

## 1.3 Linear Functions

### Exercises

In Exercises 1–5 find the slope of the line that passes through the given pair of points.

1.  $(2, -3)$  and  $(0, 4)$ ;
2.  $(-1, 2)$  and  $(2, 5)$ ;
3.  $(2, 0)$  and  $(0, 2)$ ;
4.  $(5, -1)$  and  $(-2, -1)$ ;
5.  $(\frac{2}{3}, -\frac{1}{5})$  and  $(-\frac{1}{7}, \frac{1}{8})$ .

In Exercises 6–15 find the slope and  $x$ - and  $y$ -intercepts of the line and draw the graph.

6.  $y = 3x$ ;
7.  $y = 5x + 2$ ;
8.  $y = 3x - 6$ ;
9.  $x + y = 2$ ;
10.  $3x + 2y = 6$ ;
11.  $2x - 4y = 12$ ;
12.  $5y - 3x = 4$ ;
13.  $4x = 2y + 6$ ;
14.  $y = 4$ ;
15.  $y = -1$ .

In Exercises 16–26 write an equation for the line with the given properties.

16. Through  $(2, 0)$  with slope 1;
17. Through  $(-1, 2)$  with slope  $\frac{2}{3}$ ;
18. Through  $(5, -2)$  with slope  $-\frac{1}{2}$ ;
19. Through  $(0, 0)$  with slope 5;
20. Through  $(2, 5)$  and parallel to the  $x$  axis;
21. Through  $(2, 5)$  and parallel to the  $y$ -axis;
22. Through  $(1, 0)$  and  $(0, 1)$ ;
23. Through  $(2, 5)$  and  $(1, -2)$ ;
24. Through  $(-2, 3)$  and  $(0, 5)$ ;
25. Through  $(4, 1)$  and parallel to the line  $2x + y = 3$ ;
26. Through  $(3, 5)$  and parallel to the line  $x + y = 4$ .
27. A 360,000 € building is depreciated by its owner. The value  $y$  of the building after  $x$  months of use is  $y = 360,000 - 1,500x$ .
  - (a) Sketch the graph of this function.
  - (b) How long is it until the building is completely depreciated (its value is zero)?
  - (c) The point  $(60, 270,000)$  lies on the graph. Explain what this mean?
28. A manufacturer's total cost consists of a fixed overhead of 5,000 € plus production costs of 60 € per unit. Express the total cost as a function of the number of units produced and draw the graph.
29. A certain car rental agency charges 35 € per day plus 55 cents per kilometer.
  - (a) Express the cost of renting a car from this agency for 1 day as a function of the number of kilometers driven and draw the graph.

- (b) How much does it cost to rent a car for a 1-day trip of 50 kilometers?
  - (c) How many kilometers were driven if the daily rental cost was 72 €?
30. A cell phone company charges a monthly fee of 25 € plus 0.05 € per minute. Its competitor charges 15 € a month plus 0.10 € per minute.
- (a) For each company, find a formula for the monthly charge  $C$ , in euros, as a function of the number of minutes  $t$  the phone is used during the month.
  - (b) On the same axes, graph both functions.
  - (c) How should you decide which company is cheaper?
31. The retirement plan of a public retirement fund is based on the following formula: "1.5% of average net compensation multiplied by years of credited service." Let  $p$  represent annual retirement pension,  $t$  years of service, and  $c$  average final compensation.
- (a) For someone with average net compensation of 30,000 €, write the linear equation that gives  $p$  in terms of  $t$ .
  - (b) For someone intending to retire after 30 years, write the linear equation that gives  $p$  in terms of  $c$ .
32. A manufacturer buys 20,000 € worth of machinery that depreciates linearly so that its trade-in value after 10 years will be 1,000 €.
- (a) Express the value of the machinery as a function of its age and draw the graph.
  - (b) Compute the value of the machinery after 4 years.
  - (c) When does the machinery become worthless? The manufacturer might not wait this long to dispose of the machinery. Discuss the issues the manufacturer may consider in deciding when to sell.
33. The monthly charge for a waste collection service is 16 € for 100 kg of waste and is 24 € for 180 kg of waste.
- (a) Find a linear formula for the cost  $C$  of waste collection as a function of the number of kilograms  $w$  of waste.

- (b) What is the slope of the line? Give units and interpret your answer in terms of the cost of waste collection.
  - (c) What is the  $y$ -intercept of the line? Give units and interpret your answer in terms of the cost of waste collection.
34. The value of a certain rare book doubles every 10 years. In 1900 the book was worth 100 €.
- (a) How much was it worth in 1910? In 1920?
  - (b) Is the value of the book a linear function of its age? Answer this question by evaluating the rate of change during the first two 10-year periods. Is it constant?
  - (c) Determine the constant  $a$  so that the function  $V(t) = a2^{t/10}$  gives the value of the book  $t$  years after 1900.
  - (d) How much will the book be worth in 2010?