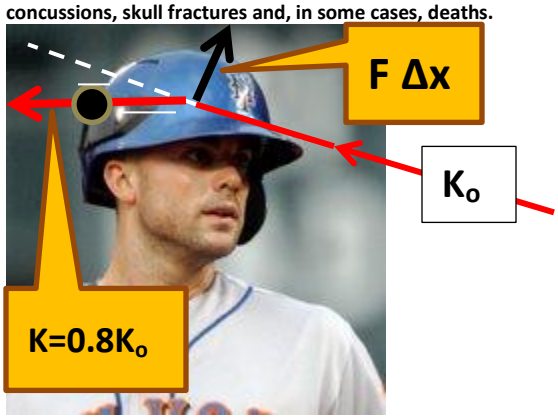
ENERGY-WORK

Units 10 & 11 Dr. John P. Cise, Professor of Physics, Austin Community College, 1212 Rio Grande St., Austin Tx 78701 jpcise@austincc.edu & NYTimes February 20, 2013 by Ken Belson

Now Batting: A Stronger, Mandatory Helmet

The Dodgers' Matt Kemp was among about 200 players who wore a more streamlined version of the S100 Pro Comp in 2012. The beanball is one of the scariest plays in sports, a baseball hurtling at the head of a batter who cannot get out of the way. Over the years, they have led to concussions, skull fractures and, in some cases, deaths.



The Mets' David Wright wore the original S100 helmet after being beaned in 2009.

INTRODUCTION & HINTS: These new S100 Pro Comp helmets will do a better job in reducing acceleration(remember from F=ma, if "a" is reduced then F is reduced) of ball on impact. The "new" material within helmet accomplishes this(smaller "acceleration") by compressing(ΔX) to absorb the force(F) during impact. From the work-energy theorem, work done on speeding ball,

$$W= F\Delta x = \Delta K = K - K_o = 0.8K_o - K_o = -0.2\,K_o$$

$$\text{Kinetic energy} = 1/2mv^2$$

HINTS: 16 oz = 1 lb., Weight = mg, g = 32 ft/s^2, baseball weight = ~ 5 ¼ oz , 88 ft/s = 60 mph

QUESTIONS: (a) Convert 5 ¼ oz to lb.? (b) Find mass of ball in slugs? (c) Convert 68 mph to ft/s.? (d) Convert 100 mph to ft/s., (e) Find kinetic energy of ball moving at 68 mph? (f) Same ? as (e) except moving at 100 mph? (g) If helmet compresses(ΔX) 1 inch on ball impact at 68 mph, and 80% of initial kinetic energy(K_0) continues on with the ball due to a glancing impact(only 20% of K_0 is dissipated by helmet….see graphic at left)…….**FIND F?**
(h) Same question as (g) except the ball hit helmet at 100 mph?

ANSWERS: (a) 0.328 lb., (b) 0.01025 slugs, (c) 68 mph = 99.73 ft/s (d) 100 mph = 146.67 ft/s., (e) 62.16 ft. lb. , (f) 134.45 ft. lb. (g) ~149.2 lb. (h) ~322.7 lb.

For Rawlings, the official provider of helmets to Major League Baseball, the S100 Pro Comp is the latest and best attempt at protecting players. Introduced last year**, it is fractions of an inch larger and an ounce or so heavier than a traditional helmet.** But **its carbon fiber shell is also 300 percent stiffer and 130 times stronger** than the helmets made with plastic shells that have been the standard for the past several years.
The S100 Pro Comp's biggest innovation is **that its hardened shell is designed to provide protection against balls thrown at up to (((100 miles per hour, compared to 68 m.p.h. for older helmets)))**.
The helmet "is going to **(((decrease the amount of energy your head will feel)))**, and the less energy transmitted to your head, the better." Until **Rawlings began using carbon fiber**, most helmets were made with a pliable plastic shaped using an injection mold. **Test Helmets are fitted on crash dummies with sensors that measure the acceleration on impact.** The cannons are placed about 18 inches from the helmets.
The original S100 met the higher impact standard, but players did not like wearing it because it was more
Rawlings set out to make **the S100 smaller and lighter while maintaining its strength by switching to carbon fiber.** The Nocsae standard, he noted, is based on balls thrown at 68 m.p.h., "but most pitchers in the M.L.B. throw much higher."