pi R} (2 V_m \cos \alpha + 2 E \alpha - \pi E)$$

$$I_{dc} = \frac{1}{2\pi \times 10} \left[2 \times 110 \cos 14.2^\circ + (2 \times 19 \times 0.248) - (\pi \times 19) \right]$$

$$I_{dc} = 4.76 \text{ A}$$

$$I_{rms} = \sqrt{\frac{1}{2\pi R} \left[\left(\frac{V_m^2}{2} + E^2 \right) (\pi - 2\alpha) + \frac{V_m^2}{2} \sin 2\alpha - 4 V_m E \alpha + \pi E^2 \right]}$$

$$I_{rms} = \sqrt{\frac{1}{2\pi \times 10} \left[\left(\frac{110^2}{2} + 19^2 \right) (\pi - 2 \times 0.248) + \frac{110^2}{2} \sin (2 \times 0.248) - 4 \times 110 \times 19 \cos (14.2^\circ) + \pi \times 19^2 \right]}$$



$$I_{rms} = \sqrt{4.44 \times 10^{-3} (4626 + 2.1 + 2570.96 - 10305.62)}$$

$$I_{rms} = 2.09 \text{ A}$$

$$P_R = I_{rms}^2 R = 8.04^2 (5) = 323.208 \text{ W}$$

$$P_{dc} = E I_{dc} = 24 \times 4.76 = 114.24 \text{ W}$$

∴ Total power is approx 2, watt

$$P_{ac} = P_{dc} + P_R = 323.208 + 114.24 \\ = 437.448 \text{ Watt}$$

3.5

3.5

The output voltage is regulated at 12V. The load current is 1A. The input voltage is 24V. The ripple voltage is 1V. The output voltage is 12V. The load current is 1A. The input voltage is 24V. The ripple voltage is 1V.



$$V_o = V_p + \frac{V_r}{2} = 12 + \frac{1}{2} = 12.5 \text{ V}$$

$$\frac{V_o}{2} = \frac{12}{2} = 6 \text{ V}$$

$$V_m = \frac{V_o}{\sqrt{2}} + \frac{V_r}{2} = \frac{12}{\sqrt{2}} + \frac{1}{2} = 8.5 \text{ V}$$

$$V_{dc} = \frac{V_m}{\pi} = \frac{8.5}{\pi} = 2.72 \text{ V}$$

$$I_{dc} = \frac{V_{dc}}{R_L} = \frac{2.72}{12} = 0.23 \text{ A}$$

$$V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{8.5}{\sqrt{2}} = 6.02 \text{ V}$$

$$I_{rms} = \frac{V_{rms}}{R_L} = \frac{6.02}{12} = 0.5 \text{ A}$$

$$P_{dc} = V_{dc} \times I_{dc} = 2.72 \times 0.23 = 0.63 \text{ W}$$

$$P_{ac} = V_{rms} \times I_{rms} = 6.02 \times 0.5 = 3.01 \text{ W}$$

$$\eta = \frac{P_{dc}}{P_{ac}} \times 100 = \frac{0.63}{3.01} \times 100 = 21.3\%$$

$$P_{ac} = \frac{V_{rms}^2}{R_L} = \frac{6.02^2}{12} = 3.01 \text{ W}$$

$$P_{dc} = \frac{V_{dc}^2}{R_L} = \frac{2.72^2}{12} = 0.63 \text{ W}$$

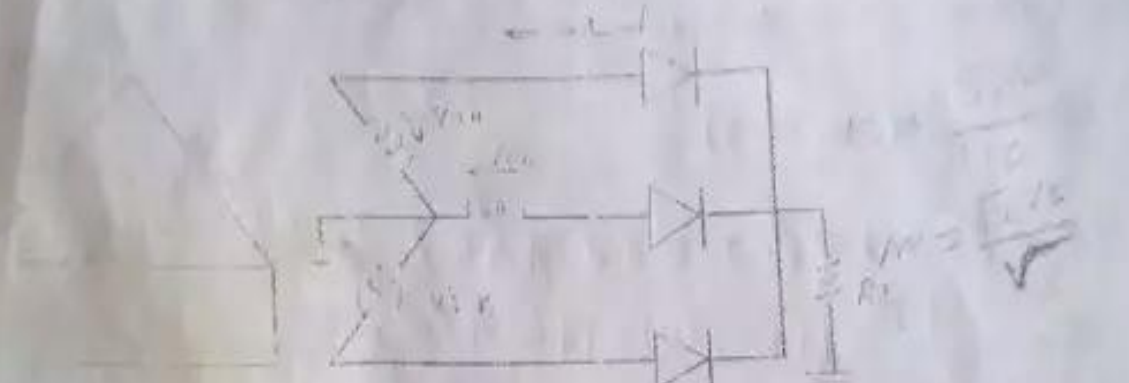
PS V = 100 V

1. Find the average value of the output voltage.

2. Find the average value of the output current.

3. Find the average value of the output power.

4. Find the average value of the output voltage across the load resistor.



$$V_s = \sqrt{V_{m1}^2 + \frac{R_L^2}{R_1}} = \sqrt{\frac{100^2}{3} + \frac{10^2}{1}} = 56.2$$

$$\frac{V_{m1} R_{L1}}{2 \pi} = \dots$$

$$V_{s1} = \frac{V_{m1} R_{L1}}{2 \pi} = \frac{38.4 \times 10}{2 \pi} = 31.02 \text{ V}$$

$$V_{s2} = \frac{31.02}{\sqrt{3}} = 25.65 \text{ Volt}$$

$$\frac{I_{dc}}{2} = \frac{51.3}{10} = 2.56 \text{ Amper}$$

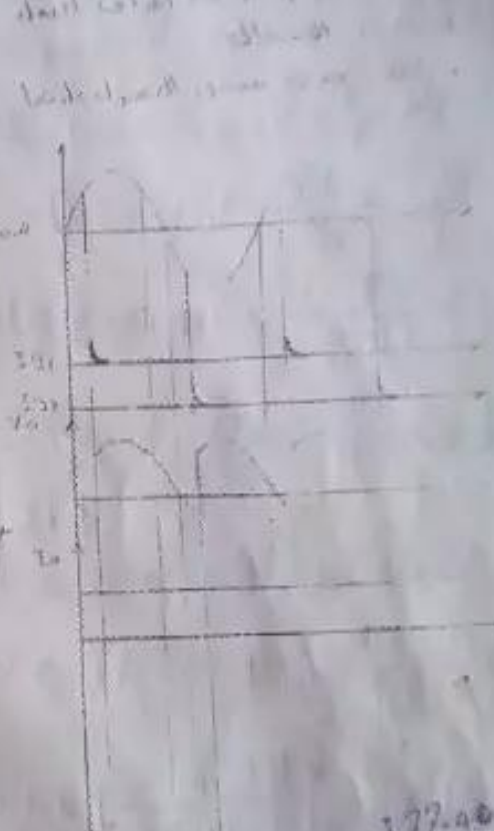
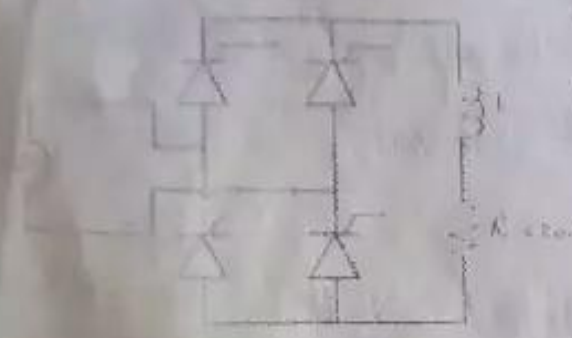
$$I_{dc} = 2.56 \text{ Amper}$$

$$V_P = \frac{V_L}{\sqrt{3}}$$

$$I_{PM} = I_L$$

$$V_P = \frac{V_L}{\sqrt{3}}$$

The circuit is a full-bridge rectifier with a load resistor \$R_L\$. The input is an AC voltage \$v_s = V_m \sin \omega t\$. The output voltage \$v_o\$ is the average value of the rectified waveform. The average value of a full-wave rectified sine wave is \$V_m / \pi\$. The average current \$I_o\$ is \$V_o / R_L\$. The average power \$P_o\$ is \$V_o I_o\$. The average power \$P_{avg}\$ is \$I_o^2 R_L\$. The average power \$P_{avg}\$ is \$V_o^2 / R_L\$. The average power \$P_{avg}\$ is \$I_o^2 R_L\$. The average power \$P_{avg}\$ is \$V_o^2 / R_L\$.



Sol
 $R_L = 20 \Omega$
 $V_m = 294.19 \text{ Volt}$
 435.57

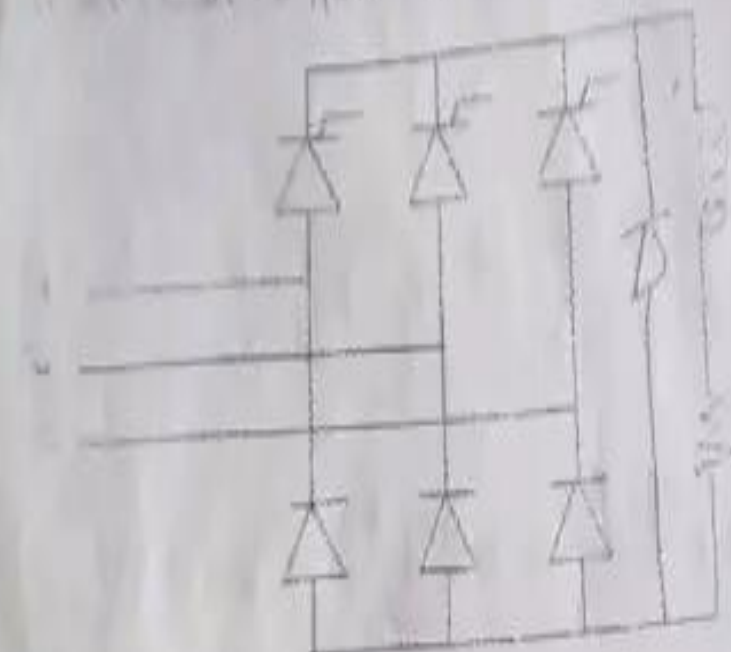
$\frac{2V_m}{\pi} \cos \alpha$
 $I_o = \frac{V_o}{R_L} = \frac{2V_m}{\pi R_L} \cos \alpha$
 $I_o = 10 \text{ A}$

$R = 10 \times 20 = 200 \Omega$
 $\frac{2V_m}{\pi} \cos \alpha$

$\alpha = 76$
 $V_{avg} = \frac{2V_m}{\pi} \cos \alpha = 172.98$
 $I_o = \frac{V_{avg}}{R} = 13.87$

277.40
 $R_{eq} = \frac{2V_m \cos \alpha}{\pi I_o} = 277.40$
 $\alpha = \cos^{-1}(0.26) = 75.38^\circ$
 $P_{avg} = V_{avg} I_o = 382.8$

The bridge rectifier circuit is shown below. The input voltage is $V_L = 200\text{ V}$. The load resistance is $R_L = 10\ \Omega$. The average output voltage is V_{avg} . The average output current is I_{avg} . The average output power is P_{avg} . The average output voltage is $V_{avg} = \frac{2\sqrt{2} V_L}{\pi} (1 + \cos \alpha)$. The average output current is $I_{avg} = \frac{V_{avg}}{R_L}$. The average output power is $P_{avg} = V_{avg} I_{avg}$.



$P_{avg} = 121.63\text{ W}$
 $V_L = 200\text{ V}$

$$V_{avg} = \frac{2\sqrt{2} V_L}{\pi} (1 + \cos \alpha) = 169.83\text{ V}$$

$$V_{avg} = \frac{V_L}{\sqrt{3}}$$

$$I_{avg} = \frac{V_{avg}}{R_L} (1 + \cos \alpha)$$

$$P_{avg} = \frac{V_{avg}^2}{R_L} (1 + \cos \alpha)^2$$

$$P_{avg} = 121.63 + 121.63 = 243.26\text{ W}$$



$$V_{\text{a}} = E_{\text{a}} + I_{\text{a}} R_{\text{a}}$$

$$E_2 = K_2 W$$

$$T = K I_a$$

$$T = \frac{P_0}{(B)}$$

$$P_{out} = 3 \times 74.6 = 223.8 \text{ watt}$$

$$y = \frac{\sqrt{10}}{\pi} (1 + \cos x)$$

$$V_s = 220 \quad \Rightarrow \quad V_m = \sqrt{2} V_s = 220\sqrt{2} = 311.127 \text{ V}$$

$$E_m = K \omega$$

$$E_m = 1.187 \times 157.07 = 186.75 \text{ V}$$

$$V_a = E_m + I_a R_a = 186.75 + (12 \times 0.2) = 122.3 \text{ V}$$

$$V_a = \frac{V_m}{\pi} (1 + \cos \alpha)$$

$$122.3 = \frac{311.2}{\pi} (1 + \cos \alpha)$$

$$1 + \cos \alpha = 1.907$$

$$\cos \alpha = 0.907$$

$$\alpha = \cos^{-1}(0.907) = 24.9^\circ$$

$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 800}{60} = 83.77 \text{ rad/sec}$$

$$\pi = \frac{P_a}{\omega} = \frac{2238}{83.77} = 26.71$$

$$E_m = K \omega = 1.187 \times 83.77 = 99.43 \text{ V}$$

$$V_a = 99.43 + (12 \times 0.2) = 101.83 \text{ V}$$

$$101.83 = \frac{311.2}{\pi} (1 + \cos \alpha)$$

$$1 + \cos \alpha = 1.028$$

$$\cos \alpha = 0.028$$

$$\alpha = \cos^{-1}(0.028) = 88.79^\circ$$

$$V_a = \frac{311.2}{\pi} (1 + \cos 180^\circ) = 17.36 \text{ V}$$

$$F_a = V_a - I_a R_a$$

$$F_a = 12 - (12 \times 0.2) = 10.6 \text{ V}$$

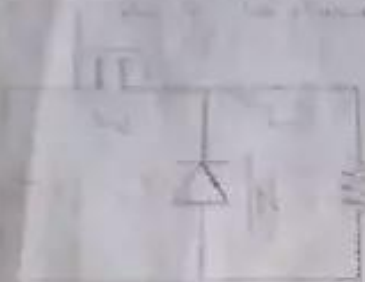
$$F_a = N \omega$$

$$10.6 = \frac{F_a}{k} = \frac{10.6}{1.182} = 8.93 \text{ rad/sec}$$

$$\omega = \frac{2\pi N}{60}$$

$$8.93 \times 60 = 2\pi N$$

$$N = \frac{8.93 \times 60}{2\pi} = 35.27 \text{ rpm}$$



Load resistor is connected in series with the output. The diode is connected in parallel with the load resistor. The output voltage is labeled 'V' and the input voltage is labeled 'Vd'.

$V_d = 230V$ $f = 3000 \text{ Hz}$ $V_d = 23V$ $R = 15 \Omega$
 $\omega = 2\pi f$ $K = ?$ $T_{on} = ?$ $T_{off} = ?$
 $V_{rms} = ?$ $P_S = ?$

$$T = \frac{1}{f} = \frac{1}{3000} = 0.000333 \text{ SEC}$$

$$\frac{1}{2} (V_S - V_d)^2 = P_o + P_R = 5000 + 15$$

$$V_S = \sqrt{2(5000 + 15)} = 273.86 \text{ V}$$

$$K = \frac{P_o R}{(V_S - V_d)^2} = \frac{5000 \times 15}{(273.86 - 23)^2} = 0.84$$

$$K V_S = 0.84 \times 273.86 = 230.23 \text{ V}$$

$$K \frac{T_{on}}{T_{on} + T_{off}} = \frac{T_{on}}{T_{on} + T_{off}} \Rightarrow K(T_{on} + T_{off}) = T_{on}$$

$$T_{on} - K T_{on} = K T_{off} \Rightarrow T_{on}(1 - K) = K T_{off}$$

$$T_{on} = \frac{K T_{off}}{1 - K} = \frac{0.84 T_{off}}{1 - 0.84} = 5.25 T_{off}$$

$$K = 1.7 \times 10^4$$

$$K \cdot (1.3 - 1) = \frac{1}{400} \cdot (400 - 1) \Rightarrow 2.02 \cdot 10^4$$

$$\Rightarrow \frac{1000}{\lambda} = \frac{2.02 \cdot 10^4}{\lambda^2} \Rightarrow \lambda = 14.14 \text{ nm}$$

$$5.22 \cdot 10^{-12} \text{ m} = 5.22 \text{ nm} \quad \text{Wahl}$$

$$\lambda = \frac{1.3(1.3 - 1)}{K} = 1.09 \cdot \frac{3 \cdot 10^8 (5.0 \cdot 10^{-12})}{1.7} = 9.32 \text{ nm} \quad \text{Wahl}$$

$$\frac{1000}{9.32} = 107.4 \Rightarrow 98.2\%$$

$V_s = 300V$
 $P_o = 5000W$
 $V_o = 2V$

$P_i = P_o / \eta = 5000 / 0.9987$
 $V_{in} = 300V$
 $V_o = 2V$
 $R = 15\Omega$

$P_s = 5000W$
 $V_s = 300V$
 $R = 15\Omega$

$$\Rightarrow T_{on} = \frac{1}{f} = \frac{1}{10000} = 0.0001s$$

$$P_o = \frac{K(V_s - V_o)^2}{R} \Rightarrow K(V_s - V_o)^2 = P_o \cdot R = 5000 \times 15 = 75000$$

$$\Rightarrow K(V_s - V_o)^2 = 75000 \Rightarrow K = \frac{75000}{(300 - 2)^2} = 0.84$$

$$\Rightarrow V_o = K(V_s - V_o)$$

$$V_o = 0.84(300 - 2) = 251.67V$$

$$\Rightarrow T_{on} = K T = 0.84 \times 0.001 = 0.00084s$$

$$\Rightarrow T_{off} = (1 - K) T \Rightarrow T = T_{on} + T_{off} = 0.001 - 0.00084 = 0.00016s$$

$$\Rightarrow V_{rms} = \sqrt{K} (V_s - V_o) = \sqrt{0.84} \times (300 - 2) = 273.12V$$

$$\Rightarrow I_{rms} = \frac{V_{rms}}{R} = \frac{273.12}{15} = 18.21A$$

$$\Rightarrow P_s = \frac{K(V_s - V_o)^2}{R} = \frac{0.84(300 - 2)^2}{15} = 5006.4W$$

$$\Rightarrow \eta = \frac{P_o}{P_s} = \frac{5000}{5006.4} = 99.87\%$$