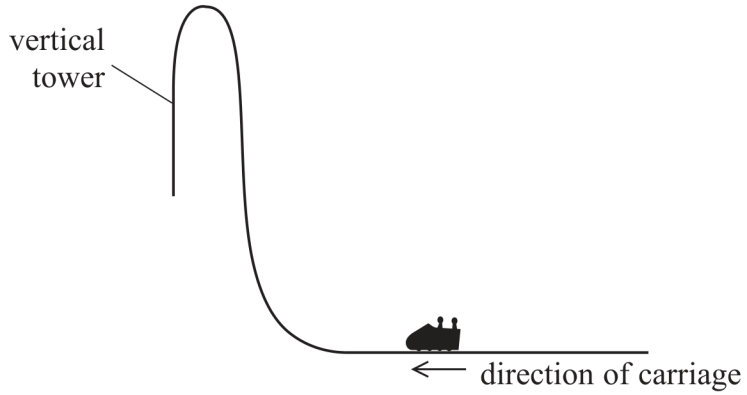
15 A carriage on a roller coaster ride travels along a horizontal track towards a vertical tower, as shown.



(a) The carriage starts from rest. A force of 109 kN acts on the carriage for 2.9 s. The carriage then moves up a vertical tower of height 81 m.

(i) Show that the velocity of the carriage is about 40 m s^{-1} as it leaves the horizontal track.

total mass of carriage and people = 7500 kg

(2)

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(ii) Deduce whether this velocity is enough for the carriage to reach the top of the tower.

Assume that resistive forces are negligible.

(3)

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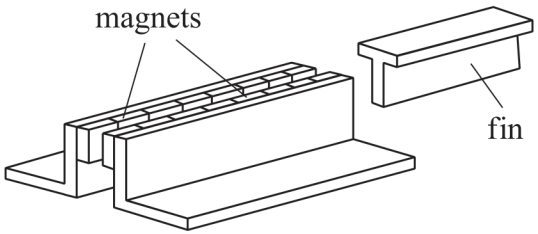
(b) Just before the carriage reaches the end of the ride it is slowed by an electromagnetic brake. Powerful magnets are attached to the track. An aluminium fin is attached to the carriage. The fin moves through a narrow gap between the magnets.



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Explain why the fin will leave the gap with a much slower speed than it entered the gap.

(5)

(Total for Question 15 = 10 marks)