

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**Determine the growth constant  $k$ , then find all solutions of the differential equation.

1)  $y' = 0.4y$  1) \_\_\_\_\_  
 A)  $k = 0.4, y = Ce^{0.4t}$  B)  $k = 0.4, y = 0.4e^t$   
 C)  $k = 0.4, y = Ce^{0.4}$  D)  $k = 0.4, y = Ce^t$

2)  $y' = \frac{y}{4}$  2) \_\_\_\_\_  
 A)  $k = \frac{1}{4}, y = Ce^{4t}$  B)  $k = 4, y = Ce^{4t}$   
 C)  $k = \frac{1}{4}, y = Ce^{(1/4)t}$  D)  $k = \frac{1}{4}, y = Ce^{1/4}$

3)  $y' - 8y = 0$  3) \_\_\_\_\_  
 A)  $k = 8, y = 8e^t$  B)  $k = -8, y = Ce^{-8t}$   
 C)  $k = -8, y = -8e^t$  D)  $k = 8, y = Ce^{8t}$

4)  $3y' - \frac{y}{4} = 0$  4) \_\_\_\_\_  
 A)  $k = \frac{1}{12}, y = Ce^{(1/12)t}$  B)  $k = 12, y = Ce^{12t}$   
 C)  $k = \frac{3}{4}, y = Ce^{(3/4)t}$  D)  $k = -\frac{1}{12}, y = Ce^{(-1/12)t}$

5)  $\frac{y}{3} = 3y'$  5) \_\_\_\_\_  
 A)  $k = 9, y = Ce^{9t}$  B)  $k = 1, y = Ce^t$   
 C)  $k = \frac{1}{9}, y = Ce^{(1/9)t}$  D)  $k = \frac{1}{3}, y = Ce^{(1/3)t}$

6)  $6y' - 5y = 0$  6) \_\_\_\_\_  
 A)  $k = \frac{6}{5}, y = Ce^{(6/5)t}$  B)  $k = 30, y = Ce^{30t}$   
 C)  $k = \frac{1}{30}, y = Ce^{(1/30)t}$  D)  $k = \frac{5}{6}, y = Ce^{(5/6)t}$

7) Which of the following functions satisfy the differential equation  $y' = -8y$ ?

7) \_\_\_\_\_

- (I)  $y = -e^{-8x}$
- (II)  $y = e^{-4x} + 3$
- (III)  $y = 5e^{-4x}$
- (IV)  $y = 6e^{-8x}$
- A) II and III
- B) III only
- C) II only
- D) I and IV
- E) none of these

8) Which of the following functions  $y = f(x)$  satisfy  $y' = 32y$ ,  $f(0) = \frac{1}{2}$ ?

8) \_\_\_\_\_

- (I)  $y = 32e^{1/2x}$
- (II)  $y = e^{16x}$
- (III)  $y = \frac{1}{2}e^{32x}$
- (IV)  $y = \frac{1}{2}x^{32}$
- A) I and II
- B) I only
- C) IV only
- D) III only
- E) none of these

9) Which of the following functions  $y = f(x)$  satisfy  $y' = -\frac{2}{3}y$ ,  $f(1) = 1$ ?

9) \_\_\_\_\_

- (I)  $y = e^x$
- (II)  $y = e^{-2/3x}$
- (III)  $y = e^{(-2/3)(x-1)}$
- (IV)  $y = -\frac{2}{3}e^x$
- A) II only
- B) IV only
- C) III only
- D) I and II
- E) none of these

10) Determine a function  $y = f(x)$  such that  $y' = \frac{1}{10}y$  and  $f(0) = -3$ ? 10) \_\_\_\_\_

A)  $y = \frac{1}{20}y^2 - 3$

B)  $y = \frac{1}{10}e^{-3x}$

C)  $y = -3e^{(1/10)x}$

D)  $y = e^{(1/10)y} - 3$

E) none of these

Solve the differential equation with initial condition.

11)  $y' = 4y$ ,  $y(0) = 0$  11) \_\_\_\_\_

A)  $y = 1$

B)  $y = e^{(1/4)t}$

C)  $y = e^{4t}$

D)  $y = 0$

12)  $y' = 5y$ ,  $y(0) = 4$  12) \_\_\_\_\_

A)  $y = 4e^{(1/5)t}$

B)  $y = 4e^{5t}$

C)  $y = 5e^{4t}$

D)  $y = e^{20t}$

13)  $y' - \frac{y}{5} = 0$ ,  $y(0) = 3$  13) \_\_\_\_\_

A)  $y = 5e^{(1/3)t}$

B)  $y = 3e^{5t}$

C)  $y = 5e^{3t}$

D)  $y = 3e^{(1/5)t}$

14)  $5y = 4y'$ ,  $y(0) = 11$  14) \_\_\_\_\_

A)  $y = 11e^{20t}$

B)  $y = 11e^{(5/4)t}$

C)  $y = 11e^{(4/5)t}$

D)  $y = 11e^{(-5/4)t}$

Solve the problem.

15) In a certain country, the rate of increase of the population is proportional to the population  $P(t)$ . In fact,  $P'(t) = 0.23P(t)$ . Suppose that initially the country's population is 50,000, and that 10 years later there are 500,000 people. Which of the following equations expresses this information mathematically? 15) \_\_\_\_\_

A)  $500,000 = 50,000e^{2.3}$

B)  $10 = e^{2.3t}$

C)  $500,000 = e^{0.23(10)}$

D)  $500 = e^{2.3(50)}$

E) none of these

16) A bacterial culture grows exponentially; that is,  $P(t) = 100e^{kt}$ , where  $P(t)$  is the size of the culture at time  $t$  hours. Suppose that after 2 hours the size of the culture is 400. What is  $k$  (approximately)? 16) \_\_\_\_\_

A) 0.06

B) 3

C) 0.48

D) 0.69

E) none of these

- 17) The size of an insect colony  $t$  days after its formation is  $P(t) = 1000e^{0.2t}$ . Approximately how many insects are present after 10 days? 17) \_\_\_\_\_
- A) 54,598  
B) 6900  
C) 7389  
D) 690  
E) none of these
- 18) The population of a colony of bacteria triples in 3 days. Assuming that the rate of growth is proportional to the size of the population, how long did it take for the colony to double in size? 18) \_\_\_\_\_
- A) 6 days  
B) 2 days  
C) 1.9 days  
D) 4.9 days  
E) none of these
- 19) A country has a population of 287 million in 2005. Assuming a growth rate of 1.3%, determine the function that expresses the population of the country  $t$  years after 2005. 19) \_\_\_\_\_
- A)  $P(t) = 287e^{0.13t}$   
B)  $P(t) = 287e^{-1.3t}$   
C)  $P(t) = 287e^{-0.13t}$   
D)  $P(t) = 287e^{1.3t}$   
E) none of these

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 20) A colony of bacteria is growing at a rate proportional to the number of bacteria present. At the beginning of an experiment there were about  $10^3$  bacteria present. In two hours, the count rose to  $3 \times 10^3$  bacteria. At what time will there be  $6 \times 10^3$  bacteria present? Enter just a real number rounded up to one decimal place (no units). 20) \_\_\_\_\_
- 21) Suppose that a school of fish in a pond grows according to the exponential law  $P(t) = P_0 e^{kt}$  and suppose that the size of the colony triples in 24 days. Determine  $k$ . Enter your answer exactly in the form  $\frac{\ln a}{b}$  where  $a, b$  are integers. 21) \_\_\_\_\_
- 22) Suppose that a school of fish in a pond grows according to the exponential law  $P(t) = P_0 e^{kt}$  and suppose that the size of the colony triples in 24 days. If the initial size of the school was 50, when will the school contain 200 fish? Enter your answer exactly in the form  $\frac{a \ln b}{\ln c}$ . 22) \_\_\_\_\_

- 23) Suppose that at any time  $t$ , a colony of fruit flies is growing at a rate equal to one half the current size of the colony. Find a formula which gives the size of the colony at time  $t$  if there were originally 500 fruit flies present. 23) \_\_\_\_\_  
Enter your answer exactly in the form:  $P(t) = ae^{bt}$
- 24) Assume that a culture of bacteria grows at a rate proportional to its size such that if  $10^6$  bacteria are present initially, then there are  $2 \times 10^6$  bacteria present after 3 hours. Determine a formula for the number of bacteria present after  $t$  hours in terms of powers of 2. (Hint: Recall that  $b^x = e^{(\ln b)x}$ .) 24) \_\_\_\_\_  
Enter your answer exactly in the form  $P(x) = a \cdot 2^{c/d}$ .
- 25) The population of a certain region was 10 million in 1950. By 1970, it had increased to 13.5 million. Assuming exponential growth, estimate the population in the year 2000. 25) \_\_\_\_\_  
Enter your answer exactly in the form  $ae^C$  (no units).

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 26) If a population has a growth rate of 6% per year, how long to the nearest tenth of a year will it take the population to double? 26) \_\_\_\_\_  
A) 1.2 years      B) 12.3 years      C) 11.6 years      D) 0.1 years
- 27) Initially, a population of rabbits was found to contain 169 rabbits. It was estimated that the population was growing exponentially at the rate of 9% per day. Estimate the population after 59 days. 27) \_\_\_\_\_  
A) 2874      B) 270      C) 34,197      D) 202
- 28) Initially, a population of rabbits was found to contain 110 rabbits. It was estimated that the population was growing exponentially at the rate of 9% per day. How long, to the nearest tenth of a day, will it take the population to double? 28) \_\_\_\_\_  
A) 77 days      B) 0.1 days      C) 16.9 days      D) 7.7 days
- 29) Sixteen pounds of a radioactive substance loses one fourth of its original mass in 2 days. The mass  $m(t)$  remaining at time  $t$  is given by: 29) \_\_\_\_\_  
A)  $m(t) = 16e^{-0.693t}$       B)  $m(t) = 4e^{-0.693t}$   
C)  $m(t) = 16e^{0.693t}$       D)  $m(t) = 16e^{0.144t}$

- 30) Let  $P(t)$  be the quantity of strontium-90 remaining after  $t$  years. Suppose the half-life of strontium-90 is 28 years. Which of the following equations expresses the half-life information? 30) \_\_\_\_\_
- A)  $28 = \frac{1}{2}P_0e^{-kt}$
- B)  $P\frac{1}{2} = 28P_0$
- C)  $P(28) = \frac{1}{2}P_0$
- D)  $28 = \frac{1}{2}P_0$
- E) none of these
- 31) A radioactive substance is observed to disintegrate at a rate such that  $\frac{9}{10}$  of the original amount remains after one year. What is the half-life of the substance? 31) \_\_\_\_\_
- A) 6.579 yr      B) 0.588 yr      C) 0.301 yr      D) 0.556 yr
- 32) A certain radioactive substance is decaying at a rate proportional to the amount present. If 100 grams decays to 13.5 grams in 4 years, how long will it take for 90 grams to decay to 30 grams? 32) \_\_\_\_\_
- A) 2.405 yr      B) 0.501 yr
- C) 2.195 yr      D) Problem cannot be solved as stated.
- 33) Radioactive carbon 11 has a half-life of 20 minutes. If there are 200 grams present at the start of our experiment, how many grams will remain after 10 minutes? 33) \_\_\_\_\_
- A) 141.421 g      B) 6.931 g      C) 100 g      D) 50 g
- 34) A certain radioactive element has a half-life of 12 minutes. At what time is the substance decaying at a rate of 3.466 grams per minute if there are 120 grams present initially? 34) \_\_\_\_\_
- A)  $t = 12$  min      B)  $t = 0$       C)  $t = 0.693$  min      D)  $t = 0.058$  min
- 35) Plutonium has a decay rate of 0.003% per year. What is the half life? 35) \_\_\_\_\_
- A) 23,100 years      B) 1630 years      C) 33,000 years      D) 2310 years
- 36)  $^{14}\text{C}$  has a half life of 5730 years. How old is a piece of charcoal which has lost 90% of its  $^{14}\text{C}$  ? 36) \_\_\_\_\_
- A) 20,000 years
- B) 19,109 years
- C) 9100 years
- D) 11,109 years
- E) none of these

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 37) A parchment is offered for sale at a Paris flea market. The owner claims it is at least 2000 years old. However, a carbon-dating test shows that  $^{14}\text{C}$  -  $^{12}\text{C}$  ratio for the manuscript is 95% of the corresponding ratio for currently manufactured parchment. How old is the manuscript? (The decay constant of  $^{14}\text{C}$  is 0.00012) 37) \_\_\_\_\_  
 Enter your answer exactly in the form  $\frac{\ln a}{b}$  (no units).
- 38) Potassium has a half-life of 12 hours. How long will it take for a quantity of potassium to decay to  $\frac{1}{10}$  its original size? 38) \_\_\_\_\_  
 Enter your answer as a real number rounded to one decimal place (no units).
- 39) Barium 140 has a half-life of 13 days. After 25 days a given sample comprises 5 grams. How large was the original sample? 39) \_\_\_\_\_  
 Enter your answer as a real number to two decimal places (no units).
- 40) Plutonium 239 has a half-life of 24,000 years. What is its decay constant? 40) \_\_\_\_\_  
 Enter your answer as just a real number to eight decimal places.
- 41) Krypton 85 gas leaks into the reactor room of an electric power plant. Its half-life is 10 years. How long is it before 99.9% of the krypton decays? 41) \_\_\_\_\_  
 Enter your answer as just a real number rounded to one decimal place (no units).
- 42) It is observed that the sales of a certain recording fall to 75% of their original level one month after advertising stops. If this continues, what will be the sales after 4 months? 42) \_\_\_\_\_  
 Enter just a real number rounded to one decimal place (no units or symbols).
- 43) The decay constant for strontium 90 is  $\lambda = 0.0244$ , where the time is measured in years. How long will it take for a quantity  $P_0$  of strontium 90 to decay to  $\frac{1}{3}$  its original size? 43) \_\_\_\_\_  
 Enter your answer exactly in the form  $\frac{\ln a}{b}$  where a is a reduced fraction and b is a real number to four decimal places (no units).
- 44) Carbon 14 has a half-life of 5730 years. Determine its decay constant. 44) \_\_\_\_\_  
 Enter just a real number rounded to five decimal places.
- 45) A fossil was discovered that had about 70% of the  $^{14}\text{C}$  level found today in living matter. Given that the decay constant for  $^{14}\text{C}$  is 0.00012, determine the age of the fossil. 45) \_\_\_\_\_  
 Enter your answer exactly as just  $\frac{\ln a}{b}$  where a is a real number to one decimal place and b is a real number to 5 decimal places.

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- 46) The decay of 372 mg of an isotope is given by  $A(t) = 372e^{-0.016t}$ , where  $t$  is time in years. Find the amount left after 96 years. 46) \_\_\_\_\_

A) 79 mg                      B) 80 mg                      C) 40 mg                      D) 366 mg

- 47) In a chemical reaction, substance A decomposes at a rate proportional to the amount of A present. It is found that 8 g of A will reduce to 4 g in 4.7 hours. After how long will there be only 1 g left? 47) \_\_\_\_\_

A) 10.7 hours                      B) 14.1 hours                      C) 9.4 hours                      D) 19.1 hours

- 48) The initial weight of a starving animal is  $W_0$ . Its weight after  $t$  days is given by 48) \_\_\_\_\_

$$W = W_0 e^{-0.005t}.$$

What percentage of its initial weight remains after 36 days?

A) 83.5%                      B) 86.9%                      C) 78.5%                      D) 16.5%

- 49) \$1000 is invested at 6% interest compounded continuously. What is the value of the investment after 5 years? 49) \_\_\_\_\_

A) \$1349.86  
B) \$6691.13  
C) \$1822.12  
D) \$1338.23  
E) none of these

- 50) How long will it take for an investment to triple if interest is paid at 10%, compounded continuously? 50) \_\_\_\_\_

A) 30 years  
B) 8.6 years  
C) 11 years  
D) 3 years  
E) none of these

- 51) How much money has to be invested now at 8% continuous interest in order to have \$1000 after 5 years? 51) \_\_\_\_\_

A) \$183.20  
B) \$670.32  
C) \$461.56  
D) \$18.32  
E) none of these



- 52) A high-yield savings pays 8% interest, compounded continuously. How long would it take an initial investment of \$2500 to grow to \$12,500? 52) \_\_\_\_\_  
 A) 22.397 years  
 B) 20.118 years  
 C) 201.18 years  
 D) 2.01 years  
 E) none of these
- 53) A savings account pays 7% interest, compounded continuously. How much should be deposited now in order to have \$5000 in the account at the end of five years? 53) \_\_\_\_\_  
 A) \$3523.44                      B) \$2884.75                      C) \$533.83                      D) \$4661.97
- 54) A bank pays 2.5% interest on deposits. What is the return on a \$1000 deposit after two years if interest is compounded continuously? 54) \_\_\_\_\_  
 A) \$1648.72  
 B) \$1051.27  
 C) \$778.80  
 D) \$1284.03  
 E) none of these
- 55) What rate of interest is required in order for a \$100 investment to double in 6 years if the interest is compounded continuously? 55) \_\_\_\_\_  
 A) 1.83%  
 B) 18.3%  
 C) 8.7%  
 D) 11.6%  
 E) none of these
- 56) Eight years ago, \$2000 was deposited in a savings account paying 3% interest compounded continuously. Three years ago, \$500 was withdrawn from the account. What is the current value of the account? 56) \_\_\_\_\_  
 A) \$3964.93                      B) \$4319.08                      C) \$1995.41                      D) \$2042.50
- 57) \$1,000 is invested at  $r\%$  interest continuously compounded. After 6 years the account has reached \$1350. What was the interest rate? 57) \_\_\_\_\_  
 A) 4.8%                      B) 5.3%                      C) 5%                      D) 6%
- 58) You deposit \$500 in a savings account paying 4% interest continuously compounded. How much will the account be worth after 32 months? 58) \_\_\_\_\_  
 A) \$526.10                      B) \$576.70                      C) \$545.20                      D) \$556.20
- 59) If an investment doubles in 5 years continuously compounded, how long will it take for the investment to triple? 59) \_\_\_\_\_  
 A) 7.5 years                      B) 7.93 years                      C) 7 years                      D) 10 years

- 60) A high school student deposits a \$500 graduation gift in a bank account that pays 4.8% interest compounded continuously. How much will the account be worth after 18 months? 60) \_\_\_\_\_
- A) \$973.71  
 B) \$1027.22  
 C) \$1123.95  
 D) \$1162.71  
 E) none of these

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 61) What rate of interest will make an investment triple in 8 years if the interest is compounded continuously? Enter your answer as a percent to one decimal place (no % symbol or words). 61) \_\_\_\_\_
- 62) Suppose that \$500 is deposited in a bank certificate paying 10% interest compounded continuously. How much will the certificate be worth after 5 years? Enter your answer in dollars to two decimal places (no symbols or words). 62) \_\_\_\_\_
- 63) Mr. Jones has two investments. The first is currently worth \$50,000 and has an annual yield of 10% compounded continuously. The second is currently worth \$70,000 and has an annual yield of 8% compounded continuously. After how many years will the two investments be worth the same amount? Enter your answer in years to one decimal place (no units). 63) \_\_\_\_\_
- 64) How long is required for an investment of \$2000 to double if the interest is 10% compounded continuously? Enter your answer in years to one decimal place (no units). 64) \_\_\_\_\_

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

Solve the problem.

- 65) Find the amount of time required for a \$26,000 investment to double if the annual interest rate  $r$  is 3.8% and interest is compounded continuously. Round your answer to the nearest hundredth of a year. 65) \_\_\_\_\_
- A) 2.68 years                      B) 267.52 years                      C) 18.24 years                      D) 285.76 years
- 66) What will be the amount in an account with initial principal \$5000 if interest is compounded continuously at an annual rate of 4.25% for 7 years? 66) \_\_\_\_\_
- A) \$6732.44                      B) \$5217.08                      C) \$5000.00                      D) \$2173.43
- 67) How long would it take \$8000 to grow to \$32,000 at 5% compounded continuously? Round your answer to the nearest tenth of a year. 67) \_\_\_\_\_
- A) 28.6 years                      B) 28.0 years                      C) 27.7 years                      D) 35.0 years

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 68) What is the present value of an investment of \$1000 payable at the end of 10 years at a 9% rate of interest compounded continuously? Enter your answer in dollars to two decimal places (no symbols or words). 68) \_\_\_\_\_

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 69) A savings account paying 3% continuously compounded interest has \$1600 after 8 years. How much was initially deposited? 69) \_\_\_\_\_  
 A) \$1020 B) \$1159 C) \$1259 D) \$630

Solve the problem.

- 70) After 3 years of continuous compounding at 12.6% the amount in an account is \$11,100. What was the amount of the initial deposit? 70) \_\_\_\_\_  
 A) \$15,088.92 B) \$16,198.92 C) \$7606.06 D) \$6496.06

- 71) Determine the percentage rate of change of  $f(x) = e^{0.9x}$  at  $x = 15$  and  $x = 30$ . 71) \_\_\_\_\_  
 A)  $\frac{f'(15)}{f(15)} = 38\%$ ,  $\frac{f'(30)}{f(30)} = 14\%$  B)  $\frac{f'(15)}{f(15)} = 17\%$ ,  $\frac{f'(30)}{f(30)} = 29\%$   
 C)  $\frac{f'(15)}{f(15)} = 90\%$ ,  $\frac{f'(30)}{f(30)} = 90\%$  D)  $\frac{f'(15)}{f(15)} = 22\%$ ,  $\frac{f'(30)}{f(30)} = 5\%$

- 72) Determine the percentage rate of change of  $F(t) = e^{-0.09t^2}$  at  $t = 1$  and  $t = 5$ . 72) \_\_\_\_\_  
 A)  $\frac{F'(1)}{F(1)} = -18\%$ ,  $\frac{F'(5)}{F(5)} = -90\%$  B)  $\frac{F'(1)}{F(1)} = 18\%$ ,  $\frac{F'(5)}{F(5)} = 90\%$   
 C)  $\frac{F'(1)}{F(1)} = 19\%$ ,  $\frac{F'(5)}{F(5)} = 70\%$  D)  $\frac{F'(1)}{F(1)} = -19\%$ ,  $\frac{F'(5)}{F(5)} = -70\%$

- 73) Determine the percentage rate of change of  $h(p) = \frac{4}{7p + 3}$  at  $p = 1$  and  $p = 9$ . 73) \_\_\_\_\_  
 A)  $\frac{h'(1)}{h(1)} = 40\%$ ,  $\frac{h'(9)}{h(9)} = 6\%$  B)  $\frac{h'(1)}{h(1)} = 70\%$ ,  $\frac{h'(9)}{h(9)} = 11\%$   
 C)  $\frac{h'(1)}{h(1)} = -70\%$ ,  $\frac{h'(9)}{h(9)} = -11\%$  D)  $\frac{h'(1)}{h(1)} = -40\%$ ,  $\frac{h'(9)}{h(9)} = -6\%$

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 74) Suppose that the value in billions of dollars of a company is determined to be  $f(t) = 0.5t + 0.2e^{-t}$  where  $t$  is measured in years. What is the percentage rate of growth of the company at time  $t = 0$ ? Enter just an integer (no units). 74) \_\_\_\_\_

75) Determine the percentage rate of change of  $f(t) = 2t^3$  at  $t = 5$ . 75) \_\_\_\_\_  
 Enter your answer as just a reduced fraction of form  $\frac{a}{b}$ .

76) Suppose that the value of a certain investment after  $t$  years can be approximated by the 76) \_\_\_\_\_  
 function  $f(t) = 100,000e^{0.12t^{2/3}}$ . What is the dollar value of the investment after 8 years?  
 Enter your answer exactly in the form:  $ae^b$  where  $a$  is an integer and  $b$  is a real number to two decimal places (no units).

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

Solve the problem.

77) An amount is invested at a certain growth rate,  $k$ , per year compounded continuously. The 77) \_\_\_\_\_  
 doubling time is 13 years. What is the growth rate  $k$ ?  
 A) 7.39% B) 6.15% C) 9.01% D) 5.33%

78) Find the doubling time for an amount invested at a growth rate 5% per year compounded 78) \_\_\_\_\_  
 continuously.  
 A) 3.5 years B) 12 years C) 13.9 years D) 7.4 years

79) For the demand function  $q = 150(245 - p^2)$ , find  $E(p)$  and determine if the demand is elastic or 79) \_\_\_\_\_  
 inelastic (or neither) at the price  $p = 7$ .  
 A)  $E(p) = \frac{2p^2}{245 - p^2}$ , elastic B)  $E(p) = \frac{p^2}{245 - p^2}$ , inelastic  
 C)  $E(p) = \frac{2p^2}{245 - p^2}$ , inelastic D)  $E(p) = \frac{p^2}{245 - p^2}$ , elastic

80) For the demand function  $q = p^2e^{-(p+7)}$ , find  $E(p)$  and determine if the demand is elastic or 80) \_\_\_\_\_  
 inelastic (or neither) at the price  $p = 5$ .  
 A)  $E(p) = 2 - p$ , elastic B)  $E(p) = p - 2$ , inelastic  
 C)  $E(p) = 2 - p$ , inelastic D)  $E(p) = p - 2$ , elastic

For the demand function given, find  $E(p)$  and determine if demand is elastic or inelastic (or neither) at the indicated price.

81)  $q = 400 - p$ ;  $p = 48$  81) \_\_\_\_\_  
 A)  $E(48) = \frac{3}{22}$ ; inelastic B)  $E(48) = \frac{3}{22}$ ; elastic  
 C)  $E(48) = 352$ ; elastic D)  $E(48) = \frac{1}{352}$ ; inelastic

- 82)  $q = 800 - 8p$ ;  $p = 53$  82) \_\_\_\_\_  
 A)  $E(53) = \frac{47}{53}$ ; inelastic B)  $E(53) = \frac{53}{47}$ ; elastic  
 C)  $E(53) = \frac{1}{47}$ ; inelastic D)  $E(53) = 376$ ; elastic
- 83)  $q = 200e^{-0.09p}$ ;  $p = 11$  83) \_\_\_\_\_  
 A)  $E(11) = 0.09$ ; inelastic B)  $E(11) = \frac{1100}{9}$ ; elastic  
 C)  $E(11) = 0.99$ ; inelastic D)  $E(11) = 1$ ; neither

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 84) Suppose a manufacturer can sell  $q = \frac{1000}{(p+2)^2} - 6$  units of a product when the price is  $p$  84) \_\_\_\_\_  
 dollars per unit. Determine the elasticity of demand,  $E(p)$ , when the price is  $p = 8$  dollars.  
 Enter just an integer.
- 85) A company has a demand function  $q = 200 - 40p$ . Determine the elasticity of demand as a 85) \_\_\_\_\_  
 function of  $p$ . Enter your answer exactly as  $\frac{P(p)}{Q(p)}$  where  $P, Q$  are polynomials in  $p$  in  
 standard form.
- 86) A manufacturer has a demand function  $q = \sqrt{100 - p^3}$ . Determine the elasticity of 86) \_\_\_\_\_  
 demand as a function of  $p$ .  
 Enter your answer exactly as  $\frac{P(p)}{Q(p)}$  where  $P, Q$  are polynomials in  $p$  in standard form, and  
 the leading coefficient of  $P$  is a reduced fraction of form  $\frac{a}{b}$ .

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

Solve the problem.

- 87) A beverage company works out a demand function for its sale of soda and finds it to be 87) \_\_\_\_\_  
 $q = D(x) = 3000 - 24x$   
 where  $q$  = the quantity of sodas sold when the price per can, in cents, is  $x$ . At what price,  $x$ , is the  
 elasticity of demand inelastic?  
 A) For  $x > 36,000$  cents B) For  $x > 250$  cents  
 C) For  $x < 125$  cents D) For  $x < 63$  cents

88) A beverage company works out a demand function for its sale of soda and finds it to be

88) \_\_\_\_\_

$$q = D(x) = 3000 - 20x,$$

where  $q$  = the quantity of sodas sold when the price per can, in cents, is  $x$ . At a price of 127 cents per can, will a small increase in price cause the total revenue to increase, decrease, or stay the same?

A) Decrease

B) Stay the same

C) Increase

89) Which of the following functions satisfy the differential equation  $y' = 3(12 - y)$ ?

89) \_\_\_\_\_

(I)  $y = 4(3 - e^{-3x})$

(II)  $y = 12(1 - e^{-3x})$

(III)  $y = 12 - e^{-3x}$

(IV)  $y = 3(1 - e^{-12x})$

A) II and III

B) I, II, and III

C) I and II

D) I and III

E) none of these

90) Let  $y = 6(1 - e^{-3x})$ . What is  $3(6 - y)$ ?

90) \_\_\_\_\_

A)  $12 - 6e^{-3x}$

B)  $3e^{-3x}$

C)  $6 - 6e^{-3x}$

D)  $18e^{-3x}$

E) none of these

91) In a town of 10,000 people, the number of people who during each day first hear the news of a local tax increase is one-tenth the number of people who have not yet heard the news. If  $f(t)$  stands for the number of informed people in the town, what is the differential equation  $f(t)$  satisfies?

91) \_\_\_\_\_

A)  $f'(t) = \frac{1}{10}(10,000 - f(t))$

B)  $f(t) = \frac{10f'(t)}{10,000}$

C)  $f'(t) + \frac{1}{10}f(t) = 10,000$

D)  $f'(t) = \frac{1}{10}f(t)$

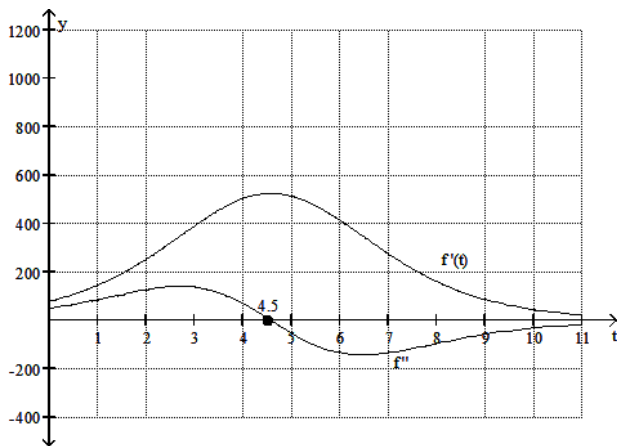
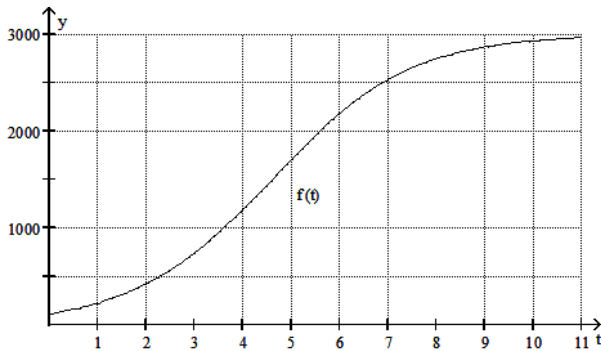
E) none of these

- 92) Let  $g(t) = 100 - 100e^{-0.01t}$  be the number of cases of measles in a certain school  $t$  days after the first case is reported. Which of the following best describes the spread of the disease? 92) \_\_\_\_\_
- A) After the first day there are 100 cases, after which the number of cases decreases daily to 0.  
 B) The disease spreads quickly until the number of cases reaches 100; then gradually the number of cases decreases.  
 C) The number of cases decreases according to exponential decay.  
 D) Initially, the disease spreads quickly, but then the rate of increase slows so that the number of cases never exceeds 100.  
 E) none of these
- 93) Let  $A'(t) = 0.3(25,000 - A(t))$ ,  $A(0) = 0$ . Which of the following is the formula for  $A(t)$ ? 93) \_\_\_\_\_
- A)  $A(t) = 25,000(1 - 0.3t)$   
 B)  $A(t) = 25,000e^{(1 - 0.3t)}$   
 C)  $A(t) = 25,000e^{-3t}$   
 D)  $A(t) = 25,000(1 - e^{-0.3t})$   
 E) none of these

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

- 94) If the relative rate of change of a function  $f$  is always 5, what kind of equation will  $f$  be represented by? Enter your answer in the form:  $f(t) = Ce^b$  (leave  $C$  in your answer). 94) \_\_\_\_\_
- 95) If  $y = 10(1 - e^{-2x})$  and  $y' = a - 2y$ , find  $a$ . Enter just an integer. 95) \_\_\_\_\_
- 96) If  $y = 2(1 - e^{-4x})$  and  $y' = 4 - by$ , find  $b$ . Enter just an integer. 96) \_\_\_\_\_
- 97) Find  $a$  so that  $y = 1 + e^{ax^2}$  solves the differential equation  $y' = x - xy$ . Enter just a reduced fraction of form  $\frac{a}{b}$ . 97) \_\_\_\_\_
- 98) Find  $a$  so that  $y = 1 - ae^{-x}$  solves the differential equation  $y' = y - 1 + 6e^{-x}$ . Enter just an integer. 98) \_\_\_\_\_

A rumor is spread by word of mouth to a potential audience of 3000 people. After  $t$  days,  $f(t) = \frac{3000}{1 + 25e^{-0.7t}}$  people will have heard the rumor. The graphs are shown below.



- 99) Approximately how many people will have heard the rumor after 7 days? Enter your answer as just an integer rounded to the nearest hundred. 99) \_\_\_\_\_
- 100) At approximately what rate will the rumor be spreading after 7 days? Enter just an integer rounded to the nearest hundred (no words or units). 100) \_\_\_\_\_
- 101) Approximately when will 1250 people have heard the rumor? Enter just an integer (no units). 101) \_\_\_\_\_
- 102) Approximately when will the rumor be spreading at a rate of 200 people per day? Enter just two integers  $a, b$  where  $a < b$  (round to the nearest integers). 102) \_\_\_\_\_
- 103) When will the rumor be spreading at the greatest rate? Enter just an integer (round to the nearest integer, no units) 103) \_\_\_\_\_



104) At what rate will the rumor be spreading when half of the potential audience has heard the rumor? Enter just an integer rounded to the nearest hundred (no units).

104) \_\_\_\_\_

Answer Key

Testname: UNTITLED5

- 1) A
- 2) C
- 3) D
- 4) A
- 5) C
- 6) D
- 7) D
- 8) D
- 9) C
- 10) C
- 11) D
- 12) B
- 13) D
- 14) B
- 15) A
- 16) D
- 17) C
- 18) C
- 19) A
- 20) 3.3
- 21)  $\frac{\ln 3}{24}$
- 22)  $\frac{24 \ln 4}{\ln 3}$
- 23)  $P(t) = 500e^{0.5t}$
- 24)  $P(t) = 10^6 \cdot 2^{t/3}$
- 25)  $10e^{0.75}$
- 26) C
- 27) C
- 28) D
- 29) D
- 30) C
- 31) A
- 32) C
- 33) A
- 34) A
- 35) A
- 36) B
- 37)  $\frac{\ln 95}{-0.00012}$
- 38) 39.9
- 39) 18.96
- 40) 0.00002888

Answer Key

Testname: UNTITLED5

41) 99.7

42) 31.6

43)  $\frac{\ln\left(\frac{1}{3}\right)}{-0.0244}$

44) 0.00012

45)  $\frac{\ln 0.7}{-0.00012}$

46) B

47) B

48) A

49) A

50) C

51) B

52) B

53) A

54) B

55) D

56) C

57) C

58) D

59) B

60) E

61) 13.7

62) 824.36

63) 16.8

64) 6.9

65) C

66) A

67) C

68) \$406.57

69) C

70) C

71) C

72) A

73) C

74) 150

75)  $\frac{3}{5}$

76)  $100,000e^{0.48}$

77) D

78) C

79) C

## Answer Key

Testname: UNTITLED5

80) D

81) A

82) B

83) C

84) 4

85)  $\frac{p}{-p+5}$

86)  $\frac{\frac{3}{2}p^3}{-p^3+100}$

87) D

88) A

89) B

90) D

91) A

92) D

93) D

94)  $f(t) = Ce^{5t}$

95) 20

96) -2

97)  $-\frac{1}{2}$

98) 3

99) 2500

100) 300

101) 4

102) 2, 8

103) 5

104) 500