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KINEMATICS

AT kinematics (20)

Directions: Solve the following problems showing all work.

1) It is about a 198 miles from Mechanicsburg to Pittsburgh running out the turnpike. Doing a reasonable (on the turnpike) 75mi/hr, how long should it take to get there without stops?

$x = 198\text{mi}$

$t = ?$

$v = 75\text{mi/hr}$

$a = \text{zero}$

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

$x = v_0 t$

$\frac{x}{v_0} = t$

$\frac{198\text{mi}}{75\frac{\text{mi}}{\text{hr}}} = 2.6\text{ hr}$

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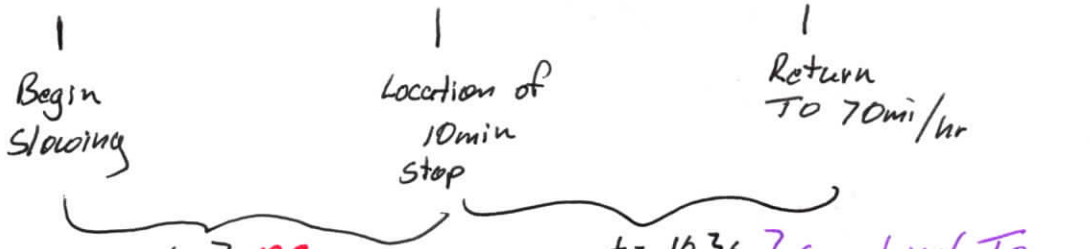
2) Two groups are taking a 200 mile road trip. Assume both cars accelerate at the same constant rate of $3m/s^2$, both cars will travel at the same speed of 70mi/hr (31m/s), and both cars will travel the same route. One of the cars stops at a rest stop along the highway for a 10 minute potty break. When the first car pulls into the parking lot at the final destination, how much time will pass until the 2nd car pulls into the parking lot? (In other words, how much time did the car loose for taking the break? Assume they slowed to a stop, magically parked, and leave accelerating to highway speed. Realistically, the time calculated will be a best case scenario. It will actually take longer. Your response should be realistic)



$t = ?$ 10.3s
$x = ?$ 160m
$a = 3 m/s^2$
$v_0 = 31 m/s$
$v = zero$

$t = 10.3s$ } Symetrical To "Slowing Down"
$x = 160m$ }

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

$\frac{v^2 - v_0^2}{2a} = x$

$\frac{0 - (31 m/s)^2}{(2)(-3 m/s^2)} = x$

$160m = x$

$v = v_0 + at$

$\frac{v - v_0}{a} = t$

$\frac{0 - 31 m/s}{(-3 m/s^2)} = 10.3s$

Total Distance Traveled While Car Slows + Speeds Up For "Stopping Car"

$x = 160m + 160m = 320m$

$t = 10.3s + 10.3s + 600s = 620.6s$ (10min)

Time For Non Stopping Car To Travel the 320m.

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

$\frac{x}{v_0} = t = \frac{320m}{31 m/s} = 10.3s$

Time For Stopping Car — Time For Non Stopping Car

$620.6s - 10.3s = 610.3s = 10.2 min$ *

* Note * I was Expecting A Greater Difference In Time, As It "Feels" Longer When Traveling. That Said, "Time" Is Different To Commute w/ Motion Sometimes. Realize How Far You Travel When Moving At 70mi/hr.

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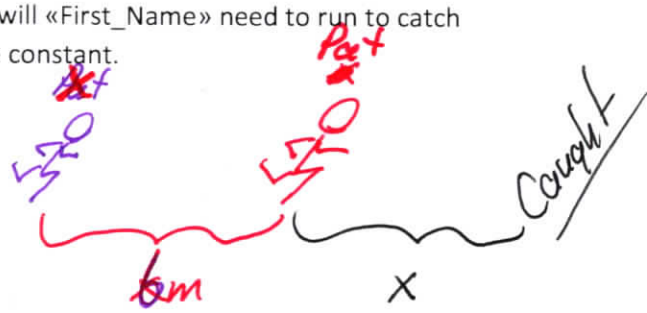
3) Pat and «First_Name» are playing tag with a large group of people. Pat runs at 6.6m/s and «First_Name» runs at 8.3 m/s. At one point, «First_Name» spots Pat at an approximate close and targetable distance of 6 m and gives chase. How far will «First_Name» need to run to catch Pat. Assume acceleration time is negligible, al speeds are constant.



Pat

$v = 6.6\,m/s$

$x = ?$

$t = ?$

$x = \frac{v}{t}$

$t = \frac{v}{x}$

x

$v = 8.3\,m/s$

$x = (x + 6m)$

$t = ?$

$x = \frac{v}{t}$

$t = \frac{v}{x}$

$$\frac{v}{x} = \frac{v}{x}$$

$$\frac{v}{x} = \frac{v}{(x+6m)}$$

$v(x+6m) = vx$ [Both x Terms are Now the Distance From Pat To When Caught]

$vx + 6mv = vx$

$6mv = vx - vx$

$6mv = x(v - v)$

$$\frac{6mv}{v - v} = x$$

$$\frac{(6m)(6.6\,m/s)}{(8.3\,m/s) - (6.6\,m/s)} = x$$

$23.3m = x$

"x" Needs To Run 23.3m plus The Initial 6m

29.3m

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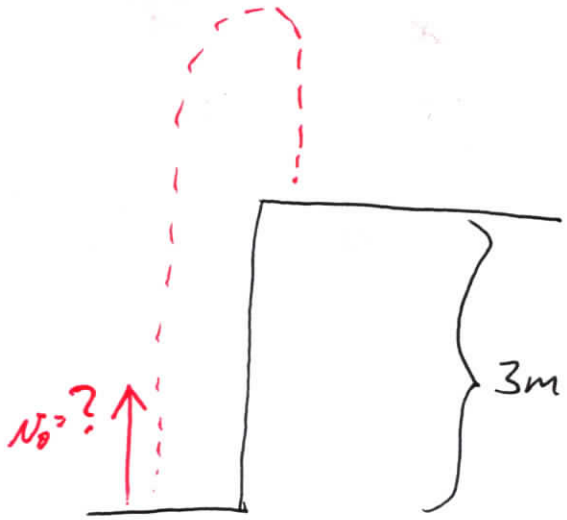
4) While standing at the bottom of a 3 m tall cliff, you throw a rock upward that then lands on top of the cliff 2.3 seconds later. How fast did you throw the rock upward?



$t = 2.3s$

$y = 3m$

$v_0 = ?$

$a = -9.8 m/s^2$

$t = 2.3s$

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

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

$\frac{3m - \frac{1}{2}(-9.8 m/s^2)(2.3s)^2}{(2.3s)} = 12.5 m/s$

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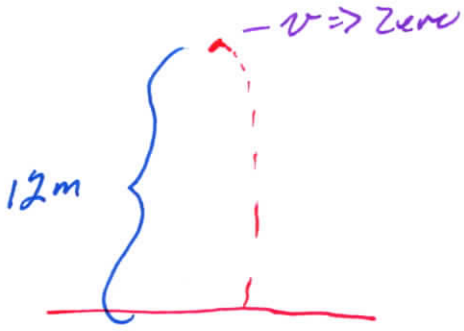
5) A ball is thrown upward that reaches a max height of 12 m. The ball lands at the same point where it was thrown. How long was it in the air?



$y = -12m$

$a = -9.8 m/s^2$

$t = ?$

$v_0 = zero$

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

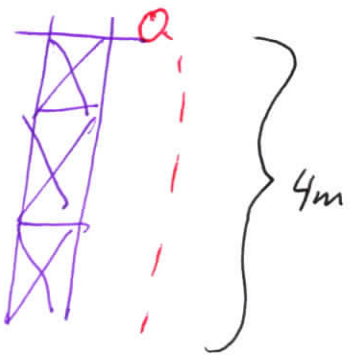
$y = \frac{1}{2} a t^2$

$\sqrt{\frac{2y}{a}} = \sqrt{\frac{(2)(-12m)}{-9.8 m/s^2}} = 1.56s$ To Fall

3.12s Round Trip

«First_Name» «Last_Name» Pd:«Period» group: «group»

6) A ball is dropped from a tower that is 4 m tall. How long does it take for the ball to hit the ground?



$y = -4m$

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

$t = ?$

$v_0 = zero$

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

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

$\sqrt{\frac{2y}{a}} = t$

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

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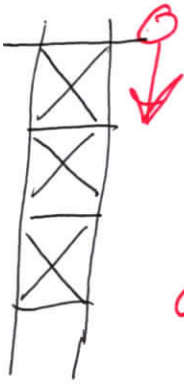
7) A ball is thrown downward at 12 m/s from a tower that is 4 m tall. How long does it take for the ball to hit the ground?



$v_0 = -12\ m/s$

$y = -4\ m$

$t = ?$

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

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

$$-4m = (-12\ m/s)t + (-4.9\ m/s^2)t^2$$

$$0 = (-4.9\ m/s^2)t^2 - 12\ m/s\ t + 4m$$

$t = -2.7\ s$

- or -

$.29\ s$

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8) Maybe you and some friends have a trip planned to Ocean City MD say in early June. Google Maps will provide directions by heading south on I-83, I-695, and ultimately on US-50. Google maps states this route is about 200 miles and will take 3 hours and 57 minutes. Is it reasonable to expect to get there in 4 hours or less? Defend your response.