Math Diversion Problem 882

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If you want that tool you're about to buy to last
more than three usages, never go cheap.
— The Author

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1 Problem

8-year-old Samantha visited Santa at a local department store. He gave her this riddle: "I started working at 15. I spent 1/4 of my working life in a factory. I spent 1/5 of my working life in an office, and I spent 1/3 of my working life as a school caretaker. For the last 13 years of my working life I've been Santa Claus. How old am I?" The problem says you need to explain how you got the answer and how you know it is correct.

2 Solution

This problem is easy if we approach it with the two questions: Are there any totals? Are there any parts? In fact, there are both.

$$\text{(Santa's total life time)} = \text{(Santa's time prior to working)} + \sum \text{(Santa's time working at various jobs)}\,. \quad (1)$$

How do I know that this equation is correct so far? I know because the RHS is the sum of a collection of collectively exclusive, mutually exclusive time intervals, whatever their individual natures are.

Let A stand for 'Santa's total life time', meaning, his current age. Let W stand for Santa's working life = A – time Santa didn't work = $A - 15$. The rest of the parts of (1) are given to us as fractional amounts of W or as a specific

number:

$$W = A - 15\,, \tag{2a}$$

$$A = 15 + \frac{1}{4}W + \frac{1}{5}W + \frac{1}{3}W + 13\,. \tag{2b}$$

which has solution $A = 75$ years old.