WORK-ENERGY + some F=ma

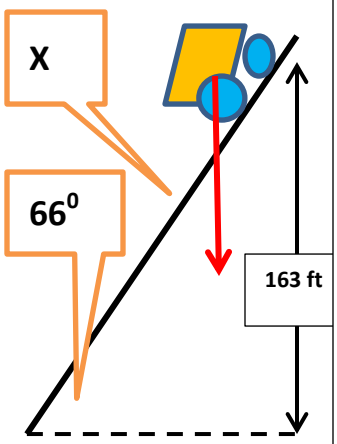
Units 10,11 + 6 &7

Dr. John P.Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu

& NYTimes July 3, 2012 by Henry Fountain

Wood Takes a Thrilling Turn

A Scream-Worthy Ride: Chad Miller, a roller coaster designer, faces unique challenges when dreaming up wooden coasters, like the Voyage , one of three such coasters at Holiday World in Santa Claus, Ind.



QUESTIONS: (a) Using energy concepts find speed(in ft/s & mph) at bottom of 163 ft high hill? Assume friction is zero. (b) Find acceleration down the hill? Use kinematic concepts. (c) Find X distance down the hill? (d) Find V at bottom of hill using Newton's 2nd law and kinematics.

HINTS:PE=mgh, KE= 1/2mv^2, F=ma , v^2 =v$_0$^{2} + 2ax, 88ft/s=60mph

ANSWERS: (a) 102 ft/s, ~ 69.6 mph (b) ~29.23ft/s^2 (c) 178.42 ft (d) 102 ft/s or 69.6 mph

MORE HINTS: On question (d): Find acceleration down hill first from Newton's second law. Then, use kinematic concepts to find V at bottom of hill. The V you obtain with energy (question a), should compare well with V obtained with Newton & kinematics in question (d).

SANTA CLAUS, Ind. — The first drop is a doozy. From the summit of the wooden roller coaster called the Voyage **((((, 163 feet vertical above the Holiday World theme park))))** in the rolling woodlands of southern Indiana, the track **drops x = 178.4 feet at(((a 66-degree angle))))). ((((The cars quickly reach a top speed of nearly 70 miles an hour))))**. Those gasp-inducing numbers help explain why more than a million people a year visit Holiday World, which is a ways off the beaten track, and why the Voyage, one of three large wooden coasters at the park, earns high marks from connoisseurs. **"It's 6,400 feet of track,"** Mr. Miller said. "We had so much track to work with, we said, 'Let's do some really cool stuff.' "It's the best I've ever ridden," said Sister Michelle Sinkhorn, a Benedictine nun who lives nearby in Ferdinand, Ind., and figures she's taken at least 100 trips on the Voyage. **She keeps her hands up during the whole ride, which lasts two minutes and 45 seconds..** "I'm free. I'm a free flyer," she said. ***Coaster designers are constrained by the amount of potential energy they have to work with, which is determined by the weight of the car and its riders, height and gravity. It is highest at the top of the first hill (called the lift hill, because the car is hauled to the top by a chain). As the car coasts down the hill and up the next one (and, as your high school physics teacher would be pleased that you remembered, (((potential energy is converted to kinetic energy))))) and then back to potential energy), friction takes its toll.*** The amount of potential energy declines along the route, and no other hill can be as high as the first. The Gravity Group's software displays a blue "energy line," and if the designers exceed it at any point, that means the car would stop and roll back. That can happen on actual coasters, usually at the start of the season during the first riderless runs**, when cold temperatures make wheel bearings sluggish, keeping speeds down.** Were it to happen with riders on board, safety features built into the track would prevent the car from rolling backward. "Wood is a very imprecise material," he said. "If it's cold, then you are going to have one amount of friction loss**. If it's hot and just rained, mixed with the oil on the track, it's going to fly like crazy."**