61. Subtract the following functions, then choose the domain of the resulting function from the list below.

$$f(x) = 7x^4 + 5x^3 + 5x^2 + 4x + 1 \text{ and } g(x) = \sqrt{-4x - 14}$$

A. The domain is all Real numbers except $x = a$, where $a \in [4, 12]$

B. The domain is all Real numbers less than or equal to $x = a$, where $a \in [-8, 1]$

C. The domain is all Real numbers greater than or equal to $x = a$, where $a \in [3, 11]$

D. The domain is all Real numbers except $x = a$ and $x = b$, where $a \in [-12, -5]$ and $b \in [5, 7]$

E. The domain is all Real numbers.

---

62. Choose the interval below that f composed with g at $x = 1$ is in.

$$f(x) = -x^3 - 2x^2 + x + 3 \text{ and } g(x) = 4x^3 - 4x^2 + 4x - 2$$

A. $(f \circ g)(1) \in [-14.7, -10.9]$

B. $(f \circ g)(1) \in [-8.1, -2.3]$

C. $(f \circ g)(1) \in [-17.2, -16.9]$

D. $(f \circ g)(1) \in [1.3, 5.4]$

E. It is not possible to compose the two functions.

---

63. Determine whether the function below is 1-1.

$$f(x) = -64x^3 + 1056x^2 - 5808x + 10648$$

A. Yes, the function is 1-1.

B. No, because the range of the function is not $(-\infty, \infty)$.

C. No, because the domain of the function is not $(-\infty, \infty)$.

D. No, because there is a y-value that goes to 2 different x-values.

E. No, because there is an x-value that goes to 2 different y-values.

---

64. Find the inverse of the function below (if it exists). Then, evaluate the inverse at $x = -10$ and choose the interval that $f^{-1}(-10)$ belongs to.

$$f(x) = 5x^2 + 3$$

A. $f^{-1}(-10) \in [1.32, 2.23]$

B. $f^{-1}(-10) \in [3.41, 3.73]$

C. $f^{-1}(-10) \in [1.04, 1.22]$

D. $f^{-1}(-10) \in [6.23, 7.19]$

E. The function is not invertible for all Real numbers.

---

65. Find the inverse of the function below. Then, evaluate the inverse at $x = 9$ and choose the interval that $f^{-1}(9)$ belongs to.

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

A. $f^{-1}(9) \in [7.57, 7.7]$

B. $f^{-1}(9) \in [7.44, 7.54]$

C. $f^{-1}(9) \in [6.73, 6.92]$

D. $f^{-1}(9) \in [4.31, 4.5]$

E. $f^{-1}(9) \in [-1.65, -1.37]$

---

66. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 - 40x^2 + 86x - 57}{x - 3}$$

A. $a \in [3, 10], \; b \in [-27, -16], \; c \in [18, 22], \text{ and } r \in [-7, 8]$.

B. $a \in [13, 21], \; b \in [-99, -85], \; c \in [363, 374], \text{ and } r \in [-1164, -1153]$.

C. $a \in [3, 10], \; b \in [-64, -55], \; c \in [259, 262], \text{ and } r \in [-838, -833]$.

D. $a \in [13, 21], \; b \in [9, 16], \; c \in [126, 133], \text{ and } r \in [321, 334]$.

E. $a \in [3, 10], \; b \in [-32, -23], \; c \in [26, 31], \text{ and } r \in [-7, 8]$.

---

67. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 - 18x + 8}{x + 2}$$

A. $a \in [-18, -5], b \in [-24.5, -23.3], c \in [-67, -62], \text{ and } r \in [-125, -123]$.

B. $a \in [5, 11], b \in [-20.4, -17.7], c \in [31, 39], \text{ and } r \in [-107, -98]$.

C. $a \in [5, 11], b \in [-15.6, -10.7], c \in [5, 13], \text{ and } r \in [-5, -3]$.

D. $a \in [-18, -5], b \in [21.6, 25.7], c \in [-67, -62], \text{ and } r \in [136, 142]$.

E. $a \in [5, 11], b \in [10.5, 13], c \in [5, 13], \text{ and } r \in [17, 24]$.

---

68. What are the *possible* Integer roots of the polynomial below?

$$5x^4 - 6x^3 + 4x^2 + 3x - 7$$

A. All combinations of: $\frac{\pm 1, \pm 5}{\pm 1, \pm 7}$

B. All combinations of: $\frac{\pm 1, \pm 7}{\pm 1, \pm 5}$

C. $\pm 1, \pm 7$

D. $\pm 1, \pm 5$

E. There is no formula or theorem that tells us all possible Integer roots.

---

69. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$.

$$f(x) = 6x^3 - 19x^2 + 19x - 6$$

A. $z_1 \in [-3.7, -2.2],\ z_2 \in [-3, 0],$ and $z_3 \in [-0.44, 0.12]$

B. $z_1 \in [-0.1, 1.7],\ z_2 \in [0, 5],$ and $z_3 \in [1.43, 1.66]$

C. $z_1 \in [-0.1, 1.7],\ z_2 \in [0, 5],$ and $z_3 \in [1.43, 1.66]$

D. $z_1 \in [-1.8, -0.1],\ z_2 \in [-3, 0],$ and $z_3 \in [-1.25, -0.62]$

E. $z_1 \in [-1.8, -0.1],\ z_2 \in [-3, 0],$ and $z_3 \in [-1.25, -0.62]$

---

70. Factor the polynomial below completely, knowing that $x - 3$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$.

$$f(x) = 3x^4 - 19x^3 + 39x^2 - 29x + 6$$

A. $z_1 \in [-3.7, -2.4],\ z_2 \in [-3.6, -2.79], z_3 \in [-1.65, -0.91],$ and $z_4 \in [-0.54, -0.49]$

B. $z_1 \in [-3.7, -2.4],\ z_2 \in [-1.05, -0.87], z_3 \in [-1.65, -0.91],$ and $z_4 \in [-0.67, -0.55]$

C. $z_1 \in [0.4, 0.6],\ z_2 \in [0.15, 1.1], z_3 \in [2.88, 3.75],$ and $z_4 \in [2.98, 3.08]$

D. $z_1 \in [-3.7, -2.4],\ z_2 \in [-2.32, -1.45], z_3 \in [-1.65, -0.91],$ and $z_4 \in [-0.38, -0.15]$

E. $z_1 \in [-0.6, 0.4],\ z_2 \in [0.15, 1.1], z_3 \in [1.04, 2.42],$ and $z_4 \in [2.98, 3.08]$

---

71. Translate the phrase "$\frac{x+3}{x^2-9}$ approaches $-\frac{1}{6}$ as x approaches -3" into limit notation.

A. $\lim_{x\to -3}\left(\frac{x+3}{x^2-9}\right) = -\frac{1}{6}$

B. $\lim_{x\to -1/6}\left(\frac{x+3}{x^2-9}\right) = -3$

C. $\lim_{x\to -1/6}(-3) = \frac{x+3}{x^2-9}$

D. $\lim_{x\to -3}\left(-\frac{1}{6}\right) = \frac{x+3}{x^2-9}$

---

72. Evaluate the limit below.

$$\lim_{x\to 0^+}\left(-\frac{1}{x}\right)$$

A. -1

B. 0

C. $-\infty$

D. ∞

E. Undefined

---

73. Evaluate the limit below.

$$\lim_{x\to 9}\frac{\sqrt{x-5}-2}{x-9}$$

A. 0

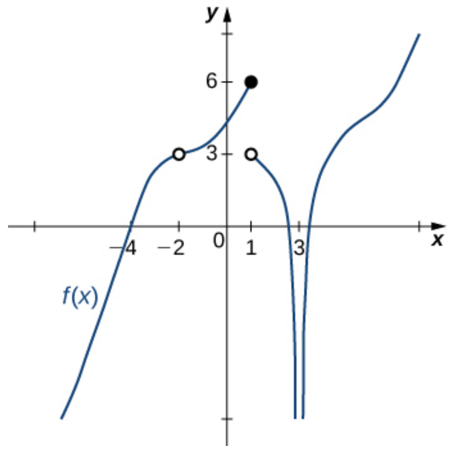
B. 1/4

C. $-\infty$

D. ∞

E. Undefined

For the next two problems, use the picture below.



74. Evaluate the limit below.

$$\lim_{x \to 1^-} f(x)$$

A. 1

B. 3

C. 6

D. Undefined

---

75. Evaluate the limit below.

$$\lim_{x \to 3} f(x)$$

A. 1

B. 3

C. $-\infty$

D. ∞

E. Undefined

---

76. Determine all holes of the rational function below (if any).

$$f(x) = \frac{x^2 + 6x + 8}{x^3 + 2x^2 + 10x + 20}$$

A. At $x = -4$.

B. At $x = -2$.

C. At $x = -4$ and $x = -2$.

D. At $x = -2$, $x = -i\sqrt{10}$, and $x = i\sqrt{10}$.

E. The function has no holes.

---

77. Determine all vertical asymptotes of the rational function below (if any).

$$f(x) = \frac{x^2 + 9x + 20}{x^3 + 5x^2 + 18x + 90}$$

A. The line $x = -5$.

B. The line $x = -4$.

C. The lines $x = -5$ and $x = -4$.

D. The lines $x = -5$, $x = -3\sqrt{2}$, and $x = 3\sqrt{2}$.

E. The function has no vertical asymptotes.

---

78. Determine all horizontal asymptotes of the rational function below (if any).

$$f(x) = \frac{x - 2}{-x^3 - 2x^2 + 23x + 60}$$

A. The line $y = -1$.

B. The line $y = 0$.

C. The line $y = 2$.

D. The line $y = x^2 + 23$.

E. The function has no horizontal asymptotes.

---

79. Determine all oblique asymptotes of the rational function below (if any).

$$f(x) = \frac{27x^3 - 57x - 34}{x - 2}$$

A. The line $y = 27$.

B. The line $y = 0$.

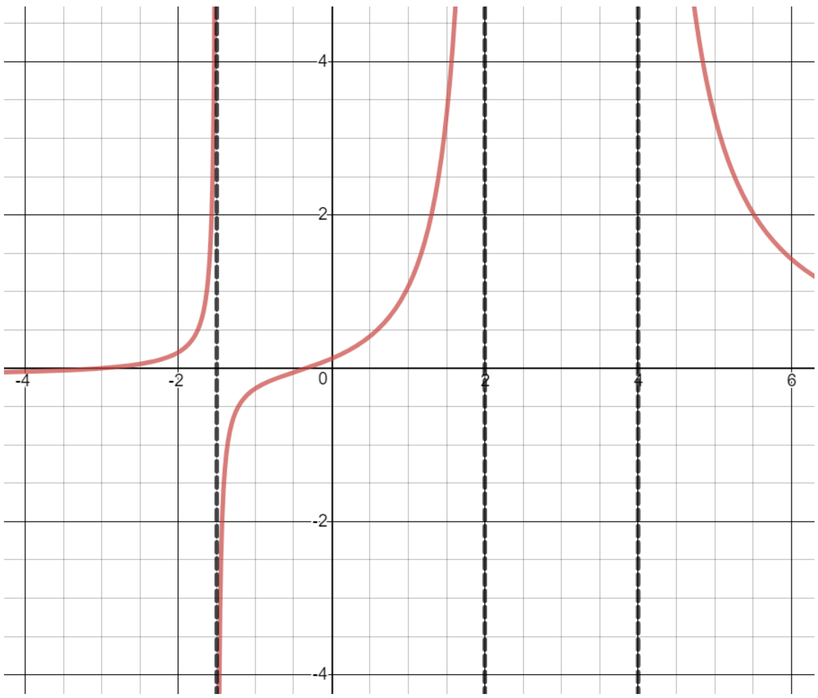
C. The line $y = 27x - 3$.

D. The line $y = 27x^2 + 54x + 51$.

E. The function has no oblique asymptotes.

---

80. Write the equation of the graph pictured below.



A. $\dfrac{6x^2 + 11x + 3}{(x-4)(x-2)(2x+3)}$

B. $\dfrac{3x^2 + 10x + 3}{(x-4)(x-2)(2x+3)}$

C. $\dfrac{3x^2 - 10x + 3}{(x+4)(x+2)(2x-3)}$

D. $\dfrac{6x^2 - 7x - 3}{(x+4)(x+2)(2x-3)}$

---

41. Is a linear model appropriate for the situation below?

A town has an initial population of 75,000. It grows at a constant rate of 2,500 per year for 5 years.

A. True

B. False

---

42. Describe the restricted domain of the situation below. *Do not solve the word problem!*

Jenna and her friend, Khalil, are having a contest to see who can save the most money. Jenna has already saved \$110 and every week she saves an additional \$20. Khalil has already saved \$80 and every week he saves an additional \$25. In how many weeks Jenna and Khalil will have the same amount of money?

A. Subset of the Rational numbers

B. All Real numbers

C. Subset of the Integers

D. Subset of the Natural numbers

E. Proper subset of the Real numbers

---

43. Using the situation below, construct a linear model that describes the total profit of film sales, P, in terms of the inventory value of black & white film, b, in stock.

A film shop carrying black & white film and color film has \$4000 of inventory in stock this month. The profit on black & white film is 12% and the profit on color film is 21%. Last month, the profit on color film was \$150 less than the profit on black & white film.

A. $P(b) = 480 + 0.09b$

B. $P(b) = 840 - 0.09b$

C. $P(b) = 2b + 3850$

D. $P(b) = 3000$

E. $P(b) = 4000 - b$

---

44. Using the situation below, construct a linear model that describes the speed of the jet in still air, J mph, in terms of the wind speed W mph.

Flying against the jet stream, a jet travels 1880 mi in 4 hours. The jet is preparing a return trip and will now be flying with the same wind as the previous trip.

A. $J(W) = 470W$

B. $J(W) = W + 1880$

C. $J(W) = 1880 - W$

D. $J(W) = W + 470$

E. $J(W) = 470 - W$

---

45. Using the situation below, construct a linear model that describes the amount of acid in the 30% acid solution, A_{30}, in terms of the volume of 10% acid solution, v_{10}.

Chemists commonly create a solution by mixing two products of differing concentrations together. A 10% and 30% solution can make an acid solution of some value between these, such as a 24% acid solution. The chemist wants to make differing solution percentages of 7 liters each.

A. $A_{30}(v_{10}) = 0.3v_{10}$

B. $A_{30}(v_{10}) = 2.1 - 0.3v_{10}$

C. $A_{30}(v_{10}) = 1.68 - 0.1v_{10}$

D. $A_{30}(v_{10}) = 2.1 - 0.2v_{10}$

E. $A_{30}(v_{10}) = 1.68 + 0.2v_{10}$

---

46. Is a power model appropriate for the situation below?

    An extremely rich uncle has offered you a choice between \$1,000,000 or a penny doubled every day for the next 30 days. Which should you choose if you want to maximize your newfound riches?

    A. True

    B. False

---

47. For the following situation, would it be appropriate to create a direct variation model, indirect variation model, or neither?

    The number of days required to build a parking deck decreases with more workers hired. For the O'Connell Center, it took 20 workers 237 days to finish. How long would it take 10 workers to finish the new parking deck?

    A. Direct variation model

    B. Indirect variation model

    C. Neither

---

48. Using the situation below, construct a power model that describes the number of moles, n, of a gas in terms of its pressure, P *(atmospheres)*, volume (*liters*), V, and temperature, T *(Celsius)*.

    The temperature of a gas varies jointly with its pressure and volume, and varies inversely with its number of moles. Assuming its temperature, 30 C, and volume, 15 liters, remain constant, there are 0.12 moles of the gas at 2 atmospheres of pressure. Assuming the 2 atmospheres of pressure and volume of 15 liters remain constant, there are 0.361 moles of the gas at 10 C.

    A. $n = 0.12\dfrac{P \cdot V}{T}$

    B. $n = 8.31\dfrac{P \cdot V}{T}$

    C. $n = 0.12\dfrac{T}{P \cdot V}$

    D. $n = 8.31\dfrac{T}{P \cdot V}$

---

49. Using the situation below, construct a power model that describes the distance, d between two unknown cities of population P_1 and P_2 that have an average daily phone call count of C.

The average number of phone calls per day between two cities has been found to be jointly proportional to the populations of the cities and inversely proportional to the square of the distance between the two cities. The population of Charlotte is about 1,500,000 and the population of Nashville is about 1,200,000, and the distance between the two cities is about 400 miles. The average number of calls between the cities is about 200,000. The average number of daily phone calls between Charlotte and Indianapolis (pop. 1,700,000) is about 134,000.

A. $d = 0.018\left(\frac{P_1 \cdot P_2}{C}\right)^{1/2}$

B. $d = 0.134\left(\frac{P_1 \cdot P_2}{C}\right)^{1/2}$

C. $d = 0.001\left(\frac{P_1 \cdot P_2}{C}\right)^{2}$

D. $d = (2.22 \cdot 10^{-6})\left(\frac{P_1 \cdot P_2}{C}\right)^{2}$

---

50. Using the situation below, construct a power model that describes the area of a new triangle, A_{new}, in terms of the original triangle's base b and height h.

The area of a triangle is jointly related to the height and the base. A new triangle is constructed by increasing the base by 40% and decreasing the height by 10%.

A. $A_{new} = 0.02b \cdot h$

B. $A_{new} = 0.04b \cdot h$

C. $A_{new} = 0.5b \cdot h$

D. $A_{new} = 0.63b \cdot h$

E. $A_{new} = 1.26b \cdot h$

---

51. For the following situation, would it be appropriate to create a model using a logarithmic function, exponential function, or neither?

In 2007, a university study was published investigating the crash risk of alcohol impaired driving. Data from 2,871 crashes were used to measure the association of a person's blood alcohol level (BAC) with the risk of being in an accident. The table below shows results from the study. The relative risk is a measure of how many times more likely a person is to crash. So, for example, a person with a BAC of 0.09 is 3.54 times as likely to crash as a person who has not been drinking alcohol.

BAC	0	0.01	0.03	0.05	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21
Risk	1	1.03	1.06	1.38	2.09	3.54	6.41	12.6	22.1	39.05	65.32	99.78

A. Logarithmic model

B. Exponential model

C. Neither

---

52. For the following situation, would it be appropriate to create a model using a logarithmic function, exponential function, or neither?

Your bank offers a savings account that will increase your total balance by 0.2% annually. You want to decide how much to initially deposit to earn $1000 in 10 years.

A. Logarithmic model

B. Exponential model

C. Neither

---

53. Using the situation below, construct an equation that models the amount of time, t hours, that has passed based on the current bacteria population.

A population of bacteria quadruples every hour. The population was initially observed to be 200.

A. $P(t) = 200 * 4^t$

B. $P(t) = 200 * e^{4t}$

C. $t(P) = \dfrac{\ln(P/200)}{\ln(4)}$

D. $t(P) = \dfrac{\ln(P)}{\ln(800)}$

---

54. The temperature of an object, T, in surrounding air with temperature T_s will behave according to the formula $T(t) = Ae^{kt} + T_s$, where t is time, A is a constant, and k is a constant. Use this formula and the situation below to construct a model that describes the amount of time (in minutes) we would need to wait before the cheesecake is T° F.

A cheesecake is taken out of the oven with an ideal internal temperature of 165° *F and is placed into a* 35° *F refrigerator. After 10 minutes, the cheesecake has cooled to* 150° *F.*

A. $T(t) = 130e^{-0.0123t} + 35$

B. $T(t) = 150e^{-0.0457t} + 35$

C. $t(T) = \dfrac{\ln((T-35)/130)}{-0.0123}$

D. $t(T) = \dfrac{\ln((T-35)/150)}{-0.0457}$

---

55. Using the situation below, construct a model that describes the amount of years that have passed, t, in terms of the ratio of Gallium-67 remaining, r.

Gallium-67 decays exponentially and has a half-life of 80 years.

A. $G(t) = G_0e^{-0.0087t}$

B. $G(t) = G_0e^{-0.01t}$

C. $t(r) = \dfrac{\ln(r)}{-0.0087}$

D. $t(r) = \dfrac{\ln(r)}{-0.001}$

---

56. Which of the following would be most appropriate to describe the situation below?

A ball is dropped from the top of Century Tower. The ball steadily picks up speed before hitting the ground. You want to figure out what the ball's height is at a certain time.

A. Linear model

B. Direct variation model

C. Indirect variation model

D. Logarithmic model

E. Exponential model

---

57. Construct a model that describes the officers' total distance from each other, D in miles, as a function of minutes, m, that have passed if they were walking in exactly 90 degrees from each other (e.g., North/East).

Two UFPD are patrolling the campus on foot. To cover more ground, they split up and begin walking in different directions. Office A is walking at 3 mph while Office B is walking at 5 mph.

A. $D(t) = 0.097t$

B. $D(t) = 0.133t$

C. $D(t) = 5.83t$

D. $D(t) = 8t$

---

58. Solve the real-world problem below.

A population of bacteria quadruples every 30 minutes. The population was initially observed to be 20. How long will it take for the population to reach 1,000,000?

A. About 8 minutes

B. About 4 hours

C. About 8 hours

D. About 16 hours

E. About 64 hours

---

59. Solve the real-world problem below.

A cheesecake is taken out of the oven with an ideal internal temperature of $165°$ *F and is placed into a* $35°$ *F refrigerator. After 10 minutes, the cheesecake has cooled to* $150°$ *F. If we must wait until the cheesecake has cooled to* $70°$ *before we eat, how long will we have to wait?*

A. About 1 hour

B. About 1.25 hours

C. About 1.5 hours

D. About 1.75 hours

E. About 2 hours

---

60. Solve the real-world problem below.

Carbon-14 decays in an object exponentially and has a half-life of 5,730 years. A bone fragment is found that contains 20% of its original carbon-14. How old is the bone?

A. About 1,850 years old

B. About 2,300 years old

C. About 2,950 years old

D. About 19,000 years old

E. About 13,300 years old
