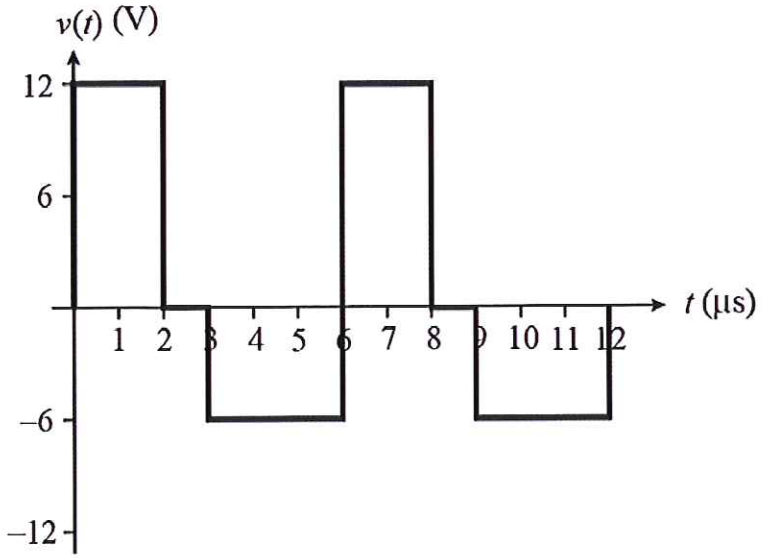
5. (20 points)



A portion of a repetitive waveform, $v(t)$, is shown above.

a) Find the period of $v(t)$.

b) Find the average power delivered by the above signal when driving a 3 Ω resistor.

soln: a) One period lasts from $t = 0\,\mu s$ to $6\,\mu s$.

$$T = 6\,\mu s - 0\,\mu s = 6\,\mu s$$

b) We multiply the power in each segment by the fraction of one period that each segment lasts. Power $= V^2/R$

For $t = 0$ to $2\,\mu s$, $p = \frac{(12\,V)^2}{3\,\Omega}$. Fraction of period is $\frac{2\,\mu s}{6\,\mu s} = \frac{1}{3}$.

For $t = 2\,\mu s$ to $3\,\mu s$, $p = 0$. Fraction of period is $\frac{1}{6}$.

For $t = 3\,\mu s$ to $6\,\mu s$, $p = \frac{(-6\,V)^2}{3\,\Omega}$. Fraction of period is $\frac{3\,\mu s}{6\,\mu s} = \frac{1}{2}$.

$$P_{ave} = \frac{144}{3}\left(\frac{1}{3}\right) + 0\left(\frac{1}{6}\right) + \frac{36}{3}\left(\frac{1}{2}\right) W = 16W + 6W = 22W.$$