ROHININ COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE & Affliated to anna university
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DEPARTMENT OF MECHANICAL ENGINEERING

NAME OF THE SUBJECT: ENGINEERING MECHANICS

SUBJECT CODE : ME3351

REGULATION 2021

UNIT V: DYNAMICS OF PARTICLES

DYNAMIC OF PARTICLES

Newton's Law Of Motion

Newton"s Law

The rate of change of momentum is directly proportional to the resultant force.

The Resultant Force acting in the direction of equal to the product of mass and the acceleration in the direction of resultant Force.

$\sum F = ma$

m= mass

a= acceleration

D' Alembert' Principle:

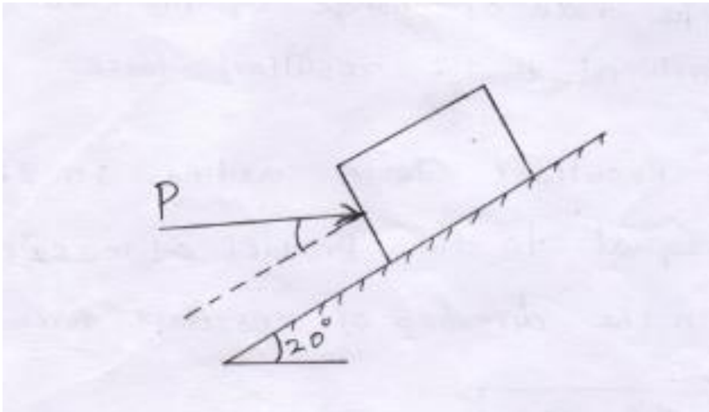
States that the inertia forces and couples, and the external forces and torques on a body together give statical equilibrium.

Inertia is a property of mater by virture of which a body resists ay change in velocity

$$F_I = \quad -mg$$

Problem:1

What horizontal force is needed to give the 50 kg block shown in fig. With an acceleration of $3^{m}/_{s}{}^{2}$ up the 20° plane. Assume the coefficient of friction b/w the block and plane is 0.25.



<u>Given:</u>

Weight of block W $= 50\ kg\ = 50 \times 9.81 = 490.5N$

Acceleration a=3 $^{m}/_{s}{}^{2}$

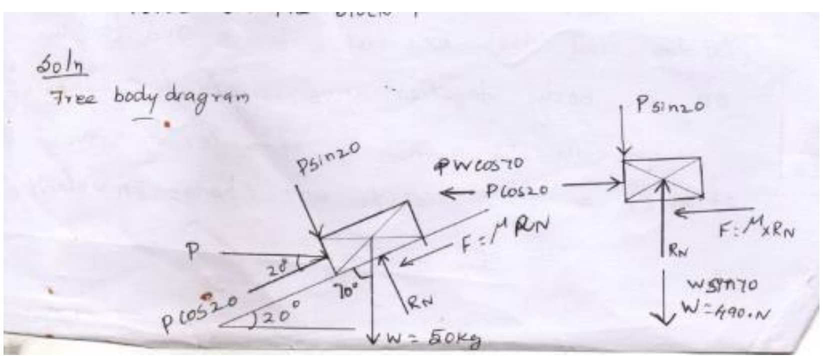
Coefficient of friction $= 0.25$

<u>To find:</u>

Force on the block P

<u>Soln:</u>

Free body diagram



$\sum FX = m\ a$

P cos $20 - M_{XRN} -$ w cos $70 = 50 \times 3$

$$P\ \ cos\,20 - 0.25 \times R_N - \ 490.5 \times cos\,70 = 150 \quad ------> \ (1)$$

$\sum FY = 0$

$R_N - p \ sin 20 - w \ sin 70 = 0$

$R_N - p \ sin 20 - 490.5 \ sin 70 = 0$

$R\_N - psin20 - 490.5 \ sin \ 70 = 0$

$RN = 0.34P - 460.91$

R_N value in Eqn (1)

$P \ cos20 - 0.25 \ [0.34 \times p - 490.91] - 490.5 \times cos70 = 150$

$0.93p - 0.085p + 122.72 - 167.76 = 150$

$0.845P - 45.04 = 150$

$0.845P = 150 + 45.04$

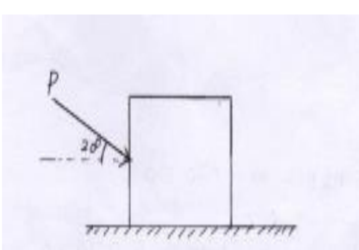
$0.845P = 195.04$

$$P = \frac{195.04}{0.845}$$

$P = 230.81N$

Problem:2

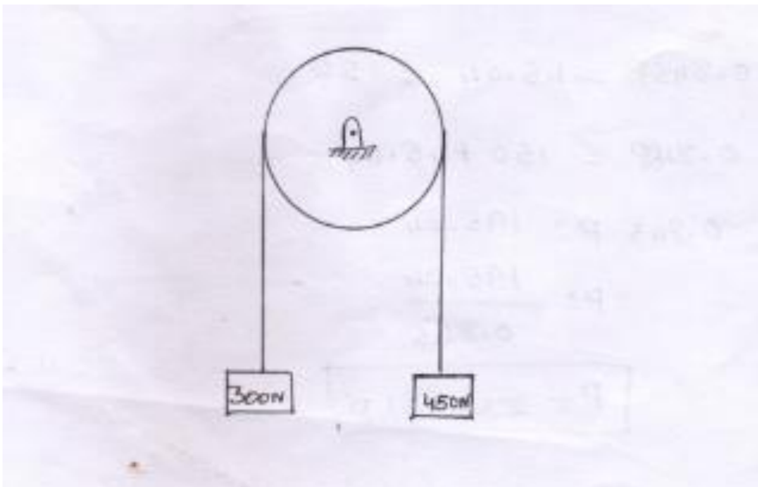
A block weighting 1KN, rest on a horizontal plane as shown in fig. Find the force P required to give an acceleration of 3 m/s^2 to right. Take the coefficient of friction M_K=0.25.



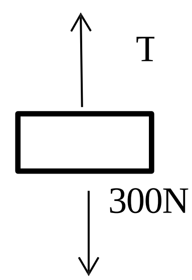
$P = 750.056N$

Problem:3

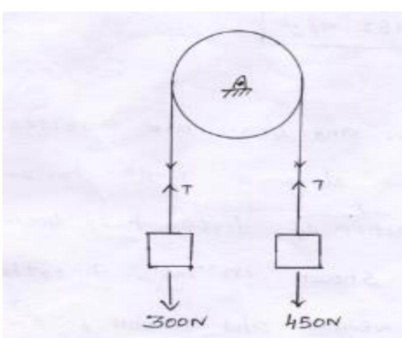
Two blocks weighting 300N and 450N are connected by a rope as shown fig. With what acceleration the heavier block comes down, and what is the tension of the rope. Pulley is frictionless and weight less.



soln :



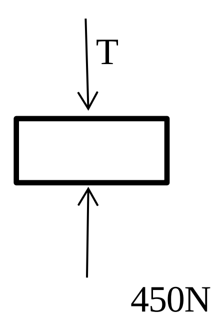
Free body diagram



$\sum F_X = ma$

T$-$300= $\frac{300}{9.81} \times a$

$T - 300 = 30.58 \times a$-----(1)



$\sum F_Y$= m a

$450 - T = \frac{450}{9.81} \times a$ ---- (1)

Solving Eqn (1) & (2)

$T - 300 = 30.58 \times a$

$\underline{450 - T = 45.87 \times a}$

$150 \quad = 76.45 \times a$

$a = \frac{150}{76.45}$

$a = 1.962\ m/s2$