

1. Given that $f(x) = \frac{2}{1-3x}$ use the **definition of a derivative** to find $f'(1)$. [6]
- (No other method will be accepted!)

2. Differentiate each of the following: [8]
- (a) $f(x) = \tan(3x-5)^3 - \sec^4 2x^5$

(b) $y = \frac{\cos^2 5x - \sin x^5}{\cot \sqrt{1-x^2}}$

3. Given that $f(x) = \frac{2}{\sqrt[3]{2-5x}}$, determine the value of $f'''(2)$ [4]

4. Determine the equation of the tangent line drawn to the curve $x^2 - 2xy = x^2y - 3x$ at the ordered pair $(-1, 2)$. [5]

5. Find the **x-intercept** of the tangent line drawn to the curve $f(x) = \frac{1-3x^3}{\sqrt{x+5}}$ at the point where $x = -1$. [6]

6. Find the points on the curve $y = \cos x - 2x$, $0 < x < 2\pi$, where a tangent to the curve would be perpendicular to the line $3y - 2x + 6 = 0$. [6]

7. A particle moves along a **vertical** line in such a way that at time t seconds after the start, the particle is located $s = 2t^3 - 21t^2 + 36t + 3$ metres from its starting position, where $t \geq 0$.

- (a) What is the velocity of the particle when the acceleration is equal to 18 m/s^2 ? [4]

- (b) Determine the acceleration of the particle the instant it changes direction for the **second** time. [4]

- (c) What is the total **distance** traveled by the particle over the first 24 seconds. [4]