11.1 – Quadratic Function & their Graphs

Suppose a hotel rents rooms for $80 a night, but $2 off per room for the total number of rooms rented in your group.

How much would they make with

  1 room?

  10 rooms?

  40 rooms?

This can be modeled by quadratic functions.

The path of a ball thrown or an object dropping can also be modeled by a quadratic.

Portrait of Orlando Magic Mark Price shooting free throw.
Multiple exposure.FL. 3/17/1998 CREDIT: Heinz Kluetmeier
http://www.gettyimages.com/detail/84564612/Sports-Illustrated
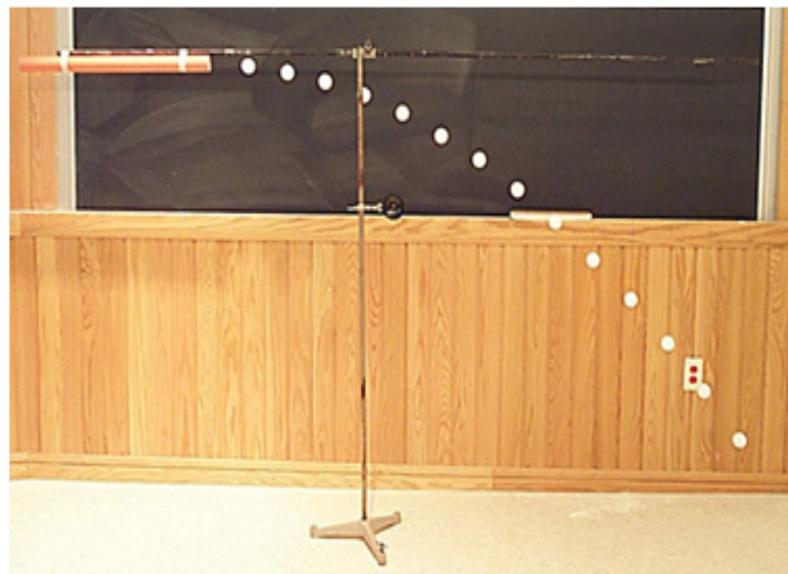
Source: Oberlin College physics department
http://www.oberlin.edu/physics/catalog/
demonstrations/mech/trajectory.jpg

A **quadratic function** can be written in the form

$$f(x) = ax^2 + bx + c,$$

where a, b, and c are constants with $a \neq 0$.

The graph is called a _____.

(standard: $y = x^2$)
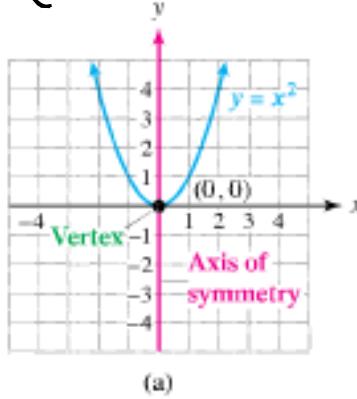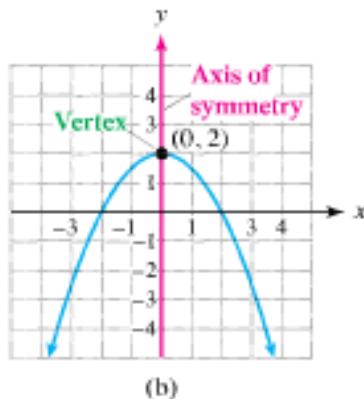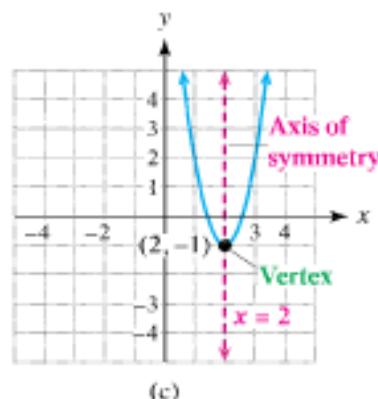
(a) (b) (c)

Moving from left to right, if the graph "goes up" – we say it's _____.

"goes down" – we say it's _____.

① Graph the quadratic functions and state their vertix, axis of symmetry, and intervals of increase & decrease.

a) $f(x) = 2 - x^2$

x	$f(x)$

b) $f(x) = (x-3)^2$

$$\begin{array}{c|c} x & f(x) \\ \hline \\ \\ \\ \\ \end{array}$$

c) $f(x) = x^2 + 2x - 3$

$$\begin{array}{c|c} x & f(x) \\ \hline \\ \\ \\ \\ \end{array}$$
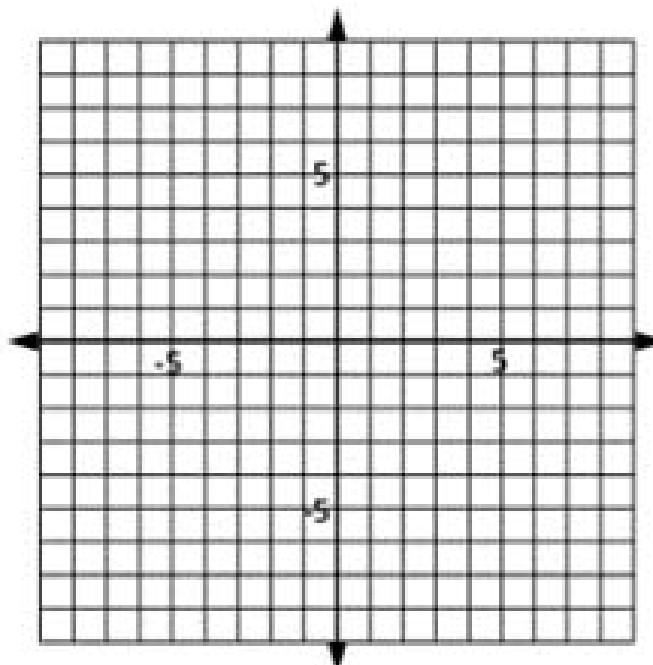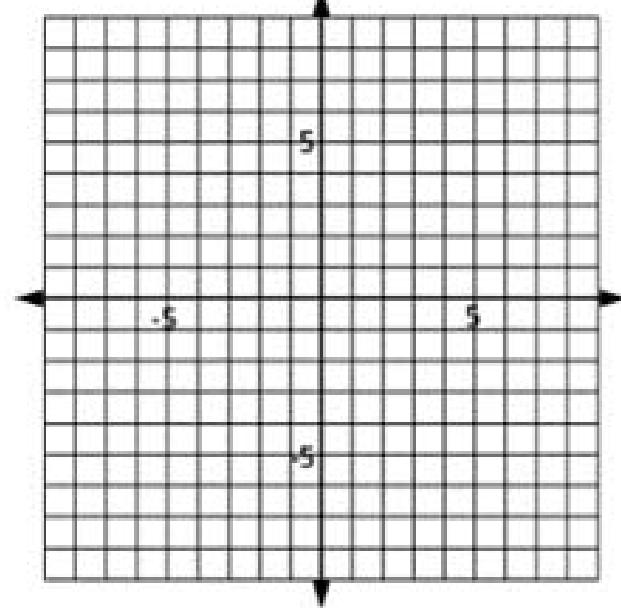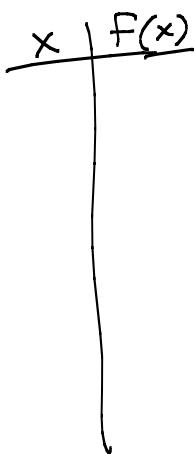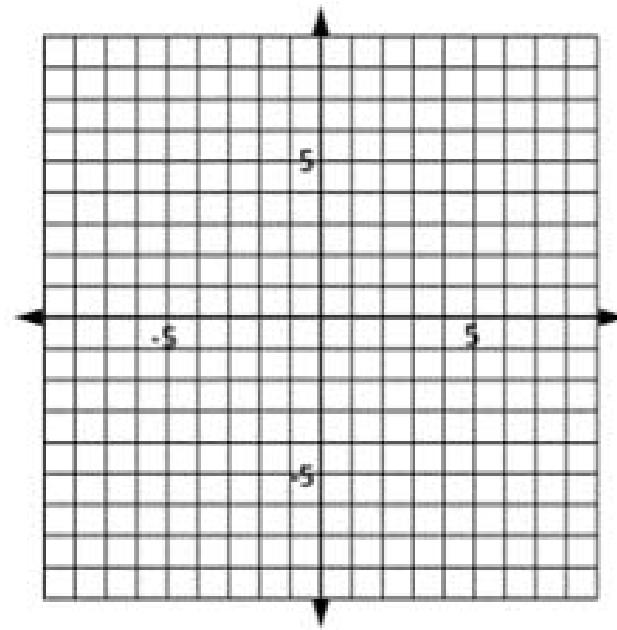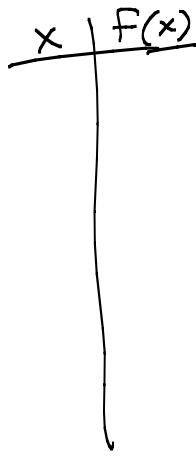
We can actually find the vertex directly with the formula

VERTEX FORMULA

The x-coordinate of the vertex of the graph of $y = ax^2 + bx + c, a \neq 0$, is given by

$$x = -\frac{b}{2a}.$$

To find the y-coordinate of the vertex, substitute this x-value in the equation.

② Find the vertex of $f(x) = \underline{3}x^2 \underline{-7}x \underline{+3}$.
Check the graph

③ Find the maximum value of $f(x) = -\underline{2}x^2 + \underline{9}x - \underline{4}$.
State where the graph is increasing and decreasing.

For the standard form $f(x) = ax^2 + bx + c$, lets observe
how a affects the graph.

Graph $f(x) = x^2$ and $f(x) = \frac{1}{2}x^2$

Graph $f(x) = x^2$ and $f(x) = 2x^2$

Graph $f(x) = x^2$ and $f(x) = -2x^2$

THE GRAPH OF $y = ax^2$

The graph of $y = ax^2$ is a parabola with the following characteristics.

1. The vertex is $(0, 0)$, and the axis of symmetry is given by $x = 0$.
2. It opens upward if $a > 0$ and opens downward if $a < 0$.
3. It is wider than the graph of $y = x^2$, if $0 < |a| < 1$. It is narrower than the graph of $y = x^2$, if $|a| > 1$.

also
$f(x) = -ax^2$ is
called the
_____ of
$f(x) = ax^2$

For $f(x) = ax^2 + bx + c$, c is the y-intercept

④

A baseball is hit into the air and its height h in feet after t seconds can be calculated by $h(t) = -16t^2 + 96t + 3$.

(a) What is the height of the baseball when it is hit?

(b) Determine the maximum height of the baseball.
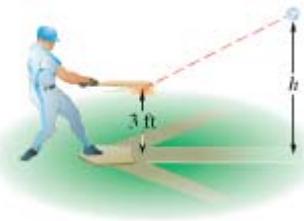
⑤ Setup a function to model the hotel example from the beginning. Find the maximum profit, and graph the function on the calculator to check it.