Subject: Mine System Engineering 05/08/2025

Assignment - 1

① **Decision Variables :**

$x \rightarrow$ barrels imported per day from Iraq

$y \rightarrow$ barrels imported per day from Dubai

Objective function :

Minimize $z = x + y$

Constraints :

Diesel : $0.2x + 0.1y \geq 14{,}000$

Gasoline : $0.25x + 0.6y \geq 30{,}000$

Lubricants : $0.1x + 0.15y \geq 10{,}000$

Jet fuel : $0.15x + 0.1y \geq 8{,}000$

minimum demand for each (in bbl/day)

$x \geq 0.4(x+y)$ OPEC production quotas

$\Rightarrow 0.6x - 0.4y \geq 0$

$x, y \geq 0$ Non-negativity constraints

Corner points = (40000, 60000), (50000, 30000), (66666.67, 22222.22), (12000, 0)

x	y	z
40,000	60,000	100,000
55,000	30,000	85,000
66666.67	22,222.22	88888.89
120000	0	120000

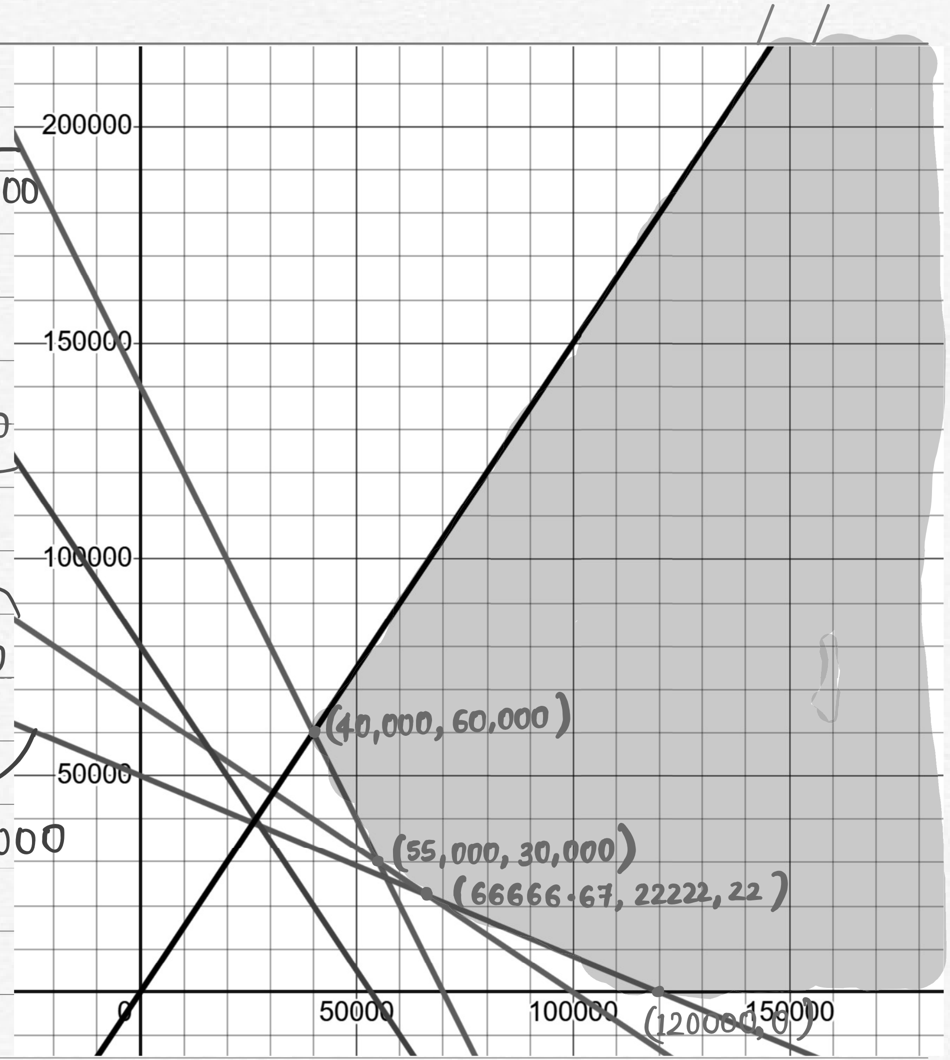
Subject:

$0.2x + 0.1y = 14000$

$0.15x + 0.1y = 8000$

$0.1x + 0.15y = 10000$

$0.25x + 0.6y = 30000$



For minimizing the capacity of the refinery the optimal point (55000, 30000) for which the minimum capacity of 85,000 bbl/day obtained.

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(2) Decision Variables :

$x_A \rightarrow$ tons of scrap aluminium metal A

$x_B \rightarrow$ tons of scrap aluminium metal B

Objective function :

Minimize $z = 100x_A + 80x_B$

Constraints :

Subject:

$$x_A + x_B = 1000 \quad \} \text{ Total alloy production}$$

Al content : $3\% \leq Al \leq 6\%$

$$0.06x_A + 0.03x_B \geq 0.03(x_A + x_B)$$
$$\Rightarrow 0.06x_A + 0.03x_B \geq 30$$

$$0.06x_A + 0.03x_B \leq 0.06(x_A + x_B)$$
$$\Rightarrow 0.06x_A + 0.03x_B \leq 60$$

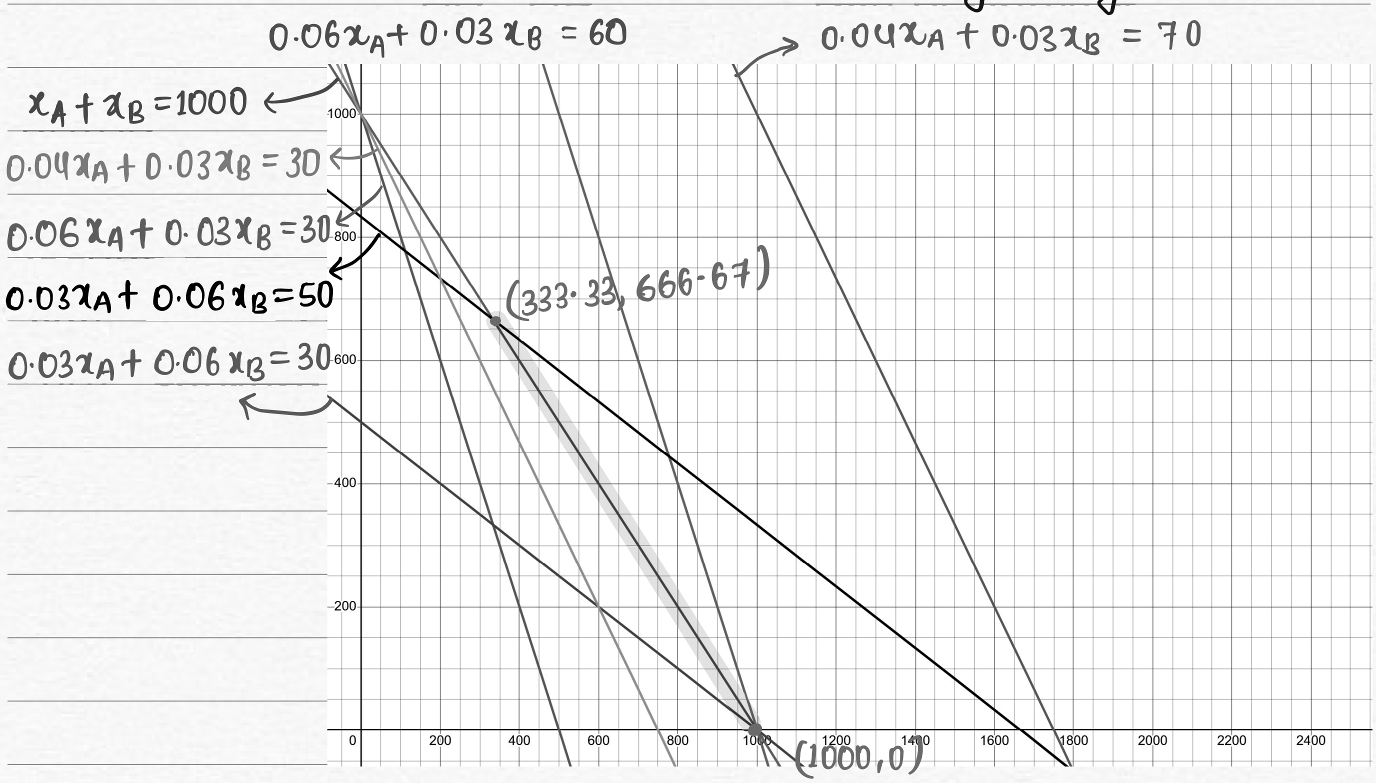
Si Content : $3\% \leq Si \leq 5\%$

$$\Rightarrow 0.03x_A + 0.06x_B \geq 30$$
$$\Rightarrow 0.03x_A + 0.06x_B \leq 50$$

C content : $3\% \leq C \leq 7\%$

$$\Rightarrow 0.04x_A + 0.03x_B \geq 30$$
$$\Rightarrow 0.04x_A + 0.03x_B \leq 70$$

$$x_A, x_B \geq 0 \quad \} \text{ Non-negativity constraints}$$



Subject: / /

x_A	x_B	z
1000	0	100000
333.33	666.67	86666.13

So the optimum mix of the scraps is (333.33, 666.67) tons which will cost \$ 86666.13.

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(3) Decision variables :

$x \rightarrow$ amount to invest in Blue chip

$y \rightarrow$ amount to invest in high tech

Objective function :

Minimize $z = x + y$

Constraints :

$0.10x + 0.25y \geq 10,000$ } Annual yield

$y \leq 0.60(x+y)$ } limitation due to risk

$\Rightarrow 0.40y - 0.60x \leq 0$

$\Rightarrow 0.60x - 0.40y \geq 0$

$x, y \geq 0$ } non-negativity constraints

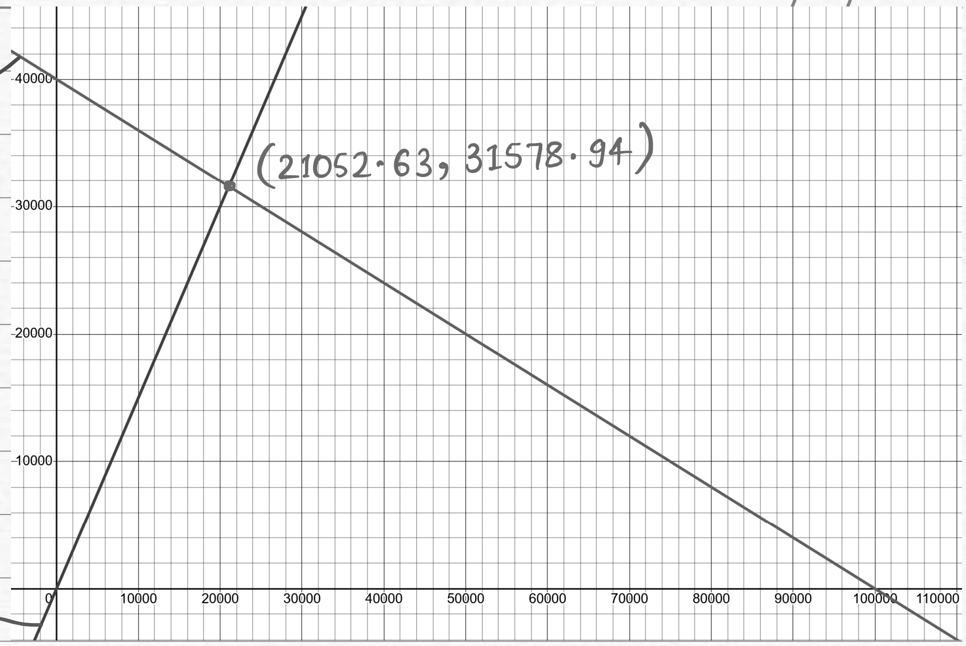
Corner point = (21052.63, 31578.94)

So the minimum amount Trader should invest in each stock is \$ 21052.63 in blue chip and \$ 31578.94 in high tech.

Total investment = \$ 52631.57

Subject:

$0.10x + 0.25y = 10000$



$0.60x - 0.40y = 0$

④ Decision Variables :

$x_A \rightarrow$ units of solution A

$x_B \rightarrow$ units of solution B

Objective function :

Maximize $z = 8x_A + 10x_B$

Constraints :

$0.5x_A + 0.5x_B \leq 150$

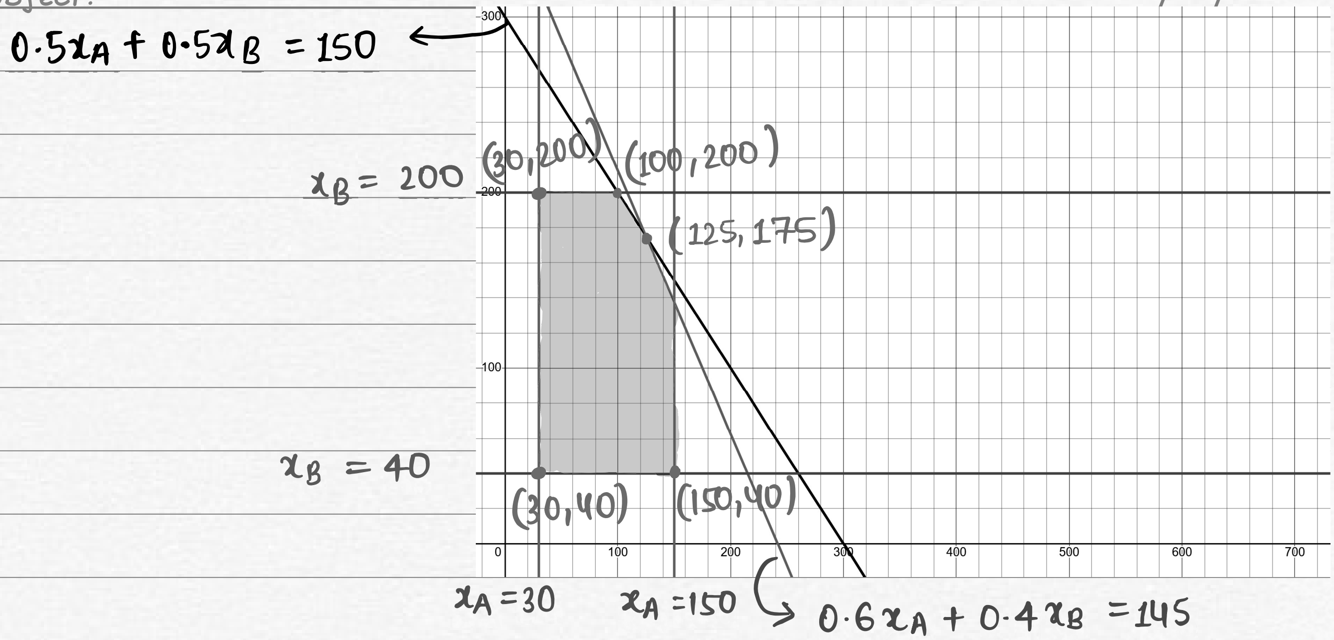
$0.6x_A + 0.4x_B \leq 145$

$x_A \geq 30 \qquad x_A \leq 150$ } Demand of solution A

$x_B \geq 40 \qquad x_A \leq 200$ } Demand of solution B

$x_A, x_B \geq 0$ } non-negativity constraints

Subject: / /



Corner points = (30, 200), (100, 200), (125, 175), (150, 40), (30, 40)

x_A	x_B	z
30	200	2240
100	200	2800
125	75	1750
150	40	1600
30	40	640

For maximum profit of the daily availabilities of raw materials I & II is \$ 2800 for the quantities 100 units of solution A & 200 units of solution B.

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⑤ Decision Variables :

$x_A \rightarrow$ number of units of Product A

$x_B \rightarrow$ number of units of product B

Subject:

Objective function :

$$\text{Maximize } z = 40x_A + 90x_B$$

Constraints :

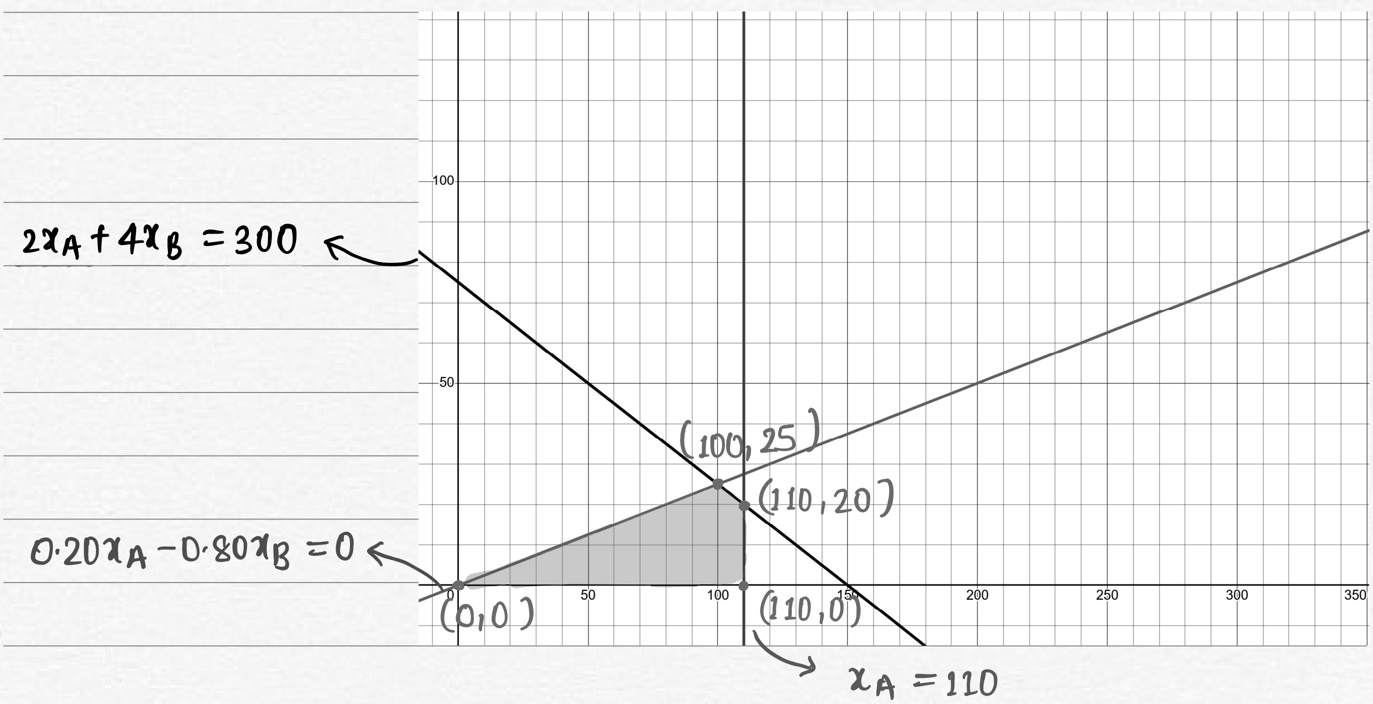
$$x_A \geq 0.80(x_A + x_B)$$

$$\Rightarrow 0.20x_A - 0.80x_B \geq 0$$

$x_A \leq 110$ } Sell limit of product A

$2x_A + 4x_B \leq 300$ } Raw material availability

$x_A, x_B \geq 0$ } non-negativity constraints



Corner points = (0,0), (100, 25), (110, 20), (110, 0)

x_A	x_B	z
0	0	0
100	25	6250
110	20	6200
110	0	4400

Subject: / /

To maximize the profit, the optimal product mix for the company is 100 units of product A & 25 units of product B.

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⑥ Decision Variables :

$x \rightarrow$ no. of units of Aluminium sheets

$y \rightarrow$ no. of units of Aluminium bars

Objective function :

Maximize $z = 40x + 35y$

Constraints :

Maximum production capacity is estimated at either 800 sheets or 600 bars per day

$$\Rightarrow \frac{x}{800} + \frac{y}{600} \leq 1$$

$$\Rightarrow 3x + 4y \leq 2400$$

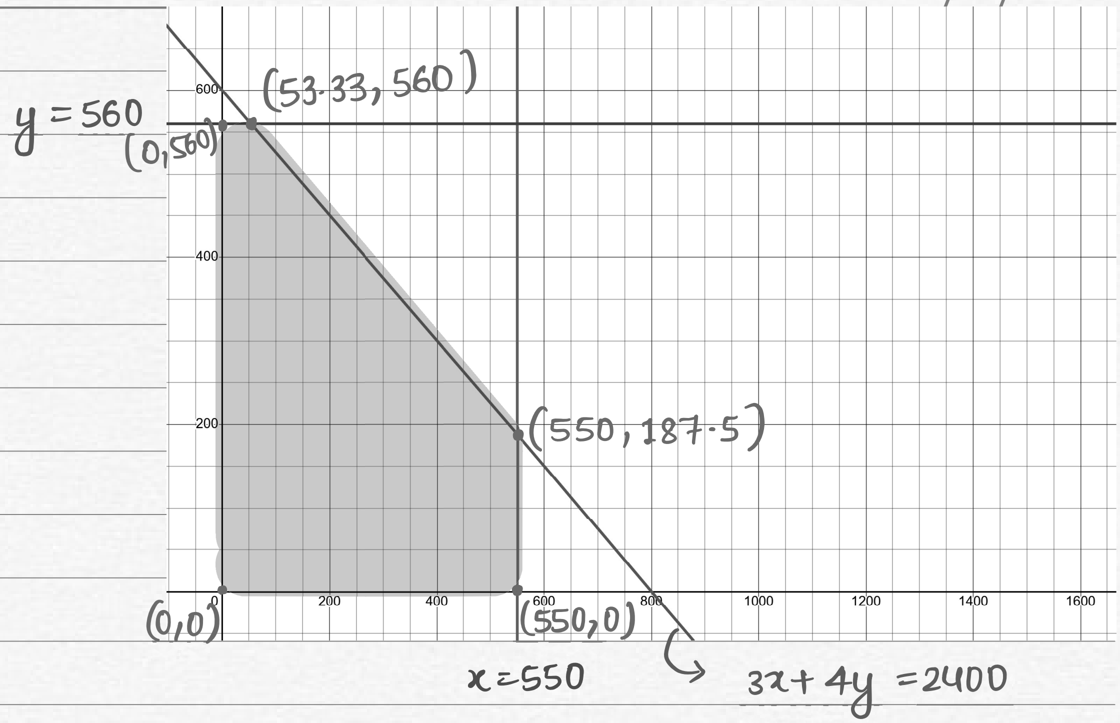
$x \leq 550$ } max. demand for sheets

$y \leq 560$ } max. demand for bars

$x, y \geq 0$ } non-negativity constraints

Corner points = $(0,0), (0,560), (53.33, 560), (550, 187.5), (550, 0)$

Subject:



x_A	x_B	z
0	0	0
0	560	19600
53.33	560	21733.2
550	187.5	28562.5
550	0	22000

∴ The optimal daily production of Product A with 550 units & 188 units of product B with maximum profit of \$ 28562.5.

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(7) Decision Variables :

$x_A \rightarrow$ amount to be invested in Investment A

$x_B \rightarrow$ amount to be invested in Investment B

Objective function :

Maximize $z = 0.05 x_A + 0.08 x_B$

Subject: / /

Constraints :

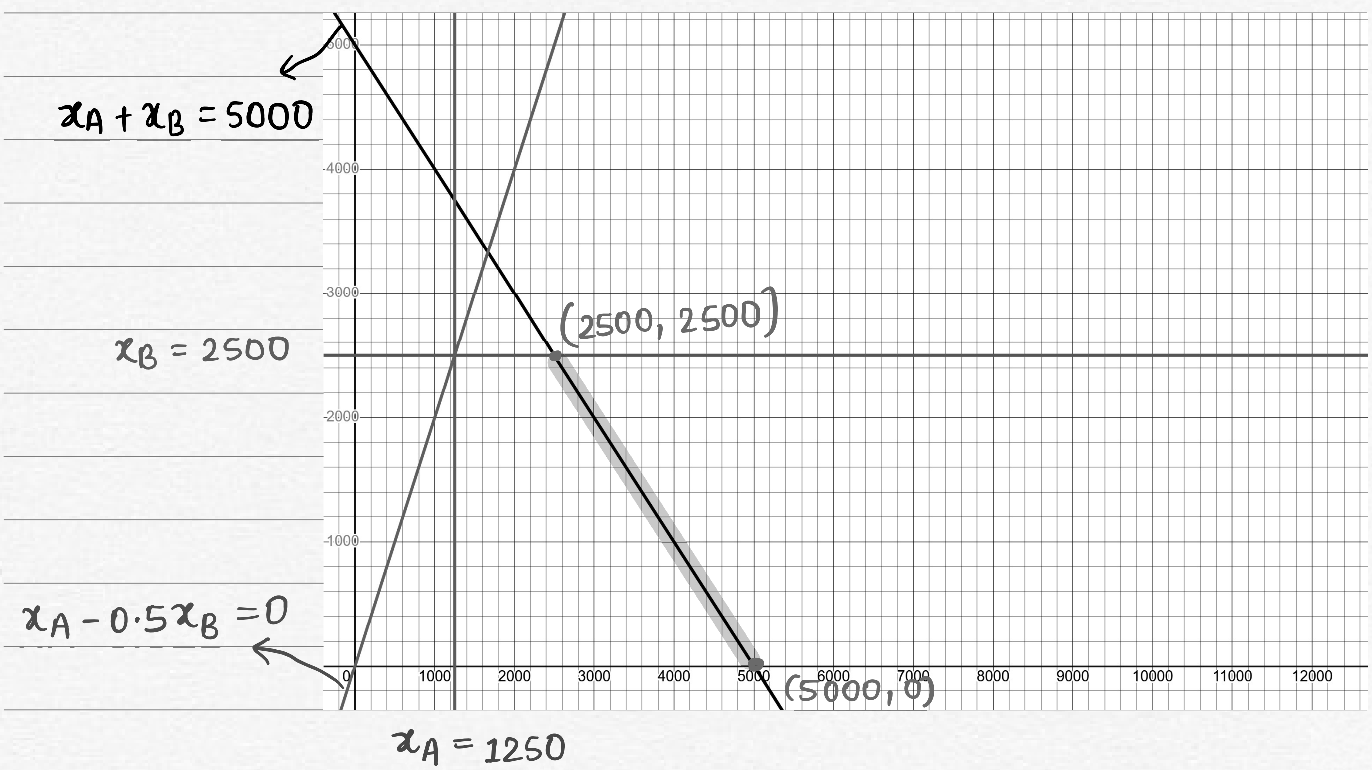
$$x_A + x_B = 5000$$

$$x_A \geq 0.25\,(x_A + x_B)$$
$$\Rightarrow x_A \geq 1250 \quad \} \text{ Allocation of A}$$

$$x_B \leq 0.50\,(x_A + x_B)$$
$$\Rightarrow x_B \leq 2500 \quad \} \text{ Allocation of B}$$

$$x_A \geq 0.5\,x_B$$
$$\Rightarrow x_A - 0.5\,x_B \geq 0$$

$$x_A,\ x_B \geq 0 \quad \} \text{ non-negativity}$$



Corner points = (2500, 2500), (5000, 0)

The optimal yield of \$ 325 when \$ 2500 is allocated in both the investments.