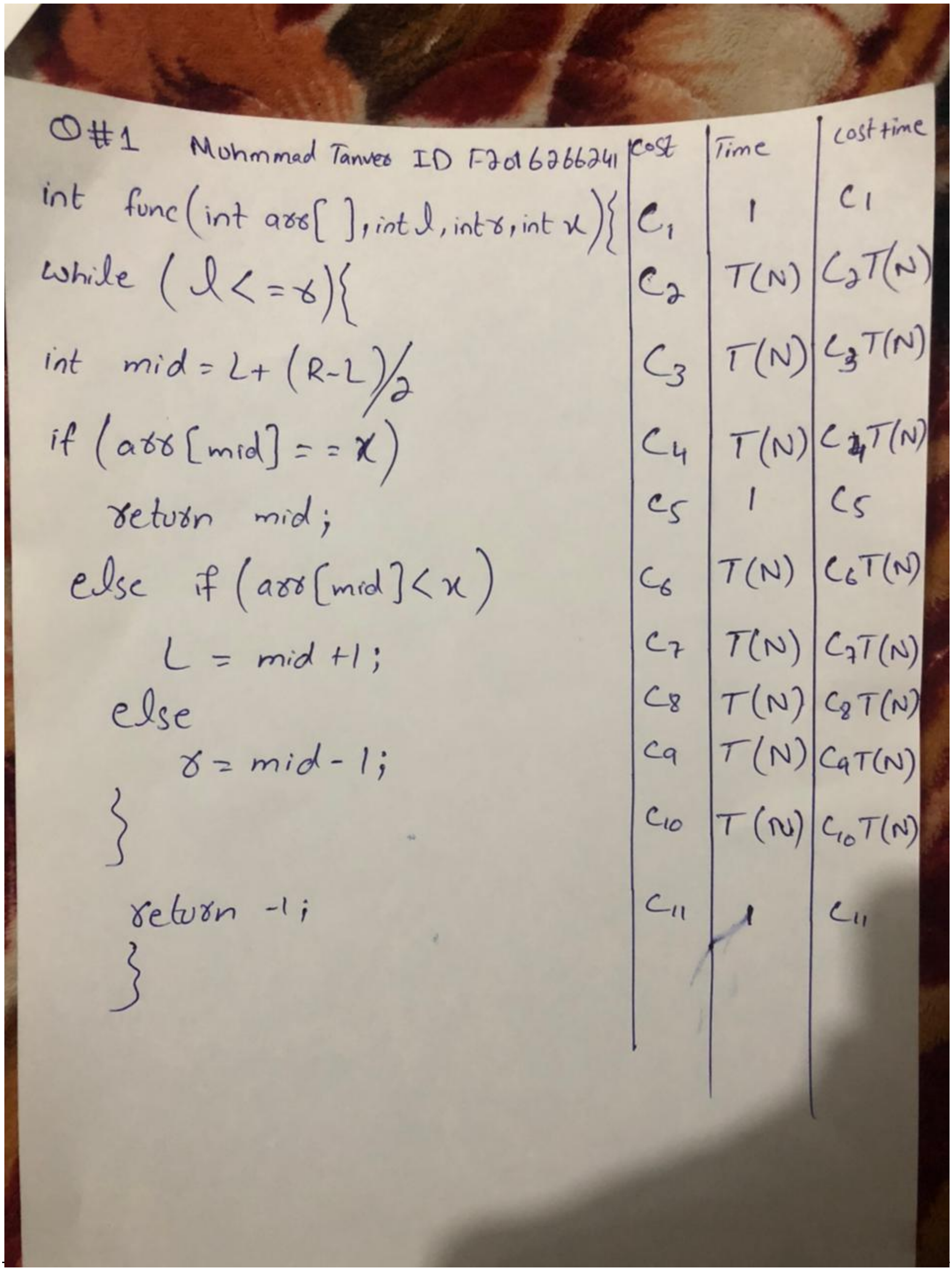
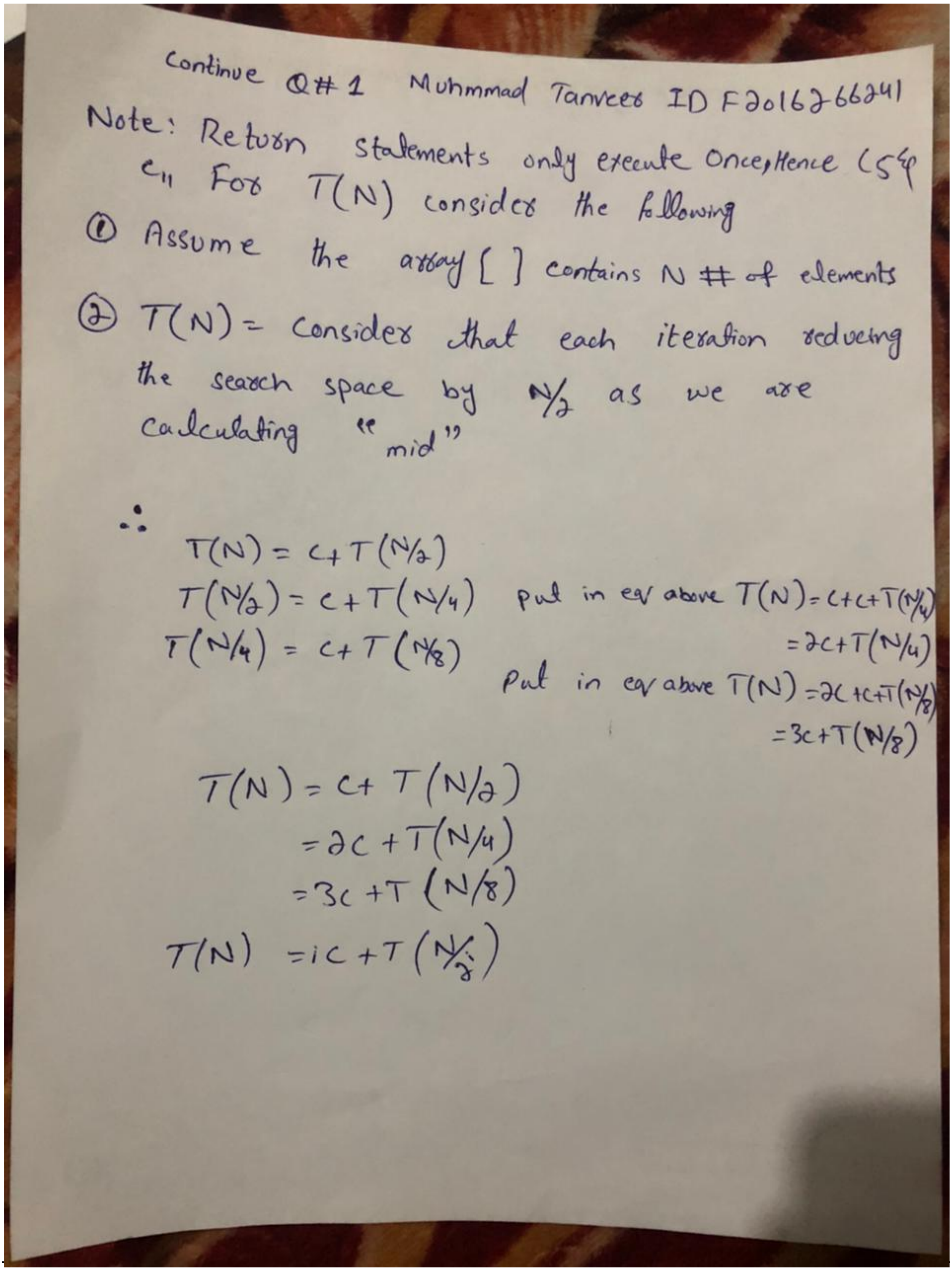


Q#1 Muhmmad Tanver ID F2016266241

	cost	Time	cost time
int func(int arr[ ], int l, int r, int x){	C_1	1	C_1
while (l<=r){	C_2	T(N)	$C_2T(N)$
int mid = L+(R-L)/2	C_3	T(N)	$C_3T(N)$
if (arr[mid] = = x)	C_4	T(N)	$C_4T(N)$
return mid;	C_5	1	C_5
else if (arr[mid]<x)	C_6	T(N)	$C_6T(N)$
L = mid +1;	C_7	T(N)	$C_7T(N)$
else	C_8	T(N)	$C_8T(N)$
r = mid - 1;	C_9	T(N)	$C_9T(N)$
}	C_{10}	T(N)	$C_{10}T(N)$
return -1;	C_{11}	1	C_{11}
}			



Continue Q# 1 Muhmmad Tanveer ID F2016266241

Note: Return statements only execute Once, Hence C_5 & c_{11} For $T(N)$ consider the following

① Assume the array [ ] contains N # of elements

② $T(N)$ = Consider that each iteration reducing the search space by $N/2$ as we are calculating "mid"

$\therefore$

$T(N) = C + T(N/2)$

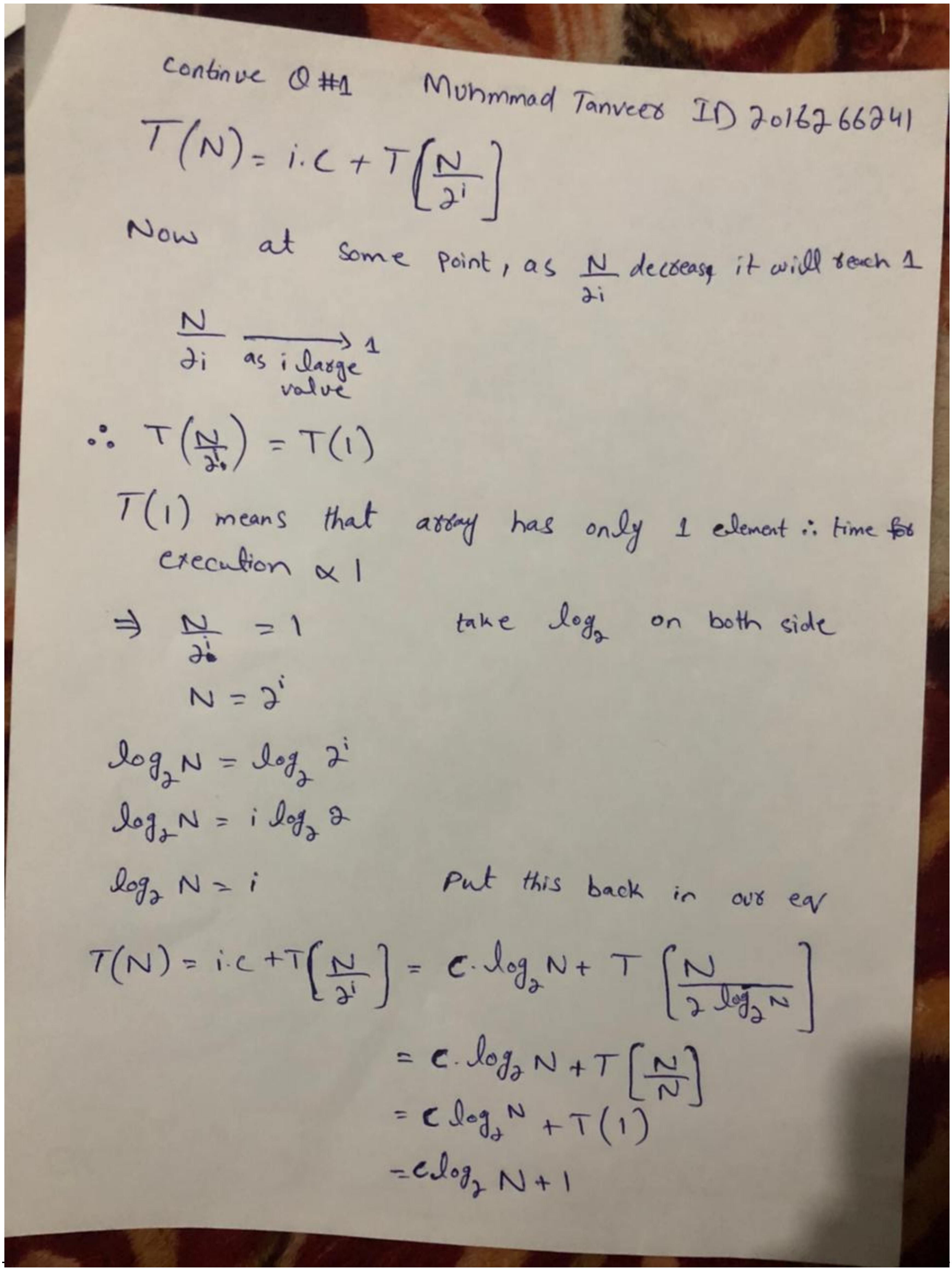
$T(N/2) = C + T(N/4)$ put in eq above $T(N) = C + C + T(N/4)$

$= 2C + T(N/4)$

$T(N/4) = C + T(N/8)$ Put in eq above $T(N) = 2C + C + T(N/8)$

$= 3C + T(N/8)$

$$T(N) = C + T(N/2)$$
$$= 2C + T(N/4)$$
$$= 3C + T(N/8)$$
$$T(N) = iC + T(N/2^i)$$



Continue Q #1 Muhmmad Tanveer ID 2016266241

$$T(N) = i.c + T\left[\frac{N}{2^i}\right]$$

Now at some point, as $\frac{N}{2^i}$ decreasy it will reach 1

$$\frac{N}{2^i} \xrightarrow[\text{as i large value}]{} 1$$

$$\therefore T\left(\frac{N}{2^i}\right) = T(1)$$

T(1) means that array has only 1 element ∴ time for execution $\propto 1$

$\Rightarrow \frac{N}{2^i} = 1$ take $\log_2$ on both side

$$N = 2^i$$

$$\log_2 N = \log_2 2^i$$

$$\log_2 N = i \log_2 2$$

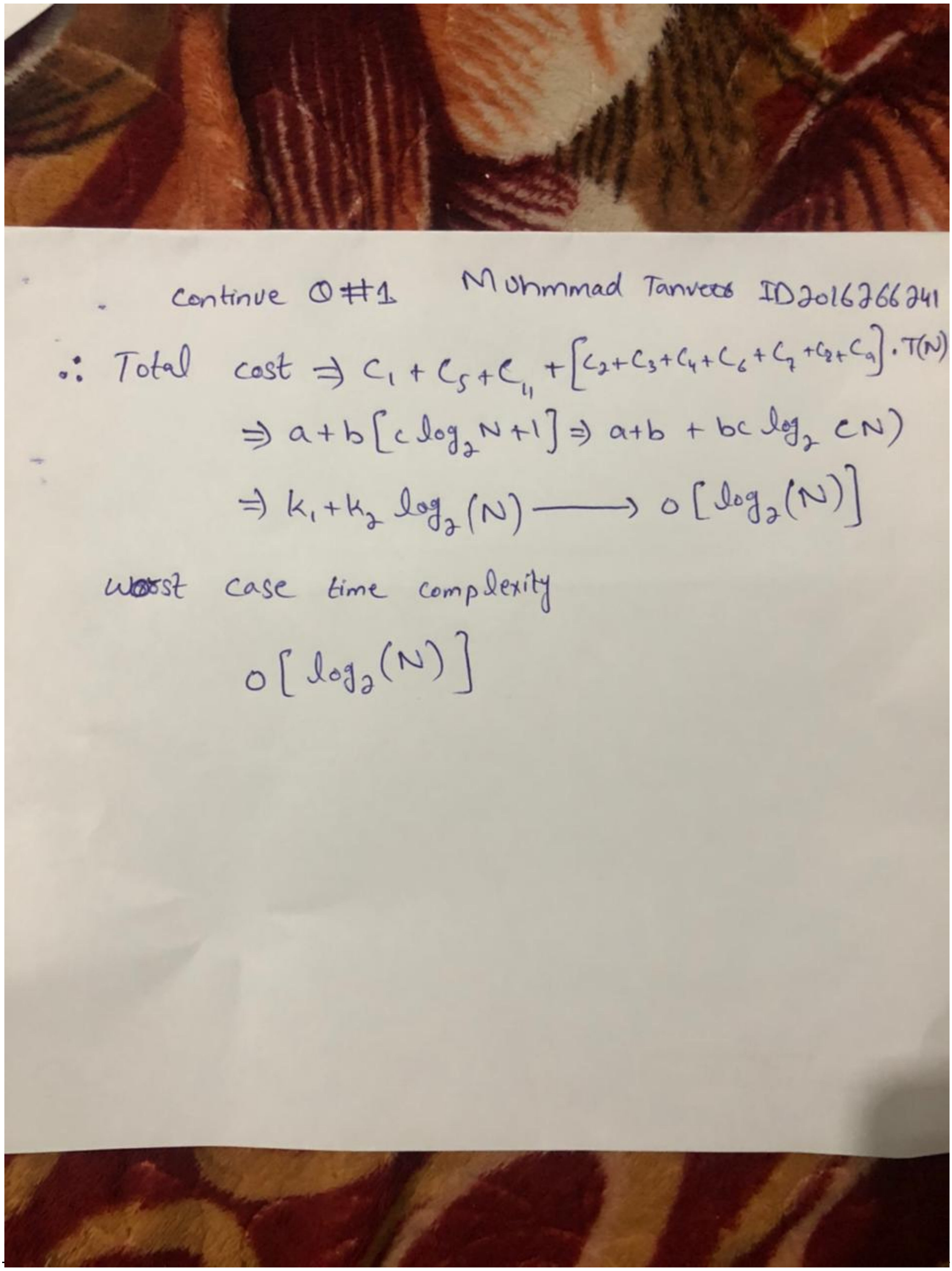
$\log_2 N = i$ Put this back in our eq

$$T(N) = i.c + T\left[\frac{N}{2^i}\right] = c.\log_2 N + T\left[\frac{N}{2^{\log_2 N}}\right]$$

$$= c.\log_2 N + T\left[\frac{N}{N}\right]$$

$$= c\log_2 N + T(1)$$

$$= c\log_2 N + 1$$



Continue Q#1 Mohmmad Tanveer ID2016266241

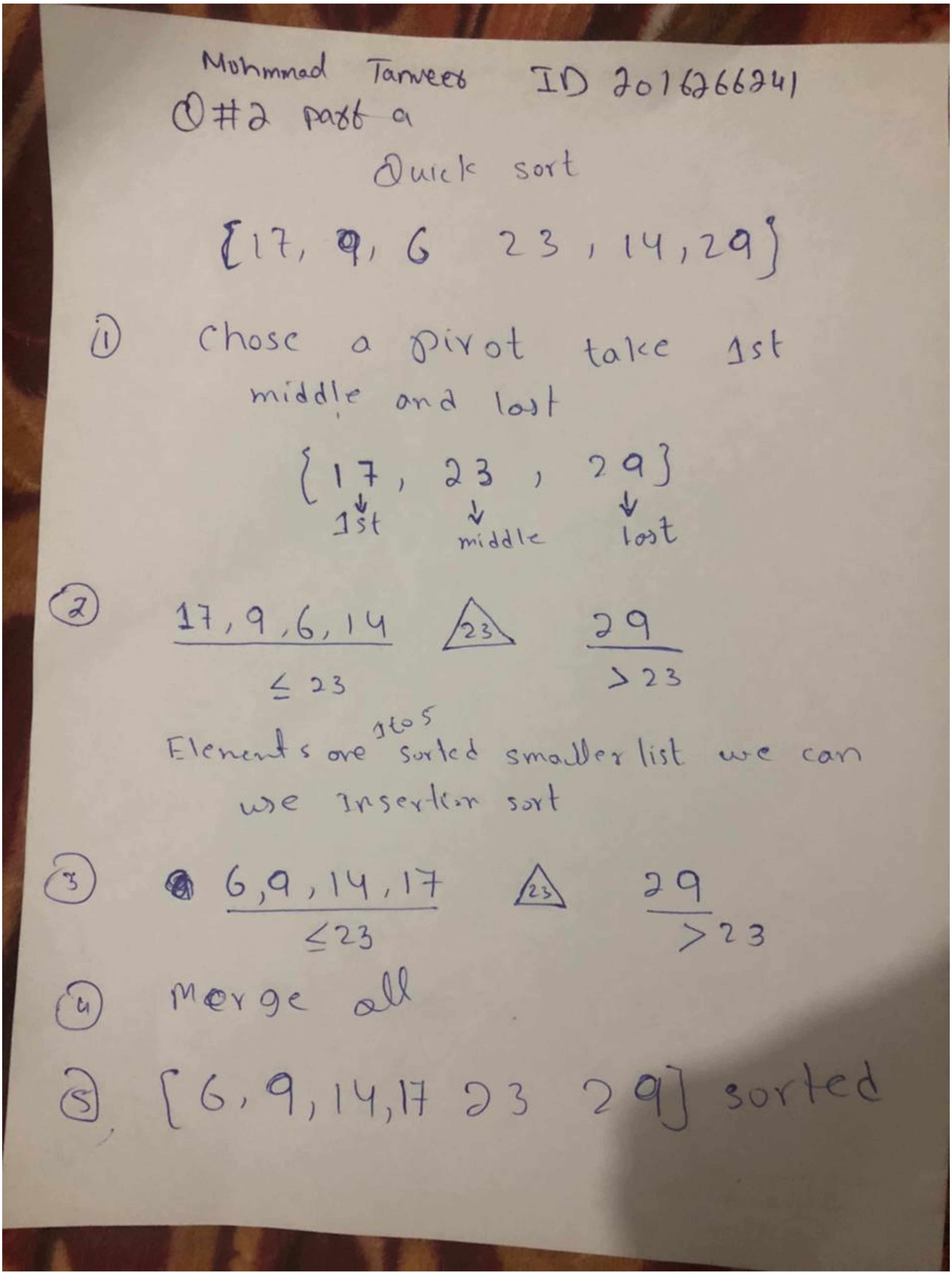
$\therefore$ Total cost $\Rightarrow C_1 + C_5 + C_{11} + [C_2+C_3+C_4+C_6+C_7+C_8+C_9] \cdot T(N)$

$\Rightarrow a+b[c \log_2 N+1] \Rightarrow a+b + bc \log_2 (N)$

$\Rightarrow k_1+k_2 \log_2(N) \longrightarrow o[\log_2(N)]$

worst case time complexity

$o[\log_2(N)]$



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Q#2 part a

Quick sort

[17, 9, 6 23 , 14, 29]

① Chose a pivot take 1st middle and lost

{17 , 23 , 29}

1st middle lost

② 17, 9, 6, 14 △23 29

≤ 23 > 23

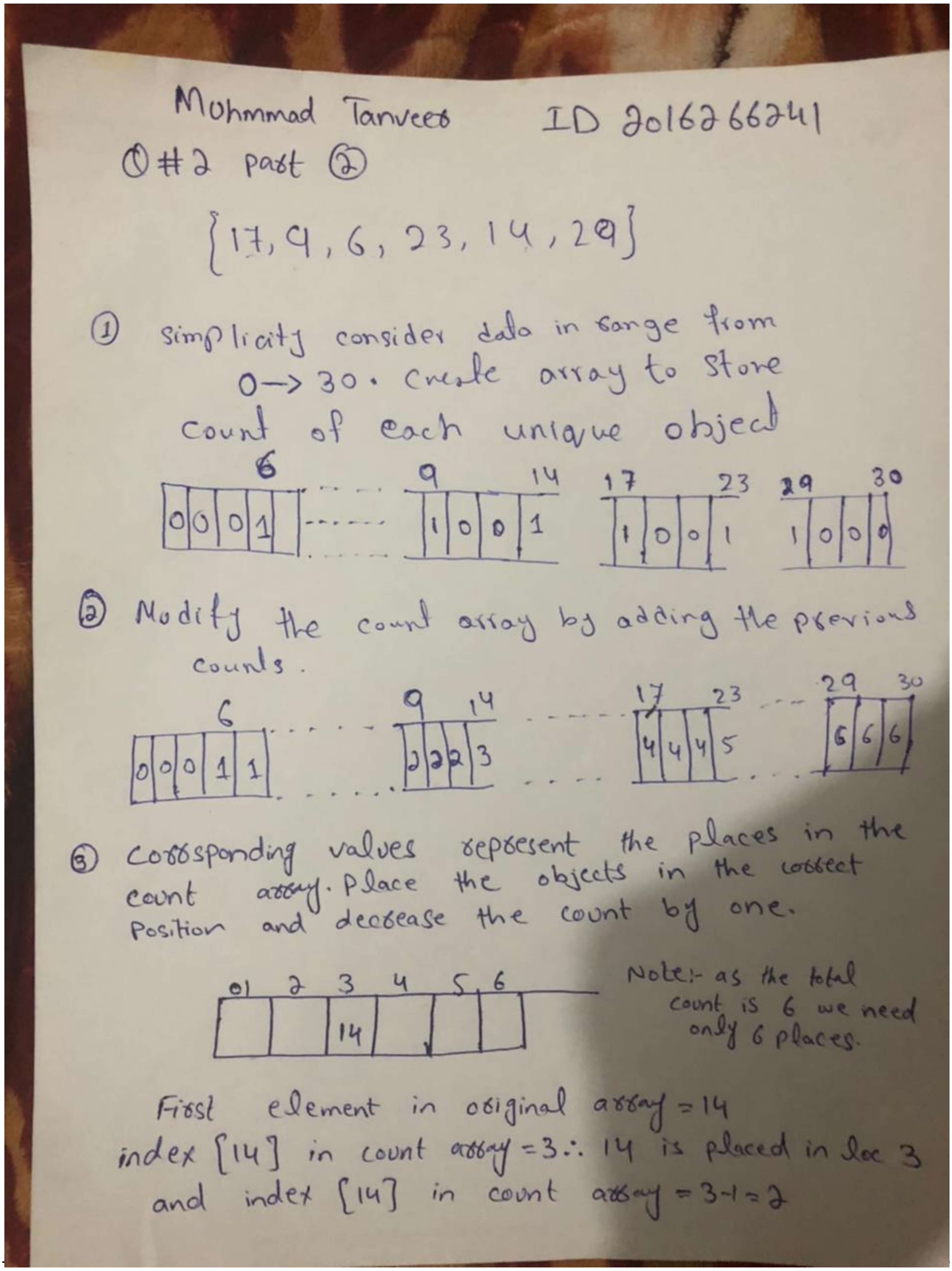
Elements are 1 to 5 sorted smaller list we can use Insertion sort

③ 6, 9, 14, 17 △23 29

≤23 >23

④ Merge all

⑤ [6, 9, 14, 17 23 29] sorted



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Q#2 part (2)

{17, 9, 6, 23, 14, 29}

(1) simplicity consider data in range from 0 —> 30. Create array to store count of each unique object

6 .... 9 14 17 23 29 30

0 | 0 | 0 | 1 | .... | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0

(2) Modify the count array by adding the previous counts.

6 .... 9 14 .... 17 23 ... 29 30

0 | 0 | 0 | 1 | 1 | .... | 2 | 2 | 2 | 3 | .... | 4 | 4 | 4 | 5 | .... | 6 | 6 | 6

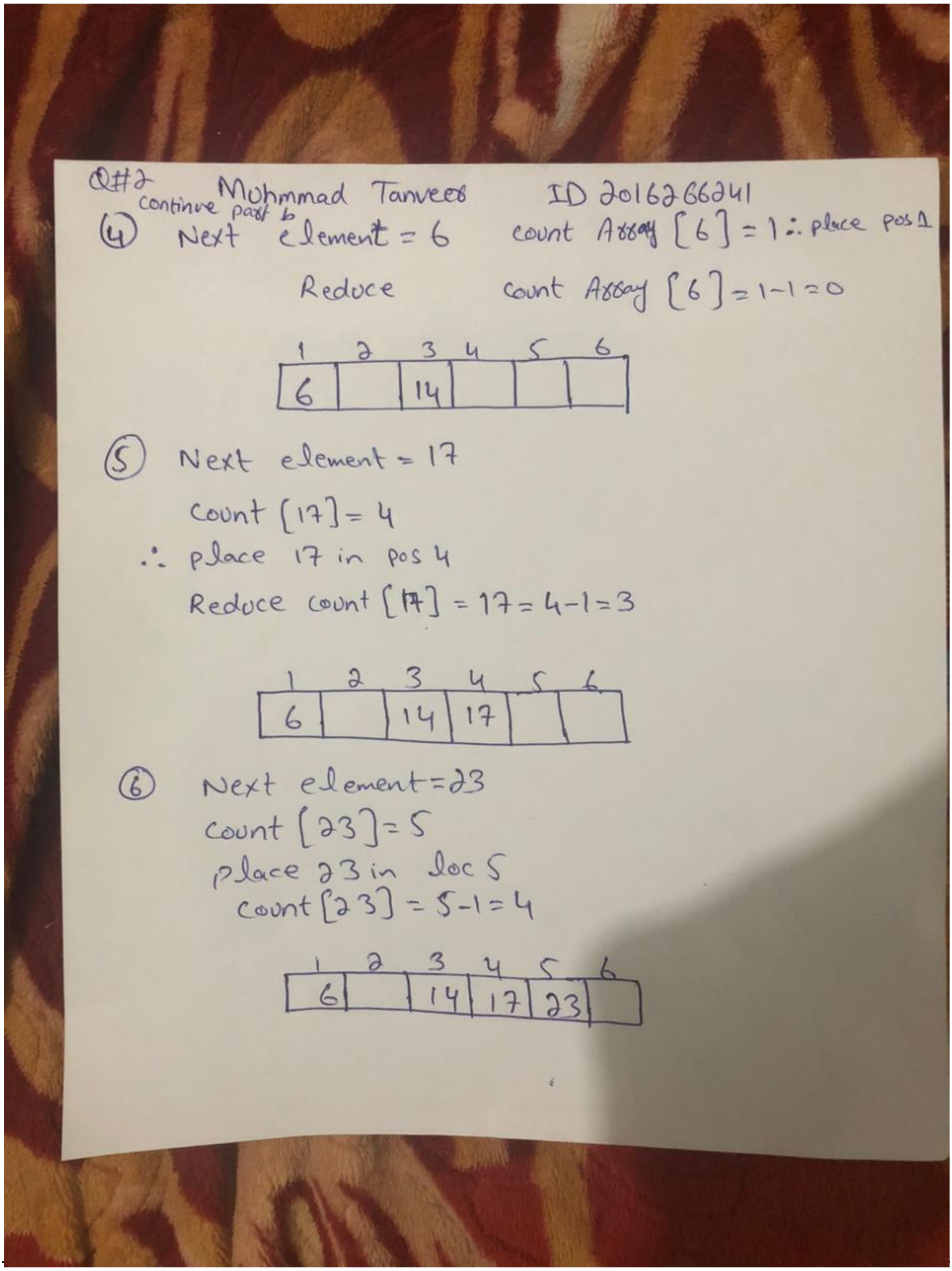
(3) corresponding values represent the places in the count array. Place the objects in the correct Position and decrease the count by one.

0 1 2 3 4 5 6

| | | 14 | | | |

Note:- as the total count is 6 we need only 6 places.

First element in original array = 14
index [14] in count array = 3 ∴ 14 is placed in loc 3
and index [14] in count array = 3-1 = 2



Q#2 Muhmmad Tanveer ID 2016266241

continue part b

(4) Next element = 6 count Array [6] = 1 ∴ place pos 1

Reduce count Array [6] = 1-1 = 0

1	2	3	4	5	6
6		14			

(5) Next element = 17

count [17] = 4

∴ place 17 in pos 4

Reduce count [17] = 17 = 4-1 = 3

1	2	3	4	5	6
6		14	17		

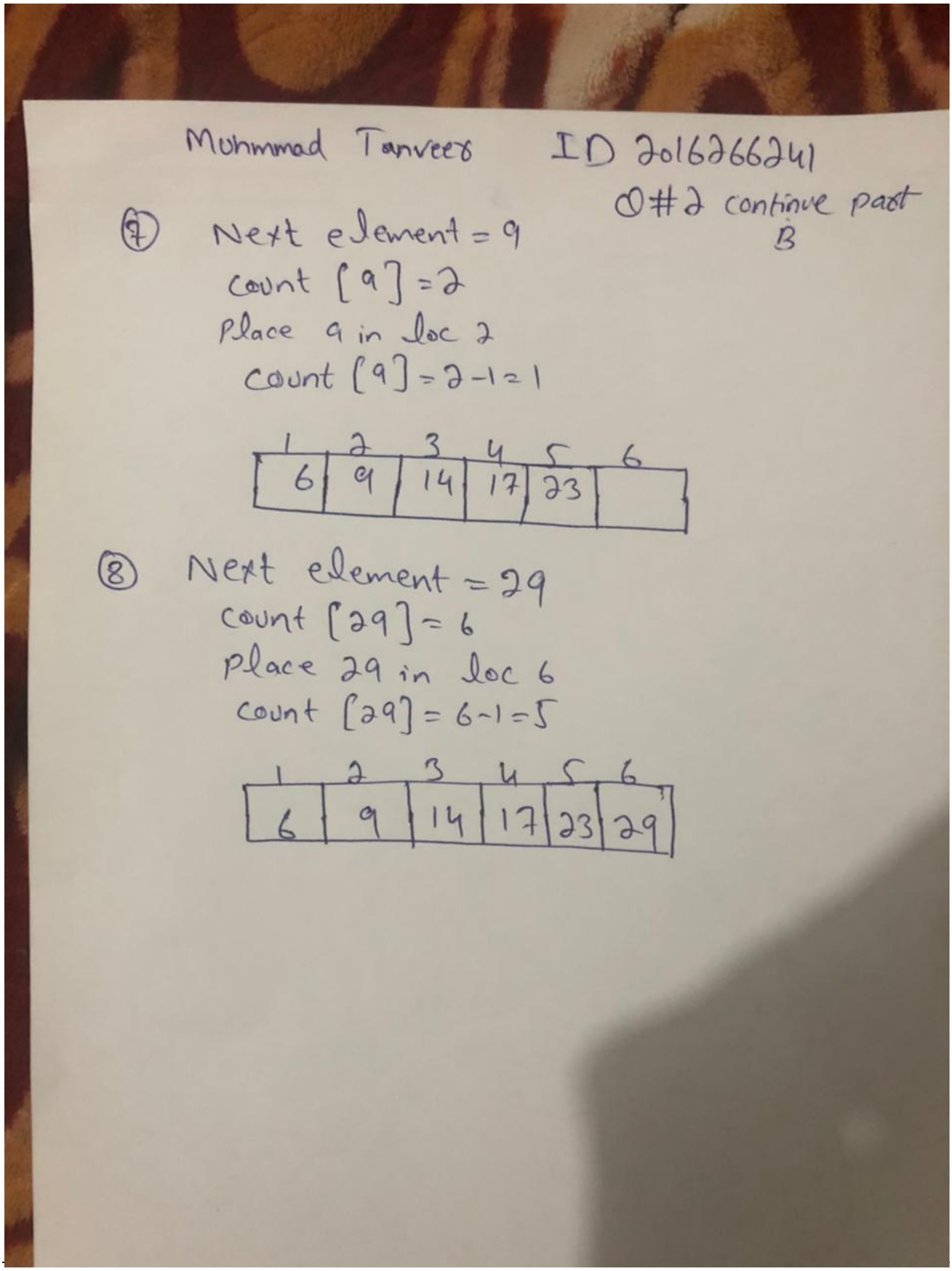
(6) Next element = 23

count [23] = 5

place 23 in loc 5

count [23] = 5-1 = 4

1	2	3	4	5	6
6		14	17	23	



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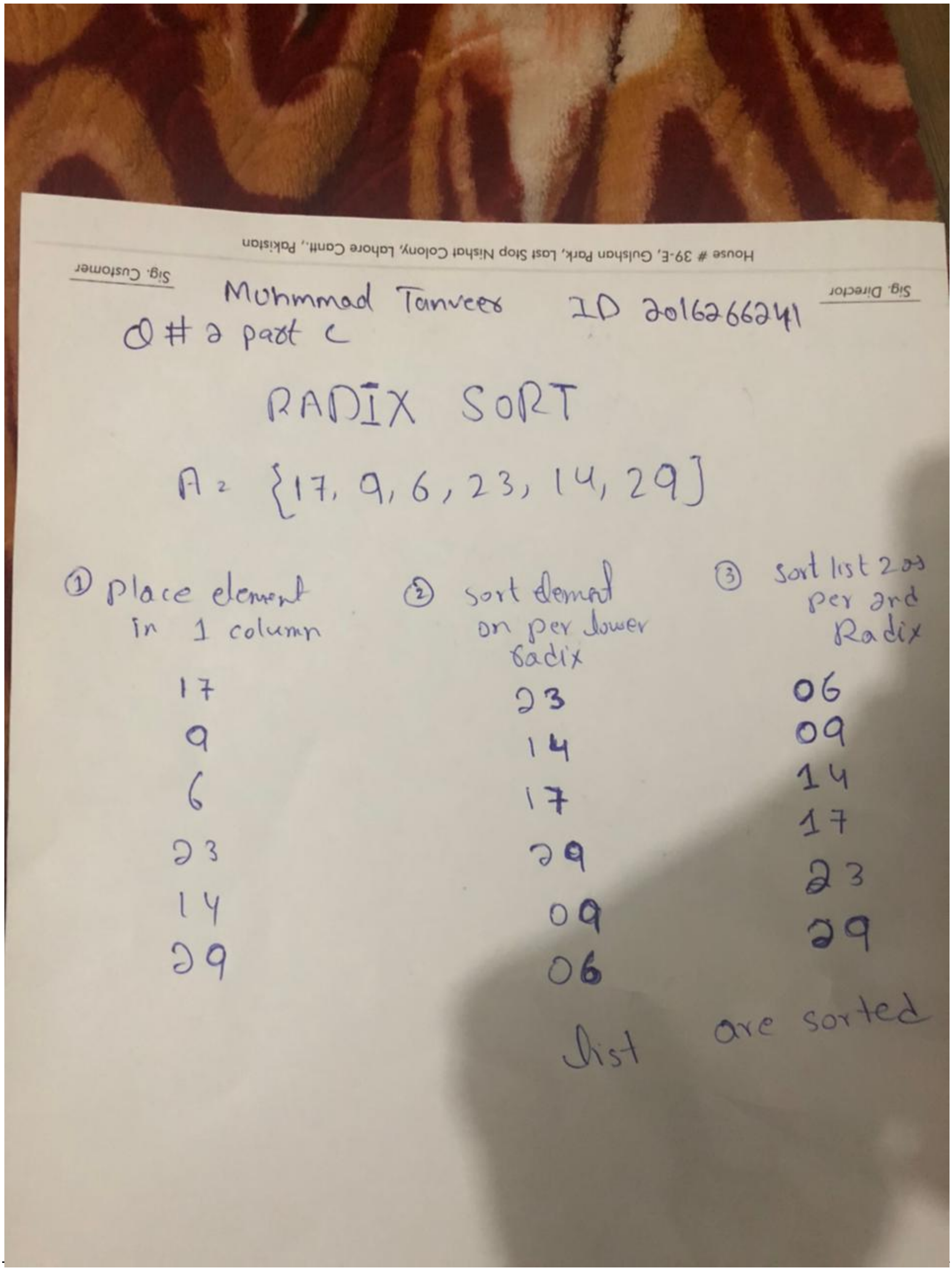
Q#2 continue part
B

⑦ Next element = 9
count [9] = 2
Place 9 in loc 2
count [9] = 2-1 = 1

1	2	3	4	5	6
6	9	14	17	23	

⑧ Next element = 29
count [29] = 6
Place 29 in loc 6
count [29] = 6-1 = 5

1	2	3	4	5	6
6	9	14	17	23	29



House # 39-E, Gulshan Park, Last Stop Nishat Colony, Lahore Cantt., Pakistan

Sig. Customer

Sig. Director

Muhmmad Tanveer ID 2016266241

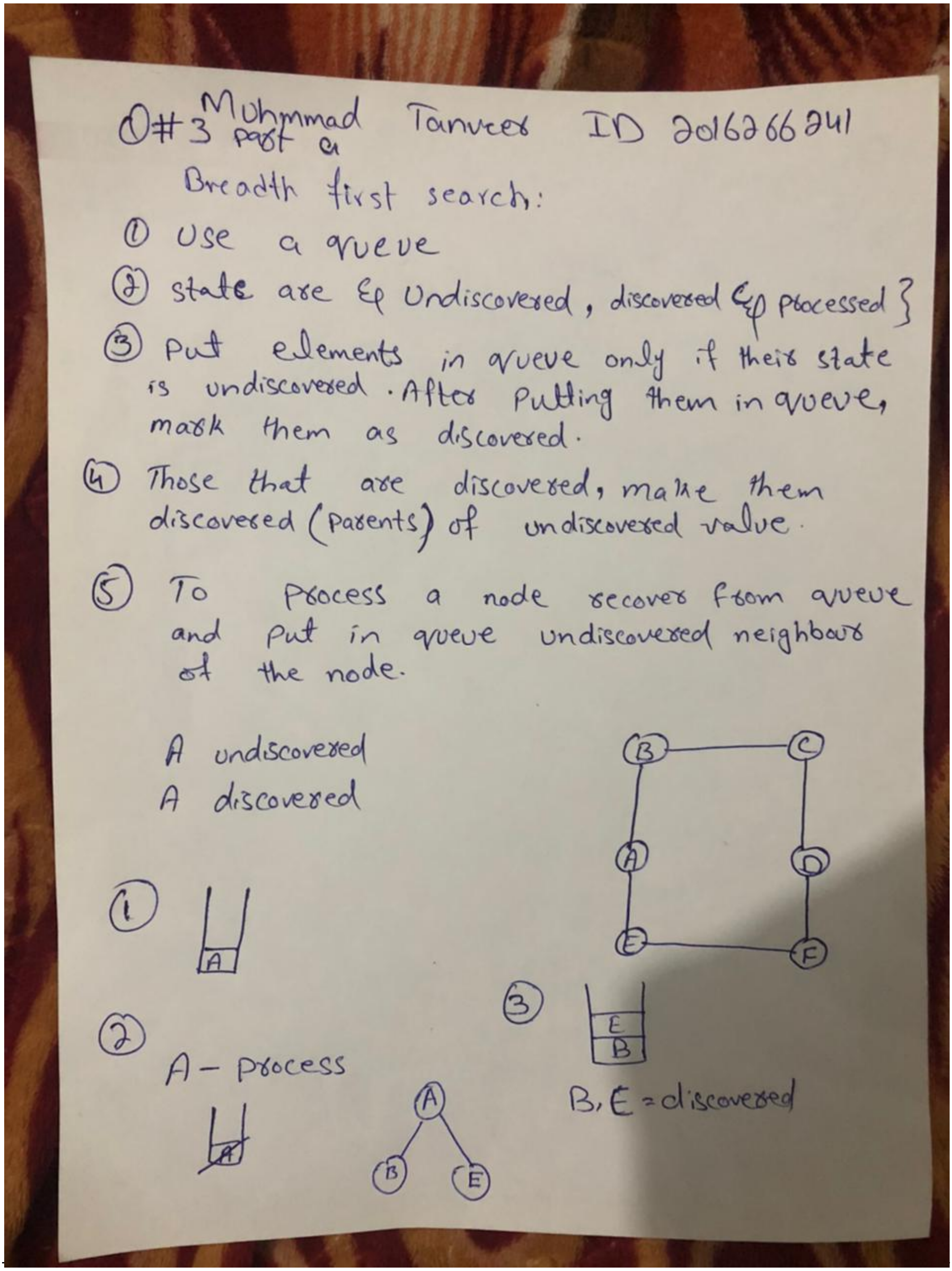
Q # 2 part c

RADIX SORT

A = {17, 9, 6, 23, 14, 29]

① place element in 1 column	② sort elemat on per lower radix	③ sort list 2as per 2rd Radix
17	23	06
9	14	09
6	17	14
23	29	17
14	09	23
29	06	29

list are sorted



Q#3 part a Muhmmad Tanveer ID 2016266241

Breadth first search:

① Use a queue

② state are { Undiscovered, discovered & processed }

③ Put elements in queue only if their state is undiscovered. After Putting them in queue, mark them as discovered.

④ Those that are discovered, make them discovered (parents) of undiscovered value.

⑤ To process a node recover from queue and put in queue undiscovered neighbour of the node.

A undiscovered

A discovered

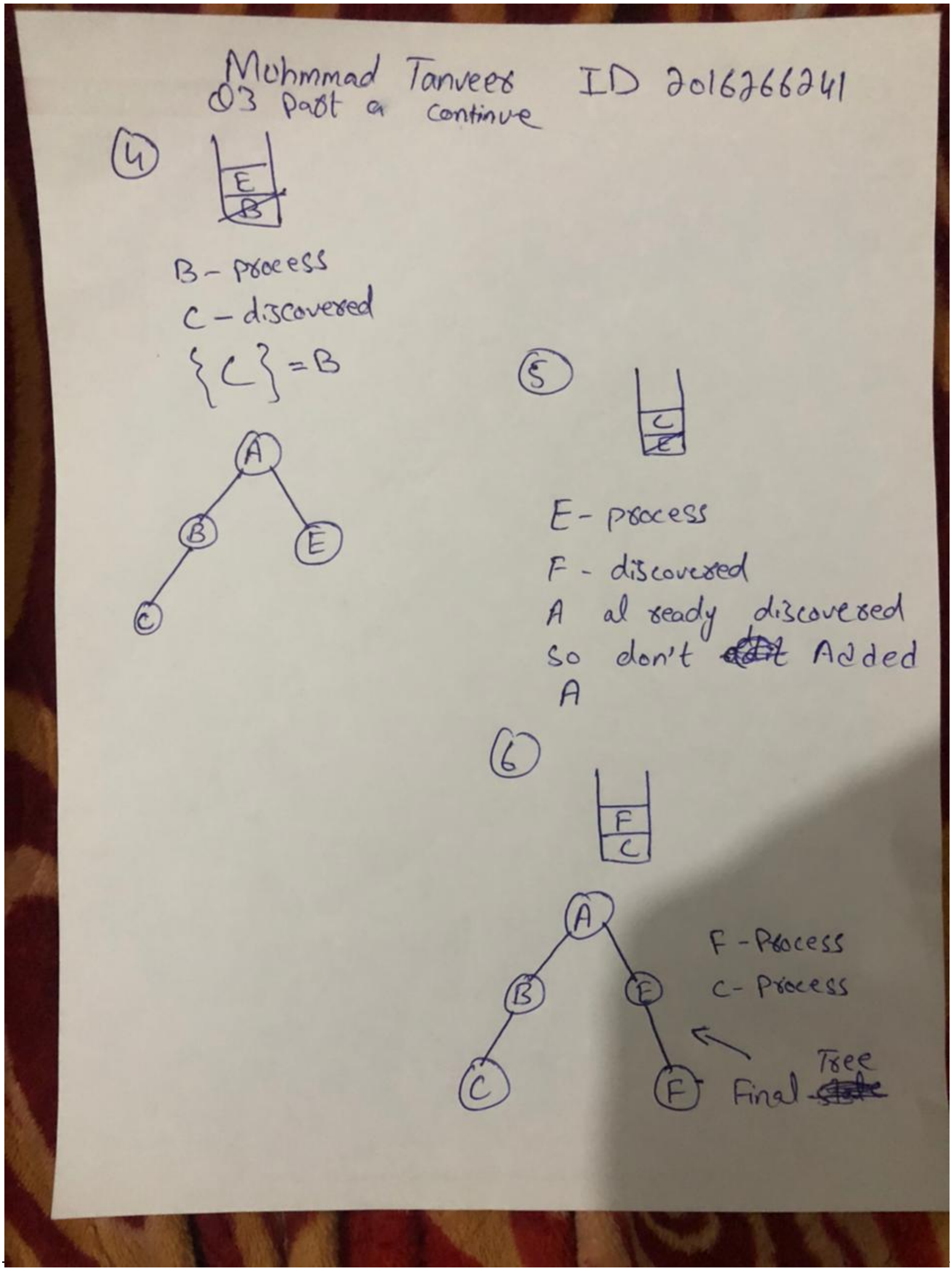
①

②

A - process

③

B, E = discovered



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Q3 Part a continue

4

E
~~B~~

B - process

C - discovered

{C} = B

A
B
E
C

5

C
~~E~~

E - process

F - discovered

A al ready discovered so don't ~~[illegible]~~ Added A

6

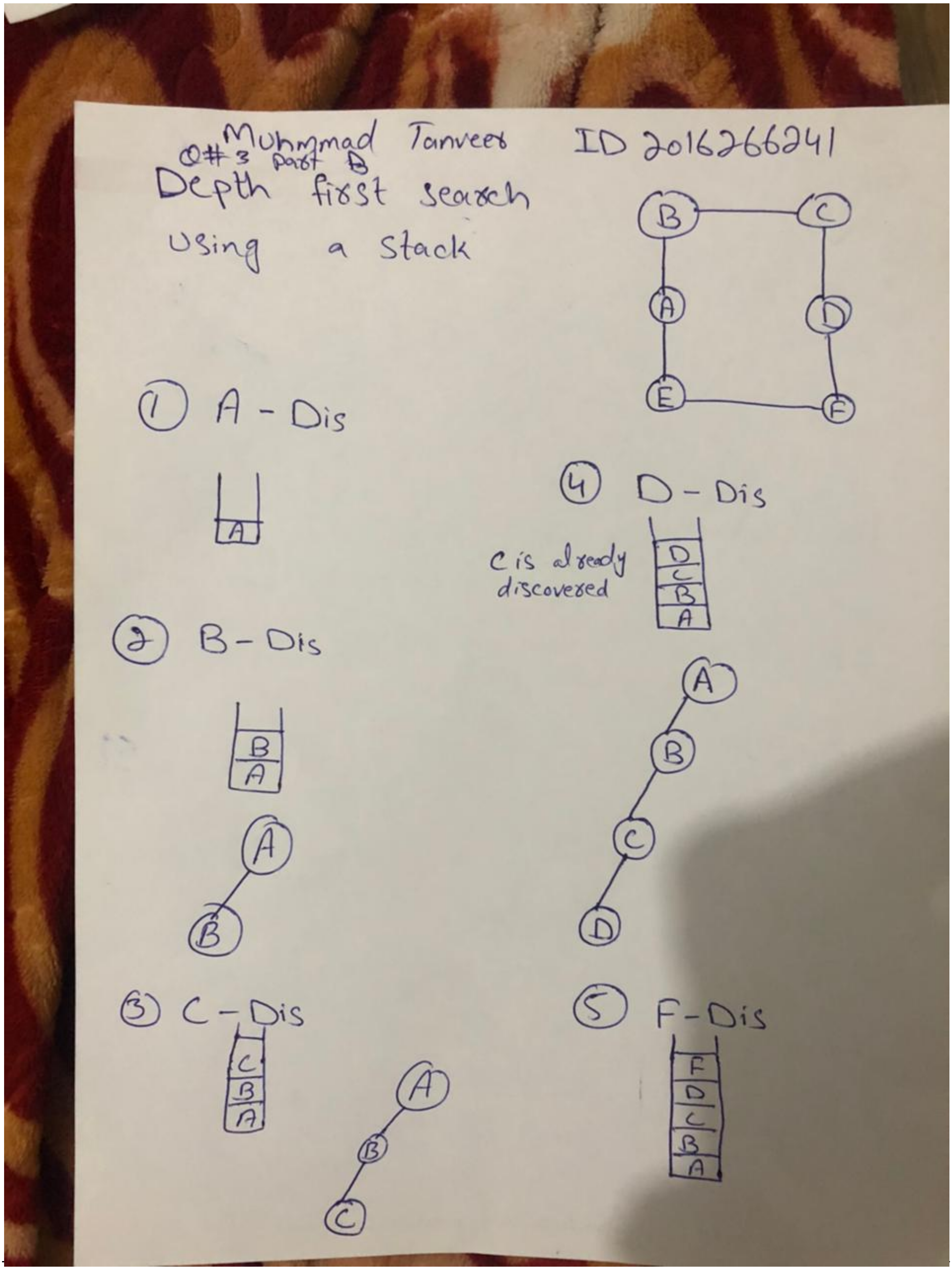
F
C

A
B
E
C
F

F - Process

C - Process

Final ~~state~~ Tree



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Q#3 part B

Depth first search

Using a Stack

B
C
A
D
E
F

① A - Dis

A

② B - Dis

B
A

A
B

③ C - Dis

C
B
A

A
B
C

④ D - Dis

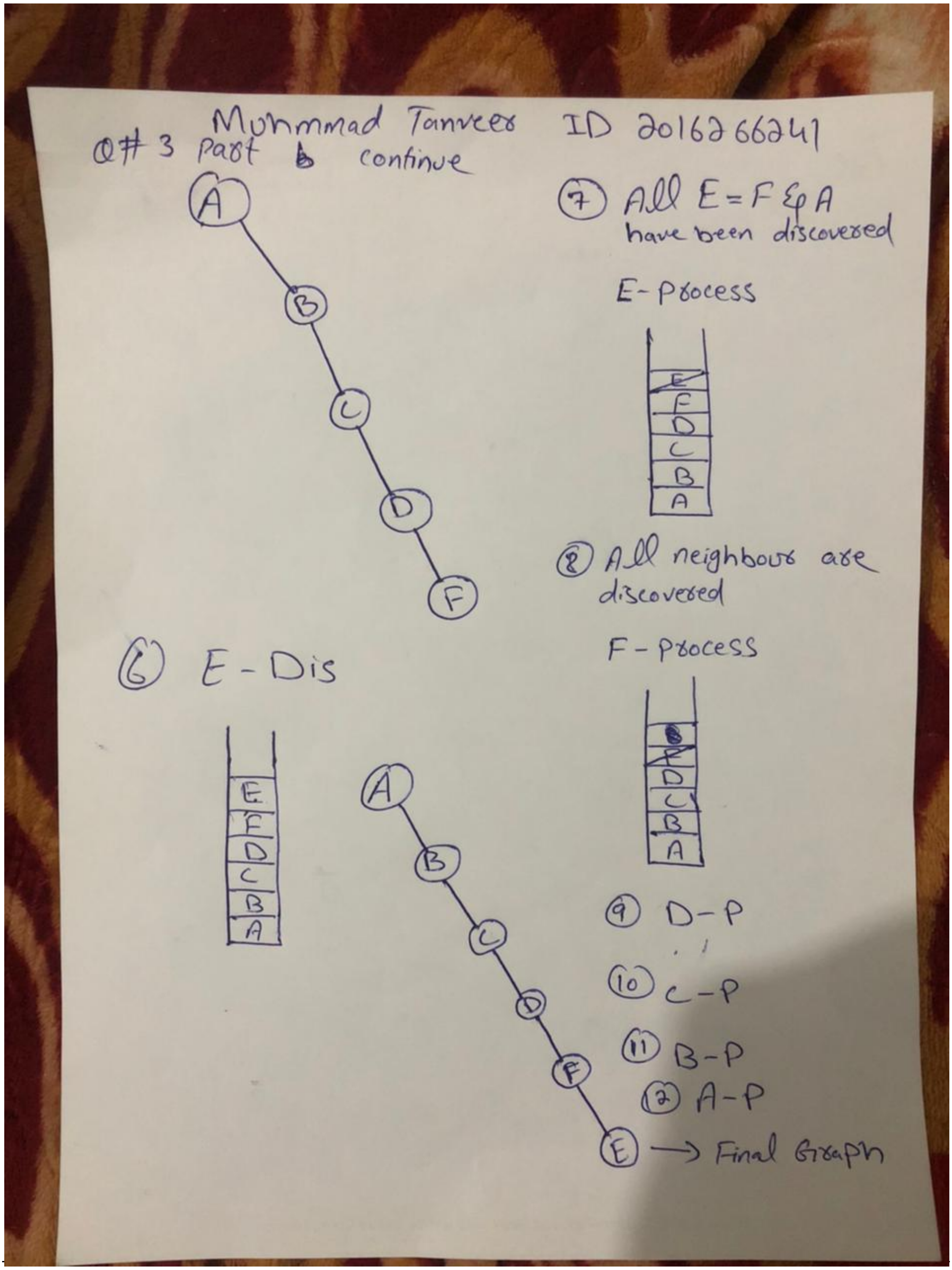
C is already discovered

D
C
B
A

A
B
C
D

⑤ F - Dis

F
D
C
B
A



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Q# 3 part b continue

A
B
C
D
F

⑥ E - Dis

E
F
D
C
B
A

A
B
C
D
F
E

⑦ All E = F & A have been discovered

E - Process

~~E~~
F
D
C
B
A

⑧ All neighbour are discovered

F - Process

~~F~~
D
C
B
A

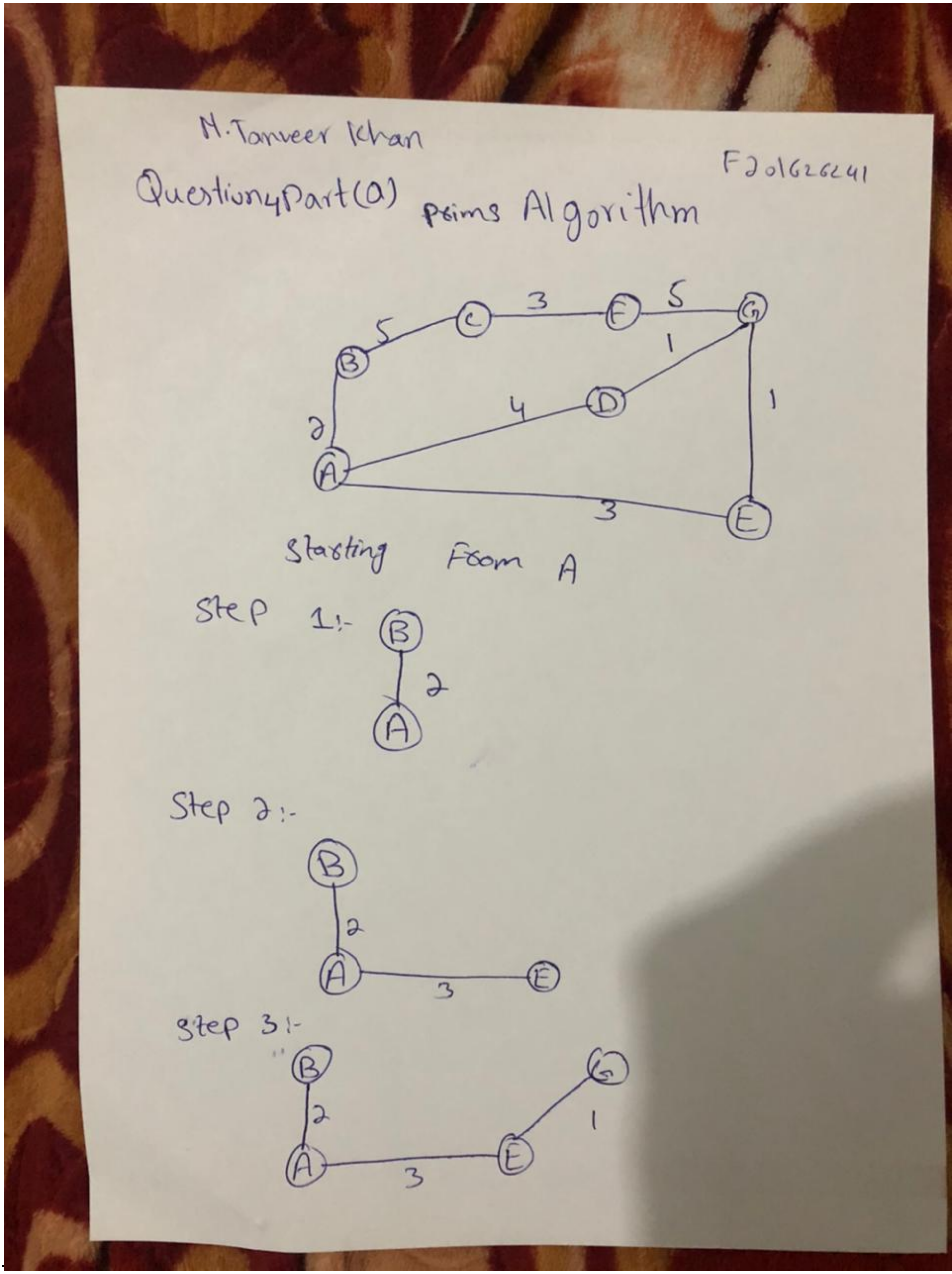
⑨ D - P

⑩ C - P

⑪ B - P

⑫ A - P

→ Final Graph



M.Tanveer khan

F201626241

Question4Part(a) Prims Algorithm

B
C
F
G
D
A
E
5
3
5
1
4
1
2
3

Starting From A

Step 1:-

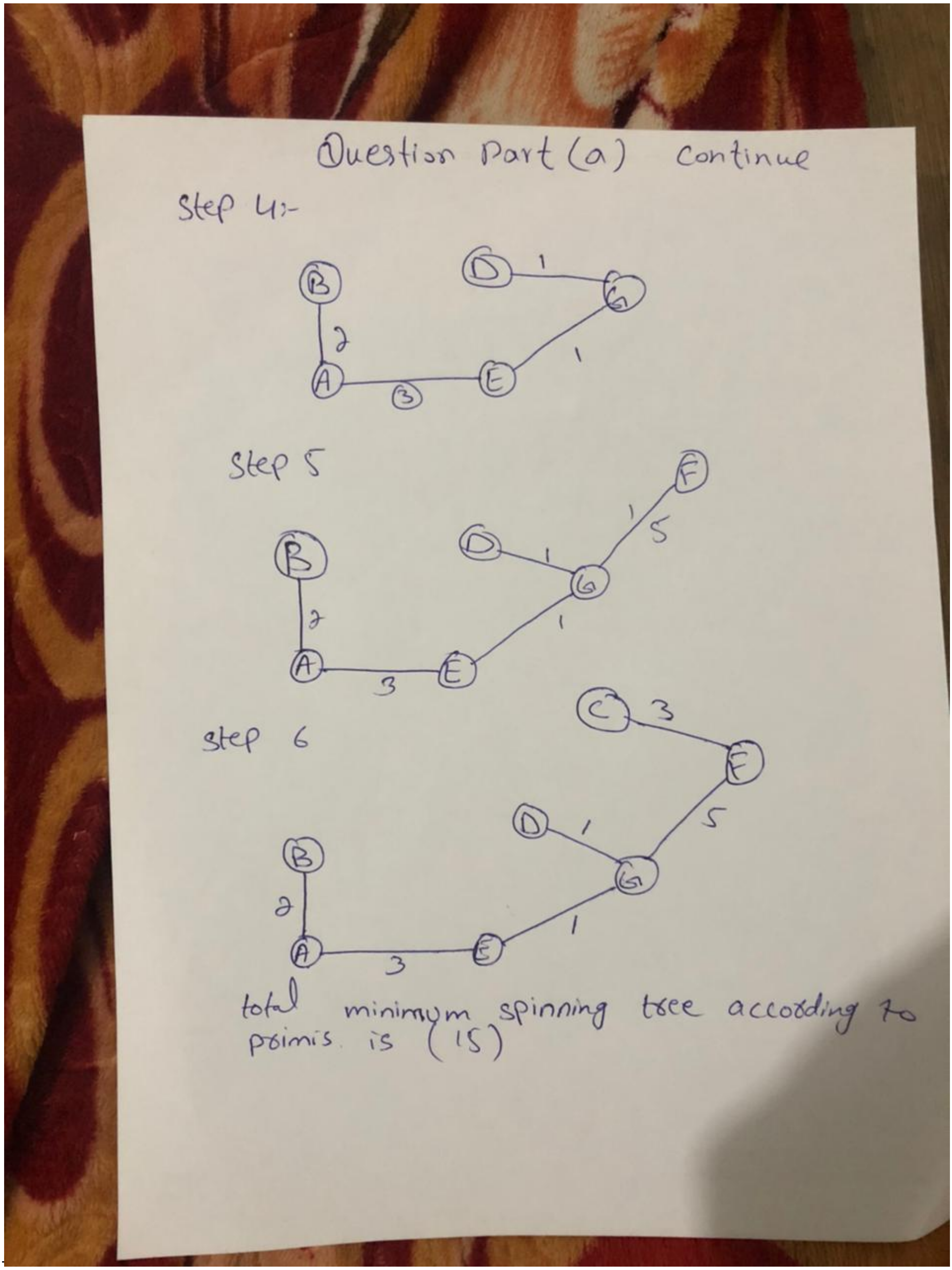
B
2
A

Step 2:-

B
2
A
3
E

step 3:-

B
2
A
3
E
1
G



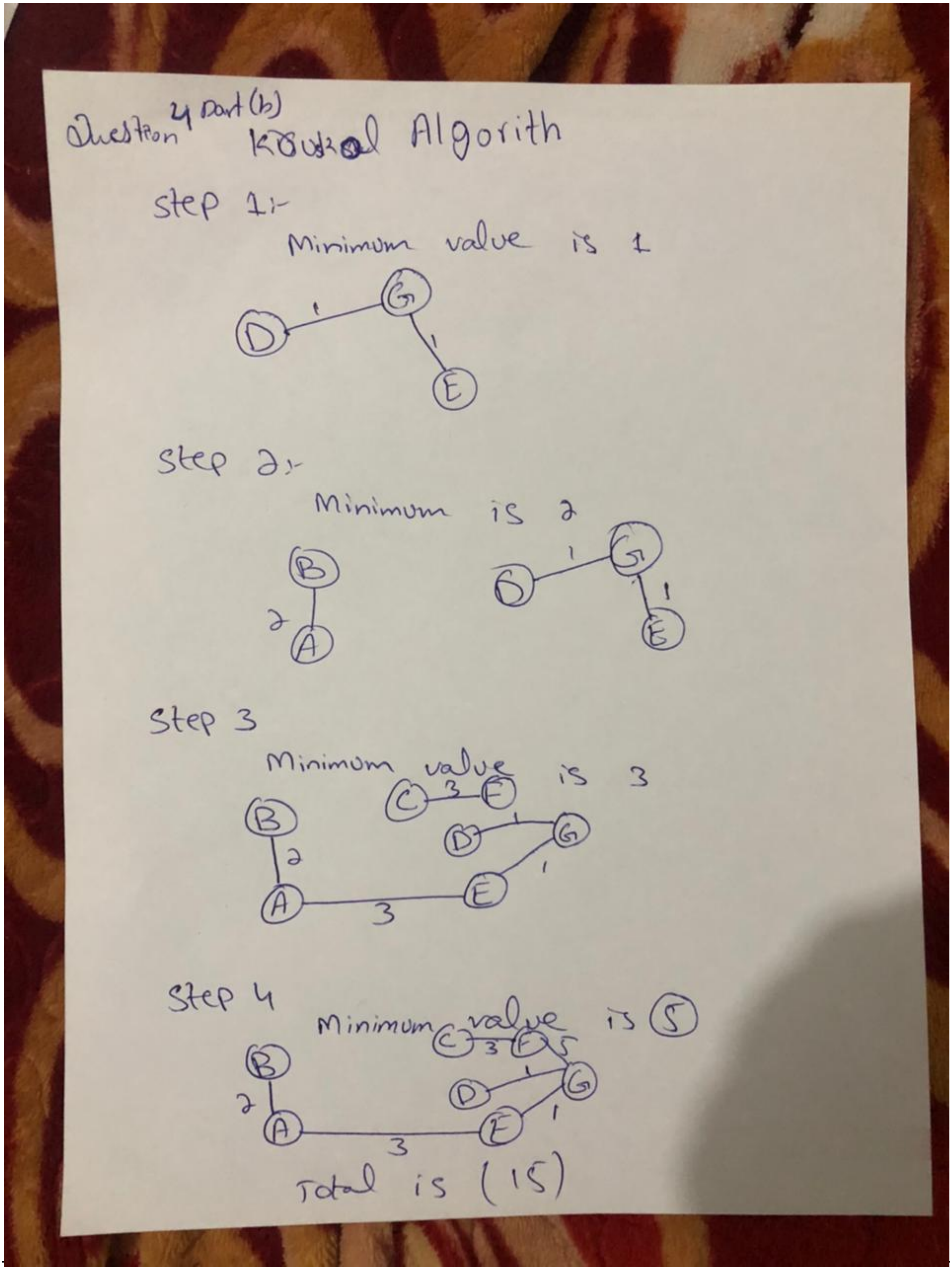
Question Part (a) continue

Step 4:-

Step 5

step 6

total minimum spinning tree according to primis. is (15)



Question 4 part (b) Kruskal Algorith

step 1:-

Minimum value is 1

D
G
E
1
1

step 2:-

Minimum is 2

B
A
2
D
G
E
1
1

Step 3

Minimum value is 3

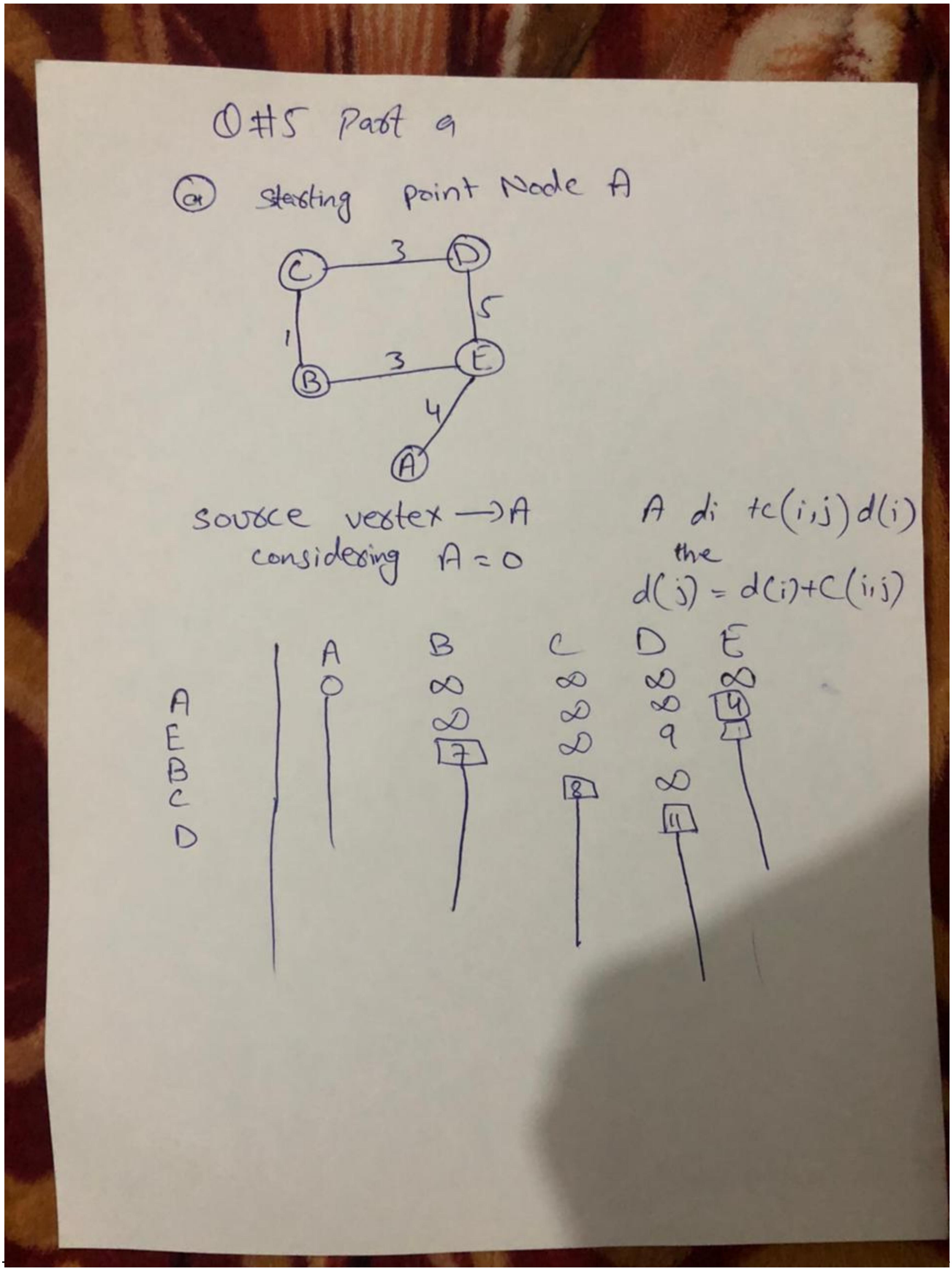
C
F
3
B
2
A
3
E
D
G
1
1

Step 4

Minimum value is 5

C
3
F
5
B
2
A
3
E
D
G
1
1

Total is (15)



Q#5 Part a

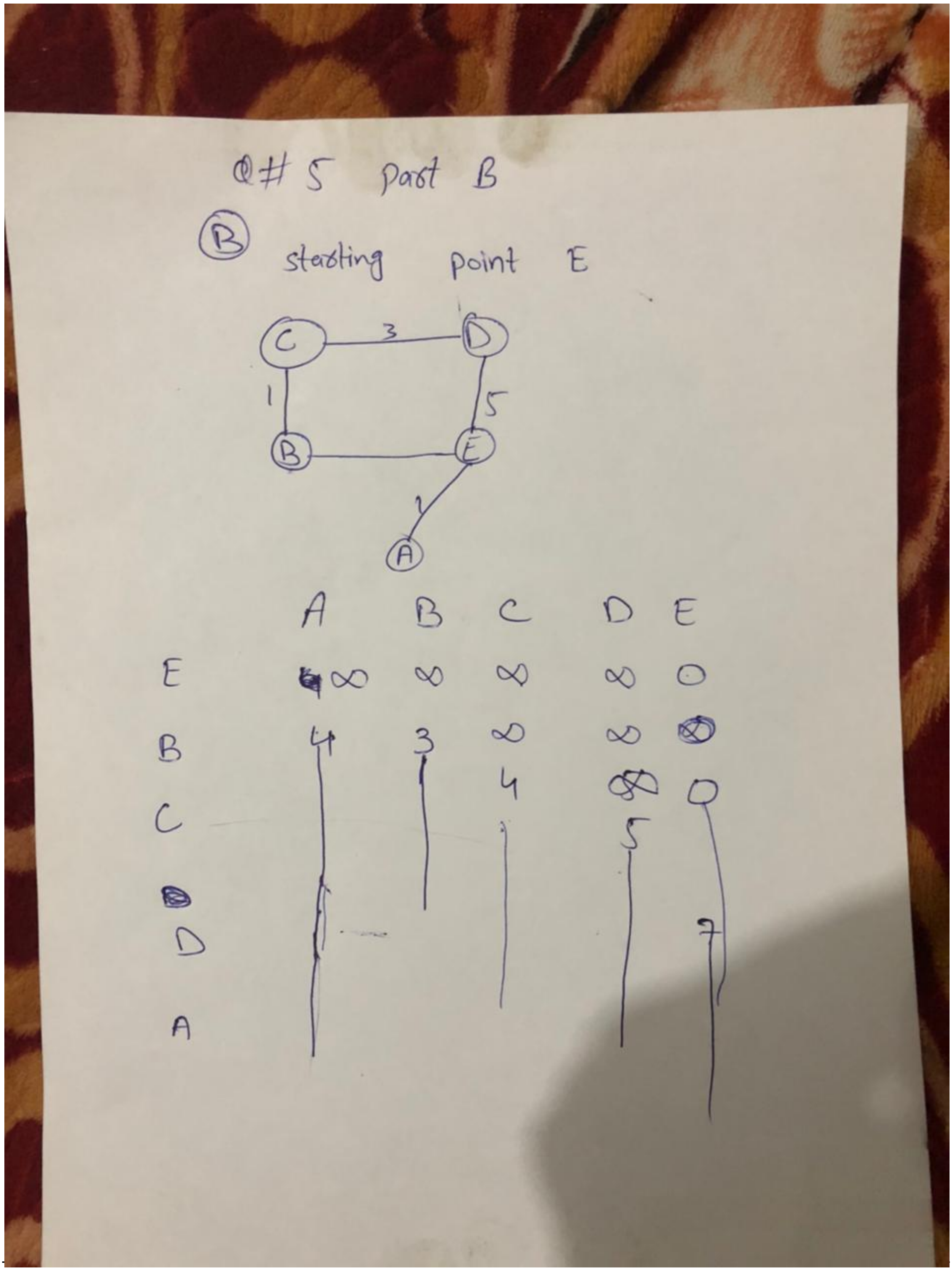
(a) starting point Node A

C
3
D
5
1
B
3
E
4
A

source vertex → A
considering A = 0

A di +c(i,j) d(i)
the
d(j) = d(i)+C(i,j)

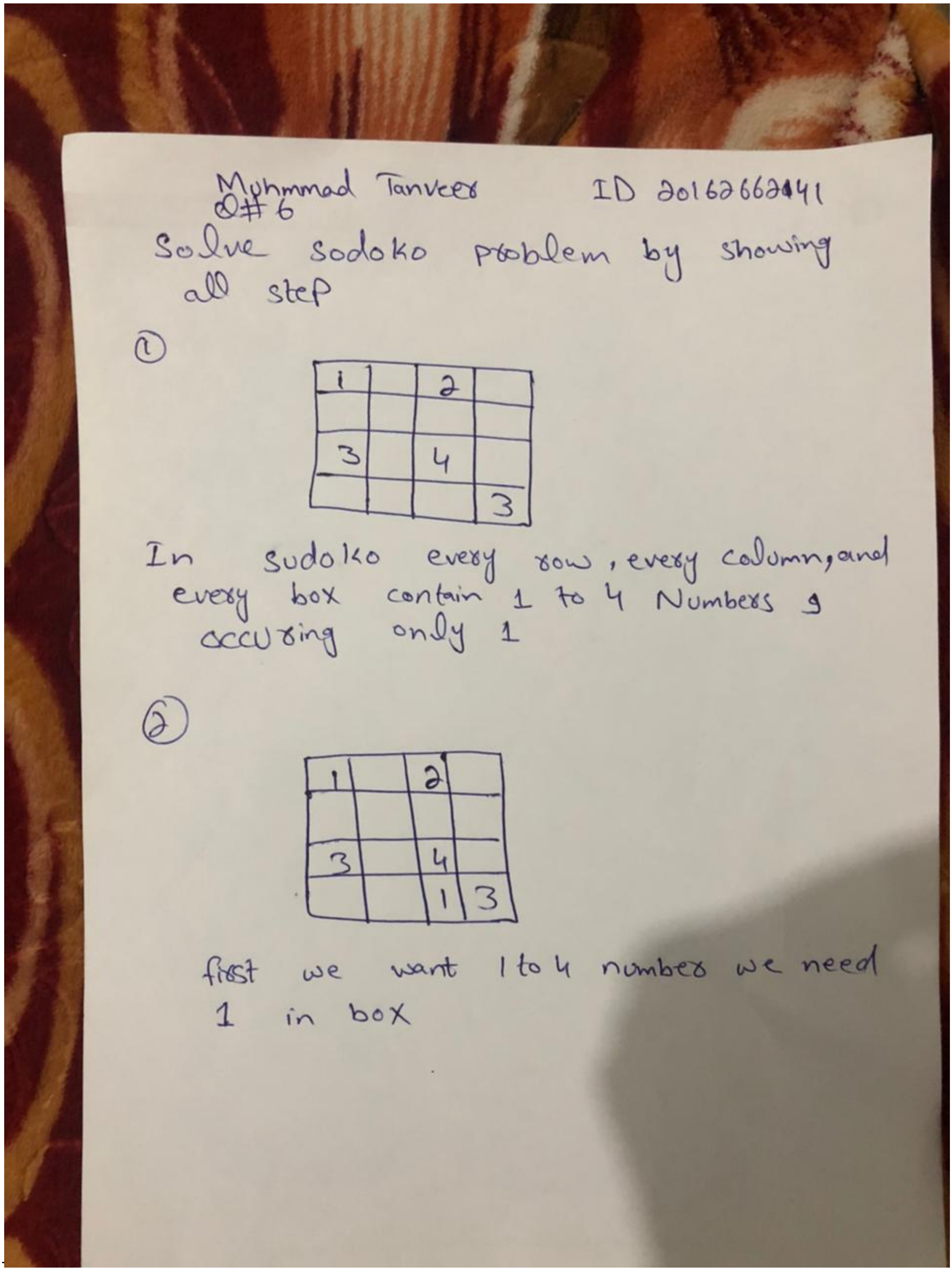
	A	B	C	D	E
	0	∞	∞	∞	∞
A		∞	∞	∞	$\boxed{4}$
E		$\boxed{7}$	∞	9	
B			$\boxed{8}$	∞	
C				$\boxed{11}$	
D					



Q# 5 Part B

(B) starting point E

	A	B	C	D	E
E	~~4~~∞	∞	∞	∞	0
B	4	3	∞	∞	~~∞~~
C			4	~~∞~~ 5	0
D					7
A					



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Q#6

Solve sodoko problem by showing all step

①

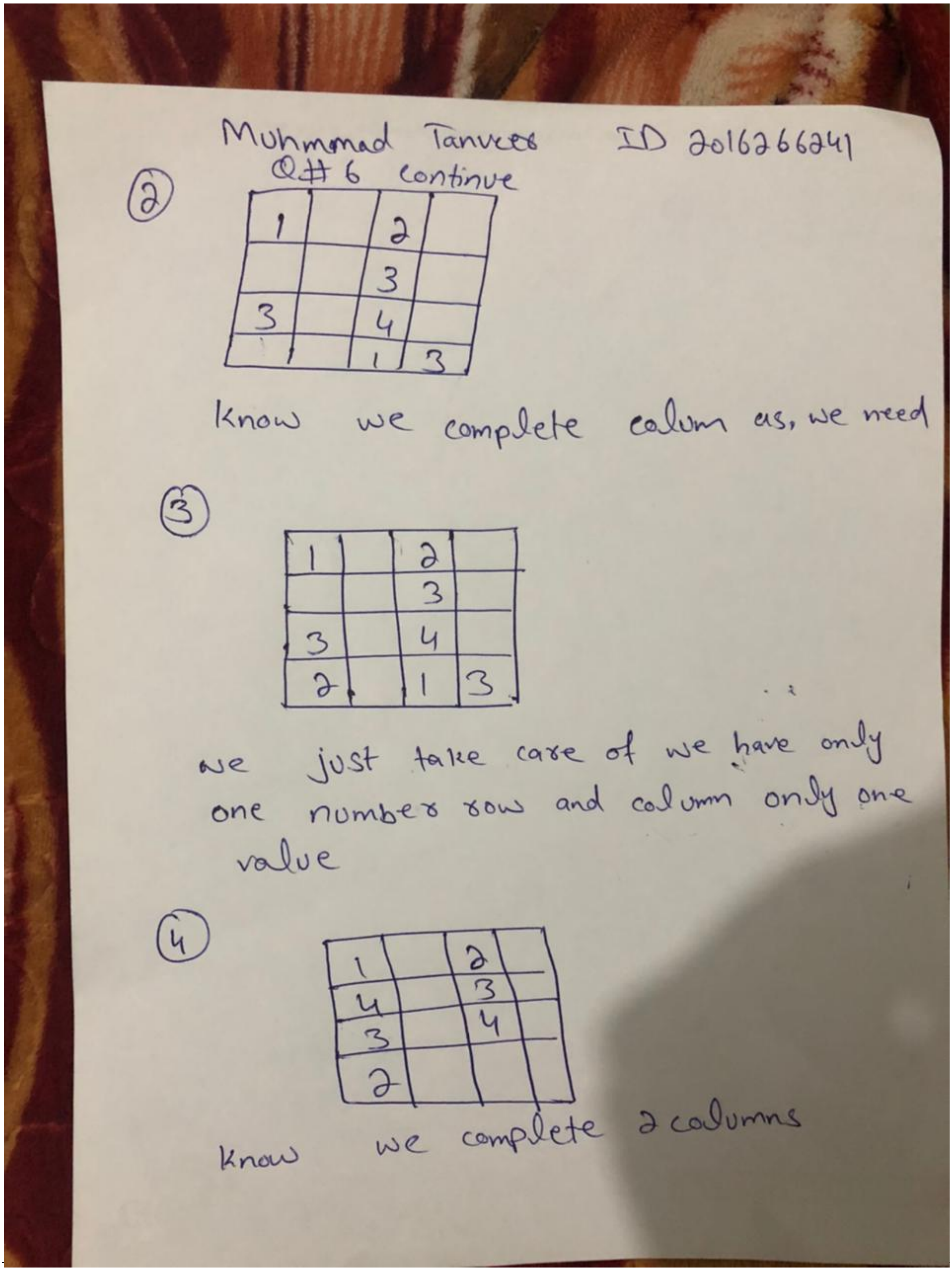
1		2	
3		4	
			3

In sudoko every row, every column, and every box contain 1 to 4 Numbers g occuring only 1

②

1		2	
3		4	
		1	3

first we want 1 to 4 number we need 1 in box



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Q#6 continue

②

1		2	
		3	
3		4	
		1	3

Know we complete colum as, we need

③

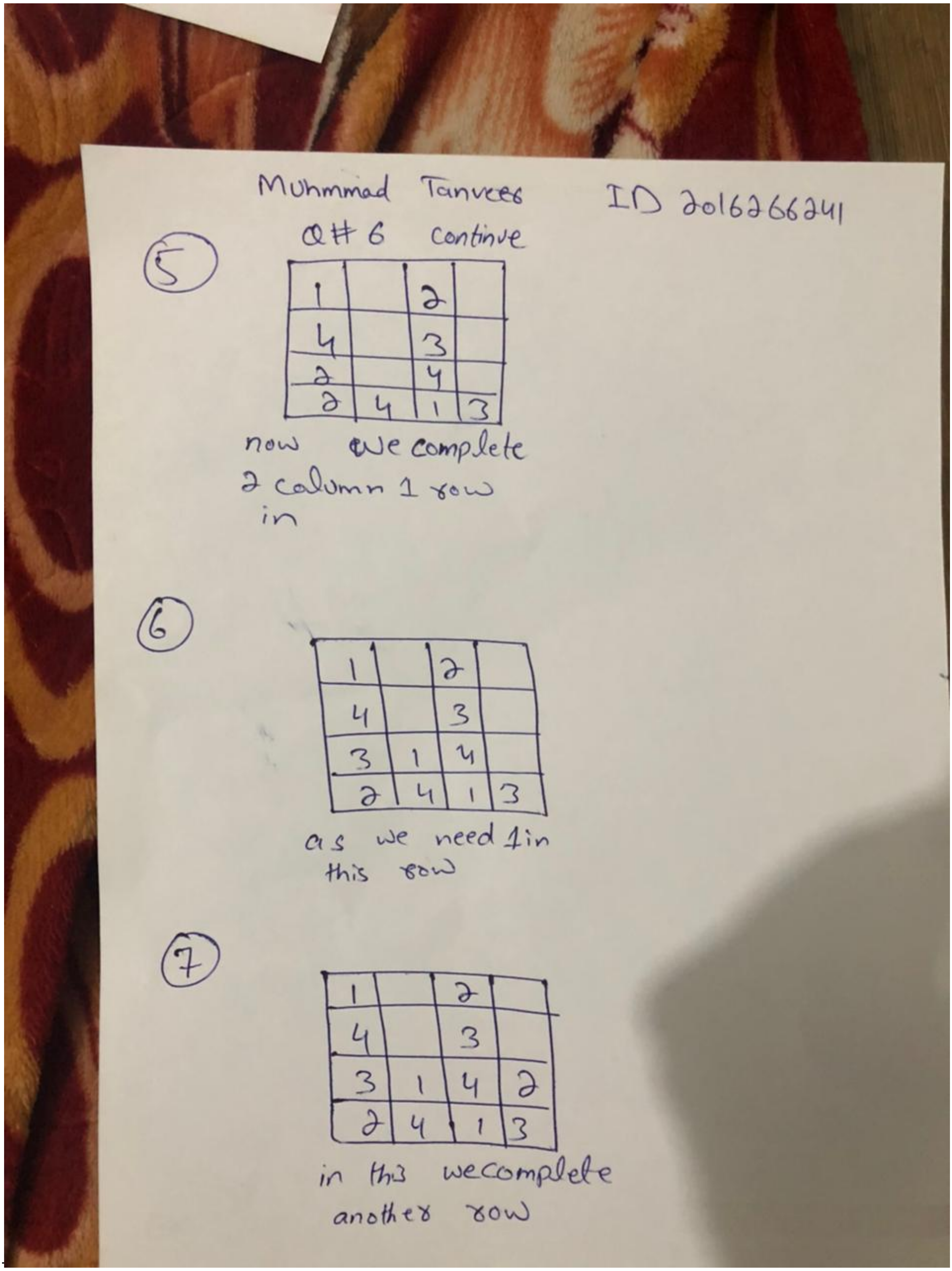
1		2	
		3	
3		4	
2		1	3

we just take care of we have only one number row and column only one value

④

1		2	
4		3	
3		4	
2			

Know we complete 2 columns



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Q# 6 continue

5

1		2	
4		3	
2		4	
2	4	1	3

now we complete 2 column 1 row in

6

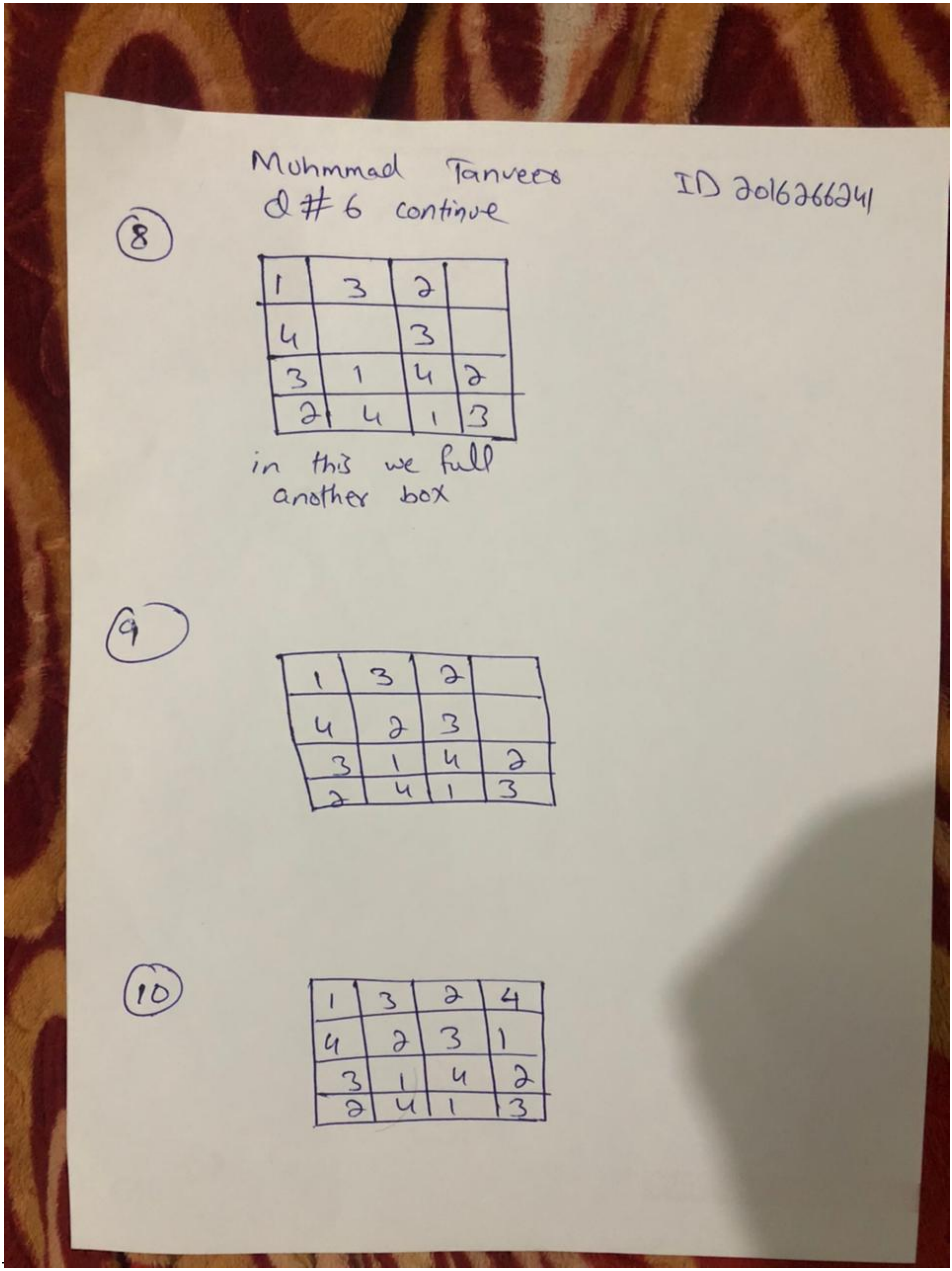
1		2	
4		3	
3	1	4	
2	4	1	3

as we need 1 in this row

7

1		2	
4		3	
3	1	4	2
2	4	1	3

in this wecomplete another row



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Q#6 continue

8

1	3	2	
4		3	
3	1	4	2
2	4	1	3

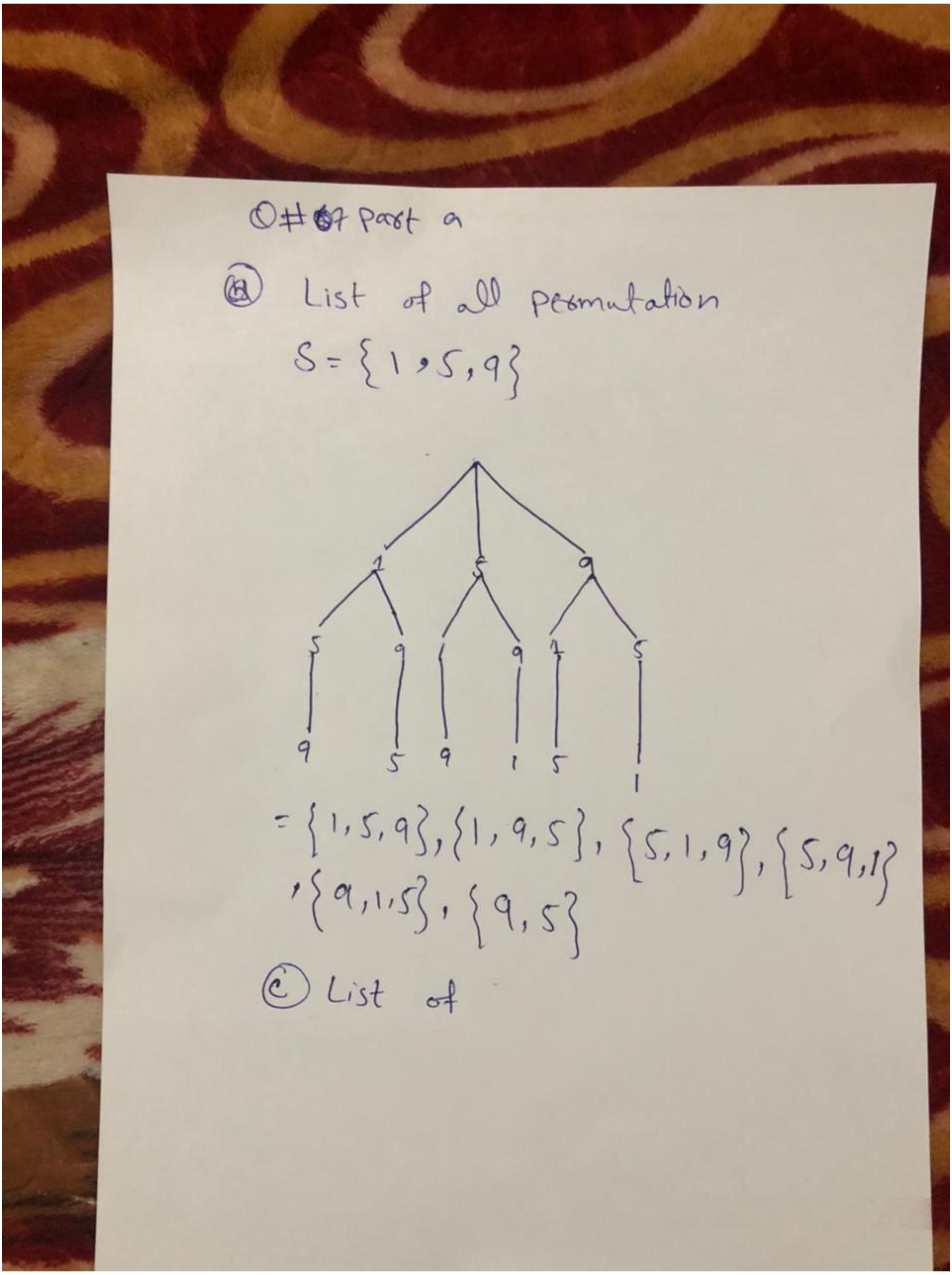
in this we full another box

9

1	3	2	
4	2	3	
3	1	4	2
2	4	1	3

10

1	3	2	4
4	2	3	1
3	1	4	2
2	4	1	3



Q# 07 part a

(a) List of all permutation

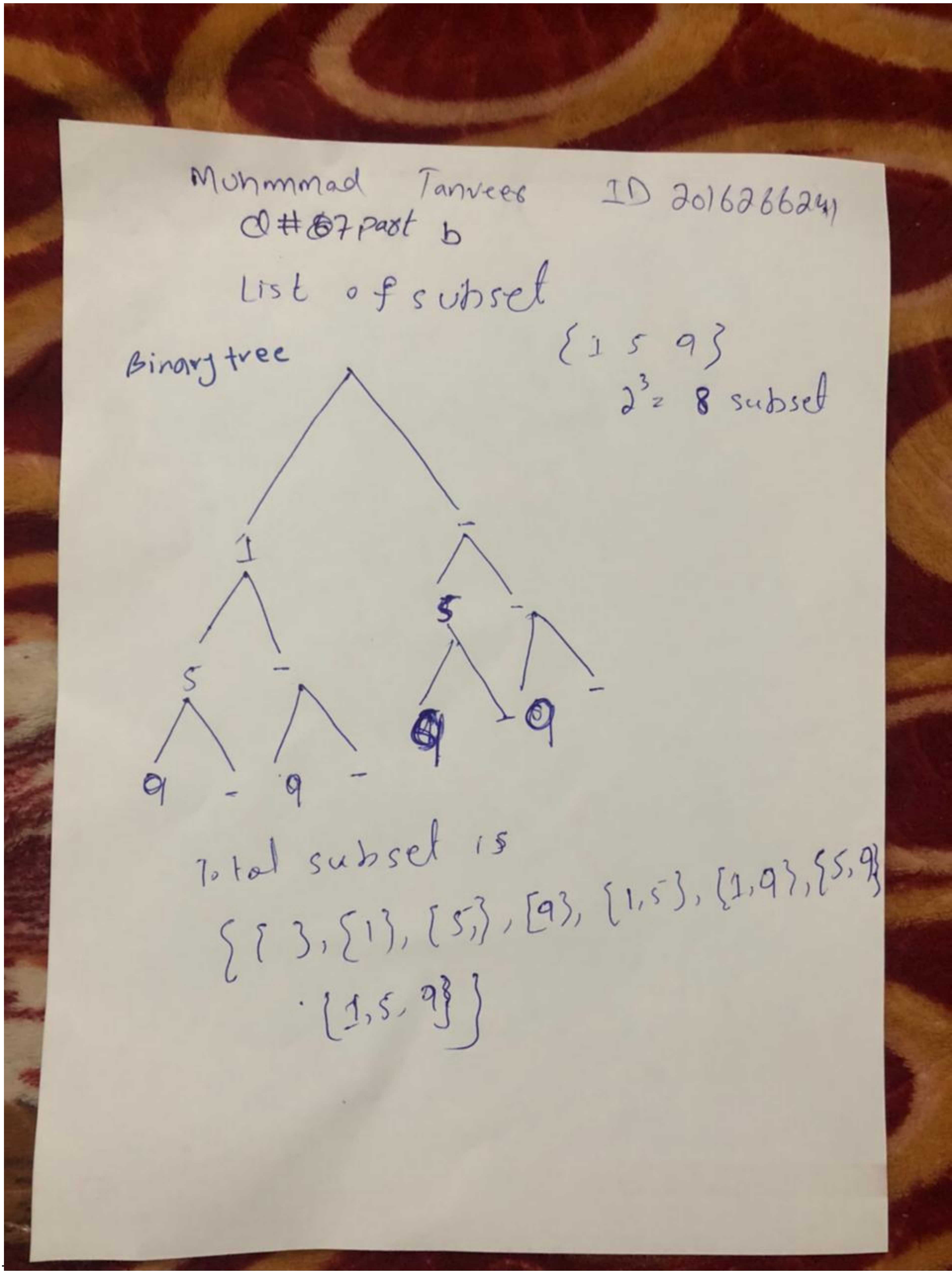
S = {1, 5, 9}

1
5
9
5
9
1
9
1
5
9
5
9
1
5
1

= {1, 5, 9}, {1, 9, 5}, {5, 1, 9}, {5, 9, 1}

, {9, 1, 5}, {9, 5}

(c) List of



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Q#07 part b

List of subset

{1 5 9}

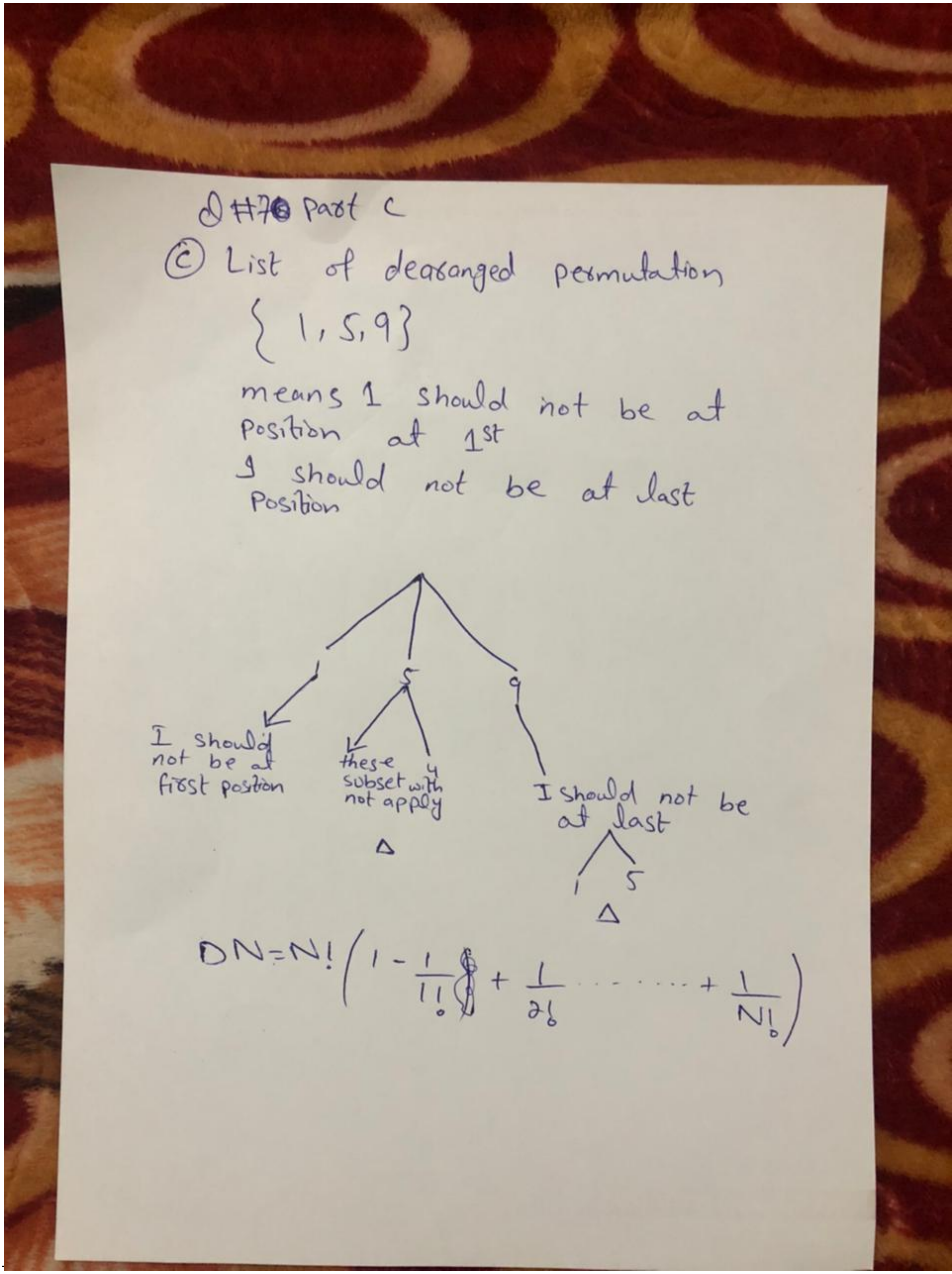
2^3 = 8 subset

Binary tree

Total subset is

{{ }, {1}, {5,}, [9}, {1,5}, {1,9}, {5,9}

· {1,5,9}}



Q #7 Part c

ⓒ List of dearanged permutation

{ 1, 5, 9 }

means 1 should not be at Position at 1st

9 should not be at last Position

1 5 9

I should not be at first position

these subset with 4 not apply

Δ

I should not be at last

1 5

Δ

$$DN=N!\left(1-\frac{1}{1!}+\frac{1}{2!}\cdots\cdots+\frac{1}{N!}\right)$$