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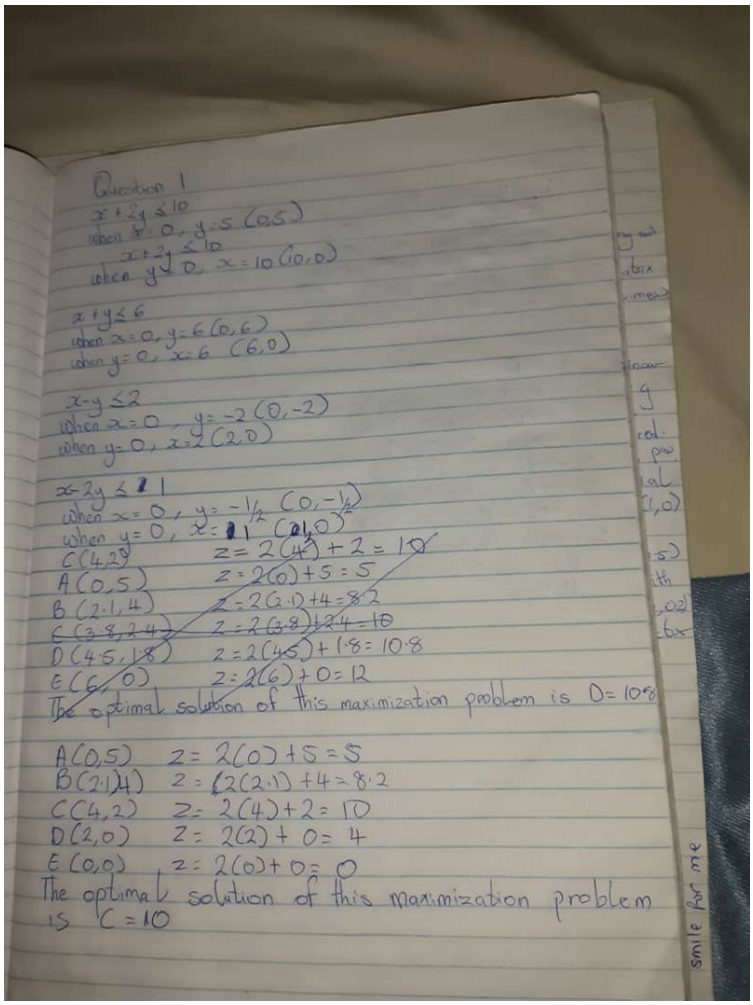
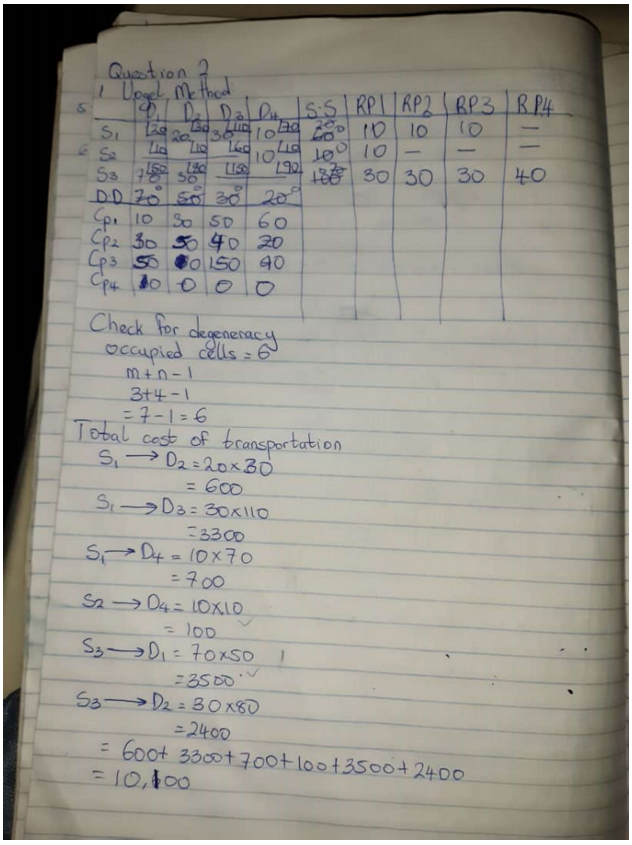
MATRIC NO:17/SCI01/033

1.



2



Question 2

1 Vogel Method

	D_1	D_2	D_3	D_4	S.S	RP1	RP2	RP3	RP4
S_1	120	20	30	10	60	10	10	10	—
S_2	10	110	140	10	10	10	—	—	—
S_3	180	130	150	190	180	30	30	30	40
DD	70	50	30	20					
C_{P1}	10	30	50	60					
C_{P2}	30	50	40	20					
C_{P3}	50	80	150	90					
C_{P4}	0	0	0	0					

Check for degeneracy

occupied cells = 6

m+n-1

3+4-1

= 7-1 = 6

Total cost of transportation

$S_1 \longrightarrow D_2 = 20 \times 30$

$= 600$

$S_1 \longrightarrow D_3 = 30 \times 110$

$= 3300$

$S_1 \longrightarrow D_4 = 10 \times 70$

$= 700$

$S_2 \longrightarrow D_4 = 10 \times 10$

$= 100$

$S_3 \longrightarrow D_1 = 70 \times 50$

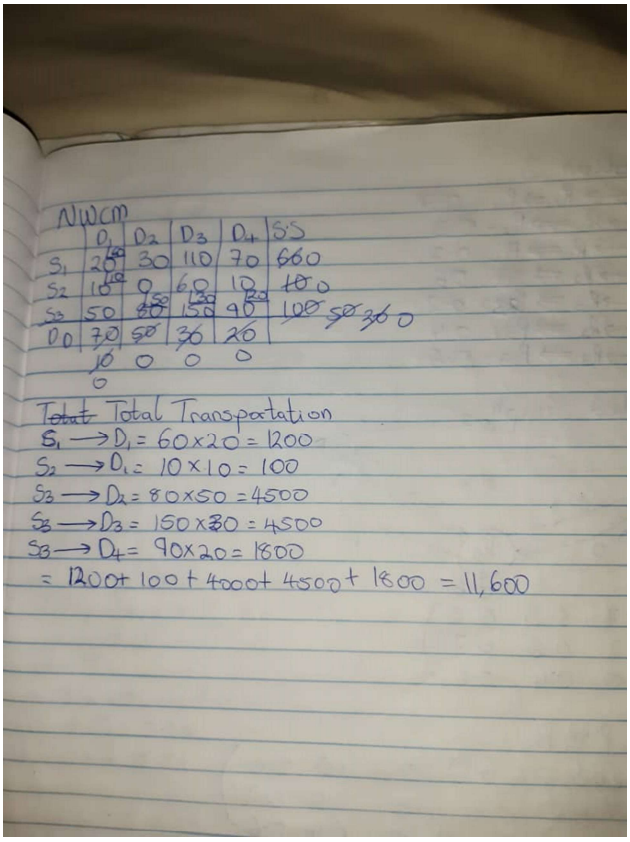
$= 3500$

$S_3 \longrightarrow D_2 = 30 \times 80$

$= 2400$

$= 600 + 3300 + 700 + 100 + 3500 + 2400$

$= 10,600$



NWCM

	D_1	D_2	D_3	D_4	S.S
S_1	20	30	110	70	660
S_2	10	0	60	10	100
S_3	50	80	150	90	100 50 30 0
D_0	70 50	50	30	20	
	10 0	0	0	0	
	0				

Total Transportation

$S_1 \longrightarrow D_1 = 60 \times 20 = 1200$

$S_2 \longrightarrow D_1 = 10 \times 10 = 100$

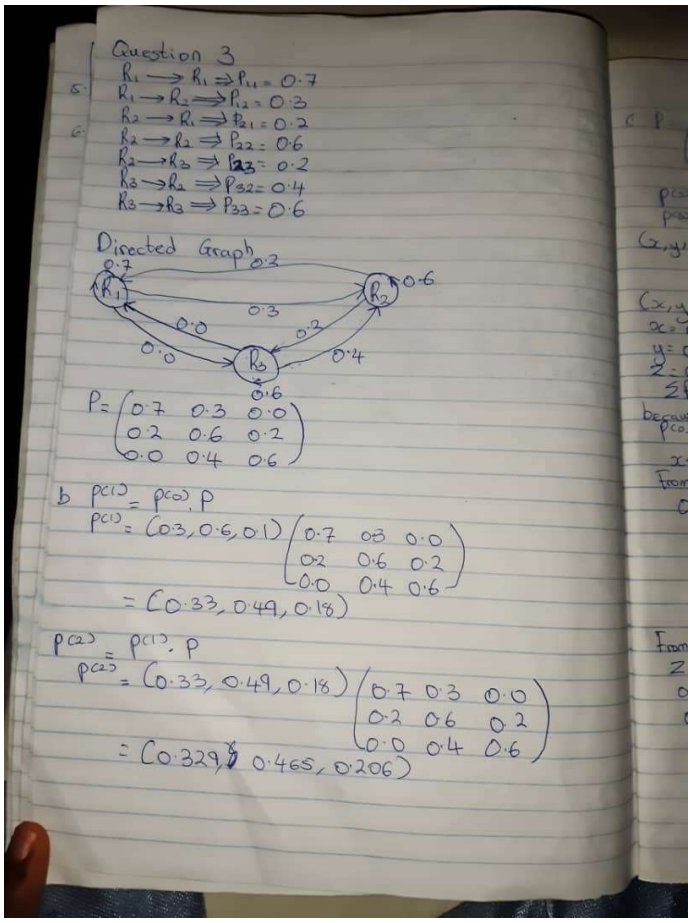
$S_3 \longrightarrow D_2 = 80 \times 50 = 4500$

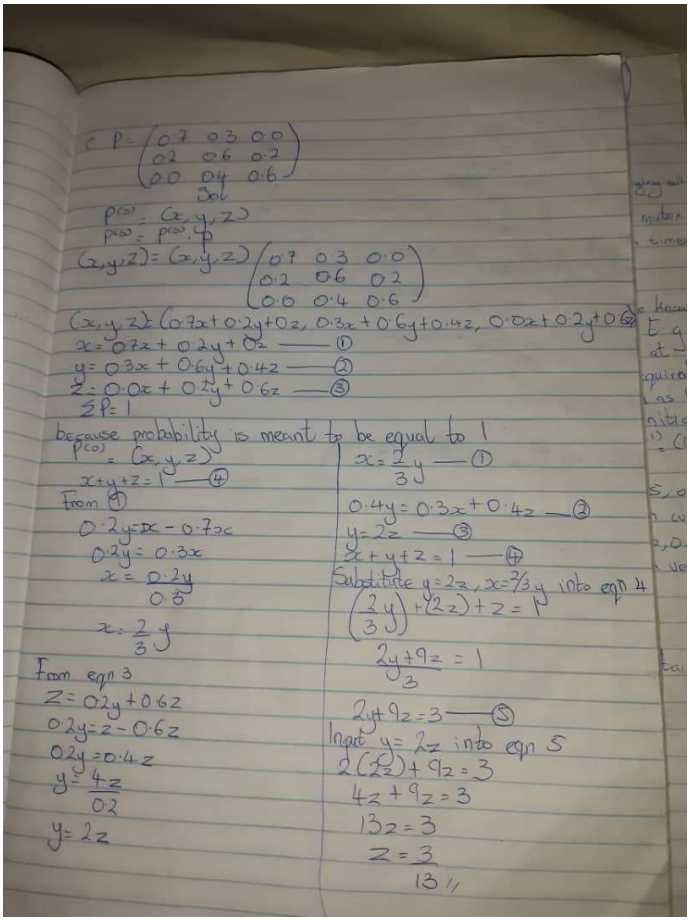
$S_3 \longrightarrow D_3 = 150 \times 30 = 4500$

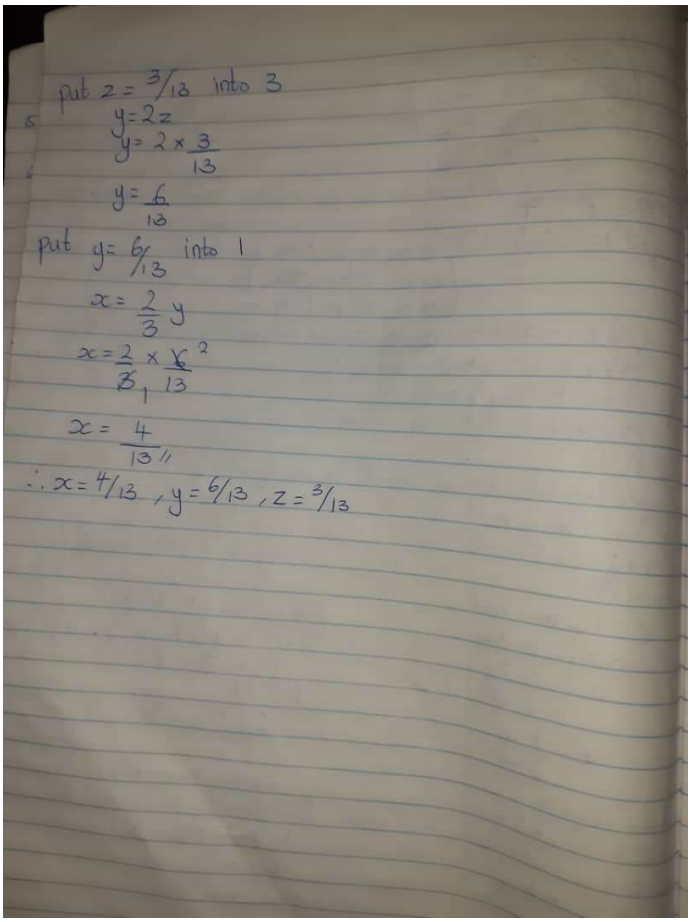
$S_3 \longrightarrow D_4 = 90 \times 20 = 1800$

$= 1200 + 100 + 4000 + 4500 + 1800 = 11,600$

3.


Question 3
$R_1 \to R_1 \Rightarrow P_{11} = 0.7$
$R_1 \to R_2 \Rightarrow P_{12} = 0.3$
$R_2 \to R_1 \Rightarrow P_{21} = 0.2$
$R_2 \to R_2 \Rightarrow P_{22} = 0.6$
$R_2 \to R_3 \Rightarrow P_{23} = 0.2$
$R_3 \to R_2 \Rightarrow P_{32} = 0.4$
$R_3 \to R_3 \Rightarrow P_{33} = 0.6$
Directed Graph
$P = \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$
b $P^{(1)} = P^{(0)} \cdot P$
$P^{(1)} = (0.3, 0.6, 0.1)$
$= (0.33, 0.49, 0.18)$
$P^{(2)} = P^{(1)} \cdot P$
$P^{(2)} = (0.33, 0.49, 0.18)$
$= (0.329, 0.465, 0.206)$


c $P = \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$
$P^{(0)} = (x, y, z)$
$P^{(1)} = P^{(0)} \cdot P$
$(x, y, z) = (x, y, z) \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$
$(x, y, z) = (0.7x + 0.2y + 0z, 0.3x + 0.6y + 0.4z, 0.0x + 0.2y + 0.6z)$
$x = 0.7x + 0.2y + 0z$ — ①
$y = 0.3x + 0.6y + 0.4z$ — ②
$z = 0.0x + 0.2y + 0.6z$ — ③
$\sum P = 1$
because probability is meant to be equal to 1
$P^{(0)} = (x, y, z)$
$x + y + z = 1$ — ④
From ①
$0.2y = x - 0.7x$
$0.2y = 0.3x$
$x = \frac{0.2y}{0.3}$
$x = \frac{2}{3}y$
From eqn 3
$z = 0.2y + 0.6z$
$0.2y = z - 0.6z$
$0.2y = 0.4z$
$y = \frac{4z}{0.2}$
$y = 2z$
$x = \frac{2}{3}y$ — ①
$0.4y = 0.3x + 0.4z$ — ②
$y = 2z$ — ③
$x + y + z = 1$ — ④
Substitute $y = 2z$, $x = \frac{2}{3}y$ into eqn 4
$\left(\frac{2}{3}y\right) + (2z) + z = 1$
$\frac{2y + 9z}{3} = 1$
$2y + 9z = 3$ — ⑤
Input $y = 2z$ into eqn 5
$2(2z) + 9z = 3$
$4z + 9z = 3$
$13z = 3$
$z = \frac{3}{13}$



Put $z = 3/13$ into 3

$y = 2z$

$y = 2 \times \frac{3}{13}$

$y = \frac{6}{13}$

Put $y = 6/13$ into 1

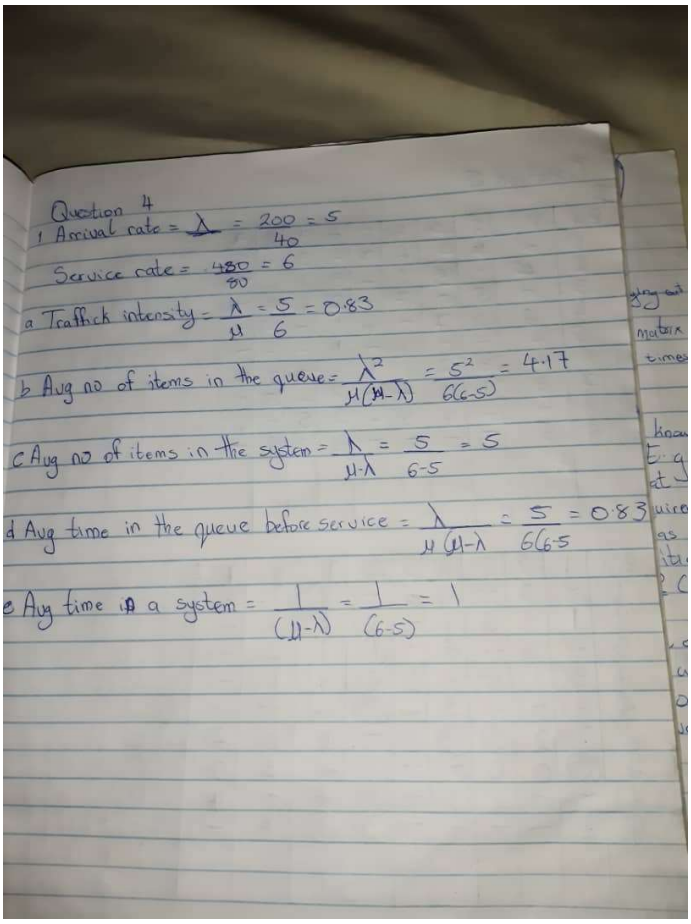
$x = \frac{2}{3} y$

$x = \frac{2}{3_1} \times \frac{6^2}{13}$

$x = \frac{4}{13}$

$\therefore x = 4/13, y = 6/13, z = 3/13$

4.



Question 4

1 Arrival rate $= \lambda = \frac{200}{40} = 5$

Service rate $= \frac{480}{80} = 6$

a Traffick intensity $= \frac{\lambda}{\mu} = \frac{5}{6} = 0.83$

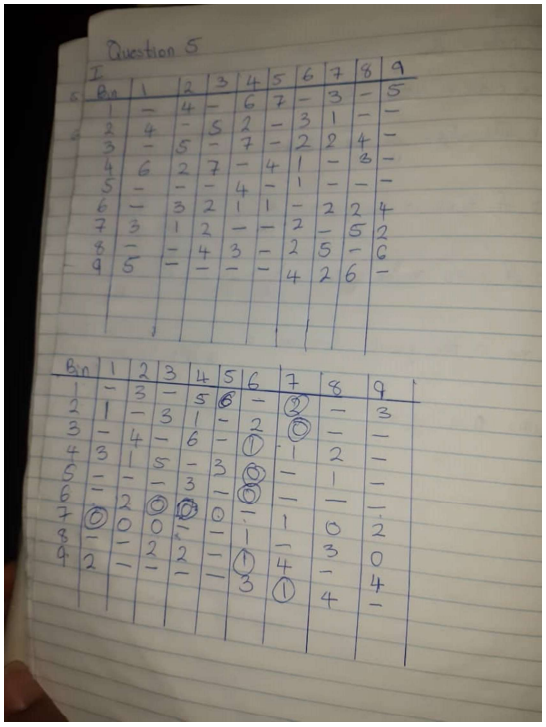
b Avg no of items in the queue $= \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{5^2}{6(6-5)} = 4.17$

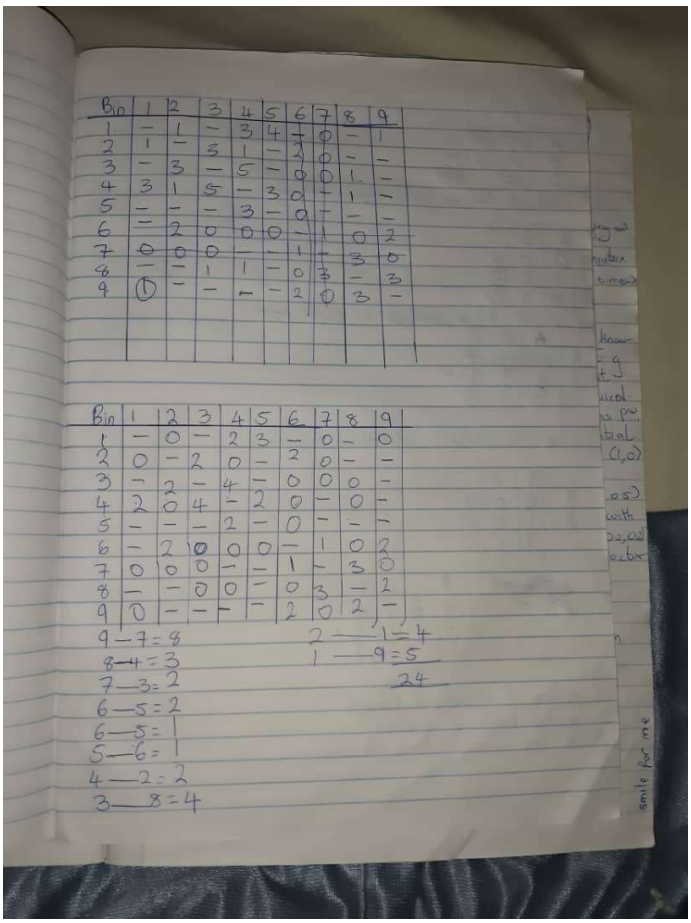
c Avg no of items in the system $= \frac{\lambda}{\mu-\lambda} = \frac{5}{6-5} = 5$

d Avg time in the queue before service $= \frac{\lambda}{\mu(\mu-\lambda)} = \frac{5}{6(6-5)} = 0.83$

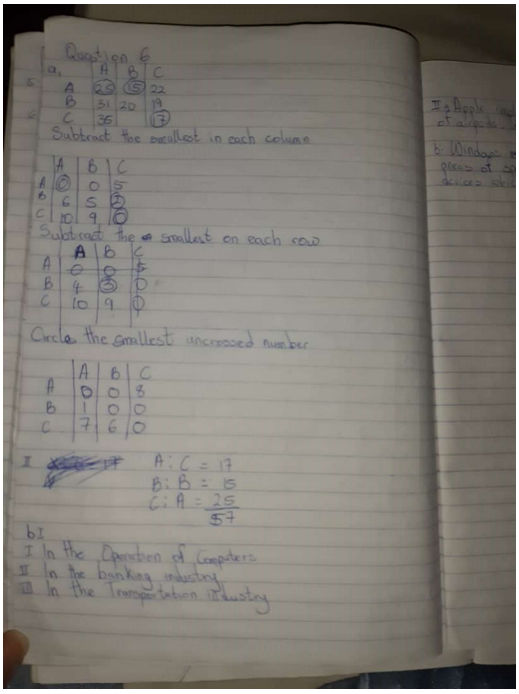
e Avg time in a system $= \frac{1}{(\mu-\lambda)} = \frac{1}{(6-5)} = 1$

5.





6.



Question 6

a.

	A	B	C
A	23	15	22
B	31	20	19
C	35		17

Subtract the smallest in each column

	A	B	C
A	0	0	5
B	6	5	2
C	10	9	0

Subtract the smallest on each row

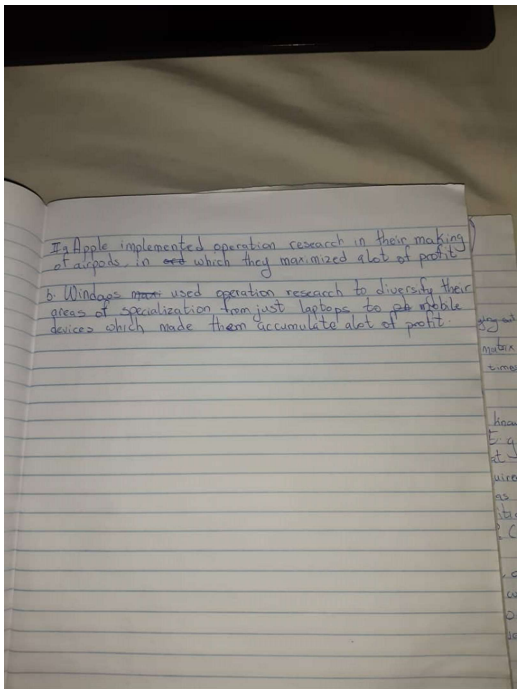
	A	B	C
A	0	0	5
B	4	3	0
C	10	9	0

Circle the smallest uncrossed number

	A	B	C
A	0	0	8
B	1	0	0
C	7	6	0

I A: C = 17
B: B = 15
C: A = 25
57

bI
I In the Operation of Computers
II In the banking industry
III In the Transportation industry



II a Apple implemented operation research in their making of airpods, in which they maximized alot of profit

b. Windows used operation research to diversify their areas of specialization from just laptops to mobile devices which made them accumulate alot of profit.

LCM

	D_1	D_2	D_3	D_4	SS
S_1	20 (60)	30	110	70	600
S_2	10 (10)	0 (10)	60	10 (20)	100
S_3	50 (10)	80 (40)	150 (30)	90 (20)	400 (50)
DD	30 (10) 0	50 (40) 0	30 0	20 0	0

$m+n-1$

$3+4-1$

$= 7-1 = 6$

Total cost of trasportation

$S_1 \rightarrow D_1 = 20 \times 60 = 1200$

$S_2 \rightarrow D_2 = 0 \times 10 = 0$

$S_3 \rightarrow D_1 = 50 \times 10 = 500$

$S_3 \rightarrow D_2 = 80 \times 40 = 3200$

$S_3 \rightarrow D_3 = 150 \times 30 = 4500$

$S_3 \rightarrow D_4 = 90 \times 20 = 1800$

$= 1200 + 500 + 3200 + 4500 + 1800$

$= 11,200$