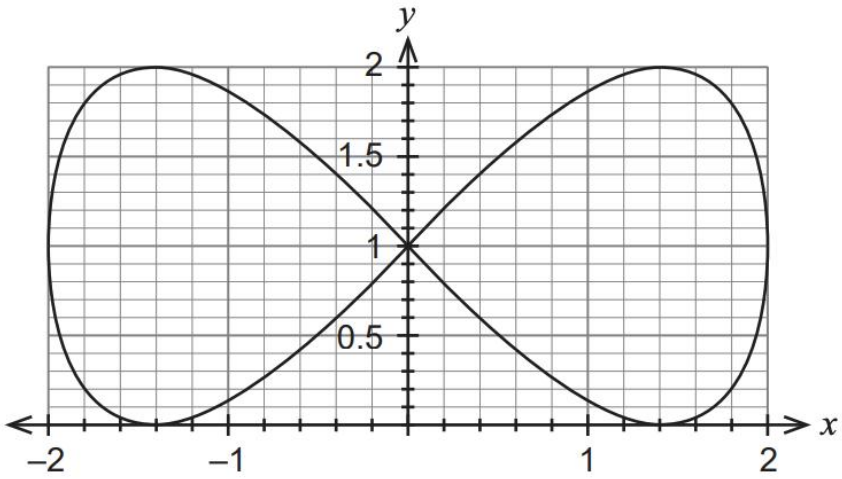
Question 13 **(10 marks)**

The path of a particle is shown below. This particle moves so that its position vector $\underset{\sim}{r}(t)$ is given by $\underset{\sim}{r}(t) = \begin{bmatrix} -2\cos\left(\frac{t}{2}\right) \\ 1 - \sin(t) \end{bmatrix}$ metres, where t is the number of seconds the particle has been in motion.



(a) Determine the starting position of the particle and mark this as point A on the diagram above. (1 mark)

(b) Determine the initial velocity of the particle and illustrate this on the diagram above. (3 marks)

(c) Write the expression, in terms of trigonometric functions, for the distance the particle would travel in completing one circuit of the given path. Do **not** evaluate this expression.

(3 marks)

(d) Determine the Cartesian equation for the path of the particle. (3 marks)