

Rules of inference:-

we have already proven facts which are true.  
and using those facts we have to infer new facts.

1. Modus ponens

$$(P \wedge P \rightarrow Q) \rightarrow Q$$

or

P

$P \rightarrow Q$

---

$$\therefore Q$$

2. Modus Tollens

$$(\sim Q \wedge P \rightarrow Q) \rightarrow \sim P$$

or

$\sim Q$

$P \rightarrow Q$

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$$\therefore \sim P$$

$$P \wedge Q \equiv P$$

$$P \wedge Q \equiv Q$$

Hypothetical syllogism

$$P \rightarrow Q$$

$$Q \rightarrow R$$

$$\therefore P \rightarrow R$$

Simplification

Disjunctive Syllogism

$$\frac{\sim P \quad P \vee Q}{\therefore Q}$$

$$\sim P \wedge (P \vee Q) \rightarrow Q$$

$$(\sim P \wedge P) \vee (\sim P \wedge Q)$$

$$F \vee (\sim P \wedge Q)$$

$$(\sim P \wedge Q) \rightarrow Q$$

$$\sim (\sim P \wedge Q) \vee Q$$

$$(P \vee \sim Q) \vee Q$$

$$P \vee T = P$$

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## Counting Techniques:- (Permutation & Combination)

- Q. How many passwords can be created of length 8 that contains digits (0-9) and alphabets (a-zA-Z) only?
- or How many number & can be generated product codes
- How many IP addresses can be generated of 46 length?

# Permutation 5

{a, b, c}

1. a b c

2. a c b

3. b a c

4. b c a

5. c a b

6. c b a

6 different passwords can  
be generated if no object  
is repeated i.e. a a a  
is ~~not~~ counted here.

Counting by  
problem in listing down

what happened if  
there are 5 or more digits  
a, b, c, d, e?

## Permutation problems

Counting objects through change of the positions  
IN PERMUTATION  $\therefore$  arrangements of objects  
matters.

password of length = 3 using symbols a, b, c  
repetition is not allowed.

$(a, b, c) (b, c)$

3 choices   2 choices   1 choice

$$\begin{aligned}\text{no of password} &= 3 \times 2 \times 1 = 6 \\ &= 3!\end{aligned}$$

Suppose I have three pencils (a, b, c)

cost of <sup>any</sup> one pencil is 2 Rs

what will be the cost of 3 pencils?

$$\text{pencil a} = 2$$

$$\text{pencil b} = 2$$

$$\text{pencil c} = 2$$

$$2 + 2 + 2 = 6$$

$$\text{or } 3 \times 2 = 6$$

Pencils

2 Rs

$$2 \times 3 = 6$$

← Pencil

↘ Rs

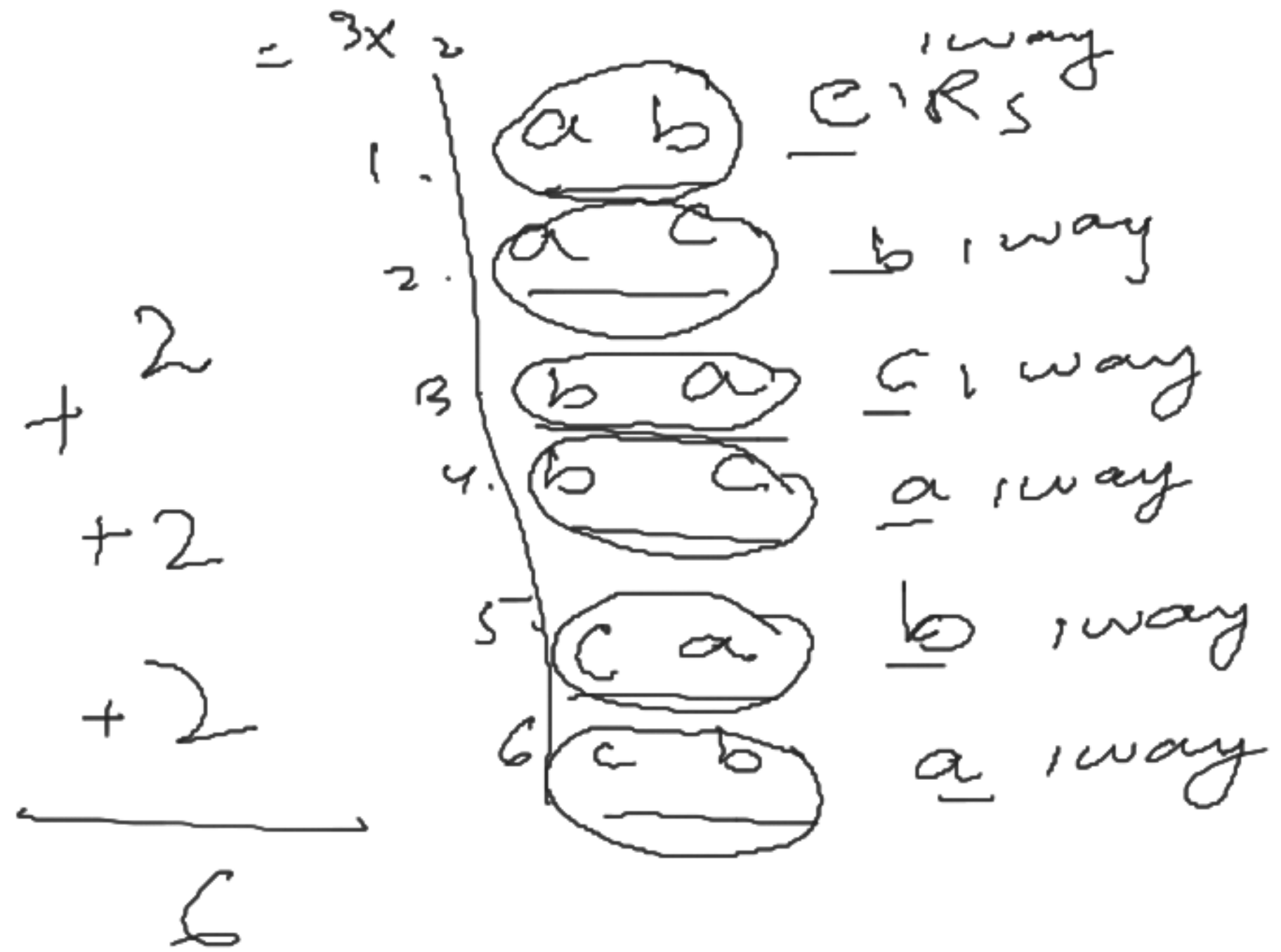
a { b c } 2 ways  
 { c b } 2 ways

b { a c } 2 ways  
 { c a } 2 ways

c { a b } 2 ways  
 { b a } 2 ways

$$3! = \underline{3 \times 2 \times 1}$$

$$6 \times 1 = 6$$



1 object  $\rightarrow$  2 ways  
 3 objects  $\rightarrow 3 \times 2 = 6$  ways  
 objects  $\swarrow$  ways

$$3 \times 2 \times 1 = 3!$$

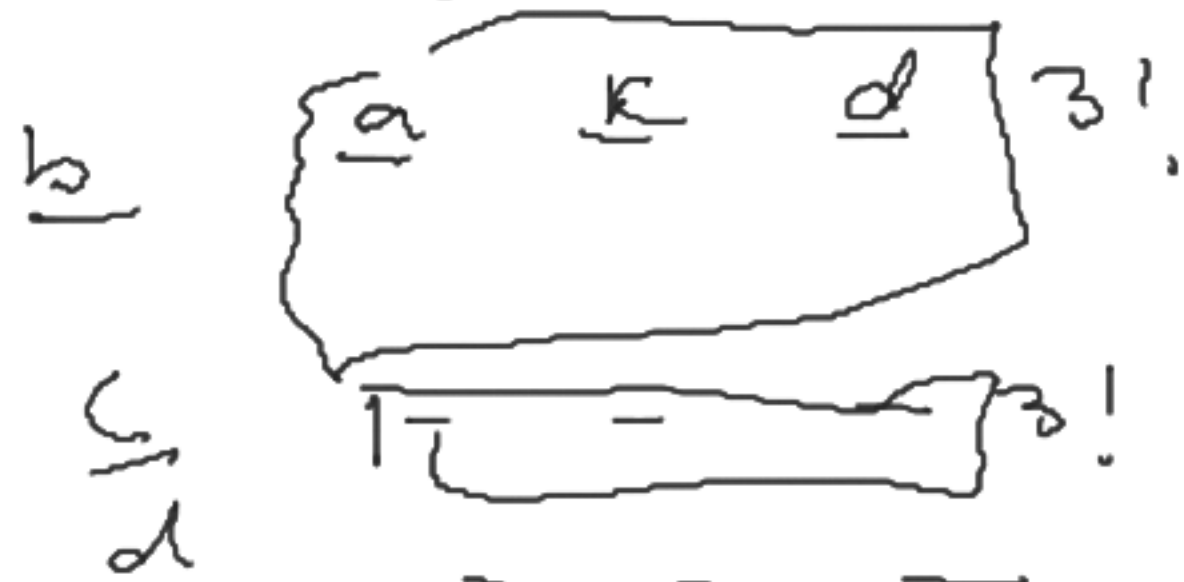
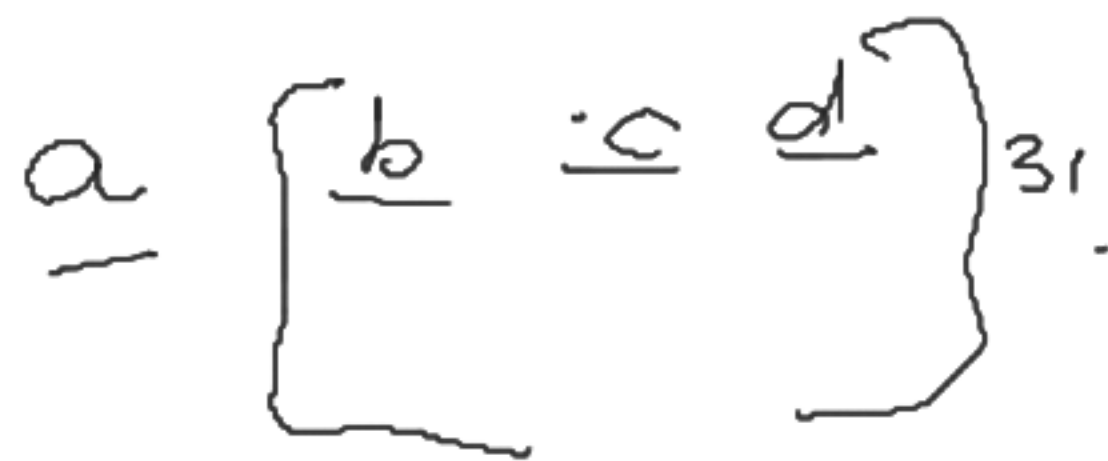
obj way = 6 objects  $\times$  1

$$6 \times 1$$

objects way = 6 ways.

4 Different objects (a, b, c, d)

4 objects



3!



$$\begin{array}{r}
 3! \\
 + 3! \\
 + 3! \\
 + 3! \\
 \hline
 \end{array}$$

4  $\times$  3!

obj ways

$= 4!$

$$\begin{array}{r}
 3! + 3! + 3! + 3! \\
 6 + 6 + 6 + 6 = 24 \\
 4! \times 6 = 24
 \end{array}$$

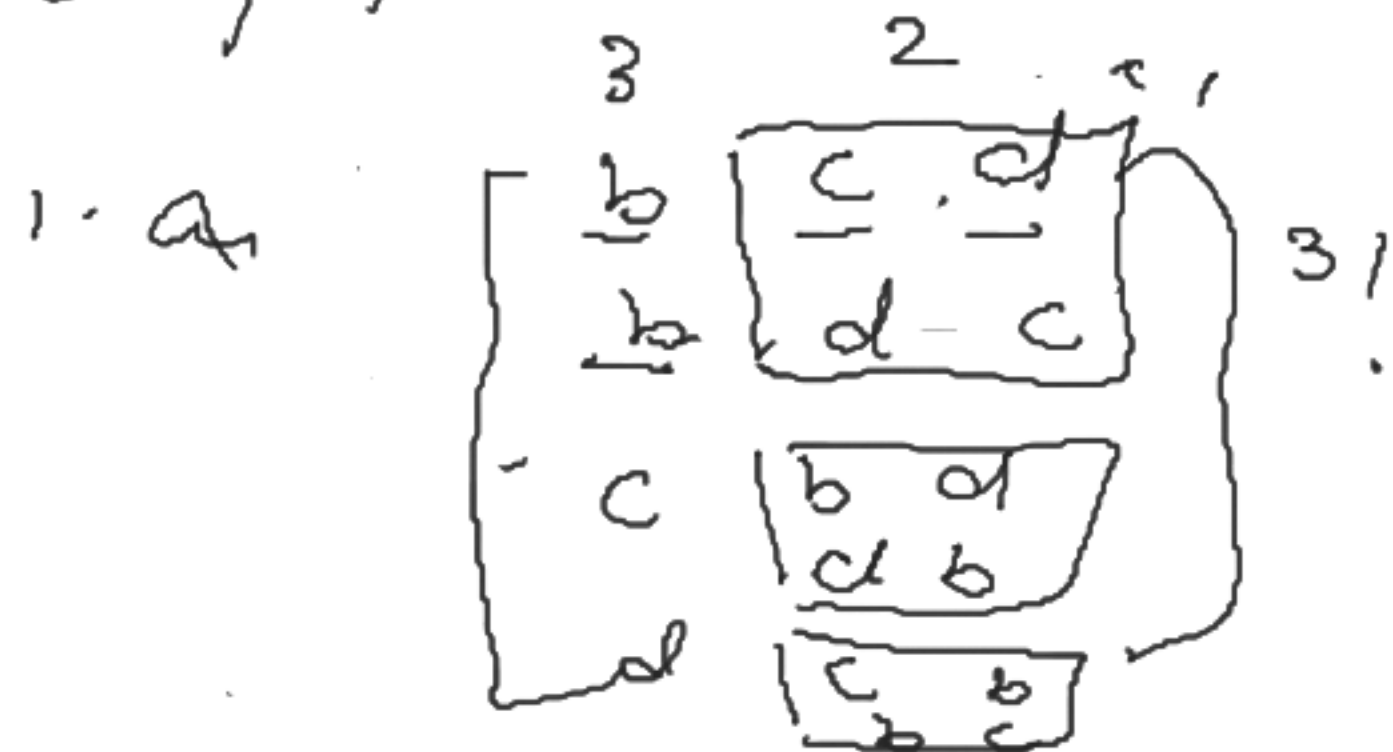


$$4! = 4 \times 3 \times 2 \times 1$$

$$= 4 \times 3!$$

$$4! = 4 \left[ \begin{array}{c} \text{ways} \\ \text{objects} \end{array} \right]$$

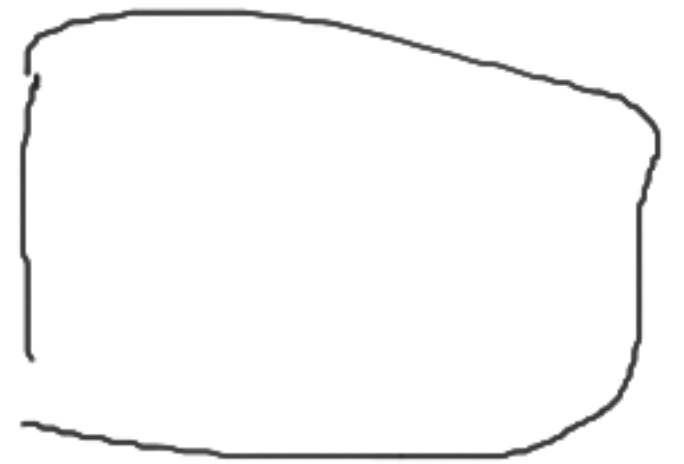
object



2. b

$$[ \quad ]$$

3. c



4. d



# Permutation

Technique 1:- If we have " $n$ " different objects then they can be arranged themselves in  $n!$  ways.

Q1. How many passwords of length 8 can be generated using alphabets  $(a-z)$  and digits only if repetition is not allowed?

No digits  
 $0-9$

$a-z = 26$

$26 + 10$   
 $= 36$  objects

$\begin{array}{cccccccc} \_ & \_ & \_ & \_ & \_ & \_ & \_ & \_ \\ 36 & 35 & 34 & 33 & 32 & 31 & 30 & 29 \end{array}$   
choices

$36 \times 35 \times 34 \times 33 \times 32 \times 31 \times 30 \times 29$

Q1 ii) How many password of length 8 if they start with 3 <sup>digits</sup> digits must followed by alphabets (a-z)

<u>D</u>	<u>D</u>	<u>D</u>	<u>A</u>	<u>A</u>	<u>A</u>	<u>A</u>	<u>A</u>
10	9	8	26	25	24	23	22

$$10 \times 9 \times 8 \times 26 \times 25 \times 24 \times 23 \times 22$$

= no. of passwords.

Q1. 1  
iii) Any two specified digits must come together at any position in the password.

for example.

a b (12) c d e f

b (12) a c d e f

67 (12) a b c d

67 a b c d (12)

count two specified digits as 1 object.

Hence total digits  $(0-9) = 10 - 1 = 9$  objects

$\{0, \textcircled{12}, 3, 4, 5, 6, 7, 8, 9\}$

9 digits objects + 26 alphabets

$= 26 + 9 = 35$  objects are to be

arrange in 8 positions

$$\begin{array}{cccccccc} \overline{35} & \overline{34} & \overline{33} & \overline{32} & \overline{31} & \overline{30} & \overline{29} & \overline{28} \\ = 35 \times 34 \times 33 \times 32 \times 31 \times 30 \times 29 \times 28 = \cancel{35 \times 34 \times 33 \times 32 \times 31 \times 30 \times 29 \times 28} \end{array}$$

no of

= no of passwords in which <sup>shape 1</sup> 1, 2 ~~can~~

a 2, 1  
shape 2

for shape ① 1, 2 there will be

\* no of passwords

for shape ② 2, 1 \* no of passwords

total no of password = \* + \* = 2 \*

total password =  $(35 \times 34 \times 33 \times 32 \times 31 \times 30 \times 29 \times 28) \times 2$

Q. How many natural numbers of three different digits can be formed using digits  $(0, 1, 2, 3, 4, 5)$  that lies b/w 320 — 445?

Solution.

H T U