**Mathematical Methods - Trigonometric Functions**

1. A bungee jump is organised from a platform above a lake.

 The function is used to model the height of a person above the water surface *t* seconds after jumping from the platform.

* 1. Determine the initial height above the water surface.

 =m (1 mark)

* 1. State the height of the person above the water surface as

 (1 mark)

* 1. Sketch a graph of the function in the space below to show the height of a person above the water surface during the first *10 seconds* after the jump.

H



t

 (3 marks)

* 1. Find the minimum distance between the person and the water surface during the jump, giving your answer to an accuracy of 3 significant figures.

From the graph min H = 1.35m

 (1 mark)

* 1. Show that the velocity of the person during the bungee jump is given by )

x

 (3 marks)

* 1. Calculate *v(2)* and *v(5)* and give an interpretation for these values.

v(2) = -9.28

person is falling at 9.28m/s (2 marks)

v(5) = 2.19 m/s

person is rising at 2.19 m/s (2 marks)

1. If show that

= - 9 5

= - 9 f

 (2 marks)

1. Find the second derivative of the following functions and summarise your results in the table below

 i)

 = (1 mark)

 ii)

 = (1 mark)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

 c)

1. The general form of the sine function is where are constants.

 Make a conjecture which describes the relationship between the general form of the function and the second derivative .

 (1 mark)

1. Prove your conjecture

 (3 marks)

 proven

1. Find the minimum value of giving a simplified answer in exact form.

y = 0 ≤ x ≤ π

 = (3 marks)

=

 = 0 if

 (2 marks)

sign

0 (1 mark)

 min value when (1 mark)

 (1 mark)

1. Triangle AOB is drawn within a circle of radius 5 cm where O is the circle centre and AB is a chord of the circle.

 Find the maximum possible area of the triangle.

5

A

B

5

O

 Area A = x x sin O

 A = 12.5 sin (2 marks)

 = 12.5 cos

= O if cos

0

 max area when

 (4 marks)

(sin = 1)

1. The function represents the predicted water depth in metres at the Adelaide Outer Harbour Tidal station on Sunday 24 September 2017 where

 t is the time in hours.

* 1. Find and give an interpretation for this value in terms of the water depth.

(Could be a calculator use question: Solutions here do not use the calculator)

H(t) = 1.1 sin (t – 3) + 1.3 0 ≤ t ≤ 24

 -3 ≤ t – 3 ≤ 21

Depth is decreasing at 0.499 m / hour at 8:00am (3 marks)

* 1. Find the maximum water depth on this day and the time(s) when that will occur.

H (t) is max when sin (t-3) = 1

When

t= 6, 18

 max depth is 2.4m at 6:00 and 18:00 hour

 (3 marks)

* 1. Determine the time period in the afternoon when the water depth will be increasing.

Water depth is increasing when H’(t) > 0

Or

0 < (t-3) < or

0 < t - 3 < 3 9 < t – 3 < 15

3 < t < 6 or 12 < t < 18 (afternoon time)

Water depth is increasing between 12:00 and 18:00 hours.

 (2 marks)

* 1. An environmental team wishes to inspect the marine growth on the wharf when the water depth is less than 0.5m, suggest a suitable time for this work.

H (t) < 0.5

10.56 < t < 13.46

Between 10.56am and 1.46 pm (2 marks)

1. For the function
	1. Find the zeros of the function

 (2 marks)

* 1. Show that

= 5

 (3 marks)

hence find:

* 1. the position and nature of the stationary points

 ,

sign

0

 = 1.61

 = -0.07

* 1. the domain for which the function is decreasing.

Function is decreasing if

 (from the sign diagram)

 (6 marks)

* 1. Sketch a graph of the function showing the information found above



5

**X**

**Y**

 (3 marks)

 (5, -0.07)

* 1. Show that the equation of the tangent to the function at is given by

When slope of tangent

m = 5

m =

y = - = 0

 (4 marks)