key Level I Physics Pd 2

KINEMATICS

AT Kinematics (11)

Solve the following problems showing ALL work and CIRCLING your answers. Each is worth 5 points.

1) According to the Amtrak website, for $39 (if you plan ahead, $49 the day of departure) you may travel the Pennsylvanian train from Harrisburg to Pittsburgh. This train will depart Harrisburg at 2:36 PM and arrive 5 hours, 29 minutes later in Pittsburgh. According to the website, the distance the train travels is 249 miles. Determine the average speed of the train. The train makes 8 stops between Harrisburg and Pittsburgh.

$v = \frac{x}{t} = \frac{249\,mi}{5.48\,hr} = 45.4\,mi/hr$

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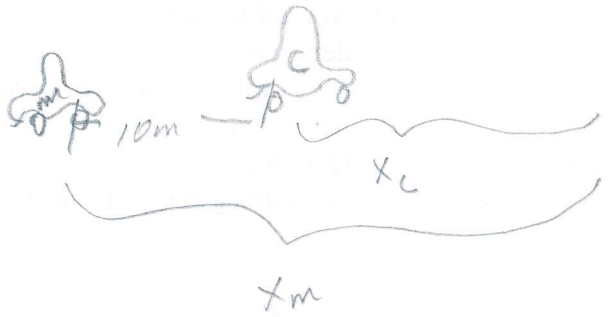
2) Someone driving a Civic is initially traveling at 10m/s on the On-Ramp to I-83. The Civic accelerates at a constant 3m/s^2 on the ramp, then enters the highway maintaining the acceleration. Ten meters back on the ramp, someone else in a Mustang initially traveling at 8 m/s begins accelerating at 5 m/s^2 at the same time the Civic begins accelerating. Both cars continue accelerating until the Mustang catches the Civic. How fast is the Mustang traveling when it catches the Civic?

Civil
$v_{0_c} = 10\,m/s$
$a_c = 3\,m/s^2$
$x_c = x$
$t_c = t_m$

mustang
$v_{0_m} = 8\,m/s$
$a_m = 5\,m/s^2$
$x_m = x_c + 10m =$
$t_m = t_c$



$x_c = v_{0_c} t + \frac{1}{2} a_c t^2$ $\quad x_m = v_{0_m} t + \frac{1}{2} a_m t^2$

$x_c + 10m = x_m$

$(x_m - 10m) = x_c$

$(x_m + 10m) = v_{0_c} t + \frac{1}{2} a_c t^2$

$v_{0_m} t + \frac{1}{2} a_m t^2 + 10m = v_{0_c} t + \frac{1}{2} a_c t^2$

$\left(8\frac{m}{s}\right)t + \left(2.5\frac{m}{s^2}\right)t^2 + 10m = \left(10\frac{m}{s}\right)t + \left(\frac{1}{2}\right)\left(3\frac{m}{s^2}\right)t^2$ SIGN

$10t + \frac{3}{2}t^2 = 8t + \frac{5}{2}t^2 - 10 = 0$

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

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

Oops... Issues

$t = -2.3s$ ← Going Back In Time, Same Position

$t = 4.3s$ ← Forward In Time, Same Position

$v = ?$
$v_0 = 8\,m/s$
$t = 4.3s$
$a = 5\,m/s^2$

$v = v_0 + at$

$v = \left(8\frac{m}{s}\right) + \left(5\frac{m}{s^2}\right)(4.3s)$

$v = 29.5\,m/s$

3) A truck is driving North on US route 15 at a constant speed of 58 mph. This truck establishes CB communication with a southbound truck traveling at a constant 62 mph, also on route 15. If the two drivers are talking for 3.8 minutes when they pass each other, how far apart were they when they initiated the conversation?

$t = 3.8\,\text{min}$

$x = vt$

$\left(55\frac{\text{mi}}{\text{hr}}\right)(3.8\,\text{min})\left(\frac{1\,\text{hr}}{60\,\text{min}}\right) = 3.67\,\text{mi}$

$\left(62\,\text{mi/hr}\right)(3.8\,\text{min})\left(\frac{1\,\text{hr}}{60\,\text{min}}\right) = 3.93\,\text{mi}$

$+$

7.6 mi Apart

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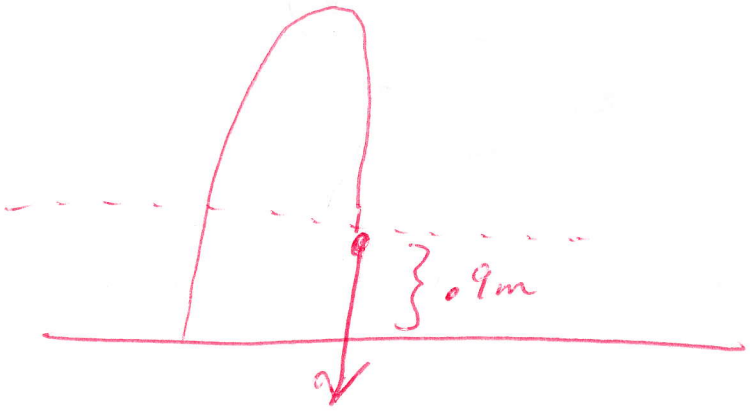
4) A ball is thrown up in the air at 15m/s. Determine how far the ball traveled through the air after 3 seconds.



9.8 m/s²

position

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

$x = (15\ m/s)(3s) + \left(\frac{1}{2}\right)(9.8\ m/s^2)(3s)^2$

$x = .9m$

Up or Down?

$v = v_0 + at$

$v = (15\ m/s) + (-9.8\ m/s^2)(3s)$

$v = -14.4\ m/s$ --- Downward

Greatest height

$v_0 = 15\ m/s$

$v = zero$

$y = ?$

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

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

$\frac{v - v_0^2}{2a} = x \Rightarrow \frac{zero - (15\ m/s)^2}{(2)(-9.8\ m/s^2)} = 11.4m$

Up => 11.4m

Down => 11.4m - .9m = 10.6m

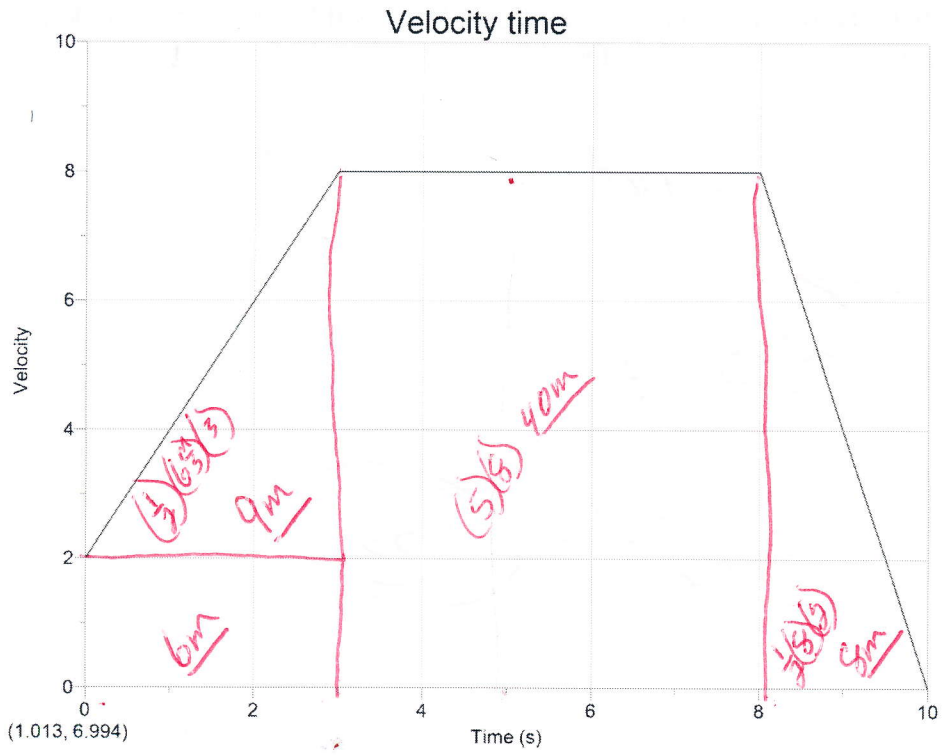
Total Dist. 11.4m + 10.6m = 21.97m

5) A ball is thrown up in the air at 32 m/s. If the ball lands at the same point it was thrown, how long was it in the air?

$v = v_0 + at$

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

$\frac{-32\ m/s - 32\ m/s}{-9.8\ m/s^2} = 6.5\ s$



6) From the graph, determine the average **speed** during the 10 second interval.

$$\frac{\text{Total Distance}}{6m + 9m + 40m + 8m} = \frac{63m}{10s} = 6.3\ m/s$$

7) From the graph, determine the average acceleration during the first 5 seconds.

$$\frac{\Delta v}{t} = \frac{6\ m/s}{5s} = 1.2\ m/s^2$$

8) A ball is thrown up in the air at a speed of 36 m/s. Where is the ball 3.2 seconds after it is thrown? (How high)

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

$\left(36 \frac{m}{s}\right)(3.2s) + \left(\frac{1}{2}\right)\left(-9.8 m/s^2\right)(3.2s)^2$

65m UP