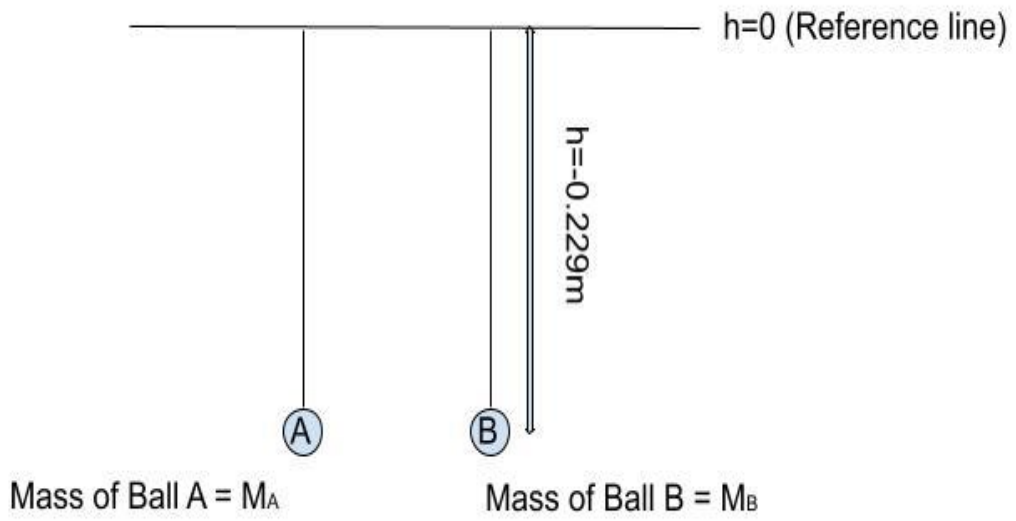
Demonstration for Conservation of Energy

Aim: To conserve total energy of the given system at 4 different positions.

Apparatus:



According to Law of Conservation of Energy,

$$(Kinetic\ Energy)_A + (Kinetic\ Energy)_B + (Potential\ Energy)_A + (Potential\ Energy)_B = Total\ Energy$$

$$\frac{m{v_A}^2}{2} + \frac{m{v_B}^2}{2} + mgh_A + mgh_B = Total\ Energy$$

$$(As\ the\ mass\ of\ both\ the\ balls\ is\ same, mass\ of\ ball\ A\ =\ mass\ of\ ball\ B\ =\ m)$$

$${v_A}^2 + {v_B}^2 + 2gh_A + 2gh_B = \frac{2\ (Total\ Energy)}{m} = E_T \ldots 1$$

a) <u>Conditions at Initial position:</u>

$$Velocity\ of\ ball\ A = 0\frac{m}{s}$$

$$Velocity\ of\ ball\ B = 0\frac{m}{s}$$

$$Height\ of\ ball\ A\ from\ reference\ line = 0m$$

$$Height\ of\ ball\ B\ from\ reference\ line = -0.229m$$

$$\therefore from\ equation\ 1,$$

$$E_T = 2 \times 9.81\ \times (-0.229)$$

$$E_T = -4.49\ Joules$$

b) Conditions just before collision:

$$Velocity\ of\ ball\ A = 1.794\frac{m}{s}$$
$$Velocity\ of\ ball\ B = 0\frac{m}{s}$$
$$Height\ of\ ball\ A\ from\ reference\ line = -0.224m$$
$$Height\ of\ ball\ B\ from\ reference\ line = -0.229m$$

$$\therefore from\ equation\ 1,$$
$$E_T = (2 \times 9.81\ \times ((-0.229) + (-0.224))) + (1.794)^2$$
$$E_T = -5.66\ Joules$$

c) Conditions at extreme (Final) position after 1st collision:

$$Velocity\ of\ ball\ A = 0\frac{m}{s}$$
$$Velocity\ of\ ball\ B = 0\frac{m}{s}$$
$$Height\ of\ ball\ A\ from\ reference\ line = -0.211m$$
$$Height\ of\ ball\ B\ from\ reference\ line = -0.03008m$$

$$\therefore from\ equation\ 1,$$
$$E_T = (2 \times 9.81\ \times ((-0.211) + (-0.03008)))$$
$$E_T = -4.72\ Joules$$

d) Conditions just after 2nd collision:

$$Velocity\ of\ ball\ A = 1.560\frac{m}{s}$$
$$Velocity\ of\ ball\ B = 0.242\frac{m}{s}$$
$$Height\ of\ ball\ A\ from\ reference\ line = -0.208m$$
$$Height\ of\ ball\ B\ from\ reference\ line = -0.219m$$

$$\therefore from\ equation\ 1,$$
$$E_T = (2 \times 9.81\ \times ((-0.208) + (-0.219))) + (1.560)^2$$
$$E_T = -5.95\ Joules$$

To summarize:

Conditions	At initial position	Just before collision	At extreme (Final) position after 1st collision	Just after 2nd Collision
Energy (in Joules)	-4.49	-5.66	-4.72	-5.95