

For each problem give a complete written solution which states the method being used and clearly shows all the mathematical steps. Numerical answers can be given in terms of constants such as $e, \pi, \ln 2, \sqrt{5}$. A calculator is not necessary. A graphing calculator with elementary functions may be used. Calculators with symbolic algebra and calculus capability cannot be used.

1. Differentiate with respect to x . Write your answers showing the use of the appropriate techniques. Do **not** simplify.

$$(a) x^{2007} - x^{2/3} \quad (b) (x^2 - 2x + 2)e^x, \quad (c) \ln(x^2 + 4).$$

2. For the curve $y^2 + xy - x^3 = 5$,

- (a) use implicit differentiation to find the derivative $\frac{dy}{dx}$,
 (b) find the equation of the line tangent to this curve at the point $(1, 2)$.

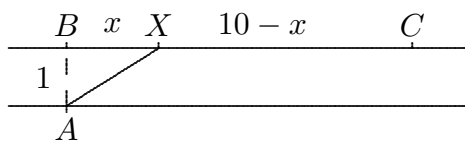
3. Use calculus to find the exact x -coordinates of any local maxima, local minima, and inflection points of the function $f(x) = 3x^5 - 20x^3 + 14$.

4. Find

$$\lim_{x \rightarrow 0} \frac{e^x - x - 1}{3x^2}.$$

Explain how you obtain your answer.

5. An electrical company at point A needs to run a wire from a generator to a factory that is on the other side of a one mile wide river and 10 miles downstream at point C . It costs \$600 per mile to run the wire on towers across the river and \$400 per mile to run the wire over land along the river. The wire will cross the river from A to a point X and then travel over land from X to C . Let x be the distance from B to X .
- (a) Find the total cost as a function $f(x)$ of the variable x .
 (b) Use calculus to find the value of x that minimizes the cost.



6. Differentiate with respect to x . Write your answers showing the use of the appropriate techniques. Do **not** simplify.

$$(a) \frac{x^2 + 1}{x^2 + x + 1}, \quad (b) \sin^3(5x + 2), \quad (c) \arctan\left(\frac{x}{2}\right).$$

7. (a) Calculate the left and right Riemann sums with three subdivisions, L_3 and R_3 , for the integral

$$\int_0^6 f(x) dx.$$

Some values of the function f are given in the table:

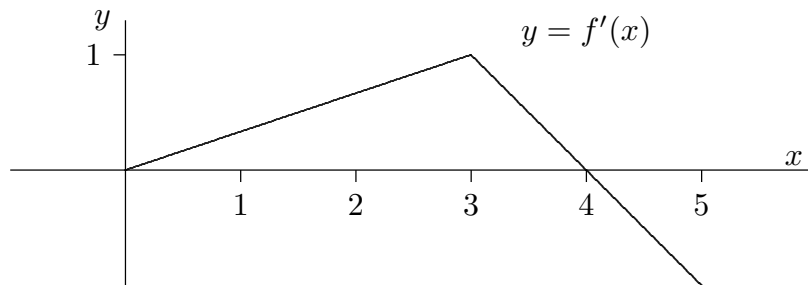
x	0	2	4	6
$f(x)$	1.6	1.9	2.4	3.1

- (b) If the function f is increasing, could the integral be greater than 15? Explain why or why not?

8. (a) Write the integral which gives the area of the region between $x = 0$ and $x = 1$, above the x -axis, and below the curve $y = x - x^3$.
 (b) Evaluate your integral exactly to find the area.

9. Evaluate the integral $\int_0^1 \frac{1}{\sqrt{3x+1}} dx$ by finding an antiderivative.

10. The graph below represents the derivative, $f'(x)$.



- (a) On what interval is f increasing?
 (b) On what interval is f decreasing?
 (c) For what value of x is $f(x)$ a maximum?
 (d) What is $\int_0^5 f'(x) dx$?
 (e) What is $f(5) - f(0)$?