Precalc13.2

Solve permutation problems with repetitions
Solve circular permutation problems

permutation   — order matters

repetition   repeats   MN   NM

circular

point of reference

activity: ring around the rosie
Probability: cubes

1 c   3
2 F   5
2 G   3

$$_3C_1 \cdot {}_5C_2 \cdot {}_3C_2$$

$$3 \cdot \quad \frac{5 \cdot 4}{(2)} \quad \frac{3 \cdot 2}{(2)}$$

$$3 \cdot 10 \cdot 3 = 90$$

MOOO $\dfrac{4!}{3!}$ $\dfrac{4 \cdot 3 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1} = 4$

The number of permutations of n objects of which p are alike and q are alike is

$$\frac{n!}{p!\,q!}.$$

cat
moo

CAT   ATC   TAG $\dfrac{3 \quad 2 \quad 1}{}$

CTA   ACT   TCA

$= 6$

$\dfrac{3!}{2!} \dfrac{\cancel{3} \cdot 2 \cdot 1}{2 \cdot 1}$ MOO   OMO   OMO

MOO   OOM   OOM

Circular Permutations	If n objects are arranged in a circle, then there are $\frac{n!}{n}$ or $(n-1)!$ permutations of the n objects around the circle.

If the circular object looks the same when it is turned over, such as a plain key ring, then the number of permutations must be divided by 2.

example…

ring around the rosie

$$A\ B\ C \qquad A\ C\ B \qquad B\ C\ A$$

$$B\ A\ C \qquad C\ A\ B \qquad C\ B\ A$$

A C B   A B C

$$\frac{1}{1} = \frac{1 \cdot 2 \cdot 1}{2 \cdot 1} = 2$$

1. If you roll two 6-sided number cubes and then spin a 6-colored spinner with equal sections, how many outcomes are possible?

2. How many ways can 8 books be arranged on a shelf?

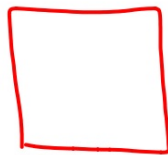$36 \cdot 6 = 216$

$8 \, 7 \, 6 \, 5 \, 4 \, 3 \, 2 \, 1 =$

State whether the events are *independent* or *dependent*.

3. tossing three coins, then rolling a die   I
4. selecting members for a committee   d
5. deciding the order in which to answer your e-mail messages   d

A B C D e

1 · 4 · 3 · 2 · 1 = 24

A
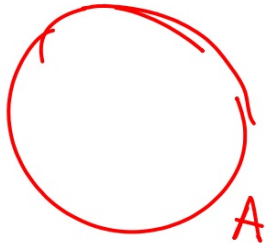
A B C D

1 · 3 · 2 · 1

How many different ways can the letters of each word be arranged?

  1. *mailbox*   **2.** *textbook*   **3.** *almanac*   **4.** *dictionary*

$$7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \qquad \frac{7!}{3!} \qquad \frac{10!}{2!}$$

$$7! \qquad\qquad \frac{8!}{2!\,2!}$$

5. How many different 4-digit access codes can have the digits 5, 7, 2, and 7?

abc b

— — — —

Determine whether each arrangement of objects is a *linear* or *circular* permutation.
Then determine the number of arrangements for each situation.

6. 4 friends seated around a square table

7. 9 charms on a charm bracelet with no clasp

8. a stack of 5 books on a table

$$\frac{4!}{2!}$$

C

C $1 \cdot 9!$
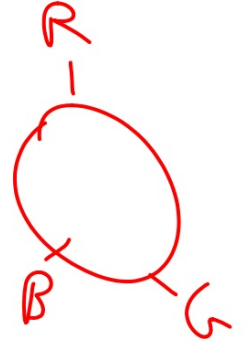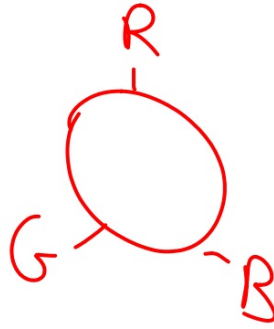
Mississippi

$$\frac{11!}{4! \, 2! \, 4!}$$

Probability with replacement/ without replacement...

13.2 13-350