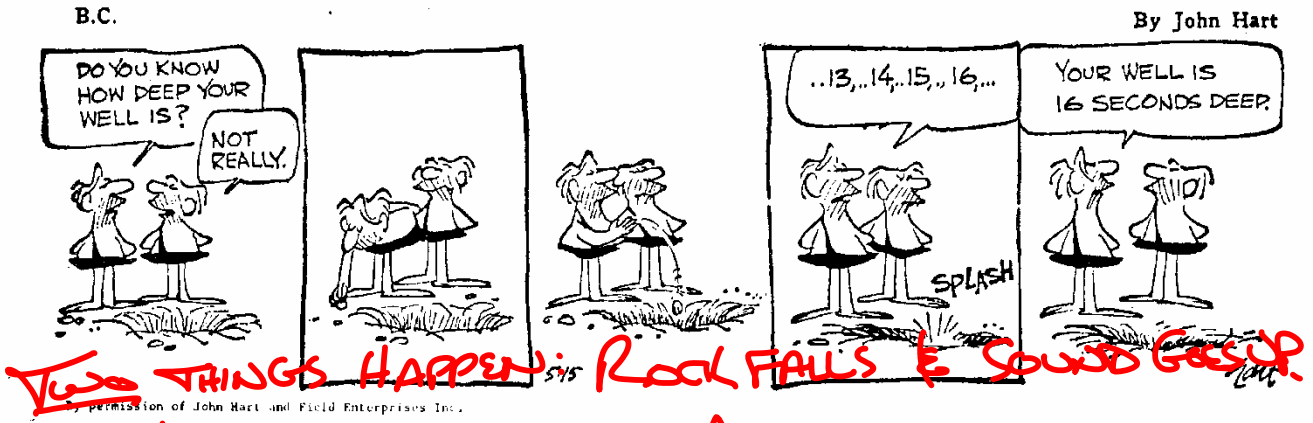
HF: HONORS FIZZIX EXAM #1 2015 SA – BL7

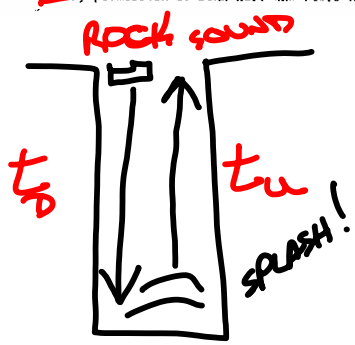
SA / Free Response / Harder / Tuffer / Math-Based / Icky Section

***You MUST do #1**. There are four other problems; choose TWO of these OTHER FOUR 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 iterations 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…*

***Show all work and MAKE REASONING CLEAR!** No credit for "Then a Miracle Occurs and…"*

1. (***MUST DO THIS ONE*** : 10 pts) How deep is Thor's well?





$d_{ROCK} = -d_{SOUND}$

$\frac{1}{2}at_D^2 = -vt_u$ $\quad t_D + t_u = 16$

$t_u = 16 - t_D$

$\frac{1}{2}at_D^2 = -v(16 - t_D)$

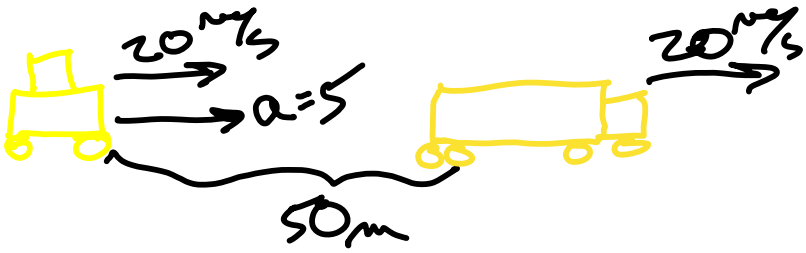
$-5t_D^2 = -340(16) + 340t_D$

$0 = 5t_D^2 + 340t_D - 5450$

$t_D = 13.4$ sec so $t_u = 2.6$

$d_{SOUND} = vt = 340(2.6)$

$\boxed{d = 884\ m}$



2. (10 pts.) A yellow car is following a brown UPS truck on a long straight level perfectly horizontal road. Each vehicle is travelling at 20m/s and the yellow car is 50m behind the truck. The driver of the yellow car, Yellow Yeltsin, decides to pass the truck. The acceleration of the yellow car is 5 m/s^2.

A. Find the time it takes the yellow car to catch the UPS truck.

$d_c = d_T + 50$

$v_i t + \frac{1}{2} a t^2 = v_i t + \frac{1}{2} a t^2 + 50$

so, $\frac{1}{2} a t^2 = 50$

$t = \sqrt{\frac{2(50)}{5}} = 4.47 \text{ sec}$

B. The distance the yellow car must travel in order to catch the brown truck.

$d_c = v_i t + \frac{1}{2} a t^2$

$= 20(4.47) + \frac{1}{2}(5)(4.47)^2$

$d_c = 139.4 \text{ m}$

C. The speed of the yellow car at the instant it catches the brown truck.

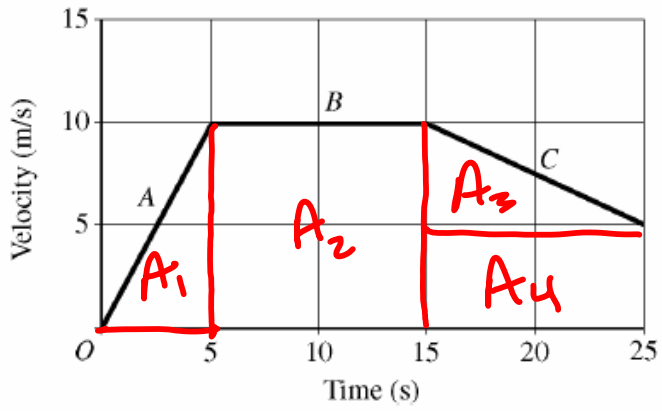
$v_{fc} = v_i + at = 20 + 5(4.47)$

$v_{fc} = 42.35 \text{ m/s}$

D. What company does the Brown UPS truck represent?

UPS

3. (10 pts.)



$A_1 = \frac{1}{2}(5)(10) = 25$

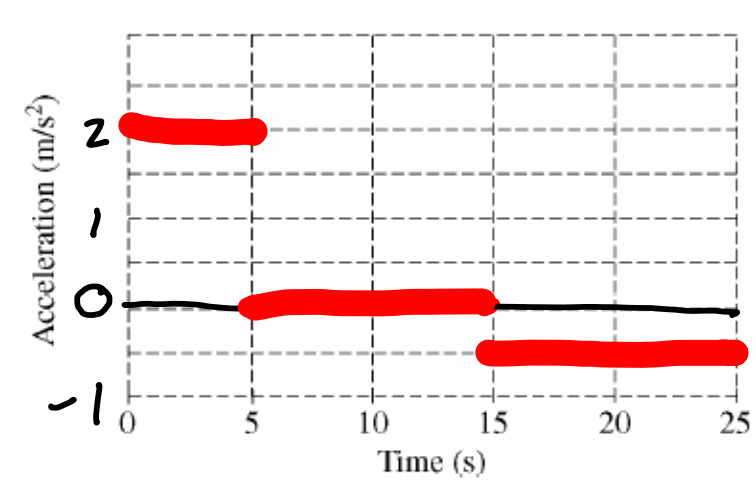
$A_2 = 10(10) = 100$

$A_3 = \frac{1}{2}(10)(5) = 25$

$A_4 = 10(5) = 50$

The graph provided above shows a 4kg object moving in a straight line for a 25 second time interval.
A) On the graph provided below, sketch the acceleration versus time of this object. Be sure to include values on the vertical scale.

a = SLOPE

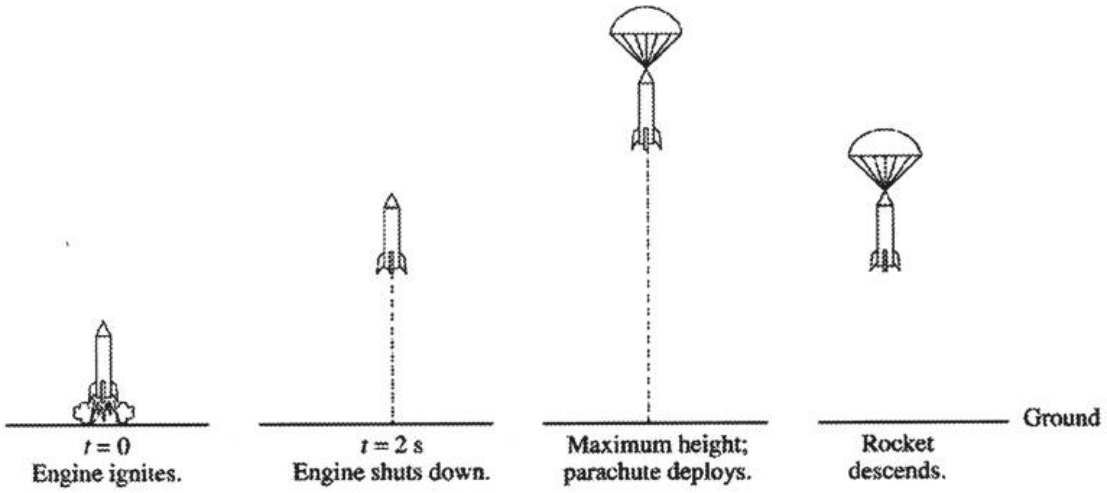


B) This object started at x = 0 at t = 0. What is the total displacement of this object for the 25 second trip?

AREA UNDER v/t GRAPH.

$A_T = d = 25 + 100 + 25 + 50$

$d = 200\ m$



Note: Figures not drawn to scale.

4. (10 pts.) A model rocket is launched vertically with an engine that is ignited at time $t = 0$, as shown above. The engine provides an upward acceleration of 70 m/s² for 2.0 s. Upon reaching its maximum height, the rocket deploys a parachute, and then descends vertically to the ground.

a. Determine the speed of the rocket after the 2 s firing of the engine.

$v_i = 0$, $a = 70$, $t = 2$

$v_f = v_i + at$

$= 70(2)$

$v_f = 140 \text{ m/s}$

b. What maximum height will the rocket reach?

$h_{MAX} = h_a + h_g$

$h_a = d = \frac{1}{2}at^2$

$= \frac{1}{2}(70)(2)^2$

$= 140 \text{ m}$

$h_g = d = \frac{v_f^2 - v_i^2}{2a} = \frac{0 - 140^2}{-20}$

$= 980 \text{ m}$

$h_{MAX} = 1120 \text{ m}$

c. At what time after $t = 0$ will the maximum height be reached?

concept:

t TO TOP w/ $v_i = 140$ = 14 sec

$+2$

16

16 sec

MATH: $t_T = 2 + t_{TOP}$

$= 2 + 14$

$t_{TOP} = \frac{v_f - v_i}{a} = \frac{0 - 140}{-10}$

5. (10 pts.) A helicopter is lifting a 70 kilogram package suspended by a rope 5 meters long. The helicopter accelerates upward from rest at a constant rate of 5 m/s^2.

A) How long does it take the helicopter to reach a speed of 30 m/s?

$t = ?$

$v_i = 0$

$a = 5$

$v_f = 30$

$t = \frac{v_f - v_i}{a} = \frac{30 - 0}{5}$

$\boxed{t = 6 \text{ sec}}$

B) At the instant the helicopter, with the package hanging from the rope, reaches a speed of 30 m/s, the rope snaps. Determine the distance between the helicopter and the package 2 seconds after the rope snaps.

HELICOPTER

$v_i = 30$

$a = 5$

$t = 2$

$d = ?$

$d_H = v_i t + \frac{1}{2} a t^2$

$= 30(2) + \frac{1}{2}(5)(2)^2$

$d_H = 70\text{m} \ (\text{UP})$

PACKAGE

$v_i = 30$

$a = -10$

$t = 2$

$d_P = v_i t + \frac{1}{2} a t^2$

$= 30(2) - 5(2)^2$

$d_P = 40\text{m} \ (\text{UP})$

$\Delta d = 70 - 40 + 5$

$\boxed{= 35\text{m}}$