Question 10 **(9 marks)**

The displacement, x, of a mass on the end of a damped spring is given by

$$x(t) = 3e^{-t}\sin(t), \quad t \geq 0$$

where x is in centimetres and t is in seconds.

(a) Determine when the mass first returns to its starting position at $x = 0$. (2 marks)

(b) Determine an expression for the velocity of the mass. (2 marks)

(c) Determine the displacement of the mass when it first changes direction. (3 marks)

(d) The mass is considered to have stopped oscillating when the oscillation amplitude $A(t) = 3e^{-t}$ drops to 0.01 cm. How long does it take for the spring to stop oscillating? (2 marks)