



# Traffic Accident: who is to blame?

## Your Task

You are asked to determine who is at fault in an accident in which a van knocked down a boy on a pedestrian crossing. A scenario and further details are given on the next page

## Scenario

The following is a brief description of the situation:

- A boy was crossing the road at a pedestrian crossing when he was hit by a van.
- This particular pedestrian crossing indicates when it is safe to cross the road by giving a 'green man' indicator by means of a set of traffic lights.
- When the green man shows towards the pedestrian, a red light is shown towards the traffic.
- The point of impact between the boy and the van on the pedestrian crossing was 4.6 m from the kerbside.
- Another pedestrian who was behind the boy waiting to cross the road acted as a witness to the accident.
- The following comments were made to the police after the accident.

*Boy:* I crossed the road immediately the 'green man' came on. I thought the van would stop, but it didn't.

*Driver of van:* I was travelling at  $40 \text{ km h}^{-1}$ . The traffic light was green for me when the boy stepped off the kerb. I slammed on the brakes immediately as hard as possible, but I still hit him - at no more than  $10 \text{ km h}^{-1}$ .

*Witness:* I was behind the boy waiting to cross the road. The boy walked across the road quickly as the 'green man' came on.

## *Additional information*

- The witness was asked to walk 5 m several times at the same pace as the boy did when crossing the road. His average time measured over the 5 m was 2.9 s.
- From the boy's slight injury, the impact speed would be at most  $10 \text{ km h}^{-1}$ .
- Four skid marks were left by the van, the longest being 19.8 m
- The coefficient of tyre/road friction was found by a skid test to be 0.76.
- The phasing of lights for traffic was that the yellow light lasted 3 s before the 'green man' and the red light for traffic came on together.

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**Developer:** Jack Holbrook (adapted from *Physics of Road Traffic Accidents* by P.K.Tao: Hong Kong, Oxford University Press, 1987)

**Institution:** International Council of Associations for Science Education (ICASE)

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## Student Activities

1. Draw a reconstruction of the scene. Indicate on this:
  - the pedestrian crossing,
  - the point of impact,
  - the distance the boy walked across the road,
  - the approximate position where the skid marks began.
2. By using the available data, and your background in undertaking calculations using the laws of motion, undertake calculations to determine how long it took the boy to cross the road before he was hit by the van.
3. Mark the outcome from your calculations from 2 on your reconstruction diagram.
4. Put forward suggestions about how to determine how long it took the van to stop. (Hint: note the skid marks).
5. To determine how long it took the van to stop because it was skidding, it is necessary to know the factor that affects the skidding process. This depends on the material skidding (the rubber) and the material on which it was skidding (the road surface), but the overall effect is that the van loses kinetic energy as work is done against the friction of the rubber and the road surface. This requires determine the relationship between change in kinetic energy and work done against friction
6. Explain why the change of kinetic energy of the van is the same as the work done against friction when the van is skidding.
7. The relationship in 5 and 6 includes a coefficient that is related to the friction between the surfaces. Explain this coefficient, called the coefficient of friction. Suggest a way in which it is possible to determine the coefficient of friction for different surfaces.
8. Following instructional guidance from the teacher, determine the coefficient of friction for some surfaces
9. Using the above expression and noting the coefficient of friction between the van types and the road surface under normal conditions is 0.76, determine the time it took the van to stop.
10. If the van driver's reaction time is 0.8 s, determine the position of the van when the lights went red and the boy started to cross the road.
11. In a small group, discuss the findings from the calculations undertaken in steps 2, 9, and 10. By also bearing in mind the reliability of the data provided, errors in measurement and other variables, determine whether the van driver was liable for the accident. Fully justify your decision and seek consensus on the decision within the group. Be prepared to justify your assumptions..

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