

## ACCIDENT RECONSTRUCTION #2

This activity was adapted from the Crash Reconstruction Proficiency Test administered by the Ohio State Highway patrol in 1995, read the police report of the accident and then answer the questions. Show the work done in arriving at your answers on a separate sheet of paper.

Highway patrol officers taking this exam are also given a table of frequently used equations. Below is the velocity-displacement formula for acceleration that changes abruptly from one constant value to another:

$$v_f^2 = v_i^2 + 2a_1\Delta x_1 + 2a_2\Delta x_2 + \dots$$

- Before the collision, vehicle #1 was traveling East on Main St. and vehicle #2 was traveling north on High St. At this intersection, traffic on High St. is controlled by a stop sign while traffic on Main St. is uncontrolled.
    - The driver of vehicle #1 states he was traveling 25 mph (11 m/s) as he approached the intersection. He further states that vehicle #2 ran the stop sign on high St., pulling out in front of him and causing the crash.
    - The driver of vehicle #2 states that he stopped at the stop bar and carefully looked both left and right before pulling out to cross Main St. (From the stop bar, vehicle #2 would have traveled 30 ft (9.1 m) to the point on impact.) He further states that he did not see the other car until the moment of impact. Confident that he had carefully looked both ways before pulling out, his only explanation for the crash is that vehicle #1 was speeding and concealed by a hill crest located on Main St. approximately 1000 ft (300 m) west of the intersection.
  - After the collision, both vehicles experience wheel lock due to crash damage and skidded over asphalt ( $\mu_k=0.72$ ) followed by grass ( $\mu_k=0.35$ ). Neither surface had any significant incline.
    - Vehicle #1 skidded on 20 ft (6.1 m) of asphalt and 30 ft (9.1 m) of grass before coming to rest. The angle of departure for vehicle #1 was  $45^\circ$  north of east. The weight of vehicle #1 including load and occupants was 4300 lb (19,200 N).
    - Vehicle #2 skidded on 25 ft (7.6 m) of asphalt and 35 ft (10.7 m) of grass before coming to rest. The angle of departure for vehicle #2 was  $35^\circ$  north of east. The weight of vehicle #2 including load and occupants was 3150 lb (14,000 N). An acceleration test was conducted with a vehicle similar in weight and performance to vehicle #2. It was found that the maximum acceleration rate would have been  $2.0 \text{ m/s}^2$  at the time of the accident.
1. Sketch a diagram of the accident showing the path of each vehicle before and after the collision. Include all the relevant distances on the paths. Label each vehicle, the streets, and the different surfaces (asphalt and grass). Indicate the location of the stop sign, stop bar, and point of collisions.
  2. What was the speed of each vehicle just after the collision?
  3. What was the speed of each vehicle just before the collision?
  4. Assess the claims of the two drivers. Justify your response with the appropriate calculations.

Source: David Larabee. "Car Collisions, Physics and the State Highway Patrol." *The Physics Teacher*. vol. 38, no. 6 (Sept. 2000): 334-336.