

**Work-out Problems**

*Study tip: Show all your work!*

**Exercise 1.** Let  $x$  denote the input variable and  $y$  denote the output variable. Determine which of the following gives  $y$  as a function of  $x$ .

1.  $\{(-1, 0), (0, -3), (2, -3), (3, 0), (4, 5)\}$

2.  $\{(6, 10), (-7, 3), (0, 4), (6, -4)\}$

3.  $y = x^2 + 1$

4.  $y^2 = x + 1$

5.  $x^2 + y^2 = 4$

**Exercise 2.** Given  $f(x) = -6x^2 + ax - 7$  and  $g(x) = -x^2 - \frac{4}{5}x$  evaluate each of the following.

1.  $f(-10)$

2.  $f(0)$

3.  $f(t)$

4.  $f(t + 1)$

5.  $f(x + 1)$

6.  $f(x) + 1$

7.  $g(x + h)$

8.  $g(x^2 - 5)$

**Exercise 3.** Express the following sets of numbers using interval notation.

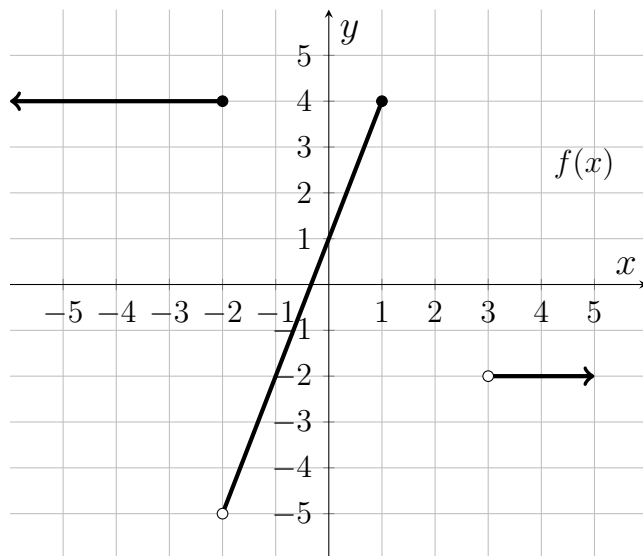
1.  $\{x \mid x \geq \frac{1}{2} \text{ and } x \neq \pm\sqrt{7}\}$

2.  $\{x \mid \frac{11}{5} > x \text{ or } \frac{11}{5} \leq x < 26\}$

3.  $\{x \mid x < -4 \text{ and } 2x + 5 > 21\}$

4.  $\{x \mid x \geq -3 \text{ and } x \leq 0\} \cup \{(x + 2)(x - 5) \neq 0 \text{ and } 0 < x \leq 6\} \cup \{x > 8 \text{ and } x \geq 10\}$

**Exercise 4.** The graph given below is the graph of a function  $f(x)$  (why?).



Determine the following.

1. The domain of  $f$  (in interval notation)

2. The range of  $f$  (in interval notation)

3.  $f(-3)$

4.  $f(-2)$

5.  $f(2)$

6. All zeros of  $f$

7. Where  $f(x) = -2$

**Exercise 5.** Anakin Skywalker, the consultant for the company “It’s Lit!” determines that if the company sells  $x$  lightsabers, their demand equation (where  $x$  is the number of lightsabers demanded and  $p$  is the price in dollars) is the function  $p(x) = -\frac{1}{50}x + 1000$ .

1. Determine the company’s revenue equation.
2. Find the number of lightsabers that should be produced to yield a maximum revenue. Round to the nearest whole number, if necessary. *Answer with a complete sentence, using the correct units.*
3. Calculate the maximum revenue of the company in dollars. Round your answer to 2 decimal places, if necessary. *Answer with a complete sentence, using the correct units.*
4. Find the price at which each lightsaber should be sold to maximize their revenue. Round your answer to 2 decimal places, if necessary. *Answer with a complete sentence, using the correct units.*
5. The company’s cost equation is given by  $C(x) = \frac{1568}{5}x + 1,139,950$ . How many lightsabers should Anakin sell to break even?

**Exercise 6.** A degree 3 polynomial  $f(x) = ax^3 + bx^2 + cx + d$  has  $y$ -intercept  $(0, -4)$  and exactly three real zeros at  $x = 8$ ,  $x = -3$ , and  $x = \frac{1}{2}$ .

1. Find the equation of  $f$ .
2. Describe the end behavior of the graph of  $f(x)$  (both symbolically and with a quick sketch).
3. What is the domain of  $f$ ?

**Exercise 7.** Determine if each of the following is a polynomial. If it is a polynomial, specify its degree, leading coefficient, end behavior, and domain. If it is not a polynomial, state a reason for your answer.

1.  $f(x) = 3x^{1/2} + x\sqrt{2}$

2.  $g(x) = x + 2x^{-1}$

3.  $h(x) = x^3 + 2x + \frac{\sqrt{6}}{7}$

4.  $j(x) = 130x - \frac{5^{2/3}}{4}\sqrt{3}x^{23} + 17x^{12}$

5.  $k(x) = ax^6 + bx^{58} - cx^5 + dx^{11} + 18x^2$  where  $a < 0$ ,  $b < 0$ ,  $c < 0$ , and  $d > 0$ .

**Exercise 8.** Given  $y = -5x^2 + 10x - 4$ , without graphing determine the vertex, axis of symmetry, maximum value, minimum value, domain, range,  $y$ -intercept, and  $x$ -intercept(s) of the function.



**Exercise 9.** Let  $f(x) = -x^2 + 3x$ . Find and simplify the following completely.

$$\frac{f(x+h) - f(x)}{h}$$

*This expression is called a difference quotient. This important concept is introduced in Section 5.2 and we will see it throughout Chapter 5.*

## Multiple Choice Problems

*Study tip: Write out all your work when you complete the multiple-choice problems.*

**Multiple Choice 1.** It has been determined that the revenue function for a stapler is given by  $R(x) = -0.025x^2 + 8.25x$  and the cost function is given by  $C(x) = 1.25x + 500$  where  $R(x)$  and  $C(x)$  are in dollars and  $x$  represents the number of staplers produced and sold. What is the selling price of the stapler when the profit is maximized? (Answers are given to the nearest penny.)

- (a) \$140.00
- (b) \$4.75
- (c) \$4.13
- (d) \$10.00
- (e) None of these

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**Multiple Choice 2.** What is the range of the function

$$h(x) = -(x - 3)^2 + 18 ?$$

- (a)  $(-\infty, \infty)$
- (b)  $[18, \infty)$
- (c)  $(-\infty, 3]$
- (d)  $(-\infty, 18]$
- (e)  $(-\infty, 18)$

**Multiple Choice 3.** Find all the exact zeros of the quadratic function:

$$f(x) = 10x^2 - 3x - 4$$

- (a)  $x = \frac{4}{5}, -\frac{1}{2}$
- (b)  $x = -\frac{4}{5}, \frac{1}{2}$
- (c)  $x = \frac{3}{20}$
- (d)  $x = -4$
- (e) None of the given answer choices are correct.

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**Multiple Choice 4.** Let  $h$  be the function  $h(x) = -5x^8 + 85x^7 + 45x^6 - 6345x^5 + 15120x^4 + 121500x^3 - 349920x^2$  which factors into:

$$h(x) = -5(x - 0)^2(x + 6)^2(x - 3)(x - 9)^2(x - 6).$$

Which of the following statements is **FALSE**?

- (a) The domain of the function is  $(-\infty, \infty)$ .
- (b)  $h(9) = 0$
- (c) The function  $h(x)$  is a polynomial.
- (d)  $h(x) \rightarrow \infty$  as  $x \rightarrow -\infty$ .
- (e) The function  $h(x)$  has zeros at  $x = -6, 0, 3, 6, 9$ .

**Multiple Choice 5.** Elena's Biking Company manufactures and sells bikes. Each bike costs \$40 to make and the company's fixed costs are \$5000. Elena knows that the company's cost is given by a linear function, and that the unit price (in dollars) of each bike is a linear function of the number of bikes sold. Based on her sales data, when the unit price of a bike is \$280, she knows that 10 bikes will be sold, and if the unit price drops by \$60, then 40 bikes will be sold. Which of the following statements is **FALSE**? (All answers are rounded to the *nearest* whole number).

- (a) Elena's cost equation is given by  $C(x) = 40x + 5000$ ,  $x$  denotes the number of bikes sold.
- (b) The graph of the profit equation is a parabola that opens downward.
- (c)  $(x, p) = (40, 60)$  is a point on the graph of the linear demand function where the unit price  $p$  is a function of number of bikes sold,  $x$
- (d) Elena will maximize her profit if 65 bikes are sold
- (e) To break even, Elena should sell approximately 23 bikes or 107 bikes.