10 A particle P moves in a straight line such that, t seconds after passing a fixed point O, its acceleration, $a\,\text{ms}^{-2}$, is given by

$$a = 6t \qquad \text{for } 0 \leqslant t \leqslant 3,$$
$$a = \frac{18\text{e}^3}{\text{e}^t} \qquad \text{for } t \geqslant 3.$$

When $t = 1$, the velocity of P is $2\,\text{ms}^{-1}$ and its displacement from O is $-4\,\text{m}$.

(a) (i) Find the velocity of P when $t = 3$. [3]

(ii) Find the displacement of P from O when $t = 3$. [3]

© UCLES 2023

(b) Find an expression in terms of t for the displacement of P from O when $t \geqslant 3$. [4]

Question 11 is printed on the next page.