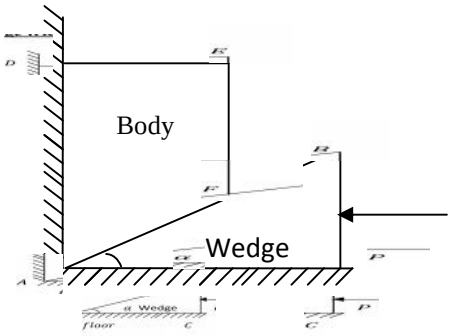
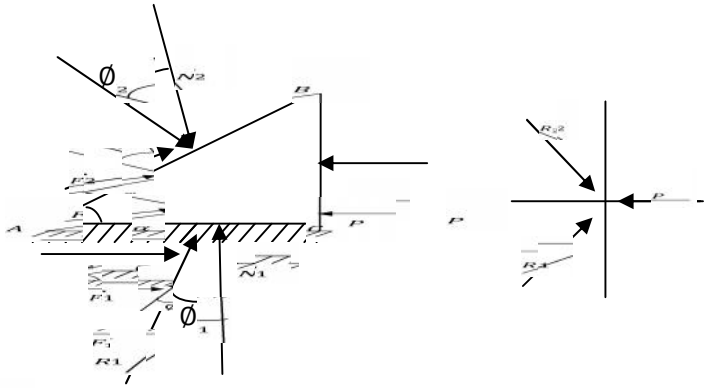
Wedge friction



A wedge is a piece of wood or metal, usually of a triangular or trapezoidal in cross-section, used for lifting loads or for slight adjustments like tightening keys for shafts.

Equilibrium of wedge



$F_1 = \mu_1 N_1 ; F_2 = \mu_2 N_2$

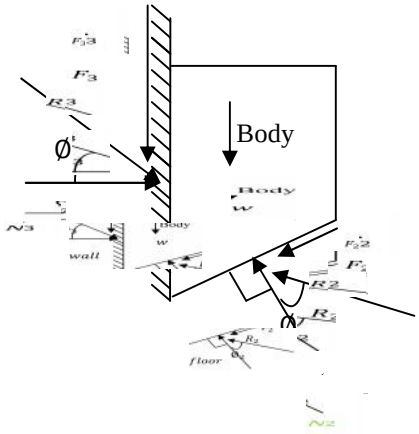
μ_1 &μ_2 are the co-efficients of friction on the edges AC and AB

Only in wedge problems the reaction components are combined to a single resultant R

R_1 & R_2 drawn on the wedges

Where $R_1 = \sqrt{{F_1}^2 + {N_1}^2}$ and $R_2 = \sqrt{{F_2}^2 + {N_2}^2}$

Equilibrium of body

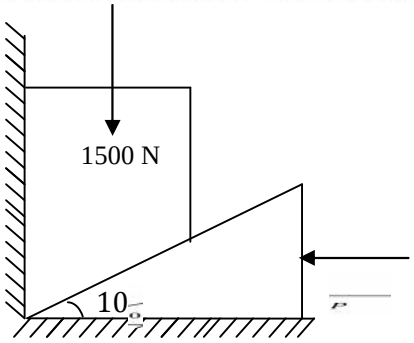


Note:

1. Always draw the freebody diagram of the wedge first, then draw the freebody diagram of the block.
2. But, while solving, if the load is given solve freebody of block first and if the force P is given, solve the freebody of wedge first.
3. Self-weight of the wedge is neglected.

Problem 8:

A block overlaying a 10^0 wedge on a horizontal floor and leaning against a vertical wall and weighting 1500N is to be raised by applying a horizontal force to the wedge. Assuming coefficient of friction between all the surfaces is contact to be 0.3, determine the minimum horizontal force to be applied to raise the block.



Solution:

Angle of wedge $=10^0$

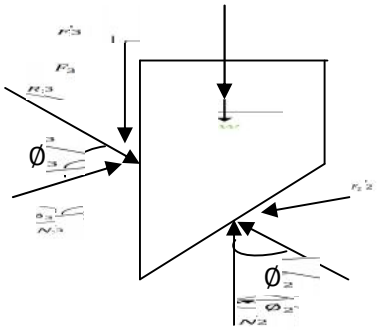
W=1500N

$\mu = 0.3$

$$\mu = \tan\phi$$

$$\phi = \tan^{-1}(0.3) = 16.69^0$$

Consider FBD of block



Applying $\sum H = 0\ (\rightarrow +)$

$R_3 \cos 16.69 - R_2 \cos 63.31 = 0$

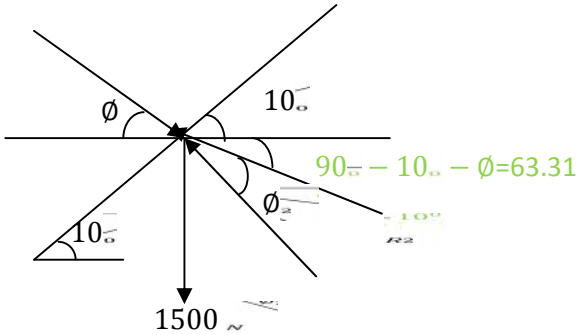
$0.9578\ R_3 = 0.4491\ R_2 = 0$

$R_3 = 0.468\ R_2$

Applying $\sum V = 0\ (\uparrow +)$

$-R_3 \sin 16.69 - 1500 + R_2 \sin 63.31 = 0$

$0.893\ R_2 - 0.287\ R_3 = 1500$



Sub $R_3 = 0.468\ R_2$

$0.893\ R_2 - (0.468 R_2 \times 0.287) = 1500$

$R_2 = 1977$ N

$\therefore R_3 = 0.468 \times 1977$

$R_3 = 925$ N

Consider FBD of wedge

Applying $\sum V = 0\ (\uparrow +)$

$R_1 \sin 73.31 - R_2 \sin 63.31 = 0$

$R_1 = 1977 \sin 63.3 / \sin 73.1$

$R_1 = 1846$N

Applying $\sum H = 0\ (\rightarrow +)$

$R_2 \cos 63.31 + R_1 \cos 73.31 - P = 0$

$P = 1977 \cos 63.1 + 1846 \cos 73.1$

$P = 1431$N