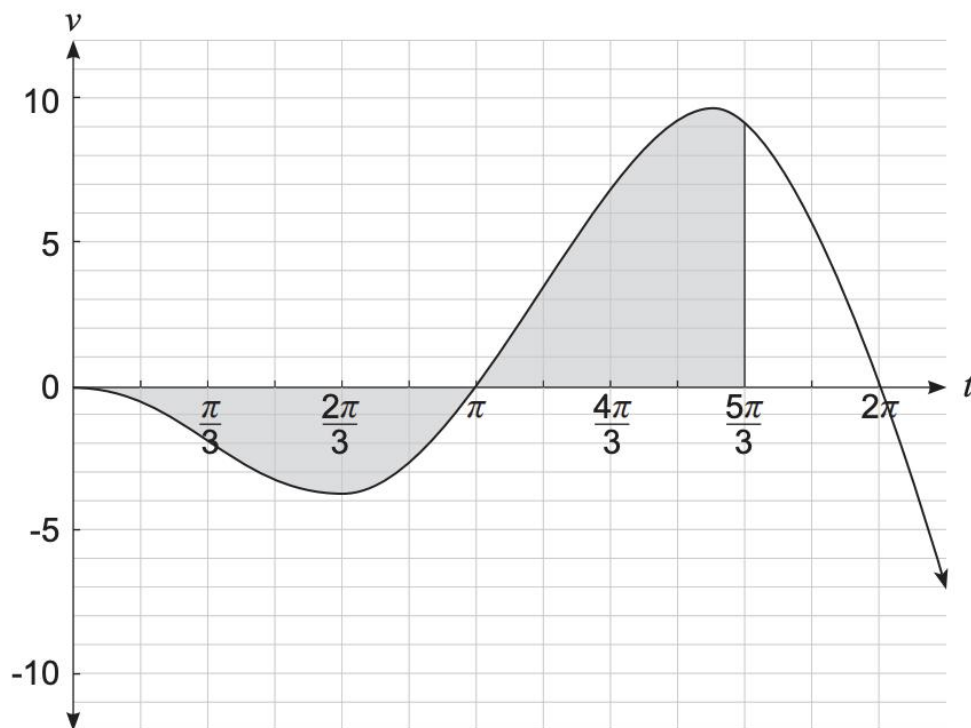


Question 8**(12 marks)**

An oscillating mass has a velocity, v , given by

$$v(t) = 2t \cos\left(t + \frac{\pi}{2}\right) \quad \text{for } t \geq 0.$$

The velocity is given in metres per second, and the time, t , is given in seconds. A graph of the velocity of the mass' motion is shown below.



- (a) Determine the first two times, $t > 0$, at which the mass changes direction. State your answers exactly. (2 marks)
- (b) What does the signed area of the shaded region in the figure represent? (2 marks)

(c) Write an integral expression for the distance travelled from $t = \frac{\pi}{3}$ to $t = \frac{4\pi}{3}$. (3 marks)

(d) Determine the first time after $t = \pi$ that the acceleration of the object will be 0 m/s^2 . (2 marks)

(e) The displacement of the mass is given by

$$x(t) = A \sin\left(t + \frac{\pi}{2}\right) + B \cos\left(t + \frac{\pi}{2}\right) + 2t \sin\left(t + \frac{\pi}{2}\right)$$

where A and B are constants. Determine the value of A and B . (3 marks)