

- 6 A 1350 kg car accelerates uniformly from  $3.0 \text{ ms}^{-1}$  along a horizontal, straight road until it reaches  $24 \text{ ms}^{-1}$ .

(a) (i) Calculate the increase in kinetic energy of the car.

increase in kinetic energy = ..... J [2]

- (ii) A second identical car and driver accelerates from  $3.0 \text{ ms}^{-1}$  to  $24 \text{ ms}^{-1}$ , however the acceleration is not uniform.

State and explain how the increase in kinetic energy of the second car compares with the answer in (a)(i).

.....  
 .....  
 ..... [2]

- (b) The first car takes 1.2 s to accelerate uniformly from rest to  $3.0 \text{ ms}^{-1}$  and it then accelerates uniformly from  $3.0 \text{ ms}^{-1}$  to  $24 \text{ ms}^{-1}$  at  $4.5 \text{ ms}^{-2}$ .

Calculate the distance travelled by the car when it accelerates from rest to  $24 \text{ ms}^{-1}$ .

distance travelled = ..... m [4]





- (c) The car reaches a bend in the road which follows a circular path with radius of curvature 65 m.

Calculate the centripetal force that must act on the car to make it follow the circular path at a constant speed of  $24 \text{ ms}^{-1}$ .

centripetal force = ..... N [2]

- (d) Explain why there must be friction between the road and the car tyres for the car to:

- (i) accelerate in part (a)

.....

.....

..... [2]

- (ii) follow the bend in the road in part (c).

.....

.....

..... [2]



- (e) The maximum frictional force between the car and the ground is given by

$$0.70 \times \text{weight of car}$$

- (i) Explain why the car is unable to travel around the bend at  $24 \text{ ms}^{-1}$ .

You will need to carry out a calculation.

..... [2]

- (ii) The road is banked at an angle to the horizontal so that it is raised towards the outside of the bend and lowered towards the inside of the bend. This is shown in Fig. 6.1.

towards centre of circular path

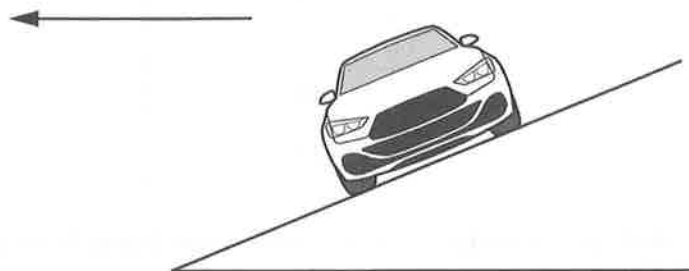


Fig. 6.1 Not to scale

Explain why the car is now able to travel around the bend at  $24 \text{ ms}^{-1}$ .

Do not make any calculations.

..... [2]

- (iii) The angle  $\theta$  is the minimum angle at which the road must be banked to the horizontal so that the car is able to travel around the bend at  $24 \text{ ms}^{-1}$ .

Explain how  $\theta$  changes in wet weather compared with dry weather.

..... [2]

[Total: 20]

