How to thin 96% alcohol to 80%

or...

.. a little mathematic challenge on a rainy day, *by Arne Kverneland...*

Last year, in 2018 I had several goes at trying to optimise my Origo alcohol stove to reduce soot and smell from it. One advice I received was to thin out the 96% alcohol with water until it held 80%. When I came over some 80% alcohol, I tried it, and sure enough; the flame now contained less yellow in it, so I reckoned it was an improvement. Moreover, time to boil 0.5l water still stayed at 4min. 30seconds.

I mostly only get the 96% (denaturised) alcohol, so now I had a go to find out how much water I need to add to end up with 80% concentration.

That was a struggle - I am not a mathematician, but this is how I did:

Let's call the pure alcohol in a unit (for instance; one litre) of (96%) *spiritus* **A**, and the remaining water in it for **W.**

The extra water needed to reach 80% concentration, is **X**.

Then, 1) $A + W = 1$

2) $A = 0.96$

3) $W = 0.04$

In other words...

4) $\dfrac{A}{A+W} = 0.96$

We then add the X amount of water into 4) to reach 80% (0.80) alcohol concentration.

Then   5) $\dfrac{A}{A+W+X} = 0.80$

Solving this equation gives us..

6) $\mathbf{X = \dfrac{A-0.80A-0.80W}{0.80} = \dfrac{0.96-0.80x0.96-0.80x0.04}{0.80} = 0.20}$

In other words, if we have one litre of alcohol with 96% concentration, just add 2dl of water to it, and the alcohol contents will drop to 80%.

This sounded a bit too simple, so I ran it through formula 5) and added those 0.2 units of water to see:

Then, sure enough, 5) $\dfrac{A}{A+W+X} = \dfrac{0.96}{0.96+0.04+0.2} = 0.80 = 80\%$ *Looks OK.*

More practical: What if you have a litre of 92% moonshine and want to thin it down to 40%? Then A=0.92, W=0.08 and the new concentration is 0.40. Insert the numbers into formula 6):

6) $\mathbf{X = \dfrac{A-0.40A-0.40W}{0.40} = \dfrac{0.92-0.40x0,92-0.40x0.08}{0.40} = 1.3}[\boldsymbol{litre}]$

Good to know!

(.. I hope I haven't screwed up completely - you'd better check it yourself...)