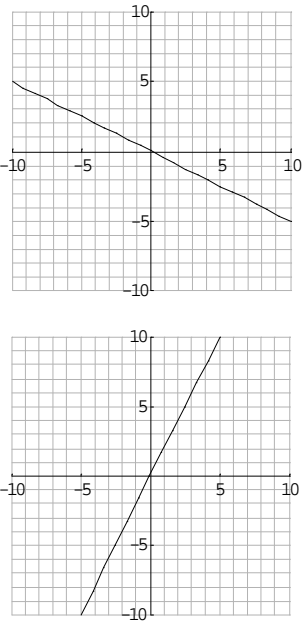
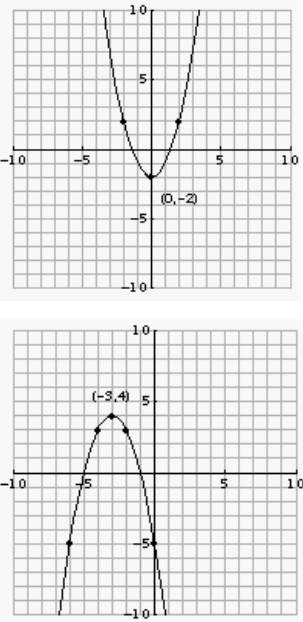
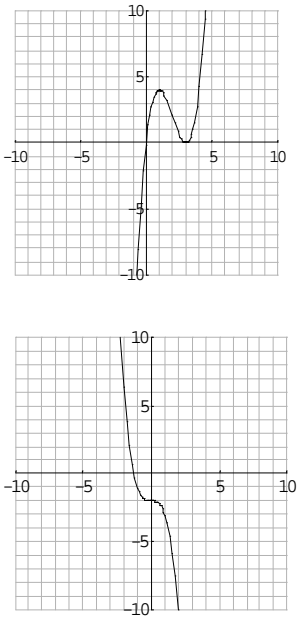
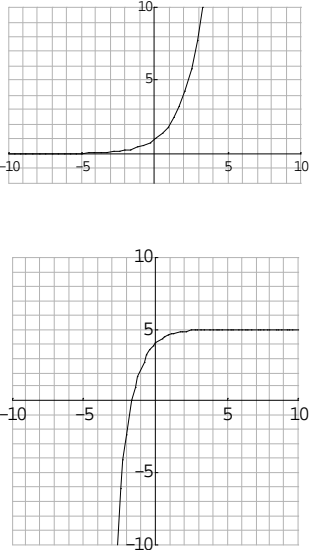
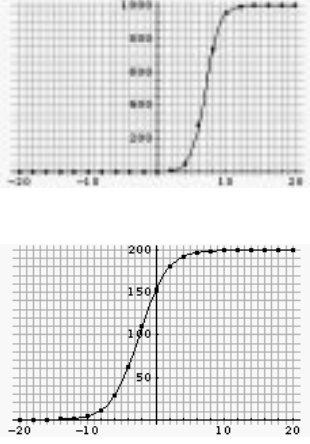
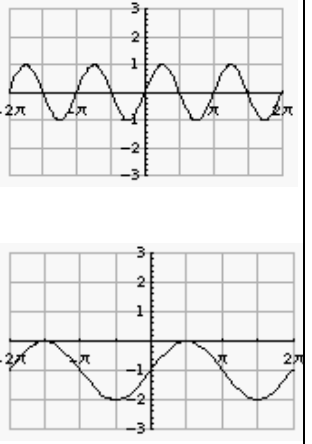


### 3.7 The Function Library

We will now summarize what we have learned about the specific function types described in Sections 3.1 through 3.6 in one convenient location. The first table contains the polynomial functions:

Function Type	Linear	Quadratic	Cubic
Formula	$f(x) = ax + b$	$f(x) = ax^2 + bx + c,$ $a \neq 0$	$f(x) = ax^3 + bx^2 + cx + d,$ $a \neq 0$
Shape of Graph	Straight line	Hill or bowl; no change of curvature	One change of curvature; values grow without bound in opposite directions (at the left end right end of the graph)
Examples of Graphs			
Numerical Test	First unit differences are constant	Second unit differences are constant	None available

The next table shows the remaining three types of functions, namely exponential, logistic and sine functions.

Function Type	Exponential	Logistic	Sine
<b>Formula</b>	$f(x) = a \cdot b^x + c,$ $b > 0$	$f(x) = \frac{L}{1 + ae^{-bx}},$ $L > 0, a > 0,$ and $b > 0.$	$f(x) = a \sin(bx + c) + d,$ $a \neq 0$
<b>Shape of Graph</b>	No change of curvature; values grow without bound at one end of the graph and level off (horizontal asymptote) at the other end.	One change in curvature at level $\frac{L}{2}$ ; function grows between two horizontal lines ( level 0 and L)	Periodic function; wavelike
<b>Examples of Graphs</b>			
<b>Numerical Test</b>	Unit Ratios are constant for $f(x) = a \cdot b^x$	None available	None available

You are now ready for two more TI-89 calculator lessons, which will be more specific to the course content. In Lesson T3, you will learn how to use the built-in functionality of the TI-89 to enter and graph data. In Lesson T4 you will learn how to use specially designed functions to perform the numerical tests (first and second unit differences, unit ratios) to determine the potential function type(s) which match(es) the data. Please go to Calculator Lesson T3.

## Chapter Review

### Key Terms

linear function	second unit difference	sine/cosine function
slope	cubic function	amplitude
first unit difference	polynomial of degree $n$	frequency
quadratic function	exponential function	period
parabola	constant unit ratios	vertical shift
vertex	logistic function	average (or middle value)

### Short Answers

1. What is the interpretation of the slope  $a$  of a linear function in the problem context?
2. What is the difference between the two alternative forms of the quadratic function?
3. Describe the context in which a logistic function is likely.
4. Describe the context in which a sine/cosine function is likely.
5. Describe the steps used to determine which function type matches given data.

### True - False Questions

- T F 1. A linear function with equation  $f(x) = a \cdot x + b$  intersects the horizontal axis at the point  $(b, 0)$ .
- T F 2. A quadratic function has constant unit ratios.
- T F 3. An exponential function grows between two horizontal lines.
- T F 4. There are no numerical tests for the logistic function.
- T F 5. Cubic functions have two changes in curvature.
- T F 6. A sine function is a polynomial.
- T F 7. An exponential function is either always increasing or always decreasing.
- T F 8. The amplitude of a sine function is computed by adding the largest and smallest output values, then dividing by 2.
- T F 9. For small input values, the logistic function behaves like an exponential function.
- T F 10. The period of a sine function is computed by subtracting the output values of consecutive points at which the function exhibits the same behavior (either increasing or decreasing).

Fill in the Blanks

1. The value of the slope  $a$  of a linear function determines the \_\_\_\_\_ of the straight line graph.
2. An exponential function of the form  $f(x) =$  \_\_\_\_\_ has constant unit ratios.
3. The graph of a \_\_\_\_\_ function shows a repeated wavelike segment. The length of this repeated segment is called the \_\_\_\_\_.
4. For a quadratic function of the form  $f(x) = ax^2 + bx + c$ , the vertex has coordinates (\_\_\_\_\_, \_\_\_\_\_).
5. A logistic function has a change of curvature at output level \_\_\_\_\_ and levels off at the maximal capacity of \_\_\_\_\_.
6. The graph of a quadratic function is called a \_\_\_\_\_ and looks like a \_\_\_\_\_ or a \_\_\_\_\_.
7. A linear function has constant \_\_\_\_\_.
8. The following types of functions have no change of curvature: \_\_\_\_\_ and \_\_\_\_\_.
9. The \_\_\_\_\_ of a sine function measures how much the extreme high and low values deviate from the average value.
10. The value of the constant  $d$  in the equation of a sine function,  $f(x) = a \sin(bx + c) + d$ , gives the \_\_\_\_\_ or the \_\_\_\_\_.
11. A linear function is a polynomial of degree \_\_\_\_\_.
12. Identify the appropriate function type for each equation below.
  - a.  $f(x) = -2x + x^2$  \_\_\_\_\_
  - b.  $f(x) = \sin(3x - 2)$  \_\_\_\_\_
  - c.  $f(x) = \frac{300}{1 + 10e^{-0.9x}}$  \_\_\_\_\_
  - d.  $f(x) = 3x$  \_\_\_\_\_
  - e.  $f(x) = -30 \cdot 2^x$  \_\_\_\_\_
  - f.  $f(x) = -x^3 + 20$  \_\_\_\_\_