

HONORS FIZZIX 1 EXAM #2 2015 SA

SA / Free Response / Harder / Tuffer / Math-Based / Icky Section

You MUST do #1. There are four other problems; choose TWO of those for a total of THREE (3, ONE more than a couple, MINIMUM for a "few", $\sqrt{9}$, # of Stooges, The Trinity, # of Strikes, # of Coins in a Fountain, # of French Hens, # Miles in a League, # in a Hat Trick, # of Little Pigs, The # of Billy Goats Gruff, # of Bears Goldilocks had to fight off, # minutes an egg needs, # English feet in a yard, # Books in LOTR Trilogy, # in ANY Trilogy, # Rings in a Circus, # Ships Columbus Sailed, #Witches in Macbeth, # Blind Mice, #Musketeers, # Bee Gees, # Branches of US Government, # Sides to a Triangle, # Races in the Triple Crown (DUH), # Cousins of Donald Duck, # Dog Nights, # Stars in Orion's Belt, # Fake Parts to the Atom you've been taught, # Quarks in a baryon (LIKE A PROTON...), # Earth Layers, # Barleycorns in an Inch, # King Lear's Daughters, # Holes in a Bowling Ball, # Colors of a US Stop Light, # Lines in Haiku, # Lifeline in Millionaire, # Leaves on a Shamrock, # Scruple in a Dram, # Minutes in a Pro Boxing Match, # Teaspoons in a Tablespoon, # MegaJoules in a KwHr, # Newton's Laws of Motion, # Points for a Field Goal, # Wise Men, # Tenors, # Gorgons, # Roman Furies, #Rings in a Notebook, # Times one can say "Betelgeuse" before all heck breaks loose, #Level of Truth (It, Whole, & Nothing But), # of representations hands can have to decide a dispute, # Sounds Rice Crispies make, # Levels of human attributes in Clint Eastwood's 1st REAL movie, # Chipmunks, ... Get it Yet? 3.) All count the same, so...

Directions: Show all work & make reasoning clear. Choose three, and **ONLY three**, of the following five AP-Style problems to turn in for grading.

DUE: All **paper** solutions are due no later than **2:15 PM ET Friday 10/23/2015**. All **electronic versions** are due HTTP time-stamped no later than **2:15 PM ET Friday 10/23/2015**.

- (10 pts; **MUST DO THIS ONE**) According to the NTSB, National Transportation Safety Board, a human being can experience a 30g deceleration during a front end collision and still survive (www.NTSB.gov/stats/). However, according to NASA (www.nasa.gov/bioinfo/), it ain't so. (Copied directly from <http://www.hq.nasa.gov/office/pao/History/conghand/mannedev.htm>)

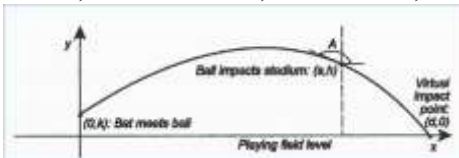
Positive longitudinal g's, short duration
(blood forced from head toward feet):

<i>Effects:</i>	<i>g's</i>
Visual symptoms appear	2.5 - 7.0
Blackout	3.5 - 8.0
Confusion, loss of consciousness	4.0 - 8.5
Structural damage, especially to spine	> 18 - 23

Using the upper limits claimed from these two sources, 8.5g from NASA and 30g from NTSB, what is the difference in height that a human in a capsule must be dropped from so he/she could experience said accelerations assuming a stopping distance (padding and air bags and such...) of 50-cm, about the distance from nose to steering wheel in a typical car?

2. (10 pts) In the game of baseball, the 2nd most boring sport to watch on TV after golf (and don't even try to tell me that bowling is a sport...), estimated distances for homeruns used to be calculated using only two variables; the *maximum height* and the *speed at that maximum height* as measured by radar gun. The current method used is, of course, a little more complex and computer-driven. It was devised by IBM in 1988.

[Note: The longest HR on verifiable record is by Mickey Mantle, New York Yankees, against the Detroit Tigers at Briggs Stadium, Detroit, on September 10, 1960. It was 634 ft! 2nd on record is Babe Ruth's 575 ft. 3rd is Mark McGwire at 538 ft... Meanwhile, Ryan Howard's longest is 501, Fielder's is 489, Sosa's is 488, and Bonds' comes in at 17th with 449.]



- a. Derive an equation that will yield the horizontal displacement (range) of any baseball projectile if the only parameters measured are these two (the *maximum height* and the *speed at that maximum height*) and any regularly used physical constants.
- b. Using your new-found equation friend, calculate the estimated range for a Daniel Murphy (Yes, a MY Mets player) homerun that is measured by radar as moving at 40m/s at the maximum height of 80 feet.

3. (10 pts) [Here it is! The dreaded car/truck problem...] Actually, a car/train problem... A car and train are traveling parallel to each other at a speed of 25 m/s. The front of the car is directly in line with the back of the train. The car, however, has to stop for a red light so the driver hits the breaks and slows down at a rate of 2.5 m/s^2 to a complete stop. 45 seconds later, the car accelerates back up to 25 m/s from rest at a rate of 2.5 m/s^2 . Assuming the train continued at a constant speed on a parallel path the whole time, how far behind the train is the front of the car when the car reaches 25 m/s again?

4. (10 pts) After a particularly dangerous Fizzix demo involving Dr. Taylor and a few semi-legal Fizzix things, the famous Greenwich Fire Department has to make a visit to the Science Building. A few firefighters are 50m away from the back of the building aiming a stream of water at an angle of 30° above horizontal. If the water leaves the nozzle with a speed of 40 m/s, how high above the ground does this stream of water hit the Science Building?

5. (10 pts) [Tuff one!] In honor of the MLB Championships going on: Outfielders are trained to throw the ball a large distance toward the infield by allowing it to bounce once on the way on the “theory” that the ball will arrive there faster than allowing it to fly through the air all the way. Let’s investigate this phenomenon. Suppose the angle of the bounced ball is the same as the angle the outfielder gave it originally; a safe assumption since we are ignoring air resistance. Also suppose (lots of supposing, eh?) the speed of the ball immediately after the bounce is one-half the speed it had just before the bounce. All supposed out yet?

- a. Assuming the outfielder throws the ball at the same initial speed in each case, find the angle θ that he should throw at so the ball goes the same distance D with one bounce as a ball he would throw at 45° with no bounce.

- b. Does the one-bounce throw get to the infielder sooner than the no-bounce throw? *Justify your answer.*