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VCE Mathematical Methods ¾
Applications of Differentiation [2.4]
Test

25.5 Marks. 33 Minutes Writing.

Results:

Test Questions	_____ / 16.5
Extension Test Questions	_____ / 9

Section A: Test Questions (16.5 Marks)

INSTRUCTION: 16.5 Marks. 21 Minutes Writing.

Question 1 (3.5 marks)

Tick whether the following statements are **true** or **false**.

	True	False
a. Tangents and normals are always perpendicular to each other if they are formed at the same point.		
b. To find the tangent line of $f(x)$ which passes through (a, b) we first need to solve $\frac{f(x)-b}{x-a} = f'(x)$ to identify where the tangent was made.		
c. To find the minimum or maximum of any function, we just need to find their stationary points.		
d. For optimisation questions, it is important to construct the function for which we want to find the maximum or minimum.		
e. Newton's iterative formula is given by $x_{n+1} = x_n - \frac{f'(x_n)}{f(x_n)}$.		
f. The purpose of Newton's method is to approximate the solution to any equation.		
g. Terminating sequence for Newton's method occurs when the x-value of a stationary point is reached within the sequence.		

Space for Personal Notes

Question 2 (2 marks)

Find the equation of the line that is normal to $y = x^3 - 2x^2 + 3x$ at $x = 1$.

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Question 3 (3 marks)

Consider the function $f: (2, \infty) \to R, f(x) = \frac{3}{x-2}$. Find the equation(s) of the lines tangent to f, which are parallel to the line $y = -\frac{1}{3}x + 2$.

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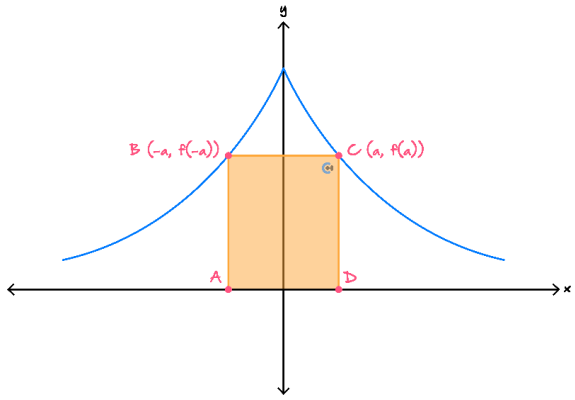
Question 4 (4 marks)

Consider the hybrid function $f(x) = \begin{cases} 2e^{x}, & -2 \leq x < 0 \\ 2e^{-x}, & 0 \leq x \leq 2 \end{cases}$



A rectangle has vertices $ABCD$, as shown in the diagram below, with coordinates $A(-a, 0)$, $B\big(-a, f(-a)\big)$, $C\big(a, f(a)\big)$ and $D(a, 0)$, where $a > 0$.

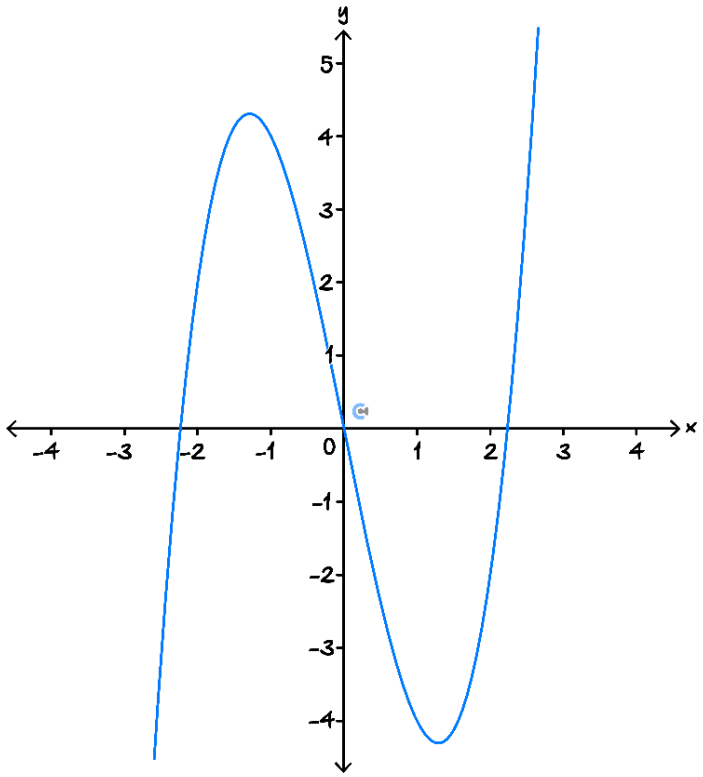
a. Find the area A of rectangle $ABCD$ in terms of a. (1 mark)

b. Find the value of a of which A is the maximum. (2 marks)

c. Hence, find the maximum area of $ABCD$. (1 mark)

Question 5 (4 marks)

Consider the function $f(x) = x^3 - 5x$ on the diagram below.



a. Find x_1 for $x_0 = -1$. (2 marks)

b. Find x_2. (1 mark)

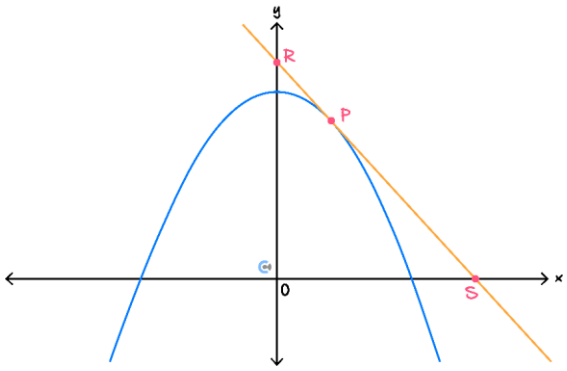
c. What do you notice? (1 mark)

Section B: Extension Test Questions (9 Marks)

INSTRUCTION: 9 Marks. 2 Minutes Reading. 12 Minutes Writing.

Question 6 (9 marks) **Tech-Active.**

The diagram shows the graph of the function $f(x) = 9 - x^2$.



The graph of the tangent line to the curve at point $P\big(p, f(p)\big)$, where $1 \leq p \leq 3$ is also shown.

a. Determine the equation of this tangent line in terms of p. (1 mark)

b. If the tangent line crosses the x-axis at the point S, and crosses the y-axis at the point R, find the coordinates of the points S and R in terms of p. (2 marks)

c. Hence, find the area A of the triangle OSR in terms of p. (1 mark)

d. Find the **minimum** area of the triangle OSR and the value of p for which the area is minimum. (3 marks)

e. Find the **maximum** area of the triangle OSR and the value of p for which the area is maximum. (2 marks)

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