IUPAC Nomenclature of Higher Alkanes – Innovative Mnemonics

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Abstract IUPAC nomenclature of lower alkanes (1C to 10C) is quite common and digestible. But students face problems remembering and predict IUPAC word-root during IUPAC nomenclature of higher alkanes (C >11). Here in this innovative article, I have tried to focus IUPAC nomenclature of higher alkanes (11C to 90C) through the prediction of IUPAC word root by using innovative mnemonics to make the concept unambiguous, simpler, time economic, and interesting.

Keywords: hydrocarbon, word-root, initial number, natural number, even number, odd number, convenient prefixes, convenient format

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1. Introduction

Anatomy of hydrocarbon unit constitutes of carbon and hydrogen. In alkane, bond order is always one. In hydrocarbon, IUPAC nomenclature of alkane should be carried out by counting the total number of carbon atoms present in the longest continuous carbon chain. Alkane is nothing but the conjunction of ‘alk’ and ‘ane’, where ‘alk’ is treated as prefix and ‘ane’ is treated as suffix. Conventional methods [1,2,3,4,5] that have been used to predict IUPAC nomenclature of higher alkanes are limited in number and are arranged for sets of tens over twenty. As per conventional method [1,2] IUPAC word-root for sets of tens over twenty are formed by adding the ending “-conta-” to the name of the corresponding units, with insertion of an "a" for thirty like as 3 tri - 30 triaconta; 4 tetra- 40 tetraconta; 5 penta- 50 pentaconta-, etc. If we want to extend the list by sets of 10, we shall need a specific ending for hundreds and for thousands.

In this present article, IUPAC word-root of higher alkanes (11C – 90C) have been illustrated in detail including intermediate higher alkanes along with alkanes having sets of tens over twenty by innovative way using useful mnemonics. Here, higher alkanes are divided into two series ‘odd’ and ‘even’ based on nature of initial numerical (natural number) present in each series.

In (11C-19C) series, initial numerical ‘1’ falls in ‘odd number’, so, it is treated as ‘odd number series’. Same track should be followed for (31C-39C), (51C-59C), and (71C-79C) series of higher alkanes.

In (21C-29C) series, initial numerical ‘2’ falls in ‘even number’, so, it is treated as ‘even number series’. Same track should be followed for (41C-49C), (61C-69C), and (81C-89C) series of higher alkanes.

2. Methodology

2.1. Classification of Higher Alkanes

First, classify the higher alkanes (11C-19C), (21C-29C), (31C-39C), (41C-49C), (51C-59C), (61C-69C), (71C-79C), (81C-89C) into two series ‘odd number’ and ‘even number’ based on nature of initial numerical (natural number) present in each series.

In (11C-19C) series, initial numerical ‘1’ falls in ‘odd number’, so, it is treated as ‘odd number series’. Same track should be followed for (31C-39C), (51C-59C), and (71C-79C) series of higher alkanes.

In (21C-29C) series, initial numerical ‘2’ falls in ‘even number’, so, it is treated as ‘even number series’. Same track should be followed for (41C-49C), (61C-69C), and (81C-89C) series of higher alkanes.

2.2. Usage of Convenient prefixes Based on Classification of Higher Alkanes

Among higher alkane series, for 1C to 4C convenient prefixes will remain same irrespective of classification of series. For 1C, 2C, 3C, and 4C useful prefixes are ‘un’, ‘bi’, ‘tri’, and ‘tetra’ respectively. But only in case of 12C (2C+10C), useful prefix for 2C is ‘do’ instead of ‘un’.

For higher alkanes suitable prefixes are used based on application of classification of series and it should be started from 5C and carried out up to 9C. For ‘odd no series’ convenient prefix will be ‘alka’ and for ‘even no series’ convenient prefix will be ‘alk’.

2.3. Usage of Convenient format in Writing

IUPAC nomenclature for 10C and 20C will be ‘decane’ and ‘icosane’ respectively where, ‘dec’ and ‘icos’ will be the word-root for 10C and 20C respectively. But for the IUPAC word-root of 30C, 40C, 50C, 60C, 70C, 80C, and
90C convenient format will be ‘alkacont’ irrespective of the classification of higher alkanes. So, for 30C, 40C, 50C, 60C, 70C, 80C, and 90C IUPAC word root will be triacont, tetacont, hexacont, heptacont, octacont, and nonacont respectively.

2.4. Usage of Convenient format of IUPAC Word-root for Intermediate Higher Alkanes other than Alkanes Having Natural Number Multiple of Ten

In the writing IUPAC word-root, convenient format used for higher alkanes (other than alkanes having natural number multiple of ten) based on ‘odd number series’, (15C-19C) will be ‘alkade’ and that for (35C-39C), (55C-59C and (75C-79C) will be ‘alkaalkacont’.

During writing IUPAC word-root, convenient format used for higher alkanes (other than alkanes having natural number multiple of ten) based on ‘even number series’, (25C-29C) will be ‘alkicos’ and that for (45C-49C), (65C-69C), and (85C-89C) will be ‘alkaalkacont’.

For 11C to 14C convenient format will be ‘prefixtriacont’; for 21C to 24C convenient format will be ‘prefixicos’; for 31C to 34C convenient format will be ‘prefixpentacont’; for 41C to 44C convenient format will be ‘prefixtetracont’; for 51C to 54C convenient format will be ‘prefixhexacont’; for 61C to 64C convenient format will be ‘prefixheptacont’; for 71C to 74C convenient format will be ‘prefixheptakont’; and for 81C to 84C convenient format will be ‘prefixoktakont’.

3. Results and Discussion

In phase I, for the classification of ‘odd number’ and ‘even number’ of series, divides the higher alkanes into two parts. During this division, sum up the natural number with 10 (for 11C to 19C) or with multiple of 10 (for 21C to 29C, 31C to 39C, 41C to 49C, 51C to 59C, 61C to 69C, 71C to 79C, 81C-89C) before placing them into suitable IUPAC format to write the appropriate IUPAC word-root.

In phase II, use suitable ‘prefixes’ for the first part of the divided natural number as per the classification of higher alkanes based on ‘odd number’ and ‘even number’ of series except 1C, 2C, 3C and 4C.

By combining phase I with phase II, formulate suitable format and thus we can easily predict IUPAC word-root of higher alkanes (11C to 90C) described in Table 1a, Table 1b, and Table 1c.

IUPAC nomenclature should be achieved by adding ‘ane’ after the word-root like triacontane (triacont + ane) for 30C, tetacontane (tetacont + ane) for 40C, pentacontane (pentacont + ane) for 50C, hexacontane (hexacont + ane) for 60C, heptacontane (heptacont + ane) for 70C, octacontane (octacont + ane) for 80C, and nonacontane (nonacont + ane) for 90C.

Table 1a. IUPAC word-root with IUPAC name of higher alkanes (11C to 40C)

| Carbons in Higher Alkanes | Division Outline | Classification of series (even or odd) w.r.t. initial numerical | Suitable prefix ('alka'-odd & 'alk'-even) | Suitable format | IUPAC word-root | IUPAC Name (word-root + ane) |
|--------------------------|-----------------|---------------------------------------------------------------|--------------------------------------|----------------|----------------|--------------------------------|
| 11C                      | (1C+10C)        | odd (w.r.t. 1)                                                | un                                  | 'prefixdec'   | undec          | undecane                       |
| 12C                      | (2C+10C)        | odd                                                            | do                                  | 'prefixdec'   | dodec          | dodecane                       |
| 13C                      | (3C+10C)        | odd                                                            | tri                                 | 'prefixdec'   | tridec         | tridecane                      |
| 14C                      | (4C+10C)        | odd                                                            | tetra                               | 'prefixdec'   | tetradec       | tetradecane                    |
| 15C                      | (5C+10C)        | odd                                                            | penta (alka)                        | 'alkade'      | pentadec       | pentadecane                    |
| 16C                      | (6C+10C)        | odd                                                            | hexa (alka)                         | 'alkade'      | hexadec        | hexadecane                     |
| 17C                      | (7C+10C)        | odd                                                            | hepta (alka)                        | 'alkade'      | heptadec       | heptadecane                    |
| 18C                      | (8C+10C)        | odd                                                            | octa (alka)                         | 'alkade'      | octadec        | octadecane                     |
| 19C                      | (9C+10C)        | odd                                                            | nona (alka)                         | 'alkade'      | nonadec        | nonadecane                     |
| 20C                      | -               | -                                                              | -                                   | -             | -              | -                               |
| 21C                      | (1C+20C)        | even (w.r.t. 2)                                                | un                                  | 'prefixicos'  | unicos         | unicosane                      |
| 22C                      | (2C+20C)        | even                                                            | bi                                  | 'prefixicos'  | bicos          | bicosane                       |
| 23C                      | (3C+20C)        | even                                                            | tri                                 | 'prefixicos'  | tricos         | tricosane                      |
| 24C                      | (4C+20C)        | even                                                            | tetra                               | 'prefixicos'  | tetraicos       | tetraicosane                   |
| 25C                      | (5C+20C)        | even                                                            | pent (alk)                          | 'alkicos'     | penticos       | penticosane                    |
| 26C                      | (6C+20C)        | even                                                            | hex (alk)                           | 'alkicos'     | hexicos        | hexicosane                     |
| 27C                      | (7C+20C)        | even                                                            | hept (alk)                          | 'alkicos'     | hepticos       | hepticosane                    |
| 28C                      | (8C+20C)        | even                                                            | oct (alk)                           | 'alkicos'     | octicos        | octicosane                     |
| 29C                      | (9C+20C)        | even                                                            | non (alk)                           | 'alkicos'     | nonicos        | nonicosane                     |
| 30C                      | -               | -                                                              | -                                   | -             | -              | -                               |
| 31C                      | (1C+30C)        | odd (w.r.t. 3)                                                 | un                                  | 'prefixtriacont' | uni-triacont | uni-triacontane               |
| 32C                      | (2C+30C)        | odd                                                            | bi                                  | 'prefixtriacont' | bitriacont | bitriacontane                |
| 33C                      | (3C+30C)        | odd                                                            | tri                                 | 'prefixtriacont' | tri-triacont | tri-triacontane               |
| 34C                      | (4C+30C)        | odd                                                            | tetra                               | 'prefixtriacont' | tetra-triacont | tetra-triacontane          |
| 35C                      | (5C+30C)        | odd                                                            | penta (alka)                        | 'alkatriacont' | pentatriacont | pentatriacontane            |
| 36C                      | (6C+30C)        | odd                                                            | hexa (alka)                         | 'alkatriacont' | hexatriacont | hexatriacontane               |
| 37C                      | (7C+30C)        | odd                                                            | hepta (alka)                        | 'alkatriacont' | heptatriacont | heptatriacontane             |
| 38C                      | (8C+30C)        | odd                                                            | octa (alka)                         | 'alkatriacont' | octatriacont | octatriacontane              |
| 39C                      | (9C+30C)        | odd                                                            | nona (alka)                         | 'alkatriacont' | nonatriacont | nonatriacontane              |
| 40C                      | -               | -                                                              | -                                   | -             | -              | -                               |
4. Conclusion

It may be expected that this time economic innovative mnemonics on IUPAC word-root of higher alkanes (11C to 90C) would go a long way to help to the students of organic chemistry at undergraduate, senior undergraduate and post-graduate level who would choose the subject as their career.
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