

Lines, parabolas, and circles

1. Find the equation of the line with slope $\frac{8}{7}$ and y -intercept $\frac{5}{7}$.
2. Find the equation of the line with slope $-\frac{2}{3}$ and x -intercept 4.
3. Find the equation of the line containing the points $(4, 1)$ and $(-2, -1)$.
4. Given the point $(1, -1)$ and the line $2x + 3y = 4$, find the equation for line passing through the point that is parallel to the given line. Then find the equation of the line passing through the point that is perpendicular to the given line.
5. Given the point $(1, -1)$ and the line $x = 4$, find the equation for line passing through the point that is parallel to the given line. Then find the equation of the line passing through the point that is perpendicular to the given line.

For each of the following parabolas:

- (a) Determine if the parabola opens up or down.
- (b) Give the coordinates of the vertex.
- (c) Give the equation for the axis of symmetry.

6. $y = x^2$

7. $y = -x^2 - 8x - 13$

8. $f(x) = 2x^2 - 16x + 33$

9. Graph the circle $(x + 1)^2 + (y - 2)^2 = 16$.

10. Give the center and radius for the circle $x^2 + y^2 + 14x - 12y + 4 = 0$.

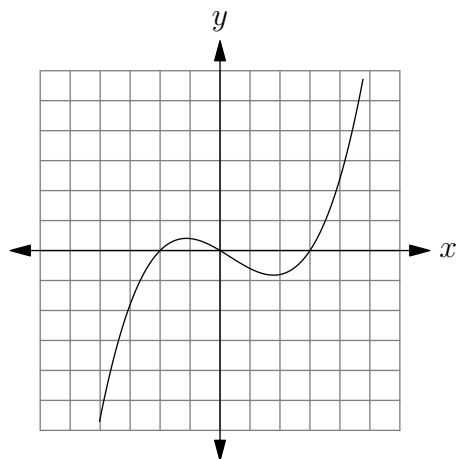
Polynomials and rational functions

11. Use the remainder theorem to determine if $(x - 2)$ is a factor of $x^3 - x^2 - x - 2$.
12. List all possible rational roots of the polynomial function $f(x) = 5x^3 - 2x^2 + 20x - 8$. You do *not* need to divide the roots to determine which ones are factors.
13. Suppose we know that $f(x) = x^3 - 5x^2 + 9x - 45$ has $x = 3i$ as one of its zeros.
 - (a) Find all remaining zeros of the function, both real and complex.
 - (b) How many x -intercepts does the function have?
 - (c) How many turning points does the function have? (Try making a graph on your calculator.)

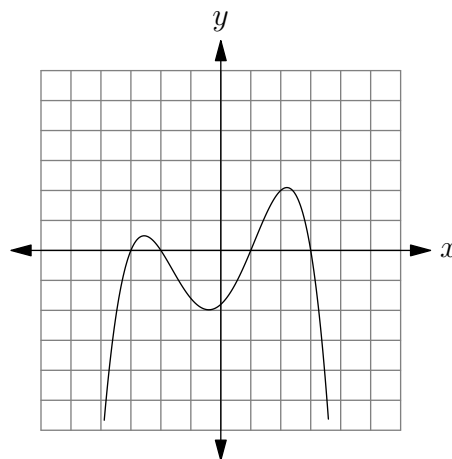
For the polynomial functions in each graph:

- Determine if the function has even or odd degree.
- Determine if the leading term has a positive or negative coefficient.

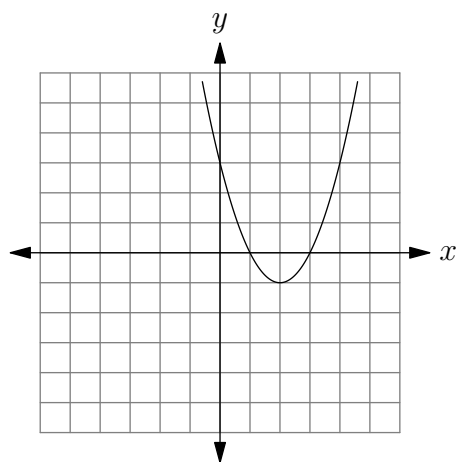
14.



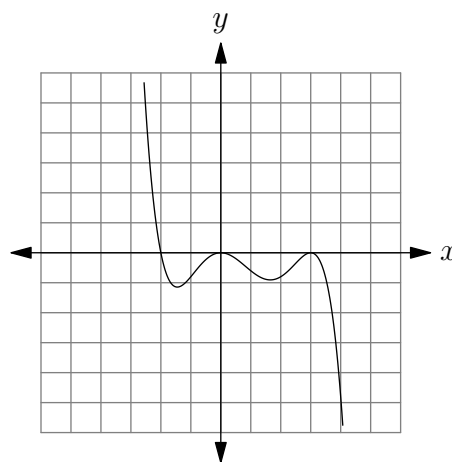
16.



15.



17.



For each of the following functions:

- Give the coordinates of the y -intercept, if any.
- Give the coordinates of the x -intercepts, if any.
- Give the equations for the vertical asymptotes, if any.
- Analyze the ratio of leading terms and determine if the equation has a horizontal asymptote or a slant asymptote. If it does, give the equation
- Give the coordinates of any holes.
- Sketch the graph. Make sure the your y -coordinates have the correct sign.

18. $R(x) = \frac{3}{x^2 - 4x}$
19. $f(x) = \frac{x^3}{x^2 + x - 6}$
20. $g(x) = \frac{x^2 - 9}{x^2 - 2x - 8}$

Applications

21. A copy shop charges customers a flat fee of \$10 per job plus an additional 20 cents per page.
- (a) Write a function giving the total cost of a job as function of the number of pages. So x will be the number of pages, and y will be dollars.
 - (b) If I am charged \$23.80, how many pages did I copy?
22. A cannonball is fired from the top of a cliff. Its height is described by the function

$$h(x) = \frac{-32}{2500}x^2 + x + 200,$$

where x is the horizontal distance from the cliff (in feet), and h is the vertical distance above the ground (also in feet).

- (a) How high is the cannonball at the time it is launched?
 - (b) What is the maximum height of the cannonball?
 - (c) How far is the cannonball from the cliff at the time it hits the ground?
23. The number of bacteria in a sample grows according to the function
- $$N(t) = 1000e^{0.01t},$$
- where t is time in hours, and N is the number of bacteria.
- (a) How many bacteria are present at time $t = 0$?
 - (b) What is the population after 4 hours?
 - (c) When does the number of bacteria reach 1700?
 - (d) How long does it take the population to double?
24. The half-life of radium is 1690 years. If 10 g are present now, how much will remain in 1000 years?

SOLUTIONS

1. $y = \frac{8}{7}x + \frac{5}{7}$

2. $y = -\frac{2}{3}x + \frac{8}{3}$

3. $y = \frac{1}{3}x - \frac{1}{3}$

4. parallel: $y = -\frac{2}{3}x - \frac{1}{3}$
perpendicular: $y = \frac{3}{2}x - \frac{5}{2}$

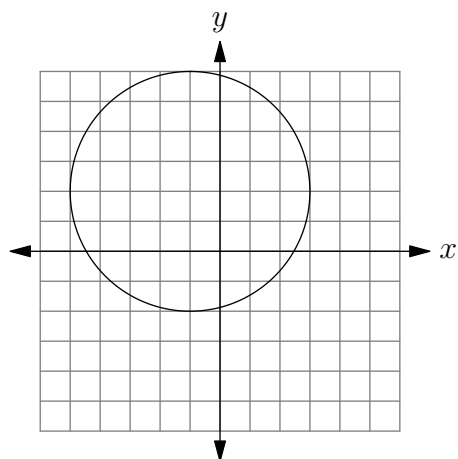
5. parallel: $x = 1$
perpendicular: $y = -1$

6. up
(0, 0)
 $x = 0$

7. down
(-4, 3)
 $x = -4$

8. up
(4, 1)
 $x = 4$

9.



10. Center: (-7, 6)
Radius: $\sqrt{89}$

11. Yes

12. $\pm 1, \pm 2, \pm 4, \pm 8, \pm \frac{1}{5}, \pm \frac{2}{5}, \pm \frac{4}{5}, \pm \frac{8}{5}$

13. (a) $5, 3i, -3i$
(b) 1
(c) none

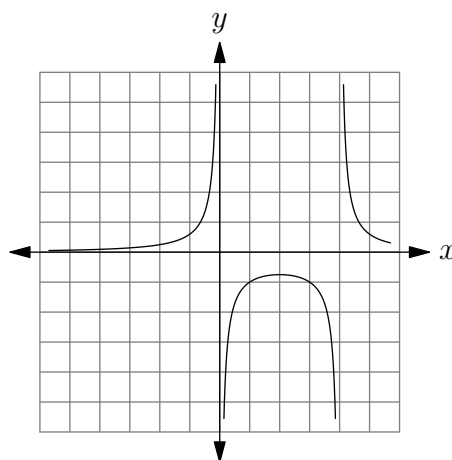
14. odd, positive

15. even, positive

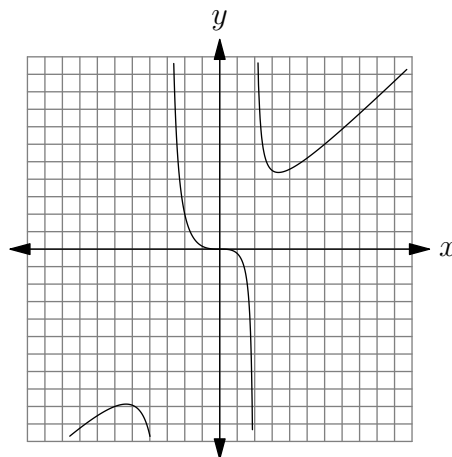
16. even, negative

17. odd, negative

18. (a) none
(b) none
(c) $x = 0, x = 4$
(d) $y = 0$
(e) none
(f)



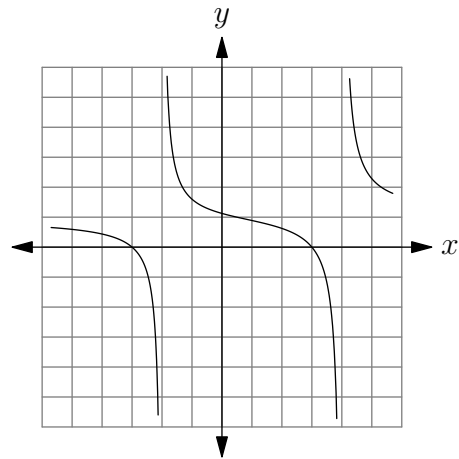
19. (a) (0, 0)
(b) (0, 0)
(c) $x = -3, x = 2$
(d) $y = x + 1$
(e) none
(f)



20. (a) $(0, \frac{9}{8})$
(b) $(-3, 0), (3, 0)$
(c) $x = -2, x = 4$
(d) $y = 1$

(e) none

(f)



21. (a) 200 feet

(b) 219.5 feet

(c) 170 feet

22. (a) $y = 0.2x + 10$

(b) 69 pages

23. (a) 1000

(b) 1041

(c) 13.3 hours

(d) 17.3 hours

24. 6.64 g