Math 150: Summer 2011

Final Exam, Form: A

Name: _____

Read all of the following information before starting the exam:

- It is to your advantage to answer ALL of the questions.

- Clearly mark your answers on the ScanTron. The ScanTron is the ONLY page that will be graded.

- There are 50 multiple choice problems on this test. It is your responsibility to make sure that you have all of the problems. There are some BONUS questions at the end.

- Each multiple choice question is worth 2 points.

- There is no need to complete the test in order. The problems are independent.

- *Budget your time!*

- If you have read all of these instructions, remember that Duey has four legs and a tail.
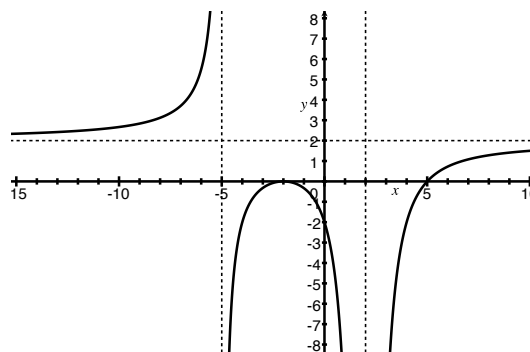
Section 1. Multiple choice

1. Solve the inequality $x^2 + x + 5 > 0$.

   (a) $(-\infty, \infty)$

   (b) $\emptyset$

   (c) $\left(-\infty, \dfrac{-1 - \sqrt{19}}{2}\right) \cup \left(\dfrac{-1 - \sqrt{19}}{2}, \infty\right)$

   (d) $\left(\dfrac{-1 - \sqrt{19}}{2}, \dfrac{-1 + \sqrt{19}}{2}\right)$

   (e) None of the above.

2. If $(1, 2)$ is a point on the graph of $y = f(x)$, which of following is on the graph of $y = 2f(x)$?

   (a) $(2, 1)$

   (b) $(2, 2)$

   (c) $(1, 1)$

   (d) $(1, 4)$

   (e) None of the above.

3. The graph of a rational function g is shown here. The dotted lines indicate asymptotes. Which of the following must be true?


   (a) The numerator of g has a factor of the form $(x - 5)^m$, where m is odd.

   (b) The numerator of g has a factor of the form $(x - 5)^m$, where m is even.

   (c) The denominator of g has a factor of the form $(x - 5)^m$, where m is odd.

   (d) The denominator of g has a factor of the form $(x - 5)^m$, where m is even.

   (e) None of the above.

2

4. Find the domain of the rational function $g(x) = \dfrac{3x^2 - 3x}{x^2 + x - 12}$.

    (a) $\{x \in \mathbb{R} \mid x \neq 0, 1\}$

    (b) $\{x \in \mathbb{R} \mid x \neq -4, 3\}$

    (c) $\{x \in \mathbb{R} \mid x \neq -4, 0, 1, 3\}$

    (d)   All real numbers.

    (e)   None of the above.

5. Which of the following best describes the graph show here.
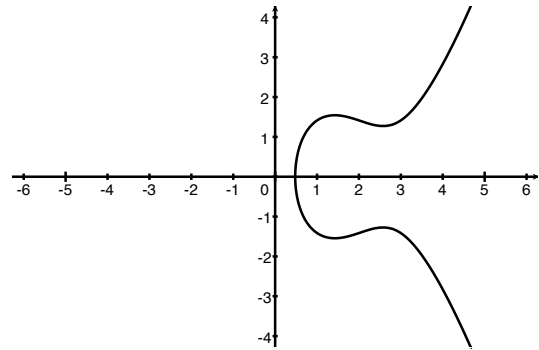
    (a)   This graph is the graph of a function.

    (b)   This graph is not the graph of a function.

    (c)   This graph is a parabola.

    (d)   This graph is purple.

    (e)   None of the above.

6. A ball is thrown vertically upward with an initial velocity of 96 feet per second. The distance s (feet) of the ball from the ground after t (seconds) is $s(t) = 80t - 16t^2$. At what time will the ball strike the ground?

    (a)   2.5 seconds

    (b)   5 seconds

    (c)   7.5 seconds

    (d)   10 seconds

    (e)   None of the above.

7. Find the real solutions to the equation

$$x^3 + 2x^2 - 5x - 10 = 0.$$

(a) -2

(b) $-2, \sqrt{5}, -\sqrt{5}$

(c) $\pm 1, \pm 2, \pm 5, \pm 10$

(d) $2, -5, 10$

(e) None of the above.

8. The point at which a company's profits equal zero is called the company's *break-even point*. Let R represent the company's revenue, and let C represent the company's cost. Then R and C are modelled by

$$R(x) = 100x \quad \text{and} \quad C(x) = 65.5x + 69000,$$

where x is the number of doodads sold each day. How many doodads must the company sell in order to break even? Round to the nearest doodad.

(a) 1000 doodads

(b) 1500 doodads

(c) 2000 doodads

(d) 2500 doodads

(e) None of the above.

9. An island is 4 miles from the nearest point P on a straight shoreline. A town is 14 miles down the shore from P. If Eric can row a boat an average of 2 miles per hour, and he can walk 5 miles per hour, how long does it take Eric to reach the town if he lands the boat 4 miles east of P? Round to 2 decimal places.

(a) 2.75 hours

(b) 4.83 hours

(c) 4.03 hours

(d) 5.54 hours

(e) None of the above.

4
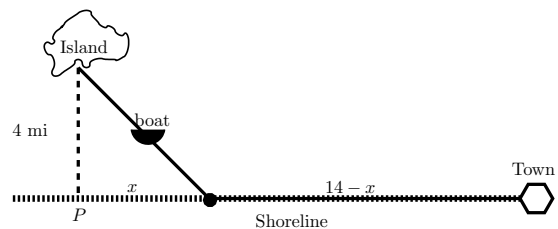
10. Use synthetic division to compute the quotient $\dfrac{2x^5 + 5x^4 - 2x^3 + 2x^2 - 2x + 3}{x + 3}$.

 (a) $2x^4 - x^3 + x^2 - x + 1$

 (b) $2x^4 + 2x^3 - x^2 + 2x + 1$

 (c) $2x^4 - x^3 - 3x^2 + x + 1$

 (d) $2x^4 + x^3 + 2x^2 - x - 1$

 (e) None of the above.

11. What is the y-intercept of the graph of $f(x) = 2(x - 1)^2 + 5$?

 (a) 5

 (b) 7

 (c) 1

 (d) $1 + \sqrt{\dfrac{5}{2}}$

 (e) None of the above.

12. Find functions f and g so that $f \circ g = H$, where $H(x) = |2x^2 + 3|$.

 (a) $g(x) = x^2 + 3$ and $f(x) = |2x|$

 (b) $f(x) = x^2$ and $g(x) = |2x + 3|$

 (c) $g(x) = |x|$ and $f(x) = 2x^2 + 3$

 (d) $f(x) = |x|$ and $g(x) = 2x^2 + 3$

 (e) None of the above.

13. Find the oblique asymptote, if one exists, of the graph of the function

$$Q(x) = \frac{3x^4 - x^2}{x^3 - x^2 + 1}.$$

 (a) $y = 3x - 2$

 (b) $x = 0$ and $x = \sqrt{\dfrac{1}{3}}$

 (c) $y = 3x + 3$

 (d) No oblique asymptote.

 (e) None of the above.
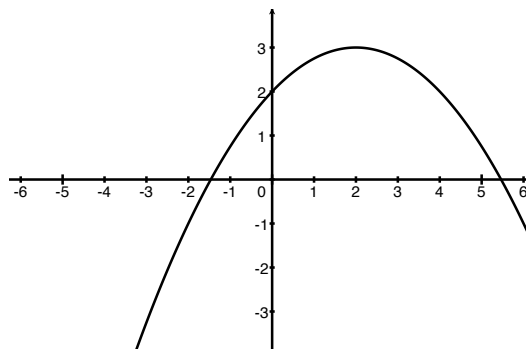
14. Which quadrant contains the point $(-3, -5)$?

    (a)   I

    (b)   II

    (c)   III

    (d)   IV

    (e)   None of the above.

15. Find the slope and y-intercept of the line $y = 2x + 3$.

    (a)   slope 2, y-intercept $-\dfrac{3}{2}$

    (b)   slope $\dfrac{2}{3}$, y-intercept 3

    (c)   slope 3, y-intercept 2

    (d)   slope 2, y-intercept 3

    (e)   None of the above.

16. The graph of $y = f(x)$ is shown here. Use the graph to determine $f(2)$.

    (a)   0

    (b)   3

    (c)   5.5

    (d) -1.5

    (e)   None of the above.

17. The function
$$f(x) = \frac{2x+1}{x-1}, \qquad x \neq 1$$

is one-to-one. Find its inverse.

(a) $f^{-1}(x) = \dfrac{x+1}{x-2}, \qquad x \neq 2$

(b) $f^{-1}(x) = \dfrac{x-1}{2x+1}, \qquad x \neq -\dfrac{1}{2}$

(c) $f^{-1}(x) = \dfrac{1}{2}(x-3)$

(d) $f^{-1}(x) = \dfrac{2x+1}{x-1}, \qquad x \neq 1$

(e) None of the above.

18. Determine if the function $F(x) = \dfrac{2x}{|x|}$ is odd, even, or neither.

(a) Odd

(b) Even

(c) Neither

(d) Rational

(e) None of the above.

19. Which of the following points is on the graph of $y = 2x - 3$?

(a) $(0,0)$

(b) $(1,-1)$

(c) $(2,-3)$

(d) $(-1,1)$

(e) None of the above.

20. Which of the following statements best describes the correspondence between x and y shown here.

x	y
salt & vinegar chips	yummy
caramel	sticky
elephant	muddy
stick	sticky

(a) y is not a function of x.

(b) y is a function of x, but it is not one-to-one.

(c) y is a one-to-one function of x.

(d) y is a continuous function of x.

(e) None of the above.

21. Determine from the data if the function f is linear. If it is linear, determine the slope.

x	$f(x)$
-2	7
-1	4
0	1
1	-2
2	-5

   (a) Not linear.

   (b) Linear with slope 3.

   (c) Linear with slope -3.

   (d) Linear with slope $-\dfrac{1}{3}$.

   (e) None of the above.

22. Use the graph of the rational function f shown here to solve the inequality $f(x) \le 0$.

   (a) $(-5, 2) \cup (2, 5]$

   (b) $[-5, 5]$
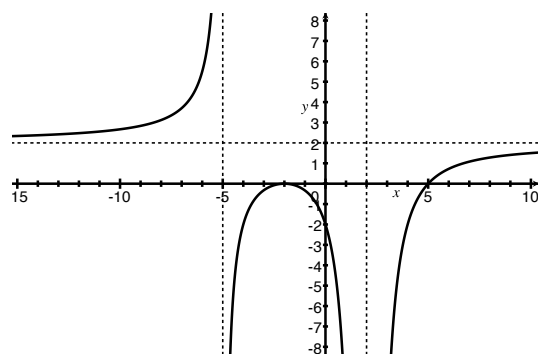
   (c) $(-5, -2] \cup (5, \infty)$

   (d) $(-\infty, -5) \cup (-5, 2) \cup (2, \infty)$

   (e) None of the above.

23. Find the distance between the points $(4, -3)$ and $(6, 4)$.

   (a) $\sqrt{53}$

   (b) $\sqrt{67}$

   (c) $\sqrt{101}$

   (d) $\sqrt{149}$

   (e) None of the above.

8

24. Use the *Rational Zeros Theorem* to list the potential rational zeros of the polynomial function

$$f(x) = 3x^4 - 3x^3 + x^2 - x + 1.$$

Do not attempt to find the zeros.

  (a) $\pm 1, \ \pm \dfrac{1}{3}$

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

  (c) $-0.4397, \ 1.1681$

  (d) $\pm 1, \ \pm 2, \ \pm \dfrac{1}{2}$

  (e) None of the above.

25. Let $f(x) = 2x^2 - 3$ and $g(x) = 4x$. Compute $(f \circ g)(1)$

  (a) -4

  (b) 29

  (c) 4

  (d) -1

  (e) None of the above.

26. A track and field playing area is in the shape of a rectangle with semicircles at each end. The perimeter of the track is to be 1500 meters. What should the dimensions of the rectangle be so that the area of the rectangle is a maximum? Round to two decimal places.

  (a) 238.73 meters by 375.00 meters

  (b) 257.93 meters by 350.75 meters

  (c) 298.32 meters by 367.33 meters

  (d) 223.65 meters by 392.22 meters

  (e) None of the above.

27. Compute $f(2)$, where f is the piecewise function defined by

$$f(x) = \begin{cases} x^2 & \text{if } x < 0, \\ 2x - 1 & \text{if } 0 \le x < 3, \\ -x + 2 & \text{if } x \ge 3. \end{cases}$$

(a) -3

(b) 0

(c) 3

(d) 4

(e) None of the above.

28. If a rock falls from a height of 20 meters on Earth, the height H (in meters) after x seconds is approximately $H(x) = 20 - 4.9x^2$. What is the height of the rock after 1.1 seconds? Round to 2 decimal places.

(a) 15.01 meters

(b) 14.07 meters

(c) 13.57 meters

(d) 12.98 meters

(e) None of the above.

29. Let $U = \{$ [Homer] , [Marge] , [Bart] , [Lisa] , [Maggie] , [Grandpa] $\}$, and let

$$G = \{x \in U \mid x \text{ is female}\}.$$

Compute the complement of G in U, which we denote $\overline{G}$.

(a) $\overline{G} = \{$ [Marge] , [Lisa] , [Maggie] $\}$

(b) $\overline{G} = \{$ [Homer] , [Bart] , [Grandpa] $\}$

(c) $\overline{G} = \{$ [Homer] , [Marge] , [Bart] , [Lisa] , [Maggie] $\}$

(d) $\overline{G} = \{$ [Homer] $\}$

(e) None of the above.

30. A trucking company transports goods between Chicago and New York, a distance of 960 miles. The company charges a \$50 loading fee. In addition, there is a transport charge of \$0.50 per mile for the first 100 miles and \$0.25 per mile for each additional mile. How much would the total charge be to load and transport one truckload from Chicago to New York?

(a) \$265

(b) \$340

(c) \$770

(d) \$315

(e) None of the above.

11

31. Find all the intercepts of the equation

$$9x + 6y^2 = 54.$$

    (a) $(9,6)$, $(6,54)$, $(9,54)$

    (b) $(0,3)$, $(6,0)$

    (c) $(0,9)$, $(6,0)$

    (d) $(0,3)$, $(0,-3)$, $(6,0)$

    (e)   None of the above.

32. Simplify the expression $\dfrac{x^{-3}y^4}{x^2y^5}$ using only positive exponents. Whenever the exponent is negative or 0, we assume that the base does not equal 0.

    (a) $\dfrac{1}{x^5y}$

    (b) x^5y^9

    (c) $\dfrac{y^{20}}{x^6}$

    (d) $\dfrac{y^{4/5}}{x^{5/3}}$

    (e)   None of the above.

33. Let $f(x) = \dfrac{1}{x+2}$, and let $g(x) = \dfrac{4}{x-1}$. Find the domain of $f \circ g$.

    (a) $\{x \in \mathbb{R} \mid x \neq 1, -1\}$

    (b) $\{x \in \mathbb{R} \mid x \neq 0\}$

    (c) $\{x \in \mathbb{R} \mid x \neq 1, -2\}$

    (d)   All real numbers.

    (e)   None of the above.

34. Find the standard form for a circle of radius 5 and center $(1,0)$.

    (a) $x^2 + x + y^2 = 5$

    (b) $(x-1)^2 + y^2 = 25$

    (c) $(x+1)^2 + y^2 = 25$

    (d) $(x-1)^2 + y^2 = 5$

    (e)   None of the above.

35. Solve the inequality $(x-1)(x+3)^2 > 0$

    (a) $(-\infty, \infty)$
    (b) $(-\infty, -3) \cup (1, \infty)$
    (c) $(1, \infty)$
    (d) $(-\infty, 1)$
    (e) None of the above.

36. What is the multiplicity of the root 1 in the polynomial function

$$f(x) = (x-1)^3(x^2+1)^4(x+1)^5?$$

    (a) 1
    (b) 3
    (c) 4
    (d) 5
    (e) None of the above.

37. The marketing manager at Levi-Strauss wishes to find a function that relates the demand D (pairs of jeans sold per day) for men's jeans and the price p (dollars) of the jeans. After collecting lots of data the line of best that models the relation between price and quantity demanded is $D = -1.336p + 86$. According to the model, which of the following statements is most correct?

    (a) If the price increases $1, the quantity sold per day decreases by about 1.336 pairs of jeans.

    (b) If the price increases $1, the quantity sold per day increases by about 1.336 pairs of jeans.

    (c) If the price increases $1.336, the quantity sold per day increases by about 1 pair of jeans.

    (d) If the price decreases $1.336, the quantity sold per day increases by about 1 pair of jeans.

    (e) None of the above.

38. Use the *Bounds on Zeros Theorem* to find bounds on the real zeros of the polynomial

$$g(x) = x^4 - 3x^2 + x - 4.$$

(a)   Every real zero of g must lie between -8 and 8.

(b)   Every real zero of g must lie between -5 and 5.

(c)   Every real zero of g must lie between -4 and 4.

(d)   Every real zero of g must lie between -3 and 3.

(e)   None of the above.

39. Find $f(0)$, where $f(x) = \dfrac{x}{x^2 - 1}$

(a)   0

(b)   1

(c) -1

(d)   Undefined.

(e)   None of the above.

40. Let f be a polynomial function of degree 17. Which of the following statements MUST be true?

(a) f has at MOST 17 roots.

(b)   The graph of f has at MOST 16 turning points.

(c)   As x goes to ∞, $f(x)$ goes to ∞, and as x goes to $-\infty$, $f(x)$ goes to $-\infty$.

(d)   All of the above.

(e)   None of the above.

41. The graph of a function g is given here. Determine all of the local maxima. Some dotted lines have been added to help (or mislead) you.


   (a)   3

   (b) -3, 0

   (c)   1.3

   (d) -1.5
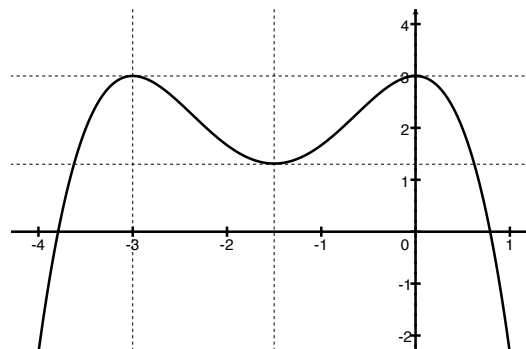
   (e)   None of the above.

42. A right triangle has a vertex in the first quadrant on the graph of $y = x^3$, a vertex at the origin, and a third on the positive y-axis as shown here. Express the area as a function of x.
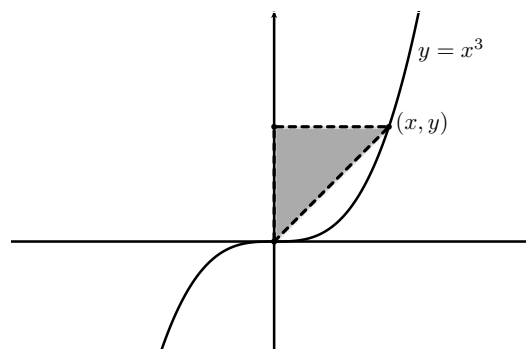
   (a) $A(x) = \dfrac{1}{2}x^4$

   (b) $A(x) = \dfrac{1}{2}x^3$

   (c) $A(x) = \pi x^2$

   (d) $A(x) = \dfrac{1}{2}x\sqrt[3]{x}$

   (e)   None of the above.

43. The graph of a function F is shown here using solid lines. The graph of G is shown on the same axes using dotted lines. Which of the following best expresses the function G in terms of F?
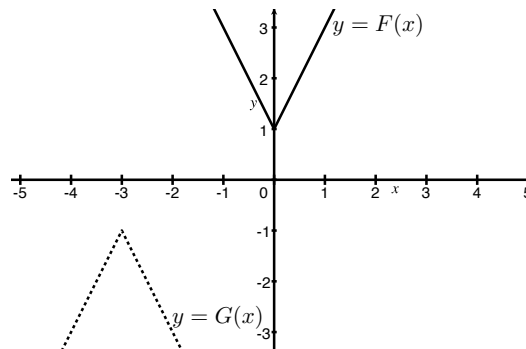
  (a) $G(x) = F(x+3) + 2$
  (b) $G(x) = -F(x-3) - 2$
  (c) $G(x) = -F(x+3) - 2$
  (d) $G(x) = F(-x+3) - 2$
  (e) None of the above.

44. Find the horizontal asymptote, if one exists, of the graph of $R(x) = \dfrac{x-12}{x^2+2x+1}$.

  (a) $y = 0$
  (b) $y = 1$
  (c) $x = -1$
  (d) $x = 12$
  (e) None of the above.

45. Solve the inequality $\dfrac{(x-5)(x+8)}{x} \geq 0$.

  (a) $(-\infty, \infty)$
  (b) $[-8, 0] \cup [5, \infty]$
  (c) $[-8, 0) \cup [5, \infty)$
  (d) $(-\infty, 8] \cup (0, 5]$
  (e) None of the above.

46. Let $f(x) = 3x + 5$, and let $g(x) = -2x + 15$. Solve $f(x) \geq g(x)$. Express your answer in interval notation.

  (a) $[2, \infty)$
  (b) $(-\infty, 2]$
  (c) $\left[-\dfrac{5}{3}, \dfrac{15}{2}\right]$
  (d) $(-\infty, \infty)$
  (e) None of the above.

47. Let D represent the percentage of people that are divorced at age x. After much data is collected, the following quadratic function of best fit is

$$D(x) = -0.0136x^2 + 1.4794x - 26.3412.$$

According to the model, what is the age with the greatest percentage divorced? Round to the nearest year.

   (a)   32 years old

   (b)   37 years old

   (c)   54 years old

   (d)   63 years old

   (e)   None of the above.

48. Find the center and radius of the circle given by the equation

$$x^2 + y^2 + 4x - 6y + 11 = 0.$$

   (a)   center $(-2, 3)$, radius 2

   (b)   center $(2, -3)$, radius $\sqrt{2}$

   (c)   center $(-2, 3)$, radius $\sqrt{2}$

   (d)   center $(4, -6)$, radius $\sqrt{13}$

   (e)   None of the above.

49. What is the vertex of the quadratic function $f(x) = 2(x - 1)^2 + 5$?

   (a) $(1, 5)$

   (b) $(-1, 5)$

   (c) $(5, 1)$

   (d) $(5, -1)$

   (e)   None of the above.

50. Find the equation of the line that contains the point $(1, -2)$ and is perpendicular to the line $x + 3y = 6$.

   (a) $y + 2 = 3(x - 1)$

   (b) $y + 2 = -3(x - 1)$

   (c) $y - 2 = -\dfrac{1}{3}(x + 1)$

   (d) $y - 3 = 2(x + 6)$

   (e)   None of the above.

Section 2. Bonus

51. Compute $0.999\ldots + 0.999\ldots$.

    (a) $1.999\ldots$

    (b) 2

    (c) $\dfrac{14}{7}$

    (d) All of the above

    (e) None of the above.

52. Who is Duey?

    (a) Our pet rumpy Manx cat, a breed of cat with no tail.

    (b) Our pet dog, a lab/hound mix shelter beast of a dog.

    (c) Our pet Burmese Python, a 17 foot snake that likes to eat chickens.

    (d) Our pet African Grey Parrot, who knows about 100 words.

    (e) Our pet Goliath Birdeater, a spider with a leg-span of around 12 inches.

Answer Key for Exam $\boxed{\text{A}}$

Section 1.   Multiple choice

1. (a)	11. (b)	21. (c)	31. (d)	41. (a)
2. (d)	12. (d)	22. (a)	32. (a)	42. (a)
3. (a)	13. (c)	23. (a)	33. (a)	43. (c)
4. (b)	14. (c)	24. (a)	34. (b)	44. (a)
5. (b)	15. (d)	25. (b)	35. (c)	45. (c)
6. (b)	16. (b)	26. (a)	36. (b)	46. (a)
7. (b)	17. (a)	27. (a)	37. (a)	47. (c)
8. (c)	18. (a)	28. (b)	38. (b)	48. (c)
9. (b)	19. (b)	29. (b)	39. (a)	49. (a)
10. (a)	20. (b)	30. (d)	40. (d)	50. (a)

Section 2. Bonus

51. (d)   52. (b)

Math 150: Summer 2011

Final Exam, Form: B

Name: _____

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- If you have read all of these instructions, remember that Duey has four legs and a tail.

Section 1. Multiple choice

1. Let $f(x) = 2x^2 - 3$ and $g(x) = 4x$. Compute $(f \circ g)(1)$

   (a) -4

   (b) 29

   (c) 4

   (d) -1

   (e) None of the above.

2. Find the distance between the points $(4, -3)$ and $(6, 4)$.

   (a) $\sqrt{53}$

   (b) $\sqrt{67}$

   (c) $\sqrt{101}$

   (d) $\sqrt{149}$

   (e) None of the above.

3. Find the equation of the line that contains the point $(1, -2)$ and is perpendicular to the line $x + 3y = 6$.

   (a) $y + 2 = 3(x - 1)$

   (b) $y + 2 = -3(x - 1)$

   (c) $y - 2 = -\dfrac{1}{3}(x + 1)$

   (d) $y - 3 = 2(x + 6)$

   (e) None of the above.

4. The point at which a company's profits equal zero is called the company's *break-even point*. Let R represent the company's revenue, and let C represent the company's cost. Then R and C are modelled by

$$R(x) = 100x \quad \text{and} \quad C(x) = 65.5x + 69000,$$

   where x is the number of doodads sold each day. How many doodads must the company sell in order to break even? Round to the nearest doodad.

   (a) 1000 doodads

   (b) 1500 doodads

   (c) 2000 doodads

   (d) 2500 doodads

   (e) None of the above.

5. If a rock falls from a height of 20 meters on Earth, the height H (in meters) after x seconds is approximately $H(x) = 20 - 4.9x^2$. What is the height of the rock after 1.1 seconds? Round to 2 decimal places.

    (a)   15.01 meters

    (b)   14.07 meters

    (c)   13.57 meters

    (d)   12.98 meters

    (e)   None of the above.

6. A right triangle has a vertex in the first quadrant on the graph of $y = x^3$, a vertex at the origin, and a third on the positive y-axis as shown here. Express the area as a function of x.
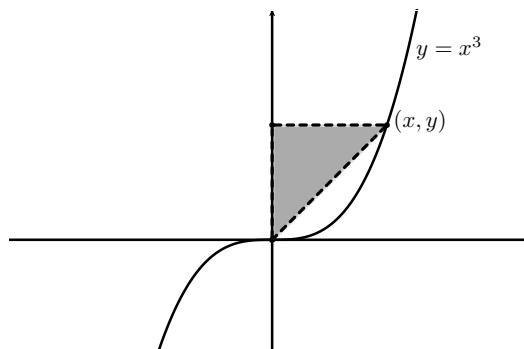
    (a) $A(x) = \dfrac{1}{2}x^4$

    (b) $A(x) = \dfrac{1}{2}x^3$

    (c) $A(x) = \pi x^2$

    (d) $A(x) = \dfrac{1}{2}x\sqrt[3]{x}$

    (e)   None of the above.

7. Find functions f and g so that $f \circ g = H$, where $H(x) = |2x^2 + 3|$.

    (a) $g(x) = x^2 + 3$ and $f(x) = |2x|$

    (b) $f(x) = x^2$ and $g(x) = |2x + 3|$

    (c) $g(x) = |x|$ and $f(x) = 2x^2 + 3$

    (d) $f(x) = |x|$ and $g(x) = 2x^2 + 3$

    (e)   None of the above.

8. Compute $f(2)$, where f is the piecewise function defined by

$$f(x) = \begin{cases} x^2 & \text{if } x < 0, \\ 2x - 1 & \text{if } 0 \leq x < 3, \\ -x + 2 & \text{if } x \geq 3. \end{cases}$$

(a) -3

(b) 0

(c) 3

(d) 4

(e) None of the above.

9. What is the multiplicity of the root 1 in the polynomial function

$$f(x) = (x - 1)^3(x^2 + 1)^4(x + 1)^5?$$

(a) 1

(b) 3

(c) 4

(d) 5

(e) None of the above.

10. Find the standard form for a circle of radius 5 and center $(1, 0)$.

(a) $x^2 + x + y^2 = 5$

(b) $(x - 1)^2 + y^2 = 25$

(c) $(x + 1)^2 + y^2 = 25$

(d) $(x - 1)^2 + y^2 = 5$

(e) None of the above.

11. Find the domain of the rational function $g(x) = \dfrac{3x^2 - 3x}{x^2 + x - 12}$.

(a) $\{x \in \mathbb{R} \mid x \neq 0, 1\}$

(b) $\{x \in \mathbb{R} \mid x \neq -4, 3\}$

(c) $\{x \in \mathbb{R} \mid x \neq -4, 0, 1, 3\}$

(d) All real numbers.

(e) None of the above.

12. If $(1, 2)$ is a point on the graph of $y = f(x)$, which of following is on the graph of $y = 2f(x)$?

    (a) $(2, 1)$

    (b) $(2, 2)$

    (c) $(1, 1)$

    (d) $(1, 4)$

    (e)   None of the above.

13. Find all the intercepts of the equation

$$9x + 6y^2 = 54.$$

    (a) $(9, 6)$, $(6, 54)$, $(9, 54)$

    (b) $(0, 3)$, $(6, 0)$

    (c) $(0, 9)$, $(6, 0)$

    (d) $(0, 3)$, $(0, -3)$, $(6, 0)$

    (e)   None of the above.

14. Find the center and radius of the circle given by the equation

$$x^2 + y^2 + 4x - 6y + 11 = 0.$$

    (a)   center $(-2, 3)$, radius 2

    (b)   center $(2, -3)$, radius $\sqrt{2}$

    (c)   center $(-2, 3)$, radius $\sqrt{2}$

    (d)   center $(4, -6)$, radius $\sqrt{13}$

    (e)   None of the above.

15. What is the vertex of the quadratic function $f(x) = 2(x - 1)^2 + 5$?

    (a) $(1, 5)$

    (b) $(-1, 5)$

    (c) $(5, 1)$

    (d) $(5, -1)$

    (e)   None of the above.

16. Solve the inequality $\dfrac{(x-5)(x+8)}{x} \geq 0$.

   (a) $(-\infty, \infty)$

   (b) $[-8, 0] \cup [5, \infty]$

   (c) $[-8, 0) \cup [5, \infty)$

   (d) $(-\infty, 8] \cup (0, 5]$

   (e) None of the above.

17. A trucking company transports goods between Chicago and New York, a distance of 960 miles. The company charges a $50 loading fee. In addition, there is a transport charge of $0.50 per mile for the first 100 miles and $0.25 per mile for each additional mile. How much would the total charge be to load and transport one truckload from Chicago to New York?

   (a) $265

   (b) $340

   (c) $770

   (d) $315

   (e) None of the above.

18. Solve the inequality $(x-1)(x+3)^2 > 0$

   (a) $(-\infty, \infty)$

   (b) $(-\infty, -3) \cup (1, \infty)$

   (c) $(1, \infty)$

   (d) $(-\infty, 1)$

   (e) None of the above.

19. Use the *Rational Zeros Theorem* to list the potential rational zeros of the polynomial function
$$f(x) = 3x^4 - 3x^3 + x^2 - x + 1.$$
Do not attempt to find the zeros.

   (a) $\pm 1, \ \pm \dfrac{1}{3}$

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

   (c) $-0.4397, \ 1.1681$

   (d) $\pm 1, \ \pm 2, \ \pm \dfrac{1}{2}$

   (e) None of the above.

20. Which quadrant contains the point $(-3, -5)$?

    (a) I

    (b) II

    (c) III

    (d) IV

    (e) None of the above.

21. Find the slope and y-intercept of the line $y = 2x + 3$.

    (a) slope 2, y-intercept $-\dfrac{3}{2}$

    (b) slope $\dfrac{2}{3}$, y-intercept 3

    (c) slope 3, y-intercept 2

    (d) slope 2, y-intercept 3

    (e) None of the above.

22. Let $f(x) = 3x + 5$, and let $g(x) = -2x + 15$. Solve $f(x) \geq g(x)$. Express your answer in interval notation.

    (a) $[2, \infty)$

    (b) $(-\infty, 2]$

    (c) $\left[-\dfrac{5}{3}, \dfrac{15}{2}\right]$

    (d) $(-\infty, \infty)$

    (e) None of the above.

23. Let f be a polynomial function of degree 17. Which of the following statements MUST be true?

    (a) f has at MOST 17 roots.

    (b) The graph of f has at MOST 16 turning points.

    (c) As x goes to ∞, $f(x)$ goes to ∞, and as x goes to $-\infty$, $f(x)$ goes to $-\infty$.
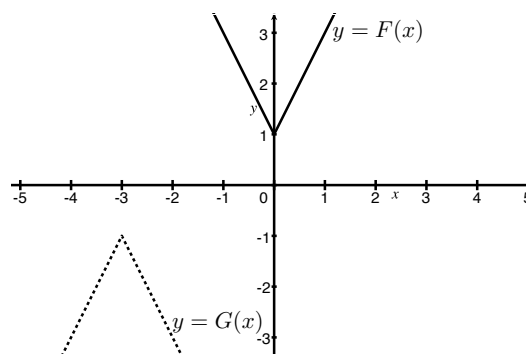
    (d) All of the above.

    (e) None of the above.

24. A track and field playing area is in the shape of a rectangle with semicircles at each end. The perimeter of the track is to be 1500 meters. What should the dimensions of the rectangle be so that the area of the rectangle is a maximum? Round to two decimal places.
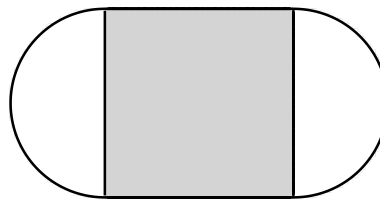
    (a)   238.73 meters by 375.00 meters

    (b)   257.93 meters by 350.75 meters

    (c)   298.32 meters by 367.33 meters

    (d)   223.65 meters by 392.22 meters

    (e)   None of the above.

25. Find the oblique asymptote, if one exists, of the graph of the function

$$Q(x) = \frac{3x^4 - x^2}{x^3 - x^2 + 1}.$$

    (a) $y = 3x - 2$

    (b) $x = 0$ and $x = \sqrt{\dfrac{1}{3}}$

    (c) $y = 3x + 3$

    (d)   No oblique asymptote.

    (e)   None of the above.

26. The graph of a function F is shown here using solid lines. The graph of G is shown on the same axes using dotted lines. Which of the following best expresses the function G in terms of F?

    (a) $G(x) = F(x + 3) + 2$

    (b) $G(x) = -F(x - 3) - 2$

    (c) $G(x) = -F(x + 3) - 2$

    (d) $G(x) = F(-x + 3) - 2$

    (e)   None of the above.

8

27. An island is 4 miles from the nearest point P on a straight shoreline. A town is 14 miles down the shore from P. If Eric can row a boat an average of 2 miles per hour, and he can walk 5 miles per hour, how long does it take Eric to reach the town if he lands the boat 4 miles east of P? Round to 2 decimal places.
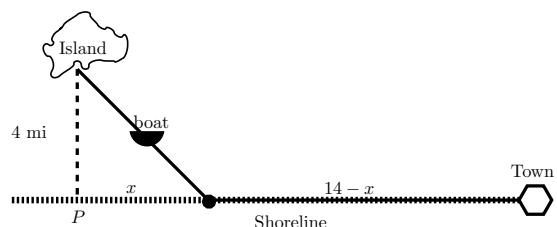
(a) 2.75 hours

(b) 4.83 hours

(c) 4.03 hours

(d) 5.54 hours

(e) None of the above.

28. Find the real solutions to the equation

$$x^3 + 2x^2 - 5x - 10 = 0.$$

(a) -2

(b) $-2, \ \sqrt{5}, \ -\sqrt{5}$

(c) $\pm 1, \pm 2, \pm 5, \pm 10$

(d) $2, \ -5, \ 10$

(e) None of the above.

29. The marketing manager at Levi-Strauss wishes to find a function that relates the demand D (pairs of jeans sold per day) for men's jeans and the price p (dollars) of the jeans. After collecting lots of data the line of best that models the relation between price and quantity demanded is $D = -1.336p + 86$. According to the model, which of the following statements is most correct?

(a) If the price increases \$1, the quantity sold per day decreases by about 1.336 pairs of jeans.

(b) If the price increases \$1, the quantity sold per day increases by about 1.336 pairs of jeans.

(c) If the price increases \$1.336, the quantity sold per day increases by about 1 pair of jeans.

(d) If the price decreases \$1.336, the quantity sold per day increases by about 1 pair of jeans.

(e) None of the above.

9

30. Find $f(0)$, where $f(x) = \dfrac{x}{x^2 - 1}$

    (a)   0

    (b)   1

    (c) -1

    (d)   Undefined.

    (e)   None of the above.

31. Determine if the function $F(x) = \dfrac{2x}{|x|}$ is odd, even, or neither.

    (a)   Odd

    (b)   Even

    (c)   Neither

    (d)   Rational

    (e)   None of the above.

32. A ball is thrown vertically upward with an initial velocity of 96 feet per second. The distance s (feet) of the ball from the ground after t (seconds) is $s(t) = 80t - 16t^2$. At what time will the ball strike the ground?

    (a)   2.5 seconds

    (b)   5 seconds

    (c)   7.5 seconds

    (d)   10 seconds

    (e)   None of the above.

33. Which of the following points is on the graph of $y = 2x - 3$?

    (a) $(0, 0)$

    (b) $(1, -1)$

    (c) $(2, -3)$

    (d) $(-1, 1)$

    (e)   None of the above.

34. Determine from the data if the function f is linear. If it is linear, determine the slope.

x	$f(x)$
-2	7
-1	4
0	1
1	-2
2	-5

   (a)   Not linear.

   (b)   Linear with slope 3.

   (c)   Linear with slope -3.

   (d)   Linear with slope $-\dfrac{1}{3}$.

   (e)   None of the above.

35. Use the graph of the rational function f shown here to solve the inequality $f(x) \leq 0$.

   (a) $(-5, 2) \cup (2, 5]$

   (b) $[-5, 5]$
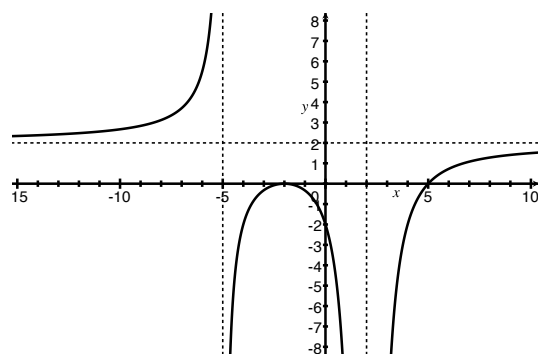
   (c) $(-5, -2] \cup (5, \infty)$

   (d) $(-\infty, -5) \cup (-5, 2) \cup (2, \infty)$

   (e)   None of the above.

36. What is the y-intercept of the graph of $f(x) = 2(x-1)^2 + 5$?

   (a)   5

   (b)   7

   (c)   1

   (d) $1 + \sqrt{\dfrac{5}{2}}$

   (e)   None of the above.

37. Solve the inequality $x^2 + x + 5 > 0$.

    (a) $(-\infty, \infty)$

    (b) $\emptyset$

    (c) $\left(-\infty, \dfrac{-1 - \sqrt{19}}{2}\right) \cup \left(\dfrac{-1 - \sqrt{19}}{2}, \infty\right)$

    (d) $\left(\dfrac{-1 - \sqrt{19}}{2}, \dfrac{-1 + \sqrt{19}}{2}\right)$

    (e)   None of the above.
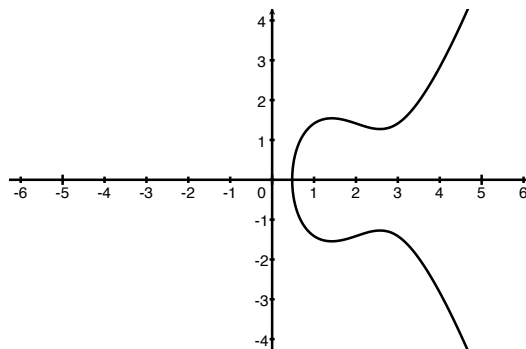
38. Let $U = \left\{$ $\right\}$, and let

$$G = \{x \in U \mid x \text{ is female}\}.$$

Compute the complement of G in U, which we denote $\overline{G}$.

    (a) $\overline{G} = \left\{ \ \right\}$

    (b) $\overline{G} = \left\{ \ \right\}$

    (c) $\overline{G} = \left\{ \ \right\}$

    (d) $\overline{G} = \left\{ \ \right\}$

    (e)   None of the above.

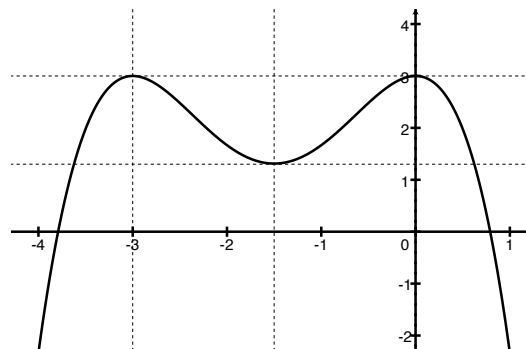39. Which of the following best describes the graph show here.

   (a)   This graph is the graph of a function.

   (b)   This graph is not the graph of a function.

   (c)   This graph is a parabola.

   (d)   This graph is purple.

   (e)   None of the above.

40. Simplify the expression $\dfrac{x^{-3}y^4}{x^2 y^5}$ using only positive exponents. Whenever the exponent is negative or 0, we assume that the base does not equal 0.

   (a) $\dfrac{1}{x^5 y}$

   (b) $x^5 y^9$

   (c) $\dfrac{y^{20}}{x^6}$

   (d) $\dfrac{y^{4/5}}{x^{5/3}}$

   (e)   None of the above.

41. Use synthetic division to compute the quotient $\dfrac{2x^5 + 5x^4 - 2x^3 + 2x^2 - 2x + 3}{x + 3}$.

   (a) $2x^4 - x^3 + x^2 - x + 1$

   (b) $2x^4 + 2x^3 - x^2 + 2x + 1$

   (c) $2x^4 - x^3 - 3x^2 + x + 1$

   (d) $2x^4 + x^3 + 2x^2 - x - 1$

   (e)   None of the above.

13

42. The graph of a function g is given here. Determine all of the local maxima. Some dotted lines have been added to help (or mislead) you.

    (a)   3

    (b) -3, 0

    (c)   1.3

    (d) -1.5

    (e)   None of the above.

43. The graph of $y = f(x)$ is shown here. Use the graph to determine $f(2)$.

    (a)   0

    (b)   3

    (c)   5.5

    (d) -1.5
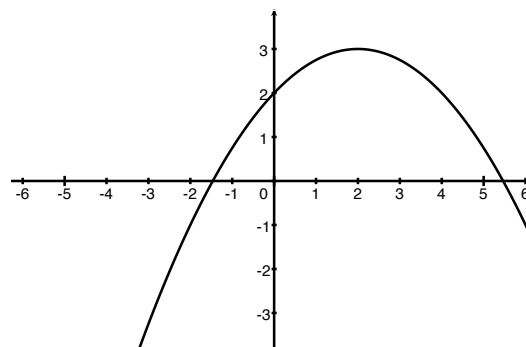
    (e)   None of the above.

44. Which of the following statements best describes the correspondence between x and y shown here.

x	y
salt & vinegar chips	yummy
caramel	sticky
elephant	muddy
stick	sticky

  (a) y is not a function of x.

  (b) y is a function of x, but it is not one-to-one.

  (c) y is a one-to-one function of x.

  (d) y is a continuous function of x.

  (e)   None of the above.

45. The function
$$f(x) = \frac{2x + 1}{x - 1}, \qquad x \neq 1$$
is one-to-one. Find its inverse.

  (a) $f^{-1}(x) = \dfrac{x + 1}{x - 2}, \qquad x \neq 2$

  (b) $f^{-1}(x) = \dfrac{x - 1}{2x + 1}, \qquad x \neq -\dfrac{1}{2}$

  (c) $f^{-1}(x) = \dfrac{1}{2}(x - 3)$

  (d) $f^{-1}(x) = \dfrac{2x + 1}{x - 1}, \qquad x \neq 1$

  (e)   None of the above.

46. Let D represent the percentage of people that are divorced at age x. After much data is collected, the following quadratic function of best fit is
$$D(x) = -0.0136x^2 + 1.4794x - 26.3412.$$

According to the model, what is the age with the greatest percentage divorced? Round to the nearest year.

  (a)   32 years old

  (b)   37 years old

  (c)   54 years old

  (d)   63 years old

  (e)   None of the above.

47. Find the horizontal asymptote, if one exists, of the graph of $R(x) = \dfrac{x - 12}{x^2 + 2x + 1}$.

    (a) $y = 0$

    (b) $y = 1$

    (c) $x = -1$

    (d) $x = 12$

    (e)   None of the above.

48. Use the *Bounds on Zeros Theorem* to find bounds on the real zeros of the polynomial
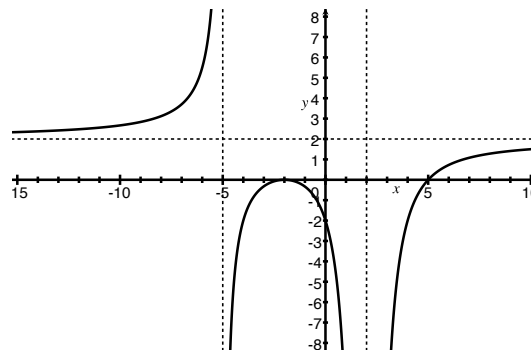
$$g(x) = x^4 - 3x^2 + x - 4.$$

    (a)   Every real zero of g must lie between -8 and 8.

    (b)   Every real zero of g must lie between -5 and 5.

    (c)   Every real zero of g must lie between -4 and 4.

    (d)   Every real zero of g must lie between -3 and 3.

    (e)   None of the above.

49. Let $f(x) = \dfrac{1}{x + 2}$, and let $g(x) = \dfrac{4}{x - 1}$. Find the domain of $f \circ g$.

    (a) $\{x \in \mathbb{R} \mid x \neq 1, -1\}$

    (b) $\{x \in \mathbb{R} \mid x \neq 0\}$

    (c) $\{x \in \mathbb{R} \mid x \neq 1, -2\}$

    (d)   All real numbers.

    (e)   None of the above.

50. The graph of a rational function g is shown here. The dotted lines indicate asymptotes. Which of the following must be true?

(a) The numerator of g has a factor of the form $(x-5)^m$, where m is odd.

(b) The numerator of g has a factor of the form $(x-5)^m$, where m is even.

(c) The denominator of g has a factor of the form $(x-5)^m$, where m is odd.

(d) The denominator of g has a factor of the form $(x-5)^m$, where m is even.

(e) None of the above.

Section 2.   Bonus

51. Compute $0.999\ldots + 0.999\ldots$.

   (a) $1.999\ldots$

   (b)   2

   (c) $\dfrac{14}{7}$

   (d)   All of the above

   (e)   None of the above.

52. Who is Duey?

   (a)   Our pet rumpy Manx cat, a breed of cat with no tail.

   (b)   Our pet dog, a lab/hound mix shelter beast of a dog.

   (c)   Our pet Burmese Python, a 17 foot snake that likes to eat chickens.

   (d)   Our pet African Grey Parrot, who knows about 100 words.

   (e)   Our pet Goliath Birdeater, a spider with a leg-span of around 12 inches.

Answer Key for Exam $\boxed{\text{B}}$

Section 1.   Multiple choice

1. (b)	11. (b)	21. (d)	31. (a)	41. (a)
2. (a)	12. (d)	22. (a)	32. (b)	42. (a)
3. (a)	13. (d)	23. (d)	33. (b)	43. (b)
4. (c)	14. (c)	24. (a)	34. (c)	44. (b)
5. (b)	15. (a)	25. (c)	35. (a)	45. (a)
6. (a)	16. (c)	26. (c)	36. (b)	46. (c)
7. (d)	17. (d)	27. (b)	37. (a)	47. (a)
8. (a)	18. (c)	28. (b)	38. (b)	48. (b)
9. (b)	19. (a)	29. (a)	39. (b)	49. (a)
10. (b)	20. (c)	30. (a)	40. (a)	50. (a)

Section 2.   Bonus

51. (d)   52. (b)