Answer on Question 75758, Physics, Other

Question:

A stone of mass $100\ g$ attached to a string of length $50\ cm$ is whirled in a vertical circle by giving velocity at lowest point as $7\ m/s$. Find the velocity at the highest point.

Solution:

We can find the velocity of the stone at the highest point from the law of conservation of energy:

$$KE_{top} + PE_{top} = KE_{bottom} + PE_{bottom},$$

here, KE_{top} is the kinetic energy of the stone at the highest point of the circle, PE_{top} is the potential energy of the stone at the highest point of the circle, KE_{bottom} is the kinetic energy of the stone at the lowest point of the circle and $PE_{bottom} = 0$ is the potential energy of the stone at the lowest point of the circle.

Then, we get:

$$\frac{1}{2}mv_{top}^2 + mg2l = \frac{1}{2}mv_{bottom}^2 + 0,$$

here, $m = 0.1\ kg$ is the mass of the ball; $l = 0.5\ m$ is the length of the string; v_{top}, v_{bottom} are the velocities of the stone at the highest and lowest points of the circle, respectively; $g = 9.8\ m/s^2$ is the acceleration due to gravity.

From this equation we can find v_{top}:

$$\frac{1}{2}mv_{top}^2 = \frac{1}{2}mv_{bottom}^2 - 2mgl,$$

$$v_{top}^2 = v_{bottom}^2 - 4gl,$$

$$v_{top} = \sqrt{v_{bottom}^2 - 4gl} = \sqrt{\left(7\ \frac{m}{s}\right)^2 - 4 \cdot 9.8\ \frac{m}{s^2} \cdot 0.5\ m} = 5.42\ \frac{m}{s}.$$

Answer:

$v_{top} = 5.42\ \frac{m}{s}$.