

# Six-pin Bowling and a Proposal for New Nomenclature for Numbers in Other Bases

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I have had the opportunity, of late, to ponder the intricacies and inconsistencies of the nomenclature for numbers in bases other than ten. You see, I have two children who love to bowl. Every week they go with their mother and grand mother to a bowling league. Mom and Gramma bowl on the league. At the end, the kids get to bowl a few frames. Back at home we have a set of toy pins and ball. So, when I come home from school my two-year old meets me at the door and says, "Daddy, me want to bowl. Me knock 'm down, you stand 'm back up." How can you say "no" to that? So I gently correct his grammar, sit myself down and become a human pin-setter. He knocks 'm down, I stand 'm back up, all six of them.

For whatever reason toy bowling sets come with only six pins. So as I sit there for hours setting pins up six at a time, I get thinking about how you might score a game of six-pin bowling. With ten pins you have ten frames per game. So, perhaps with six pins you should have six frames. And maybe, just for fun, we should keep score in base six. This turns out to be the perfect way to score. We will look at a few examples game later but first we need a good way to talk about numbers in base six.

## Nomenclature for numbers in other bases

From the day I started learning about other bases it has bothered me when I hear someone count in base six like this, "one, two, three, four, five, ten." They do this because they are looking at the numerals "1, 2, 3, 4, 5, 10." To me the word "ten" has a meaning. It is the mode of the number fingers on a pair of human hands. In base six, I propose that we use the word "six" for the numerals "10." The following discussion usually follows when I make this proposition.

They say, "But there is no 'six' in base six."

So I say, "Then there should be no 'ten' in base ten."

But then, they say, "But 'ten' means one of the base."

To which I say, "Well, if I can't use the word 'six' then instead of saying 'base six' I would have to say 'base ten,' where this 'ten' means one more than five, not one more than nine. In fact I would never be able to tell what base I was in because I would always have to say 'base ten.'"

They say, "Oh, you are just trying to make things confusing."

In fact, I'm trying to make things less confusing. The confusion comes from the distinction between the word 'six' and the numeral 6. The statement "but there is no 'six' in base six," should be "but there is no 6 in base six." When we look at base ten we have the word "ten" but we do not have a single numeral that represents ten.

So here is my proposition: In base six we should use the word "six" for the numerals "10." Then we could coin some descriptive words for bigger powers of six. For "100" we could use "sixsquare." Then for "1000" we could use "sixcube." The table bellow compares base six nomenclature with base ten nomenclature.

Numerals	Name in base ten	Name in base 6
1	One	One
10	Ten	Six
20	Twenty	Two six
30	Thirty	Three six
100	One hundred	One sixsquare
200	Two hundred	Two sixsquare
300	Three hundred	Three sixsquare
1000	One thousand	One sixcube
2000	Two thousand	Two sixcube
3000	Three thousand	Three sixcube
10,000	Ten thousand	Six sixcube
100,000	One hundred thousand	One sixsquare sixcube
1,000,000	One million	One sixmil
10,000,000	Ten million	Six sixmil
100,000,000	One hundred million	One Sixsquare sixmil
1,000,000,000	One billion	One sixbil

So the base six number 2341 would be "two sixcube three sixsquare four six one." In comparison, the base ten number 2341 is "two thousand three hundred forty one." We could use similar nomenclature in any base. For instance, the base five number 2341 is "two fivecube three fivesquare four five one." In this way we can talk about numbers in any base and not get confused by the meaning of the word "ten." It will always mean the number of fingers that I have on my hands. Now that we have a consistent nomenclature for numbers in other bases, lets go bowling.

## Six-Pin Bowling

Mom and Gramma take the two kids to the bowling alley. The adults will bowl regular ten-pin games. The kids will bowl six-pin games. Here are the rules.

Adult Rules: In ten-pin bowling there are ten pins set in each of ten frames, with all scores kept in base ten.

Kid Rules: In six-pin bowling there are six pins set in each of six frames, with all scores kept in base six.

It is easy to see how we could generalize to n-pin bowling. If we write the rules using numerals then they are the same in any base.

Any Base Rule: In 10-pin bowling there are 10 pins set in each of 10 frames, with all scores kept in base 10. (Remember that “10” stands for one of the base.)

In order to illustrate the nomenclature I will use base ten words and numerals for the adult scores and base six words and numerals for all kids scores. Notice that for each person there are 10 pins per frame. “Ten” for the adults, “six” for the kids.

Here are four games where Mom, Gramma, Kirsten, and Willie play a round-robin tournament. Dad keeps score. Papa watches, not quite sure why Dad gets so excited about this.

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Game 1

	1		2		3		4		5		6		7		8		9		10	
	--	9	1	8	2	7	3	6	4	5	5	4	6	3	7	2	8	1	9	-
Mom	9		18		27		36		45		54		63		72		81		90	

Frame	1		2		3		4		5		10	
	--	5	1	4	2	3	3	2	4	1	5	--
Kirsten	5		14		23		32		41		50	

In game 1, Mom and Kirsten have similar games. In each frame one pin is left standing. Mom knocks down ninety pins. Kirsten knocks down five six pins (thirty, if you insist on converting to base ten.) Who wins? Mom knocked down more pins but she had more chances. Notice that each bowler is 10 pins short of 100. That is, Mom is ten (10) pins short of one hundred (100), and Kirsten is six (10) pins short of one sixsquare (100). TIE GAME.

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**Game 2**

	1	2	3	4	5	6	7	8	9	10
	1 /	1 /	1 /	1 /	1 /	1 /	1 /	1 /	1 /	1 / 1
Gram	11	22	33	44	55	66	77	88	99	110

	1	2	3	4	5	10
	1 /	1 /	1 /	1 /	1 /	1 / 1
Willie	11	22	33	44	55	110

Game 2 pits Gramma against Willie. Here, the first ball in each frame knocks down one pin. Then the remaining pins are knocked down on the second ball to pick up the spare. So each frame gets 11 points. That is Gramma gets eleven (11) pins per frame, and Willie gets one six one (11) pins per frame. Each ends with 10 more than 100. TIE GAME.

**Game 3**

	1	2	3	4	5	6	7	8	9	10
	9 /	9 /	9 /	9 /	9 /	9 /	9 /	9 /	9 /	9 / 9
Gram	19	38	57	76	95	114	133	152	171	190

Frame	1	2	3	4	5	10
	5 /	5 /	5 /	5 /	5 /	5 / 5
Kirsten	15	34	53	112	131	150

In game 3 we see Gramma and Kirsten with some improved bowling. In each frame the first ball knocks down all but one pin. The second ball knocks down the remaining pin to pick up the spare. Gramma gets 19 per frame Kirsten gets 15 per round. For either bowler this is one pin short of 20 per frame, and the final scores are each 10 pins short of 200. TIE GAME.

**Game 4**

	1	2	3	4	5	6	7	8	9	10
	X	X	X	X	X	X	X	X	X	X X X
Mom	30	60	90	120	150	180	210	240	270	300

	1	2	3	4	5	10
	X	X	X	X	X	X X X
Willie	30	100	130	200	230	300

WOW! Game 4 shows Mom and Willie both throw perfect games. Mom gets thirty (30) pins per frame and Willie gets three six (30) pins per frame. Each bowler gets a 300. TIE GAME.

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Now that we have done ten-pin and six-pin bowling why not do three pin bowling? Or fifteen-pin bowling? For that matter why not use any triangular number? Included below are four fifteen-pin games that are similar to Games 1 through 4 above.

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	10
	-   E   1   D	2   C	3   B	4   A	5   9	6   8	7   7	8   6	9   5	A   4	B   3	C   2	D   1	E   -	
	E	1D	2C	3B	4A	59	68	77	86	95	A4	B3	C2	D1	E0
	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /	1   /
	11	22	33	44	55	66	77	88	99	AA	BB	CC	DD	EE	110
	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /	E   /
	1E	3D	5C	7B	9A	B9	D8	107	126	145	164	183	1A2	1C1	1E0
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X   X   X
	30	60	90	C0	100	130	160	190	1C0	200	230	260	290	2C0	300

Perhaps this is not of great importance to the world. Then again maybe it could be used for a new handicapping system. But at least it makes for a fun activity involving calculations in other bases.