1.1 LINES

Much of Calculus focuses on the concept of "local linearity", meaning that even if a function curves, if you were to pick a point and stay very close (local) to that point, the function behaves very much like that of a line.

Example: Graph the functions $y = \sin x$ and $y = x$ on your calculator. Obviously these are not the same function. However, if you were to stay close to the point (0, 0), these two functions are very close. To see this, use the $\boxed{\text{ZOOM}}$ feature of your calculator, and zoom in on (0, 0). Try zooming in more than once.

We can say that as long as we stay "close" to (0, 0), the functions $y = \sin x$ and $y = x$ are almost the same thing. Now, the concept of "close" is more complicated than it might sound, but more on that in chapter 2. For now, we focus on lines.

As stated in the syllabus, calculus has to do with change. For notational purposes, we use the capital Greek letter delta, Δ .

Slope

The slope of a non-vertical line is given by
$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

A vertical line has _____, and a horizontal line has _____ .

Parallel Lines have slopes that are _____ .

Perpendicular Lines have slopes that are _____.

IMPORTANT ♪: You will be best served in calculus if you think of slope as a _____.

Equations of a Line

The first equation of a line you used in algebra was probably the *slope – intercept form*: _____
        The slope is _____, and the *y*-intercept is _____.

In calculus, it is actually easier to write the equation of a line in *point – slope form*: _____
        The point is _____, and the slope is _____.

♪: To write an equation of a line, all you need is a _____ and the _____.

Another format used to write the equation of a line is called *standard (general) form*: _____

Example: Which of the equations above has "*y* written as a function of *x*" ?

Example: The point-slope form is written as _____ if you want "*y* written as a function of *x*"

Example: Find the equations of the lines passing through (–2, 4) and having the following characteristics:

    a) Slope of $\frac{7}{16}$

    b) Parallel to the line $5x - 3y = 3$

    c) Passing through the origin

    d) Parallel to the y – axis.

Example: Find the equations of the lines passing through (1, 3) and having the following characteristics:

    a) Slope of $-\frac{2}{3}$

    b) Perpendicular to the line $x + y = 0$

    c) Passing through the point (2, 4)

    d) Parallel to the x – axis.

Example: [Page 11, #57] Consider the circle of radius 5 centered at (0, 0). Find an equation of the line tangent to the circle at the point (3, 4).

Example: The relationship between Fahrenheit and Celsius temperatures in linear.
    a) Use the facts that water freezes at 0° C or 32° F, and water boils at 100° C or 212° F (not your recollection of temperature formulas) to find an equation that relates Celsius and Fahrenheit.

    b) Using your equation, find the Celsius equivalent of 80° F and the Fahrenheit equivalent of –10° C.

    c) [Page 11, #54] Is there a temperature at which a Fahrenheit thermometer and a Celsius thermometer give the same reading? If so, what is it?
    [see part *b* in the textbook for a hint]

Regression Analysis is a process of finding a curve to fit a set of data. The basic process involves plotting the points and finding a function that "best fits" those points. The curve you find is called the regression curve. For the purposes of this section, our "curve" is linear, but it could be a parabola or other power function, a logarithmic function, a trigonometric function, or an exponential function.

Example: [Page 11, #53] The median price of existing single-family homes has increased consistently during the past few years. However, the data in the table below show that there have been differences in various parts of the country.

Year	South (dollars)	West (dollars)
1999	145,900	173,700
2000	148,000	196,400
2001	155,400	213,600
2002	163,400	238,500
2003	168,100	260,900

a) Find the linear regression equation for home cost in the South.

b) What does the slope of the regression line represent?

c) Find the linear regression equation for home cost in the West.

d) Where is the median price increasing more rapidly, in the South or the West?

Notecards from Section 1.1: Rules for Rounding