(2) FORMULATING THE DUAL OF THIS TRANSPORTATION PROBLEM

	Warehouse 1	Warehouse 2	Warehouse 3	Unit production Cost	production capacity
	Unit Shipping Cost				
plant A	$ 22	$ 14	$ 30	$ 600	100
plant B	$ 16	$ 20	$ 24	$ 625	120
Monthly Demand	80	60	70		

Objective function for the given problem, is given as,

PRIMAL

$$\text{Min } C = 622x_{11} + 614x_{12} + 630x_{13} + 136x_{21} + 140x_{22} + 144x_{23}$$

Subject to, constraints ⟶

$$x_{11} + x_{12} + x_{13} \leq 100$$
$$x_{21} + x_{22} + x_{23} \leq 120$$

↓

"Supply Constraints"

"Demand Constraints"

$$x_{11} + x_{21} \geq 80$$
$$x_{12} + x_{22} \geq 60$$
$$x_{13} + x_{23} \geq 70$$

$$x_{ij} \geq 0$$

$$\begin{bmatrix} 22 & 14 & 30 \\ 16 & 20 & 24 \end{bmatrix}\begin{matrix}100 \\ 120\end{matrix} \quad \begin{bmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \end{bmatrix}$$

$$\begin{matrix} 80 & 60 & 70 \end{matrix} \qquad D$$

Dual :- x_{11}

Max = 2

[Constraints $AX = b$ for Primal.]

$$\begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{21} & x_{22} & x_{23} \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix} \begin{pmatrix} x_{11} \\ x_{12} \\ x_{13} \\ x_{21} \\ x_{22} \\ x_{23} \end{pmatrix}$$

DUAL FORMULATION :

Maximize Z ;

$u_1 + v_1 \le 22$	$u_1 \le 22 - v_1$
$u_1 + v_2 \le 14$	$u_1 \le 14 - v_2$
$u_1 + v_3 \le 30$	$u_1 \le 30 - v_3$
$u_2 + v_1 \le 16$	$u_2 \le 16 - v_1$
$u_2 + v_2 \le 20$	$u_2 \le 20 - v_2$
$u_3 + v_3 \le 24$	$u_3 \le 24 - v_3$

$$d_{ij} = c_{ij} - (u_i + v_j)$$

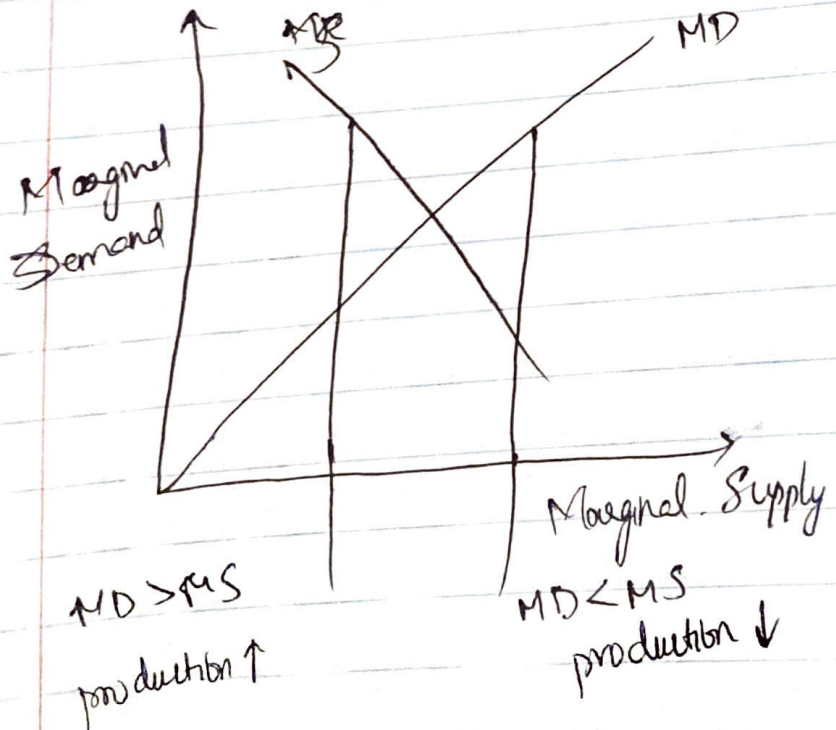
$(u_1 + u_2 + u_3 + v_1 + v_2 + v_3) \longrightarrow$ unrestricted

3A) Economic Interpretation of Transportation problem

$$u_1^d - v_1^o \leq 22$$
$$u_1^d - v_2^o \leq 14$$
$$u_1^d - v_3^o \leq 30$$
$$u_2^d - v_1^o \leq 16$$
$$u_2^d - v_2^o \leq 20$$
$$u_3^d - v_3^d \leq 24$$

$$MR_1 \geq MC_1$$

Marginal Demand ≥ Marginal Supply



TC	TR	MC	MR	profit
8	8	0 –	—	0
9	16	1	8	7
10	24	1	8	14
11	32	1.	8	21
~~12~~	~~40~~			2
13	48	2	8	27
19	88	6	8	24
27	56	8	8	24
37	64	10	8	27

Objective func.