Work done on the block by Spring-force

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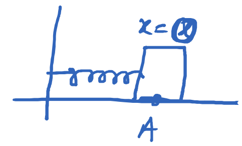
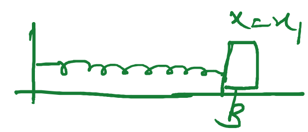
$W = \vec{F} \cdot d\vec{x}$ → displacement; $\vec{F}$ → force





Hook's law: —

$F = k \times$ Elongation of the spring

$\boxed{F = kx}$

$\Rightarrow F = kx$

$\Rightarrow \boxed{W = \int \vec{F} \cdot dx}$

$\Rightarrow$ your block moves from x to $x+dx$, i.e. very small interval. In this case, $F = kx$ and displacement $= dx$

$$\boxed{\vec{F} \cdot d\vec{x} = F\,dx = -kx\,dx}$$

$$\Rightarrow W = \int \vec{F}\,dx = -\int_0^{x_1} kx\,dx$$

$$\boxed{W = \Big[\qquad \Big]_0^{x_1} = -\frac{1}{2}kx_1^2}$$

Suppose, box is moving from x_1 to x_2.

$$W = \left[-\frac{1}{2}kx^2\right]_{x_1}^{x_2}$$

$$\boxed{W = \left[\frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2\right]}$$

NP 50 N/m Compression = 1 Cm. Calculate the work done by spring force on the agency compressing the string.

25×10^{-4} Joule $\Rightarrow$ 2.5×10^{-3} Joule

$ Potential Energy :— Potential Energy is the energy held by an object because of its position relative to other objects.

$\boxed{U = mgh}$ i — Initial Position /

$$\boxed{U = mgh}$$

i — Initial Position

$f \rightarrow$ final Position

$$U_f - U_i = -W = -\int_i^f \vec{F} \cdot d\vec{r}$$

$$W = K_2 - K_1 = \Delta K$$

$$\boxed{W = K_f - K_i = \Delta K}$$

$$\Rightarrow U_f - U_i = -(K_f - K_i)$$

$$\boxed{\underbrace{U_f + K_f}_{M_f} = \underbrace{U_i + K_i}_{M_i}}$$

$$M_f = M_i$$

Sum of kinetic & Potential Energy is known as mechnical Energy.

Conservation of mechnical Energy.

$ Ball falling from Height H

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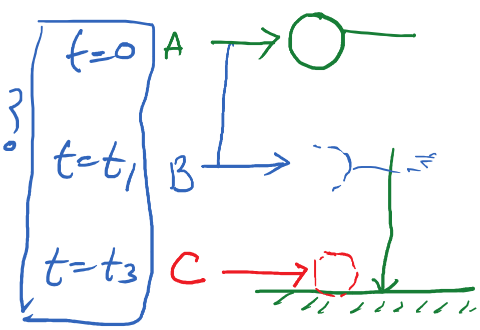
$(M.E.)_A = ?$ $(M.E.)_B = ?$ $(M.E.)_C = ?$

$$\boxed{M.E. = K.E. + P.E.}$$



Mass of the Ball = m

AB = AC − BC

$\boxed{AB = H - X}$

$ Location A

$K.E. = 0$

$P.E. = mgH$

$$\boxed{(M.E.)_A = 0 + mgH = mgH}$$

$ Location B

$K.E = \frac{1}{2} m u^2$

$K.E = \frac{1}{\cancel{2}} m \cancel{2}g(H-x)$

$$\boxed{K.E = mg(H-x)}$$

Use of Newton' law Motion

$\boxed{v^2 = u^2 + 2g\cancel{h}}$

$u \to 0$

$v^2 = 0 + 2g(H-x)$

$v^2 = 2g(H-x)$

$P.E. = mgx$

$(M.E.)_B = K.E. + P.E.$

$= mg(H-x) + mgx$

$= mgH - \cancel{mgx} \cancel{+mgx} = \boxed{mgH}$

$ Location C

$\boxed{P.E. = mg \times 0 = 0}$

h ≈ 0 because the ball is about to hit the surface

$K.E = \frac{1}{2} m u^2$

$= \frac{1}{\cancel{2}} m \times \cancel{2g} H$

$= mgH$

3rd law

$v^2 = u^2 + 2gh$

$u \to 0$

$v^2 = 2gH$

$(M.E.)_C = K.E. + P.E.$

$= mgH + 0 = mgH$

$$\Rightarrow \boxed{(M.E.)_A = (M.E)_B = (M.E)_C = mgH}$$

Hence, the Energy is Conserved. Changing from one form to another.

Momentum:-

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$$\boxed{\vec{p} = m\vec{v}}$$

$\vec{p}$ is a vector. If it is the vector then what will be the direction?

⇒ Direction of momentum = direction of velocity

$$\boxed{\vec{P}_{system} = \sum \vec{p}_i = \sum m_i u_i}$$

Can you get zero or negative momentum of a system?

Yes -

Conservation of Momentum

$$\frac{d\vec{p}}{dt} = \frac{d(mu)}{dt} = m\frac{du}{dt}$$

↑ a

$$\boxed{\frac{d\vec{p}}{dt} = ma = \vec{F}}$$

Net force on the system is zero $\vec{F} = 0$

$$\boxed{\frac{d\vec{p}}{dt} = 0 \Rightarrow \vec{p} = \text{Constant}}$$