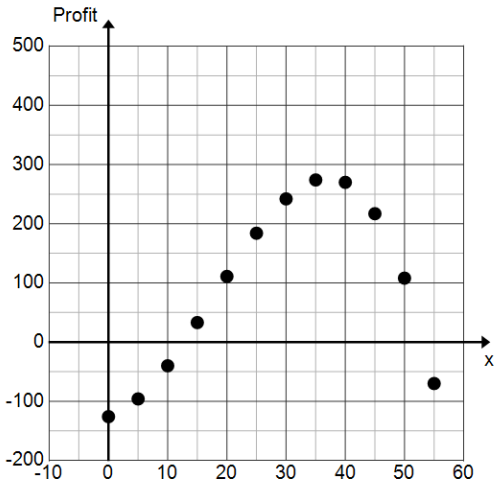
Homework Problem Set Sample Solutions

Bonus: Ask students what is meant by the caption on the t-shirt. (Hint that they can do a web search to find out.) Note: The data in Homework Problem Set #1 is discrete, while the data in the activity was continuous.

1. **For a fundraiser, members of the math club decide to make and sell "Pythagoras may have been Fermat's first problem but not his last!" t-shirts. They are trying to decide how many t-shirts to make and sell at a fixed price. They surveyed the level of interest of students around school and made a scatterplot of the number of t-shirts sold (x) versus profit shown below.**



   a. **Identify the y-intercept. Interpret its meaning within the context of this problem.**

      The y-intercept is approximately -125. The -125 represents the money that they must spend on supplies in order to start making t-shirts. That is, they will lose $\$125$ if they sell 0 t-shirts.

   b. **If we model this data with a function, what point on the graph of that function represents the number of t-shirts they need to sell in order to break even? Why?**

      The break-even point is the first x-intercept of the graph of the function because at this point profit changes from negative to positive. When profit is 0, the club is breaking even.

   c. **What is the smallest number of t-shirts they can sell and still make a profit?**

      Approximately 12 or 13 t-shirts

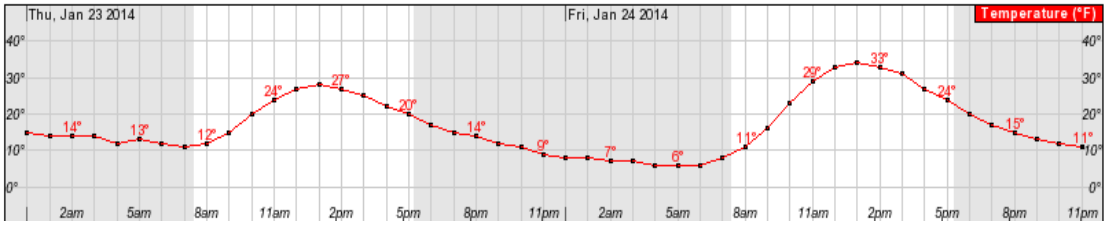
   d. **How many t-shirts should they sell in order to maximize the profit?** Approximately 35 t-shirts

   e. **What is the maximum profit?** Approximately $\$280$

   f. **What factors would affect the profit?** The price of the t-shirts, the cost of supplies, the number of people who are willing to purchase a t-shirt

   g. **What would cause the profit to start decreasing?** Making more t-shirts than can be sold

2. **The following graph shows the temperature in Aspen, Colorado during a 48-hour period beginning at midnight on Thursday, January 21, 2014. (Source: National Weather Service)**



a. **Let T be the function that represents the temperature, in degrees Fahrenheit, as a function of time t, in hours. If we let $t = 0$ correspond to midnight on Thursday, interpret the meaning of $T(5)$. What is $T(5)$?**

The value $T(5)$ represents the temperature at 5 a.m. on Thursday. From the graph, $T(5) = 13$.

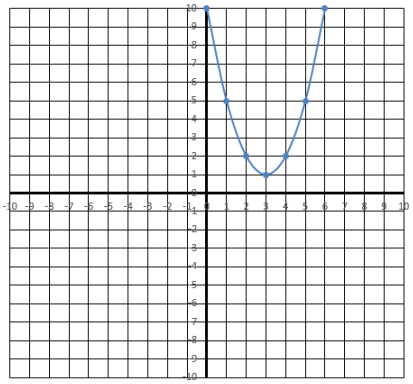
b. **What are the relative maximum values? Interpret their meanings.**

The relative maximum values are approximately $T(13) = 28$ and $T(37) = 34$. These points represent the high temperature on Thursday and Friday and the times at which they occurred. The high on Thursday occurred at $1{:}00$ (when $t = 13$) and was $28°F$. The high on Friday occurred at $1{:}00$ (when $t = 37$) and was $34°F$.

Review

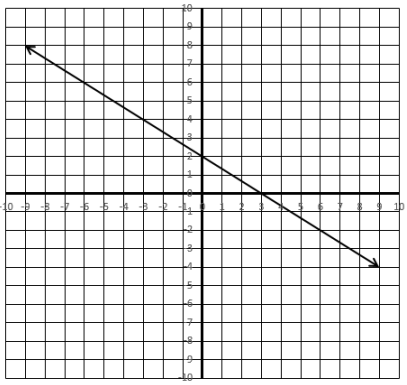
3. Graph each function on the grid provided. You may use what you know about the functions or you can create a table of values to complete the graphs. Then identify the type of graph each one is.

A. $y = (x-3)^2 + 1$



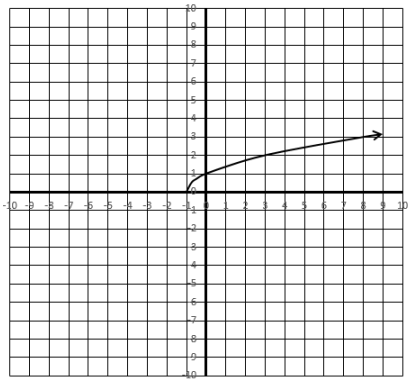
Quadratic Function

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



Linear Function

C. $y = \sqrt{x+1}$



Square Root Function

	Rule in Symbols	Example
Product Rule	$x^m \cdot x^n = x^{m+n}$	$x^7 \cdot x^3 = x^{10}$
Quotient Rule	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{x^7}{x^3} = x^4$
Power Rule	$\left(x^m\right)^n = x^{m \cdot n}$	$\left(x^7\right)^3 = x^{21}$
Negative Exponent Rule	$x^{-m} = \frac{1}{x^m}$	$x^{-7} = \frac{1}{x^7}$
Zero Power Rule	$x^0 = 1$	$\left(xyz\right)^0 = 1$

4. Use the rules above to simplify each expression.

A. $x^6 \cdot x^2 \cdot x^3 = x^{11}$

B. $y^{-2} \cdot y^2 = y^0 = 1$

C. $\left(m^2 n^3\right)^4 = m^8 n^{12}$

D. $\left(2g^3 h^{-1}\right)^{-2} = \frac{h^2}{4g^6}$

E. $\frac{t^6 u^2}{t^3 u} = t^3 u$

F. $\frac{a^2 b^{-3} c d^4}{a^{-1} b^0 c^3} = \frac{a^3 d^4}{b^3 c^2}$

5. Write an integer in the empty space to make a true equation.

A. $\left(\frac{a^3 \cdot a^2}{a^7}\right)^2 = a^{\underline{-9}} \cdot a^5$

B. $\left(\frac{b^{-3} \cdot b^4}{b^0}\right)^{-1} = \frac{b^{\underline{-2}} \cdot b^3}{b^2}$

C. $\left(c^{x+y}\right)^2 = c^{2x} \cdot c^{\underline{2y}}$