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A LEVEL MATHS

(45) Applications of Parametric Equations

WORKING AT D/E

(1) Doris is holding a fireworks display. She lets off a rocket. The flight of the rocket can be modelled by the parametric equations:

$$x = 2t, \qquad y = 3t - 0.25t^2, \qquad t \geq 0$$

where x is the horizontal distance and y is the vertical distance in metres from the ground. t is the time in seconds after the rocket is launched.

(a) Show that the rocket was launched from the ground.

(b) Find how long it takes the rocket to hit the ground.

(c) Using your answer to part (b), find the horizontal distance from where the rocket was launched to where it hits the floor.

(d) State one limitation of the model.

(2) Cyril has a drone. The drone is flown off a ledge 10m above the ground and Cyril guides the drone into land on the floor. The position of the drone relative to the ground can be modelled by the parametric equations

$$x = 8t, \qquad y = 10 - \frac{t^2}{10}, \qquad t \geq 0$$

Find the horizontal distance the drone travels from its starting point when it lands on the ground.

WORKING AT B/C

(1) A speed boat is moving around a buoy. Its horizontal displacement x metres and vertical displacement y metres relative to the buoy after t seconds can be modelled by the parametric equations:

$x = 20\cos t, \qquad y = 20\sin t, \qquad t \geq 0$

Where t is measured in degrees.

(a) Describe the motion of the boat.

(b) How far from the buoy is the boat at all times?

(c) Show that the boat is directly north of the buoy for the first time after approximately 1.57 seconds.

(2) A jet ski is moving around a buoy. Its horizontal displacement x metres and vertical displacement y metres relative to the buoy after t seconds can be modelled by the parametric equations:

$x = 30\cos t, \qquad y = 20\sin t, \qquad t \geq 0$

Where t is measured in degrees.

(a) Show that the boat is not on a circular path.

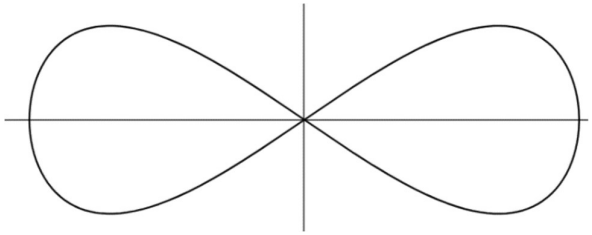
(b) How far from the buoy is the jet-ski at the start?

(c) Show that when the jet ski is due north of the buoy it is 20 metres away.

(d) Write down the maximum distance the jet-ski is from the buoy at any time.

WORKING AT A*/A

(1) In a computer animation a buggy is racing around a track in the shape of a figure of 8 as shown below.



Its position (in cm) relative to the centre of the track after t seconds can be modelled by the parametric equations: $x = 20\cos 2t, \quad y = 10\sin 4t, \quad t \geq 0$

x and y are measured in radians.

(a) Mark on diagram the starting point of the buggy

(b) Find the first time the buggy is in the centre of the track.

(c) Find the time taken for the buggy to do one full figure of 8.