Question 28765

2.A pendulum ball with a massof 2.5 kg is lifted for 50 cm and given an initial speed of 3.0 m/s.Ignoring air resistance, what is its max speed?

This is a clasic problem to illustrate the law of conservation of mechanical energy.

At point 1, when the ball is lifted to the $h = 50cm = 0.5m$ and given an initial speed of $v = 3.0\frac{m}{s}$, it has both potential energy and kinetic energy, correspondingly:

Potential energy granted by lifting: $U_1 = mgh = 2.5kg \times 9.81\frac{m}{s^2} \times 0.5m$;
Kinetic energy granted by initial speed $K_1 = \frac{1}{2}mv^2 = \frac{1}{2} \times 2.5kg \times (3.0\frac{m}{s})^2$.

At point 2, where the max speed is reached, all the net available energy is transferred into kinetic energy, i.e. potential energy is at zero (the height of the pendulum ball is the lowest).

This kinetic energy is $K_2 = \frac{1}{2}mu^2$, where u is the new, sought-for speed.

From the conservation of energy, $U_1 + K_1 = K_2$.

From this, $u = \sqrt{2\frac{U_1+K_1}{m}} = \sqrt{2 * (9.81\frac{m}{s^2} \times 0.5m + 0.5 * (3.0\frac{m}{s})^2} = 4.337\frac{m}{s}$.

Answer: about $4.34\frac{m}{s}$.