ANGULAR: INERTIA, TORQUE,WORK,ENERGY

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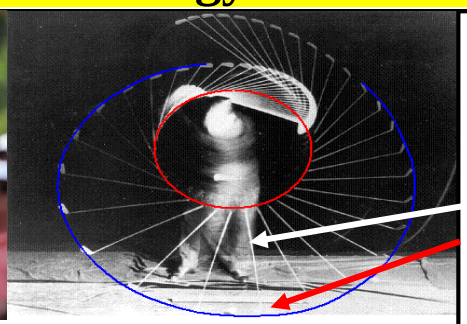
For a Golf Tinkerer, a Strategy Just Crazy Enough to Work



Bryson DeChambeau at the Arnold Palmer Invitational last month.
All of his irons and wedges are made with 6-iron shafts.

INTRODUCTION: Bryson, **Pro Golfer and Student of Physics at SMU wants all his club faces have the same speed when they hit the golf balls.To achieve uniform $V_{CLUB\ FACE}$ = constant he has made all his club((shafts 37.5 inches in length)) and all Iron club heads the same mass 280 grams Having the same club mass and speed assures the golf balls hit will always leave the club head at the same speed. Using momentum and kinetic energy concepts same speed exists**

AUGUSTA, Ga. — How to improve one's game? It is the eternal question for golfers, as predictable as their next shank. When planted in Bryson DeChambeau's fertile mind, the query flourished like the grape vines climbing vines from the rich soil of the San Joaquin Valley in California, where he grew into one of the world's top amateurs.

DeChambeau's search for answers led him to experiment as a teenager with **a three-quarters swing** and a putting style that involved bracing his forearm against his right thigh and making the stroke with a flick of his wrist. His native curiosity, nourished by his longtime instructor, Mike Schy, caused him to consider a one-plane swing, in which a player maintains the same angle to the ground (or base) throughout the swing. Taking apart his irons as if they were Lego toys, DeChambeau pieced them back together in a novel way with the help of the custom clubmaker David Edel. Their tinkering led to the biggest innovation in clubs since woods became metal. DeChambeau, a 22-year-old amateur from Clovis, Calif., will play in his first Masters this week **using a set of irons and wedges that are all the same length and weight. The clubs, built with 6-iron shafts, measure 37 ½ inches and have a head weight of 280 grams.** "It's pretty simple," said DeChambeau, who offered an explanation befitting someone who **majored in physics at Southern Methodist.** "I knew **that F equals MA, mass and acceleration," he said, using "F" to represent force.** "Those two can be exchanged in relatively equal terms when swung at a relatively low velocity, like compared to other things in this world." Schy(his coach)was a disciple of "The Golfing Machine," a 1969 instructional book that reads like an engineering manual. It was written by a Seattle aircraft mechanic, Homer Kelley, in language that read like poetry to DeChambeau, who digested it when he was 15. The book answered his core question: What could he do to make it easier to play the game? DeChambeau approached Schy with a idea, inspired by Kelley, of a **single-plane swing. There was one problem: His posture changed with the different-length clubs. He asked Schy if they could make a set of irons and wedges of equal length. It took two weeks to fashion new clubs.** "I took a set and messed it up, made all the clubs the same length.

HYBRID, IRON & WEDGE CHART

Number	Weight	Men's Graphite	Men's Steel	Ladies Graphite
Hybrid	216g	41.5"	41"	40.5"
Hybrid	223g	41"	40.5"	40"
1-iron	229g	40.5"	40"	39.5"
2-iron	236g	40"	39.5"	39"
3-iron	243g	39.5"	39"	38.5"
4-iron	250g	39"	38.5"	38"
5-iron	257g	38.5"	38"	37.5"
6-iron	264g	38"	37.5"	37"
7-iron	271g	37.5"	37"	36.5"
8-iron	278g	37"	36.5"	36"
9-iron	285g	36.5"	36"	35.5"
Wedges	291+g	36"	35.5"	35"

QUESTIONS: **(a) Convert 37.5 inch to meters? (b) Find moment of inertia of the 280 gram club head at end of shaft?, (c) Iron Club shafts normally hit golf balls at 90 mph. Convert 90 mph to m./s.? (d) Find angular kinetic energy of 280 gm. Club head as it hits ball at 90 mph? HINT: $K = \frac{1}{2} I \omega^2 = \frac{1}{2} (m r^2) (v^2/r^2)$ since $v = r \omega$ (e)Find work Bryson needs to do to achieve that amount of K in(d)? (f) Article mentions Bryson hits balls after a ¾ swing: $\Theta = 1.5 \pi$. Find torque T Bryson needs to produce in his wrists to achieve K?**

MORE HINTS: $I_{POINT\ MASS} = m r^2$ **, 0.0254 m./inch, 0.44704 m./s. =mph** $W = \Delta K + \Delta U$, $W_{ANGULAR} = T \Theta$

ANSWERS: **(a) 0.9525 m. , (b) 0.254 kg. m.^{2} , (c) 40.23 m./s. (d) K = ~ 226.62 N. m. , (e) Work = ~ 226.62 Nm , (f) T = ~ 48.1 Nm**
EXTRAS: **Using momentum & energy conservation for elastic collisions show 90 mph hit ball (46 gm.) produces ball speeds of 154 mph =1.71 V_o**