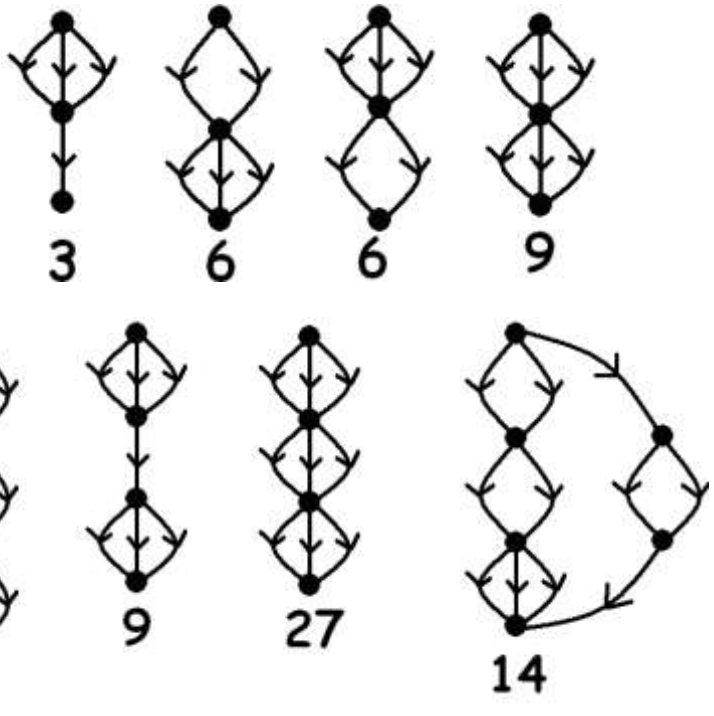
WITHOUT WORDS

Mathematical Puzzles to Confound and Delight

WW 12: SOLUTION



Here's a question:

> *I own five different shirts, three different pairs of trousers, and four different sets of shoes. How many different outfits might you see me in?*

The answer is $5 \times 3 \times 4 = 60$.

But does the answer change if I now tell you that I will never wear my purple shirt with my green trousers (but all other combinations of trousers and shirts – and shoes – are fine)?

The *Multiplication Principle* in mathematics states that if there are a ways to complete a first task and b ways to complete a second task, and choices made for the first task can in no way affect choices made in the second, then the total number of ways to complete both tasks is $a \times b$.
(And this principle generalizes to the completion of three tasks or more.)

We see the multiplication principle at play in each of the diagrams above. (Although the last one has an added feature.)

The multiplication principle also at play when rearranging letters of a word.

1. *My name is JIM. In how many different ways can I rearrange the letters of my name?*

(Think of this as three tasks: Choose a letter to place first, a letter to place second and a letter to place third. Now apply the multiplication principle.)

2. *Actually, my proper name is JAMES. How many ways can I rearrange the letters of my proper name?*

3. *What if my name was actually spelled JAAMES with a repeated letter A? What if my name was actually JAAMMMEEEESSSS?*

Now question three is tricky! To learn how to handle counting arrangements, have a look at the free online course www.gdaymath.com/courses/permutations-and-combinations/ .