One of the remaining two liquids is an acid. The indicator (phenolphthalein) however, cannot be used directly. One has to alkalize part of it slightly by pouring a dropper of the indicator in a test-tube or a beaker and adding one drop of aqueous ammonia. In this way, the solution is intensely colored. Then, only the acid will make the color disappear. The remaining liquid will be water. In our opinion, all other chemicals and equipment were distracters and served to make the problem a bit more complicated.

What the students did

Indeed, many of the students identified ethanol in the way described above; some decided that the characteristic smell is enough of a proof. Some of them used our further procedure, but in a somewhat reversed order; they advised that a few drops of the indicator be added to part of both remaining solutions, followed by one drop of aqueous ammonia. The intense color reveals which one is the distilled water; the other one is oxalic acid solution.

But not everyone did it this way. Unlike ourselves, our students proved to be really inventive. One student suggested that the CuSO\textsubscript{4} solution be evaporated and the dry residue be used as a test for the distilled water. The idea is generally not so bad, but there is no burner in the equipment list! Further, the third beaker contains an aqueous solution of oxalic acid, so this approach, although original, was not really useful.

Two boys, however, offered really intriguing solutions to the problem. Both identified ethanol in the standard way (characteristic smell and/or flammability of the liquid). For the remaining two unknowns, one of them suggested that, first, the silver nitrate solution that is provided be added to some distilled water (“the distilled water that is available as a chemical in the lab”). This is the control test-tube. Then, he would put the two remaining liquids into separate test-tubes and add AgNO\textsubscript{3}(aq) to each. The test-tube that “looks exactly the same” as the control contains distilled water. The other one contains oxalic acid. True, a silver oxalate precipitate would form in the test-tube containing oxalic acid, thus enabling positive identification of all three liquids. Somehow, we overlooked this possibility. The boy must have known that silver nitrate gives a white precipitate in the presence of chlorides. He probably wasn’t aware of the exact type of chemical change when oxalic acid is present, but guessed correctly that some visible difference would occur.

The other guy (after identifying ethanol), suggested that upon addition of aqueous ammonia to each of the remaining two liquids “… Some heat will be released in the test-tube containing oxalic acid, because that is what one expects during neutralization. Since both the acid and the base are weak (\textit{f}), the amount of heat may not be large, but still it could be sensed.” Needless to say, he was right. The temperature change was later measured to be ~6 Celsius degrees — more than enough for sensing the difference by touch.

There is an old Latin saying: ‘\textit{Si duo faciunt idem, non est idem}’ (meaning that if two individuals are given the same task, the output is never the same). The results of our bright youngsters suggest that one could hardly find a better illustration for the above proverb.