2

A block of mass *2m* initially rests on a track at the bottom of the circular, vertical loop of radius *r* as shown in Fig. 2.1. A bullet of mass *m* strikes the block horizontally and remains embedded in the block as the block and bullet circle the loop. Assume frictional force of the loop is negligible.
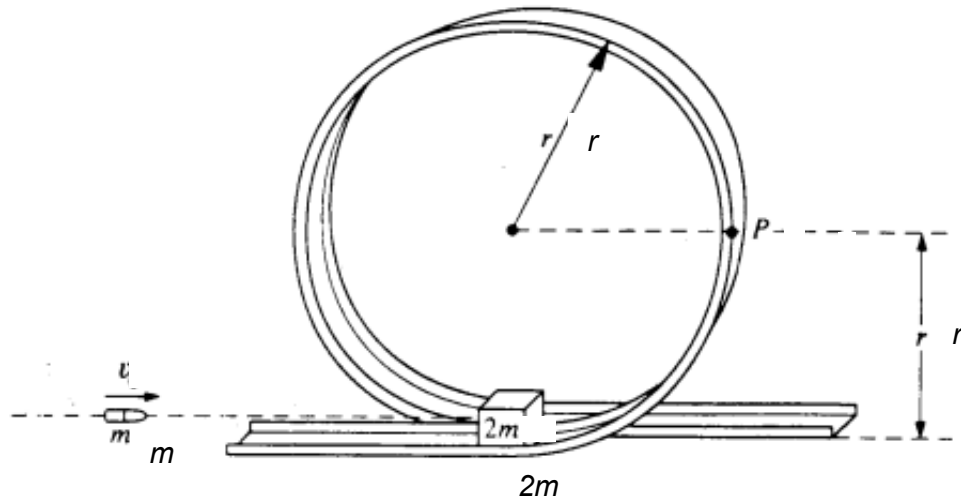

Fig. 2.1

(a)

Show that the minimum speed of the block at the top of the loop such that it just completes the vertical circular motion without falling off the loop is given by

$$\sqrt{gr}$$

where *g* is the acceleration due to gravity.

[3]

(b)

Derive an expression for the minimum speed of the bullet in order for the block to just complete the vertical circular motion without falling off the loop.

Explain your working.

[4]