

Problem Detail

Title: A Day in the Life of John Henry, Traffic Cop

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Discipline: Physics and Astronomy

Target Audience: Introductory, Can be used for majors and non-majors

Keywords: car accident, conservation of momentum, forces, friction

Length of Time/Staging: about one week

Abstract: This problem introduces students to conservation of momentum as working through a 2-dimensional automobile accident.

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Problem content: [Part 1](#)
[Part 2](#)
[Part 3](#)
[Part 4](#)
[Field Sketch](#)

Supporting Materials: [Format of Delivery](#)
[Student Learning Objectives](#)
[Student Resources](#)
[Instructor Resources](#)
[Author's Teaching Notes](#)
[Assessment Strategies](#)

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A Day in the Life of John Henry, Traffic Cop



Part 1.

At 13:20 on the last Friday in September, 1989 a frantic call was received at the local police station. There had been a serious automobile accident at the intersection of Main Street and State Street, with injuries involved. Lt. John Henry arrived at the scene 10 minutes after the phone call and found that two cars had collided at the intersection. In one car, the driver was unconscious and in the other car both driver and one passenger were injured.

After the emergency vehicles transported the injured to the hospital, Lt. Henry's responsibility is to investigate the accident in order to determine whether one of the drivers (or both) are responsible. With the severity of injury in this accident, the investigation is critical because there may be a fatality involved.

Questions:

1. What questions does John Henry have to answer in this investigation? What measurements does he need to take? What data should he collect? What other information does he need to record in order to aid the investigation? What physics principles will John Henry need to use in order to help analyze the data and answer his questions?
2. If two cars moving at right angles to each other collide, in what direction do you expect the cars to be moving after the collision?
3. What factors will influence the direction and distance traveled after impact?

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Images courtesy of [Public Safety Photo Journal](#) (left) and [Wreck of the Week](#) (right)

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Part 2.

[Refer to the attached sketch.](#) Main street, a thoroughfare, has a 45 mile per hour speed limit. State Street also has a 45 mile per hour limit, but has a stop sign on either side of the road. Vehicle 2, which weighs 5800 lbs, skidded for 24 feet before coming to a stop next to the utility pole, marked Dec #20. Vehicle 1, which weighs 2060 lbs, showed no skid marks after the impact and came to a rest next to the house on the corner. Looking at the impact areas of the cars, it was clear to Lt. Henry that the cars impacted at right angles, hitting the front right bumper of vehicle 2 and the front left bumper of vehicle 1. After impact, they initially were traveling in the same direction. Lt. Henry noted that the weather was clear and sunny, 69° and the roadway was dry.

Before John Henry got any further in his analysis, he was informed that driver who was unconscious at the scene of the accident died at the hospital.

Questions:

4. Can you make an educated guess about which driver died based on the evidence so far? Justify your answer.
5. Why would John Henry note the weather and the condition of the road?
6. Why did vehicle 1 travel further than vehicle 2?

Part 2. (contd.)

John Henry has to determine whether the driver of vehicle 2 ran the stop sign and/or if the driver of vehicle 1 was speeding. Outline a procedure that Lt. Henry can use to answer these important questions. Be sure that your reasoning is sound, since he will have to testify in court on the evidence.

Question:

7. Does John Henry have all the information he needs to determine the velocities?

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Part 3.

Lt. Henry used a drag sled to determine that the coefficient of friction between the tires and road was 0.60. He can't use the drag sled to determine the coefficient of friction between the tires of vehicle 1 as they roll over the roadway and grass.

Questions:

8. Does he need this information? What procedure can he use to find out this information?
9. Using your outlined procedures, find the velocities of the two vehicles just prior to impact and estimate the coefficient of friction between the rolling tires of vehicle 1 and the roadway and grass. Be sure to state any assumptions that you make and justify them.
10. During the collision, which vehicle delivered the greater force of impact? Justify your reasoning using physics principles.
11. How can Lt. Henry determine the speeds of both vehicles just before they applied their brakes? What further information will he need?

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Student Learning Objectives

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1. Use understanding of the principles of forces, motion, and energy to design a plan to reconstruct a car accident.
2. Explain how frictional forces related to varying surfaces affect the motion of an object.
3. Calculate the velocities of two vehicles before and after impact using physics principles, such as forces, motion, mechanical energy, and conservation of momentum.
4. Evaluate real world data related to a car accident in order to make a judgement about the drivers' fault.
5. Find and use appropriate learning resources to aid in reconstructing the accident.

Student Resources

Title: A Day in the Life of John Henry, Traffic Cop

National Highway Traffic Safety Administration

<http://www.nhtsa.gov/>

Custom Design & Consultation:

Accident Reconstruction Resources

<http://www.c-design.com/accrec.html>

National Association of Investigative Specialists:

Links related to accident investigation, highway safety, and accident reconstruction

<http://pimall.com/nais/links.acc.html>

Texas Association of Accident Reconstruction Specialists:

Hot links to related sites

<http://www.taars.org/links.htm>

PBS Nova Online: Escape!:

Car Resources

<http://www.pbs.org/wgbh/nova/escape/resourcescar.htm>