Question 10 (9 marks)
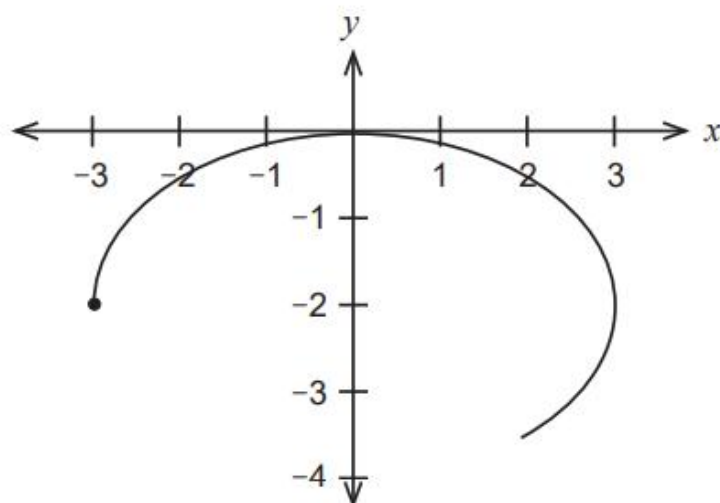
The velocity of a particle is given by $v(t) = \begin{pmatrix} 3\sin t \\ 2\cos t \end{pmatrix}$ where $t \geq 0$. The particle's initial position

vector $r(0) = \begin{pmatrix} -3 \\ -2 \end{pmatrix}$. The path of the particle is shown for the first 4 seconds.

(a)   State what the following definite integrals measure about the motion of the particle:

(i) $\int_0^1 v(t)\, dt$ (2 marks)

(ii) $\int_0^{2\pi} |v(t)|\, dt$ (2 marks)

(b)   Determine $\underset{\sim}{r}(t)$.   (3 marks)

(c)   Determine the Cartesian equation for the path of the particle.   (2 marks)