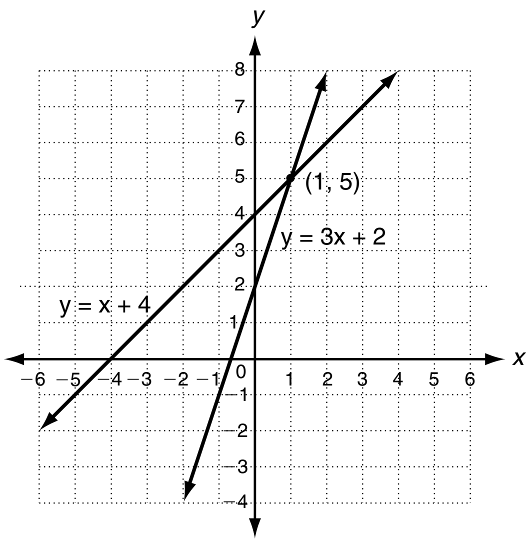
Date ___________________

Dear Family,

In Chapter 3, your child will learn to solve systems of linear equations and linear inequalities.

A **system of equations** is a set of two or more equations containing two or more variables. The solution of a system is the point or set of points that make all of its equations true.

A **linear system** contains only linear equations. The graph of a linear system of two equations in two variables is two lines. If the two lines intersect, their point of intersection is the solution to the system.

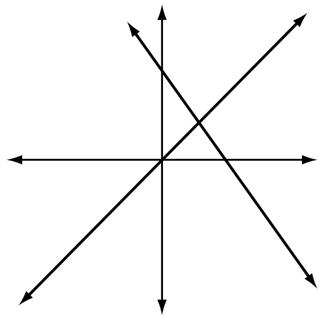
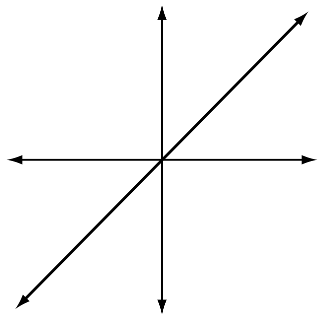
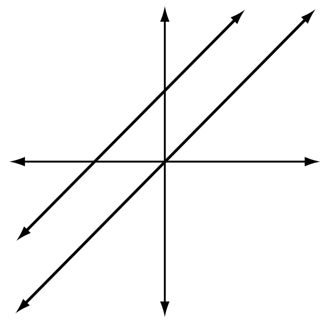


Linear system:

$$\begin{cases} y = 3x + 2 \\ y = x + 4 \end{cases}$$

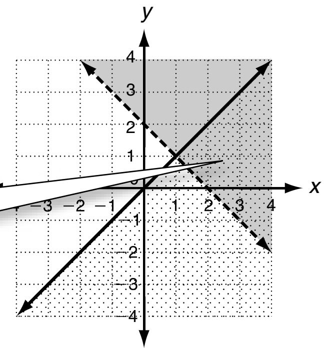
Solution to system:
$(1, 5)$

Not all linear systems have exactly one solution. If the lines coincide, then there are infinitely many solutions. If the lines never intersect, then there is no solution. A system can be classified as either **consistent** (at least one solution), or **inconsistent** (no solution). A consistent system can be further classified as **dependent** (same slope and *y*-intercept) or **independent** (different slopes).

graph			
solutions	one	infinitely many	none
classification	consistent and independent	consistent and dependent	inconsistent

Your child will also learn two algebraic methods of solving systems. In **substitution**, you solve one equation for one variable and then substitute the expression into the other equation. In **elimination**, you add or subtract multiples of the equations in order to get rid of one of the variables.

A **system of linear inequalities** is two or more linear inequalities with the same variables. The solution is the region where the shadings overlap.



System of linear inequalities:

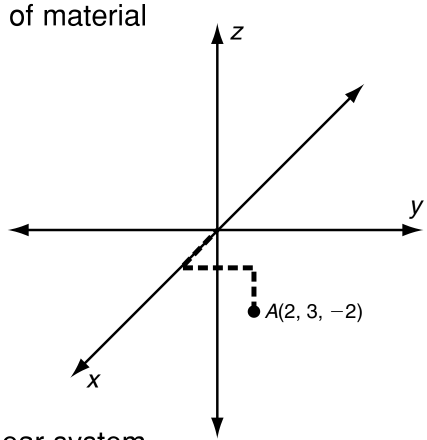
$$\begin{cases} y \le x \\ y > -x + 2 \end{cases}$$

solution to system: all of the points in the overlapping region

Systems can be applied to solve many real-world problems. A special application of systems of linear inequalities is **linear programming**, a method of finding optimal values of a function given a set of **constraints.** Linear programming often has business applications. For example, you may want to maximize a production function under constraints of material and labor.

Chapter 3 concludes by introducing linear equations in three-dimensions. In a **three-dimensional coordinate system,** there are three axes (*x, y,* and *z*) and points are plotted with **ordered triples.**

Ordered triple: $(\underset{x}{2}, \underset{y}{3}, \underset{z}{-2})$



A linear equation in three dimensions represents a *plane.* A linear system in three variables represents several planes, and the intersection of those planes is the solution.

Because it can be difficult to graph planes and visualize their points of intersection, linear systems in three variables are usually solved using elimination.

Solve: $\begin{cases} x + 2y + z = 8 \\ 2x + y - z = 4 \\ x + y + 3z = 7 \end{cases}$

Step 1:
Add the first two equations to eliminate *z:*

$$\begin{array}{r} x + 2y + z = 8 \\ 2x + y - z = 4 \\ \hline 3x + 3y \quad = 12 \end{array}$$

Step 2:
Add multiples of the second two equations to eliminate *z:*

$$\begin{array}{r} 6x + 3y - 3z = 12 \\ x + y + 3z = 7 \\ \hline 7x + 4y \quad = 19 \end{array}$$

Step 3:
Use $\begin{cases} 3x + 3y = 12 \\ 7x + 4y = 19 \end{cases}$ to solve for x and y.

Step 4:
Find z by substituting x and y into one of the original equations.

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