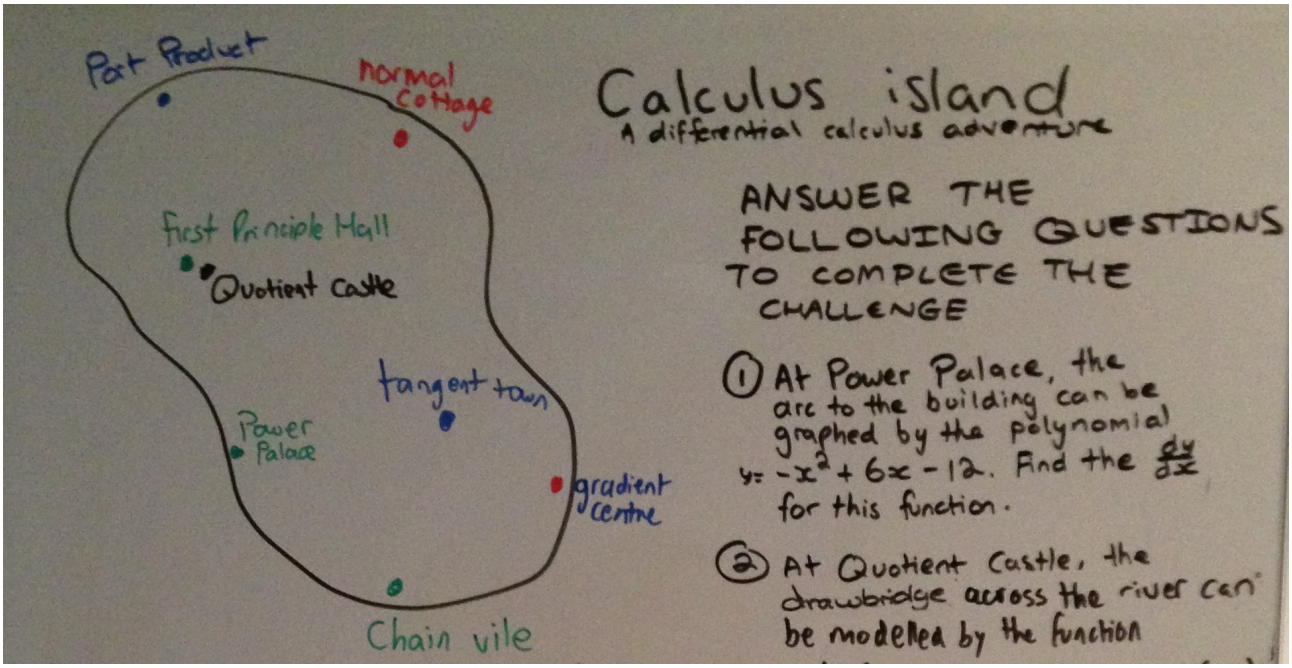
CALCULUS ISLAND

Welcome to Calculus Island, an ideal location for all mathematicians on their holiday. There are several different locations each with a unique problem associated with the concepts of Differential Calculus. Your job is to solve the series of ten problems that vary in difficulty. Throughout your stay, you will encounter popular tourist locations like Quotient Castle and Normal Cottage. By solving all ten questions successfully and confidently, you will receive a "Calculus Island Certificate" (attached). Good luck and start deriving.



1. At Power Palace, the arc of the building can be graphed by the polynomial $y = -x^2 + 6x - 12$. Find the first derivative of this function.

2. At Quotient Castle, the drawbridge can be modeled by the function $y = (-1/9x^2 + 10)/2$. Find the f'(7). If the f(7) is <0, then the drawbridge will likely rust. Will the drawbridge rust? (READ THE QUESTION CAREFULLY)

3. At Chain Vile, the rollercoaster is a representation of the function $(-x+1)^2$. Find the gradient of the tangent at f(2). Draw a displacement to time graph for the rollercoaster on its journey and derive the second derivative of f(2). What is the significance of this point?

4. In Tangent Town, the roof of the library can be modeled by the function $f(x) = -x^2 + (7/2)$. Derive the equation of the tangent when x=7.

5. At First Principles Hall, the shape of the seating arena relative to the stage can be modeled by the function $y = 9/x^2$. Find the f'(6) using first principles and prove your answer using the rules of differentiation.

6. In Normal Cottage, the hill region can be modeled by the function $y = x^3 + 5x^2 + x$ where the cottage is located at x=3/2. Find the slope of the normal to the cottage for a telephone line to be placed between the hill and another location at which the normal rejoins the other side of another hill. Determine the co-ordinate of the location at which the normal rejoins the curve (if it does rejoin the curve) and hereby calculate an approximate length of the telephone wire between the cottage and the other side of the hill. If the normal does not rejoin the curve then calculate from the vertex of the other side of the hill to the cottage. Assume 1 unit = 1km.

QUESTION 6 CONTINUED

7. In Port Product, the number of ships coming in to the dock can be modeled by the function $y = -x^2 + 17x$, where x is the number of ships since sunrise. Determine the dy/dx for the number of ships coming into Port and hence what does this mean in context.

8. In Gradient Centre, the skate park ramp can be modeled by the function $f(x) = (1/4x^2) – 3x – 36$. Determine the point of contact when the tangent to the function is a horizontal line. Is this a vertex? If so, is it a minimum or maximum? How do you know?

9. Solve the dy/dx for the following functions

- $3x^2 – 5x^4 – 5x^7 – 16 = y + 6x$

- $14x^3 – xy – 5y – 17 – 19xy – y^6 = xy + y^4$

10. Find when the tangent to $2x^2 – (6/4)x – (7/3)$ at x=2 meets the tangent again. Repeat this for the normal too. Compare the two values. Consider the distance between the two, is the distance shorter for the normal rejoining the curve or is the tangent shorter?

UPON COMPLETION, cut the dotted line below, add your name and date as applicable

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CONGRATULATIONS

This certificate certifies that _____ successfully

completed the Calculus Island challenge on _____/ _____ / _____

WELL DONE!