

Lesson 8-1: Zero and Negative Exponents

Part 1: Zero and Negative Exponents

1. 060020a, P.I. A2.A.8
What is the value of 3^{-2} ?
[A] $\frac{1}{9}$ [B] -9 [C] 9 [D] $-\frac{1}{9}$
2. 080522a, P.I. A2.A.8
What is the value of 2^{-3} ?
[A] -6 [B] -8 [C] $\frac{1}{6}$ [D] $\frac{1}{8}$
3. 010723a, P.I. A2.A.8
What is the value of $3^0 + 3^{-2}$?
[A] $\frac{1}{9}$ [B] $1\frac{1}{9}$ [C] 6 [D] 0
4. 080730a, P.I. A2.A.8
The expression $(\frac{3}{4})^2 \bullet (\frac{1}{4})^{-2}$ is equivalent to
[A] 3 [B] $\frac{9}{16}$ [C] $\frac{9}{256}$ [D] 9
5. 010511a, P.I. A2.A.9
Which expression is equivalent to x^{-4} ?
[A] $-4x$ [B] $\frac{1}{x^4}$ [C] x^4 [D] 0
6. 080119a, P.I. A2.A.9
Which expression is equivalent to $x^{-1} \cdot y^2$?
[A] xy^{-2} [B] $\frac{x}{y^2}$ [C] $\frac{y^2}{x}$ [D] xy^2

Lesson 8-2: Scientific Notation

Part 1: Writing Numbers in Scientific and Standard Notation

7. 080004a, P.I. 7.N.6
Expressed in decimal notation, 4.726×10^{-3} is
[A] 0.004726 [B] 4,726
[C] 0.04726 [D] 472.6
8. 060301a, P.I. 7.N.6
The number 8.375×10^{-3} is equivalent to
[A] 0.08375 [B] 8,375
[C] 0.008375 [D] 0.0008375
9. 080424a, P.I. 7.N.6
The number 156×10^{-2} is equivalent to
[A] 156 [B] 0.0156
[C] 0.00156 [D] 0.156
10. 080511a, P.I. 7.N.5
The expression 0.62×10^3 is equivalent to
[A] 62,000 [B] 0.062
[C] 6.2×10^4 [D] 6.2×10^2
11. 089904a, P.I. 7.N.7
Which expression is equivalent to 6.02×10^{23} ?
[A] 602×10^{21} [B] 0.602×10^{21}
[C] 60.2×10^{21} [D] 6020×10^{21}
12. 080210a, P.I. 7.N.5
If 0.0347 is written by a scientist in the form 3.47×10^n , the value of n is
[A] -3 [B] 3 [C] -2 [D] 2

13. 060720a, P.I. 7.N.5
According to the 2000 census, the population of New York State was approximately 18,900,000. How is this number expressed in scientific notation?

[A] 18.9×10^6 [B] 189×10^7
[C] 1890×10^4 [D] 189×10^5

14. 010111a, P.I. 7.N.5
The distance from Earth to the Sun is approximately 93 million miles. A scientist would write that number as

[A] 93×10^7 [B] 93×10^{10}
[C] 9.3×10^6 [D] 9.3×10^7

15. 080715a, P.I. 7.N.5
The video of the movie *Star Wars* earned \$193,500,000 in rental fees during its first year. Expressed in scientific notation, the number of dollars earned is

[A] 193.5×10^6 [B] 1935×10^8
[C] 1.935×10^6 [D] 1.935×10^8

16. 080607a, P.I. 7.N.5
A micron is a unit used to measure specimens viewed with a microscope. One micron is equivalent to 0.00003937 inch. How is this number expressed in scientific notation?

[A] 3.937×10^{-5} [B] 3.937×10^5
[C] 3937×10^{-8} [D] 3937×10^8

17. 010206a, P.I. 7.N.5
The approximate number of seconds in a year is 32,000,000. When this number is written in scientific notation, the numerical value of the exponent is

[A] 8 [B] 7 [C] -7 [D] 6

18. 060504a, P.I. 7.N.5
The mass of an orchid seed is approximately 0.0000035 gram. Written in scientific notation, that mass is equivalent to 3.5×10^n . What is the value of n ?

[A] -7 [B] -6 [C] -5 [D] -8

19. 010609a, P.I. 7.N.5
The size of a certain type of molecule is 0.00009078 inch. If this number is expressed as 9.078×10^n , what is the value of n ?

[A] 8 [B] 5 [C] -5 [D] -8

Part 2: Using Scientific Notation

20. 060628a
What is the sum of 6×10^3 and 3×10^2 ?

[A] 6.3×10^3 [B] 18×10^5
[C] 9×10^5 [D] 9×10^6

21. 010018a, P.I. A.N.4
If the number of molecules in 1 mole of a substance is 6.02×10^{23} , then the number of molecules in 100 moles is

[A] 6.02×10^{22} [B] 6.02×10^{25}
[C] 6.02×10^{21} [D] 6.02×10^{24}

22. 060429a, P.I. A.N.4
If the mass of a proton is 1.67×10^{-24} gram, what is the mass of 1,000 protons?

[A] 1.67×10^{-23} [B] 1.67×10^{-22}
[C] 1.67×10^{-21} [D] 1.67×10^{-27}

23. 060029a, P.I. A.N.4
The distance from Earth to the imaginary planet Med is 1.7×10^7 miles. If a spaceship is capable of traveling 1,420 miles per hour, how many days will it take the spaceship to reach the planet Med? Round your answer to the nearest day.

Lesson 8-3: Multiplication Properties of Exponents

Part 1: Multiplying

24. 010413a, P.I. A.A.12
The expression $8^{-4} \cdot 8^6$ is equivalent to
[A] 8^{-24} [B] 8^{10} [C] 8^2 [D] 8^{-2}
25. 060312a, P.I. A.A.12
The expression $3^2 \cdot 3^3 \cdot 3^4$ is equivalent to
[A] 27^{24} [B] 3^{24} [C] 3^9 [D] 27^9
26. 069911a, P.I. A.A.12
The expression $2^3 \cdot 4^2$ is equivalent to
[A] 2^{12} [B] 8^6 [C] 2^7 [D] 8^5
27. 010008a, P.I. A.A.12
The expression $(x^2z^3)(xy^2z)$ is equivalent to
[A] $x^2y^2z^3$ [B] $x^4y^2z^5$
[C] $x^3y^2z^4$ [D] $x^3y^3z^4$
28. 080001a, P.I. A.A.12
The product of $2x^3$ and $6x^5$ is
[A] $10x^{15}$ [B] $12x^{15}$
[C] $12x^8$ [D] $10x^8$
29. 010205a, P.I. A.A.12
The product of $3x^2y$ and $-4xy^3$ is
[A] $-12x^2y^3$ [B] $-12x^3y^4$
[C] $12x^2y^3$ [D] $12x^3y^4$
30. 010306a, P.I. A.A.12
The product of $3x^5$ and $2x^4$ is
[A] $6x^{20}$ [B] $6x^9$ [C] $5x^{20}$ [D] $5x^9$

31. 089906a, P.I. A.A.12
The product of $4x^2y$ and $2xy^3$ is
[A] $8x^2y^4$ [B] $8x^3y^4$
[C] $8x^2y^3$ [D] $8x^3y^3$
32. 080605a, P.I. A.A.12
What is the product of $10x^4y^2$ and $3xy^3$?
[A] $30x^5y^6$ [B] $30x^4y^6$
[C] $30x^5y^5$ [D] $30x^4y^5$
33. 060604a, P.I. A.A.12
What is the product of $\frac{1}{3}x^2y$ and $\frac{1}{6}xy^3$?
[A] $\frac{1}{9}x^3y^4$ [B] $\frac{1}{18}x^3y^4$
[C] $\frac{1}{18}x^2y^3$ [D] $\frac{1}{2}x^2y^3$

Lesson 8-4: More Multiplication Properties of Exponents

Part 2: Raising a Product to a Power

34. 010728a, P.I. A.A.12
The expression $(6x^3y^6)^2$ is equivalent to
[A] $36x^6y^{12}$ [B] $12x^6y^{12}$
[C] $6x^6y^{12}$ [D] $36x^5y^8$
35. 010529a, P.I. A.A.12
Expressed in its simplest form,
 $(3x^3)(2y)^2(4x^4)$ is equivalent to
[A] $48x^{12}y^2$ [B] $48x^7y^2$
[C] $24x^7y^2$ [D] $24x^{12}y^2$

36. 010506a, P.I. A.A.12

The product of $(5ab)$ and $(-2a^2b)^3$ is

- [A] $-40a^6b^4$ [B] $-40a^7b^4$
[C] $-30a^7b^4$ [D] $-30a^6b^4$

Lesson 8-5: Division Properties of Exponents

Part 1: Dividing Powers with the Same Base

37. 080405a, P.I. A.A.12

When $-9x^5$ is divided by $-3x^3$, $x \neq 0$, the quotient is

- [A] $-27x^{15}$ [B] $-3x^2$
[C] $27x^8$ [D] $3x^2$

38. 060005a, P.I. A.A.12

The quotient of $-\frac{15x^8}{5x^2}$, $x \neq 0$, is

- [A] $-3x^6$ [B] $-3x^4$
[C] $-10x^4$ [D] $-10x^6$

39. 060707a, P.I. A.A.12

The expression $\frac{-32x^8}{4x^2}$, $x \neq 0$, is equivalent to

- [A] $-8x^4$ [B] $-8x^6$
[C] $8x^4$ [D] $8x^6$

40. 060518a, P.I. A.A.12

If $x \neq 0$, then $\frac{(x^2)^3}{x^5} \cdot 1000$ is equivalent to

- [A] $1000x$ [B] 1000
[C] $1000 + x$ [D] 0

41. 080526a, P.I. A.A.12

The expression $\frac{5x^6y^2}{x^8y}$ is equivalent to

- [A] $\frac{5y}{x^2}$ [B] $\frac{5y^3}{x^{14}}$
[C] $5x^{14}y^3$ [D] $5x^2y$

42. 010817a, P.I. A.A.12

The expression $\frac{4x^2y^3}{2xy^4}$ is equivalent to

- [A] $-2xy$ [B] $2xy$ [C] $\frac{2x}{y}$ [D] $\frac{2y}{x}$

43. fall0703ia, P.I. A.A.12

Which expression represents $\frac{(2x^3)(8x^5)}{4x^6}$ in simplest form?

- [A] x^9 [B] $4x^2$ [C] $4x^9$ [D] x^2

44. 080415b, P.I. A.A.12

The expression $\frac{(b^{2n+1})^3}{b^n \cdot b^{4n+3}}$ is equivalent to

- [A] $\frac{b^n}{2}$ [B] b^n [C] b^{-3n+1} [D] b^{-3n}

45. 060207a, P.I. A.N.4

If 385×10^6 is divided by 385×10^4 , the result is

- [A] 0.01 [B] 1
[C] 385×10^4 [D] 385×10^{10}

46. 010319a, P.I. A.N.4

What is the value of $\frac{6.3 \times 10^8}{3 \times 10^4}$ in scientific notation?

- [A] 2.1×10^2 [B] 2.1×10^{-2}
[C] 2.1×10^4 [D] 2.1×10^{-4}

47. fall0725ia, P.I. A.N.4

What is the quotient of 8.05×10^6 and 3.5×10^2 ?

- [A] 2.3×10^3 [B] 2.3×10^4
[C] 2.3×10^8 [D] 2.3×10^{12}

48. 060308b, P.I. A.N.4

Two objects are 2.4×10^{20} centimeters apart. A message from one object travels to the other at a rate of 1.2×10^5 centimeters per second. How many seconds does it take the message to travel from one object to the other?

- [A] 2.0×10^4 [B] 2.88×10^{25}
[C] 1.2×10^{15} [D] 2.0×10^{15}

Lesson 8-7: Exponential Functions

Part 1: Evaluating Exponential Functions

49. 060411b

Which equation models the data in the accompanying table?

Time in hours, x	0	1	2	3	4	5	6
Population, y	5	10	20	40	80	160	320

- [A] $y = 2x$ [B] $y = 5(2^x)$
[C] $y = 2^x$ [D] $y = 2x + 5$

50. 080204b, P.I. A2.A.39

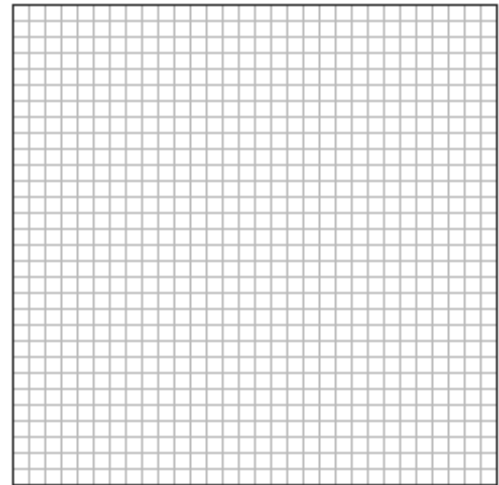
What is the domain of $f(x) = 2^x$?

- [A] $x \geq 0$ [B] all real numbers
[C] all integers [D] $x \leq 0$

Part 2: Graphing Exponential Functions

51. 010628b

On the accompanying grid, sketch the graphs of $y = 2^x$ and $3y = 7x + 3$ over the interval $-3 \leq x \leq 4$. Identify and state the coordinates of all points of intersection.

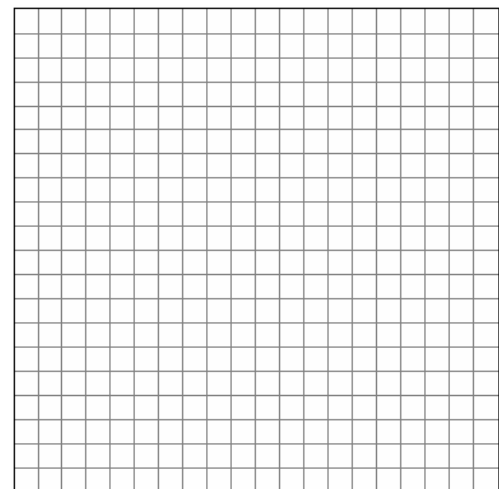


52. 010527b

On the accompanying grid, solve the following system of equations graphically:

$$y = -x^2 + 2x + 1$$

$$y = 2^x$$



53. 060519b

The graphs of the equations $y = 2^x$ and $y = -2x + a$ intersect in Quadrant I for which values of a ?

- [A] $a \geq 1$ [B] $0 < a < 1$
[C] $a < 1$ [D] $a > 1$

54. 080705b

The flight paths of two Thunderbird jets are plotted on a Cartesian coordinate plane, and the equations of the jets' flight paths are represented by $y = 2^x + 3$ and $y = 0.5^x$. The best approximation of the intersection of the flight paths is

- [A] (-1.72, 3.3) [B] (-2, -1)
[C] (-1.50, 2.82) [D] (0, 1)

Lesson 8-8: Exponential Growth and Decay

Part 1: Exponential Growth

55. 010525b, P.I. A.A.9

On January 1, 1999, the price of gasoline was \$1.39 per gallon. If the price of gasoline increased by 0.5% per month, what was the cost of one gallon of gasoline, to the *nearest cent*, on January 1 one year later?

56. 080224b, P.I. A.A.9

The Franklins inherited \$3,500, which they want to invest for their child's future college expenses. If they invest it at 8.25% with interest compounded monthly, determine the value of the account, in dollars, after 5 years.

Use the formula $A = P(1 + \frac{r}{n})^n$, where $A =$

value of the investment after t years,
 P = principal invested, r = annual interest rate, and n = number of times compounded per year.

Part 2: Exponential Decay

57. 010813b

A radioactive substance has an initial mass of 100 grams and its mass halves every 4 years. Which expression shows the number of grams remaining after t years?

[A] $100(\frac{1}{2})^{\frac{t}{4}}$ [B] $100(\frac{1}{2})^{4t}$

[C] $100(4)^{\frac{t}{4}}$ [D] $100(4)^{-2t}$

58. 060607b, P.I. A.A.9

The height, $f(x)$, of a bouncing ball after x bounces is represented by $f(x) = 80(0.5)^x$. How many times higher is the first bounce than the fourth bounce?

- [A] 2 [B] 4 [C] 8 [D] 16

59. 060721b, P.I. A.A.9

A population of wolves in a county is represented by the equation $P(t) = 80(0.98)^t$, where t is the number of years since 1998. Predict the number of wolves in the population in the year 2008.

60. 080221b, P.I. A.A.9

A used car was purchased in July 1999 for \$11,900. If the car depreciates 13% of its value each year, what is the value of the car, to the *nearest hundred dollars*, in July 2002?

61. fall0719ia, P.I. A.A.9

Daniel's Print Shop purchased a new printer for \$35,000. Each year it depreciates (loses value) at a rate of 5%. What will its approximate value be at the end of the fourth year?

- [A] \$27,082.33 [B] \$33,250.00
[C] \$28,507.72 [D] \$30,008.13

Part 1: Zero and Negative Exponents

- [1] A
- [2] D
- [3] B
- [4] D
- [5] B
- [6] C
- [7] A
- [8] C
- [9] B
- [10] D
- [11] A
- [12] C
- [13] B
- [14] D
- [15] D
- [16] A
- [17] B
- [18] B
- [19] C
- [20] A
- [21] B
- [22] C

[3] 499 days and appropriate work is shown,

such as $\frac{17,000,000 \text{ miles}}{1420 \frac{\text{miles}}{\text{hour}} \times 24 \frac{\text{hours}}{\text{day}}}$.

[2] Appropriate work is shown, but one computational error is made or the student incorrectly calculates 1.7×10^7 by one decimal place.

or [2] Appropriate work is shown, but the answer is rounded incorrectly or is not rounded.

[1] $1.7 \times 10^7 = 17,000,000$ is shown.

or [1] $\frac{1.7 \times 10^7}{1420} = 11,971.831$ hours is shown.

or [1] 34,080 miles in 1 day is shown.

or [1] 499 but no work is shown.

[0] The student does not understand scientific notation.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

- [23] _____
- [24] C
- [25] C
- [26] C
- [27] C
- [28] C
- [29] B
- [30] B
- [31] B
- [32] C
- [33] B
- [34] A
- [35] B
- [36] B
- [37] D

[38] A

[39] B

[40] A

[41] A

[42] C

[43] B

[44] B

[45] B

[46] C

[47] B

[48] D

[49] B

[50] B

[4] (0,1) and (3,8), and both graphs are sketched correctly.

[3] Appropriate work is shown, but one graphing error is made, but all appropriate points of intersection are identified.

[2] Appropriate work is shown, but two or more graphing errors are made, but all appropriate points of intersection are identified.

or [2] Appropriate work is shown, but one conceptual error is made, such as failing to draw the graph over the specified interval, resulting in only one point of intersection.

or [2] Both graphs are sketched correctly, and the two points of intersection are indicated, but the coordinates are not stated or are stated incorrectly.

[1] Only the graph of the exponential function is sketched correctly, and no further correct work is shown.

or [1] (0,1) and (3,8), but no graph is sketched.

[0] (0,1) or (3,8), but no graph is sketched.

or [0] Only the line is graphed correctly.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[51] obviously incorrect procedure.

[4] (0,1) and (1,2), and a correct graph is drawn with at least one function labeled.

[3] Appropriate work is shown, but one graphing error is made, such as plotting one point incorrectly or not labeling either function.

or [3] The graphs are drawn correctly, but only one correct solution is found or only the x- or the y-values are found correctly.

[2] Appropriate work is shown, but two or more graphing errors are made.

or [2] (0,1) and (1,2), but the solution is found by a nongraphic method.

or [2] The graphs are drawn correctly, but no correct solutions are found.

[1] The graph of only one equation is drawn correctly, and no further correct work is shown.

or [1] (0,1) and (1,2), but no work is shown.

[0] (0,1) or (1,2), but no work is shown.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[52] _____

[53] D _____

[54] A _____

[2] \$1.48, and appropriate work is shown, such as providing a correctly labeled table or solving the equation $(1.39)(1.005)^{12} = C$.

[1] Appropriate work is shown, but one computational or rounding error is made.

or [1] Appropriate work is shown, but one conceptual error is made, such as using 1.05 or 1.5 or using an incorrect exponent.

or [1] A correct equation is written, but no further correct work is shown.

or [1] An incorrect equation of equal difficulty is solved appropriately.

or [1] \$1.48, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[55] incorrect procedure. _____

[2] 5,279.61, and appropriate work is shown, such as $3,500(1 + \frac{0.0825}{12})^{(12 \times 5)}$.

[1] Appropriate work is shown, but one computational or substitution error is made.

or [1] 5,279.61, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[56] incorrect procedure. _____

[57] A _____

[58] C _____

[2] 65, and appropriate work is shown, such as $P(10) = 80(0.98)^{10}$.

[1] Appropriate work is shown, but one computational or rounding error is made.

or [1] Appropriate work is shown, but one conceptual error is made.

or [1] 65, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[59] incorrect procedure. _____

[2] 7,800, and appropriate work is shown.

[1] Appropriate work is shown, but one computational or rounding error is made.

or [1] 7,800, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[60] incorrect procedure. _____

[61] C _____