

QQQ – Further Mechanics 2 – Chapter 4 – Kinematics (Version 1)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1. A particle P moves on the positive x -axis. When the distance of P from the origin O is x metres, the acceleration of P is $(7 - 2x) \text{ m s}^{-2}$, measured in the positive x -direction. When $t = 0$, P is at O and is moving in the positive x -direction with speed 6 m s^{-1} . Find the distance of P from O when P first comes to instantaneous rest. **(6)**

(Total 6 marks)

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2. A particle P is moving along the x -axis.

At time t seconds, $t \geq 0$, P has acceleration $a \text{ m s}^{-2}$ and velocity $v \text{ m s}^{-1}$ in the direction of x increasing, where

$$v = e^{2t} + 6e^t - kt$$

and k is a positive constant.

When $t = \ln 2$, $a = 0$

- (a) Find the value of k . **(4)**

When $t = 0$, the particle passes through the fixed point A .

When $t = \ln 2$, the particle is d metres from A .

- (b) Showing all stages of your working, find the value of d correct to 2 significant figures.

[Solutions relying entirely on calculator technology are not acceptable.] **(4)**

(Total 8 marks)

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3. A particle P is moving along the x -axis. At time t seconds, P has velocity $v \text{ m s}^{-1}$ in the positive x direction and acceleration $a \text{ m s}^{-2}$ in the positive x direction.

In a model of the motion of P

$$a = 4 - 3v$$

When $t = 0$, $v = 0$

(a) Use integration to show that $v = k(1 - e^{-3t})$, where k is a constant to be found. **(7)**

When $t = 0$, P is at the origin O

(b) Find, in terms of t only, the distance of P from O at time t seconds. **(4)**

(Total 11 marks)