

Chapter 3, Form A**Differentiate.**

1. $y = 5e^{3x}$

1. _____

2. $y = (\ln x)^7$

2. _____

3. $f(x) = e^{-x^7}$

3. _____

4. $f(x) = \ln \frac{x}{6}$

4. _____

5. $f(x) = e^x - 3x^5$

5. _____

6. $f(x) = 4e^x \ln x$

6. _____

7. $y = 10^x - 5^x$

7. _____

8. $y = \log_{16} x$

8. _____

Given $\log_b 3 = 0.5283$ and $\log_b 18 = 1.3900$, find each of the following.

9. $\log_b \frac{1}{3}$

9. _____

10. $\log_b 6$

10. _____

11. $\log_b 54$

11. _____

12. Find the function that satisfies $dW/dt = 5W$, with $W(0) = 7$. 12. _____
13. The doubling time of a certain bacteria culture is 4 hr. What is the growth rate? Round to the nearest tenth of a percent. 13. _____
14. *Business: interest compounded continuously.* An investment is made at 3.512% per year, compounded continuously. What is the doubling time? Round to the nearest tenth of a year. 14. _____
15. *Business: cost of apples.* The cost C of a pound of apples was \$1.20 in 2006. In 2010 the cost was \$1.31 per pound. Assuming the exponential-growth model applies:
- (a) Find the exponential-growth rate to the nearest tenth of a percent, and write the equation. 15. (a) _____
- (b) Find the cost of a pound of apples in 2012 and 2018. (b) _____
16. *Life Science: bacterial population.* After beginning antiseptic treatment, the number of bacteria in a population decreases at the rate of 18% per hour, that is,
- $$\frac{dN}{dt} = -0.18N,$$
- where N is the number of bacteria and t is the time, in hours.
- (a) When $t = 0$, there are 200,000 bacteria present. Find a function that satisfies the equation. 16. (a) _____
- (b) How many bacteria will remain after 10 hr? (b) _____
- (c) After how long do half of the original bacteria remain? (c) _____

17. *Life Science: decay rate.* The decay rate of phosphorus-32 is 4.85% per day. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of lead -214 is 27 minutes. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: effect of advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function

$$P(t) = \frac{100}{1 + 80e^{-0.32t}}.$$

(a) What percentage of the people bought the product before seeing the ad ($t = 0$)?

19. (a) _____

(b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?

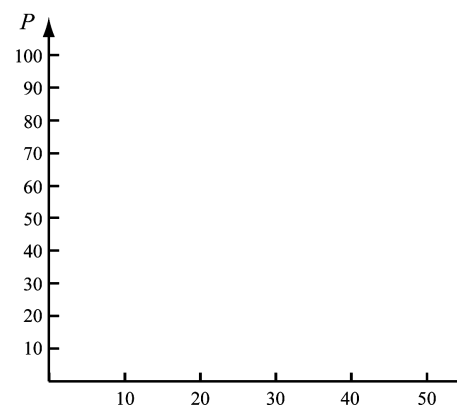
(b) _____

(c) Find the rate of change $P'(t)$.

(c) _____

(d) Sketch a graph of the function.

(d) _____



20. In 2010 Norman's grandparents set up a college savings plan to give him \$25,000 in 2018. Find the present value of that amount in 2010, assuming 4.1% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 300e^{-0.25x}.$$

- (a) Find the elasticity.
 (b) Find the elasticity at $x = 3$, and state whether the demand is elastic or inelastic.
 (c) Find the elasticity $x = 12$, and state whether the demand is elastic or inelastic.
 (d) At a price of \$3, will a small increase in price cause the total revenue to increase or decrease?
 (e) Find the price for which the total revenue is a maximum.

21. (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____

22. Differentiate: $y = 4x(\ln x)^2 - 8x \ln x + 8x$.

22. _____

23. Find the maximum and minimum values of $f(x) = x^4 e^{-4x}$ over $[0, 5]$.

23. _____

24. Find $\lim_{x \rightarrow 0} \frac{e^{-0.5x} - e^{0.5x}}{e^{-0.5x} + e^{0.5x}}$.

24. _____

25. *Finance: student loan debt.* The average amount of a student loan debt for graduating seniors (undergraduates) through U.S. student loan institutions has been increasing exponentially. Data in the table shows student loan debt for years after 1996.

| Years, t after 1996 | Student loan debt, in dollars |
|-----------------------|-------------------------------|
| 0 | 12,750 |
| 4 | 17,350 |
| 8 | 18,650 |
| 12 | 23,200 |

(http://projectonstudentdebt.org/files/File/Debt_Facts_and_Sources.pdf)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 1996.
 (b) Estimate the average student loan debt in 2012 and 2015.
 (c) After what amount of time will the average student loan debt be \$45,000?
 (d) What is the doubling time of the average student loan debt?

25. (a) _____
 (b) _____
 (c) _____
 (d) _____

Chapter 3, Form B**Differentiate.**

1. $y = 7e^{4x}$

1. _____

2. $y = (\ln x)^5$

2. _____

3. $f(x) = e^{x^5}$

3. _____

4. $f(x) = \ln \frac{2x}{5}$

4. _____

5. $f(x) = e^x + 5x^7$

5. _____

6. $f(x) = 9e^x \ln x$

6. _____

7. $y = 3^x + 4^x$

7. _____

8. $y = \log_{13} x$

8. _____

Given $\log_b 5 = 0.7740$ and $\log_b 3 = 0.5283$, find each of the following.

9. $\log_b 15$

9. _____

10. $\log_b 25$

10. _____

11. $\log_b \frac{1}{3}$

11. _____

12. Find the function that satisfies $dM/dt = 10M$,
with $M(0) = 4$. 12. _____
13. The doubling time of a certain bacteria culture is
8 hr. What is the growth rate? Round to the
nearest tenth of a percent. 13. _____
14. *Business: interest compounded continuously.* An
investment is made at 5.125% per year,
compounded continuously. What is the doubling
time? Round to the nearest tenth of a year. 14. _____
15. *Business: cost of eggs.* The cost C of a dozen
large eggs was \$1.56 in 2006. In 2010 the cost
was \$1.88. Assuming the exponential-growth
model applies: 15. (a) _____
(b) _____
- (a) Find the exponential-growth rate to the
nearest tenth of a percent and write the
equation.
- (b) Find the cost of a dozen large eggs in 2012
and 2018.
16. *Life Science: drug dosage.* A dose of a drug is
injected into the body of a patient. The drug
amount in the body decreases at the rate of 22%
per hour, that is,
- $$\frac{dA}{dt} = -0.22A,$$
- where A is the amount in the body and t is the
time, in hours.
- (a) A dose of 5 cubic centimeters (cc) is
administered. Assuming $A_0 = 5$, find the
function that satisfies the equation. 16. (a) _____
- (b) How much of the initial dose of 5cc will
remain after 8 hr? (b) _____
- (c) After how long does half of the original dose
remain? (c) _____

17. *Life Science: decay rate.* The decay rate of polonium-214 is 3.47% per minute. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of bismuth-210 is 22 years. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: effect of advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function

$$P(t) = \frac{100}{1 + 40e^{-0.32t}}.$$

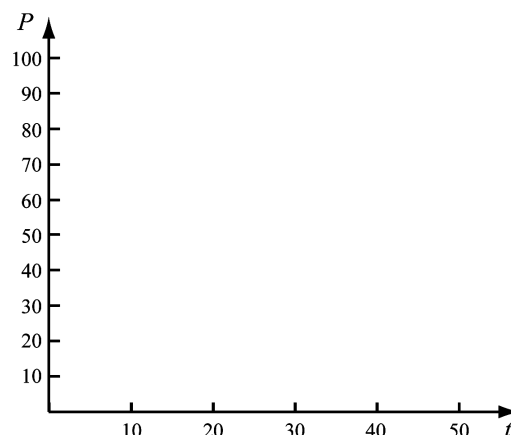
- (a) What percentage of the people bought the product before seeing the ad ($t = 0$)?
 (b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?
 (c) Find the rate of change $P'(t)$.
 (d) Sketch a graph of the function.

19. (a) _____

(b) _____

(c) _____

(d)



20. In 2010, a professional athlete signed a contract paying him \$9 million in 2014. Find the present value of that amount in 2010, assuming 5.1% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 250e^{-0.24x}.$$

- (a) Find the elasticity.
- (b) Find the elasticity at $x = 5$, and state whether the demand is elastic or inelastic.
- (c) Find the elasticity as $x = 3$, and state whether the demand is elastic or inelastic.
- (d) At a price of \$5, will a small increase in price cause the total revenue to increase or decrease?
- (e) Find the price for which the total revenue is a maximum.
21. (a) _____
- (b) _____
- (c) _____
- (d) _____
- (e) _____
-
22. Differentiate: $y = 3x(\ln x)^2 - 6x \ln x + 6x$.
22. _____
23. Find the maximum and minimum values of $f(x) = x^3 e^{-3x}$ over $[0, 10]$.
23. _____

-
24. Find $\lim_{x \rightarrow 0} \frac{e^{-3x} - e^{3x}}{e^{-3x} + e^{3x}}$.
24. _____

25. *Entertainment: price of movie tickets.* The average price of movie tickets has been increasing exponentially. Data in the table shows average movie ticket prices for years after 1990.

| Years, t after 1990 | Average price per ticket, in dollars |
|-----------------------|--------------------------------------|
| 0 | 4.22 |
| 5 | 4.35 |
| 10 | 5.39 |
| 15 | 6.41 |
| 19 | 7.50 |

(Source: <http://www.natoonline.org/statisticstickets.htm>)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 1990.
- (b) Estimate the average price of a movie ticket in 2012 and 2015.
- (c) After what amount of time will the average price of a movie ticket be \$15?
- (d) What is the doubling time of the average price of a movie ticket?
25. (a) _____
- (b) _____
- (c) _____
- (d) _____

Chapter 3, Form C**Differentiate.**

1. $y = 4e^{2x}$

1. _____

2. $y = (\ln x)^9$

2. _____

3. $f(x) = e^{4x^7}$

3. _____

4. $f(x) = \ln \frac{x}{9}$

4. _____

5. $f(x) = e^x - 2x^3$

5. _____

6. $f(x) = 3e^x \ln x$

6. _____

7. $y = 4^x - 8^x$

7. _____

8. $y = \log_7 x$

8. _____

Given $\log_b 4 = 0.7124$ and $\log_b 12 = 1.2770$, find each of the following.

9. $\log_b 3$

9. _____

10. $\log_b \frac{1}{12}$

10. _____

11. $\log_b 8$

11. _____

12. Find the function that satisfies $dJ/dt = 4J$ with $J(0) = 5$. 12. _____

13. The doubling time of a certain bacteria culture is 5 hr. What is the growth rate? Round to the nearest tenth of a percent. 13. _____

14. *Business: interest compounded continuously.* An investment is made at 4.382% per year, compounded continuously. What is the doubling time? Round to the nearest tenth of a year. 14. _____

15. *Business: cost of margarine.* The cost C of a pound of margarine in 2006 was 66¢. In 2010 the cost was 83¢. Assuming the exponential-growth model applies:
- (a) Find the exponential-growth rate to the nearest tenth of a percent, and write the equation. 15. (a) _____
- (b) Find the cost of a pound of margarine in 2012 and 2018. (b) _____

16. *Life Science: bacterial population.* After beginning antiseptic treatment, the number of bacteria in a population decreases at the rate of 45% per hour, that is,

$$\frac{dN}{dt} = -0.45N,$$

where N is the number of bacteria and t is the time, in hours.

- (a) When $t = 0$, there are 1,500,000 bacteria present. Find a function that satisfies the equation.
- (b) How many bacteria will remain after 12 hr?
- (c) After how long do half of the original bacteria remain?

16. (a) _____

(b) _____

(c) _____

17. *Life Science: decay rate.* The decay rate of protactinium-234 is 2.9% per day. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of cobalt-60 is 5.3 years. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: Effect of Advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function

$$P(t) = \frac{100}{1 + 50e^{-0.17t}}.$$

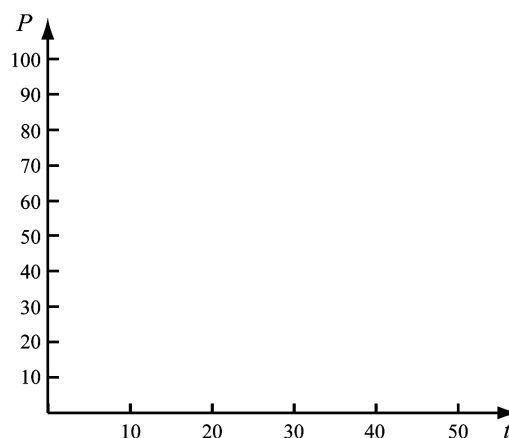
- (a) What percentage of the people bought the product before seeing the ad ($t = 0$)?
 (b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?
 (c) Find the rate of change $P'(t)$.
 (d) Sketch a graph of the function.

19. (a) _____

(b) _____

(c) _____

(d)



20. In 2010, a best-selling author signed a contract paying her \$250,000 in 2015. Find the present value of that amount in 2010, assuming 4.7% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 400e^{-0.3x}.$$

- (a) Find the elasticity.
 (b) Find the elasticity at $x = 6$, and state whether the demand is elastic or inelastic.
 (c) Find the elasticity $x = 3$, and state whether the demand is elastic or inelastic.
 (d) At a price of \$6, will a small increase in price cause the total revenue to increase or decrease?
 (e) Find the price for which the total revenue is a maximum.

21. (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____

22. Differentiate: $y = 5x(\ln x)^2 - 10x \ln x + 10x$.

22. _____

23. Find the maximum and minimum values of $f(x) = x^5 e^{-x}$ over $[0, 10]$

23. _____

24. Find $\lim_{x \rightarrow 0} \frac{e^{-5x} - e^{5x}}{e^{-5x} + e^{5x}}$.

24. _____

25. *Finance: health insurance premiums.* The average annual premium for family coverage for an employer-sponsored health insurance plan has been increasing exponentially. Data in the table shows costs for years after 2000.

| Years, t after 2000 | Annual premium, in dollars |
|-----------------------|----------------------------|
| 0 | 6438 |
| 2 | 8003 |
| 3 | 9068 |
| 5 | 10,880 |
| 7 | 12,106 |
| 9 | 13,375 |

(Source: Kaiser Family Foundation; Health Research & Educational Trust http://www.usatoday.com/money/industries/health/2009-09-15-insurance-costs_N.htm)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 2000.
 (b) Estimate the annual premium for this coverage in 2012 and 2015.
 (c) After what amount of time will the premium be \$30,000?
 (d) What is the doubling time of the annual premium for this type of coverage?

25. (a) _____
 (b) _____
 (c) _____
 (d) _____

Chapter 3, Form D**Differentiate.**

1. $y = 6e^{5x}$

1. _____

2. $y = (\ln x)^8$

2. _____

3. $f(x) = e^{-5x^2}$

3. _____

4. $f(x) = \ln \frac{5x}{7}$

4. _____

5. $f(x) = e^x + 3x^4$

5. _____

6. $f(x) = 7e^x \ln x$

6. _____

7. $y = 19^x - 6^x$

7. _____

8. $y = \log_{18} x$

8. _____

Given $\log_b 6 = 1.2925$ and $\log_b 8 = 1.5000$, find each of the following.

9. $\log_b 48$

9. _____

10. $\log_b 2$

10. _____

11. $\log_b \frac{1}{8}$

11. _____

12. Find the function that satisfies $dQ/dt = 8Q$, with $Q(0) = 2$. 12. _____

13. The doubling time of a certain bacteria culture is 10 hr. What is the growth rate? Round to the nearest tenth of a percent. 13. _____

14. *Business: interest compounded continuously.* An investment is made at 6.237% per year, compounded continuously. What is the doubling time? Round to the nearest tenth of a year. 14. _____

15. *Business: cost of ketchup.* The cost C of a bottle of ketchup was \$1.21 in 2004. In 2010 the cost was \$1.43. Assuming the exponential-growth model applies:

(a) Find the exponential-growth rate to the nearest ten of a percent, and write the equation. 15. (a) _____

(b) Find the cost of a bottle of ketchup in 2012 and 2018. (b) _____

16. *Life Science: bacterial population.* After beginning antiseptic treatment, the number of bacteria in a population decreases at the rate of 30% per day, that is

$$\frac{dN}{dt} = -0.30N,$$

where N is the number of bacteria and t is the time, in days.

(a) When $t = 0$, there are 150,000 bacteria present. Find a function that satisfies the equation. 16. (a) _____

(b) How many bacteria will remain after 5 days? (b) _____

(c) After how long do half of the original bacteria remain? (c) _____

17. *Life Science: decay rate.* The decay rate of iodine-131 is 8.6% per day. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of polonium-214 is 20 minutes. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: Effect of Advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function

$$P(t) = \frac{100}{1 + 60e^{-0.28t}}.$$

(a) What percentage of the people bought the product before seeing the ad ($t = 0$)?

19. (a) _____

(b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?

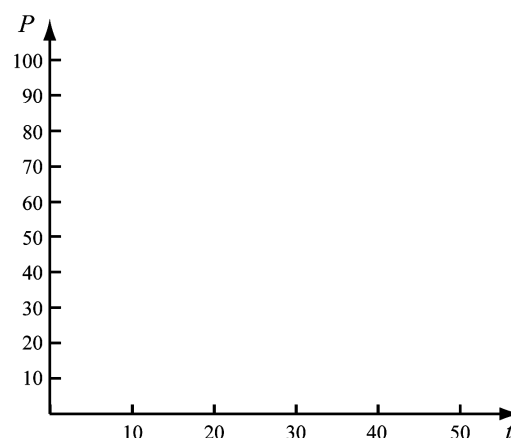
(b) _____

(c) Find the rate of change $P'(t)$.

(c) _____

(d) Sketch a graph of the function.

(d)



20. In 2010, a talk-show host signed a contract paying him \$21 million in 2017. Find the present value of that amount in 2010, assuming 3.8% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 500e^{-0.1x}.$$

- (a) Find the elasticity.
 (b) Find the elasticity at $x = 8$, and state whether the demand is elastic or inelastic.
 (c) Find the elasticity $x = 15$, and state whether the demand is elastic or inelastic.
 (d) At a price of \$8, will a small increase in price cause the total revenue to increase or decrease?
 (e) Find the price for which the total revenue is a maximum.

21. (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____

22. Differentiate: $y = 2x(\ln x)^2 - 4x \ln x + 4x$.

22. _____

23. Find the maximum and minimum values of $f(x) = x^2 e^{-x}$ over $[0, 10]$.

23. _____

24. Find $\lim_{x \rightarrow 0} \frac{e^{2x} - e^{-2x}}{e^{2x} + e^{-2x}}$.

24. _____

25. *Education: total fall enrollment in college.* The number of students enrolling in degree-granting institutions has been increasing exponentially. Data in the table shows the number of undergraduate students (in thousands) for years after 2000.

| Years, t after 2000 | Number of undergraduate students, in thousands |
|-----------------------|--|
| 0 | 13,155 |
| 1 | 13,716 |
| 3 | 14,480 |
| 4 | 14,781 |
| 6 | 15,184 |
| 7 | 15,604 |

(Source: <http://nces.ed.gov/fastfacts/display.asp?id=98>)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 2000.
 (b) Estimate the number of undergraduate students (in thousands) enrolling in college 2012 and 2015.
 (c) After what amount of time will the undergraduate enrollment (in thousands) be 25,000?
 (d) What is the doubling time for the number of undergraduate student enrollment (in thousands)?

25. (a) _____
 (b) _____
 (c) _____
 (d) _____

Chapter 3, Form E**Differentiate.**

1. $y = 2e^{8x}$

1. _____

2. $y = (\ln x)^6$

2. _____

3. $f(x) = e^{-x^3}$

3. _____

4. $f(x) = \ln \frac{x}{8}$

4. _____

5. $f(x) = e^x - 7x^3$

5. _____

6. $f(x) = 5e^x \ln x$

6. _____

7. $y = 11^x + 2^x$

7. _____

8. $y = \log_3 x$

8. _____

Given $\log_b 6 = 1.2925$ and $\log_b 12 = 1.7925$, find each of the following.

9. $\log_b 36$

9. _____

10. $\log_b 2$

10. _____

11. $\log_b 72$

11. _____

12. Find the function that satisfies $dS/dt = 7S$, with $S(0) = 2$. 12. _____
13. The doubling time of a certain bacteria culture is 20 hr. What is the growth rate? Round to the nearest tenth of a percent. 13. _____
14. *Business: interest compounded continuously.* An investment is made at 5.500% per year, compounded continuously. What is the doubling time? Round to the nearest tenth of a year. 14. _____
15. *Business: cost of sliced bread.* The cost C of a loaf of sliced bread was \$1.74 in 2004. In 2010 the cost was \$2.18. Assuming the exponential-growth model applies:
- (a) Find the exponential-growth rate to the nearest tenth of a percent, and write the equation. 15. (a) _____
- (b) Find the cost of a loaf of sliced bread in 2012 and 2018. (b) _____
16. *Life Science: drug dosage.* A dose of a drug is injected into the body of a patient. The drug amount in the body decreases at the rate of 15% per hour, that is,
- $$\frac{dA}{dt} = -0.15A,$$
- where A is the amount in the body and t is the time, in hours.
- (a) A dose of 3 cubic centimeters (cc) is administered. Assuming $A_0 = 3$, find the function that satisfies the equation. 16. (a) _____
- (b) How much of the initial dose of 3 cc will remain after 12 hr? (b) _____
- (c) After how long does half of the original dose remain? (c) _____

17. *Life Science: decay rate.* The decay rate of hydrogen-3 is 5.6% per year. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of protactinium-234 is 24 days. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: effect of advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function:

$$P(t) = \frac{100}{1 + 20e^{-0.15t}}.$$

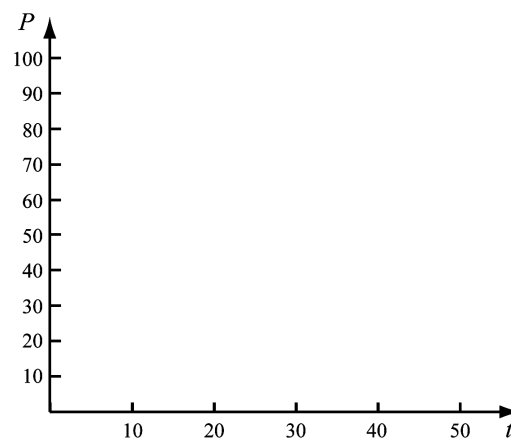
- (a) What percentage of the people bought the product before seeing the ad ($t = 0$)?
- (b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?
- (c) Find the rate of change $P'(t)$.
- (d) Sketch a graph of the function.

19. (a) _____

(b) _____

(c) _____

(d)



20. In 2010, a late-night comedian signed a contract paying him \$3.5 million in 2016. Find the present value of that amount in 2010, assuming 3.8% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 350e^{-0.4x}.$$

- (a) Find the elasticity.
 (b) Find the elasticity at $x = 2$, and state whether the demand is elastic or inelastic.
 (c) Find the elasticity $x = 5$, and state whether the demand is elastic or inelastic.
 (d) At a price of \$2, will a small increase in price cause the total revenue to increase or decrease?
 (e) Find the price for which the total revenue is a maximum.

21. (a) _____

(b) _____

(c) _____

(d) _____

(e) _____

22. Differentiate: $y = 7x(\ln x)^2 - 14x \ln x + 14$.

22. _____

23. Find the maximum and minimum values of $f(x) = x^2 e^{-2x}$ over $[0, 5]$.

23. _____

24. Find $\lim_{x \rightarrow 0} \frac{e^{3x} - e^{-3x}}{e^{3x} + e^{-3x}}$.

24. _____

25. *Government: salaries of members of congress.* The annual salaries of members of congress have been increasing exponentially. Data in the table shows the salaries for years after 2000.

| Years, t after 2000 | Annual salary, in dollars |
|-----------------------|---------------------------|
| 0 | 141,300 |
| 2 | 150,000 |
| 4 | 158,100 |
| 5 | 162,100 |
| 6 | 165,200 |
| 8 | 169,300 |

(Source: <http://www.senate.gov/reference/resources/pdf/97-1011.pdf>)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 2000.
 (b) Estimate the annual salaries for members of congress in 2012 and 2015.
 (c) After what amount of time will the annual salary be 250,000?
 (d) What is the doubling time for the salary of a member of congress?

25. (a) _____

(b) _____

(c) _____

(d) _____

Chapter 3, Form F**Differentiate.**

1. $y = 6e^{4x}$

1. _____

2. $y = (\ln x)^3$

2. _____

3. $y = e^{-x^4}$

3. _____

4. $f(x) = \ln \frac{3x}{4}$

4. _____

5. $f(x) = e^x - 8x^4$

5. _____

6. $f(x) = 10e^x \ln x$

6. _____

7. $y = 2^x + 5^x$

7. _____

8. $y = \log_{21} x$

8. _____

Given $\log_b 6 = 1.2925$ and $\log_b 10 = 1.6610$, find each of the following.

9. $\log_b \frac{1}{6}$

9. _____

10. $\log_b 60$

10. _____

11. $\log_b 100$

11. _____

12. Find the function that satisfies $dN/dt = 5N$, with $N(0) = 2$. 12. _____

13. The doubling time of a certain bacteria culture is 7 hr. What is the growth rate? Round to the nearest tenth of a percent. 13. _____

14. *Business: interest compounded continuously.* An investment is made at 3.780% per year, compounded continuously. What is the doubling time? Round to the nearest tenth of a year. 14. _____

15. *Business: cost of tuna.* The cost C of a can of tuna in 2004 was \$1.29. In 2010 the cost was \$1.87. Assuming the exponential-growth model applies:
- (a) Find the exponential-growth rate to the nearest tenth of a percent, and write the equation. 15. (a) _____
- (b) Find the cost of a can of tuna in 2012 and 2018. (b) _____

16. *Life Science: drug dosage.* A dose of a drug is injected into the body of a patient. The drug amount in the body decrease at a rate of 55% per hour, that is,

$$\frac{dA}{dt} = -0.55A,$$

where A is the amount in the body and t is the time, in hours.

- (a) A dose of 7 cubic centimeters (cc) is administered. Assuming $A_0 = 7$, find the function that satisfies the equation. 16. (a) _____
- (b) How much of the initial dose of 7 cc will remain after 4 hr? (b) _____
- (c) After how long does half of the original dose remain? (c) _____

17. *Life Science: decay rate.* The decay rate of krypton-85 is 6.3% per year. What is its half-life?

17. _____

18. *Life Science: half-life.* The half-life of phosphorus-32 is 8.1 days. What is its decay rate? Express the rate as a percentage rounded to four decimal places.

18. _____

19. *Business: effect of advertising.* A company introduces a new product on a trial run in a city. They advertised the product on television and found the percentage P of people who bought the product after t ads had run satisfied the function

$$P(t) = \frac{100}{1 + 20e^{-0.25t}}.$$

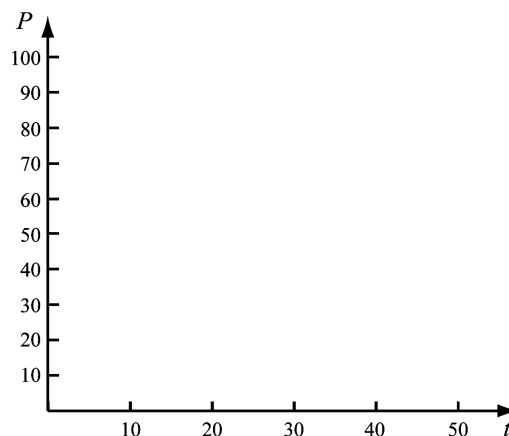
- (a) What percentage of the people bought the product before seeing the ad ($t = 0$)?
- (b) What percentage bought the product after the ad has been run 1 time, 5 times, 20 times?
- (c) Find the rate of change $P'(t)$.
- (d) Sketch a graph of the function.

19. (a) _____

(b) _____

(c) _____

(d) _____



20. In 2010, a new hire is given a contract for a \$10,000 bonus to be paid in 2012. Find the present value of that amount in 2010, assuming 4.5% interest, compounded continuously.

20. _____

21. *Economics: elasticity of demand.* Consider the demand function

$$q = D(x) = 150e^{-0.25x}.$$

- (a) Find the elasticity.
 (b) Find the elasticity at $x = 6$, and state whether the demand is elastic or inelastic.
 (c) Find the elasticity $x = 3$, and state whether the demand is elastic or inelastic.
 (d) At a price of \$6, will a small increase in price cause the total revenue to increase or decrease?
 (e) Find the price for which the total revenue is a maximum.

21. (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____

22. Differentiate: $y = 6x(\ln x)^2 - 12x \ln x + 12x$.

23. Find the maximum and minimum values of $f(x) = 4x^2e^{-2x}$ over $[0, 10]$.

22. _____

23. _____

24. Find $\lim_{x \rightarrow 0} \frac{e^{3x} - e^{-x}}{e^{3x} + e^{-x}}$.

24. _____

25. *Finance: health insurance premiums.* The average annual premium for single coverage for an employer-sponsored health insurance plan has been increasing exponentially. Data in the table shows for years after 2000.

| Years, t after 2000 | Annual premium, dollars |
|-----------------------|-------------------------|
| 0 | 2471 |
| 1 | 2689 |
| 4 | 3695 |
| 5 | 4024 |
| 7 | 4479 |
| 9 | 4824 |

(Source: Kaiser Family Foundation; Health Research & Educational Trust http://www.usatoday.com/money/industries/health/2009-09-15-insurance-costs_N.htm)

- (a) Use REGRESSION to fit an exponential function $y = a \cdot b^x$ to the data. Then convert that formula to an exponential function, base e , where t is the number of years after 2000.
 (b) Estimate the annual premium for this coverage in 2012 and 2015.
 (c) After what amount of time will the premium be \$8,000?
 (d) What is the doubling time of the annual premium for this type of coverage?

25. (a) _____
 (b) _____
 (c) _____
 (d) _____