

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

Unit A154: (controlled assessment)

A154

PHYSICS A

Unit A184: (controlled assessment)

A184

Factors that affect the motion of a vehicle along a surface

Information for candidates (2)

To be issued to candidates **only** on completion of the data collection part of their practical investigation.

This secondary data can be used as part of your practical investigation.

You can select the data that is useful for you.

The effect of road texture on fuel consumption

Fuel consumption of cars is affected by many factors, including the resistance offered by the road surface. The following investigation was carried out by scientists at the Swedish Road and Traffic Research Institute.

A Volvo car with special instrumentation was run on four types of road surface at 20 test sites in Sweden. Its average fuel consumption was measured when run at three different speeds.

Some of the results are shown below.

road type	average fuel consumption in cm ³ /km		
	speed = 50 km/h	speed = 60 km/h	speed = 70 km/h
asphalt, with 0 – 8 mm chippings	69.5	67.6	73.6
asphalt, with 0 -16mm chippings	71.4	69.2	73.2
asphalt, with 12 -16mm chippings	70.8	72.5	78.8
concrete, with 0 – 25mm chippings	72.0	71.0	75.6

The scientists also measured the texture of the four road types the car was driven on. Road texture is dependent on several factors, including the roughness of the road surface caused by the chippings of rock or aggregate that are used to make it.

Road texture is difficult to measure. As an indication of road texture, the scientists recorded data about the surface by scanning a laser over the road from a moving vehicle.

road type	road texture in arbitrary units
asphalt, with 0-8 mm chippings	48.0
asphalt, with 0-16 mm chippings	50.2
asphalt, with 12-16 mm chippings	63.9
concrete, with 0-25 mm chippings	52.0

From: Sandberg, Ulf S. I. *Road Macro- and Megatexture Influence on Fuel Consumption*. ASTM STP 1031 page 460-479, USA 1990, published in JOINT EAPA/EUROBITUME TASK GROUP FUEL EFFICIENCY (2004). *Environmental Impacts and Fuel Efficiency of Road Pavements*. EAPA/EUROBITUME

The effect of 20 mph speed limits on road injuries

In order to reduce deaths and injuries on the roads, many towns have introduced 20 mph speed limits in residential areas. In London, the effect of these new 20 mph zones was monitored by measuring the reduction in the number of injuries to pedestrians.

pedestrians	% reduction in injuries after introduction of 20 mph zones	
	in the 20 mph zones	in nearby 30 mph zones
All pedestrians	32.4	4.3
0-5 years old	47.0	9.9
6-11 years old	50.8	3.7
12-15 years old	26.3	6.3

Effect of 20 mph traffic speed zones on road injuries in London, 1986-2006: controlled interrupted time series analysis; Chris Grundy et al; <http://www.bmj.com/content/339/bmj.b4469.full>

Braking distance

The theoretical braking distance can be calculated from this equation:

$$s = \frac{v^2}{2a}$$

where:

v = initial velocity

a = rate of deceleration

s = distance travelled during deceleration (the braking distance)

If we assume that the deceleration due to braking is 10 m/s^2 , we can estimate braking distances for cars travelling at different speeds. For example:

speed in km/h	braking distance in metres
65.0	16.3
60.0	13.9

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