

Think It Over



This section of *Resonance* presents thought-provoking questions, and discusses answers a few months later. Readers are invited to send new questions, solutions to old ones and comments, to 'Think It Over', *Resonance*, Indian Academy of Sciences, Bangalore 560 080. Items illustrating ideas and concepts will generally be chosen.

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How much can pH Change through Dilution?

Let us consider an acidic solution with a hydrogen ion concentration, $[H^+]$ of $10^{-5}M$. Since $pH = -\log [H^+]$ the pH of the solution is 5. Suppose we dilute the solution 10 times with water. Now, $[H^+]$ is $10^{-6} M$ and the pH is 6. Further dilution should increase the pH from 6 to 7 and then from 7 to 8 and ... Can this go on for ever? Does this not imply that an acidic solution can be made basic/alkaline simply by adding water? Where is the catch?

Answer to 'Burning Question' which appeared in *Resonance*, Vol.3, No.3, March 1998 by Vilas Gohad.

❶ To determine 45 minutes

Burn both ends of one lace and one end of the other lace at the same time.

First lace being ignited from both the ends will burn for 30 minutes and will be fully burnt.

The other lace will also burn for 30 minutes in the same period and 30 minute length will remain.

Now, ignite the other end also of the second lace. Its remaining length will burn for 30 minutes. Therefore, it will burn for 15 minutes, being now ignited at both ends.

The time from first lace is 30 minutes and from the second lace is 15 minutes, hence we get a total of 45 minutes.

- ② To determine 15 minutes from one lace only

Short answer:

Always make sure that there are 4 burning ends till the entire lace is fully burnt.

Analysis:

Cut the lace anywhere along its length and ignite all four ends simultaneously. (If cutting is not permissible, then ignite both the ends and anywhere along its length.)

Normally, one piece will burn out earlier than the other. Then again ignite the remaining piece anywhere. Continue this process till the complete lace is fully burnt, always making sure that at any moment, 4 ends are burning.



The Theoretical Physics Seminar

The role of theory in science should be fairly obvious, and yet in my own case it took me a long time to get a real feeling for it, even though I was to devote my whole career to theoretical science. It was only when I entered graduate school at MIT that it finally dawned on me how theoretical physics works.

As an undergraduate at Yale, I had managed to get high grades in science and math courses without always understanding the point of what I was learning. In most cases, it seemed, what was required was merely to regurgitate on examinations what one had been fed in class. My views changed when I attended one of the sessions of the Harvard–MIT theoretical seminar. I had thought of the seminar as some sort of glorified class. In fact, it was not a class at all, but a serious discussion group on subjects in theoretical physics, particularly the physics of atomic nuclei and elementary particles. Professors, post-docs, and graduate students from both institutions attended; one theorist would lecture and then there would be a general discussion of the topic he had presented. I was unable to appreciate such scientific activity properly because my way of thinking was still circumscribed by notions of classes and grades and pleasing the teacher.

Murray Gell-Mann

The Quark and the Jaguar: Adventures in the Simple and the Complex
W H Freeman and Company, New York, 1994, pp.75–76.

