

Name _____

State whether the function is a polynomial function or not. If it is, give its degree. If it is not, tell why not.

1) $f(x) = \frac{4 - x^4}{7}$ 1) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

2) $f(x) = \frac{1}{2} - \frac{1}{4}x$ 2) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

3) $f(x) = 1 + \frac{9}{x}$ 3) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

4) $f(x) = 4 - \frac{2}{x^5}$ 4) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

5) $f(x) = x^{5/4} - x^6 - 1$ 5) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

6) $f(x) = -12x^5 + \pi x^4 + 4$ 6) _____

Objective: (4.1) Identify Polynomial Functions and Their Degree

Form a polynomial whose zeros and degree are given.

7) Zeros: $-1, 1, -3$; degree 3

7) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

8) Zeros: 2, multiplicity 2; -2 , multiplicity 2; degree 4

8) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

For the polynomial, list each real zero and its multiplicity. Determine whether the graph crosses or touches the x -axis at each x -intercept.

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

9) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

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

10) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

11) $f(x) = \frac{1}{3}x^2(x^2 - 5)$

11) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

12) $f(x) = 2(x^2 + 5)(x^2 + 1)^2$

12) _____

Objective: (4.1) Identify the Real Zeros of a Polynomial Function and Their Multiplicity

Find the x - and y -intercepts of f .

13) $f(x) = (x + 6)(x - 3)(x + 3)$

13) _____

Objective: (4.1) Analyze the Graph of a Polynomial Function

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

Objective: (4.1) Analyze the Graph of a Polynomial Function

14) _____

Find the power function that the graph of f resembles for large values of $|x|$.

15) $f(x) = (x - 4)^3$

Objective: (4.1) Analyze the Graph of a Polynomial Function

15) _____

16) $f(x) = (x + 2)^2(x + 7)^6$

Objective: (4.1) Analyze the Graph of a Polynomial Function

16) _____

17) $f(x) = -x^2(x + 9)^3(x^2 - 1)$

Objective: (4.1) Analyze the Graph of a Polynomial Function

17) _____

Determine the maximum number of turning points of f .

18) $f(x) = -x^2(x + 7)^3(x^2 - 1)$

Objective: (4.1) Analyze the Graph of a Polynomial Function

18) _____

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

Objective: (4.1) Analyze the Graph of a Polynomial Function

19) _____

Analyze the graph of the given function f as follows:

- (a) Determine the end behavior: find the power function that the graph of f resembles for large values of $|x|$.
- (b) Find the x - and y -intercepts of the graph.
- (c) Determine whether the graph crosses or touches the x -axis at each x -intercept.
- (d) Graph f using a graphing utility.
- (e) Use the graph to determine the local maxima and local minima, if any exist. Round turning points to two decimal places.
- (f) Use the information obtained in (a) – (e) to draw a complete graph of f by hand. Label all intercepts and turning points.
- (g) Find the domain of f . Use the graph to find the range of f .
- (h) Use the graph to determine where f is increasing and where f is decreasing.

20) $f(x) = (x + 2)(x - 3)^2$ 20) _____

Objective: (4.1) Analyze the Graph of a Polynomial Function

21) $f(x) = (x - 3)(x - 1)(x + 2)$ 21) _____

Objective: (4.1) Analyze the Graph of a Polynomial Function

Find the domain of the rational function.

22) $f(x) = \frac{x + 4}{x^2 - 36x}$ 22) _____

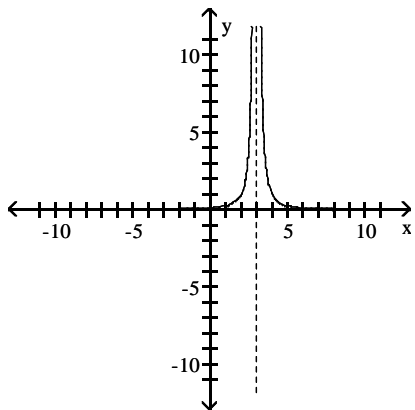
Objective: (4.2) Find the Domain of a Rational Function

23) $f(x) = \frac{-2x(x + 2)}{2x^2 - 7x - 9}$ 23) _____

Objective: (4.2) Find the Domain of a Rational Function

Use the graph to determine the domain and range of the function.

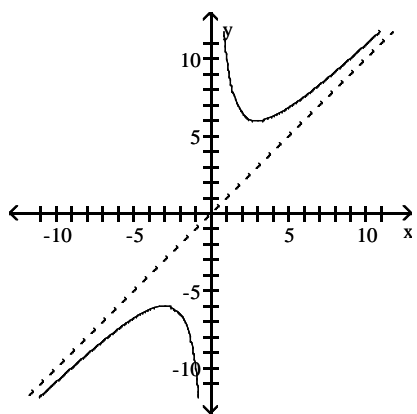
24)



24) _____

Objective: (4.2) Find the Domain of a Rational Function

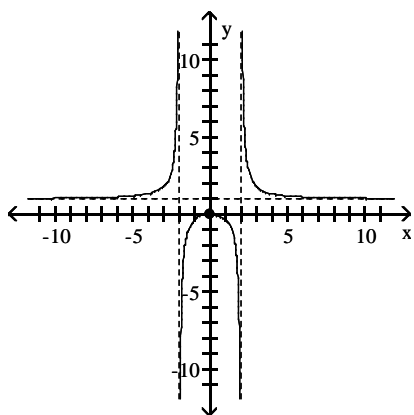
25)



25) _____

Objective: (4.2) Find the Domain of a Rational Function

26)



26) _____

Objective: (4.2) Find the Domain of a Rational Function

Find the vertical asymptotes of the rational function.

27) $h(x) = \frac{2x}{x+9}$

27) _____

Objective: (4.2) Find the Vertical Asymptotes of a Rational Function

28) $g(x) = \frac{x+11}{x^2+36x}$

28) _____

Objective: (4.2) Find the Vertical Asymptotes of a Rational Function

29) $f(x) = \frac{-x^2+16}{x^2+5x+4}$

29) _____

Objective: (4.2) Find the Vertical Asymptotes of a Rational Function

Give the equation of the horizontal asymptote, if any, of the function.

30) $h(x) = \frac{5x - 6}{x - 6}$

30) _____

Objective: (4.2) Find the Horizontal or Oblique Asymptotes of a Rational Function

31) $g(x) = \frac{x^2 + 2x - 7}{x - 7}$

31) _____

Objective: (4.2) Find the Horizontal or Oblique Asymptotes of a Rational Function

32) $h(x) = \frac{8x^2 - 5x - 2}{5x^2 - 4x + 8}$

32) _____

Objective: (4.2) Find the Horizontal or Oblique Asymptotes of a Rational Function

33) $g(x) = \frac{x + 8}{x^2 - 49}$

33) _____

Objective: (4.2) Find the Horizontal or Oblique Asymptotes of a Rational Function

Give the equation of the oblique asymptote, if any, of the function.

34) $f(x) = \frac{x^2 + 4x - 7}{x - 8}$

34) _____

Objective: (4.2) Find the Horizontal or Oblique Asymptotes of a Rational Function

Find the domain of the rational function.

35) $R(x) = \frac{-3x^2}{x^2 + 7x - 30}$

35) _____

Objective: (4.3) Analyze the Graph of a Rational Function

Find the indicated intercept(s) of the graph of the function.

36) y-intercept of $f(x) = \frac{7}{x^2 - 3x - 23}$

36) _____

Objective: (4.3) Analyze the Graph of a Rational Function

37) y-intercept of $f(x) = x + \frac{9}{x}$

37) _____

Objective: (4.3) Analyze the Graph of a Rational Function

38) x-intercepts of $f(x) = \frac{x^2 + 7}{x^2 + 8x + 5}$

38) _____

Objective: (4.3) Analyze the Graph of a Rational Function

39) x-intercepts of $f(x) = \frac{5}{x^2 - x - 56}$

39) _____

Objective: (4.3) Analyze the Graph of a Rational Function

40) x-intercepts of $f(x) = \frac{x^2 - 25}{6 + x^4}$

40) _____

Objective: (4.3) Analyze the Graph of a Rational Function

41) x-intercepts of $f(x) = \frac{x^2 + 3x}{x^2 + 3x - 4}$

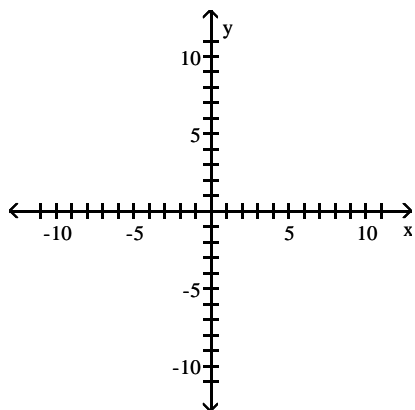
41) _____

Objective: (4.3) Analyze the Graph of a Rational Function

Graph the function.

$$42) f(x) = \frac{x}{x^2 - 64}$$

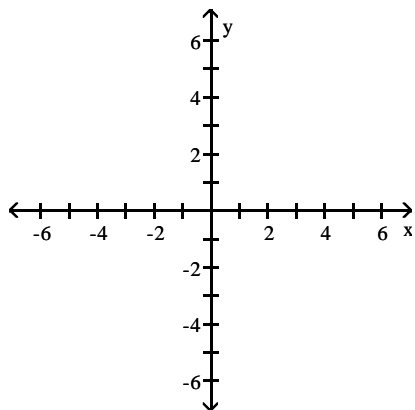
42) _____



Objective: (4.3) Analyze the Graph of a Rational Function

$$43) f(x) = \frac{x^2 + 4x + 4}{(x - 1)^2}$$

43) _____



Objective: (4.3) Analyze the Graph of a Rational Function

Solve the problem.

- 44) A rare species of insect was discovered in the rain forest of Costa Rica. Environmentalists transplant the insect into a protected area. The population of the insect t months after being transplanted is 44) _____

$$P(t) = \frac{45(1 + 0.6t)}{(3 + 0.02t)}.$$

- a) What was the population when $t = 0$?
- b) What will the population be after 10 years?
- c) What is the largest value the population could reach?

Objective: (4.3) Solve Applied Problems Involving Rational Functions

- 45) A can in the shape of a right circular cylinder is required to have a volume of 700 cubic centimeters. The top and bottom are made up of a material that costs 8¢ per square centimeter, while the sides are made of material that costs 5¢ per square centimeter. Which function below describes the total cost of the material as a function of the radius r of the cylinder? 45) _____

A) $C(r) = 0.16\pi r^2 + \frac{70}{r}$

B) $C(r) = 0.16\pi r^2 + \frac{140}{r}$

C) $C(r) = 0.08\pi r^2 + \frac{70}{r}$

D) $C(r) = 0.08\pi r^2 + \frac{140}{r}$

Objective: (4.3) Solve Applied Problems Involving Rational Functions

Solve the inequality.

- 46) $(x + 5)(x - 1) > 0$ 46) _____

Objective: (4.4) Solve Polynomial Inequalities

- 47) $(x + 1)(x - 4) \leq 0$ 47) _____

Objective: (4.4) Solve Polynomial Inequalities

- 48) $x(x - 4) \geq -3$ 48) _____

Objective: (4.4) Solve Polynomial Inequalities

49) $(b + 7)(b + 4)(b - 5) < 0$

Objective: (4.4) Solve Polynomial Inequalities

49) _____

Solve the problem.

50) A ball is thrown vertically upward with an initial velocity of 160 feet per second. The distance in feet of the ball from the ground after t seconds is $s = 160t - 16t^2$. For what interval of time is the ball more than 256 above the ground?

Objective: (4.4) Solve Polynomial Inequalities

50) _____

51) The revenue achieved by selling x graphing calculators is figured to be $x(39 - 0.2x)$ dollars. The cost of each calculator is \$23. How many graphing calculators must be sold to make a profit (revenue - cost) of at least \$312.80?

Objective: (4.4) Solve Polynomial Inequalities

51) _____

Solve the inequality.

52) $\frac{x - 7}{x + 9} < 0$

Objective: (4.4) Solve Rational Inequalities

52) _____

53) $\frac{x - 8}{x + 2} < 1$

Objective: (4.4) Solve Rational Inequalities

53) _____

54) $x + \frac{18}{x} < 9$

Objective: (4.4) Solve Rational Inequalities

54) _____

$$55) \frac{(x-3)(x+3)}{x} \leq 0$$

55) _____

Objective: (4.4) Solve Rational Inequalities

$$56) \frac{(x-1)(3-x)}{(x-2)^2} \leq 0$$

56) _____

Objective: (4.4) Solve Rational Inequalities

$$57) \frac{12}{x-5} > \frac{10}{x-1}$$

57) _____

Objective: (4.4) Solve Rational Inequalities

Use the Factor Theorem to determine whether $x - c$ is a factor of $f(x)$.

$$58) f(x) = x^3 + 3x^2 - 8x + 10; x + 5$$

58) _____

Objective: (4.5) Use the Remainder and Factor Theorems

$$59) f(x) = x^3 + 2x^2 - 6x + 8; x - 4$$

59) _____

Objective: (4.5) Use the Remainder and Factor Theorems

List the potential rational zeros of the polynomial function. Do not find the zeros.

$$60) f(x) = 5x^4 - x^2 + 3$$

60) _____

Objective: (4.5) Use the Rational Zeros Theorem to List the Potential Rational Zeros of a Polynomial Function

61) $f(x) = 6x^4 + 2x^3 - 3x^2 + 2$

61) _____

Objective: (4.5) Use the Rational Zeros Theorem to List the Potential Rational Zeros of a Polynomial Function

Use the Rational Zeros Theorem to find all the real zeros of the polynomial function. Use the zeros to factor f over the real numbers.

62) $f(x) = 5x^3 - 9x^2 - 6x + 8$

62) _____

Objective: (4.5) Find the Real Zeros of a Polynomial Function

63) $f(x) = 2x^4 - 5x^3 + 7x^2 - 10x + 6$

63) _____

Objective: (4.5) Find the Real Zeros of a Polynomial Function

Find the intercepts of the function $f(x)$.

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

64) _____

Objective: (4.5) Find the Real Zeros of a Polynomial Function

Use the Intermediate Value Theorem to determine whether the polynomial function has a zero in the given interval.

65) $f(x) = 5x^3 - 6x^2 - 2x - 6$; $[1, 2]$

65) _____

Objective: (4.5) Use the Intermediate Value Theorem

Information is given about a polynomial $f(x)$ whose coefficients are real numbers. Find the remaining zeros of f .

66) Degree 3; zeros: $4, 5 - i$

66) _____

Objective: (4.6) Use the Conjugate Pairs Theorem

67) Degree 4; zeros: $4 - 5i, 8i$

67) _____

Objective: (4.6) Use the Conjugate Pairs Theorem

Form a polynomial $f(x)$ with real coefficients having the given degree and zeros.

68) Degree 3; zeros: $1 + i$ and -8

68) _____

Objective: (4.6) Find a Polynomial Function with Specified Zeros

69) Degree: 3; zeros: -4 and $3 - 2i$

69) _____

Objective: (4.6) Find a Polynomial Function with Specified Zeros

Use the given zero to find the remaining zeros of the function.

70) $f(x) = x^4 - 12x^2 - 64$; zero: $-2i$

70) _____

Objective: (4.6) Find the Complex Zeros of a Polynomial Function

Find all zeros of the function and write the polynomial as a product of linear factors.

71) $f(x) = x^3 + 4x^2 - 2x - 20$

71) _____

Objective: (4.6) Find the Complex Zeros of a Polynomial Function

72) $f(x) = x^4 + 13x^2 + 36$

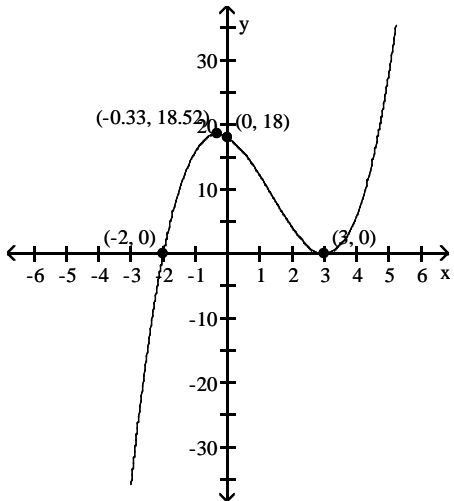
72) _____

Objective: (4.6) Find the Complex Zeros of a Polynomial Function

Answer Key

Testname: 13SPR_CH4_MATH2_HW_3

- 1) Yes; degree 4
- 2) Yes; degree 1
- 3) No; x is raised to a negative power
- 4) No; x is raised to the negative 5 power
- 5) No; x is raised to non-integer $5/4$ power
- 6) Yes; degree 5
- 7) $f(x) = x^3 + 3x^2 - x - 3$ for $a = 1$
- 8) $f(x) = x^4 - 8x^2 + 16$
- 9) -3 , multiplicity 1, crosses x -axis; 1 , multiplicity 2, touches x -axis
- 10) -2 , multiplicity 2, touches x -axis
- 11) 0 , multiplicity 2, touches x -axis;
 $\sqrt{5}$, multiplicity 1, crosses x -axis;
 $-\sqrt{5}$, multiplicity 1, crosses x -axis
- 12) No real zeros
- 13) x -intercepts: $-6, -3, 3$; y -intercept: -54
- 14) x -intercepts: $-3, -1, 0, 1$; y -intercept: 0
- 15) $y = x^3$
- 16) $y = x^8$
- 17) $y = -x^7$
- 18) 6
- 19) 2
- 20) (a) For large values of $|x|$, the graph of $f(x)$ will resemble the graph of $y = x^3$.
(b) y -intercept: $(0, 18)$, x -intercepts: $(3, 0)$ and $(-2, 0)$
(c) The graph of f crosses the x -axis at $(-2, 0)$ and touches the x -axis at $(3, 0)$.
(e) Local minimum at $(3, 0)$; Local maximum at $(-0.33, 18.52)$
(f)

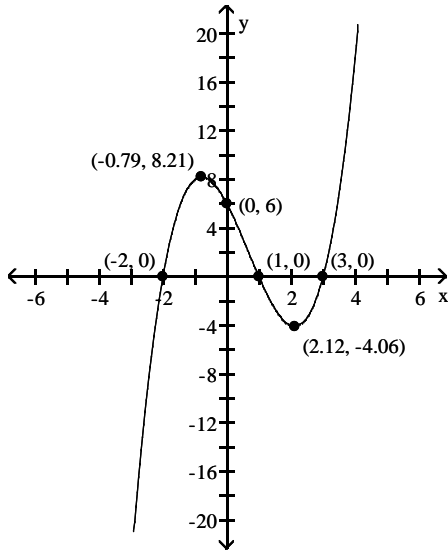


- (g) Domain of f : all real numbers; range of f : all real numbers
- (h) f is increasing on $(-\infty, -0.33)$ and $(3, \infty)$; f is decreasing on $(-0.33, 3)$

Answer Key

Testname: 13SPR_CH4_MATH2_HW_3

- 21) (a) For large values of $|x|$, the graph of $f(x)$ will resemble the graph of $y = x^3$.
 (b) y-intercept: $(0, 6)$, x-intercepts: $(-2, 0)$, $(1, 0)$, and $(3, 0)$
 (c) The graph of f crosses the x-axis at each of the intercepts $(-2, 0)$, $(1, 0)$, and $(3, 0)$
 (e) Local maximum at $(-0.79, 8.21)$; Local minimum at $(2.12, -4.06)$
 (f)

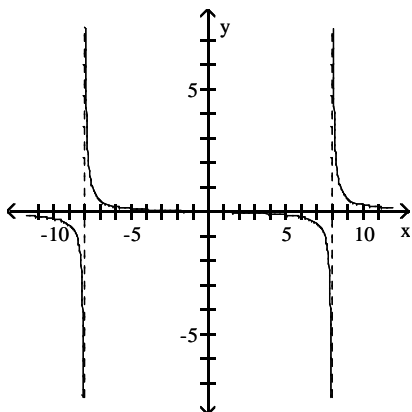


- (g) Domain of f : all real numbers; range of f : all real numbers
 (h) f is increasing on $(-\infty, -0.79)$ and $(2.12, \infty)$; f is decreasing on $(-0.79, 2.12)$
- 22) $\{x \mid x \neq 0, x \neq 36\}$
 23) $\left\{x \mid x \neq \frac{9}{2}, -1\right\}$
 24) domain: $\{x \mid x \neq 3\}$
 range: $\{y \mid y > 0\}$
 25) domain: $\{x \mid x \neq 0\}$
 range: $\{y \mid y \leq -6 \text{ or } y \geq 6\}$
 26) domain: $\{x \mid x \neq -2, x \neq 2\}$
 range: $\{y \mid y \leq 0 \text{ or } y > 1\}$
 27) $x = -9$
 28) $x = 0, x = -36$
 29) $x = -1$
 30) $y = 5$
 31) no horizontal asymptotes
 32) $y = \frac{8}{5}$
 33) $y = 0$
 34) $y = x + 12$
 35) $\{x \mid x \neq -10, 3\}$
 36) $\left(0, -\frac{7}{23}\right)$
 37) none
 38) none
 39) none
 40) $(-5, 0), (5, 0)$
 41) $(0, 0), (-3, 0)$

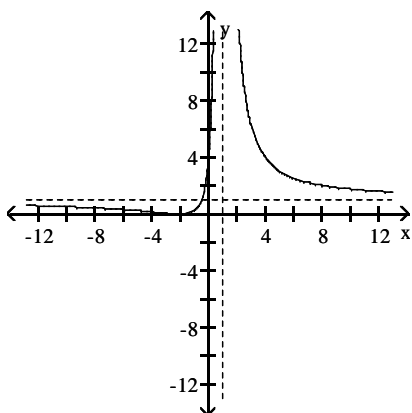
Answer Key

Testname: 13SPR_CH4_MATH2_HW_3

42)



43)



- 44) a) $P(0) = 15$ insects
 b) $P(120) \approx 608$ insects
 c) 1,350

45) A

46) $(-\infty, -5)$ or $(1, \infty)$

47) $[-1, 4]$

48) $(-\infty, 1]$ or $[3, \infty)$

49) $(-\infty, -7)$ or $(-4, 5)$

50) $\{x \mid 2 \text{ sec} < x < 8 \text{ sec}\}$

51) $\{x \mid 34 < x < 46\}$

52) $(-9, 7)$

53) $(-2, \infty)$

54) $(-\infty, 0)$ or $(3, 6)$

55) $(-\infty, -3]$ or $(0, 3]$

56) $(-\infty, 1]$ or $[3, \infty)$

57) $(-19, 1)$ or $(5, \infty)$

58) Yes

59) No

60) $\pm \frac{1}{5}, \pm \frac{3}{5}, \pm 1, \pm 3$

61) $\pm \frac{1}{6}, \pm \frac{1}{3}, \pm \frac{1}{2}, \pm \frac{2}{3}, \pm 1, \pm 2$

Answer Key

Testname: 13SPR_CH4_MATH2_HW_3

62) $-1, \frac{4}{5}, 2$; $f(x) = (5x - 4)(x - 2)(x + 1)$

63) $1, \frac{3}{2}$; $f(x) = (x - 1)(2x - 3)(x^2 + 2)$

64) x-intercepts: 1, -1, 3; y-intercept: 3

65) $f(1) = -9$ and $f(2) = 6$; yes

66) $5 + i$

67) $4 + 5i, -8i$

68) $f(x) = x^3 + 6x^2 - 14x + 16$

69) $f(x) = x^3 - 2x^2 - 11x + 52$

70) $2i, 4, -4$

71) $f(x) = (x - 2)(x + 3 + i)(x + 3 - i)$

72) $f(x) = (x + 2i)(x - 2i)(x + 3i)(x - 3i)$