

Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. For the quadratic function  $f(x) = 3x^2 - 6x - 7$ , rewrite the equation in standard (vertex) form.

$$3(x^2 - 2x + 1) - 7 - 3$$

$$3(x-1)^2 - 10 = f(x)$$

2. For the equation in #1, determine the zeros of the function. Are they real? Repeating? Or complex? State the values. Find them by factoring or using the quadratic formula as needed.

$$x = \frac{6 \pm \sqrt{36 + 4(3)(7)}}{6} = \frac{6 \pm \sqrt{120}}{6} = \frac{6 \pm 2\sqrt{30}}{6}$$

$$= 1 \pm \frac{\sqrt{30}}{3} \quad \text{real, non-repeating}$$

3. The cost in dollars of a new T-shirt line is  $C(x) = 2x + 26$ , and the demand function for the price of those t-shirts is  $p(x) = 30 - 2x$  (for  $0 \leq x \leq 15$ ). Use this information to:

- a. Find the revenue function.

$$R = xp = x(30 - 2x) = 30x - 2x^2$$

- b. Find the profit function.

$$P = R - C = 30x - 2x^2 - 2x - 26 = -2x^2 + 28x - 26$$

- c. Find the number of t-shirts that should be sold to achieve maximum profit.

$$\text{vertex} = -\frac{b}{2a} = \frac{-28}{2(-2)} = \frac{-28}{-4} = 7$$

- d. What is the price of t-shirts needed to achieve that profit?

$$30 - 2(7) = 30 - 14 = 16$$

4. Write the solution to the inequalities in interval notation.

a.  $|1 - 2x| \geq x + 5$

$$1 - 2x \geq x + 5$$

$$-3x \geq 4$$

$$x \leq -\frac{4}{3}$$

$$\text{or } -(1 - 2x) \geq x + 5$$

$$-1 + 2x \geq x + 5$$

$$x \geq 6$$

$$(-\infty, -\frac{4}{3}] \cup [6, \infty)$$

b.  $5x + 4 \leq 3x^2$

$$3x^2 - 5x - 4 \geq 0$$

$$x = \frac{5 \pm \sqrt{25 + 4(3)(4)}}{6} = \frac{5 \pm \sqrt{73}}{6}$$

$$\left[ \frac{5 - \sqrt{73}}{6}, \frac{5 + \sqrt{73}}{6} \right]$$

5. Jeff and Toby take a trip and log their mileage and gallons of gas used. Find the line of best fit for the data. Write the equation of the best-fit line. What does the slope of the line mean in context?

|                         |    |      |       |       |       |       |       |       |       |       |       |
|-------------------------|----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Gasoline Used (Gallons) | 0  | 9.26 | 19.03 | 28.25 | 36.45 | 44.64 | 53.57 | 62.62 | 71.93 | 81.69 | 90.43 |
| Odometer (Miles)        | 41 | 356  | 731   | 1051  | 1347  | 1631  | 1966  | 2310  | 2670  | 3030  | 3371  |

$$y = 36.80x + 16.39$$

for each gallon of gas, the vehicle can expect to travel around 36.8 miles

i.e. it gets 36.8 mpg.