TEAMS Competition 2019

December Math Challenge Solution

Problem 1

Let's assume that an octopus is at rest then makes a quick movement downwards and backwards to avoid a predator. We can assume the movement is only in one plane so we can view the statocyst as a circular 2D cross section. After 0.81s into its movement, its nervous system detects the statocyst at a location 24o west of north in our 2D representation.

What was the octopuses' acceleration if the statocyst has a circumference of 2.2 cm? Assume the acceleration of the statolith is equivalent to that of the octopus.

Solution = 0.011 m/s^2

First, calculate the diameter of the statocyst

R = 2.2/pi/2

Second, calculate the cord length in the circular cross section from the initial position (south) to the final position (24 degrees west of north). This can be done using the Law of Cosines on a triangle made between the initial and ending position since the obtuse angle will be 180-24 and two side lengths are the radius of the circle

Dist = sqrt(R^2 + R^2 - 2*R*R*cos(180-24))

Third, calculate the acceleration knowing the initial velocity (0), total movement (Dist), and time elapsed (1.5s) of the statolith which is equivalent to the animal.

Vo = 0; time = 0.81;

acc = (2*Dist-(Vo*time))/(time^2)

Last, convery to m

acc = acc/100;

disp('The acceleration in m/s^2 is: ') disp(acc)

Solution: 0.011 m/s^2