Condition for Ball Losing Contact w/ Loop

Solution:

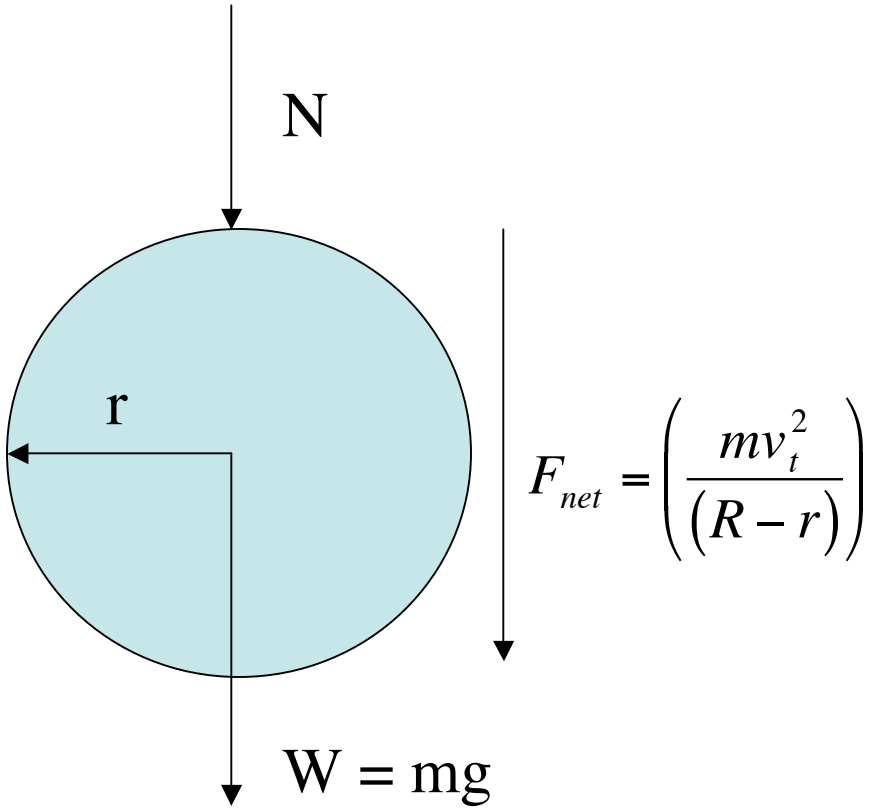
The correct answer is e.)

The net force on the ball is the centripetal force acting on it, so that:

$$(W + N) = F_{net}$$

But if the ball loses contact, the normal force vanishes, i.e., $N = 0 \Rightarrow F_{net} = W$

$$\Rightarrow \left(\frac{\not{m} v_t^2}{(R - r)} \right) = \not{m} g$$



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Thus,

$$v_t^2 = g(R-r) \Rightarrow v_t = \sqrt{g(R-r)}$$

Note that the expression for centripetal force requires the term $(R-r)$ *, since the radius of the ball is not negligible, and the speed* v_t *refers to the speed of the center of mass of the ball at the top of the loop. Thus, the* **effective radius** *for the center of mass of the ball is* $(R-r)$*, as opposed to just* R *.*