Counting Rules

Sometimes we have to calculate the number of possible outcomes for a squence of events. There are three rules to determine the number:

1. Fundamental Counting Rule
2. Permutation Rule
3. Combination Rule

Fundamental Counting Rule

In a sequence of n events in which the first one has 'a' possibilities, second one has 'b' possibilities and so on. The total number of possibilies of the sequence will be:
a * b * c * . . . .

For example:
A coin is tossed and a die is rolled. Find the number of outcomes for the sequence of events.

```
# total outcomes
coin_possibilities = ['H', 'T']
die_possibilities = [1, 2, 3, 4, 5, 6]

# possible combinations
combinations = [(coin, die) for coin in coin_possibilities for die in
die_possibilities]

# displaying the number of combinations
print(len(combinations))
```

```
12
```

Question 1

A paint manufacturer wishes to manufacture several different paints. The categories include:
color: red, blue, white, black, green, brown, yellow type: latex, oil texture: flat, semigloss, high gloss use: outdoor, indoor

How many different kinds of paint can be made if you can select one color, one type, one texture and one use?

```
## Write Your Code Here ##
```

Permutation

A permutation is an arrangement of n objects in a specific order.

Permutation Rule The arrangement of *n* objects in a specific order using r objects at a time is called a permutation of n objects taking r objects at a time. The formula is:
${}_nP_r \ or \ P(n,r) = \frac{n!}{(n-r)!}$

For example:
A radio talk show host can select 3 of 6 special guests for her program. The order of appearance of the guests is important. How many different ways can this be done?

Solution:
n = 6
r = 3
${}_6P_3 = \frac{6!}{(6-3)!} = \frac{6 \ . \ 5 \ . \ 4 \ . \ 3!}{3!} = 120$

But, we can calculate in python easily.

```
# importing module
import math

```

```
# assigning the values
n = 6
r = 3

# calculating the permuation
permutation = math.perm(n, r)

# displaying the result
print(f"The host can have {permutation} different ways for her program.")

```

```
The host can have 120 different ways for her program.
```

Question 2

A school musical director can select 2 musical plays to present next year. One will be presented in the fall, and one will be presented in the spring. If she has 9 to pick from, how many different possibilities are there?

```
## Write Your Code Here ##
```

Combinations

A selection of distinct objects without regard to order is called a **combination**.

Combination Rule

The number of combinations of r objects selected from n objects is denoted by ${}_nC_r \ or \ C(n,r)$

${}_nC_r = \frac{n!}{(n-r)!r!}$

For example:

How many combinations of 4 objects are there, taken 2 at a time?

Solution:

n = 4

r = 2

${}_4C_2 = \frac{4!}{(4-2)!2!} = \frac{4.3.2.1}{2.1.2.1} = 6$

Lets solve this using Python.

```
# import module
import math

# assigning the variable
n = 4
r = 2

# calculating
combinations = math.comb(n, r)

# displaying the result
print(f"The combination is {combinations}")
```

```
The combination is 6
```

Question 3

An advertising executive must select 3 different photographs for an advertising flier. If she has 10 different photographs that can be used, how many ways can she select 3 of them?

```
## Write Your Code Here ##
```