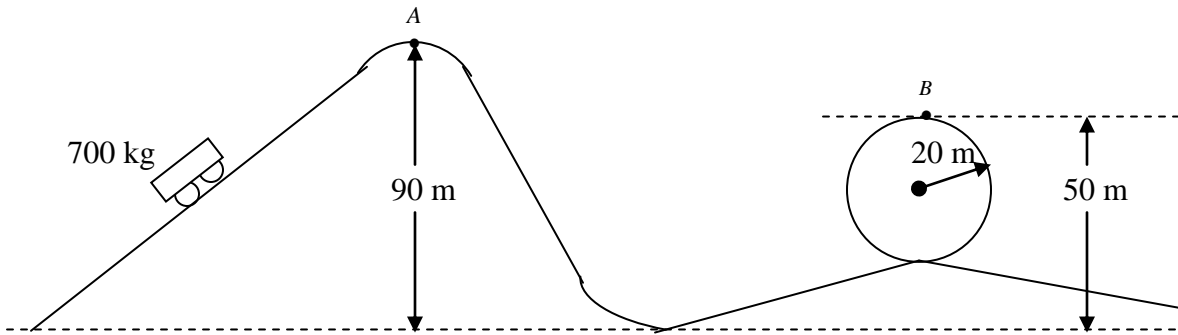


January Problem of the Month



(15 points)

A roller coaster ride at an amusement park lifts a car of mass 700 kg to point A at a height of 90 m above the lowest point on the track, as shown above. The car starts from rest at point A , rolls with negligible friction down the incline and follows the track around a loop of radius 20 m. Point B , the highest point on the loop, is at a height of 50 m above the lowest point on the track.

- (a)
- i. Indicate on the figure the point P at which the maximum speed of the car is attained.
 - ii. Calculate the value v_{\max} of this maximum speed.
- (b) Calculate the speed v_B of the car at point B .
- (c)
- i. On the figure of the car below, draw and label vectors to represent the forces acting on the car when it is upside down at point B .



- ii. Calculate the magnitude of all the forces identified in (c)i.
- (d) Now suppose that friction is not negligible. How could the loop be modified to maintain the same speed at the top of the loop as found in (b)? Justify your answer.