1. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

A particle P starts from the origin O and moves along the positive x-axis.

At time t seconds, where $t \geqslant 0$

- the distance of P from O is x metres
- the acceleration of P has magnitude $a\,\text{m s}^{-2}$
- the speed of P is $v\,\text{m s}^{-1}$, where

$$v = \frac{1}{8}t^2 \qquad (0 \leqslant t < 4)$$

$$v = \frac{1}{8}t^2 - \frac{8}{t} + k \qquad (t \geqslant 4)$$

and k is a constant.

(a) Find the value of a when $t = 8$

(3)

Given that v is a continuous function of t and that $x = 0$ when $t = 0$

(b) find the exact value of x when $t = 8$

(6)

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Question 1 continued

(Total for Question 1 is 9 marks)