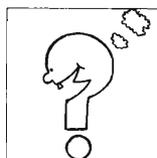


Think It Over



This section of Resonance is meant to raise thought-provoking, interesting, or just plain brain-teasing questions every month, and discuss answers a few months later. Readers are welcome to send in suggestions for such questions, solutions to questions already posed, comments on the solutions discussed in the journal, etc. to Resonance, Indian Academy of Sciences, Bangalore 560 080, with "Think It Over" written on the cover or card to help us sort the correspondence. Due to limitations of space, it may not be possible to use all the material received. However, the coordinators of this section (currently A Sitaram and R Nityananda) will try and select items which best illustrate various ideas and concepts, for inclusion in this section.

1 The Population Explosion

"Is the real population explosion developing in the past?". We all know that the answer is no, so what is wrong with the reasoning?

Each one of us has two parents. Each one of them has two parents. Going back ten generations, we seem to acquire a respectably large number of ancestors, $2^{10} = 1024$. But go back forty generations, only a little more than a thousand years ago and hence well within historical times, and we calculate 2^{40} which is approximately 10^{12} . This number is comfortably more than the current population of the globe! One immediate reaction is that all these people did not live at the same time. But one only needs to go back a few more generations to make the number large enough. Another reaction one hears is that these people did not have only one descendant, but many. While that is true, one can see that by counting the ancestors of just one person, one has if anything underestimated the population at earlier times. The question therefore is, "Is the real population explosion developing in the past?" We all know that the answer is "no", so what is wrong with the reasoning?

2 A Question of Weight.

A large closed box contains air at room temperature and atmospheric pressure, and a bird. The whole box hangs from a spring balance. How is the measured weight of the box affected if the bird

- just sits at the bottom of the box?
- flies?
- stops flying and starts falling downwards?
- falls at the terminal velocity?
- hits the bottom of the box?

What is the effect of (a) having the box open on the sides, with the roof supported by narrow pillars? (b) replacing the bird by a fish and air by water?

3 All About Amino Acids

From J Chandrasekhar and
Uday Maitra

Test your knowledge of amino acids which occur in proteins ('coded amino acids'). Answers can be deduced from the accompanying poster.

- 1 How many of the amino acids are chiral?
- 2 All chiral amino acids have the *L* configuration; however, in the *R/S* nomenclature only one has the *R* configuration. Which one, and why?
- 3 Which amino acids have more than one asymmetric centre?
- 4 What are the two common letter-code systems used to represent amino acid residues?
- 5 What is the ionization form of an amino acid at neutral pH?
- 6 How many amino acids have aliphatic (hydrocarbon) sidechains?
- 7 Which amino acids have basic sidechains?
- 8 Which amino acid sidechains contain a carboxylic acid group?



- 9 Which amino acids have a hydroxyl group in the sidechain?
- 10 Which amino acids contain sulphur in the sidechain?
- 11 Which is the only *imino* acid which occurs in proteins?
- 12 Aromatic groups can be detected by UV absorption. How many amino acids can be detected by UV?
- 13 How many amino acids have ionizable sidechains?
- 14 Which basic sidechain exists predominantly in the unprotonated form at neutral pH?
- 15 Some amino acids occur both in the acid (COOH) and the amide (CONH₂) forms? What are they?
- 16 Hydrophobic amino acids are usually found in the interior of a protein. Which amino acids are hydrophobic (*Hint*: look for non-polar sidechains)?
- 17 Which amino acid sidechains are hydrophilic?
- 18 Disulphide bonds in proteins cross-link two segments. Which amino acid is responsible for this?
- 19 Normally an amide (RCO-NHR') group adopts a *trans* conformation. There is one amino acid which can lead to both *trans* and *cis* peptide bonds (this leads to bends in the peptide chain). Which one?
- 20 Which is the most abundant amino acid in *E. coli* proteins?



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