Year 12 Extension 1 **Geometrical Applications of Calculus Assignment** **Date Due:**

1. Show that the function $y = x^3 + 5x^2 + 7x + 2$ is increasing when $x = 3$.

2. For what values of x is $y = 2x^2 - 9x + 4$ a decreasing function?

3. (a) Find the stationary points of the curve $y = 2x^3 + 3x^2 - 12x + 7$.
   (b) Determine the nature of these stationary points.
   (c) Find the value of the absolute minimum and absolute maximum values o this curve when $-3 \le x \le 4$.
   (d) Hence sketch the curve.

4. Show that the stationary point of the curve $y = x^3 - 3x^2 + 3x + 1$ is a horizontal point of inflexion.

5. Find the second derivative of: (a) $y = x^6 + 3x^5 - 4x^3 + 2x^2 - 9x - 7$ (b) $y = (2x^2 + 5)^8$

6. If $y = 2x^2 - 2x - 1$, show that $y + y' + y'' = 2x^2 + 2x + 1$.

7. Show that the curve $y = (x - 1)(x^2 - 2)^2$ is concave down when $x < 1$.

8. Find any points of inflexion on the curve $y = x^3 + x - 3$.

9. Sketch the curve $y = (x - 1)(x^2 - 1)$ showing all important features.

10. Find the maximum product of two numbers, x and y, whose sum is 25.

11. Find the equation of the tangent to the curve $y = \sqrt{25 - x^2}$ at the point where $x = 3$.

12. Find the equation of the normal to the curve $y = x^3 - 5x^2 + 4x + 6$ at the point (1, 6).

13. Find the primitive functions of:
   (a) $x^2 + 7x - 5$ (b) $4x^3 - 9x^2 - 6x + 6$ (c) $\frac{1}{x^2}$

14. A sheet of cardboard measures 15cm by 7cm. Four equal squares, each of length x cm, are cut out of the coroners and the sides are turned up to form an open rectangular box.
   (a) Draw a diagram to illustrate this information.
   (b) Write down expressions for the length, breadth and height of the rectangular box.
   (c) Find the length, x, of the edge of the squares cut out, so that the box will have maximum volume.

15. For the curve $y = \frac{x^2}{x^2 - 4}$:
   (a) Find and determine the nature of any turning points.
   (b) Find any asymptotes.
   (c) Hence sketch the curve.