

1. What is the best first step for solving the following equation?

$$10^x = 50$$

Choose the correct answer below.

- ☐ A. Write the sum of logarithms as the logarithm of a product.
- ☐ B. Take the common logarithm on each side.
- ☐ C. Let $u = e^x$ and write the equation in quadratic form.
- ☐ D. Use the product rule for exponents.
- ☐ E. Take the natural logarithm on each side.
- ☐ F. Change to exponential form.

2. What is the best first step for solving the following equation?

$$e^{5x-1} = 23$$

Choose the correct answer below.

- ☐ A. Take the natural logarithm on each side.
- ☐ B. Take the common logarithm on each side.
- ☐ C. Write the sum of logarithms as the logarithm of a product.
- ☐ D. Use the product rule for exponents.
- ☐ E. Change to exponential form.
- ☐ F. Let $u = e^x$ and write the equation in quadratic form.

3. What is the best first step for solving the following equation?

$$\log_7(x^2 - 10) = 19$$

Choose the correct answer below.

- ☐ A. Take the natural logarithm on each side.
- ☐ B. Take the common logarithm on each side.
- ☐ C. Let $u = e^x$ and write the equation in quadratic form.
- ☐ D. Write the sum of logarithms as the logarithm of a product.
- ☐ E. Change to exponential form.
- ☐ F. Use the product rule for exponents.

4. What is the best first step for solving the following equation?

$$e^{2x} \cdot e^x = 7e$$

Choose the correct answer below.

- ☐ A. Change to exponential form.
- ☐ B. Take the common logarithm on each side.
- ☐ C. Use the product rule for exponents.
- ☐ D. Write the sum of logarithms as the logarithm of a product.
- ☐ E. Take the natural logarithm on each side.
- ☐ F. Let $u = e^x$ and write the equation in quadratic form.

5. What is the best first step for solving the following equation?

$$2e^{2x} - 2e^x - 10 = 0$$

Choose the correct answer below.

- ☐ A. Use the product rule for exponents.
- ☐ B. Change to exponential form.
- ☐ C. Take the common logarithm on each side.
- ☐ D. Write the sum of logarithms as the logarithm of a product.
- ☐ E. Let $u = e^x$ and write the equation in quadratic form.
- ☐ F. Take the natural logarithm on each side.

6. What is the best first step for solving the following equation?

$$\log(5x - 1) + \log(x + 9) = 1$$

Choose the correct answer below.

- ☐ A. Write the sum of logarithms as the logarithm of a product.
- ☐ B. Take the natural logarithm on each side.
- ☐ C. Change to exponential form.
- ☐ D. Use the product rule for exponents.
- ☐ E. Let $u = e^x$ and write the equation in quadratic form.
- ☐ F. Take the common logarithm on each side.

7. An exponential equation such as $5^x = 9$ can be solved for its exact solution using the meaning of logarithms and the change-of-base theorem. Because x is the exponent to which 5 must be raised in order to obtain 9, the exact solution is

$$\log_5 9, \text{ or } \frac{\log 9}{\log 5}, \text{ or } \frac{\ln 9}{\ln 5}.$$

For the following equation, give the exact solution in three forms similar to the forms above.

$$6^x = 22$$

For the given equation, the exact solutions in three forms are _____.

(Use a comma to separate answers as needed. Use integers or fractions for any numbers in the expression.)

8. Find an approximate irrational solution to $3^x = 5$.

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is { _____ }. (Round to four decimal places.)
- ☐ B. The solution is the empty set.

9. Solve the exponential equation. Express irrational solutions as decimals correct to the nearest thousandth.

$$\left(\frac{1}{5}\right)^x = 14$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is { _____ }.
(Round to the nearest thousandth as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

10. Solve the exponential equation. Express irrational solutions as decimals correct to the nearest thousandth.

$$4(2)^{x-1} + 1 = 109$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is { _____ }.
(Round to the nearest thousandth as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

11. Solve the following equation.

$$e^{2x} - 9e^x + 20 = 0$$

What is the solution in terms of natural logarithms? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is { _____ }.
(Use a comma to separate answers as needed. Type an exact answer in simplified form.)
- ☐ B. The solution set is the empty set.

12. Solve the logarithmic equation. Express all solutions in exact form.

$$5 \ln x = 10$$

Select the correct choice below and fill in any answer boxes in your choice.

- ☐ A. The solution set is { _____ }.
(Type an exact answer in simplified form. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

13. Solve the logarithmic equation. Express all solutions in exact form.

$$\log(10 - x) = 0.5$$

Select the correct choice below and fill in any answer boxes in your choice.

- ☐ A. The solution set is {_____}.
(Type an exact answer, using radicals as needed. Simplify your answer.)
- ☐ B. The solution is the empty set.

14. Solve the logarithmic equation. Express all solutions in exact form.

$$\log_2(x^3 + 7) = 3$$

Select the correct choice below and fill in any answer boxes in your choice.

- ☐ A. The solution set is {_____}.
(Simplify your answer. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

15. Solve the logarithmic equation. Express all solutions in exact form.

$$\log_6[(x + 5)(x - 4)] = 2$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is {_____}.
(Type an exact solution, using radicals as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

16. Solve for x.

$$\log_6 x + \log_6(x - 5) = 2$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is {_____}.
(Simplify your answer. Type an integer or a decimal. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

17. Solve the following logarithmic equation. Use a calculator if appropriate.

$$\log(4x + 3) + \log 5 = \log(19x + 20)$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is {_____}.
(Simplify your answer. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set, \emptyset .

18. Solve the following logarithmic equation. Use a calculator if appropriate.

$$\log_{12}(x - 2) - \log_{12}(x + 3) = \log_{12}3$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is $\{\rule{1.5cm}{0.4pt}\}$.
(Simplify your answer. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set, \emptyset .

19. Solve the logarithmic equation. Express all solutions in exact form.

$$\ln(5 - x) + \ln(-3 - x) = \ln(3 - 9x)$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is $\{\rule{1.5cm}{0.4pt}\}$.
(Type an exact solution, using radicals as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

20. Solve the logarithmic equation. Express all solutions in exact form.

$$\log x + \log(x - 21) = \log 72$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is $\{\rule{1.5cm}{0.4pt}\}$.
(Type an exact solution, using radicals as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution is the empty set.

21. Solve the equation.

$$\ln e^x - 2 \ln e = \ln e^7$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The solution set is $\{\rule{1.5cm}{0.4pt}\}$.
(Type an exact solution, using radicals as needed. Use a comma to separate answers as needed.)
- ☐ B. The solution set is the empty set.

22. Solve the equation for the indicated variable. Use logarithms with the appropriate base.

$$A = P \left(1 + \frac{r}{m} \right)^{tm}, \text{ for } t.$$

Choose a correct answer for t.

☐ A. $\frac{\log \frac{A}{P}}{m \log \left(1 + \frac{r}{m} \right)}$

☐ B. $\frac{\log \left(1 + \frac{r}{m} \right)}{m \log \frac{A}{P}}$

☐ C. $-\frac{\log \left(1 + \frac{m}{r} \right)}{\log \frac{A}{P}}$

☐ D. $\frac{m \log \left(\frac{A}{P} \right)}{\log \left(1 + \frac{r}{m} \right)}$

23. How much money will there be in an account at the end of 10 years if \$3000 is deposited at 5% interest compounded semi-annually? (Assume no withdrawals are made.) Use the formula $A = P \left(1 + \frac{r}{n} \right)^{tn}$ for compound interest.

The amount after 10 years will be \$ _____.
(Round to the nearest cent as needed.)

24. How much time will be needed for \$22,000 to grow to \$29,038.45 if deposited at 7% compounded quarterly? For calculating use the formula $A = P \left(1 + \frac{r}{k} \right)^{kt}$.

The amount \$22,000 will grow to \$29,038.45 in _____ year(s).
(Do not round until the final answer. Then round to the nearest tenth as needed.)

25. Find the interest rate to the nearest hundredth of a percent that will produce \$2000, if \$1500 is left at interest compounded semiannually for 3.5 yr. Use the formula $A = P \left(1 + \frac{r}{n} \right)^{tn}$ for compound interest.

The interest rate to the nearest hundredth of a percent is _____ %.
(Do not round until the final answer. Then round to the nearest hundredth as needed.)

26. A population is increasing according to the exponential function $y = 4e^{0.03x}$, where y is in millions and x is the number of years. How long will it take for the population to double? Which of the following is the correct procedure to answer the question?

A. Evaluate $y = 4e^{0.03(1/2)}$.

B. Solve $4e^{0.03x} = 8$.

C. Evaluate $y = 4e^{0.03(2)}$.

D. Solve $4e^{0.03x} = 2$.

Choose the correct answer below.

☐ A. Evaluate $y = 4e^{0.03(1/2)}$.

☐ B. Solve $4e^{0.03x} = 8$.

☐ C. Evaluate $y = 4e^{0.03(2)}$.

☐ D. Solve $4e^{0.03x} = 2$.

27. A population is increasing according to the exponential function $y = 5e^{0.02x}$, where y is in millions and x is the number of years. How large will the population be in 2 yr? Which of the following is the correct procedure to answer the question?
- A. Evaluate $y = 5e^{0.02(1/2)}$. B. Solve $5e^{0.02x} = 10$.
C. Evaluate $y = 5e^{0.02(2)}$. D. Solve $5e^{0.02x} = 2$.
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Choose the correct answer below.

- ☐ A. Evaluate $y = 5e^{0.02(1/2)}$.
☐ B. Solve $5e^{0.02x} = 10$.
☐ C. Evaluate $y = 5e^{0.02(2)}$.
☐ D. Solve $5e^{0.02x} = 2$.
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28. Strontium-90 decays according to the exponential function $y = y_0 e^{-0.0241t}$, where t is time in years. Match the given question with the correct procedure to answer the question.

If the initial amount of Strontium-90 is 500 g, how much will remain after 20 yr?

Choose the correct answer below.

- ☐ A. Solve $\frac{1}{2}y_0 = y_0 e^{-0.0241t}$.
☐ B. Evaluate $y = 500e^{-0.0241(20)}$.
☐ C. Solve $0.75y_0 = y_0 e^{-0.0241t}$.
☐ D. Evaluate $y = 500e^{-0.0241(40)}$.
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29. Plutonium-241 decays according to the exponential function $y = y_0 e^{-0.053t}$, where t is time in years. Match the given question with the correct procedure to answer the question.

What is the half-life of Plutonium-241?

Choose the correct answer below.

- ☐ A. Solve $0.85y_0 = y_0 e^{-0.053t}$.
☐ B. Evaluate $y = 800e^{-0.053(22)}$.
☐ C. Evaluate $y = 800e^{-0.053(11)}$.
☐ D. Solve $\frac{1}{2}y_0 = y_0 e^{-0.053t}$.
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30. If 14 g of a radioactive substance are present initially and 2 yr later only 7 g remain, how much of the substance will be present after 5 yr?
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After 5 yr there will be _____ g of a radioactive substance.

(Round the final answer to three decimal places as needed. Round all intermediate values to seven decimal places as needed.)

31. Suppose an Egyptian mummy is discovered in which the amount of carbon-14 present is only about one-fourth the amount found in living human beings. The amount of carbon-14 present in animal bones after t years is given by $y = y_0 e^{-0.0001216t}$, where y_0 is the amount of carbon-14 present in living human beings. About how long ago did the Egyptian die?

About _____ yr ago the Egyptian had died.
(Round to the nearest integer as needed.)

32. The amount of carbon-14 present in a paint after t years is given by $y = y_0 e^{-0.00012t}$. The paint contains 27% of its carbon-14. How old are the paintings?

The age of the paintings is _____ years.
(Round to the nearest year.)

33. An employee wants to invest \$50,000 in a pension plan. One investment offers 4% compounded semiannually. Another offers 3.25% compounded continuously.

- (a) Which investment will earn more interest in 5 yr?
(b) How much more will the better plan earn?

(a) After 5 years, (1) _____ will earn more interest.

(b) The better plan will earn \$ _____ more. (Round to the nearest cent as needed.)

- (1) ☐ the 3.25% compounded continuously plan
☐ the 4% compounded semiannually plan

34. Find the doubling time of an investment earning 7% interest if interest is compounded continuously.

The doubling time of an investment earning 7% interest if interest is compounded continuously is _____ years.
(Round to the nearest tenth of a year.)

35. In 2000 the population of country A reached 4 million, and in 2025 it is projected to be 7 million.
(a) Find values for P_0 and a so that the following formula models the population of country A in year x .

$$f(x) = P_0 a^{x-2000}$$

- (b) Estimate the country's population in 2010 to the nearest hundredth of a million.
(c) Use f to determine the year during which the country's population might reach 12 million.

- (a) Find values for P_0 and a .

$P_0 =$ _____ million
(Round to the nearest hundredth as needed.)

$a =$ _____
(Round to five decimal places as needed.)

- (b) The population in 2010 will be _____ million.
(Use the rounded answer from part (a) to find this answer. Round to the nearest hundredth as needed.)

- (c) The country's population might reach 12 million during the year _____.
(Use the rounded answer from part (a) to find this answer. Round down to the nearest year.)

36. Out-of-pocket spending in a country for health care increased between 2003 and 2007. The function $f(x) = 2578 e^{0.0359x}$ models average annual expenditures per household, in dollars. In this model, x represents the year, where $x = 0$ corresponds to 2003.
- (a) Estimate out-of-pocket household spending on health care in 2007.
(b) Determine the year when spending reached \$2847 per household.
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- (a) The total expenditures per household in the year 2007 were approximately \$ _____.
(Round to the nearest dollar as needed.)
- (b) During the year _____, spending reached \$2847 per household.
(Round down to the nearest year.)