$$\int F\,dt = m(v-u)$$

Impulse = Final momentum − Initial Momentum.

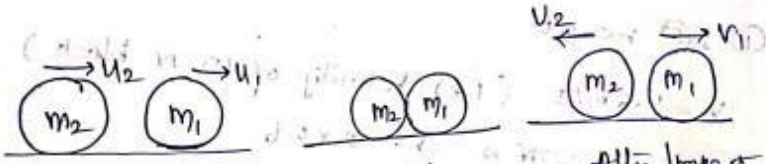
~~For a system of particle~~

For system of force on a particle, impulse $= \Sigma F \times t$

When impulse is zero ; t can be zero and hence $\Sigma F = 0$.

If there is no external force acting on system then the total linear momentum of system remains constant". This is known as law of conservation of linear momentum.

Initial momentum = Final Momentum.

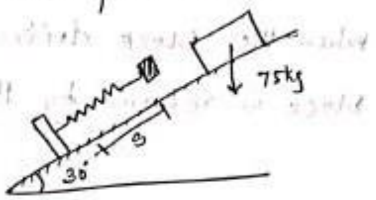


Before impact   during Impact   After Impact

sum of ~~impact~~ momentum of two bodies ~~after~~ before impact } = Sum of momentum of two bodies after Impact

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2.$$

(9) A block of mass 75 kg slides down a 30 inclined plane from rest, as shown. After moving 1.2 m, the block strikes a spring whose modulus is 20 N/mm. Det the max deformation of spring. Take μ coefficient of kinetic friction b/w the block and plane is 0.25



$\delta \rightarrow$ max deformation of spring

$u \rightarrow$ velocity at which the block strikes.

Resolving the force normal to plane

$N_R - (75 \times 9.81 \cos 30) = 0$

$N_R = 637.17\,N$

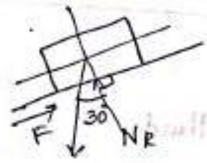
Resolving the force along the plane,

$\Sigma F_x = -(75 \times 9.81 \sin 30) + F$

$\Sigma F_x = -(75 \times 9.81 \sin 30) + \mu N_R$

$= -208.58\,N$

$\Sigma F_x = 208.58\,N$



Second law of motion → Newton

$P = ma$

$a = P/m = \frac{208.58}{75} = 2.781\,m/s^2.$

$V^2 = u^2 + 2as \quad (u = 0)$

$V^2 = 0 + 2 \times 2.781 \times 1.2$

$V = 2.583\,m/s$

(1) A car of mass 300 kg is travelling at 36 kmph on level road. It is brought to rest after travelling a distance of 5m. What is the average force of resistance acting on car.

(1) From Conservation of Energy

mass, $m = 300 kg$

$u = 36 kmph = \frac{36 \times 1000}{3600} = 10 m/s$

$v = 0$

distance travelled, $s = 5m$

Find the average resistance?

Force of resistance be 'F'

K.E of the moving car, $KE = \frac{1}{2} mu^2$

$= \frac{1}{2} \times 300 \times 10^2 = 15000 Nm$

The moving car is brought to rest.

Whole K.E is lost at a distance of 5m.

K.E = Workdone by resistance

15000 = Resistance x distance

$15000 = F \times 5$

$\boxed{F = 3000 N}$

Apply work energy method.

Workdone = change in KE

$(-F) s = \frac{W}{2g} \times (v^2 - u^2)$

$-F \times 5 = \frac{300 \times 9.81}{2 \times 9.81} (0 - 10^2)$

$\underline{F = 3000 N}$

$-F - ma = 0$

$\boxed{F = -ma}$

$v^2 = u^2 + 2as$

$0 = 10^2 + (2 \times a \times 5)$

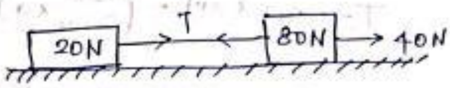
$a = \frac{-100}{10} = -10 m/s^2$

$F = -ma$

$= -300 \times (-10)$

$\underline{= 3000 N}$

(P) Two weights 80N and 20N are connected by a thread and move along a rough horizontal plane under the action of a force 40N, applied to the first weight of 80N as shown. The coefficient of friction between the sliding surfaces of the weights and the plane is 0.3. Determine the acceleration of the weights and the tension in the thread using D'Alembert's principle.

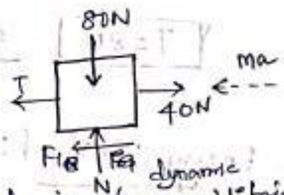


Soln.

a = acceleration of the weights

T = Tension in the thread.

Consider 80N Block.



with the forces, the block will move towards right.

D'Alembert's principle states the body is in equilibrium condition, with the imaginary force 'ma' (called inertia force in opposite direction.

$\Sigma V = 0 \; (\uparrow +)$

$$N_1 - 80 = 0 \text{ (or) } N_1 = 80N$$

$\Sigma H = 0 \; (\rightarrow +)$

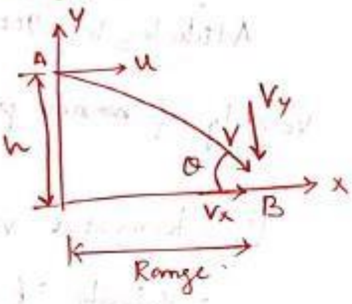
$$40 - T - F_1 - ma = 0$$

$$40 - T - (\mu N_1) - ma = 0$$

$$40 - T - (0.3 \times 80) - \left(\frac{80}{9.81} \times a\right) = 0$$

$$T + 8.155a = 16 \rightarrow (1)$$

Motion of Particle thrown horizontal from known height



At A : $u \Rightarrow$ horizontal velocity with the particle is thrown.
vertical velocity is zero

At B $\rightarrow$ V_y = Vertical
V_x = horizontal

$$\boxed{V_x = u}$$

$V_y \Rightarrow$ To find

$V = u + gt$

$V = V_y$ $\qquad u = u\sin\alpha = 0$

$$\boxed{V_y = gt}$$

$$V = \sqrt{V_x^2 + V_y^2}$$

$$= \sqrt{u^2 + (gt)^2}$$

$$\theta = \tan^{-1}\left(\frac{V_y}{V_x}\right)$$