



Study Guide 1

MATH 140 Lab: Section 1

Lab Instructor (TA): Mohammed Kaabar

Student's Name:-----

Student's ID:-----

Note: This study guide contains my practice questions that I think will be useful for preparing you for the first exam in Calculus for Life Scientists.

Question 1: Find the following limits. Show your work.

a. $\lim_{x \rightarrow 2} \left(\frac{x^2 - 5x + 6}{x^2 - 2x} \right)$

b. $\lim_{x \rightarrow 1} \left(\frac{\sqrt{x} - x}{1 - \sqrt{x}} \right)$

c. $\lim_{x \rightarrow 1} \frac{x-1}{|x-x^2|}$

d. $\lim_{x \rightarrow 0} \frac{3 - 3 \cos^2 x}{4x^2}$

e. $\lim_{x \rightarrow -1^+} \frac{1-x}{(x+1)^2}$

f. $\lim_{x \rightarrow 2^-} \frac{x}{x-2}$

g. $\lim_{x \rightarrow \infty} \frac{2x^2 - 1}{4x^3 - 5x - 1}$

h. $\lim_{x \rightarrow 0^+} e^{\left(-\frac{1}{x}\right)}$

i. $\lim_{x \rightarrow 0} \frac{\sin(x) + 3x}{2x}$

j. $\lim_{x \rightarrow -\infty} \frac{2x}{\sqrt{x^2 + 4}}$

Question 2: Find $f'(1)$ and $h'(2)$ using the definition of derivative where:

$$f(x) = \frac{x}{x+1} \quad \text{and} \quad h(x) = \sqrt{x-1}$$

Question 3: Discuss the continuity at $x = 2$ for the following function:

$$f(x) = \begin{cases} 3, & x = 2 \\ 3x - 2, & x > 2 \\ x^2, & x < 2 \end{cases}$$

Question 4: Find the equation of the tangent line to the curve: $y = 4\sqrt{x} - 2x$ at $x = 4$.

Question 5: Find y' without simplifying your answer for the following:

a. $y = 12x - x^2 - \frac{3}{\sqrt{x}}$

b. $y = x(3x^2 - \sqrt{x})$

c. $y = \frac{2}{x^4} - x^3 + 2$

d. $y = \frac{x^3}{(x^2+4)^2}$

e. $y = e^{\sin(2x)}$

f. $y = \ln(\sin(x^2))$

g. $y = (x^2)^x$

Question 6: Find the equation of the tangent line to the curve: $y = \sin(4x)$ at $x = \frac{\pi}{8}$.

b. $m(x) = \frac{3}{|2x|+4}$

Question 9: Consider the function: $f(x) = \begin{cases} \frac{1}{x^3+1}, & x < -1 \\ 2x + 1, & -1 \leq x < 1 \\ 3x^2, & 1 < x \leq 2 \\ x^3, & x > 2 \end{cases}$

Find the following limits or state that the limit does exist. Explain why.

a. $\lim_{x \rightarrow -\infty} f(x)$

b. $\lim_{x \rightarrow 1} f(x)$

c. $\lim_{x \rightarrow -1} f(x)$

d. $\lim_{x \rightarrow 2} f(x)$

Question 10: Determine whether the following statements are true or false:

- a. Assume that $f(x) = x^2 - 2\sqrt{x} - 1$ is defined on $[1,2]$. Then, there exists a number c between 1 and 2 such that $f(c) = 0$. [.....]
- b. $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$ [.....]
- c. $y = 1$ is a horizontal asymptote of $y = \frac{1}{x-1}$. [.....]
- d. If $y = x^x$, $y' = x^x(\ln x + 1)$. [.....]
- e. $x = -1$ is a vertical asymptote of $y = \frac{x-2}{x^2-x-2}$. [.....]

Question 11: If $f(1) = 3$, $f'(1) = 2$, $g(1) = 10$, $g'(1) = 4$, $g'(3) = -2$, then find the value of $w'(1)$ where:

- a. $w(x) = g(f(x))$
- b. $w(x) = x^3 f(x)$
- c. $w(x) = \ln(g(x)^2 + 1)$

Question 12: Find the equilibrium at $c_1 = 1$ for the following difference equation:

$$c_{n+1} = \sqrt{c_n + 2}$$

Question 13*: Assume that the height of a falling object t seconds after being dropped from a height of 64 feet can be written as follows:

$$h(t) = 64 - 16t^2 \text{ feet}$$

- Find the average velocity between times $t = 1$ and $t = 2$.
- Find the instantaneous velocity at times $t = 2$.

***Reference:** Calculus: Early Transcendental Functions by Smith Minton 3rd Edition

Good Luck in Exam 1
Mohammed Kaabar