Law of Conservation of Energy

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Law of Conservation of Energy:

Energy can neither be created nor destroyed, but simply transformed from one form into another.

This means:

Total energy in a closed system is constant.

Total Energy = sum of all energy types

E_T = PE + KE + Thermal + Elastic + Electric + ... + Energy

↳ normally comes From Friction

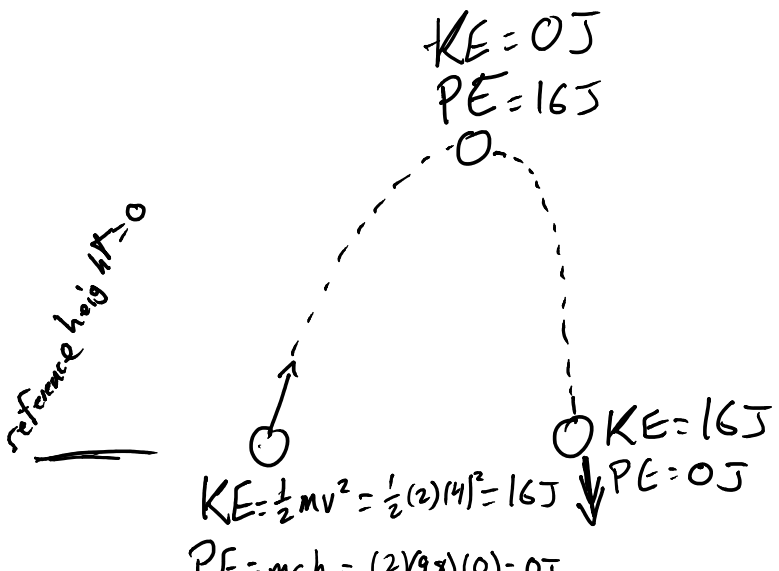
Today: No Friction

Imagine a ball thrown into the air.

E_T = constant

Ball m = 2kg

at bottom v = 4m/s

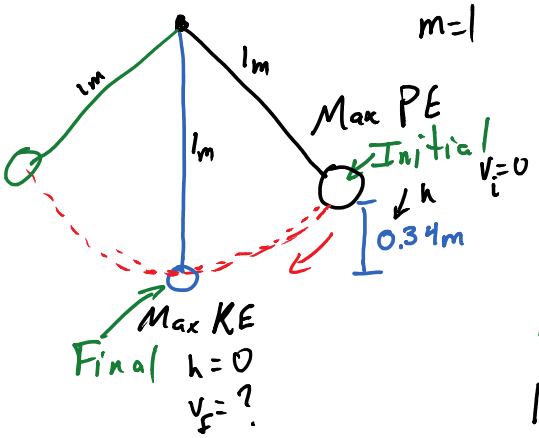


We see:

$E_T = KE + PE = 16J$

... with a 1kg ball at the

A 1m pendulum with a 1kg ball at the end is raised 0.34m vertically. If it is released, what is the maximum velocity?



$$E_{Ti} = E_{TF}$$

$$PE_i + KE_i = PE_F + KE_F$$

$$mgh_i + \tfrac{1}{2}mv_i^2 = mgh_F + \tfrac{1}{2}mv_F^2$$

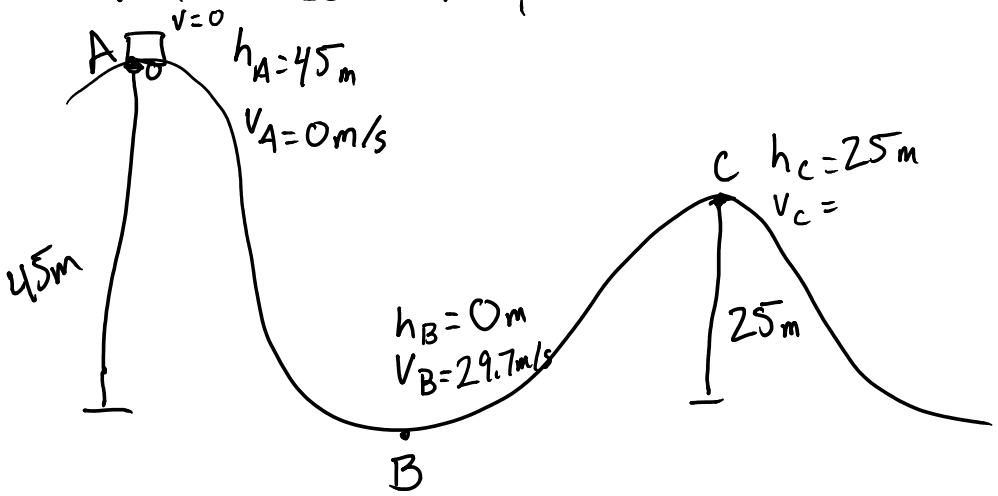
$$1(9.8)(0.34) + \tfrac{1}{2}(1)(0)^2 = (1)(9.8)(0) + \tfrac{1}{2}(1)v_F^2$$

$$3.332 + 0 = 0 + \tfrac{1}{2}v_F^2$$

$$\sqrt{6.664} = \sqrt{v_F^2}$$

$$v_F = 2.6\ m/s$$

Roller Coasters! Frictionless.



a). Find v at point B.

$$E_{TA} = E_{TB}$$

$$mgh_A + \tfrac{1}{2}mv_A^2 = mgh_B + \tfrac{1}{2}mv_B^2$$

$$m(9.8)(45) + 0 = 0 + \tfrac{1}{2}mv_B^2$$

$$441m = \tfrac{1}{2}mv_B^2$$

b) Find v at point C

But we could use point B → $E_{TA} = E_{TC}$

$$441m = m(9.8)(25) + \tfrac{1}{2}mv_c^2$$

$$441m = 245m + \tfrac{1}{2}mv^2$$

$$-245m \quad -245m$$

$$196m = \tfrac{1}{2}mv_c^2$$

$441J = \frac{1}{2}mv_B^2$

$\frac{1}{2}m$ $\quad \frac{1}{2}m$

$\sqrt{882} = \sqrt{v_B^2}$

$v_B = 29.7\ m/s$

$-49m = -49m$

$196m = \frac{1}{2}mv_C^2$

$\frac{1}{2}m$ $\quad \frac{1}{2}m$

$392 = v_C^2$

$v_C = 19.8\ m/s$

A Pendulum is lifted at a 34° angle. The pendulum is 2.7m long. What is the velocity of the pendulum when it is at the bottom of its swing?

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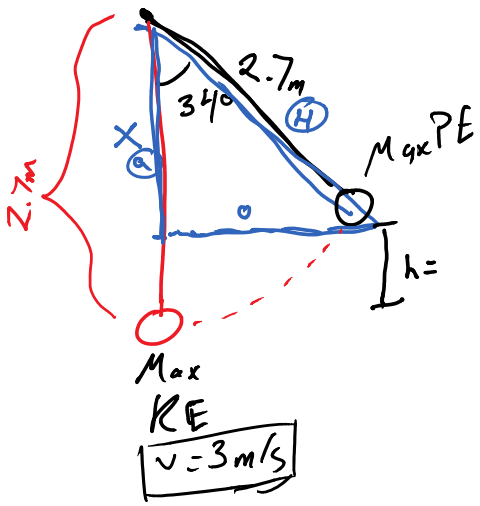
$\cos 34° = \frac{x}{2.7} \Rightarrow x = 2.7\cos 34°$



$h = 2.7 - x$