Answer all the following questions.

1. Find an equation for the tangent line to the graph at the specified value of x.:

$$y = Sec^3\left(\frac{\pi}{2} - x\right), x = -\frac{\pi}{2}$$ **[2]**

2. Use implicit differentiation to find $\frac{dy}{dx}$ if $x^3y^2 - 5x^2y + x = 1$ **[2]**

3. Consider the following function:

$$f(x) = x^4 - 5x^3 + 9x^2$$

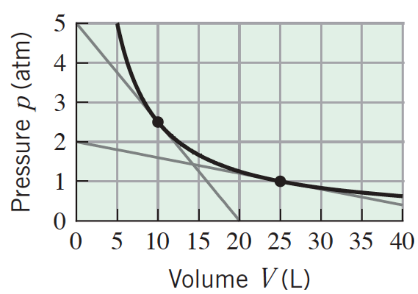
i) Determine the intervals on which f(x) is increasing and decreasing. **[2]**

ii)Determine the intervals on which f(x) is concave up and concave down. **[2]**

4. Find the derivative of the following functions using logarithmic differentiation.

$$y = \frac{x^3\sqrt[3]{3x-4}}{(1+x^3)^3}$$ **[2]**

5. The accompanying figure shows the graph of the pressure p in atmospheres (atm) versus the volume V in liters (L) of 1 mole of an ideal gas at a constant temperature of 300 K (kelvins). Use the line segments shown in the figure to estimate the rate of change of pressure with respect to volume at the points where V = 10 L. **[2]**



6. A searchlight is trained on the side of a tall building. As the light rotates, the spot it illuminates moves up and down the side of the building. That is, the distance D between ground level and the illuminated spot on the side of the building is a function of the angle θ formed by the light beam and the horizontal (see the accompanying figure). If the searchlight is located 50 m from the building, find the rate at which D is changing with respect to θ when θ = 60^0 . Express your answer in units of meters/degree. **[3]**