World Journal of Chemical Education, 2021, Vol. 9, No. 2, 42-45
Available online at http://pubs.sciepub.com/wjce/9/2/1
Published by Science and Education Publishing
DOI:10.12691/wjce-9-2-1

IUPAC Nomenclature of Higher Alkanes – Innovative Mnemonics

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Received February 19, 2021; Revised March 22, 2021; Accepted March 30, 2021

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*

Cite This Article: Arijit Das, "IUPAC Nomenclature of Higher Alkanes – Innovative Mnemonics." *World Journal of Chemical Education*, vol. 9, no. 2 (2021): 42-45. doi: 10.12691/wjce-9-2-1.

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' for which two different prefixes 'alka' and 'alk' should be used, respectively.

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), and (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 Word-root of Higher Alkanes Containing Natural Number Multiple of Ten

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, tetracont, pentacont, 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 'alkadec' 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 'alkalkacont'.

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

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, tetracontane (tetracont + 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)	*'alkadec'*	pentadec	pentadecane
16C	(6C+10C)	odd	hexa (alka)	*'alkadec'*	hexadec	hexadecane
17C	(7C+10C)	odd	hepta (alka)	*'alkadec'*	heptadec	heptadecane
18C	(8C+10C)	odd	octa (alka)	*'alkadec'*	octadec	octadecane
19C	(9C+10C)	odd	nona (alka)	*'alkadec'*	nonadec	nonadecane
20C	-	-	-	-	icos	icosane
21C	(1C+20C)	even (w.r.t. 2)	un	*'prefixicos'*	unicos	unicosane
22C	(2C+20C)	even	bi	*'prefixicos'*	biicos	biicosane
23C	(3C+20C)	even	tri	*'prefixicos'*	triicos	triicosane
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	-	-	-	*'alkacont'*	triacont	triacontane
31C	(1C+30C)	odd (w.r.t. 3)	un	*'prefixtriacont'*	untriacont	untriacontane
32C	(2C+30C)	odd	bi	*'prefixtriacont'*	bitriacont	bitriacontane
33C	(3C+30C)	odd	tri	*'prefixtriacont'*	tritriacont	tritriacontane
34C	(4C+30C)	odd	tetra	*'prefixtriacont'*	tetratriacont	tetratriacontane
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	-	-	-	*'alkacont'*	tetracont	tetracontane

Table 1b. IUPAC word-root with IUPAC name of higher alkanes (41C to 70C)

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)
41C	(1C+40C)	even (w.r.t.4)	un	*‘prefixtetracont’*	untetracont	untetracontane
42C	(2C+40C)	even	bi	*‘prefixtetracont’*	bitetracont	bitetracontane
43C	(3C+40C)	even	tri	*‘prefixtetracont’*	tritetracont	tritetracontane
44C	(4C+40C)	even	tetra	*‘prefixtetracont’*	tetratetracont	tetratetracontane
45C	(5C+40C)	even	pent (alk)	*‘alkalkacont’*	penttetracont	penttetracontane
46C	(6C+40C)	even	hex (alk)	*‘alkalkacont’*	hextetracont	hextetracontane
47C	(7C+40C)	even	hept (alk)	*‘alkalkacont’*	heptetracont	heptetracontane
48C	(8C+40C)	even	oct (alk)	*‘alkalkacont’*	octtetracont	octtetracontane
49C	(9C+40C)	even	non (alk)	*‘alkalkacont’*	nontetracont	nontetracontane
50C	-	-	-	*‘alkacont’*	pentacont	pentacontane
51C	(1C+50C)	odd (w.r.t. 5)	un	*‘prefixpentacont’*	unpentacont	unpentacontane
52C	(2C+50C)	odd	bi	*‘prefixpentacont’*	bipentacont	bipentacontane
53C	(3C+50C)	odd	tri	*‘prefixpentacont’*	tripentacont	tripentacontane
54C	(4C+50C)	odd	tetra	*‘prefixpentacont’*	tetrapentacont	tetrapentacontane
55C	(5C+50C)	odd	penta (alka)	*‘alkaalkacont’*	pentapentacont	pentapentacontane
56C	(6C+50C)	odd	hexa (alka)	*‘alkaalkacont’*	hexapentacont	hexapentacontane
57C	(7C+50C)	odd	hepta (alka)	*‘alkaalkacont’*	heptapentacont	heptapentacontane
58C	(8C+50C)	odd	octa (alka)	*‘alkaalkacont’*	octapentacont	octapentacontane
59C	(9C+50C)	odd	nona (alka)	*‘alkaalkacont’*	nonapentacont	nonapentacontane
60C	-	-	-	*‘alkacont’*	hexacont	hexacontane
61C	(1C+60C)	even (w.r.t. 6)	un	*‘prefixhexacont’*	unhexacont	unhexacontane
62C	(2C+60C)	even	bi	*‘prefixhexacont’*	bihexacont	bihexacontane
63C	(3C+60C)	even	tri	*‘prefixhexacont’*	trihexacont	trihexacontane
64C	(4C+60C)	even	tetra	*‘prefixhexacont’*	tetrahexacont	tetrahexacontane
65C	(5C+60C)	even	pent (alk)	*‘alkalkacont’*	penthexacont	penthexacontane
66C	(6C+60C)	even	hex (alk)	*‘alkalkacont’*	hexhexacont	hexhexacontane
67C	(7C+60C)	even	hept (alk)	*‘alkalkacont’*	hepthexacont	hepthexacontane
68C	(8C+60C)	even	oct (alk)	*‘alkalkacont’*	octhexacont	octhexacontane
69C	(9C+60C)	even	non (alk)	*‘alkalkacont’*	nonhexacont	nonhexacontane
70C	-	-	-	*‘alkacont’*	heptacont	heptacontane

Table 1c. IUPAC word-root with IUPAC name of higher alkanes (71C to 90C)

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)
71C	(1C+40C)	odd (w.r.t. 7)	un	*‘prefixheptacont’*	unheptacont	unheptacontane
72C	(2C+40C)	odd	bi	*‘prefixheptacont’*	biheptacont	biheptacontane
73C	(3C+40C)	odd	tri	*‘prefixheptacont’*	triheptacont	triheptacontane
74C	(4C+40C)	odd	tetra	*‘prefixheptacont’*	tetraheptacont	tetraheptacontane
75C	(5C+40C)	odd	penta (alka)	*‘alkaalkacont’*	pentaheptacont	pentaheptacontane
76C	(6C+40C)	odd	hexa (alka)	*‘alkaalkacont’*	hexatheptacont	hexatheptacontane
77C	(7C+40C)	odd	hepta (alka)	*‘alkaalkacont’*	heptaheptacont	heptaheptacontane
78C	(8C+40C)	odd	octa (alka)	*‘alkaalkacont’*	octaheptacont	octaheptacontane
79C	(9C+40C)	odd	nona (alka)	*‘alkaalkacont’*	nonaheptacont	nonaheptacontane
80C	-	-	-	*‘alkacont’*	octacont	octacontane
81C	(1C+80C)	even (w.r.t. 8)	un	*‘prefixoctacont’*	unoctacont	unoctacontane
82C	(2C+80C)	even	bi	*‘prefixoctacont’*	bioctacont	bioctacontane
83C	(3C+80C)	even	tri	*‘prefixoctacont’*	trioctacont	trioctacontane
84C	(4C+80C)	even	tetra	*‘prefixoctacont’*	tetraoctacont	tetraoctacontane
85C	(5C+80C)	even	pent (alk)	*‘alkalkacont’*	pentoctacont	pentoctacontane
86C	(6C+80C)	even	hex (alk)	*‘alkalkacont’*	hexoctacont	hexoctacontane
87C	(7C+80C)	even	hept (alk)	*‘alkalkacont’*	heptoctacont	heptoctacontane
88C	(8C+80C)	even	oct (alk)	*‘alkalkacont’*	octoctacont	octoctacontane
89C	(9C+80C)	even	non (alk)	*‘alkalkacont’*	nonoctacont	nonoctacontane
90C	-	-	-	*‘alkacont’*	nonacont	nonacontane

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.

Acknowledgements

I give my special accolade to Dr. Ajoy Das, Department of Mathematics, Bir Bikram Memorial College; Dr. Abhijit Bhattacharya, Department of Chemistry, Bir Bikram Memorial College; and Dr. Sayan Chaudhury, Department of English, Bir Bikram Memorial College for their most valuable support and sustaining mentality to prepare the manuscript.

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