MATH 140 Practice Final Exam
Semester 20XX
Version X

Name _____

ID# _____

Instructor _____

Section ___

Do not open this booklet until told to do so.

On the separate answer sheet, fill in your name and identification number and code the appropriate spaces with a #2 pencil. Use the spaces marked "Year" under Birth Date to code the version of the exam you are taking.

There are 50 multiple choice questions on this exam. Select the one best answer for each problem. Mark all answers on the separate answer sheet with a #2 pencil. Make your marks heavy and black. Mark only one answer for each question. If you make a mistake or wish to change an answer, be sure to erase your first choice completely. Answer all questions. There is no penalty for guessing.

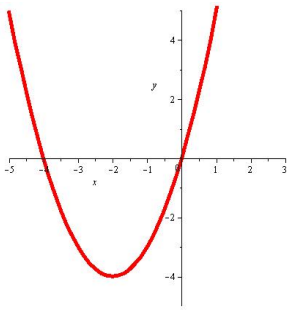
In the test booklet, do all of the work on the back of the preceding page and circle the letter of the answer for each problem.

When you finish the exam, place your answer sheet inside the front cover of the test booklet and turn it in to your instructor.

1. Find all the zeros of the polynomial $p(x) = x^3 + x^2 - 7x - 3$.

   (a) -3 (b) $3, 1+\sqrt{2}, 1-\sqrt{2}$ (c) $-3, 1+\sqrt{2}, 1-\sqrt{2}$ (d) $1, 3, 7$

2. The graph of a function f is shown. Find the range of f.



   (a) $[4, \infty)$ (b) $[-4, \infty)$ (c) $(-\infty, -4]$ (d) $(-\infty, \infty)$

3. Suppose $f(x) = x^2 + 3$ and $g(x) = x - 2$. Which of the following is a formula for $\big(f - g\big)(x)$?

   (a) $\big(f - g\big)(x) = x^2 - x + 1$
   (b) $\big(f - g\big)(x) = x^3 + 2x^2 + 3x - 2$
   (c) $\big(f - g\big)(x) = x^2 - 4x + 7$
   (d) $\big(f - g\big)(x) = x^2 - x + 5$

4. Suppose that when the polynomial $p(x)$ is divided by $x - 5$, the quotient is $3x^4 - 5x^2 + 2x - 5$ with a remainder of 4. We may conclude that ...

   (a) $x - 4$ is a factor of p, and 4 is a zero of p.
   (b) $x + 5$ is not a factor of p, and -5 is not a zero of p.
   (c) $x - 5$ is a factor of p, and 5 is a zero of p.
   (d) $x - 5$ is not a factor of p, and 5 is not a zero of p.

5. Find the balance for \$1,000 invested at a rate of 8% for four years if the interest is compounded quarterly.

   (a) \$1,375.67 (b) \$1,372.79 (c) \$1,083.00 (d) \$372.79

6. For the matrices A and B defined below, find their sum $A + B$, if possible.

$$A = \begin{bmatrix} 3 & -7 \\ 1 & -3 \end{bmatrix} \quad B = \begin{bmatrix} -1 \\ 5 \end{bmatrix}$$

$A + B =$

(a) $\begin{bmatrix} 2 & -8 \\ 6 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} -15 \\ -16 \end{bmatrix}$ (c) $\begin{bmatrix} 8 & -8 \\ 1 & 2 \end{bmatrix}$ (d) Undefined

7. Divide the polynomial $p(x) = x^3 - 3x^2 - 6x + 15$ by $x + 2$.

(a) $x^3 - 5x^2 + 4x + 7$ (b) $x^2 - x - 8 - \dfrac{1}{x+2}$ (c) $x^2 - 5x + 4 + \dfrac{7}{x+2}$ (d) $x^2 + 3x + 6$

8. Let $f(x) = 3x + 1$, and let $g(x) = \sqrt{x-1}$. Find $\big(f \circ g\big)(5)$.

(a) 0 (b) $\sqrt{15}$ (c) 4 (d) 7

9. Let $f(x) = \dfrac{x^2 + 3}{(x-4)(x+8)}$. Find any vertical asymptote(s) of the graph of f.

(a) $x = 1$ (b) $x = 4,\ x = -8$ (c) $x = -4,\ x = 8$ (d) $x = \sqrt{3}\,i,\ x = -\sqrt{3}\,i$

10. Let f be the one-to-one function defined by the following set of ordered pairs. Find $f^{-1}(4)$.

$\{(-3, 2), (4, 5), (7, 4), (10, 19)\}$

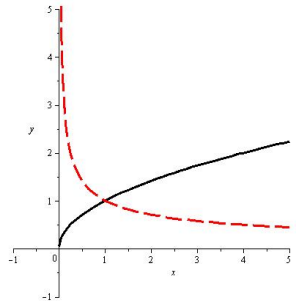
(a) $\dfrac{1}{4}$ (b) $\dfrac{1}{5}$ (c) 5 (d) 7

11. The number of bacteria N in a culture is given by the model $N(t) = 250e^{0.015t}$, where t is the time in hours. Find how many hours it takes for the original population to double. Round your answer to the nearest hundredth of an hour.

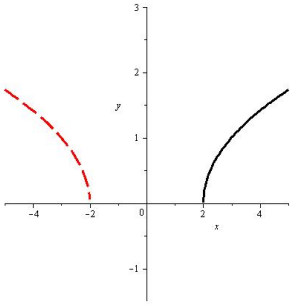
(a) 44.03 hours (b) 45.21 hours (c) 46.21 hours (d) 47.23 hours

12. Which of the following images depicts the graph of a function as a solid curve and the graph of its inverse function as a dashed curve?

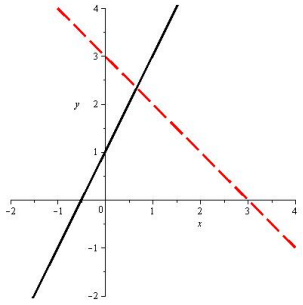
(a)



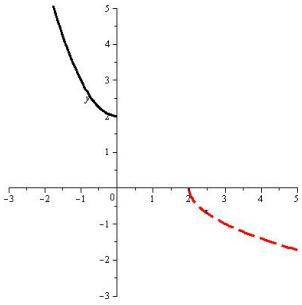
(b)



(c)



(d)



13. Let $f(x) = \dfrac{1}{x+3}$. Which of the following is a formula for $f^{-1}(x)$?

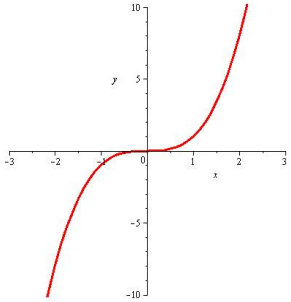
(a) $f^{-1}(x) = \dfrac{1}{x+3}$ (b) $f^{-1}(x) = \dfrac{1}{x} - 3$ (c) $f^{-1}(x) = x + 3$ (d) No inverse

14. Let $f(x) = \begin{cases} 3x & \text{if } x < -1 \\ 2x - 1 & \text{if } -1 \le x \le 5 \\ x + 3 & \text{if } x > 5 \end{cases}$

Find $f(3)$.

(a) 3 (b) 5 (c) 6 (d) 9

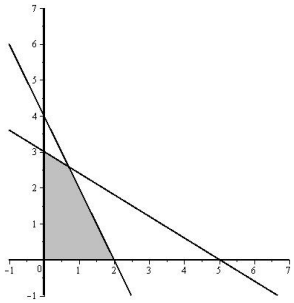
15. Which of the following could be the formula of the function whose graph is shown?



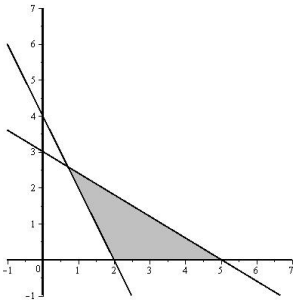
(a) $f(x) = |x|$ (b) $f(x) = x^3$ (c) $f(x) = x^2$ (d) $f(x) = \log x$

16. Shade the solution set of the system of inequalities: $\begin{cases} x & \geq & 0 \\ y & \geq & 0 \\ 2x + y & \leq & 4 \\ 3x + 5y & \leq & 15 \end{cases}$

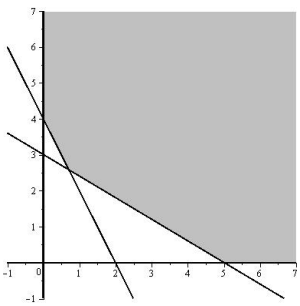
(a)



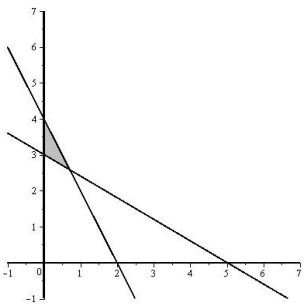
(b)



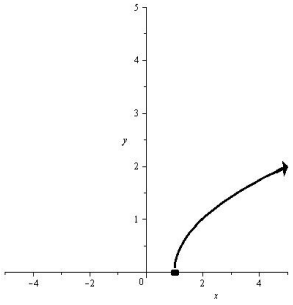
(c)



(d)



17. Find the domain of the function whose graph is shown.



(a) $(-\infty, \infty)$ (b) $[1, \infty)$ (c) $(0, \infty)$ (d) $(1, \infty)$

18. Solve the equation: $\log_6(x+2) - \log_6 x = 2$.

(a) $\frac{2}{35}$ (b) $\frac{35}{2}$ (c) -6 (d) $\frac{1}{18}$

19. The inverse of the coefficient matrix for the system of equations below is $A = \begin{bmatrix} -9 & -5 \\ 2 & 1 \end{bmatrix}$. Use this inverse to solve the system of equations:

$$\begin{cases} x + 5y = -22 \\ -2x - 9y = 39 \end{cases}$$

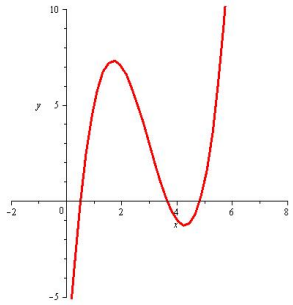
(a) (-15, -1) (b) (3, -5) (c) (2, -4) (d) (173, -307)

20. Due to atmospheric pressure, the temperature at which water boils varies with altitude. Using equipment to duplicate atmospheric pressure, a physics student studied this relationship for altitudes between 3000 ft and 7000 ft. Her results are shown in the table, where h is altitude in feet, and t is the Fahrenheit temperature at which water boiled in the lab. Assume that the relationship between t and h is linear, and use a graphing utility to find the equation which best models t in terms of h. Then use the model to estimate, to the nearest tenth of a degree, the temperature at which water will boil on Pike's Peak, 14,115 feet above sea level.

h	3000	4000	5000	6000	7000
t	206.5	204.7	202.9	201.0	199.2

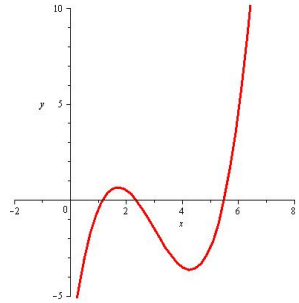
(a) 186.0° (b) 186.2° (c) 186.4° (d) 186.6°

21. The graph of a function f is shown.

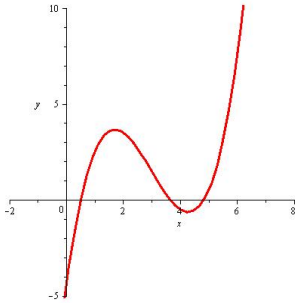


Which of the following images depicts $y = \frac{1}{2}f(x) - 3$?

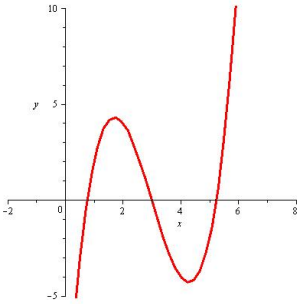
(a)



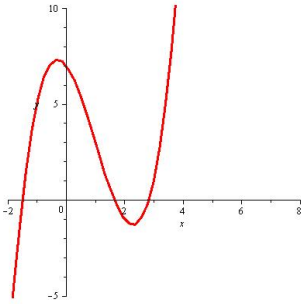
(b)



(c)



(d)



22. Suppose $f(x) = \log(x - 3)$ and $g(x) = x + 4$. Find the domain of $\big(f \circ g\big)(x)$.

(a) $(-3, \infty)$ (b) $(-\infty, -3)$ (c) $(-1, \infty)$ (d) $[-1, \infty)$

23. Solve the equation: $16 = 2^{7x-5}$.

(a) 0.1143 (b) -0.3010 (c) $\frac{13}{7}$ (d) $\frac{9}{7}$

24. Suppose $f(x) = 2x^2$ and $g(x) = \sqrt{x+1}$. Which of the following is a formula for $\big(f \cdot g\big)(x)$?

(a) $\big(f \cdot g\big)(x) = 2x^2\sqrt{x+1}$

(b) $\big(f \cdot g\big)(x) = \dfrac{2x^2}{\sqrt{x+1}}$

(c) $\big(f \cdot g\big)(x) = \sqrt{2x^2+1}$

(d) $\big(f \cdot g\big)(x) = 3x + 1$

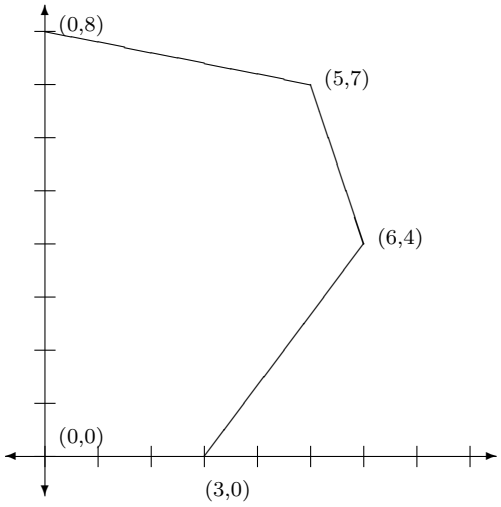
25. Solve the equation: $e^{5x} = 7$.

(a) 0.39 (b) 0.23 (c) 9.73 (d) 3.81

26. Let $g(x) = \dfrac{5}{x-4}$. Find the domain of g.

(a) $(-\infty, 4) \cup (4, \infty)$ (b) $[4, \infty)$ (c) $(-\infty, -4) \cup (-4, \infty)$ (d) $(-\infty, \infty)$

27. Maximize the objective function $z = 0.5x + 1.5y$ in the feasible region which is shown.



The maximum value of z is (a) 0 (b) 12 (c) 13 (d) 15

28. Use the rational root theorem to list all possible rational zeros of the polynomial $p(x) = 15x^4 + 4x^3 - 8x + 7$.

(a) $\pm 1, \pm 3, \pm 5, \pm 15, \pm\frac{1}{7}, \pm\frac{3}{7}, \pm\frac{5}{7}, \pm\frac{15}{7}$

(b) $\pm 1, \pm 3, \pm 5, \pm 15$

(c) $\pm 1, \pm 7$

(d) $\pm 1, \pm 7, \pm\frac{1}{3}, \pm\frac{7}{3}, \pm\frac{1}{5}, \pm\frac{7}{5}, \pm\frac{1}{15}, \pm\frac{7}{15}$

29. Which of the following functions is odd?

(a) $f(x) = x^2 - x + 4$

(b) $g(x) = 2x^3 - x$

(c) $h(x) = 5e^{3x}$

(d) $k(x) = \dfrac{1}{x^2}$

30. Let $f(x) = \dfrac{2x^2 - 3x + 7}{5x^2 - 2x}$. Find $f(3)$.

(a) $\frac{2}{5}$ (b) $\frac{16}{39}$ (c) 3 (d) $\frac{18}{45}$

31. Describe the end behavior of the graph of the polynomial function $q(x) = -0.01x^7 + 7x^5 - 10$.

(a) Up to the left; Up to the right.

(b) Up to the left; Down to the right.

(c) Down to the left; Up to the right.

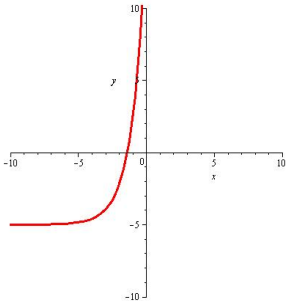
(d) Down to the left; Down to the right.

32. Solve the system of equations. $\begin{cases} y &= x^2 - 6x + 4 \\ -2x + 2y &= -4 \end{cases}$

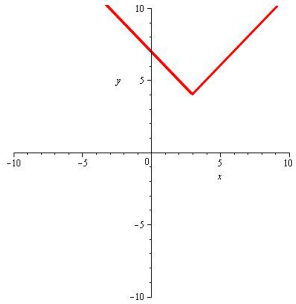
(a) $(1, -1)$ (b) $(1, 4),\ (6, -1)$ (c) $(1, -1),\ (6, 4)$ (d) $(-1, 1),\ (-6, -4)$

33. Each of the following images shows the graph of a function. Each image is at an appropriate scale to accurately suggest the end behavior and any other important characteristics of the graph. Which could be the graph of a polynomial function?

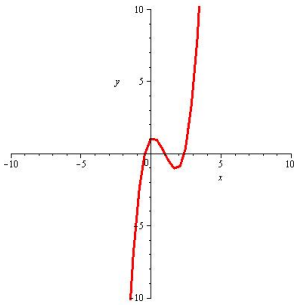
(a)



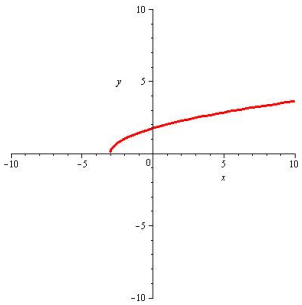
(b)



(c)



(d)



34. Suppose $f(x) = \sqrt{x-3}$ and $g(x) = x^2 + 5$. Which of the following is a formula for $\big(f \circ g\big)(x)$?

(a) $\big(f \circ g\big)(x) = x + \sqrt{2}$
(b) $\big(f \circ g\big)(x) = \sqrt{x^2 + 2}$
(c) $\big(f \circ g\big)(x) = x + 2$
(d) $\big(f \circ g\big)(x) = x^2 + 5 + \sqrt{x-3}$

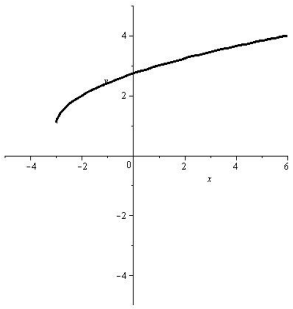
35. Let $f(x) = \dfrac{3x^4 - x^2 + 8x}{5x^3 - 2x^2 + 3x}$. Find any horizontal asymptote of the graph of f.

(a) $y = 0$ (b) $y = \dfrac{8}{3}$ (c) $y = \dfrac{3}{5}$ (d) No horizontal asymptote

36. Find the inverse of the matrix $\begin{bmatrix} 2/3 & -1/3 & 0 \\ -5/3 & 19/12 & -1/4 \\ 0 & -1/4 & 1/4 \end{bmatrix}$.

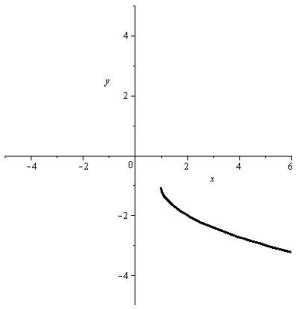
(a) $\begin{bmatrix} 4 & 1 & 1 \\ 5 & 2 & 2 \\ 5 & 2 & 6 \end{bmatrix}$ (b) $\begin{bmatrix} 3/2 & -3 & 0 \\ -3/5 & 12/19 & -4 \\ 0 & -4 & 4 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) No Inverse

37. The graph of a function f is shown.

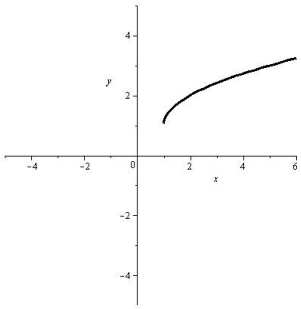


Which of the following images depicts the graph $y = -f(x-4)$?

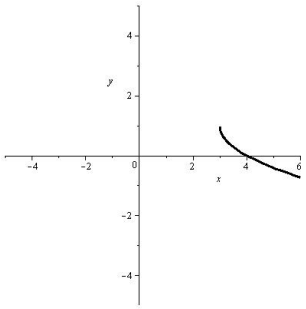
(a)



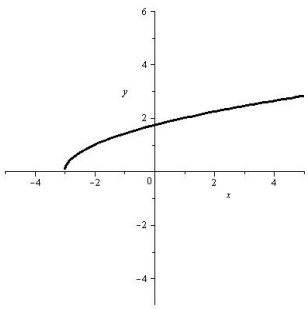
(b)



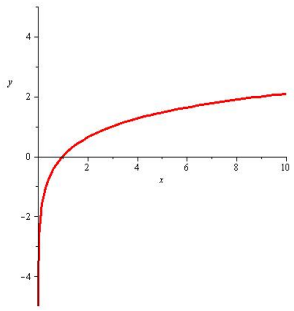
(c)



(d)



38. The image shows the graph of a function g. Find $g(9)$.



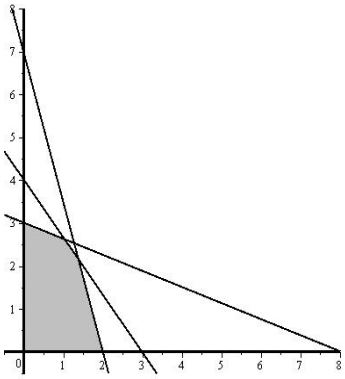
(a) -1 (b) 0 (c) 2 (d) 9

39. Write a partial fraction decomposition for $\dfrac{x+7}{(x-3)(x+2)}$.

(a) $\dfrac{x}{x-3}+\dfrac{7}{x+2}$ (b) $\dfrac{x+7}{x^2-x-6}$ (c) $\dfrac{11}{x-3}+\dfrac{5}{x+2}$ (d) $\dfrac{2}{x-3}-\dfrac{1}{x+2}$

40. The graph of the feasible region for the indicated set of constraints is given. Find the vertices of this feasible region.

$$\begin{cases} x & \geq & 0 \\ y & \geq & 0 \\ 3x+8y & \leq & 24 \\ 7x+2y & \leq & 14 \\ 4x+3y & \leq & 12 \end{cases}$$



(a) (0, 0), (0, 3), (1, 2.5), (1.1, 2.1), (2, 0)

(b) (0, 0), (0, 3), (1, 2.5), $\left(\dfrac{18}{13}, \dfrac{28}{13}\right)$, (2, 0)

(c) (0, 0), (0, 3), $\left(\dfrac{24}{23}, \dfrac{60}{23}\right)$, (1.1, 2.1) (2, 0)

(d) (0, 0), (0, 3), $\left(\dfrac{24}{23}, \dfrac{60}{23}\right)$, $\left(\dfrac{18}{13}, \dfrac{28}{13}\right)$, (2, 0)

41. Find all the zeros of the polynomial $p(x) = 2x^3 - 9x^2 - 6x + 40$.

(a) $-2, \frac{5}{2}, 4$ (b) $0, 2, \frac{5}{2}$ (c) $2, -\frac{5}{2}, -4$ (d) $2, -9, -6$

42. For the matrices A and B defined below, find their product AB, if possible.

$$A = \begin{bmatrix} 1 & 4 & -3 \\ 1 & -2 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 3 & -1 \\ 0 & 2 \\ 4 & 6 \end{bmatrix}$$

$AB =$

(a) Undefined (b) $\begin{bmatrix} 1 & 12 & -12 \\ -6 & 4 & 2 \\ 1 & 8 & 7 \end{bmatrix}$ (c) $\begin{bmatrix} 4 & 3 \\ -2 & 3 \end{bmatrix}$ (d) $\begin{bmatrix} -9 & -11 \\ 7 & 1 \end{bmatrix}$

43. Solve the system of equations. $\begin{cases} 3x + 4y &= 40 \\ 5x - y &= 13 \end{cases}$

(a) $(4, 7)$ (b) $(7, 4)$ (c) $(11.5, 7)$ (d) $(1, 5)$

44. For the matrices A and B defined below, find their sum $A + B$, if possible.

$$A = \begin{bmatrix} 6 & 4 & -7 \\ 2 & 1 & 8 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 3 & 5 \\ 1 & 0 & -7 \end{bmatrix}$$

$A + B =$

(a) $\begin{bmatrix} 10 & 7 & 2 \\ 3 & 1 & 15 \end{bmatrix}$ (b) $\begin{bmatrix} 10 & 7 & -2 \\ 3 & 1 & 1 \end{bmatrix}$ (c) $\begin{bmatrix} 24 & 12 & -35 \\ 2 & 0 & -56 \end{bmatrix}$ (d) Undefined

45. Use a graphing utility to approximate the positive zero of the polynomial $p(x) = x^3 + 4x^2 - 35x - 24$ to the nearest ten-thousandth.

(a) 4.6458 (b) 4.6453 (c) 4.5000 (d) 4.6455

46. For the matrix A defined below, find the scalar product $2A$, if possible.

$A = \begin{bmatrix} 6 & 4 & -7 & 3 \end{bmatrix}$

(a) $\begin{bmatrix} 12 & 8 & -14 & 6 \end{bmatrix}$ (b) 6 (c) $\begin{bmatrix} 12 & 4 & -7 & 3 \end{bmatrix}$ (d) Undefined

47. Write the system of equations in the form of a matrix equation. $\begin{cases} 2x - 3y &= 9 \\ -5x + 7y &= 8 \end{cases}$

(a) $\begin{bmatrix} 2 & -3 \\ -5 & 7 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 9 \\ 8 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & -3 \\ -5 & 7 \end{bmatrix} \begin{bmatrix} x & y \end{bmatrix} = \begin{bmatrix} 9 & 8 \end{bmatrix}$

(c) $\begin{bmatrix} 2x & -3y \\ -5x & 7y \end{bmatrix} = \begin{bmatrix} 9 & 8 \end{bmatrix}$

(d) $\begin{bmatrix} x & y \end{bmatrix} = \begin{bmatrix} 9 \\ 8 \end{bmatrix}$

48. Which of the following matrix equations would give the solution to the indicated system of equations?

$\begin{cases} 4x - 3y &= 6 \\ 5x + 7y &= 9 \end{cases}$

(a) $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 & -3 \\ 5 & 7 \end{bmatrix}^{-1} \begin{bmatrix} 6 \\ 9 \end{bmatrix}$

(b) $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 6 \\ 9 \end{bmatrix} \begin{bmatrix} 4 & -3 \\ 5 & 7 \end{bmatrix}$

(c) $\begin{bmatrix} x & y \end{bmatrix} = \begin{bmatrix} 6 & 9 \end{bmatrix} \begin{bmatrix} 4 & -3 \\ 5 & 7 \end{bmatrix}^{-1}$

(d) $\left[\begin{array}{cc|c} 4 & -3 & 6 \\ 5 & 7 & 9 \end{array}\right]$

49. Which of the following functions has an inverse function?

(a) $f(x) = |x - 4|$
(b) $g(x) = (x + 4)^2$
(c) $h(x) = \dfrac{1}{(x - 4)(x + 4)}$
(d) $k(x) = (x - 4)^3$

50. Write the decomposition template for $\dfrac{x^2 - 3x + 5}{(x - 3)(x + 2)^2}$.

(a) $\dfrac{x^2}{x - 3} + \dfrac{-3x + 5}{(x + 2)^2}$
(b) $\dfrac{A}{x - 3} + \dfrac{B}{x + 2} + \dfrac{C}{(x + 2)^2}$
(c) $\dfrac{Ax + B}{x - 3} + \dfrac{Cx + D}{x + 2} + \dfrac{Ex + F}{(x + 2)^2}$
(d) $\dfrac{A}{x - 3} + \dfrac{B}{x + 2}$