M119 Exam Jam
Spring 2017

Concise Packet
1. Find the average rate of change of \( f(x) = x^2 - 3 \) between \( x = 1 \) and \( x = 5 \).

2. Find the instantaneous rate of change of \( f(x) = x^4 - 3x^2 + 2 \) at \( x = 4 \).

3. Find \( f'(-1) \) if \( f(x) = x^5 - 3x^4 + 1 \).

4. Differentiate: \( y = 8\sqrt{x} - \frac{2}{x^2} \).

5. If \( g(t) = e^{-4t} \) find \( g''(0) \).

6. Find \( \frac{d^2y}{dx^2} \big|_{x=4} \) if \( y = \ln x \).

7. Find the slope of the line tangent to \( f(x) = x^4 + 7x - 8 \) at \( x = 0 \).

8. Find an equation for the line tangent to the graph of \( y = 3x^2 - x \) at \( x = -1 \).

9. Find an equation for the line tangent to the graph of \( f(x) = e^{3x} + 2x + 1 \) at \( x = 0 \).

10. Given that \( y = 5(x^4 - 2)^3 \), find \( \frac{dy}{dx} \big|_{x=1} \).

11. Given \( y = 2 \ln (5x^3 - x) \), find \( \frac{dy}{dx} \).

12. If \( P(t) = 200e^{0.04t} \), find \( P'(t) \).

13. Given \( f(z) = z^5 \ln z \), find \( f'(z) \).

14. Find all points where the tangent line is horizontal: \( f(x) = x^3 - 3x^2 - 9x \).

15. Given \( f(x) = 16x - x^2 \), find all points where the tangent line is horizontal.

16. For \( f(x) = x^4 + 4x^3 + 10 \), find the critical points, and then determine if each point is a local minimum, local maximum, or neither.

17. Given that \( g(t) = t^3 - 3t^2 + 3t - 2 \), find the inflection points.

18. Find the absolute maximum and absolute minimum values of the function on the given interval: \( f(x) = x^2 - 10x \) on the interval \([0, 6]\).

19. At a price of $20 per ticket, a group can fill every seat in a theater with 930 seats. For every additional dollar charged, the number of people buying tickets decreases by 30.

   a. Find the revenue function (as a function of price).

   b. Find the ticket price that maximizes the revenue.

   c. What is the maximum revenue?

20. A company finds that the demand equation for a quantity \( q \) of Jphones sold at price \( p \), in dollars is \( p = 870 - 3q \). To produce these Jphones, the company finds that fixed costs are $2875 and the variable cost per unit is $126.

   a. At what quantity is the profit maximized?

   b. What is the maximum profit?
21. If the population of a town doubled in 15 years, find the continuous annual growth rate. Write your answer as a percent.

22. If money is invested in an account that pays interest compounded continuously at 2.9% per year, how long will it take for the investment to double. Write your answer with 1 decimal place and include units.

23. If the half-life of a medication is 9 hours, find the rate of decay.

24. If the decay rate for a substance is 4.2% per week, find the half-life. Give your answer with 1 decimal place and include units.

25. Find each of the following indefinite integrals:
   a. $\int (e^{5t} + t^5)\,dt$
   b. $\int \frac{2}{x^3}\,dx$
   c. $\int \left( \frac{1}{x^4} - \frac{4}{x} \right)\,dx$

26. Evaluate each of the following definite integrals:
   a. $\int_1^2 2t^4\,dt$
   b. $\int_{-1}^1 (4x^3 - 1)\,dx$
   c. $\int_{16}^{36} 3\sqrt{x}\,dx$
   d. $\int_1^e \frac{5}{x}\,dx$

27. The marginal cost function of a product, in dollars per unit, is $C'(x) = 6x^2 - 60x + 10$. Find the total cost function if fixed costs are $4,000.

28. Find the area of the region bounded by $y = x^3 + 3$ and the x-axis over the interval $[0, 2]$

29. Find the area of the region bounded by $f(x) = 9 - x^2$ over the interval $[-3, 3]$

30. Your business estimates that sales are growing continuously at a rate given by $S'(t) = 3t^2 + 2$, where $S'(t)$ is given in dollars per day on day $t$. Find the accumulated sales for the first 5 days.

31. Find the present value of $7,000 due 8 years from now if interest is compounded continuously at a rate of 2.5% per year.

32. Find the present value of a continuous income stream of $7,000 per year for 8 years if interest is compounded continuously at a rate of 2.5% per year.