Question 1. [2+2+2 marks]

Find the derivatives of the following functions:

$$1)\ f(x) = e^{\sin 4x}, \qquad 2)\ g(x) = x^3(\cos^2 x + 2), \qquad 3)\ h(x) = \frac{x^2}{\ln(x^2 + 2)}.$$

Question 2. [1+1 marks]

Consider the function f defined by $f(x) = x^4 - x^3 + 1$.

1) Verify that f satisfies the conditions of Rolle's theorem on the interval $[0, 1]$.

2) Find a value of c satisfying the conclusion of Rolles's theorem on the interval $[0, 1]$.

Question 3. [2 marks]

Use implicit differentiation to find y' if $x^3y^3 - 2x^2 - 5y = 0$.

Question 4. [1+2+1 marks]

Use l'Hôpital's rule to compute the following limits:

$$1)\ \lim_{x \to 2} \frac{\ln(3 - x)}{x - 2}, \qquad 2)\ \lim_{x \to 0} \frac{\cos x - 3x^2 - 1}{x^2}, \qquad 3)\ \lim_{x \to -\infty} \frac{3x}{e^{-2x}}.$$

Question 5. [1+1+2+2 marks]

Let $f(x) = 3x^4 - 4x^3 + 2$.

1) Find all critical numbers of the function f.

2) Find the absolute extrema of the function f on the interval $[-1, 2]$.

3) Determine the intervals on which the function f is increasing and the ones where f is decreasing.

4) Find the local extrema of the function f.