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

A particle P moves on the x-axis.

At time t seconds, $t \geqslant 0$

- the acceleration of P is $(2t - 3)\,\text{m s}^{-2}$ in the positive x direction
- the velocity of P is $v\,\text{m s}^{-1}$ in the positive x direction

When $t = 3$, $v = 2$

(a) Find v in terms of t.

(4)

The particle first comes to instantaneous rest at the point A and then comes to instantaneous rest again at the point B.

(b) Find the distance AB.

(6)

(Total for Question 6 is 10 marks)

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7. A particle P is projected from a fixed point A with speed $12\,\text{m s}^{-1}$ at an angle α above the horizontal and moves freely under gravity.

As P passes through the point B on its path, P is moving with speed $8\,\text{m s}^{-1}$ at an angle β below the horizontal.

(a) By using the principle of the conservation of mechanical energy, find the vertical distance between A and B.

(4)

Particle P takes 1.5 seconds to travel from A to B.

(b) Find the size of angle α.

(3)

(c) Find the size of angle β.

(3)

(d) Find the length of time for which the speed of P is less than $8\,\text{m s}^{-1}$.

(4)

(Total for Question 7 is 14 marks)
