1.

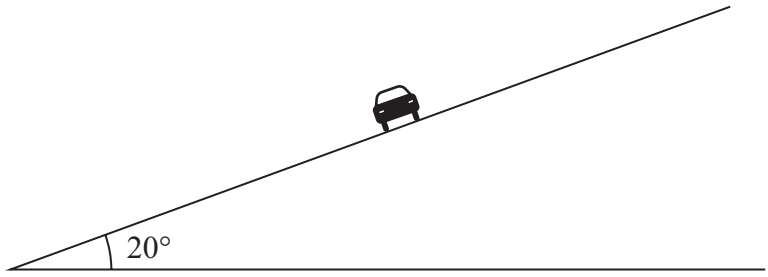


Figure 1

A car moves on a horizontal circular path round a banked bend on a race track.
The radius of the path is 60 m.
The bend is banked at 20° to the horizontal, as shown in Figure 1.

The coefficient of friction between the car and the track is 0.25
The maximum speed at which the car can be driven round the bend without slipping sideways is $V\,\text{m s}^{-1}$
The car and driver are modelled as a single particle of mass 700 kg.

Using the model,

(a) find the magnitude of the normal reaction between the car and the track when the speed of the car is $V\,\text{m s}^{-1}$

(4)

(b) find the value of V.

(4)

(Total for Question 1 is 8 marks)

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2. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

A particle is moving along the x-axis.

At time t seconds, $t \geqslant 0$

- the particle has velocity $v\,\text{m s}^{-1}$ in the positive x direction
- the particle has acceleration $\left(3 - \dfrac{8}{2t+3}\right)\text{m s}^{-2}$ in the positive x direction

When $t = 0$, the particle passes through the origin with velocity $2(\ln 3)\,\text{m s}^{-1}$ in the positive x direction.

(a) Use algebraic integration to show that $v = pt + q\ln(2t+3) + r\ln 3$, where p, q and r are constants to be found.

(4)

(b) Use algebraic integration to find the distance of the particle from the origin at time $t = 3$, giving your answer to 3 significant figures.

(4)

(Total for Question 2 is 8 marks)