12 A particle P moves in a straight line. The velocity $v\,\text{m s}^{-1}$ of P at time t seconds is given by

$$v = \tfrac{1}{12}kt(t-3) \qquad \text{for } 0 \leqslant t \leqslant 6,$$

$$v = \frac{54k}{t^2} \qquad \text{for } 6 \leqslant t \leqslant 9,$$

where k is a positive constant.

(a) Sketch, on the axes in the Printed Answer Booklet, the velocity-time graph for P for values of t from 0 to 9. **[3]**

(b) State the value of t in the interval $0 \leqslant t \leqslant 9$ when the acceleration of P is zero. **[1]**

(c) In this question you must show detailed reasoning.

You are given that the total distance travelled by P in the interval $0 \leqslant t \leqslant 9$ is 84 m.

Find the value of k. **[6]**