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

\[ m = \frac{y_2 - y_1}{x_2 - x_1} \]

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

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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 \( f(y) = x \).