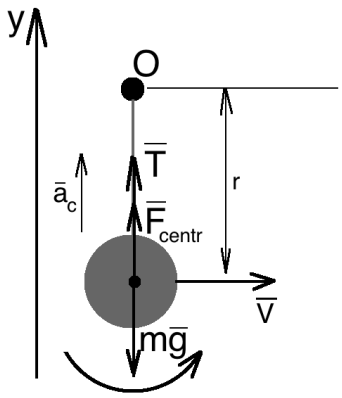
Q.A stone, of mass m, is attached to a strong string and whirled in a vertical circle of radius r. At the exact bottom of the path the tension in the string is 3 times the stone's weight. The stone's speed at this point is given by ...?
A. 2gr)1/2.

please explain everything in detail

Solution:

Newton's second law for the stone At the exact bottom of the path:



$m\vec{g} + \vec{T} = m\vec{a}_c = \vec{F}_{centr}$

mg - stone's weight;

$T = 3mg$- tension in the string;

F_{centr} - Centripetal force (the stone is going in a circle);

a_c - centripetal acceleration.

Projection on the Y-axis:

$y: T - mg = ma_c \qquad (1)$

at the bottom the tension is is 3 times the stone's weight:

$T = 3mg \qquad (2)$

Formula for centripetal acceleration:

$a_c = \frac{V^2}{r} \qquad (3)$

$(3) and (2) in (1)$:

$3mg - mg = m\frac{V^2}{r}$

$2mg = m\frac{V^2}{r}$

$2gr = V^2$

$V = \sqrt{2gr}$

Answer: The stone's speed at the exact bottom of the path is given by $V = \sqrt{2gr}$