2 A theme park ride is illustrated in Fig. 2.1. The carriage of mass 450 kg, moving at 1.0 m s^{-1}, slides down the slope and then moves over a small hill. The slope consists of two circular arcs of the same radius 15 m and the hill has a small circular arc of radius 20 m at the top.

Assume no resistive force acts on the carriage.

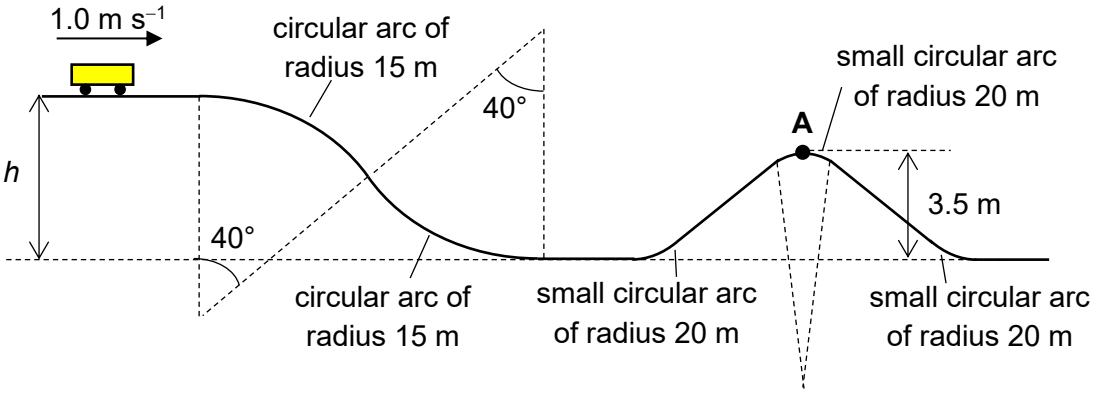

Fig. 2.1 (not to scale)

(a) Show that *h* is 7.0 m.

[1]

(b) Calculate the speed of the carriage when it reaches point A.

speed of the carriage at point A = ... m s^{-1} [2]

(c) On Fig. 2.2, draw and label the forces acting on the carriage when it is at A.

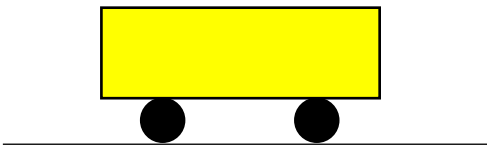

Fig. 2.2

[2]

(d) Calculate the normal contact force acting on the carriage at A.

normal contact force on carriage at A = ... N [2]

(e) During the entire journey, the carriage experiences varying normal contact force.

(i) On Fig. 2.1, mark with an "X" the point at which the carriage experiences the largest normal contact force.

[1]

(ii) Explain your answer in **(e)(i)**.

.....

.....

.....

..... [2]

(f) Determine the maximum speed of the carriage at A such that the carriage does not lose contact with the track.

maximum speed of the carriage = ... $m\ s^{-1}$ [2]