*Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, technical proofs (TP), and all of my past articles can be accessed and viewed online at **billiards.colostate.edu**. The reference numbers used in the articles help you locate the resources on the website.*

Pool is fascinating, especially to an engineer-type like me who sees beauty in the math and physics of the game. There are many interesting facts, principles, and “rules of thumb” of pool that can be expressed as simple numbers. In this article, I summarize in numerical order some of the most interesting “pool by numbers” wonders.

0.0003 sec

Three ten-thousandth of a second (which is a tiny amount of time) is the typical duration over which pool balls stay in contact when they collide, for a wide range of shot speeds. For more information, and demonstrations, see the “contact time” resource page under “balls” in the FAQ section at ***billiards.colostate.edu***. Pool balls do not compress very much and do not stay in contact very long, even with fast-speed shots.

0.001 sec

One thousandth of a second is the average length of time a cue tip stays in contact with the cue ball (CB) during a hit. A slow-speed shot with a soft tip has a longer contact time (about 0.002 sec), but this is still extremely small. A very hard tip (for example, phenolic) at fast speed has a shorter contact time (about 0.0005 sec). People who think they can apply action to the CB while the tip is in contact with the CB are flat wrong. The action of the shot depends only on the cue speed, tip contact point, cue direction, and cue elevation angle at impact. There is nothing you can do while the tip is in contact with the CB that can change the outcome of the shot. Only what you do before contact makes any real difference. For more information, and further explanations, see “contact time” under “cue tip” in the FAQ section at ***billiards.colostate.edu***.

3x

For a fairly full hit, with a ball-hit-fraction greater than 3/4, the CB will deflect about three-times the cut angle. This principle is illustrated in **Diagram 1**. The cut angle of the shot is “A,” and the resulting angle between the initial and final CB directions is “3A.” For more information, see the “where the CB goes for different types of shots” resource page under “cue ball control” in the FAQ section at ***billiards.colostate.edu***.

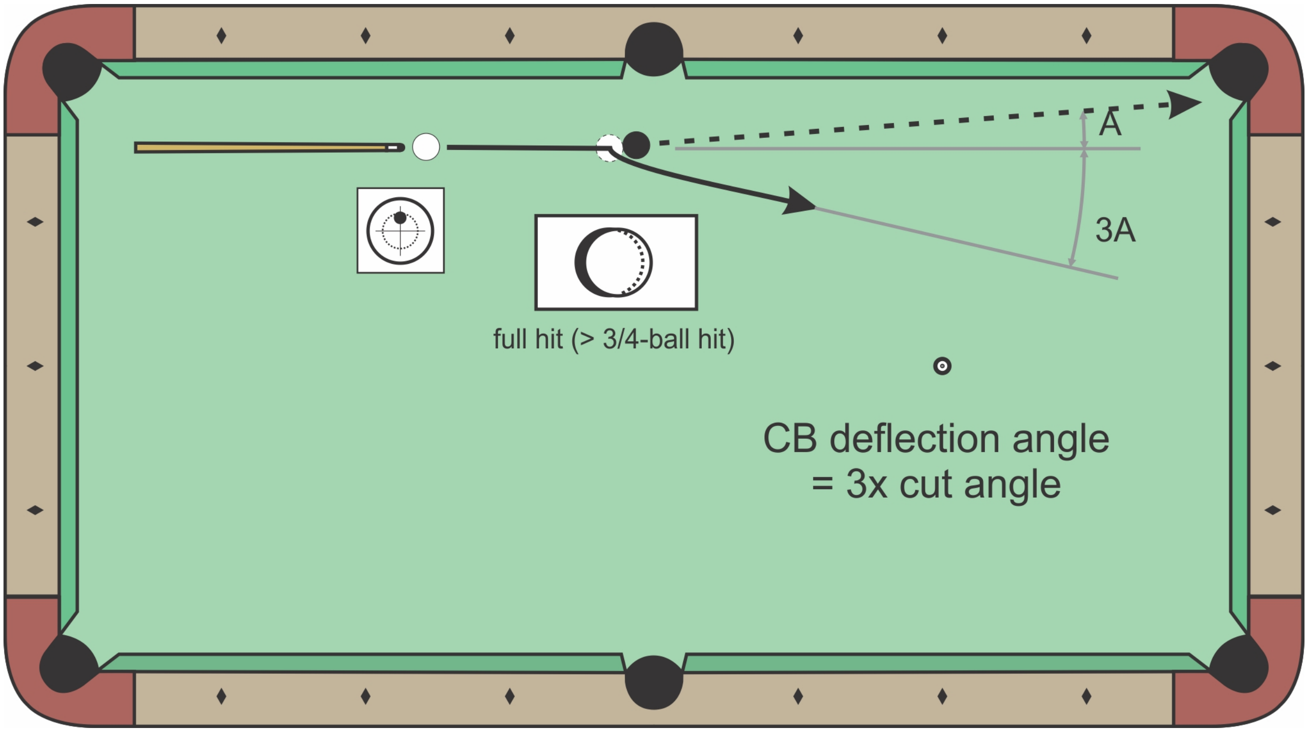

Diagram 1 Full-hit rolling CB deflection angle

For a good action draw shot with a cut angle smaller than about 40º (in other words, a ball-hit fraction greater than about 3/8), the total angle between the original and final CB directions will be three-times the cut angle of the shot. This principle is called the "trisect system" and is illustrated in **Diagram 2**. For more information and demonstrations, see **NV B.67** and the "trisect aiming system" resource page under "draw" in the FAQ section at ***billiards.colostate.edu***.

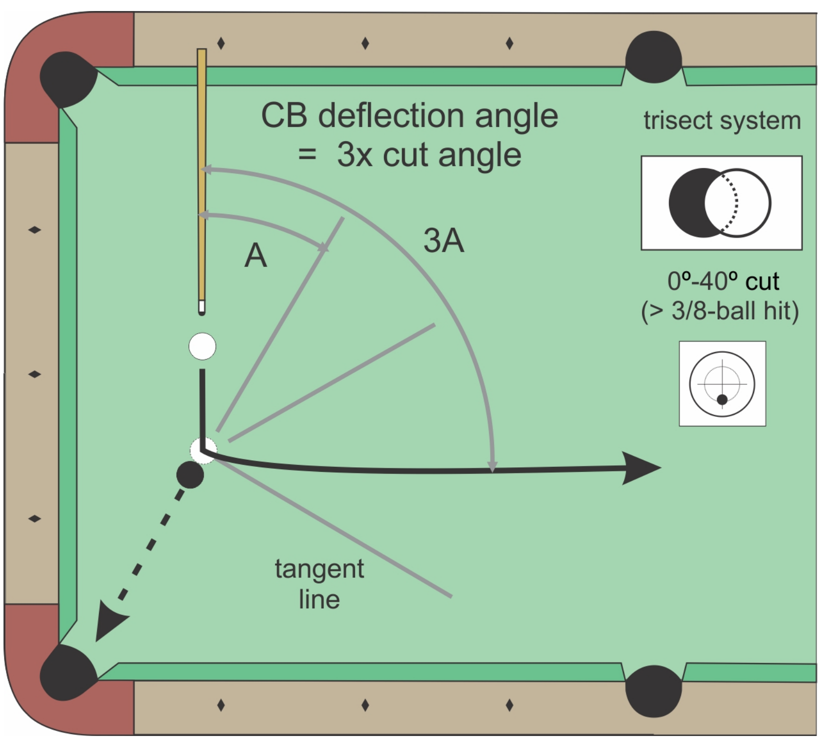

Diagram 2 Trisect system

7-8x

If a rolling CB hits an object ball (OB) squarely, the OB will travel about 7 to 8 times farther than the CB after impact (assuming the OB doesn't hit a cushion). This rule is useful when trying to visualize how far the CB might roll forward based on the speed you intend to hit the OB (for example, a pocket-speed shot, where it is easy to visualize the OB travel distance). For more information, see "ball speeds and travel distances" under "speed control" in the FAQ section at ***billiards.colostate.edu***.

25-30 mph

25-30 miles per hour (11-13 meters per second) is the typical speed range for very good power break. The best power breakers in the world can approach 35 mph, but this is very unusual (and difficult to control). For more information, see "typical speeds for a range of shots" under "speed control" in the FAQ section at ***billiards.colostate.edu***.

30º

The 30º rule states that for a rolling-CB shot, over a wide range of cut angles between a 1/4-ball and 3/4-ball hit, the CB will deflect by very close to 30° from its original direction after hitting the OB. I consider the 30º rule the most useful and important principle of pool, and it is the topic for which I have written the most articles over my many years as a *Billiards Digest* columnist. **Diagram 3** shows how the CB deflection angle is very close to the natural angle (about 30º) over a wide range of shots. For more information and demonstrations, see **NV B.66** and the "30-degree rule" resource page in the FAQ section at ***billiards.colostate.edu***.

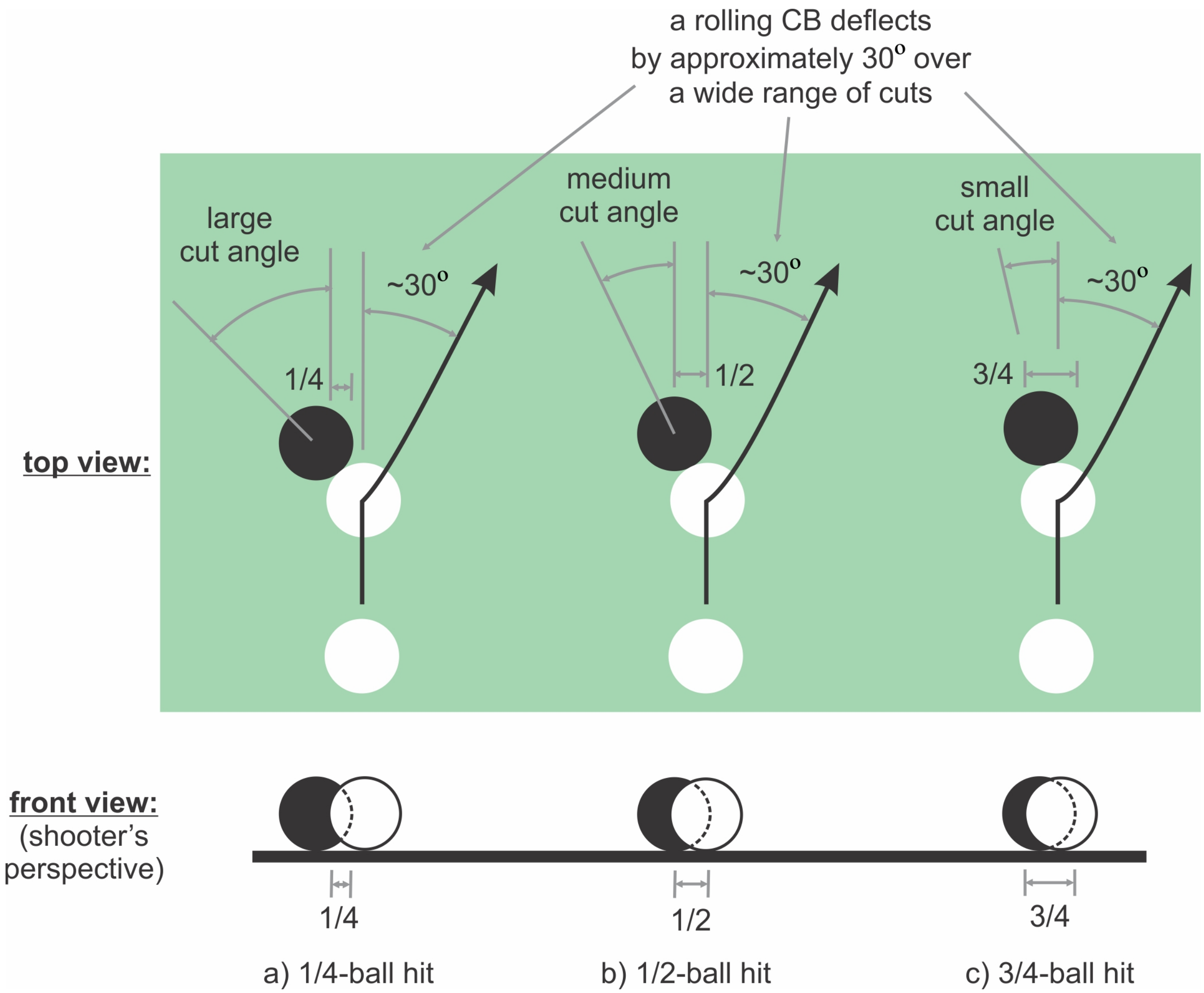

Diagram 3 30º rule

45º

The 45º rule states that if the CB rolls into the short rail (fairly close to the center of the rail) at close to a 45º angle, it will head off two rails toward the center of the table. This principle, illustrated by the shot in **Diagram 4**, is very useful when trying to get center-table shape and when needing to go around the table for position (especially in rotation games like 9-ball and 10-ball). As shown by the gray lines parallel to the CB tangent line in the diagram, it is easy to visualize the 45º direction by connecting diamonds equal distances from the pocket. For more information and demonstrations, see **NV B.74** and the "45-degree rule for center-table position and routes" resource page under "cue ball control" in the FAQ section at ***billiards.colostate.edu***.

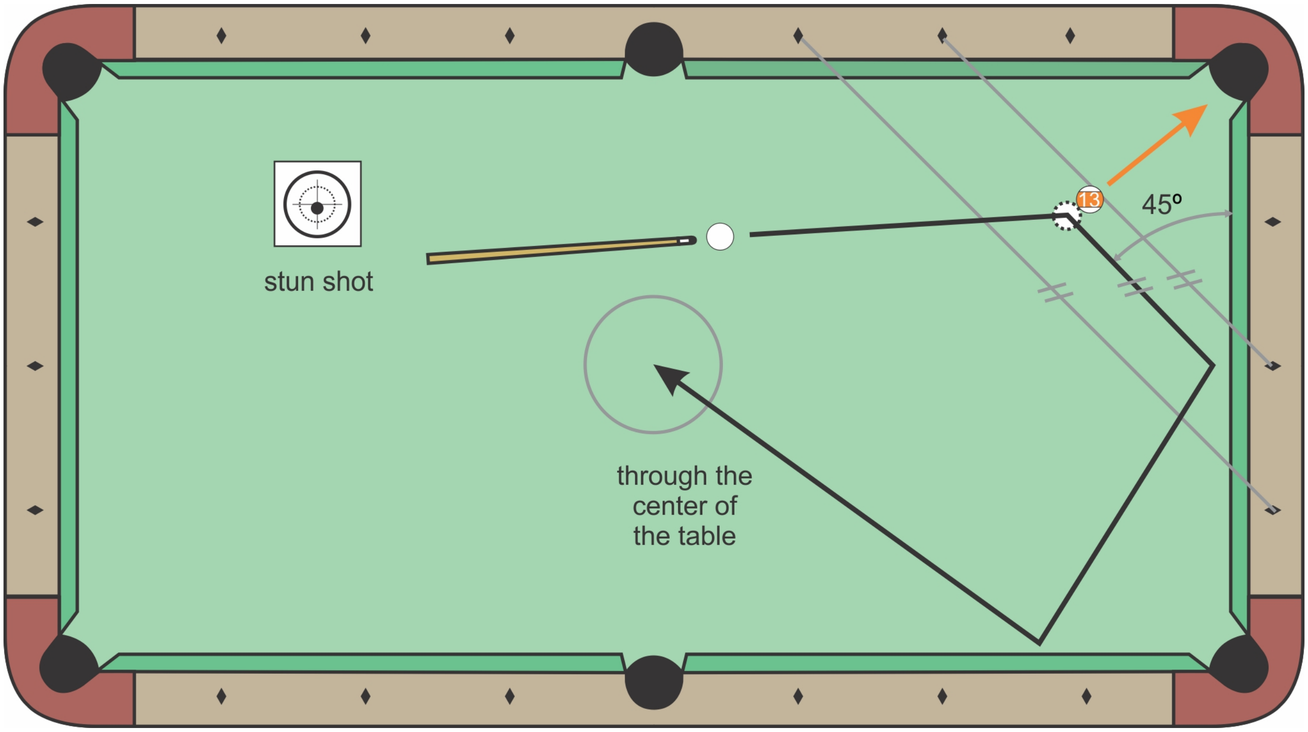

Diagram 4 45º rule

90º

The 90º rule states that for a stun shot, where the CB has no top or bottom spin at impact with the OB, the CB and OB separate at 90º, regardless of the cut angle (except for a straight-in shot, in which case the CB stops in place). In other words, with a stun shot, the CB heads and persists along the tangent line direction, which is perpendicular to the line of centers (the line between the center of the ghost ball position and the OB). For more information and demonstrations, see the "90 degree rule" resource page in the FAQ section at ***billiards.colostate.edu***.

1700 lb (7600 N)

The peak force between the cue tip and CB during a fast-speed power break can reach and exceed 1700 pounds (7600 Newtons). For those with a math/physics education and an interest to learn more, the derivation can be found in **TP B.20**.

10,000 hr

An anecdotal "rule" usually attributed to writer Malcolm Gladwell states that 10,000 hours of "deliberate practice" are required to become "world class" in any field. Obviously, there are exceptions to this "rule." For example, in pool, some people can achieve excellence with well less than 10,000 hours of practice (due to tremendous "natural ability"), and some (with poorer vision, less physical coordination and control, less competitive drive, and less ability to stay focused) can never become "world class" regardless of how much they practice. For more information, see the "what it takes to play like a pro" resource page under "advice" in the FAQ section at ***billiards.colostate.edu***.

I hope you enjoyed my numerical summary of some of pool's amazing wonders. This was Dr. Dave's article number **1** in the year **2017**.

Good luck with your game,
Dr. Dave

normal video

NV B.66 – The 30-degree rule, from VEPS I
NV B.67 – The trisect system for draw shots, from VEPS I
NV B.74 – Center-of-table position and routes, with the 45-degree rule, from VEPS II

technical proof

TP B.20 – Peak forces during a break shot

PS:

- I know other authors and I tend to use lots of terminology, and I know not all readers are totally familiar with these terms. If you ever come across a word or phrase you don't fully understand, please refer to the online glossary at ***billiards.colostate.edu***.

Dr. Dave is author of "The Illustrated Principles of Pool and Billiards" book and DVD, and co-author of the Video Encyclopedias of "Pool Shots (VEPS)," "Pool Practice (VEPP)," and "Eight Ball (VEEB)," and the "How to Aim Pool Shots (HAPS)" and "Billiard University (BU)" instructional DVD series, all available at: ***dr-dave-billiards.com****.*