Level I Answer Key Pd1

Kinematics

AT Kinematics (19)

Directions: Solve the following problems. Each is worth 5 points. Show all work. All solutions should "read" complete. All numbers must have units.

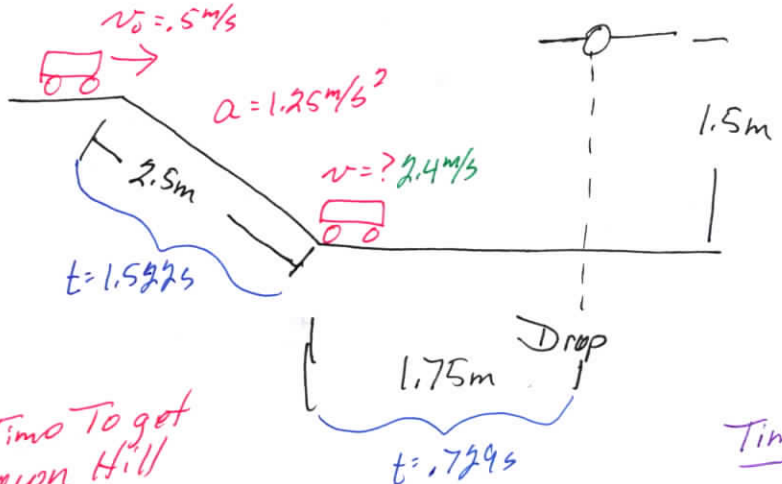
1) Virginia Tech (Virginia Polytechnic Institute and State University) is in Blacksburg VA. According to Google Maps, from MASH to Virginia Tech is 310 miles, and it will take you 4 hours and 42 minutes to drive traveling on I-81. The speed limit on I-81 varies between 65mph and 70mph. Assume no accidents or construction. Is it possible for you to drive your car (or the "family car") to VT in the time stated? Defend your answer. (Please keep it brief, concise and to the point. Sentences are not needed, just thoughts, equations, and maybe diagrams. Extra words just make it take longer to grade)

$42\text{min} = .7\text{ hr}$

$v = \frac{x}{t} = \frac{310\text{mi}}{4.7\text{hr}} = 65.9\frac{\text{mi}}{\text{hr}}$

possible but Not Probable...
you may Be Able To Drive ~ 5hrs non-stop ~ 310 miles,
But Would Need To Run Above 66 mi/hr.

2) A cart rolls down a hill that is 2.5m long. The cart starts at the top of the hill with an initial velocity of 0.5m/s and accelerates at 1.25m/s^2 while on the hill. At the bottom of the hill, the cart rolls onto a level surface. A "Drop zone" is located 1.75 m out from the bottom of the ramp on the level surface. There is a ball at a position 1.5 m directly above the drop zone. How long after the cart is released should the ball be released for the ball to land on top of the cart?



Time To get Down Hill

$t = ?$
$x = 2.5$m
$a = 1.25$m/s^2
$v_0 = .5$m/s

$x = v_0 t + \frac{1}{2} a t^2$

$0 = \frac{1}{2} a t^2 + v_0 t - x$

$\left(\frac{1}{2}\right)(1.25\text{m/s}^2) t^2 + (.5\text{m/s}) t - 2.5\text{m}$

$t = 1.64$2s

Velocity @ Bottom of Hill

$v = ?$
$a = 1.25$m/s^2
$t =$ ~~1.522s~~ 1.64s
$v_0 = .5$m/s

$v = v_0 + at$

$v = (.5\text{m/s}) + (1.25\text{m/s}^2)(1.64\text{s})$ ~~1.522s~~

$v = 2.55$m/s

Time For Ball To Drop

$x = 1.5$m
$a = -9.8$m/s^2
$v_0 =$ zero
$t = ?$

$x = v_0 t + \frac{1}{2} a t^2$

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

$\sqrt{\frac{2x}{a}} = t = \sqrt{\frac{(2)(-1.5\text{m})}{-9.8\text{m/s}^2}} = .55$s

time For Cart To Get From Bottom Of Hill To Drop Zone

$a =$ zero
$v = 2.55$m/s
$x = 1.75$m
$t = ?$

$x = v_0 t + \frac{1}{2} a t^2$

$x = v_0 t$

$\frac{x}{v} = t = \frac{1.75\text{m}}{2.55\text{m/s}} =$ ~~.729s~~ .69s

Total Time For Cart To Get To Drop Zone

~~1.522s~~ 1.64s + ~~.225s~~ .69s

~~1.747s~~ 2.33s

~~2.33s~~ ~~2.25s~~ s - .55s

1.8 seconds After Cart starts Down Hill

3) Standing on a 4m tall "cliff" determine the difference in time for a ball to hit the ground that is just dropped vs. a ball that is thrown downward at 18m/s.

Thrown Down

$v_0 = -18 m/s$
$x = -4m$
$a = -9.8 m/s^2$
$t = ?$

$x = v_0 t + \frac{1}{2} a t^2$

$0 = \frac{1}{2} a t^2 + v_0 t - x$

$0 = (-4.9 m/s^2) t^2 + (-18 m/s) t + 4m$

$t = .21 s$

Dropped

$v_0 = Zero$
$x = -4m$
$a = -9.8 m/s^2$
$t = ?$

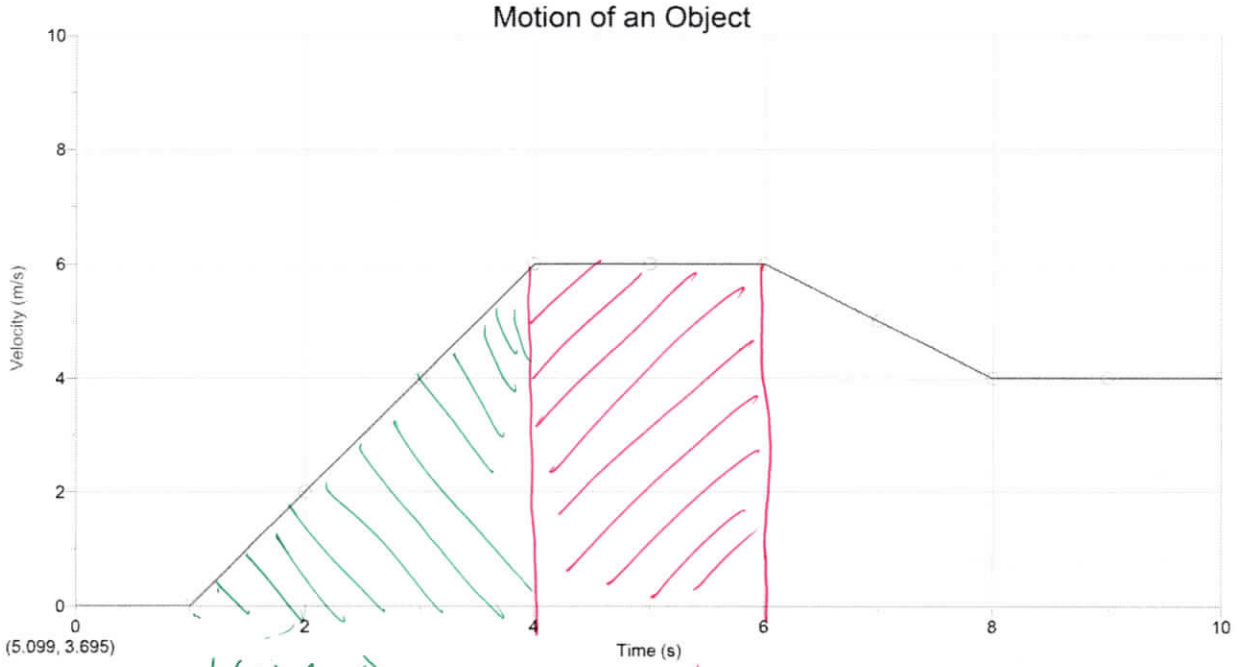
$x = v_0 t + \frac{1}{2} a t^2$

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

$\sqrt{\frac{2x}{a}} = t = \sqrt{\frac{2(-4m)}{(-9.8 m/s^2)}} = .9 s$

Diff
.69s

4) An object moves to create the graph below. Determine how far the object moves during the first 6 seconds.



$\frac{1}{2}(3s)(6m/s)$

9m

$(2s)(6m/s)$

12m

21m

5) While standing in the middle of a football field, a ball is thrown upward at 10 m/s. Determine the location of the ball after 3.5 seconds

$v_0 = 10\ m/s$

$t = 3.5\ s$

$y = ?$

$a = -9.8\ m/s^2$

$y = v_0 t + \frac{1}{2} a t^2$

$y = (10\ m/s)(3.5\ s) + \left(\frac{1}{2}\right)(-9.8\ m/s^2)(3.5\ s)^2$

On the ground

6) A basketball is shot at a hoop. The ball hit hits the rim, bounces around a little, then ends up essentially almost stopped on the rim, then it falls to the floor. Determine how long it will take a basketball to fall from the rim to the floor. The rim is 10 feet (3.05m) above the floor

$t = ?$

$v_0 = \text{zero}$

$a = -9.8\ m/s$

$y = -3.05\ m$

$y = v_0 t + \frac{1}{2} a t^2$

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

$\sqrt{\frac{2y}{a}} = t = \sqrt{\frac{(2)(-3.05m)}{-9.8\ m/s^2}} = .79s$

7) Motor Trend is reporting the 2018 Honda Accord 1.5 liter turbo accelerates 0-60mph in 7.6 seconds. (Note, this engine is smaller than all but the smallest motors used in Harley Davidson and Indian Motorcycles!). This yields an average acceleration of 7.8 mi/hr/s or 3.5m/s^2. What distance would be expected for this Honda to go from a stand-still to 60mph?

$a = 3.5\ m/s^2$

$v_0 = 0$

~~$t = ?$~~

$x = ?$

$v = 26.8\ m/s$

$v^2 = v_0^2 + 2ax$

$v^2 = 2ax$

$\frac{v^2}{2a} = x = \frac{(26.8\ m/s)^2}{(2)(3.5\ m/s^2)} = x = 102.6m$