**Dangerous Driver? - Michael**

The question is can it be proven that the driver cannot accelerate to 133kmh-1 (37ms-1) over a distance of 338m from a standing start in a car that accelerates from 0-96kmh-1(27ms-1) in 10.5s? I have supposed that everyone in court told the truth.

I am also assuming that the car accelerates at a constant velocity. Please note that my working continues to use the exact number required even if I do not show this on the screen.

The car can reach 27ms-1 in 10.5 seconds so...
$a=\frac{27}{10.5}$ $a=2.54$ms-2

And

$$v^{2}=u^{2}+2as$$

So because $s=338$ and $u=0$

$v=\sqrt{0+2×2.54×388}$ $v=41.43$ms-1 or 149kmh-1

This means that, using this model, it is possible that the driver could have accelerated to 133kmh-1. However, there are some problems with this model. In reality the gradient of the velocity-time graph would be decreasing due to the resultant forward force on the car decreasing due to greater air resistance and other factors. The real graph would more closely resemble a square route graph than a straight line graph. This would cast doubt on the proceedings as it is feasible that the car’s acceleration declined rapidly after reaching 27ms-1. I will now examine how likely this is.

In the first 10.5 seconds the car drove 140m because its average speed was 46kmh-1 (92kmh-1 divided by 2) and distance equals speed multiplied by time. This leaves 198m still to go and, in order to reach a speed of 133kmh-1, the time taken to cross it must be less than 6.225s because

$198=0.5\left(27+37\right)t$ $t=6.225 (3DP)$ This is due to $s=0.5\left(u+v\right)t$

This implies an acceleration of around 1.7ms-2 because 10ms-1 (speed increase) divided by 6s (amount of time taken) is around 1.7ms-2. This is significantly less than the acceleration from 0-27ms-1 and, as 133kmh-1 should be well within the car’s maximum speed, the acceleration of the velocity-time curve could be greater than this. We cannot be certain that this is so without more information of the specific curve of the car in question. However, as the question asks: “Could the penalty reasonably be rejected on mathematical grounds?” the answer is no – at the moment it is almost certainly not impossible.