Kinematics

AT kinematics(09)

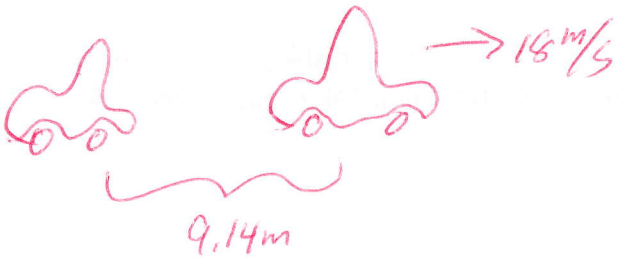
Directions: Solve the following problems, showing all work and circling your answer. Each is worth 3 points. Also, check the data below and make any needed changes.

1. You are driving to a vacation spot (fill in your favorite spot) 223 miles away. If you average 53 mi/hr, how long will it take you to get there (assuming no stops).

$t = \frac{x}{v} = \frac{223\,mi}{53\,mi/hr} = 4.2\,hr$

$\cdot\ 252\,min$

2. Imagine you are driving on a straight road at a constant speed of 18 m/s (40 mi/hr). A "friend" is following you at a distance of 9.14m (30 ft) also traveling at a constant speed, and maintaining a constant distance behind you. You are chewing on gum, and it's getting stale. You think it would be funny to "spit" the gum straight up in the air and have it land on their windshield. How fast would the gum have to leave your mouth in order for the gum to hit the windshield? (Assume no air resistance. In no way do I promote littering of any kind)



$t = \frac{9.14m}{18 m/s} = .5s$

$t = .5s$

$-v = +v_0$

$a = 9.8 m/s^2$

$v = v_0 + at$

$-v_0 = v_0 + at$

$-2v_0 = at$

$-v_0 = \frac{at}{-2} = \frac{(-9.8 m/s)(.5s)}{-2} = 2.45 m/s$

3. A pigeon starts flying north from York, and a train (EMD GP9…there you go Joel!!!) heads out of Enola heading south, both at the same time. The Enola Yard and York are 30 miles (48,000 m) apart (not really, but close). The pigeon flies low over the train tracks at a constant speed of 18 m/s, and the train starts out from rest and steadily accelerates at 0.05 m/s^2. Determine how far north the pigeon flies north until it has to fly up and over the train….or else…

$a = .05\ m/s^2$

$v_0 = zero$

$x_T = 45{,}000 - x_P$

$t = t$

$v = 15\ m/s$

$x_P = ?$

$t = t$

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

$t = \frac{x_P}{15\ m/s}$

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

$x_T = \frac{1}{2} a \left(\frac{x_P}{15\ m/s}\right)^2$

$(45{,}000m - x_P) = \left(\frac{1}{2}\right)\left(.05\ \frac{m}{s^2}\right) \frac{x_P^2}{324\ m^2/s^2}$

$(45{,}000m - x_P) = [7.72 \times 10^{-5}\ \frac{1}{m}]\ (x_P)^2$

$6.22 \times 10^8\ m^2 - 1.295 \times 10^4\ m\ x_P = (x_P)^2 + 1.295 \times 10^4\ x_P - 6.22 \times 10^8\ m^2$

A B C

Quadratic Roots

$x_P = 19255m$ or $-32234m$

19,300m
-or-
12mi

4. You throw a ball straight up in the air with a speed of 32m/s. Where is the ball after a time of 3.2 seconds?

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

$(32\ m/s)(3.2\ s) + \left(\frac{1}{2}\right)\left(-9.8\ m/s^2\right)(3.2\ s)^2$

52 m Above Ground

5. You are standing on the edge of a cliff that is 12 m high. You are holding a hand grenade with a 3 second fuse. You wish the hand grenade to explode just as it hits the ground. How fast and in what direction must you throw it for this to happen?

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

$$-12\,m = (v_0)(3s) + \left(\frac{1}{2}\right)\left(-9.8\,\frac{m}{s^2}\right)(3s)^2$$

$$\frac{-12\,m + \left(4.9\,\frac{m}{s^2}\right) 9s^2}{3s} = v_0$$

$$10.7\,\frac{m}{s} = v_0$$

upward

6. For the train in #3, how long does it take to get to 10 m/s?

$v = v_0 + at$

$\left(10 \frac{m}{s}\right) \left(.05 \frac{m}{s^2}\right) t$

$200\,s = t$

7. (Information from Wikipedia regarding Kingda Ka at Six Flags/great Adventure: reaching 456 ft high and accelerating up to 128 miles per hour (206 km/h) in 3.5 seconds. Six Flags is currently under chapter 11 bankruptcy, and Kingda Ka had some major malfunctions.) **Determine the acceleration of the train, in m/s^2.**

$$\left(\frac{206\,km}{hr}\right)\left(\frac{1{,}000\,m}{1\,km}\right)\left(\frac{1\,hr}{3600\,s}\right) = 57.2\,\frac{m}{s}$$

$v_0 = \text{zero}$

$v = 57.2\,\frac{m}{s}$

$a = ?$

$t = 3.5\,s$

$v = v_0 + at$

$v = at$

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

$\frac{57.2\,\frac{m}{s}}{3.5\,s} : 16.3\,m/s^2$

-or-

$1.67g$

8. When you throw a ball up in the air, determine the velocity at the top of the path

v = zero