3.1 – Linear Equations and Inequalities

A linear relation compares two variables to see how they relate. The degree on both variables can not exceed 1. As such, a linear relation is often called a first degree relation. In most cases this relation will also be a function. A vertical line (i.e. x = ?) is the one exception.

Ex. As a formula $y = x + 3$
Ex. In function notation: $f(x) = x + 3$

An equation sets a given relation or function, in most cases, equal to some value one is interested in solving for. This is often called, "finding the zeros" because equation is re-arrange to this form which is then where the graph will cross the x-axis (i.e. y = 0)

Ex. When is function f(x) = x + 3 equal to zero? $0 = x + 3$
Ex. When is function f(x) = x + 3 equal to 5? $5 = x + 3$

An inequality is interested in determining the domain (as an interval of values) when the function satisfies the given scenario.

Ex. If p(h) = 5h then when is pay greater than \$30? $5h > 30$
Ex. If h(t) = 8t + 10 then when is height less then 18m? $h(t) < 18$, $8t + 10 < 18$

Inequalities are best set up exactly how worded then re-written afterwards

Example 1: Solve the following linear equations.

a) $2x + 3x = 10$
$5x = 10$
$x = \frac{10}{5}$
$x = 2$

One can always check their answer by substituting back into original equation.

b) $6 + 2x = -4 - 3x$
$2x + 3x = -4 - 6$
$5x = -10$
$x = \frac{-10}{5}$
$x = -2$

c) $2(x + 3) = 3(2x - 2)$
$2x + 6 = 6x - 6$
$6 + 6 = 6x - 2x$
$12 = 4x$
$\frac{12}{4} = x$
$3 = x$

d) $\frac{x}{2} + 4 = \frac{x}{3} - 2$
$6\left(\frac{x}{2} + 4\right) = 6\left(\frac{x}{3} - 2\right)$
$3x + 24 = 2x - 12$
$3x - 2x = -12 - 24$
$x = -36$

Example 2: Solve the following linear inequalities and graph the solution.

a) $3x - 5 > 14$
$3x > 9$
$x > 3$

Inequalities are best read from left to right. So this says x is greater than 3.

b) $\frac{x}{2} - 3 \le -5$
$x - 6 \le -10$
$x \le -4$

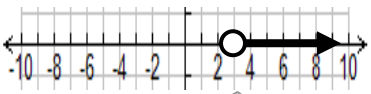
x is less than or equal to -4.

c) $4x < 3 + 5x$
$-3 < 5x - 4x$
$-3 < x$

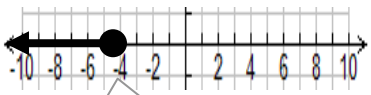
Keeping x positive means you have to say -3 is less than x. How does this graph look?

d) $4x < 3 + 5x$
$4x - 5x < 3$
$-x < 3$
$x > -3$

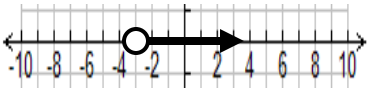
A negative x means you will switch the inequality when multiplying through by -1. But this math statement is easier to say and think about?



A number line is a useful tool to think about inequalities. Open circle tell one not to include this value



Closed circle tell one that this value is to be included.



Graph for c & d are the same

3.1 – Linear Equations and Inequalities Practice Questions

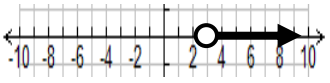
1. Solve for unknown

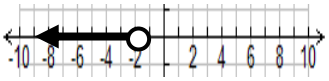
a) $2x + 1 = 7$	b) $5 – 3x = -7$	c) $8x + 3 = 6$	d) $2 = 8 – 2x$
e) $2x = x – 9$	f) $3x + 1 = 2x –7$	g) $15x + 2 = 12 – 10x$	h) $3x – 2 = 1 – x$
i) $2x + 6 = 6x – 6$	j) $–24 = 8(2y + 5)$	k) $2(x + 3) = 3(2x – 2)$	l) $2(y – 1) = - 4$
m) $8 + 3x = 4x$	n) $–x = 4x - 6$	o) $8 – 2x = 3x + 3$	p) $3y – 6 = 9(2 – y)$

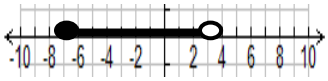
2. Solve for unknown

a) $\frac{x}{2}+\frac{x}{3}=5$	b) $4+\frac{2}{3}y=1$	c) $-\frac{2}{3}x-4=-\frac{4}{5}$	d) $\frac{x}{3}+1=\frac{x}{2}-1$
e) $\frac{x+1}{2}=3$	f) $\frac{2x+1}{3}=-5$	g) $\frac{x+3}{4}=\frac{x+5}{6}$	h) $\frac{2}{y-5}=\frac{3}{y+2}$

3. Write a statement to describe the following number line graphs.

a) 

b) 

c) 

4. Solve the following inequalities.

a) $3x – 7 < 14$	b) $5x + 4x > 18$	c) $2(y – 1) < - 4$	d) $7x – 5x > 12$
e) $2x + 6 \le 6x - 6$	f) $-3y \ge -2y + 7$	g) $7x \le 16 – x$	h) $4x \le 3x + 7$
i) $8 + 3x \le 4x$	j) $–x > 4x - 60$	k) $8 – 2x < 3x + 13$	l) $3x \le 9(2 + x)$
m) $\frac{2y+3}{3}\ge y+2$	n) $\frac{x}{2}+\frac{x}{3}>5$	o) $\frac{2+x}{-5}<\frac{2}{3}x-1$	p) $\frac{2}{x-1}\ge\frac{1}{3x}$

5. An employees pay is given by the function p(h) = 8h +10. Set up an inequality statement to describe after how many hours the employees pay will exceed $74. Solve your inequality.

6. To raise money, the school basketball team is going to sell t-shirts. The cost of making the shirts includes a fixed cost of $500 plus a cost of $7 per shirt printed. If the team intends to sell the shirts for $15 each, what is the minimum number of shirts they need to sell to break even?

Answers 1. a) 3 **b)** 4 **c)** 3/8 **d)** 3 **e)** -9 **f)** -8 **g)** 2/5 **h)** 3/4 **i)** 3 **j)** -4 **k)** 3 **l)** -1 **m)** 8 **n)** 6/5 **o)** 1 **p)** 2 **2. a)** 6 **b)** -4.5 **c)** -4.8 **d)** 12 **e)** 5 **f)** -8 **g)** 1 **h)** 19 **3. a)** x>3 **b)** x ≤ -2 **c)** -7 ≤ x< 3 **4. a)** x<7 **b)** x>2 **c)** y<-1 **d)** x>6 **e)** 3 ≤ x or ≥ 3 **f)** y ≤ -7 **g)** x ≤ 2 **h)** x ≤ 7 **i)** 8 ≤ x **j)** x<12 **k)** -1<x **l)** x ≥ -3 **m)** y ≤ -3 **n)** x>6 **o)** x>9/13 **p)** x ≥ -1/5 **5.** 8h+10>74, h=8 **6.** 63 shirts