

## **STEP II, 2015, Q10**

- 10 A particle of mass  $m$  is pulled along the floor of a room in a straight line by a light string which is pulled at constant speed  $V$  through a hole in the ceiling. The floor is smooth and horizontal, and the height of the room is  $h$ . Find, in terms of  $V$  and  $\theta$ , the speed of the particle when the string makes an angle of  $\theta$  with the vertical (and the particle is still in contact with the floor). Find also the acceleration, in terms of  $V$ ,  $h$  and  $\theta$ .

Find the tension in the string and hence show that the particle will leave the floor when

$$\tan^4 \theta = \frac{V^2}{gh}.$$



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