📓 Calculus Homework – Bloom Learning

Topic: *Derivatives, Integrals & Applications*
Due Date: *[Insert Date]*
Instructions: Show all work clearly. Partial credit will be awarded for correct methods.

Part A: Derivatives (Basics)

1. Differentiate the following functions:
   - (a) f(x)=5x3−2x2+7x−4f(x) = 5x^3 - 2x^2 + 7x - 4
   - (b) g(x)=1x2+3xg(x) = \frac{1}{x^2} + 3x
   - (c) h(x)=sin(x)+ln(x)h(x) = \sin(x) + \ln(x)

Part B: Product, Quotient, and Chain Rule

2. Find dydx\frac{dy}{dx} for the following:
   - (a) y=(2x2+1)(3x−4)y = (2x^2 + 1)(3x - 4)
   - (b) y=5x3(x2+1)y = \frac{5x^3}{(x^2 + 1)}
   - (c) y=3x2+2y = \sqrt{3x^2 + 2}

Part C: Integrals

3. Compute the indefinite integrals:
   - (a) ∫(6x2−4x+5)dx\int (6x^2 - 4x + 5) dx
   - (b) ∫1xdx\int \frac{1}{x} dx
   - (c) ∫e2xdx\int e^{2x} dx
4. Evaluate the definite integral:

   ∫02(x2+3)dx\int_{0}^{2} (x^2 + 3) dx

Part D: Applications of Calculus

5. **Optimization Problem:**
   A farmer has 200m of fencing to create a rectangular pen next to a river (so only 3 sides are fenced).

- (i) Express the area of the pen in terms of width ww.

- (ii) Use derivatives to find the width that maximizes the area.

6. **Rate of Change:**
   A spherical balloon is being inflated so that its volume increases at a rate of $100 \, cm^3/s$.

- Find the rate at which the radius is increasing when the radius is 5 cm.
  (Volume of a sphere: $V = \frac{4}{3} \pi r^3$)

Part E: Challenge Question

7. Show that the function $y = x^3 - 3x + 1$ has a **local maximum** and a **local minimum**. Identify their coordinates.

✅ **[Total Marks: 50]**

- **Part A:** 10 marks
- **Part B:** 10 marks
- **Part C:** 10 marks
- **Part D:** 15 marks
- **Part E:** 5 marks
