# Railway Crossing Problem

1 July 2024

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This is an interesting problem from the 1966 *Eureka* magazine ([1]).

A railway and a road run together for seven miles from P to Q. Two miles from P there is a level crossing, which is closed one minute before, and opened one minute after, a train passes.

A train passes a Stationary car at P and travels on to Q at 60 m.p.h., and, forgetting to slow down, crashes at Q; the car passes the train as it crashes. Assuming that stopping for an instant from full speed loses the car one minute, of what speed must it be capable?

## Solution

This seems a bit complicated at first. But the space-time diagram (Figure 1) capturing the information of the problem reveals a simple answer.

First, realize that the train going 60 mph means it is going a mile a minute. Therefore, it covers the 7 miles between P and Q in 7 minutes. This means it reaches the level crossing at 2 miles in 2 minutes. Therefore, the crossing is blocked from 1 minute after leaving P to the 3 minutes as shown.

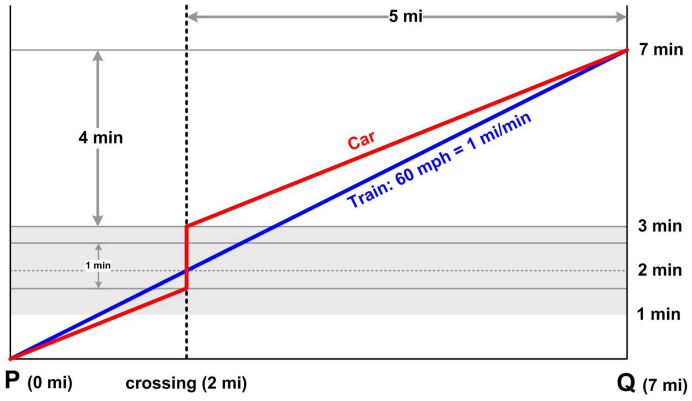


**Figure 1**

The car reaches the crossing after it has started being blocked and has to wait until it is unblocked at 3 minutes. (We are assuming the 1 minute it takes the car to stop occurs within the 2-minute blocked period.) This means the car has 7 – 3 = 4 minutes to cover the remaining 7 – 2 = 5 miles to Q. That means the car's (constant) speed must be

$$\frac{5mi}{4\,\text{min}} \times \frac{60\,\text{min}}{1hr} = 75mph$$

As a check, 75 mph = 1¼ mi/min. Therefore (2 mi)/(1¼ mi/min) = 1⅗ min, which proves the car arrived after the crossing was blocked at 1 minute. And since it took a minute to stop, it had to wait ⅖ minute until the crossing was unblocked, as Figure 1 anticipated. So the assumptions of the solution were satisfied by the 75 mph answer.

(The problem must be assuming the length of the train does not come into play, otherwise the time when the crossing is opened is undetermined and so also is the max speed of the car—though at least it must be able to go 75 mph. 75 mph is given as the *Eureka* answer (without a solution). Perhaps the minimum sufficient speed is what is meant by "of what speed must it be capable?", though that is a stretch, since I would be expecting the actual speed necessary.)

## References

[1] "The Problems Drive #6", *Eureka*, No. 29, October 1966. p.6
(https://www.archim.org.uk/eureka/archive/Eureka-29.pdf)