

1) (9 marks) Find these limits. **Do not** use l'Hôpital's rule.

a)

2) (6 marks) Use l'Hôpital's rule to compute:

$$\text{a) } \lim_{x \rightarrow 0} \frac{1}{x} - \frac{1}{\sin x}$$

3) (6 marks) Consider for $f(x) = \begin{cases} x^5 & \text{if } x < 1 \\ \sqrt{x+3} & \text{if } 1 \leq x < 6 \\ a & \text{if } x = 6 \\ \frac{a}{x+1} & \text{if } x > 6 \end{cases}$

a) Is f continuous at

4) (5 marks) Use the Limit Definition of the Derivative to find

6) (5 marks) Let $y = \frac{x^2 + 1}{x^2 - 1}$ Find $\frac{dy}{dx} \Big|_{x=2}$

7) (5 marks) Given $x^4 + y^4 = 3$, find $\frac{dy}{dx}$, simplifying your answer as much as possible.

8) (5 marks) Use Logarithmic

10) (5 marks) Let $y = \sqrt{x}$. Find $\frac{dy}{dx}$, simplifying your answer as much as possible.

11) (5 marks) Show that $y = \frac{1}{x}$ satisfies the differential equation: $y' + y^2 = \sin$

12) (12 marks) Given $f(x) = \frac{x}{x}$, with

13) (8 marks) Sam plans to buy 1000 square meters of a rectangular plot of land, one side of

15) (6 marks) Find the integrals:

a) _____

b) $\int \frac{x^{-}}{x - x} dx$

16) (5 marks) Solve the differential equation $\frac{dy}{dx} = \frac{\sec^2 x}{1+y}$, given that $y = 0$ when $x = 0$.