

PHYS 1211 *University Physics I*

Winter Quarter, 2007

Problem Set 2

Due: Wednesday, Jan. 17, 2007

INSTRUCTOR

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THE FLYING TRAIN

The world record speed for a train (581 km/h) was set recently by a Japanese Magnetically-levitated, or Mag-Lev Train. Several other countries are researching or already using these “flying trains” for high-speed rail travel. They use the repulsive force between large magnets (sometimes electromagnets made from high-temperature superconducting materials) to float the train off a special track. As a result the vehicle can move with no friction. We will discuss friction and magnetic forces later in the course. For now, let’s examine the kinematics of these trains.

One developer of this technology states that, from a standing start, its train reaches 300 km/h in a distance of only 5 km. A current state-of-the-art high speed train (for example the German ICE) requires 30 km to reach the same speed.

Answer the following (30 points total):

1. How fast is 300 km/h in miles-per-hour? How about in meters per second?[1 point]
2. Calculate the acceleration of each train, assuming it remains constant until 300 km/h is reached. [3 points]
3. Let’s pretend RTD is considering installing a high-speed train between Denver and Boulder, and have hired you to consult on the choice between a Mag-Lev and an ICE-type train. Calculate the time of the Denver-Boulder express trip (no stops) in the Mag-Lev train, assuming the route is 30 miles long, and that the acceleration is the same for starting and stopping the train. [5 points]
4. Now determine the time for the trip in the ICE, but remember this wheeled train needs 30 km to reach top speed, and 30 km to stop from top speed. You will find that puts the train well beyond Boulder. To stop the train in Boulder where should you start slowing down? What is the highest speed the ICE achieved? How long is the trip in the ICE? [5 points]
5. Now consider a non-express route that stops in Westminster (10 miles), Broomfield (20 miles), and Superior (25 miles) before reaching Boulder. What is the total time of the non-express Denver-Boulder trip for each train? [10 points]
6. For comparison, how long do the current Express and non-express RTD buses take to travel from Denver to Boulder? (Route BX and B, www.rtd.com) [1 point]
7. What is your final recommendation to RTD? Consider that the Mag-Lev is slightly more costly than the ICE, but either one is considerably more expensive than the bus system. [5 points]

HALLIDAY, RESNICK, AND WALKER (HRW)_____

Read Chapter 2.

Complete the following problems from HRW Chapter 2: 1, 2, 3, 5, 18, 25, 35 (each is worth 10 points)