Math 116
Fall 2025

Study Guide for Exam 3

1. Solve for x: $e^{-3x} = \left(e^{8}\right)^{2-x}$.

   x is:

   (A) between 1 and 2 **(B)** between 2 and 3

   (C) between 3 and 4 **(D)** between 4 and 5

   (E) between 5 and 6

2. Joe plans to invest \$6,000 into a money market account. Find the interest rate that is needed for the money to grow to \$45,000 in 30 years if the interest is compounded quarterly.

   The interest rate is:

   (A) between 6.65% and 6.75% **(B)** between 6.75% and 6.85%

   (C) between 6.85% and 6.95% **(D)** between 6.95% and 7.05%

   (E) between 7.05% and 7.15%

3. An item costs \$5000 today. What will the item cost in 6 years assuming an inflation rate of 4.2% compounded continuously?

   Rounded to the nearest cent, it will cost:

   (A) \$3886,22 **(B)** \$6260.00 **(C)** \$6424.53

   (D) \$6430.15 **(E)** \$6432.98

4. Find the interest earned on \$25,000 invested for 3 years at 4% interest compounded as follows. (Round your answer to the nearest cent)

   (i) Annually

   (A) \$3,000.00 **(B)** \$3,121.60 **(C)** \$3,181.80

   (D) \$3,187.42 **(E)** \$28,121.60

   (ii) Monthly

   (A) \$3,000.00 **(B)** \$3,121.60 **(C)** \$3,181.80

   (D) \$3,187.42 **(E)** \$28,181.80

   (iii) Continuously

   (A) \$3,000.00 **(B)** \$3,121.60 **(C)** \$3,181.80

   (D) \$3,187.42 **(E)** \$28,187.42

5. Give the $x-$ intercept of the function $y=\ln(x+3)$

   The $x-$ intercept is:

   (A) $(-3,0)$ **(B)** $(-2,0)$ **(C)** $(\ln 3,0)$

   (D) $(e^3,0)$ **(E)** undefined

6. Solve for x: $3^{2x-1} = 187.$

x is:

(A) between 2 and 2.5 **(B)** between 2.5 and 3 **(C)** between 3 and 3.5

(D) between 3.5 and 4 **(E)** between 4 and 4.5

7. Joanie invests $15,000 in an account paying 3% per year, compounded quarterly. How many years are required for the compound amount to at least double?

The time is takes for the compound amount to at least double is:

(A) less than 5 years **(B)** between 5 and 10 years

(C) between 10 and 15 years **(D)** between 15 and 20 years

(E) more than 20 years

8. Find the effective rate of interest corresponding to a nominal rate of 8.35% compounded continuously. (Round your answer to the nearest hundredth of a percent.)

(A) 8.35% **(B)** 8.62% **(C)** 8.68% **(D)** 8.71% **(E)** None of these

FOLLOW_UP: (Be sure you can find the effective rate if the rate is compounded monthly, daily, quarterly, etc…)

9. Frank must make a balloon payment of $25,000 in 7 years. Find the present value of the payment if it includes annual interest of 5.2% compounded monthly.

Rounded to the nearest cent, the present value is:

(A) $15,900.00 **(B)** $17,372.28 **(C)** $17,385.95

(D) $17,413.08 **(E)** $35,948.57

10. Southwest Dry Cleaners believes that it will need new equipment in 11 years. The equipment will cost $175,000. What lump sum should be invested today at 4.21% compounded continuously, to obtain an amount of $175,000?

The lump sum is:

(A) between $109,800 and $109,900 **(B)** between $109,900 and $110,000

(C) between $110,000 and $110,100 **(D)** between $110,100 and $110,200

(E) between $110,200 and $110,300

11. Christine, who is self-employed, wants to invest $80,000 in a pension plan. One investment offers 6% compounded quarterly. Another investment offers 5.75% compounded continuously.

(i) Which investment will earn the most interest in 4 years?

(ii) How much more in interest will the better plan earn?

(iii) What is the effective rate of interest (rounded to the nearest hundredth of a percent) in each case?

(iv) If Christine chooses the plan with continuous compounding, how long will it take for her $80,000 to grow to $90,000? (round to two decimal places)

12. Sales of a new model of Blu-Ray player are approximated by the function

$$S(x) = 1100 - 800e^{-x},$$

where $S(x)$ is in appropriate units and x represents the number of years the player has been on the market.

(i) Find the sales during year 0.

(ii) In how many years will sales reach 900 units? (Round to two decimal places)

(iii) Will sales ever reach 1,100 units?

13. Find the derivative of the function $g(x) = 2e^{4x+1}$.

(A) $g'(x) = 2e^{4x+1}$ **(B)** $g'(x) = 8e^{4x+1}$ **(C)** $g'(x) = 2e^{4}$

(D) $g'(x) = 2(\ln 4)e^{4x+1}$ **(E)** None of these

14. Find the derivative of the function $h(x)=\left(2x^2-4x+4\right)e^{-4x}$.

(A) $h'(x)=(-4x+1)e^{-4x}$ **(B)** $h'(x)=\left(-16x^2+16x\right)e^{-3x}$

(C) $h'(x)=(-16x+16)e^{-4x}$ **(D)** $h'(x)=\left(-8x^2+20x-20\right)e^{-4x}$

(E) None of these

15. Find the derivative of the function $f(x)=\dfrac{8e^{4x}}{5x-2}$.

(A) $f'(x)=\dfrac{32e^{4x}}{5}$ **(B)** $f'(x)=\dfrac{8e^{4x}(20x-13)}{(5x-2)^2}$ **(C)** $f'(x)=\dfrac{8e^4}{5}$

(D) $f'(x)=\dfrac{8e^{4x}}{5}$ **(E)** $f'(x)=\dfrac{8e^{4x}(13-20x)}{(5x-2)^2}$

16. Find the equation of the tangent line to $f(x)=e^{2x}+3$ at $x=0$.

(A) $y=4x+2$ **(B)** $y=5x+2$ **(C)** $y=2xe^{2x}+4$

(D) $y=2x+4$ **(E)** None of these

17. The sales of a new high-tech item are given by

$$S(t) = 9400 - 9000e^{-0.4t},$$

where t represents time in years. Find the rate of change of sales after 5 years. (Round to one decimal place as needed.

(A) 3.3 **(B)** 487.2 **(C)** 8182.0 **(D)** 9887.2 **(E)** None of these

18. Using data in a car magazine, we constructed the mathematical model

$$y = 100e^{-0.08044t}$$

for the percent of cars of a certain type still on the road after t years.

(i) Find the percent of cars on the road after 5 years.

The percent of cars is:

(A) less than 50% **(B)** between 50% and 60% **(C)** between 60% and 70%

(D) between 70% and 80% **(E)** More than 80%

(ii) Find the rate of change of the percent of cars still on the road after 5 years.

The rate of change is:

(A) between -10% and -8% per year **(B)** between -8% and -6% per year

(C) between -6% and -4% per year **(D)** between -4% and -2% per year

(E) between -2% and 0% per year

19. Find the derivative of the function $f(x)=\ln(5-4x)$.

(A) $f'(x)=-4\ln(5-4x)$ **(B)** $f'(x)=\dfrac{1}{5-4x}$ **(C)** $f'(x)=\dfrac{-4}{5-4x}$

(D) $f'(x)=\dfrac{1}{\ln(5-4x)}$ **(E)** $f'(x)=\dfrac{-4}{x}$

20. Find the derivative of the function $g(x)=\dfrac{4\ln(4x)}{4+5x}$.

(A) $g'(x)=\dfrac{16+20x-20x\ln(4x)}{x(4+5x)^2}$ **(B)** $g'(x)=\dfrac{1}{5x}$ **(C)** $g'(x)=\dfrac{4}{5x}$

(D) $g'(x)=\dfrac{4+5x-20x\ln(4x)}{x(4+5x)^2}$ **(E)** None of these

21. The cost function (in dollars) for x units of a certain item is $C(x) = 102x + 91$. The revenue function (also in dollars) for the same item is given by $R(x) = 102x + \dfrac{54x}{\ln(x)}$.

Answer parts **(i)** through **(iv)**.

(i) Find the marginal cost function $C'(x)$.

(A) $C'(x) = 91$ **(B)** $C'(x) = x$ **(C)** $C'(x) = 102$

(D) $C'(x) = 102x + 91$ **(E)** None of these

(ii) Find the marginal revenue function $R'(x)$.

(iii) Find the profit function.

(iv) Find the marginal profit when 8 units are sold.

The marginal profit is:

(A) less than \$9 per unit **(B)** between \$9 and \$10 per unit

(C) between \$10 and \$11 per unit **(D)** between \$11 and \$12 per unit

(E) more than \$12 per unit

22. A small company manufactures and sells lamps. The production manager has determined that the cost and demand functions for x lamps per week are

Cost (dollars): $C(x) = 200 + 30xe^{-0.02x}$, Demand (Dollars/lamp): $p(x) = 60e^{-0.02x}$

(i) Express the profit, $P(x)$, as a function of x.

(ii) Find the number of lamps, (rounded to the nearest whole number) that produces the maximum profit.

(iii) Find the price, p, per lamp that produces maximum profit. Round your answer to the nearest cent.

(iv) Find the maximum profit. Round your answer to the nearest cent.

23. Evaluate the following indefinite integral: $\int \left(e^{2x} + 3x^2 \right) dx$

(A) $\frac{e^{2x}}{2} + x^3 + C$ **(B)** $2e^{2x} + x^3 + C$

(C) $\frac{e^{2x}}{2} + 6x + C$ **(D)** $2e^{2x} + 6x + C$

(E) None of these

24. Evaluate the following indefinite integral: $\int \left(\frac{3}{\sqrt{x}} - \frac{1}{x} \right) dx$

(A) $\frac{3}{2}\sqrt{x} - \ln|x| + C$

(B) $\frac{-3}{2\sqrt{x^3}} + \frac{1}{x^2} + C$

(C) $6\sqrt{x} - \ln|x| + C$

(D) $\frac{-3}{2\sqrt{x^3}} - 1 + C$

(E) None of these

25. Evaluate the following indefinite integral: $\int \left(10x^3 + 4x^2 - 3x + 5\right) dx$

(A) $30x^2 + 8x - 3 + C$ **(B)** $\frac{5}{2}x^4 + \frac{4}{3}x^3 - \frac{3}{2}x^2 + 5x + C$

(C) $\frac{10}{3}x^4 + 2x^3 - 3x^2 + 5x + C$ **(D)** $\frac{10}{3}x^2 + 2x - 3 + C$

(E) None of these

26. Evaluate the following indefinite integral: $\int \left(\frac{1}{4x} + \frac{3}{\sqrt[4]{x}} + 1\right) dx$

27. Evaluate the following indefinite integral: $\int \left(-4e^x + \frac{3}{x^6}\right) dx$

28. Find the cost function if the marginal cost function is

$$C'(x) = 6x - 3$$

and the fixed cost is \$11.

(A) $C(x) = 3x^2 - 3x + 11$ **(B)** $C(x) = 6x + 8$

(C) $C(x) = 11x$ **(D)** $C(x) = 3x^2 + 8x$

(E) None of these

29. Find the revenue function if the marginal revenue function is

$$R'(x) = 6x^2 + 4x + 5\,.$$

(A) $R(x) = 6x^2 + 4x + 5$ **(B)** $R(x) = 6x^3 + 4x^2 + 5x$

(C) $R(x) = 12x + 4$ **(D)** $R(x) = 2x^3 + 2x^2 + 5x$

(E) None of these

30. Find the demand function for the marginal revenue function.

$$R'(x) = 0.03x^2 - 0.04x + 208\,.$$

(A) $p(x) = 0.01x^3 - 0.02x^2 + 208x$ **(B)** $p(x) = 0.03x - 0.04 + \dfrac{208}{x}$

(C) $p(x) = 0.01x^2 - 0.02x + 208$ **(D)** $p(x) = 0.03x^2 - 0.04x + 208$

(E) None of these

31. Suppose the marginal cost from a product is given by $C'(x) = 3x(x+4)$, when x units are sold. Assume the cost is \$17 when 1 unit is sold. Determine the cost function $C(x)$.

(A) $C(x) = x^3 + 6x^2 + 17$

(B) $C(x) = \dfrac{3}{4}x^4 + 4x + 17$

(C) $C(x) = \dfrac{3}{4}x^4 + 4x + 12.25$

(D) $C(x) = 6x + 11$

(E) $C(x) = x^3 + 6x^2 + 10$

32. The marginal profit in dollars on Brie cheese sold at a cheese store is given by

$$P'(x) = 90x^3 + 60x^2,$$

where x is the amount of cheese sold, in hundreds of pounds. The "profit" is $\$-20$ when no cheese is sold. Find the profit from selling 200 pounds of Brie cheese.

The profit is:

(A) less than \$550 **(B)** between \$550 and \$600

(C) between \$600 and \$650 **(D)** between \$650 and \$700

(E) more than \$700

33. The approximate rate of change in the number (in billions) of monthly text messages is given by the equation

$$f'(t) = 4.2t - 7.4,$$

where t represents the number of years since 2000. In 2000, (when $t = 0$) there were approximately 9.2 billion text messages. How many monthly text messages were there in 2005?

In 2005, the number of text messages were:

(A) less than 10 billion **(B)** between 10 billion and 20 billion

(C) between 20 billion and 30 billion **(D)** between 30 billion and 40 billion

(E) more than 40 billion

34. Approximate the area under the graph of $f(x) = x^2 + 3$ and above the $x-$axis from $x = -1$ to $x = 5$ with rectangles, using left endpoints, with $n = 3$. The approximate area is:

(A) less than 36

(B) between 36 and 46

(C) between 46 and 56

(D) between 56 and 66

(E) more than 66

35. Approximate the area under the graph of $f(x) = x^2 + 3$ and above the $x-$axis from $x = -1$ to $x = 5$ with rectangles, using right endpoints, with $n = 3$. The approximate area is:

(A) less than 55

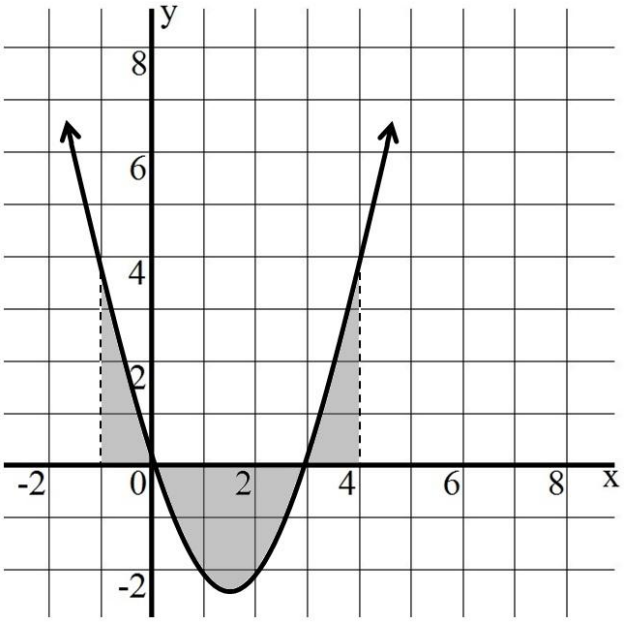
(B) between 55 and 70

(C) between 70 and 85

(D) between 85 and 100

(E) more than 100

36. Below is a graph of $f(x) = x^2 - 3x$. Find the total area of the shaded regions.



The total area of the shaded regions is

(A) more than 8.7

(B) between 8.4 and 8.7

(C) between 8.1 and 8.4

(D) between 7.8 and 8.1

(E) less than 7.8

37. Find the area under the graph of $f(x) = -x^2 + 5$ and above the $x-$axis from $x = -2$ to $x = 2$.

The area is:

(A) less than 4 **(B)** between 4 and 8

(C) between 8 and 12 **(D)** between 12 and 16

(E) more than 1

38. Evaluate the definite integral $\int_2^5 \left(e^x - \frac{3}{x} + 2 \right) dx$.

The definite integral is

(A) less than 150 **(B)** between 150 and 155

(C) between 155 and 160 **(D)** between 160 and 165

(E) more than 165

39. Using the Fundamental Theorem of Calculus, which of the following expressions is equivalent to

$$\int_3^6 \left(e^x + 5x^4 \right)$$

(A) $\left[e^6 + 20(6)^3 \right] - \left[e^3 + 20(3)^3 \right]$ **(B)** $\left[\frac{e^7}{7} + 6^5 \right] - \left[\frac{e^4}{4} + (3)^5 \right]$

(C) $\left[e^6 + 6^5 \right] - \left[e^3 + (3)^5 \right]$ **(D)** $\left[6e^5 + 20(6)^3 \right] - \left[3e^2 + 20(3)^3 \right]$

(E) None of these

40. Find the area between the curves

$$x = -5, \quad x = 3, \quad y = 2x, \quad y = x^2 - 3$$

The area between the curves is:

(A) less than 30 **(B)** between 30 and 40

(C) between 40 and 50 **(D)** between 50 and 60

(E) more than 60

41. Find the area of the region between the graphs of $f(x) = x^2 + 1$ and $g(x) = x + 3$.

The area is:

(A) more than 8

(B) between 6 and 8

(C) between 4 and 6

(D) between 2 and 4

(E) less than 2

Answers to Exam 3 Study Guide

1. C

2. B

3. E

4. **(i)** B
   (ii) C
   (iii) D

5. B

6. B

7. E

8. D

9. C

10. D

11. **(i)** 6% compounded quarterly
    (ii) \$830.84
    (iii) 6% compounded quarterly: 6.14%, 5.75% compounded continuously: 5.92%
    (iv) 2.05 years

12. **(i)** 300 units
    (ii) 1.39 years
    (iii) No

13. B

14. D

15. B

16. D

17. B

18. **(i)** C
    (ii) C

19. C

20. A

21. **(i)** C
    (ii) $R'(x) = 102 + \dfrac{54\ln x - 54}{(\ln x)^2}$
    (iii) $P(x) = \dfrac{54x}{\ln x} - 91$
    (iv) E

22. **(i)** $P(x) = 30xe^{-0.02x} - 200$

(ii) $x = 50$ lamps

(iii) \$22.07 per lamp

(iv) \$351.82

23. A

24. C

25. B

26. $\frac{1}{4}\ln|x| + 4x^{3/4} + x + C$

27. $-4e^{x} - \frac{3}{5x^{5}} + C$

28. A

29. D

30. C

31. E

32. A

33. C

34. B

35. D

36. C

37. D

38. A

39. C

40. E

41. C

Formulas you might find useful

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$$

$$\frac{d}{dx}\left(f(x)\cdot g(x)\right) = f(x)g'(x) + g(x)f'(x)$$

$$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{\left[g(x)\right]^2}$$

$$\frac{d}{dx}\left(f\left(g(x)\right)\right) = f'\left(g(x)\right)g'(x)$$

$$\frac{d}{dx}\left(e^x\right) = e^x$$

$$\frac{d}{dx}\left(e^{f(x)}\right) = e^{f(x)}f'(x)$$

$$\frac{d}{dx}\left(\ln x\right) = \frac{1}{x}$$

$$\frac{d}{dx}\ln\left(f(x)\right) = \frac{f'(x)}{f(x)}$$

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C \quad (n \neq 1)$$

$$\int x^{-1} dx = \ln|x| + C$$

$$\int e^{kx} \, dx = \frac{e^{kx}}{k} + C$$

$$A = P\left(1 + \frac{r}{m}\right)^{mt}$$

$$A = Pe^{rt}$$

$$r_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$$

$$r_{eff} = e^r - 1$$

Terminology you might find useful

1. Derivative
2. Tangent Line
3. Marginal (Revenue, Cost, Profit)
4. Average (Revenue, Cost, Profit)
5. Absolute Extrema
5. Exponential Function
6. Logarithmic Function
7. Compound Interest
8. Effective Rate of Interest
9. Antiderivative
10. Indefinite Integral
11. Definite Integral
12. Fundamental Theorem of Calculus