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ASSIGNMENT 1

DISCRETE STRUCTURE

SESSION 2024/2025 - SEM 1

SECTION 02

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Question 1

a) Presint 4 → Presint 5 [3 car routes or 4 walking routes]

3 + 4 = 7 ways

Presint 5 → Presint 6 [4 car routes or 5 walking routes]

4 + 5 = 9

7 × 9 = 63 ways

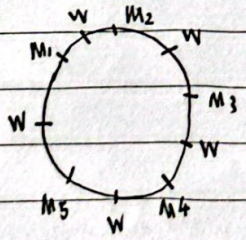
b) i) $P(8,8) = \frac{8!}{(8-8)!} = 40320$ ways

ii) $P(8,5) = \frac{8!}{(8-5)!}$

$= 6720$ ways

iii) $1 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 \times 1 = 720$ ways

c) i)

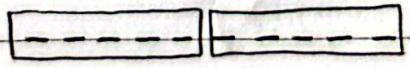


$(5-1)! \times 5!$

$= 2880$ ways

ii) $(9-1)! \times 2! = 80640$ ways

iii)



$= (2-1)! \times 5! \times 5!$

$= 14400$ ways

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Question 2

a) 8 men, 6 women → 5 person
⇒ at least 3 women

3 women, 2 men = ${}^{6}C_{3} \times {}^{8}C_{2} = 560$
4 women, 1 man = ${}^{6}C_{4} \times {}^{8}C_{1} = 120$
5 women = ${}^{6}C_{5} = 6$

$560 + 120 + 6 = 686$ ways

b) 10 boys, 10 girls → 4 students
⇒ at least one boy

1 boy, 3 girls = ${}^{10}C_{1} \times {}^{10}C_{3} = 1200$
2 boys, 2 girls = ${}^{10}C_{2} \times {}^{10}C_{2} = 2025$
3 boys, 1 girl = ${}^{10}C_{3} \times {}^{10}C_{1} = 1200$
4 boys = ${}^{10}C_{4} = 210$

$1200 + 2025 + 1200 + 210 = 4635$ ways

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3 a)i) $(5-1)! = 24$ ways

ii) C V V _ _ _ $= (3-1)! \times 3!$

$= 12$ ways

b) 5 people, head and assistant cannot seat together

all ways $= 5! = 120$

seat together :  $= 4! \times 2!$

$= 48$ ways

head and assistant cannot be together $= 120 - 48$

$= 72$ ways

c)i) $C(6+10-1, 6) = C(15, 6)$

$= \frac{15!}{6!(10-1)!}$

$= 5005$ ways

ii)

Hazelnut	Others - 9 flavours
$C(4,4) = 1$	$C(10,2) = 45$
$C(5,5) = 1$	$C(9,1) = 9$
$C(6,6) = 1$	$C(8,0) = 1$

Total $= 45 + 9 + 1 = 55$ ways

iii) $C(10,6) = \frac{10!}{6!(10-6)!} = \frac{10!}{6!4!} = 210$ ways

d) i) $C(13,11) = \frac{13!}{11!(2!)} = 78$ ways

ii) $P(13,11) = \frac{13!}{2!} = 3113510400$ ways

iii) 3 woman, 10 man

	woman	man	
case 1:	$C(3,1) = 3$	$C(10,10) = 1$	$\rightarrow 3 \times 1 = 3$
case 2:	$C(3,2) = 3$	$C(10,9) = 10$	$\rightarrow 3 \times 10 = 30$
case 3:	$C(3,3) = 1$	$C(10,8) = 45$	$\rightarrow 1 \times 45 = 45$

Total = 3 + 30 + 45 = 78 ways

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Question 4 :

Pigeons : balls taken

Pigeonholes : balls (red, yellow, green)

a) case 1 : not having two balls of the same colour, we could pick 1 red, 1 yellow, 1 green

case 2 : we pick one more ball, total of 4 balls. Since there are only 3 colours and 4 balls, at least 2 balls will share the same colour.

Answer : 4 balls must be taken from the box to get two balls of the same colour.

b) $10 \times 8 = 80$ pieces of cake

$32 \times 3 = 96$ pieces required

Pigeons : piecer of cheesecake ($n = 80$)

Pigeonholes : people ($m = 32$)

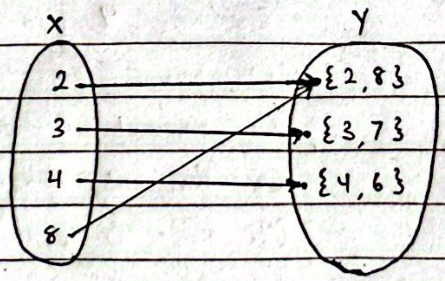
Thus

$$k = \left\lceil \frac{n}{m} \right\rceil = \left\lceil \frac{80}{32} \right\rceil = 2.5$$

2 full portions

1 half-piece

c) {2, 8}, {3, 7}, {4, 6} only pairs of them has a sum of 10



$|X| = 4$ and $|Y| = 3$. By second form of Pigeonhole Principle, two elements of X must be mapped to the same element of Y.

4 number of integers must be chosen so that at least one pair of them has a sum of 10.

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d) Pigeons = students in the class

Pigeonholes : grades - A, B, C, D, E

5 students per grade : 5 × 5 = 25 students

Now each grades have 5 students

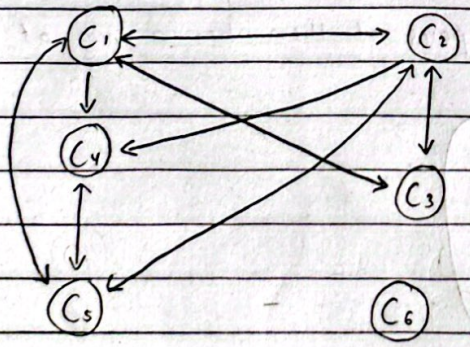
Add one more student into any grade, make the grade have 6 students.

The minimum number of students required that at least 6 will receive the same grade is 26 students.

e) Pigeons : 6 computers

Pigeonholes : computer that connected to zero or more of the other compute

6 computers can connect to 0, 1, 2, 3, 4 or 5 others computers. The only possible connection is {0, 1, 2, 3, 4} because if 1 computer is not connected to any computers, it means that no computer can be connected to all five others.



C1 has 4 connection

C2 has 4 connection

C3 has 2 connection

C4 has 1 connection

C5 has 3 connection

C6 has 0 connection

At least 2 computers are directly connected to the same number of other computer.