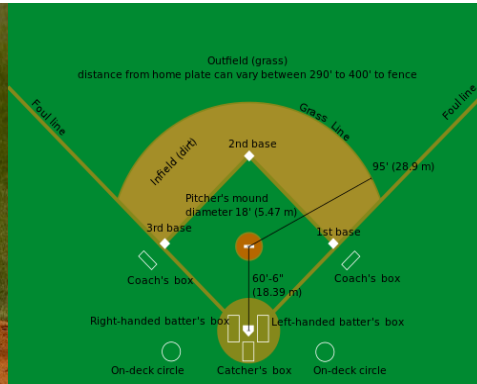


KINEMATICS

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Austin Tx. 78701 , jpcise@austincc.edu & New York Times , Oct. 29, 2016 by Tyler Kepner , Dedicated to authors Marist HS baseball coach.

Unhittable? Aroldis Chapman and His 105-M.P.H. Fastball



INTRODUCTION: If the batter decides to swing, he must start when the ball is approximately 25 to 35 feet in front of the plate. For this application we will use 35 ft. before home plate. Balls thrown from pitchers mound slow down about 10 mph due to friction. Thus, the thrown 102 mph ball we will make 92 mph prior to home plate. The 92 mph slower thrown ball we will consider moving at 82 mph.

Chicago Cubs closer Aroldis Chapman is the only pitcher to throw as hard as 104 m.p.h. in the 2016 season — which he did 26 times, peaking at 105.1.

During the entire middle portion of the pitch, the batter must time the ball and decide where to swing. If the batter decides to swing, he must start when the ball is approximately 25 to 35 feet in front of the plate. The ball will arrive at the plate about 250 thousandths of a second later -- about the limit of human reaction time.

The bat must make contact with the ball within an even smaller time range: A few thousandths of a second error in timing will result in a foul ball. Position is important, too. Hitting the ball only a few millimeters too high or too low results in a fly ball or a grounder. Exactly how humans are able to estimate the expected position of a quickly moving ball is unknown. Obviously, this remarkable skill is learned through long practice over and over: even so, the batter misses most of the time.

INTRODUCTION (CONTINUED): Our goal here is to show "The difference between a 102-mile-an-hour fastball and a 92-mile-an-hour fastball, in reaction time, is four and a half feet."

QUESTIONS: (a) Convert 92 mph and 82 mph to ft./s. ? These are the speeds of 102 & 92 mph fastballs slowed down by air friction near home plate., (b) Find time for fast 92 mph fastball to cover the last 35 ft. to Homeplate? (c) Find time for slower 82 mph fastball to cover the last 35 ft. to Homeplate?, (d) Find the time differential $\Delta t = t_s - t_f$ comparing time 92 mph fastball to cover last 35 ft. vs. the 82 mph Fastball to cover the same last 35 ft.?, (e) Find distance covered by the 92 mph fastball for the time differential Δt between slower 82 mph fastball vs the faster 92 mph fastball to cover the same last 35 ft.?, (f) Comment on article stated reaction distance ΔX of 4.5 ft.(see below) vs computed value for ΔX in (e)?

HINTS: 88 ft./s. = 60 mph, $X = v t$.

ANSWERS: (a) $V_{FAST} = 134.933$ ft./s., $V_{SLOW} = 120.26$ ft./s., (b) $t_f = 0.25939$ s. , (c) $t_s = 0.291036$ s., (d) $\Delta t = 0.031646$ s. (e) $\Delta X = \sim 4.27$ ft.. (f) Computed 4.27 ft. reaction distance is quite close to stated 4.5 ft reaction distance between 92 vs 82 mph thrown balls.

CHICAGO — Aroldis Chapman threw 13 pitches in h. Eye-brain-body coordination is acquired only by going through the motions is World Series debut on Wednesday in Cleveland. The fastest was clocked at 102.5 miles per hour by Major League Baseball's Statcast radar gun. The batter, Coco Crisp of the Indians, put it in play. If anyone could do it, it would seemingly be Chapman, the only pitcher to throw as hard as 104 m.p.h. this season — which he did 26 times, peaking at 105.1. Of his 26 pitches in the regular season that reached at least 104 m.p.h., just one was a swinging strike. Eleven were balls, 10 were fouled off, two were called strikes, and two were put in play — one for a single by Pittsburgh's Francisco Cervelli and the other for a groundout by Baltimore's Ryan Flaherty, who said there was no way to prepare for a pitch that fast.

A well-located fastball remains the best pitch in the majors — but the modifier is important. A pitcher who can spot his fastball can get ahead in the count and bait hitters with pitches off the plate, where it is much harder for them to do damage. No pitcher can rely on velocity alone, a statement widely accepted as fact but still rather astounding. "The difference between a 102-mile-an-hour fastball and a 92-mile-an-hour fastball, in reaction time, is four and a half feet," said Ty Van Burkleo, the Indians' hitting coach. "That's a lot. It's unbelievable, because physiologically, the eyes can't physically track the ball. You get an image in your mind that you think you see it the whole way, but the brain maps it for you."