

1. Find the following limits: a)  $\lim_{x \rightarrow 4} \frac{\sqrt{6x+1}-5}{x-4}$       b)  $\lim_{x \rightarrow 4} \frac{x^2-2x-8}{x-4}$

2. Determine which statement best describes the continuity of the function:

$$f(x) = \begin{cases} x^2 - 3 & \text{if } x < -2 \\ 2x + 5 & \text{if } -2 \leq x < 1 \\ 7x & \text{if } x > 1 \end{cases}$$

- a)  $f(x)$  is Continuous for All Real values of  $x$
- b)  $f(x)$  is Continuous for All Reals except  $x = -2$
- c)  $f(x)$  is Continuous for All Reals except  $x = 1$
- d)  $f(x)$  is Continuous for All Reals except  $x = -2$  and  $x = 1$

3. Find the derivative of:  $f(x) = 7 - x + 4x^2 + 5x^4$

4. Find the derivative of:  $y = \frac{2}{x^3} - \frac{4}{x}$

5. Find the equation of the line tangent to  $y = x^3 - 2x^2 + 2$  at  $x = \frac{1}{2}$

6. Use Marginal analysis to predict the estimated profits from the 221<sup>st</sup> unit sold if  $C(x) = 1200 + 5x$  and  $R(x) = -.04x^2 + 32x - 200$ .

7. Use Implicit Differentiation to find  $dy/dx$  for:  $y^3 - 5x + 6 = 3x^2y^4$

8. Find derivatives of the following:

a)  $h(x) = \frac{x+3}{x^2+2}$       b)  $y = (2x^3 - 5)^6$       c)  $F(x) = \ln(8x + 2x^4)$       d)  $h(x) = e^{4\sqrt{x}}$

9. Find the derivative of:  $h(x) = x^3 e^{-x^2}$

10. Find the Absolute Maximum and Absolute Minimum of  $f(x) = -x^3 + 4x^2 + 3$  on  $[-1, 5]$

11. Find the derivative of:  $h(x) = \ln(4x^2 - 2x^3)$

12. How long will it take an investment of \$45000 to become \$100000 if it earns 4.65% compounded continuously?

13. How much does it take invested today to grow to \$30000 at 4.8% compounded continuously in 8 years?

14. Find the Elasticity function for the Demand function,  $D(x) = 800 - 4x$ , and then determine the elasticity at  $x = 75$ .  $E(x) = \frac{-x \cdot D'(x)}{D(x)}$

15. Take first and second derivatives of  $f(x) = 54x^2 - x^4$ , and then build a sign chart to determine Intervals of Concavity
16. Find the specific function  $f(x)$  satisfying the following conditions:  $f'(x) = 6x^2 + x - 2$  and  $f(4) = 5$
17. Evaluate the Integral:  $\int_{-1}^3 (4x^3 - 4x + 3) dx$
18. Find the value of the each Definite Integral:  
 a)  $\int_{-2}^1 x^2 (x^3 + 3)^3 dx$     b)  $\int_{-2}^1 x^2 e^{x^3+1} dx$     c)  $\int_2^{10} \frac{2x}{x^2 + 4} dx$
19. Use Integration by Parts:  $\int (x+2)e^{4x} dx$
20. Find the Area bounded by  $y = x+5$  and  $y = x^2 - 6x + 11$
21. Tim invests money in a 403b account according to the function  $f(t) = 15000e^{0.02t}$ . If the account earns continuous gains at 5.5%, and the contributions are made for 25 years, what will be the value of the account? Use:  $FV = e^{kt} \int_0^T R(t)e^{-kt} dt$  and round to the nearest \$1.
22. An investor is looking at a business opportunity, which will pay him \$100000 each of the next 8 years. Assuming continuous growth at 6%, what is the Present Value of this income stream?  
 Use:  $PV = \int_0^T R(t)e^{-kt} dt$
23. Find  $f(-3, 2)$  if  $f(x, y) = \frac{4xy^2}{(2x+y)^2}$
24. Find Critical Points and then whether they are a Relative Max, Relative Min, or Saddle Point.  
 $f(x, y) = x^2 + y^2 - xy + x^3$
25. The function  $f(x, y) = 2x^4 + y^2 - 12xy$  has derivatives:  $f_x = 8x^3 - 12y$ ,  $f_y = 2y - 12x$ . Find the critical points and determine whether each is a Relative Max, Relative Min, or Saddle Point.
26. Find the Partial Derivative  $f_{xy}$  for  $f(x, y) = \frac{1}{y} \ln x$
27. Find ALL 5 first and second order Partial Derivatives of:  
 a)  $P(x, y) = 2x^4 - y^5 + 4xy^6$     b)  $f(x, y) = \frac{2x}{y} - \frac{y}{6x}$
28. Use the Method of Lagrange Multipliers to find the Maximum and Minimum of  $f(x, y) = 2xy$  subject to  $x^2 + y^2 = 18$