

ACCIDENT RECONSTRUCTION

- ☞ 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 the paper I provide. Do not put more than one question on a page. Write only on the front of the pages. When you are finished, assemble all the sheets in order and staple them together. Write your names on the top of the first page. Submit only one report for your group.
- ☞ Highway patrol officers taking this exam are also given a table of frequently used equations. Most of the equations on this reference table can easily be found in the mechanics chapters of any introductory physics textbook; either in the general text or in the sample problems. One important exception was the velocity-distance formula for acceleration that changes abruptly from one constant value to another. This formula is shown below.

$$v^2 = v_0^2 + 2a_1\Delta s_1 + 2a_2\Delta s_2 + \dots$$

- Before the collision, vehicle #1 was traveling east on Main Street and vehicle #2 was traveling north on High Street. At this intersection, traffic on High Street is controlled by a stop sign while traffic on Main Street is uncontrolled.
 - The driver of vehicle #1 states he was traveling 25 mph (11 m/s) as he approached the intersection. He continues to state that vehicle #2 ran the stop sign at High Street, pulling out in front of him and causing the crash.
 - The driver of vehicle #2 states he stopped at the stop bar and carefully looked both left and right before pulling out to cross Main Street. (From the stop bar, vehicle #2 would have traveled 30 feet (9.1 m) to the point of 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 Street approximately 1000 feet (300 m) west of the intersection.
 - After the collision, both vehicles experienced 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 feet (6.1 m) of asphalt and 30 feet (9.1 m) of grass before coming to rest. The angle of departure for vehicle #1 was 45° north of east. The weight of vehicle #1 including load and occupants was 4300 lb. (19,200 N).
 - Vehicle #2 skidded on 25 feet (7.6 m) of asphalt and 35 feet (10.7 m) of grass before coming to rest. The angle of departure for vehicle #2 was 35° 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 for vehicle #2 would have been 2.0 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 collision. Include all the relevant distances on the paths. Label each vehicle, label the streets, and label the different surfaces (asphalt and grass). Indicate the location of the stop sign, stop bar, and point of collision.
 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 (September 2000): 334-336.