CHAVES DE RESPOSTA - PRIMEIRA ETAPA

21º PROCESSO DE SELEÇÃO DE CANDIDATOS AO CURSO DE MESTRADO EM QUÍMICA - 2023/2 (2)

In May 1919, an undergraduate chemistry student named Maurice Huggins at the University of California was panicking. His professor William Bray required his students to write a term paper to pass his course, but Huggins had not yet done that, and the deadline was approaching. In desperation, he showed Bray rough notes he had made about some of the 'unsolved problems in chemistry'.

Bray did [accept], but with caveats. 'Huggins,' he said, 'there are several interesting ideas in this paper, but there is one you will never get chemists to believe: the idea that a hydrogen atom can be bonded to two other atoms at the same time.' Huggins had advanced this strange idea using the electron-sharing theory of chemical bonding proposed by Gilbert Lewis, depicting, for example, a dimer of HF in which the four atoms were arranged in a square, with each hydrogen bonded to both fluorines.

As is often the case, younger researchers were more ready to accept new ideas that older scientists resisted. So it was that in 1920 Wendell Latimer published a paper on Lewis theory in which they laid out Huggins' suggestion, crediting him in a footnote. But this weird sort of bonding didn't get a name until Lewis himself, having been won round, wrote in his seminal 1923 book *Valence and the Structure of Atoms and Molecules* that 'the most important addition to my theory of valence lies in the suggestion of what has become known as the hydrogen bond'.

In 1926, British chemist Henry Armstrong ridiculed the idea that hydrogen could act as a 'bigamist'. Instrumental in the acceptance of the hydrogen bond was the intervention of Linus Pauling. In a 1925 paper with his graduate student Sterling Hendricks, he showed how such a bond might explain the ion HF_2^-, with the hydrogen sandwiched between fluorines. Pauling's 1939 book *The Nature of the Chemical Bond* cemented the hydrogen bond as a part of the chemist's lexicon. It was not just Pauling's status that secured the idea, but the fact that he tied it to crystallographic data.

Students typically learn now that a hydrogen bond is essentially electrostatic: a positively polarised hydrogen attached to an electron-withdrawing entity such as oxygen or fluorine is attracted to an electron lone pair on another molecule. But it has been long recognised that there is some covalency in the hydrogen bond too. And while the hydrogen bonds in liquid water are about 25 times weaker than the covalent bonds in H_2O molecules, others – like that in HF_2^- – are stronger and shorter, and generally regarded as delocalised, non-classical three-centre bonds.

Text fragment adapted from
https://www.chemistryworld.com/opinion/when-does-a-hydrogen-bond-become-a-covalent-bond/4012975.article By Phylip Ball, 7 January 2021. (Accessed 14/09/23)

Questionary. In all questions below, choose on option as the correct answer.

1) In the sentence "Students typically learn now that a hydrogen bond is essentially electrostatic…" the word "typically" can be replaced with:
   a) usually
   b) infrequently
   c) rarely
   d) never

2) In the sentence “It was not just Pauling’s status that secured the idea, but the fact that he tied it to crystallographic data.”

The pronoun “he” refers to:
a) idea
b) Pauling
c) status
d) crystallographic

3) In the sentence “His professor William Bray required his students to write a term paper to pass his course…”

The word “required” is better replaced with:
a) presented
b) named
c) asked
d) imagined

4) This text fragment is related to:
a) The magnitude of hydrogen bond
b) The life of Linus Pauling
c) The conception of the idea of hydrogen bond
d) The explanation of covalent bonds in water

5) The idea of hydrogen bonds in “a dimer of HF in which the four atoms were arranged in a square” was proposed by:
a) William Bray
b) Maurice Huggins
c) Gilbert Lewis
d) Linus Pauling

6) The interesting and revolutionary idea in the Huggins’ paper is:
a) The formation of strong covalent bond with hydrogen atom
b) A hydrogen atom bonded to two different atoms
c) The hydrogen bond was stabilized by an electrostatic electron lone pair
d) The energy involved in the hydrogen bond was smaller than that involved in a covalent bond

7) According to the text, ‘In science, and in general, the young researchers …’:
a) are more anxious and do not have enough patience to make discoveries
b) are more creative and can make more discoveries
c) are more open to new and revolutionary ideas
d) hard workers and can make more discoveries.

8) According to the text, the book ‘*The Nature of Chemical Bond*’ published by Linus Pauling was:
a) Fundamental for proving the concept of hydrogen bond was not correct
b) Important for the acceptance of the concept of covalent bond proposed by Gilbert Lewis
c) The decisive work for the acceptance of the concept of hydrogen bond
d) For the proof of the theory of ionic chemical bond