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Q1. (13p) Find the absolute extreme values of the function $f(x) = \sqrt{4 - x^2}$ on the interval [-2, 1].

Q2. (16p) Find the derivative of the function

$$f(x) = \sqrt{x^3 + 4} + \sin(e^{2x}) + \tan^{-1}(x).$$

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Q3. (14p) Find the following limits,

a) $\lim_{x\to\infty} \dfrac{\ln(x^2 + 2x)}{\ln x}$, b) $\lim_{x\to 0} \left(\dfrac{1}{\sin x} - \dfrac{1}{x}\right)$.

Q4. (13p) State the conditions of the Mean Value Theorem. Does the function $f(x) = x + \dfrac{1}{x}$ satisfy these conditions on the interval [1/2, 2]. For this function find the value of "c " which satisfies the Mean Value Theorem.

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Q5. (14p) Using implicit differentiation find the equation of the tangent line to the curve $2x^3 + xy - y^3 = 2$ at the point (1, 1). (Do not use the formula $\dfrac{dy}{dx} = -\dfrac{F_x}{F_y}$.)

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Q6. (14p) Find the derivative of the function $y = (x^2 + 1)^{\sin x}$ by using logarithmic differentiation.

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Q7. (16p) Given the function $y = \dfrac{x^2}{x - 1}$. a) Find the intervals where the function is increasing, decreasing, concave up and concave down. b) Find the local extrema and the inflection points, if there are any. c) Find the asymptotes if there are any. c) Sketch the graph of the function.

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