

- (a) Find an expression for x in terms of t . [5]

[illegible][illegible]

- (b) Find the time when P next goes through O . [2]

[illegible]

- (a) Show that $t = \frac{1}{gk} \ln \left(\frac{kU + \mu}{kv + \mu} \right)$. [4]

[4]

(b) Find the distance P moves before coming to rest.

[4]

(c) Find the average speed of P over the period it is moving.

[2]

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

- 5 A particle P of mass m kg is projected vertically upwards from a point O with an initial speed of 20 ms^{-1} and moves under gravity. There is a resistive force of magnitude $0.025mv^2 \text{ N}$, where $v \text{ ms}^{-1}$ is the speed of P at time t s after projection. The displacement of P from O is x m at time t s after projection.

- (a) Find an expression for v in terms of x , while P is moving upwards.

- [4]

7

- (a) Find an expression for v in terms of x , giving your answer in the form $v = ax^2 + b$, where a and b are constants to be determined. [3]

Find an expression for x in terms of t . [2]

- 3 A ball of mass m kg is projected vertically upwards with initial speed U m s⁻¹ and moves under gravity. At time ts after projection, the ball has travelled a distance x m and its speed is v m s⁻¹. There is a resistive force of magnitude mkv^2 N, where k is a positive constant.

(a) Show that the distance travelled by the ball when it is moving upwards is $x = \frac{1}{2k} \ln \left(\frac{g + kU^2}{g + kv^2} \right)$. [4]

It is given that $k = 0.025$ and that $U = 20$.

- (b) Find the time taken for the ball to reach its maximum height.

[4]