

HF: HONORS FIZZIX EXAM #1 2015 SA – BL6

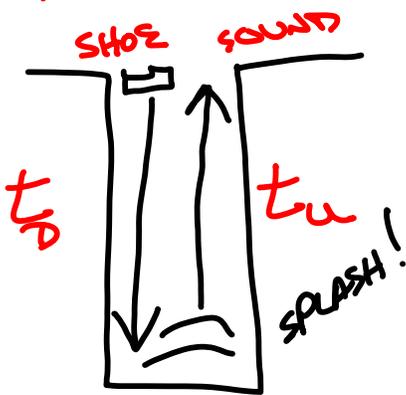
SA / Free Response / Harder / Tuffer / Math-Based / Icky Section

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 that well the kid with the Crocks© is going to fall into, but get saved at the last instant by Ultraviolet, the futuristic Vampire with limitless powers because the sky is the limit? [Ask if you need to see the video again].

Two THINGS HAPPEN: SHOE FALLS & SOUND GOES UP.



$$d_{\text{SHOE}} = -d_{\text{SOUND}}$$

$$\frac{1}{2}at_D^2 = -v t_u \quad t_D + t_u = 30$$

$$t_u = 30 - t_D$$

$$\frac{1}{2}at_D^2 = -v(30 - t_D)$$

$$-5t_D^2 = -340(30) + 340t_D$$

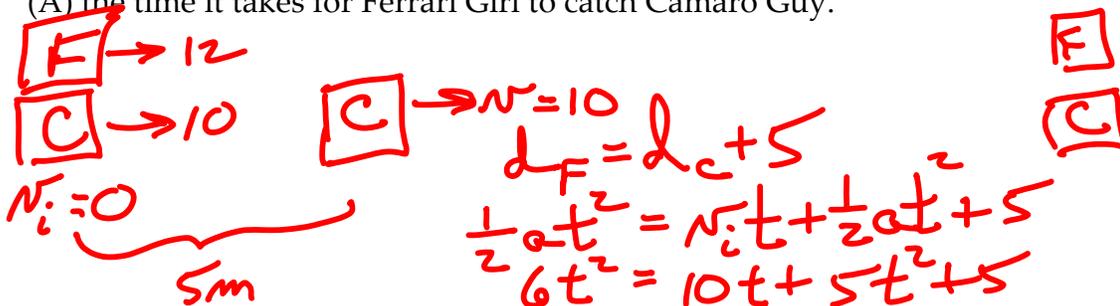
$$0 = 5t_D^2 + 340t_D - 10,200$$

$$t_D = 22.5 \text{ sec so } t_u = 7.5 \text{ sec}$$

$$d_{\text{SOUND}} = v t = 340(7.5)$$

$$d = 2550 \text{ m}$$

2. (10 pts.) A sports car enthusiast, Alice, buys a deluxe machine from a little known manufacturer called Ferrari. It can accelerate at an astonishing 12 m/s^2 . She enters a drag race and ends up against an experienced racer, Dastardly Daryl, in an old yellow "bumblebee" 1968 SS350 Camaro. Both start from rest, but the experienced driver takes off like a shot on time while she delays a little due to slow reflexes. The Camaro Guy accelerates at only 10 m/s^2 and she (the Ferrari Gal) starts accelerating exactly one second AFTER the Camaro Guy took off. If both accelerations are constant, find (A) the time it takes for Ferrari Girl to catch Camaro Guy.



(B) the total distance traveled to catch the Camaro Guy.

$$t^2 - 10t - 5 = 0$$

$$t = 10.48 \text{ sec} \quad (\pm .48)$$

$$d_F = \frac{1}{2} a t^2$$

$$= 6(10.48)^2$$

$$d_F = 659 \text{ m}$$

(C) the velocities of both cars at the instant she catches him.

[MUST SHOW each & every step, assumption, and/or ANYTHING...]

$$v_{5F} = v_i + a t$$

$$= 0 + 12(10.48)$$

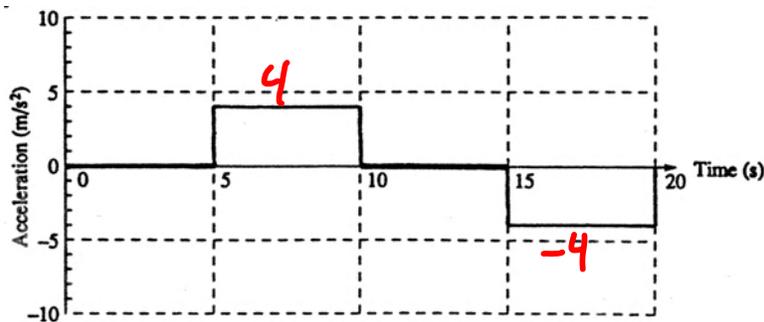
$$v_F = 125.76 \text{ m/s}$$

$$v_c = v_i + a t$$

$$= 0 + 10(11.48)$$

$$v_c = 114.8 \text{ m/s}$$

3. (10 pts.)



Luis stands in an elevator and records his acceleration as a function of time. The data is/are shown in the graph above. At time $t = 0$, the elevator is at displacement $x = 0$ with velocity $v = 0$. Assume that the positive directions for displacement, velocity, and acceleration are upward.

- a. Determine the velocity v of the elevator at the end of each 5-second interval.
i. Indicate your results by completing the following table.

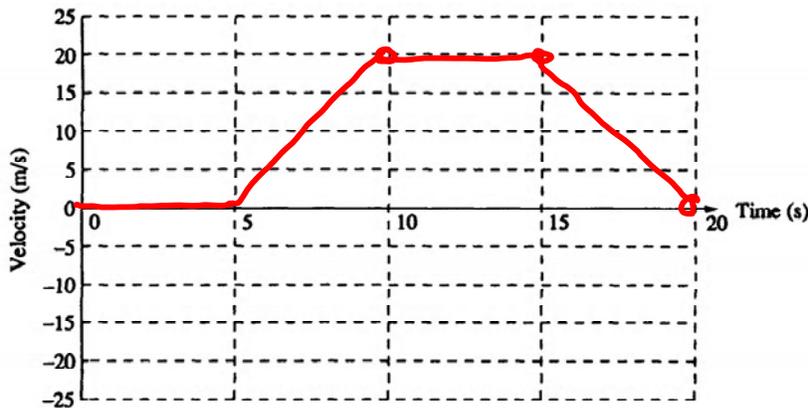
$$v_f = v_i + at$$

$$=$$

Time Interval (s)	0-5	5-10	10-15	15-20
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v (m/s)	<u>0</u>	<u>20</u>	<u>20</u>	<u>0</u>
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- ii. Plot the velocity as a function of time on the following graph.



- b. Determine the displacement x of the elevator above the starting point at the end of each 5-second interval.
i. Indicate your results by completing the following table.

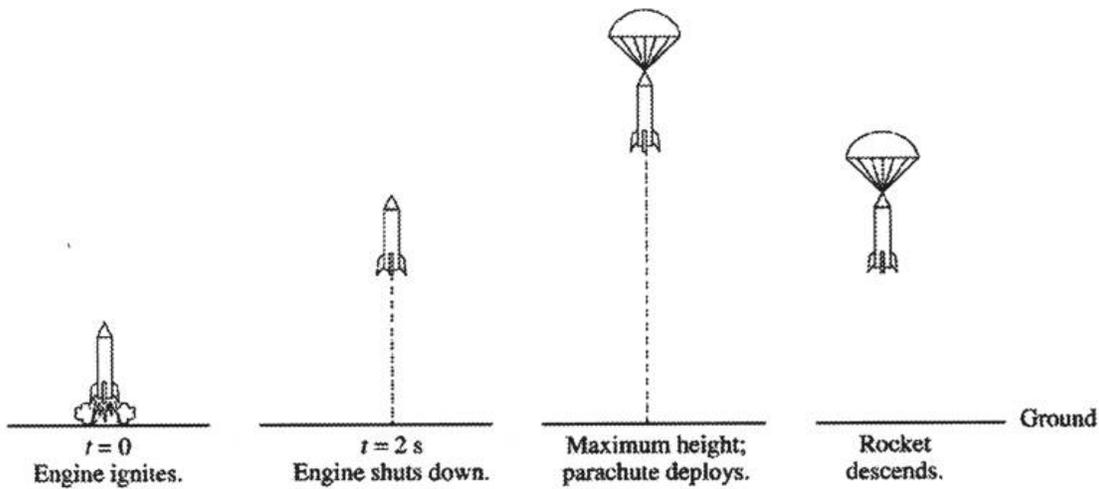
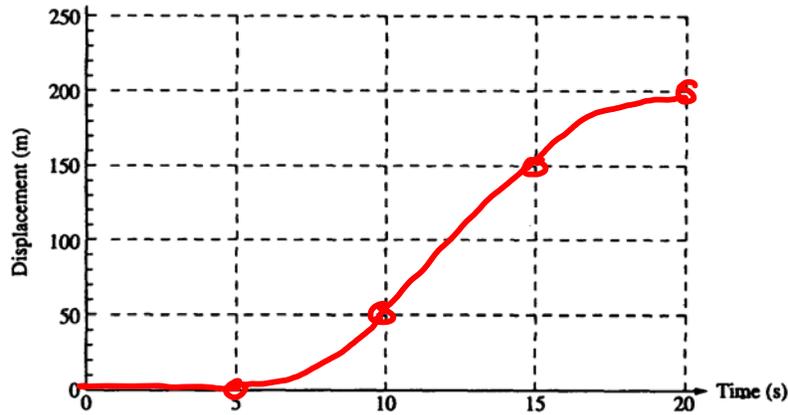
Time Interval (s)	0-5	5-10	10-15	15-20
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$$d = v_i t + \frac{1}{2} a t^2$$

OR
AREA

x (m) 0 50 150 200

ii. Plot the displacement as a function of time on the following graph.



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/s^2 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?

$$h_{\text{max}} = h_a + h_{g,2}$$

$$h_a = d = \frac{1}{2} a t^2$$

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

$$= 140 \text{ m}$$

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

$$= 980 \text{ m}$$

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

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

~~concept:~~

16 sec

$t \text{ TO TOP } \omega / v_i = 140 = 14 \text{ sec}$

MATH: $t_T = z + t_{\text{TOP}}$
 $= 2 + 14$

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

←

5. (10 pts.) A paratrooper, Captain Conrad, is descending with his parachute open, 'cuz that's what paratroopers do, at a constant 5 m/s when one he tosses a lead ball stolen from Fizzix Lab straight up into the air with an initial speed of 20 m/s when he is 200m above the ground. So, anyway, ignoring air resistance:

a. How long does it take the ball to hit the ground?

$v_i = 15$
 $d_i = -200$
 $a = -10$

$d = v_i t + \frac{1}{2} a t^2$
 $-200 = 15t - 5t^2$
 $t^2 - 3t - 40 = 0$
 $t = -5 \text{ \& } 8 \text{ sec}$

b. How fast is the ball moving at the instant it hits the ground?

$v_f = v_i + at$
 $= 15 - 10(8)$
 $= -65 \text{ m/s}$