The Fundamental Counting Principle

Lesson objectives

- I can use the fundamental counting principle for counting and problem solving

1.1

Lesson objectives | Teachers' notes | Lesson notes

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Warm Up

There are many different types of random number generators. At their simplest, dice and spinners are used in many board games. On a graphing calculator, randInt($lower$,$upper$) returns a random integer between the lower and upper values.

- How many different outcomes (ordered pairs) are possible when rolling two dice? 36 (6x6)
- How many different outcomes are possible when spinning the pictured spinner twice? 16 (4x4)
- How many different outcomes are possible when generating a random number twice on a calculator using randInt(1,100)? 10,000 (100x100)
- What operation did you use to do your calculations?

Multiplication

AND means multiply

The **fundamental counting principle** is used to calculate the number of outcomes. If one event can occur in *m* ways and another event can occur in *n* ways then together they can occur in *m* x *n* ways.

1. a) Roll one die and flip a coin. Make a list or a diagram to illustrate all the possible outcomes.

   b) How many outcomes are possible?

	1	2	3	4	5	6
H	H1	H2	H3	H4	H5	H6
T	T1	T2	T3	T4	T5	T6

12 outcomes

2. Roll one die, flip a coin, and spin a spinner with four equal sections. Without making a list or diagram, determine how many outcomes are possible. Describe your method.

Die = 6
Coin = 2
Spinner = 4
$\Rightarrow$ Total possible outcomes $= 6 \times 2 \times 4 = 48$

3. Randomly select a number between 1 and 100, and a letter from the alphabet. How many outcomes are possible? How did you know this without counting all the outcomes?

$100 \times 26 = 2600$ possible outcomes

Example 1

Use the Fundamental Counting Principle

At an ice-cream stand, customers have a choice of a plain cone or a sugar cone. There are six choices for ice-cream flavours: vanilla, chocolate, strawberry, butterscotch, lemon, and raspberry. How many different single-scoop ice-cream cones can be made?

Cones = 2
Flavours = 6
$\Rightarrow 2 \times 6 = 12$ types of Single Scoop Cones

Your Turn

When buying a new smartphone, Li Ming has the following choices:

- 2 GB, 4 GB, or 8 GB of memory
- 64 GB or 128 GB of storage
- 10 colours

How many different configurations of the smartphone are available?

Memory = 3
Storage = 2
Colours = 10
$\Rightarrow 3 \times 2 \times 10 = 60$ different configurations

Example 2

Counting Repeated Independent Trials

You roll a standard die. How many outcomes are possible with

a) two rolls? b) three rolls?

a) $6 \times 6 = 36$ outcomes

b) $6 \times 6 \times 6 = 216$ outcomes

Your Turn

A password consists of six letters of the alphabet, with repetition permitted.

a) How many different passwords are possible?

b) How many passwords are possible if the letters can be capitals or lower case?

a) $26 \times 26 \times 26 \times 26 \times 26 \times 26 = 308,915,776$

b) 26 lower case and 26 upper case $= 52$

$\Rightarrow (52)^6 = 19,770,609,664$

Example 3

Counting Repeated Trials Without Replacement

Two cards are chosen from a standard deck without replacement. How many possible outcomes are there?

1ST card = 52 outcomes

2ND card = 51 outcomes (1ST card not replaced)

$\Rightarrow 52 \times 51 = 2652$ outcomes

Your Turn

From a class of 25 students, in how many ways could three of them be selected to attend a workshop—one as a speaker, one as a videographer, and one to take notes?

Speaker = 25 outcomes

Videographer = 24 outcomes [once chosen, they cannot be chosen again]

Notes = 23 outcomes $\Rightarrow 25 \times 24 \times 23 = 13,800$

Homework

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