11.3) Maxima and minima problems

Worked example

A child is playing with a yo-yo. The yo-yo leaves the child's hand at time $t = 0$ and travels vertically in a straight line before returning to the child's hand. The distance, s m, of the yo-yo from the child's hand after time t seconds is given by:

$$s = 2.4t - 0.4t^2 - 0.4t^3, \qquad 0 \leq t \leq 2$$

(a) Justify the restriction $0 \leq t \leq 2$

(b) Find the maximum distance of the yo-yo from the child's hand, correct to 3sf.

Your turn

A child is playing with a yo-yo. The yo-yo leaves the child's hand at time $t = 0$ and travels vertically in a straight line before returning to the child's hand. The distance, s m, of the yo-yo from the child's hand after time t seconds is given by:

$$s = 0.6t + 0.4t^2 - 0.2t^3, \qquad 0 \leq t \leq 3$$

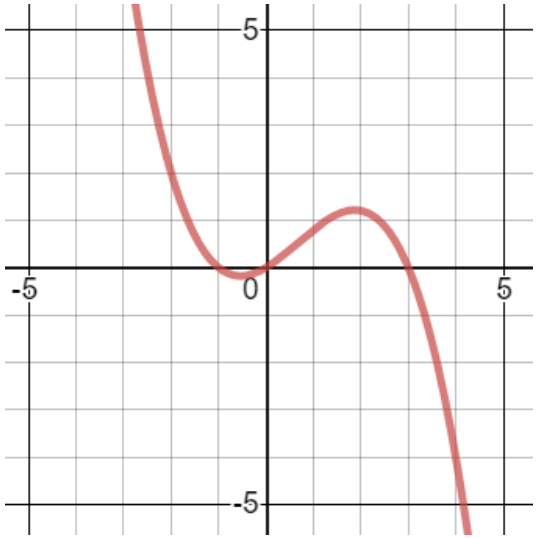
(a) Justify the restriction $0 \leq t \leq 3$

(b) Find the maximum distance of the yo-yo from the child's hand, correct to 3sf.

a) $s = 0.2t(3 + 2t - t^2) = 0.2t(3 - t)(1 + t)$

$t \geq 0$ as time cannot be negative.

If $t > 3, s < 0$ (but distance cannot be negative)



b) 1.21 m (3 sf)

Graphs used with permission from DESMOS: https://www.desmos.com/

Worked example

A particle P is moving along the x-axis. At time t seconds, the velocity of P in the direction of x increasing, is:

$$v = \frac{5}{3}t^3 - 18t^2 + 36t$$

Find the maximum velocity of the particle

Your turn

A particle P is moving along the x-axis. At time t seconds, the velocity of P in the direction of x increasing, is:

$$v = t^3 - 16t^2 + 64t$$

Find the maximum velocity of the particle

$75.9\ ms^{-1}$ (3 sf)

Worked example

A particle P is moving along the x-axis. At time t seconds, the velocity of P in the direction of x increasing, is:

$$v = 3t^2 - 21t + 30, t \geq 0$$

Find the maximum speed of the particle

Your turn

A particle P is moving along the x-axis. At time t seconds, the velocity of P in the direction of x increasing, is:

$$v = 2t^2 - 14t + 20, t \geq 0$$

Find the maximum speed of the particle

$20\ ms^{-1}$