AS Mechanics Chapter 4 Assessment – Variable Acceleration

1 A particle *P* moves in a straight line. At time *t* s the displacement *s* cm from a fixed point *O* is given by $s = \frac{1}{6}\left(8t^3 - 105t^2 + 144t + 540\right)$.

Find the distance between the points at which the particle is instantaneously at rest. **(7 marks)**

2 A sled is moving down a steep hill in a straight line. At time *t* s, the acceleration of the sled is *a* m s^{-2} where $a = \frac{1}{500}\left(20t^2 - t^3\right)$, $0 \leqslant t \leqslant 20$.

When *t* = 0 the sled is at rest at the top of the hill. Find the distance the sled travels in the first 10 s of its motion. **(5 marks)**

3 A car starts from the point *A*. At time *t* s after leaving *A*, the distance of the car from *A* is *s* m, where $s = 30t - 0.4t^2$, $0 \leqslant t \leqslant 25$. The car reaches the point *B* when *t* = 25.

a Find the distance *AB*. **(2 mark)**

b Show that the car travels with a constant acceleration and state the value of this acceleration. **(3 marks)**

A runner passes through *B* when *t* = 0 with an initial velocity of 2 m s^{-1} running directly towards *A*. The runner has a constant acceleration of 0.1 m s^{-2}.

c Find the distance from *A* at which the runner and the car pass one another. **(8 marks)**