Q1. Standard form:

$\max z = 5x_1 + 3x_2 + 0s_1 + 0s_2$

s.t. $3x_1 + 5x_2 + s_1 = 15$

$5x_1 + 2x_2 + s_2 = 10$

$x_1, x_2, s_1, s_2 \geq 0$

Step 2:- Starting simplex table.

	C_j	5	3	0	0		
C_{Bi}	BV	x_1	x_2	s_1	s_2	sol^n	Ratio
0	s_1	3	5	1	0	15	5
0	s_2	5	2	0	1	10 →	2 →
	$C_j - Z_j$	5 ↓	3	0	0		

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Step 3:- Calculate $c_j - z_j$ values, since all $c_j - z_j$ values are (+)ve
∴ the sol^n is not optimal.

Step 4:- Find incoming and outgoing vector

Since $x_1 = 5$ in $c_j - z_j$ is the largest (+)ve value, so it is incoming vector. and because in the Ratio column $S_2 = 2$ is the least value which is (+)ve, so it is outgoing vector.

Step 5:- making iteration table 1.

	C_j	5	3	0	0		
C_{Bi}	BV	x_1	x_2	S_1	S_2	sol^n	Ratio
0	S_1	0	19/5	1	-3/5	9	45/19
5	x_1	1	2/5	0	1/5	2	5
	z_j	5	2	0	1		
	$c_j - z_j$	0	1	0	-1		

for calculating R_2 values or (x_1 values) we will simply divide the whole row by the key element (5). and to obtain the new values of R_1 or S_1 we have a formula:-

$$N.V = O.V - \left(\frac{\text{corresponding key column value} \times \text{corresponding key row value}}{\text{Key element}} \right)$$

Step 6 Since $x_2 = 1$ is the maximum (+)ve value in $C_j - Z_j$ row, so it is incoming variable and S_1 is the least (+)ve value in Ratio column so, S_1 is outgoing variable.

Step 7 making simplex table 2.

	C_j	5	3	0	0		
CBi	BV	x_1	x_2	S_1	S_2	sol^n	Ratio
3	x_2	0	1	5/19	-3/19	45/19	
5	x_1	1	0	-2/19	5/19	20/19	
	Z_j	5	3	5/19	16/19	235/19	
	$C_j - Z_j$	0	0	-5/19	-16/19		

all $C_j - Z_j \leq 0$, so above sol^n is the optimal sol^n.

Optimal sol^n is $x_1 = \frac{20}{19}$, $x_2 = \frac{45}{19}$

and $Z_{max} = \frac{235}{19}$

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Q2. Step1 :- standard form of primal:-

$\min z = 6x_1 + 4x_2$

s.t. $2x_1 + x_2 \geq 1$ and $3x_1 + 4x_2 \geq 1.5$

where $x_1, x_2 \geq 0$

Step2 :- dual of the primal is

$\max w = y_1 + 1.5y_2$

s.t. $2y_1 + 3y_2 \leq 6$

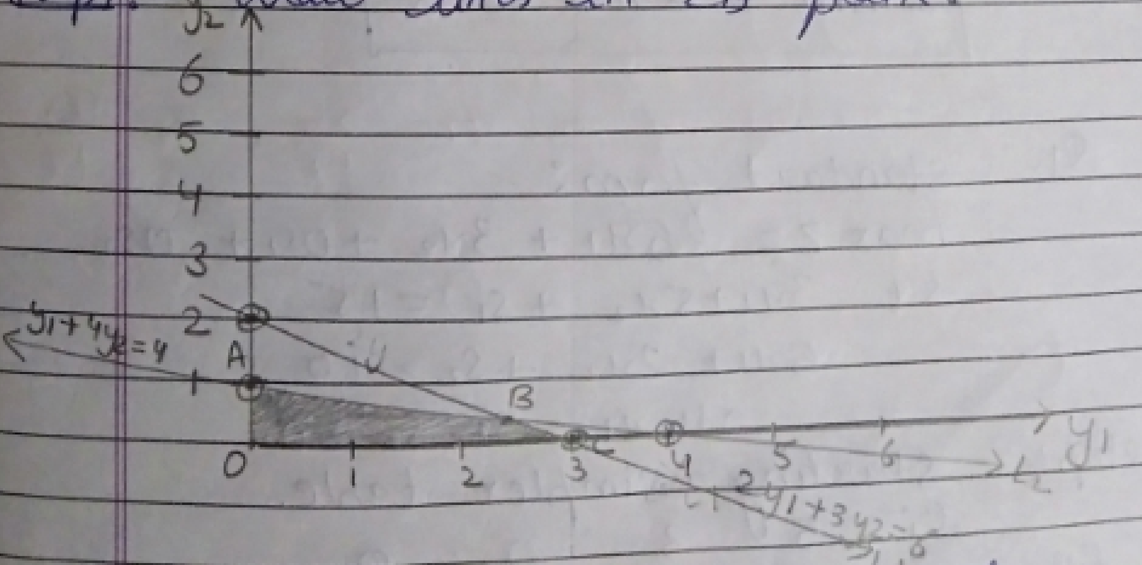
and $y_1 + 4y_2 \leq 4$, $y_1, y_2 \geq 0$

Step3 :- Solving dual by graphical method.

Consider the constraints as equations.

$2y_1 + 3y_2 = 6$ and $y_1 + 4y_2 = 4$

Step4 :- draw lines in 2D plane.



Step5 :- Solving L_1 and L_2 we get

$y_1 = \frac{12}{5}$ and $y_2 = \frac{2}{5}$, point B is $\left(\frac{12}{5}, \frac{2}{5}\right)$

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Step6:- Shaded region is the permissible region for the values of y_1 & y_2.

Step7:- Calculating the values of ω at the shaded region.

$\omega_0 = 1(0) + 1.5(0) = 0$

$\omega_A = 1(0) + 1.5(1) = 1.5$

$\omega_B = 1\left(\frac{12}{5}\right) + 1.5\left(\frac{2}{5}\right) = \frac{12}{5} + \frac{3}{5} = 3$

$\omega_C = 1(3) + 1.5(0) = 3$

$\omega_{max} = 3$ at $\left(\frac{12}{5}, \frac{2}{5}\right)$ and $(3,0)$

$\therefore$ It have multiple sol^n

$$\boxed{Z_{min} = \omega_{max} = 3}$$