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A LEVEL MATHS

(40) Applications of Trigonometric Functions

WORKING AT D/E

(1) A dot is moving backwards and forwards across the full length of a computer screen. The position $(P\,cm)$ of the dot after (t) seconds relative to the centre of the screen can be modelled by the equation

$$P = 10\cos 20t^{o}, \quad t \geq 0$$

(a) Explain why the width of the computer screen is $20cm$.

(b) Find out where the dot was when it first started moving.

(c) Calculate the time when the dot was first 4cm to the left of the centre. Give your answer to 3SF.

WORKING AT B/C

(1) Cyril is making a mini wave machine for a science project. He places the device in a tank with water. The tank is in the shape of a cuboid. He positions a small rubber duck in the water and studies the height of the duck over a period of time. The duck's height $(H\,cm)$ relative to the central height of the tank after (t) seconds can be modelled by the equation

$$H = 8\sin\left(4t + \frac{\pi}{2}\right) + 2, \ t \geq 0$$

where all angles are measured in radians.

(a) Show that the initial height of the duck is $6cm$ above the centre of the tank.

(b) Find the maximum possible height above the centre of the tank the duck reaches.

(c) Find how long it takes the duck to first reach this height giving your answer to 3SF..

(d) Given that the depth of the tank is $30cm$, explain why the duck never hits the bottom of the tank.

(e) Find the first time that the duck is at the central height of the tank to 3SF.

WORKING AT A*/A

(1) (a) Express $5\cos x + 2\sin x$ in the form $R\sin(x + \alpha)$ where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$, giving your answer for R in exact form and α to 1 decimal. place.

A robot is programmed to follow a path that can be modelled by the equation

$$H = 5\cos\left(\frac{\pi t}{12}\right) + 2\sin\left(\frac{t\pi}{12}\right) + 4, \quad 0 \leq t \leq 10$$

where H is the height of the robot relative to a fixed point and t is the time in seconds after the robot starts the path.

(b) Find the maximum height of the robot.

(c) Find the first time the robot reaches this maximum height giving your answer to 3SF.

(d) Find to 2 decimal places, the time when the robot has a height of 5 metres above the fixed point.

(e) Find to 2 decimal places, the time when the robot has a height of 1 metre below the fixed point.