

Plant food. A farmer can buy two types of plant food, mix A and mix B. Each cubic yard of mix A contains 20 pounds of phosphoric acid, 30 pounds of nitrogen, and 5 pounds of potash. Each cubic yard of mix B contains 10 pounds of phosphoric acid, 30 pounds of nitrogen, and 10 pounds of potash. The minimum monthly requirements are 460 pounds of phosphoric acid, 960 pounds of nitrogen, and 220 pounds of potash. If x is the number of cubic yards of mix A used and y is the number of cubic yards of mix B used, write a system of linear inequalities that indicates appropriate restraints on x and y . Find the set of feasible solutions graphically for the amounts of mix A and mix B that can be used.

GIVEN
↓ (1) ✓
MATH
↓ (2) ✓
SOLVE

		Ph Ac	Nit	Potash
x	A	20	30	5
y	B	10	30	10
	MIN	460	960	220

$$\text{TOTAL Ph Ac : } \begin{cases} (20x + 10y \geq 460) \div 10 & 2x + y \geq 46 \\ (30x + 30y \geq 960) \div 30 & x + y \geq 32 \\ (5x + 10y \geq 220) \div 5 & x + 2y \geq 44 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

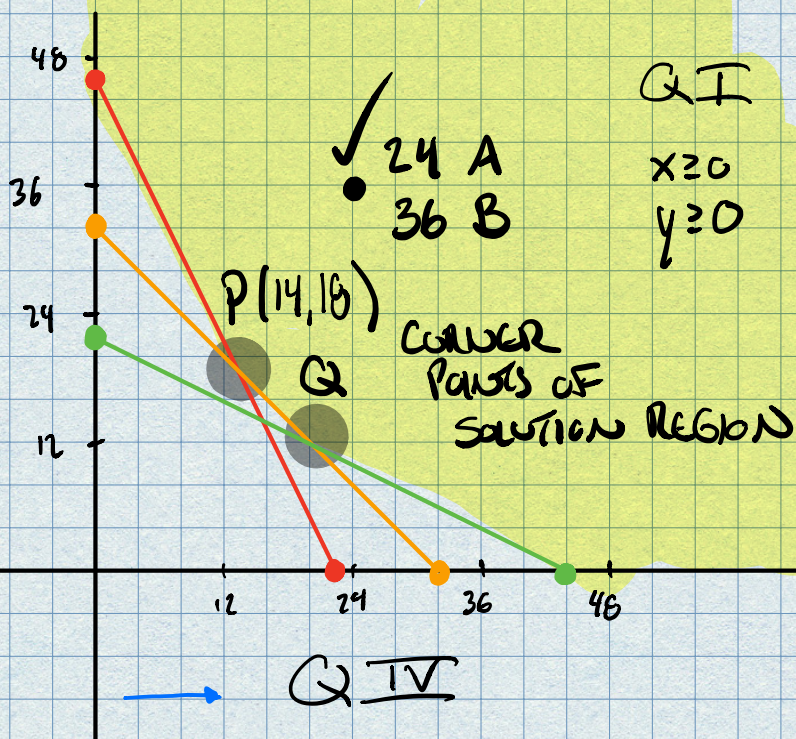
$$\begin{aligned} 2x + y &\geq 46 & \bullet & (0, 46) \\ x + y &\geq 32 & \bullet & (0, 32) \\ x + 2y &\geq 44 & \bullet & (0, 22) \\ x &\geq 0 & \bullet & (44, 0) \\ y &\geq 0 & \bullet & (23, 0) \end{aligned}$$

REGION IN QI
ABOVE THE
3 LINES:

QII

QIII

QIV



P: INTERSECTION OF

$$\begin{cases} 2x + y = 46 \\ x + y = 32 \end{cases} \quad \text{SOLVE THIS SYSTEM}$$

$$\downarrow$$

$$y = 32 - x$$

$$\downarrow$$

$$2x + (32 - x) = 46 \quad (\text{NO } y)$$

SOLVE FOR x :

$$x + 32 = 46$$

$$x = 46 - 32 = 14$$

$$y = 32 - x = 32 - 14 = 18$$

P(14, 18)

LINEAR INEQUALITIES: BOUNDARIES TO SOLUTION REGIONS (EQUATIONS) ARE ALL STRAIGHT LINES.

NON-LINEAR INEQUALITIES

$$x^2 + y^2 < 1$$

GRAPH SOLUTION REGION

BOUNDARY: $x^2 + y^2 = 1$

INTERIOR
INSIDE

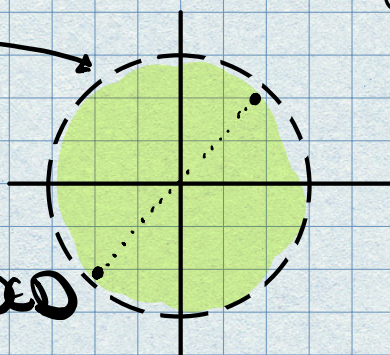
EXTERIOR
OUTSIDE

BOUNDED

$$0^2 + 0^2 < 1 \quad \checkmark \quad (0,0)$$

$$2^2 + 0^2 < 1 \quad (\times)$$

(2,0)
NOT A
SOLN.



EQUATION OF A CIRCLE WITH CENTER $(0,0)$ &

RADIUS r :

$$x^2 + y^2 = r^2$$

Def: REGION IS BOUNDED IF IT CAN BE CONTAINED INSIDE A DISK.

EGW. IF THERE IS A MAX DISTANCE BETWEEN POINTS IN THE REGION.

ex. $2x^2 + 2y^2 \geq 8$ GRAPH SOL'N REGION.

$$\downarrow \div 2$$

$$x^2 + y^2 \geq 4 = 2^2$$

BOUNDARY

$$x^2 + y^2 = 2^2$$

CIRCLE CENTER $(0,0)$
RADIUS 2

UNBOUNDED SOL'N REGION

BOUNDARY INCLUDED.

ex.

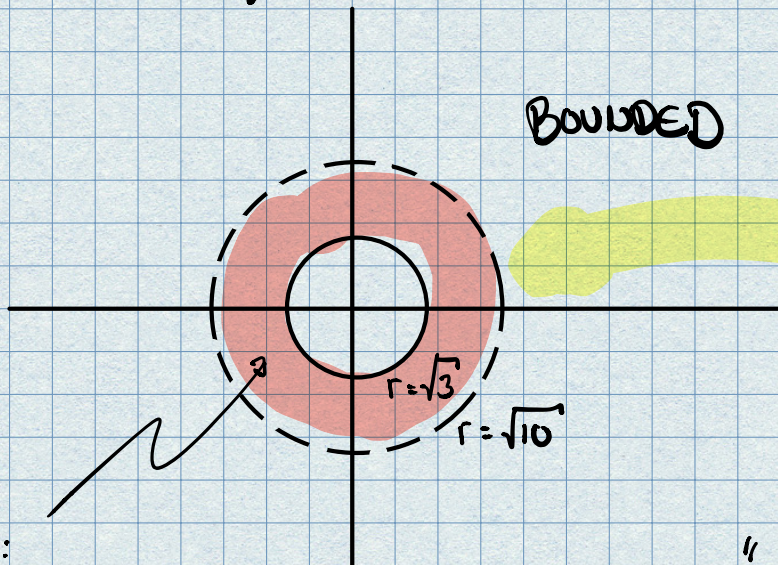
(1)

(2)

$$3 \leq x^2 + y^2 < 10$$

BOUNDARY (1) $x^2 + y^2 = 3$ ($r = \sqrt{3}$) ✓

(2) $x^2 + y^2 = 10$ ($r = \sqrt{10}$) ✗

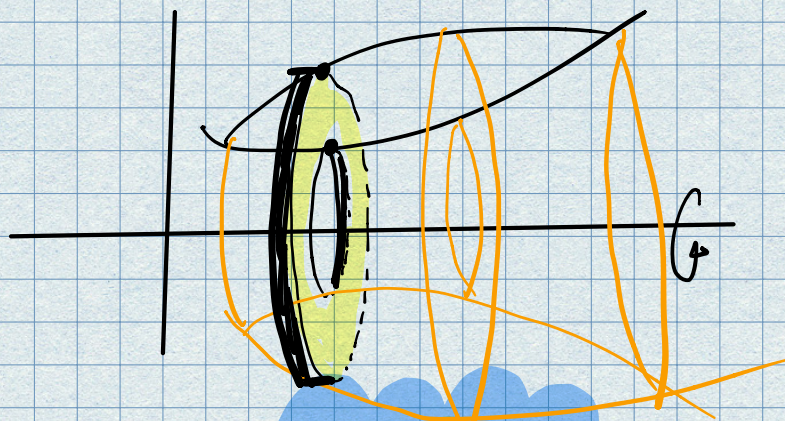


SHAPE:

DOUGH/BAGEL (3D) "TORUS"

"WASHER"

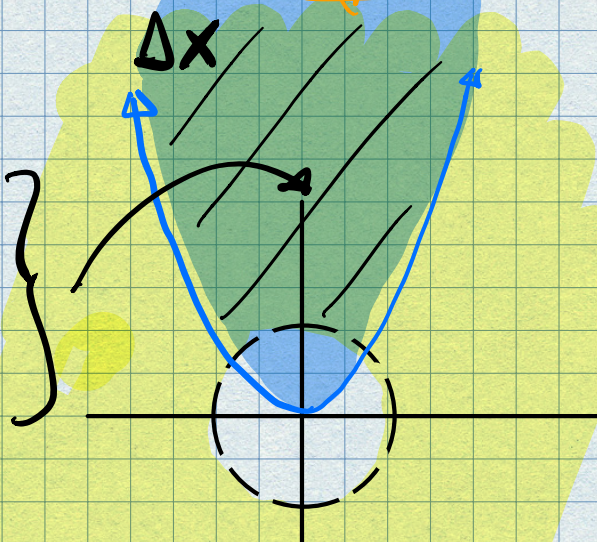
ANNULUS



ex.

$$x^2 + y^2 > 1$$

• $y \geq x^2$



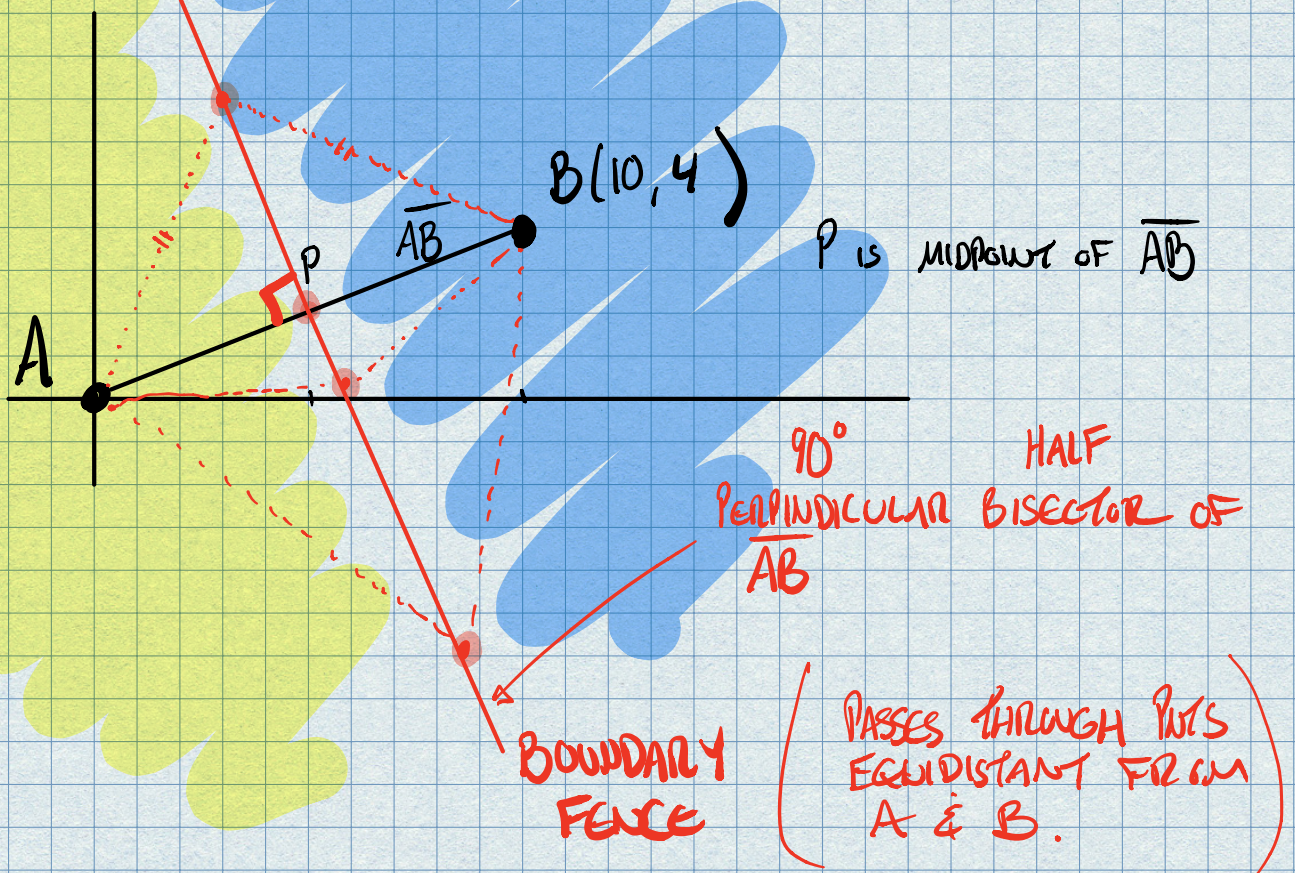
GEOMETRY PROBLEMS WITH LINEAR INEQUALITIES

"MEASURING LAND"

Problem: Two Farmers with Homes at $A(0,0)$ & $B(10,4)$.

THEY WANT TO BUILD A FENCE TO DIVIDE THE LAND INTO 2 REGIONS:

- (1.) LAND CLOSER TO A THAN TO B
- (2.) LAND CLOSER TO B THAN TO A.

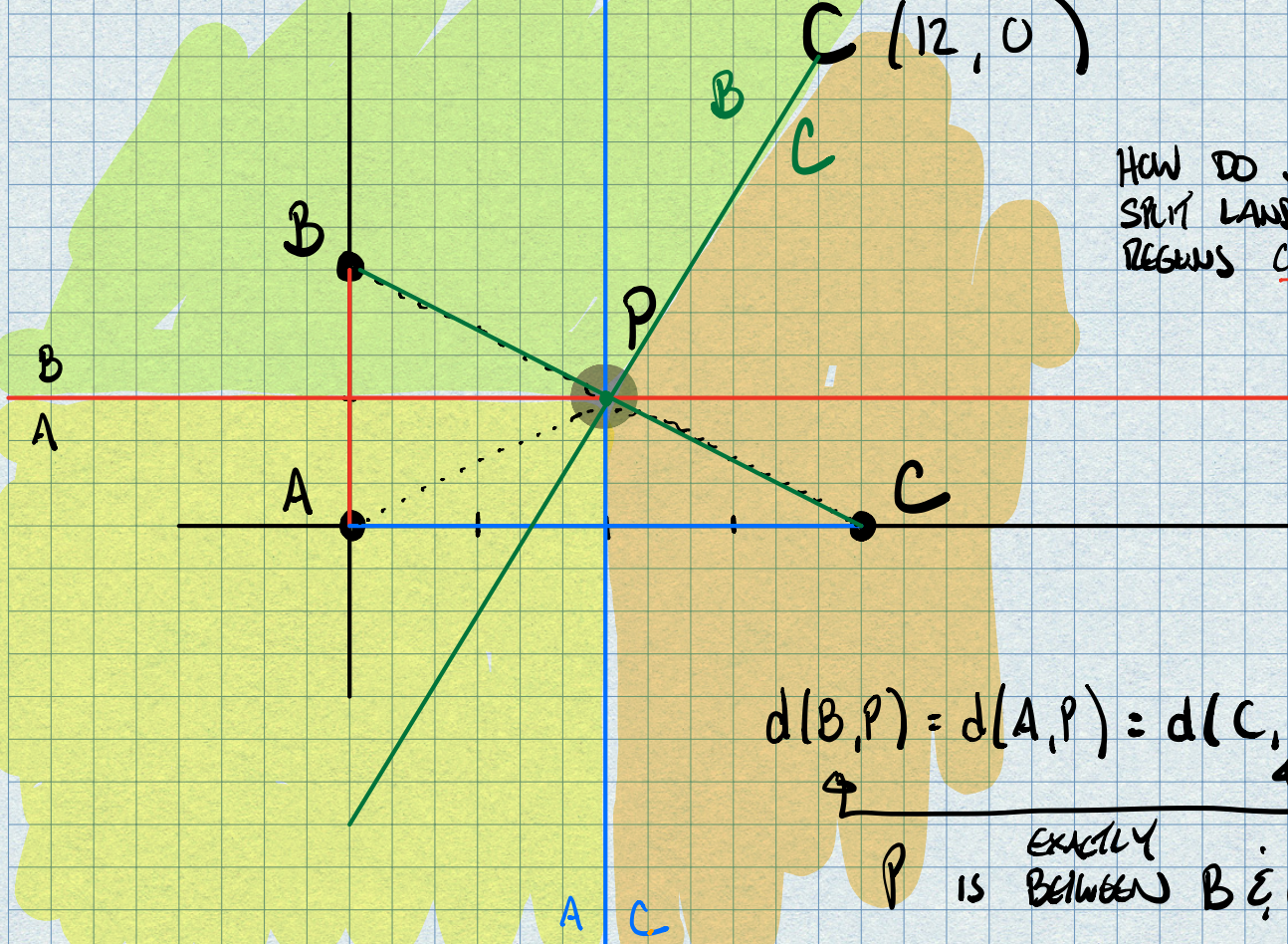


Problem: 3 FARMERS

A (0,0)

B (0,6)

C (12,0)



HOW DO 3 FARMERS
SPLIT LAND INTO
REGIONS CLOSEST TO
A
B
C

$$d(B,P) = d(A,P) = d(C,P)$$

P IS EXACTLY BETWEEN B & C

CHALLENGE:

4 FARMERS

?

