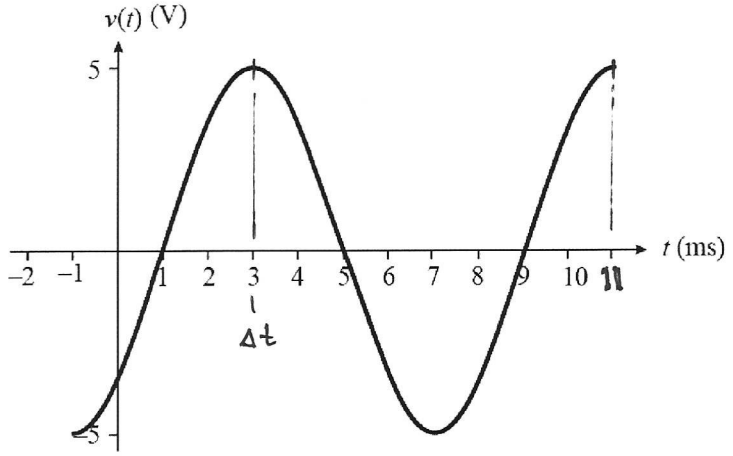
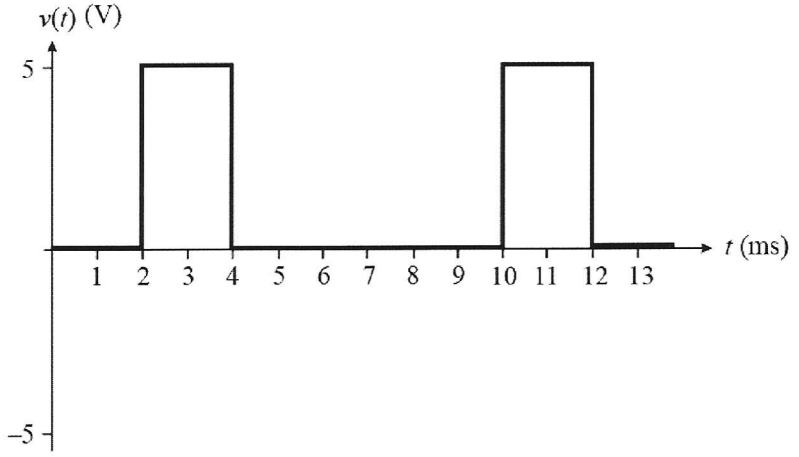
5. a) $v(t) = A\cos(\omega t + \phi)$ is shown below. Find the values of A, ω, ϕ, and period T for $v(t)$.



b) Find the average power for the PWM signal below driving a 10Ω resistor.



sol'n: a) From the peak height, $A = 5\,V$.

From the horizontal distance between peaks,

$T = 11\,ms - 3\,ms = 8\,ms$

Angular frequency comes from T:

$$\omega = \frac{2\pi}{T} \doteq \frac{6.28}{8\,ms} \doteq 785\ r/s$$

The phase shift is a function the position of the peak.

$$\phi = -\frac{\Delta t}{T} \cdot 360^\circ = -\frac{3\,ms}{8\,ms} \cdot 360^\circ = -135^\circ$$

Note: For more accurate values of T and Δt, it is better to use zero crossings.

b) The power at any instant is $v^2(t)/R$. The average power is found by computing a weighted average of the different power levels times the fraction of time each power level is in effect.

$$P_{ave} = \frac{1}{4}\frac{(5V)^2}{10\Omega} + \frac{3}{4}\frac{(0V)^2}{10\Omega}$$

↑ The 5V level is present for 2 ms out of period $T = 8$ ms, or $\frac{1}{4}$ of the time.

$$P_{ave} = \frac{25}{40} + 0 \quad W = 0.625W = 625\,mW$$