Important !!!

- First homework is due on Monday, September 26 at 8:00 am.
- You can solve and submit the homework on line using webwork: `http://webwork.dartmouth.edu/webwork2/m3cod/`.
- If you do not have a user name and password for webwork, send an email to Professor Lahr (`C.Dwight.Lahr@dartmouth.edu`).
- For the answer, you must input the letter corresponding to the answer you think is correct; e.g: B (without any dot).

Lines in the Plane

If a line passes through points (x_1, x_2) and (x_2, y_2), where $x_1 \neq x_2$, we call

$$m = \frac{y2 - y1}{x2 - x1}$$

the *slope* of the line.

Equations of a line

- **Point-Slope Form of Equation of a Line:** $y - y_1 = m(x - x_1)$.

- **Slope-Intercept Form of Equation of a Line:** $y = mx + b$.

- **General Form of Equation of a Line:** $ax + by + c$.

- Two lines are parallel if and only if $m_1 = m_2$.

- Two lines are perpendicular if and only if $m_1 = -\frac{1}{m_2}$.

Functions and Their Graphs

A function f on a set D into a set S is a rule that assigns a unique element $f(x)$ in S to each element x of D. The set D is called the domain of the function f and the subset $\{f(x) \in S : x \in D\}$ of S is called the range of f. It is common in this context to call x the *independent* variable because we assign its value, and y the *dependent* variable because we compute its value.

The Spread of Aids

Year	No of AIDS cases
1982	295
1983	1374
1984	4293
1985	10211
1986	21278
1987	39353
1988	66290
1989	98910
1990	135614
1991	170851

Graphing Functions

Try the Function Grapher Applet.

Even and Odd Functions: Symmetry and Reflections

- A function f is said to be an *even* function if $-x$ is in its domain whenever x is, and $f(-x) = f(x)$. Such a function is symmetric about the y-axis.

- A function f is said to be an *odd* function if $-x$ is in its domain whenever x is, and $f(-x) = -f(x)$. Such a function is symmetric about the origin.

- Play with the "Symmetry: Odd and Even Functions" Applet.

Defining new Functions from Old

Theorem 1. Reflections in special lines: *For an equation in x and y*

1. Replacing x by $-x$ corresponds to reflecting the graph of the equation in the y-axis.

2. Replacing y by $-y$ corresponds to reflecting the graph of the equation in the x-axis.

3. Replacing both x and y by their negatives corresponds to reflecting the graph of the equation in the origin.

4. Interchanging x and y in an equation corresponds to reflecting the graph of the equation in the line $y = x$.

Play with the applet "New Functions from Old".

Scaling a graph

A simple geometric transformation that yields new functions from old is a stretch–either parallel to the x-axis or parallel to the y-axis.

Theorem 2. *Replacing* x *by* cx *in a function* $y = f(x)$ *results in a horizontal stretching or compression of the graph of* f*. When* $0 < c < 1$ *the graph is elongated horizontally by the factor* $1/c$*, and when* $c > 1$ *it is compressed horizontally by the factor* $1/c$*.*

Applet: Stretching Graphs.

Shifting a Graph

Theorem 3. *Assume that the constant a is positive. To shift the graph of a function $f(x)$ to the right by a units, replace x by $x - a$. To shift it to the left by a units, replace x by $x + a$.*

Applet: Shifting Graphs.

Arithmetical operations

Definition 1. *Let f and g be functions and let x be in the domain of both functions. Then the functions $f+g$, $f-g$, fg and f/g are defined by the rules:*

1. $(f+g)(x) = f(x) + g(x)$

2. $(f-g)(x) = f(x) - g(x)$

3. $(fg)(x) = f(x) \cdot g(x)$

4. $(f/g)(x) = f(x)/g(x)$, when $g(x) \neq 0$.

Composition of functions

Definition 2. *Let f and g be functions, let x be in the domain of f, and $g(x)$ in the domain of f. Then the composite function $f \circ g$ is defined by the rule $(f \circ g)(x) = f(g(x))$.*

Applet: Arithmetical Operations on Functions.

Inverse Functions

If one considers a function to be a set of ordered pairs (x, y), then the corresponding inverse relation is the set of ordered pairs (y, x). If this inverse relation is also a function, then we call it the *inverse function*.

Definition 3. *A function f is said to be 1-1 if $f(x_1) = f(x_2)$ implies that $x_1 = x_2$. In other words different values of x are mapped to different values of y. Such a function is also said to pass the horizontal line test, in the sense that every line parallel to the x-axis intersects the graph of f in at most one point.*

Theorem 4. *If f is a 1-1 function then it has an inverse function which we will denote by f^{-1}. (Caution: do not confuse this with $1/f$, the reciprocal of f.) The domain of f^{-1} is the range of f; and the range of f^{-1} is the domain of f. The functions f and f^{-1} satisfy $y = f^{-1}(x)$ if and only if $f(y) = x$.*