

M45 SSM 2/e 3.7 Linear Inequalities in Two Variables

- Objectives:
- 1) Determine if an ordered pair is a solution of a linear inequality.
 - 2) Graph linear inequalities
 - 3) Solve problems.

① Determine if the given points are solutions of $2x + y \leq 9$.

a) $(3, 5)$

step 1: Substitute $x=3$ and $y=5$

$$2(3) + 5 \leq 9$$

step 2: Use order of operations to evaluate LHS (and RHS).

$$6 + 5 \leq 9$$

$$11 \leq 9$$

step 3: If true result, yes.
If false result, no.

$11 \leq 9$ is false because 11 is not less than or equal to 9.

NO

b) $(1, 3)$

$$2(1) + 3 \leq 9$$

$$2 + 3 \leq 9$$

$$5 \leq 9$$

true

YES

c) $(4, -1)$

$$2(4) + (-1) \leq 9$$

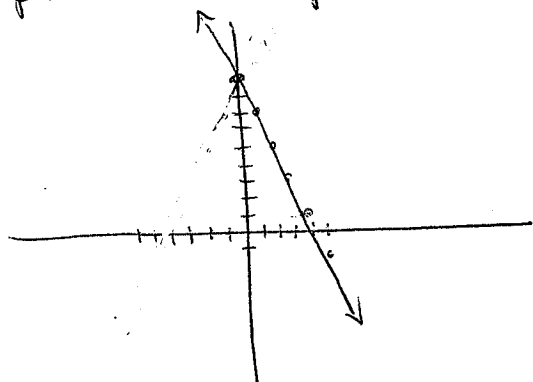
$$8 + 1 \leq 9$$

$$9 \leq 9$$

true

YES

② Explore: a) Graph the line



$$2x + y = 9. \quad (\text{no } \leq)$$

$$y = -2x + 9$$

b) Find coordinates of 3 points on $2x + y = 9$.

$$(0, 9)$$

$$(1, 7)$$

$$(2, 5)$$

② Explore, cont.

c) Are the points in b) solutions of $2x + y \leq 9$?

$$2(0) + 9 \leq 9$$

$$9 \leq 9 \text{ yes } (0, 9)$$

$$2(1) + 7 \leq 9$$

$$9 \leq 9 \text{ yes } (1, 7)$$

$$2(2) + 5 \leq 9$$

$$9 \leq 9 \text{ yes } (2, 5).$$

d) Are the points in b) solutions of $2x + y < 9$?

$$2(0) + 9 < 9$$

$$9 < 9 \text{ no } (0, 9)$$

$$2(1) + 7 < 9$$

$$9 < 9 \text{ no } (1, 7)$$

$$2(2) + 5 < 9$$

$$9 < 9 \text{ no } (2, 5).$$

e) Find 3 points up and to right of $2x + y = 9$. (use graph).

$$(5, 5)$$

$$(6, 0)$$

$$(0, 11)$$

f) Are the points in e) solutions of $2x + y \leq 9$?

$$2(5) + 5 \leq 9$$

$$15 \leq 9 \text{ no } (5, 5)$$

$$2(6) + 0 \leq 9$$

$$12 \leq 9 \text{ no } (6, 0)$$

$$2(0) + 11 \leq 9$$

$$11 \leq 9 \text{ no } (0, 11).$$

g) Find 3 points down and left of $2x + y = 9$ (use graph)

$$(0, 0)$$

$$(-2, 2)$$

$$(2, -3).$$

h) Are the points in g) solutions of $2x + y \leq 9$?

$$2(0) + 0 \leq 9$$

$$0 \leq 9 \text{ yes } (0, 0)$$

$$2(-2) + 2 \leq 9$$

$$-2 \leq 9 \text{ yes } (-2, 2)$$

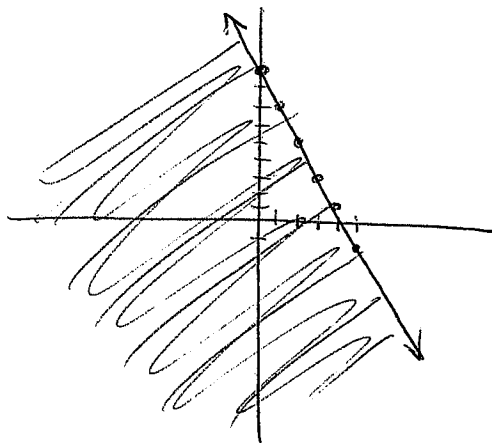
$$2(2) + (-3) \leq 9$$

$$1 \leq 9 \text{ yes } (2, -3).$$

i) graph the solutions of $2x + y \leq 9$

step 1: Draw line $2x + y = 9$. (solid line)

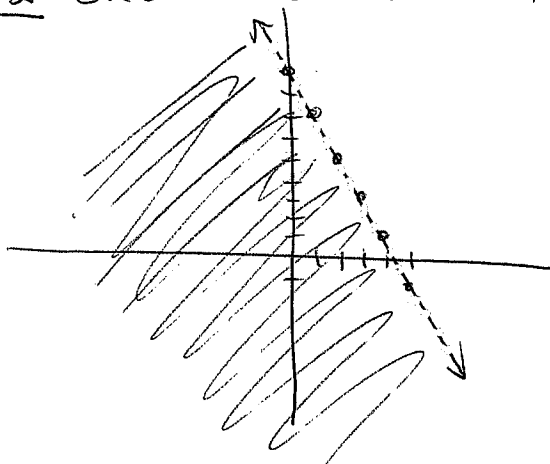
step 2: Shade down and left of the line.



j) graph the solutions of $2x + y < 9$.

step 1: Draw line $2x + y = 9$ (dotted line)

step 2: Shade down and left of line.



To graph a linear inequality

step 1: Use solid lines for $\leq$ or $\geq$.
Use dotted lines for $<$ or $>$.

step 2: Change $\leq, \geq, <, \text{ or } >$ to $=$ and graph line.

step 3: Test a point that's not on the line, plot test point.
If test point is true, shade side including test point.
If test point is false, shade side that does not include the test point.

Alternate step 3: Isolate y in inequality if $y >$ or $y \geq$ shade up
if $y <$ or $y \leq$ shade down

③ Graph $y < 2x - 5$.

step 1: $<$ means dotted.

step 2: Graph $y = 2x - 5$

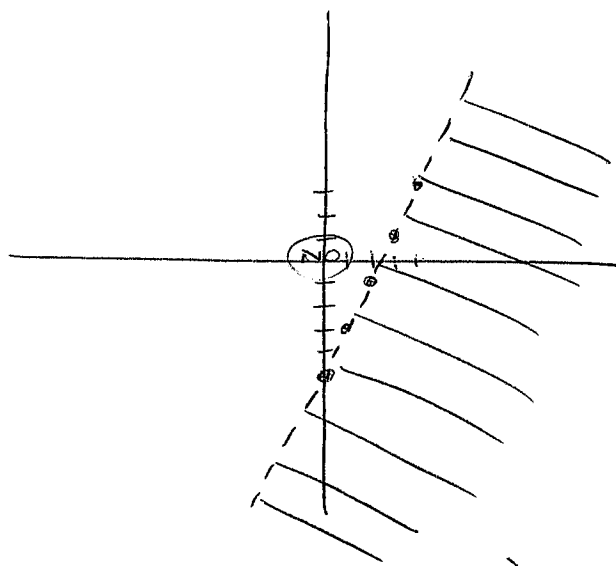
$$m = 2$$

$$y\text{-int } (0, -5)$$

step 3: Test $(0, 0)$

$$0 < 2(0) - 5$$

$$0 < -5 \text{ false}$$



④ Graph $-4x + 3y \geq 0$

step 1: $\geq$ means solid line.

step 2: $-4x + 3y = 0$

$$3y = 4x$$

$$y = \frac{4}{3}x + 0$$

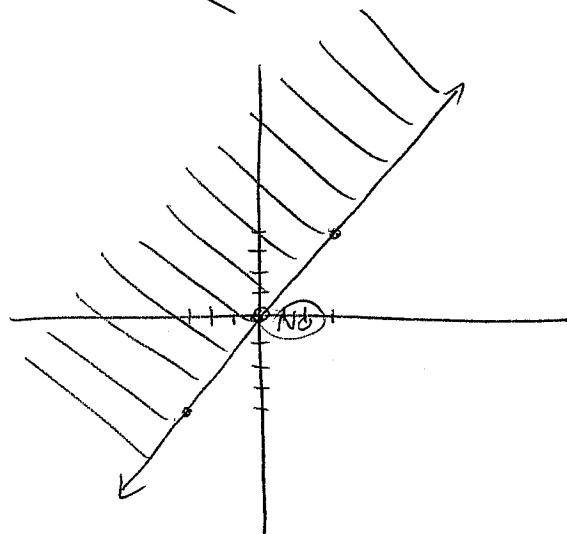
$$m = \frac{4}{3}$$

$$y\text{-int} = (0, 0)$$

test $(1, 0)$

$$-4(1) + 3(0) \geq 0$$

$$-4 \geq 0 \text{ false}$$



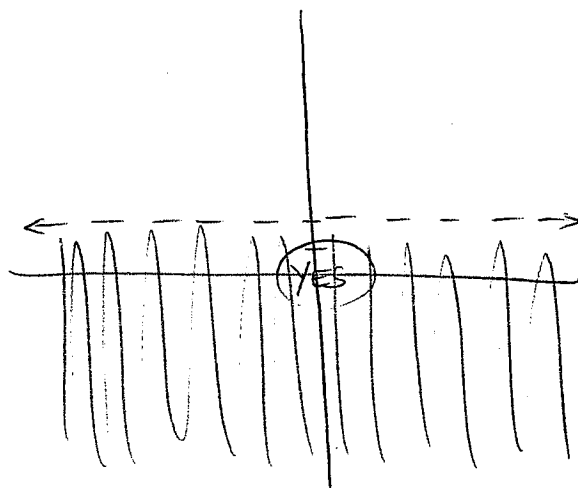
⑤ Graph $y < 2$.

step 1: $<$ means dotted

step 2: $y = 2$ horizontal.

step 3: Test $(0, 0)$

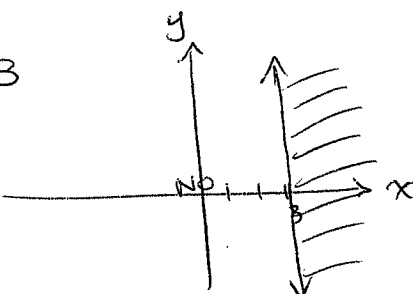
$$0 < 2 \text{ yes}$$



⑥ Graph $x \geq 3$

test $(0, 0)$

$$0 \geq 0 \text{ false}$$



- ⑦ Kevin received \$2 from Grandma and went to a candy store where suckers are \$0.20 and taffy is \$0.25.

a) Write a linear inequality showing how many suckers (x) and how many taffies (y) Kevin can buy?

$$\begin{array}{ccc} \text{cost of suckers} & + & \text{cost of taffy} \\ \underbrace{.20x} & + & \underbrace{.25y} & \leq & 2 \\ \left(\begin{array}{c} \text{cost} \\ \text{per} \\ \text{sucker} \end{array} \right) \cdot \left(\begin{array}{c} \# \text{ of} \\ \text{suckers} \end{array} \right) & & \left(\begin{array}{c} \text{cost} \\ \text{per} \\ \text{taffy} \end{array} \right) \cdot \left(\begin{array}{c} \# \text{ of} \\ \text{taffies} \end{array} \right) & & \begin{array}{c} \uparrow \\ \text{available} \\ \text{money} \end{array} \end{array}$$

$$\boxed{.2x + .25y \leq 2}$$

b) Graph the inequality.

step 1: $\leq$ means solid line

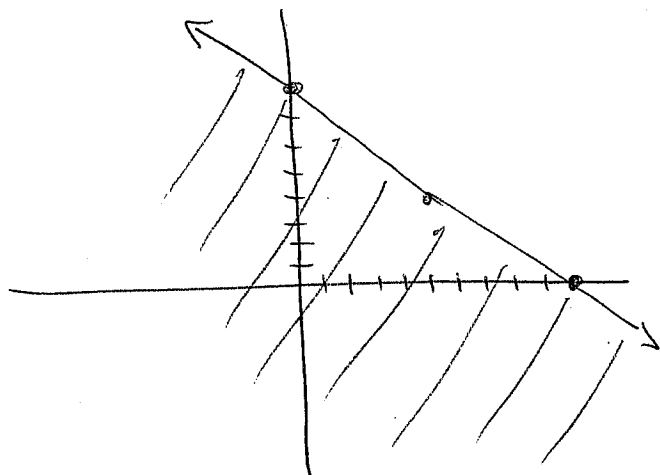
step 2: graph $.2x + .25y = 2$

$$\begin{array}{l} \text{mult by 100} \quad \frac{20x}{5} + \frac{25y}{5} = \frac{200}{5} \\ \div 5 \end{array}$$

$$4x + 5y = 40$$

$$\frac{5y}{5} = -\frac{4x}{5} + \frac{40}{5}$$

$$y = -\frac{4}{5}x + 8$$



c) Can Kevin buy 6 suckers and 3 taffies?

$$.2(6) + .25(3) \leq 2$$

$$1.95 \leq 2 \quad \boxed{\text{yes}}$$

d) Can Kevin buy 5 suckers and 5 taffies?

$$.2(5) + .25(5) \leq 2$$

$$2.25 \leq 2 \quad \boxed{\text{no}}$$

⑧ A kindergarten class has \$120 maximum to spend going to the aquarium. Students cost \$3, adults \$5.

a) Write a linear inequality showing the number of students, x , and # of adults, y , that can go.

$$3x + 5y \leq 120$$

$\left(\begin{smallmatrix} \text{cost} \\ \text{per} \\ \text{student} \end{smallmatrix} \right) \cdot \left(\begin{smallmatrix} \# \\ \text{students} \end{smallmatrix} \right) + \left(\begin{smallmatrix} \text{cost} \\ \text{per} \\ \text{adult} \end{smallmatrix} \right) \cdot \left(\begin{smallmatrix} \# \\ \text{adults} \end{smallmatrix} \right) \leq \text{available money}$

 less than or equal to

b) Can 32 students and 6 adults go?

$$3(32) + 5(6) \leq 120$$

$$126 \leq 120 \quad \boxed{\text{no}}$$

c) Can 29 students and 4 adults go?

$$3(29) + 5(4) \leq 120$$

$$107 \leq 120 \quad \boxed{\text{yes}}$$

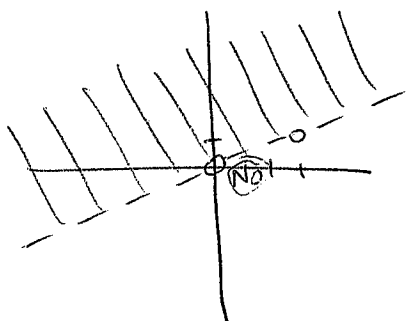
Graph the inequalities

⑨ $y > \frac{x}{3}$

$> \Rightarrow$ dotted

$$y = \frac{x}{3}$$

$$y = \frac{1}{3}x + 0$$



Test (1, 0)

$$0 > \frac{1}{3} \text{ false}$$

⑩ $\frac{x}{4} + \frac{y}{2} < 1$

$< \Rightarrow$ dotted

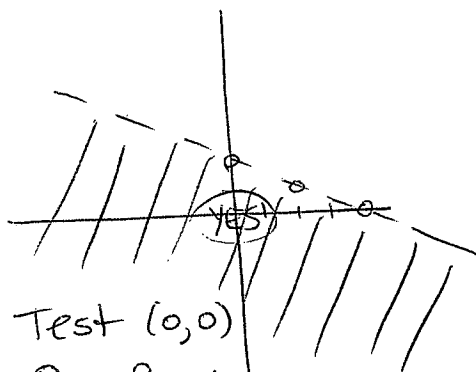
$$\frac{x}{4} + \frac{y}{2} \leq 1$$

$$4 \cdot \frac{x}{4} + 4 \cdot \frac{y}{2} = 4 \cdot 1$$

$$x + 2y = 4$$

$$2y = -x + 4$$

$$y = -\frac{1}{2}x + 2$$



Test (0, 0)

$$\frac{0}{4} + \frac{0}{2} < 1$$

$0 < 1$ true

⑪ $-3 \geq x - y$

is equivalent to

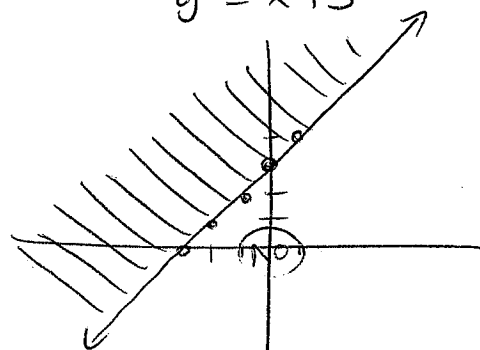
$$x - y \leq -3$$

$\leq \Rightarrow$ solid

$$x - y = -3$$

$$-y = -x - 3$$

$$y = x + 3$$



test (0, 0)

$$-3 \geq 0 - 0$$

$$-3 \geq 0 \text{ false}$$