

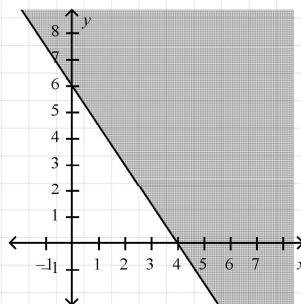
1. LINEAR INEQUALITIES in 2 VARIABLES

How to represent the solution of linear inequality in two variables?

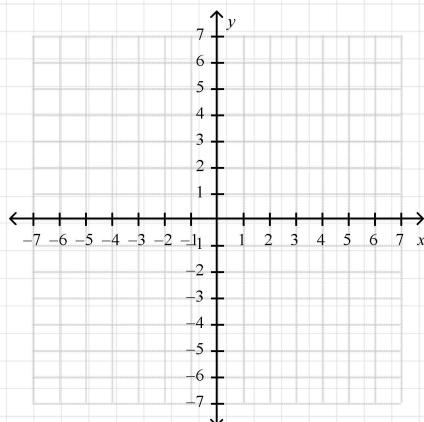
Example: $3x + 2y \geq 12$

- Draw the graph of $3x + 2y = 12$.
- Determine the solution set satisfying inequality.
- Determine whether line itself is included in the solution set.

$>$ } → line is not included, so it is shown as dashed line.
 $<$ }
 \geq } → line is included, so it is shown as straight line.
 \leq }



Example: Sketch the graph satisfying the solution set of $x - 3y < 6$.

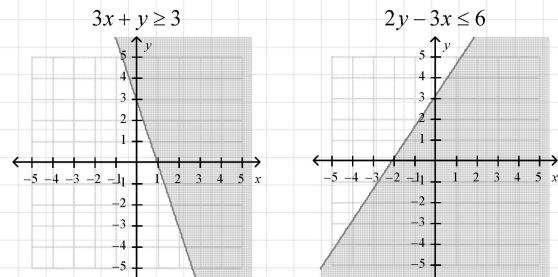


SYSTEM of LINEAR INEQUALITIES in 2 VARIABLES

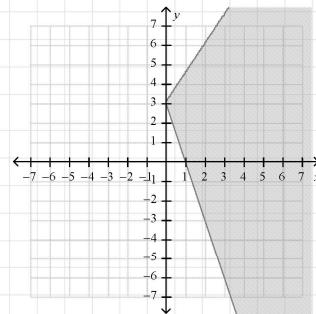
How to represent the solution of system of linear inequalities in two variables?

Example: $\begin{cases} 3x + y \geq 3 \\ 2y - 3x \leq 6 \end{cases}$

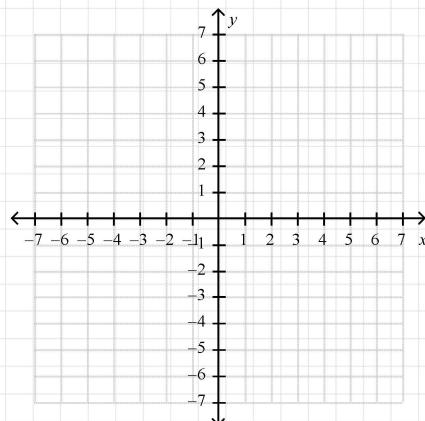
- Determine the solution set of both inequalities on same coordinate plane.
- Determine the intersection part.



$$\begin{cases} 3x + y \geq 3 \\ 2y - 3x \leq 6 \end{cases}$$

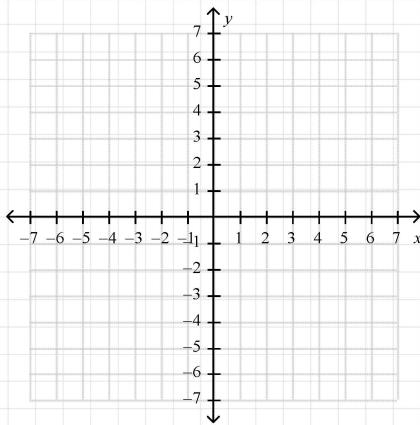


Example: Sketch the graph satisfying the system of $\begin{cases} x + 2y > 4 \\ x + 3y < 6 \end{cases}$.



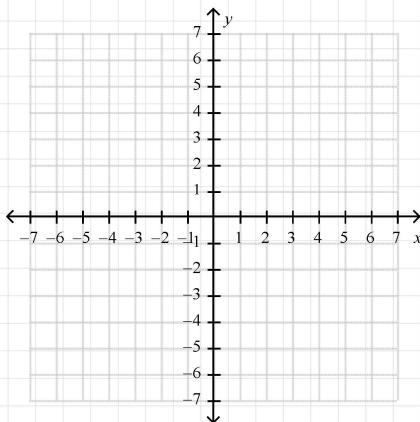
Example: Sketch the graph satisfying the system of

$$\begin{cases} 5x + 6y \leq 30 \\ x \geq -2 \\ y \leq 5 \end{cases} .$$



Example: Sketch the graph satisfying the system of

$$\begin{cases} x + 2y \leq 0 \\ 2x - 3y \leq 0 \\ x \leq 5 \\ y \leq 0 \end{cases}$$



2. LINEAR PROGRAMMING PROBLEMS

Example: A 920 m² parking area can accommodate totally 80 cars and trucks. Each car needs 4 m² and each truck needs 19 m². The parking ticket costs Rp 1.500.00 for each car and Rp 2,500.00 for each truck. What is the maximum income which can be obtained in this parking area?

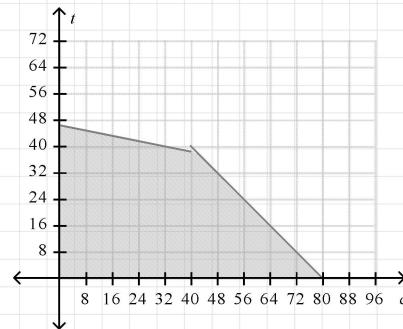
Let's formulate the problem:

$$\begin{array}{lll} c \rightarrow \text{number of cars} & \Rightarrow & (c \geq 0) \\ t \rightarrow \text{number of trucks} & \Rightarrow & (t \geq 0) \\ \text{totally 80 vehicles} & \Rightarrow & (c + t \leq 80) \\ \text{total parking area}=920 \text{ m}^2 & \Rightarrow & (4 \cdot c + 19 \cdot t \leq 920) \\ \text{income} = 1,500 \cdot c + 2,500 \cdot t & \Rightarrow & \text{objective function} \end{array}$$

Solve the system of inequality obtained by given information.

That is,

$$\begin{cases} c \geq 0 \\ t \geq 0 \\ c + t \leq 80 \\ 4 \cdot c + 19 \cdot t \leq 920 \end{cases}$$



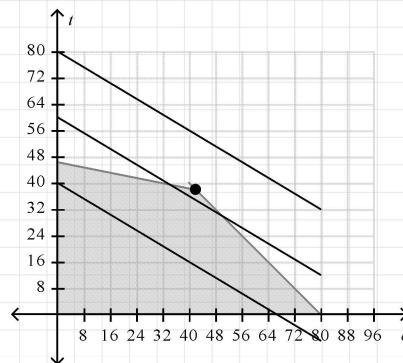
1st Way: Sliding Line:

- Sketch the objective function.
- Slide up to maximize.
- Slide up to minimize.

$$I = 1,500 \cdot c + 2,500 \cdot t \quad (I \text{ is the constant number})$$

So,

$$I = 1,500 \cdot c + 2,500 \cdot t \Rightarrow t = \frac{I}{2,500} - \frac{1,500}{2,500} \cdot c \Rightarrow t = \frac{I}{2,500} - \frac{3}{5} \cdot c$$



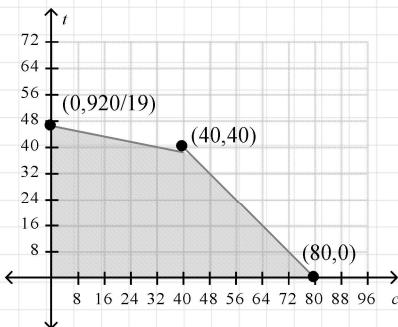
As it is observed, the maximum value is obtained at marked point.

That is, the intersection point of $c + t = 80$ and $4 \cdot c + 19 \cdot t = 920$.

$$(c, t) = (40, 40) \Rightarrow I = 1,500 \cdot 40 + 2,500 \cdot 40 = 160,000$$

2nd Way: Corner Point:

- Determine all corner points.
- Substitute in objective function.
- Choose the maximum/minimum value.



- $(c, t) = \left(0, \frac{920}{19}\right)$ since c and t must be discrete number.

We try

$$(c, t) = (0, 48) \Rightarrow I = 1,500 \cdot 0 + 2,500 \cdot 48 = 120,000$$

- $(c, t) = (40, 40) \Rightarrow I = 1,500 \cdot 40 + 2,500 \cdot 40 = 160,000$
- $(c, t) = (80, 0) \Rightarrow I = 1,500 \cdot 80 + 2,500 \cdot 0 = 120,000$

So, the maximum value for Income is 160,000 .

Example: (UN 2002)

Nilai minimum fungsi obyektif $x + 3y$ yang memenuhi pertidaksamaan $3x + 2y \geq 12$, $x + 2y \geq 8$, $x + y \leq 8$, $x \geq 0$ adalah ...
The minimum value of the objective function $x + 3y$ which is satisfying the system of inequality of $3x + 2y \geq 12$, $x + 2y \geq 8$, $x + y \leq 8$, $x \geq 0$ is ...

- A. 8 B. 9 C. 11 D. 18 E. 24

Example: (UN 2012/D49)

Seorang pedagang sepeda ingin membeli 25 sepeda untuk persediaan. Ia ingin membeli sepeda gunung harga Rp1.500.000,00 per buah dan sepeda balap dengan harga Rp2.000.000,00 per buah. Ia merencanakan tidak akan mengeluarkan uang lebih dari Rp42.000.000,00, jika keuntungan sebuah sepeda gunung Rp500.000,00 dan sebuah sepeda balap Rp600.000,00, maka keuntungan maksimum yang di terima pedagang adalah

- A. Rp13.400.000,00
B. Rp12.600.000,00
C. Rp12.500.000,00
D. Rp10.400.000,00
E. Rp8.400.000,00

Example: Fred's Coffee sells two blends of beans: Yusip Blend and Exotic Blend. Yusip Blend is one-half Costa Rican beans and one-half Ethiopian beans. Exotic Blend is one-quarter Costa Rican beans and three-quarters Ethiopian beans. Profit on the Yusip Blend is \$3.50 per pound, while profit on the Exotic Blend is \$4.00 per pound. Each day Fred receives a shipment of 200 pounds of Costa Rican beans and 330 pounds of Ethiopian beans to use for the two blends. How many pounds of each blend should be prepared each day to maximize profit? What is the maximum profit?

Example: A farmer can plant up to 8 acres of land with wheat and barley. He can earn \$5,000 for every acre he plants with wheat and \$3,000 for every acre he plants with barley. His use of a necessary pesticide is limited by federal regulations to 10 gallons for his entire 8 acres. Wheat requires 2 gallons of pesticide for every acre planted and barley requires just 1 gallon per acre. What is the maximum profit he can make?

Review Test:

1. A ship contains 300 seats, divided into executive class and business class. Each passenger of executive class can load of 80 kg, while each passenger of business class can load of 40 kg. The ship can only load 12.8 tons of goods. The ticket prices are Rp 170.000,00 for executive class and Rp 120.000,00 for business class. For maximum of profit to be obtained, the number of seats of executive class is

A) 10 B) 20 C) 30 D) 270 E) 280

2. (UN 2010)

Suatu perusahaan menghasilkan x produk dengan biaya total sebesar $(9.000 + 1.000x + \frac{1}{2}x^2)$ rupiah. Jika semua

hasil produk perusahaan tersebut habis dijual dengan harga Rp. 5.000,00 untuk satu produknya, maka laba maksimum yang dapat diperoleh perusahaan tersebut adalah

- A) Rp. 149.000,00
B) Rp. 249.000,00
C) Rp. 391.000,00
D) Rp. 609.000,00
E) Rp. 757.000,00

3. (UN 2011 PAKET 12)

Seorang anak diharuskan minum dua jenis tablet setiap hari. Tablet jenis I mengandung 5 unit vitamin A dan 3 unit vitamin B. Tablet jenis II mengandung 10 unit vitamin A dan 1 unit vitamin B. Dalam 1 hari anak tersebut memerlukan 25 unit vitamin A dan 5 unit vitamin B. Jika harga tablet I Rp 4.000,00 per biji dan tablet II Rp 8.000,00 per biji, pengeluaran minimum untuk pembelian tablet per hari adalah

- A) Rp 12.000,00
B) Rp 14.000,00
C) Rp 16.000,00
D) Rp 18.000,00
E) Rp 20.000,00

4. A merchant spends four millions rupiahs to buy the cigarette A and B. The cigarette A Cost Rp 4.000,00 and the cigarette B cost Rp 5.000,00. The cigarette A is sold of Rp 4,200.00 and the cigarette B is sold of Rp 5.100,00. Meanwhile, the shop of the broader can only accommodate 900 packs of cigarettes. If all of cigarettes are sold, then maximum profit of the merchant is

- A) Rp 80.000,00
B) Rp 140.000,00
C) Rp 180.000,00
D) Rp 200.000,00
E) Rp 240.000,00

5. A farmer has 10 acres to plant in wheat and rye. However, he has only \$1200 to spend and each acre of wheat costs \$200 to plant and each acre of rye costs \$100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is \$500 per acre of wheat and \$300 per acre of rye how many acres of each should be planted to maximize profits?

- A) 1.800
- B) 2.000
- C) 3.000
- D) 3.200
- E) 3.400

6. A gold processor has two sources of gold ore, source A and source B. In order to keep his plant running, at least three tons of ore must be processed each day. Ore from source A costs \$20 per ton to process, and ore from source B costs \$10 per ton to process. Costs must be kept to less than \$80 per day. Moreover, Federal Regulations require that the amount of ore from source B cannot exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton, and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize the amount of gold extracted subject to the above constraints?

- A) A=4, B=0
- B) A=2, B=4
- C) A=1, B=2
- D) A=8, B=0
- E) A=6, B=2

7. (UN 2009 PAKET A/B)

Tanah seluas 10.000 m² akan dibangun toko 2 tipe. Untuk toko tipe A diperlukan tanah seluas 100 m² dan tipe B diperlukan 75 m². Jumlah toko yang dibangun paling banyak 125 unit. Keuntungan tiap tipe A sebesar Rp7.000.000,00 dan tiap tipe B sebesar Rp4.000.000,00. Keuntungan maksimum yang diperoleh dari penjualan toko tersebut adalah ...

- A) Rp 575.000.000,00
- B) Rp 675.000.000,00
- C) Rp 700.000.000,00
- D) Rp 750.000.000,00
- E) Rp 800.000.000,00

8. A calculator company produces a scientific calculator and a graphing calculator. Long-term projections indicate an expected demand of at least 100 scientific and 80 graphing calculators each day. Because of limitations on production capacity, no more than 200 scientific and 170 graphing calculators can be made daily. To satisfy a shipping contract, a total of at least 200 calculators must be shipped each day.

If each scientific calculator sold results in a \$2 loss, but each graphing calculator produces a \$5 profit, how many of each type should be made daily to maximize net profits?

- A) 250
- B) 350
- C) 450
- D) 550
- E) 650

9. (UN 2010 PAKET B)

Luas daerah parkir 1.760m² luas rata-rata untuk mobil kecil 4m² dan mobil besar 20m². Daya tampung maksimum hanya 200 kendaraan, biaya parkir mobil kecil Rp1.000,00/jam dan mobil besar Rp2.000,00 / jam. Jika dalam satu jam terisi penuh dan tidak ada kendaraan yang pergi dan datang, penghasilan maksimum tempat parkir adalah ...

- A) Rp 176.000,00
- B) Rp 200.000,00
- C) Rp 260.000,00
- D) Rp 300.000,00
- E) Rp 340.000,00

10. A painter has exactly 32 units of yellow dye and 54 units of green dye. He plans to mix as many gallons as possible of color A and color B. Each gallon of color A requires 4 units of yellow dye and 1 unit of green dye. Each gallon of color B requires 1 unit of yellow dye and 6 units of green dye. Find the maximum number of gallons he can mix.

- A) 9
- B) 14
- C) 18
- D) 22
- E) 14