3 A roller coaster ride in an amusement park consists of an unpowered car moving freely along a smooth track. Fig. 3.1 shows the roller coaster car moving with speed v at the top of a vertical loop with radius R. Ignore any resistive forces on the car.

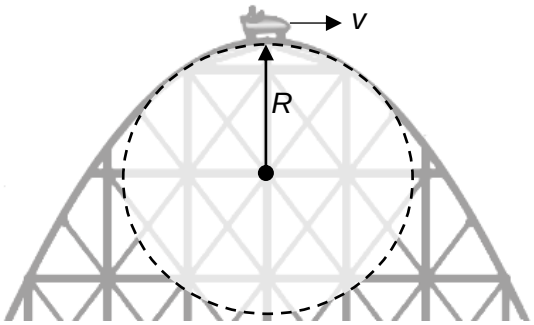

Fig. 3.1

(a) For the car to remain in contact with the track at the top of the loop, show that the maximum speed v_{max} of the car is

$$v_{max} = \sqrt{Rg}.$$

Explain your working.

[3]

(b) The entire roller coaster ride consists of two of such vertical loops with positions A and B as shown in Fig. 3.3. The two loops have radii R_1 and R_2 respectively.

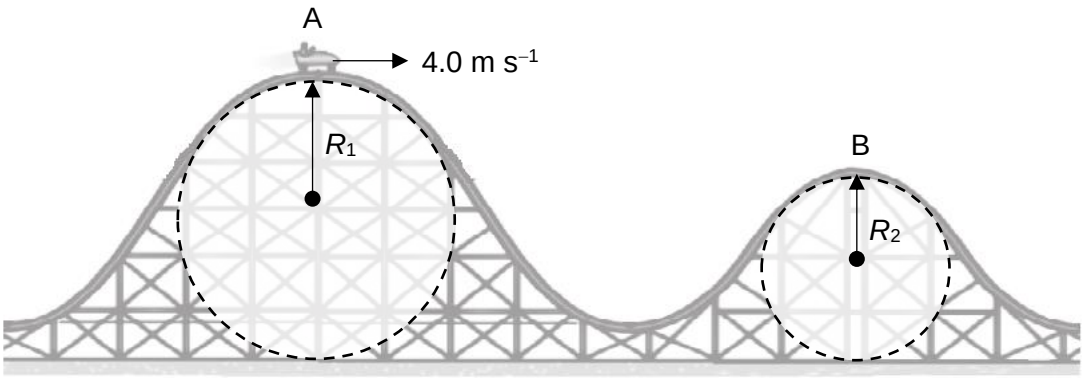

Fig. 3.3

During a test run, the car has a speed of 4.0 m s^{-1} at A where radius of the first loop R_1 is 15 m. Determine the minimum radius R_2 so that the car will remain in contact with the track throughout its journey.

R_2 = ... m [3]

(c) Fig. 3.4 shows the car when it is at position C after it leaves A.

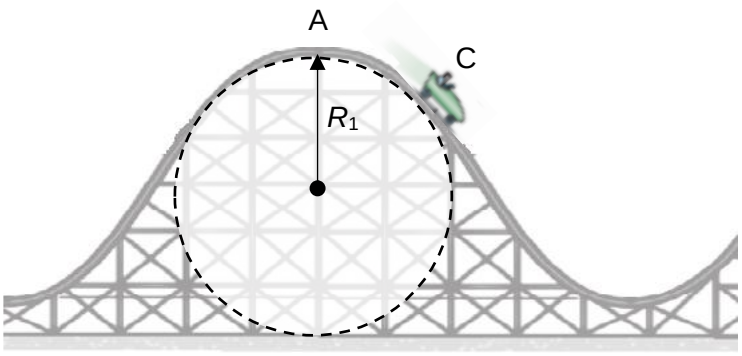

Fig. 3.4

On Fig. 3.4, draw an arrow to show the resultant force on the car at point C. Explain your answer.

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.....[2]

[Total: 8]