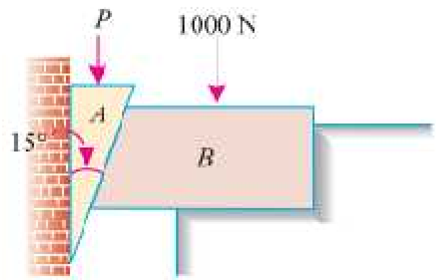
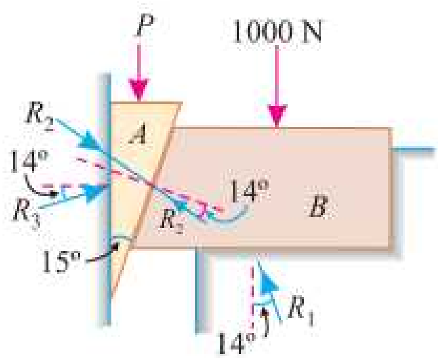
Example *A 15° wedge (A) has to be driven for tightening a body (B) loaded with 1000 N weight as shown .*



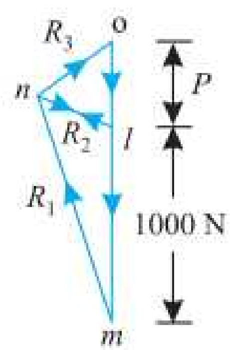
If the angle of friction for all the surfaces is 14°, find graphically the force (P), which should be applied to the wedge. Also check the answer analytically.

Solution. Given: Angle of the Wedge (α) = 15°; Weight acting on the body (W) = 1000 N and angle of friction for all the surfaces of contact (ϕ) = 14°.

Graphical solution



(*a*) Space diagram

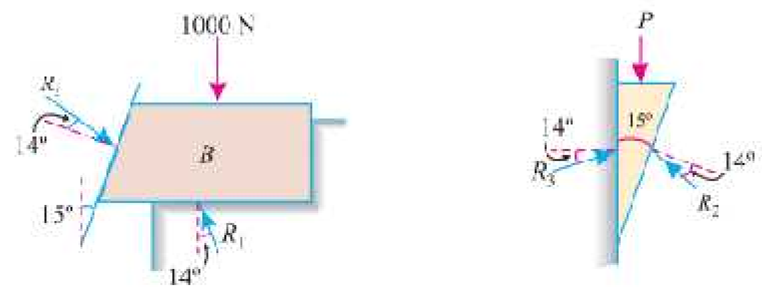


(*b*) Vector diagram

1. First of all, draw the space diagram for the body (B) and wedge (A) as shown in Fig. (a). Now draw the reactions R_1, R_2 and R_3 at angles of 14° with normal to the faces.
2. Take some suitable point l and draw a vertical line lm equal to 1000 N to some suitable scale, representing the weight of the body. Through l draw a line parallel to the reaction R_2. Similarly, through m draw another line parallel to the reaction R_1 meeting first line at n.
3. Now through l draw a vertical line representing the vertical force (P). Similarly, through n draw a line parallel to the reaction R_3 meeting the first line at O as shown in Fig. (b).
4. Now measuring ol to the scale, we find that the required vertical force, $P = 232$ N **Ans.**

Analytical check

First of all, consider equilibrium of the body. We know that it is in equilibrium under the action of the following forces as shown in Fig. 9.17 (a).



(a) Body B (b) Wedge A

1. Its own weight 1000 N acting downwards
2. Reaction R_1 acting on the floor, and
3. Reaction R_2 of the wedge on the body.

Resolving the forces horizontally,

$$R_1 \sin 14° = R_2 \cos (15° + 14°) = R_2 \cos 29°$$

$$R_1 \times 0.2419 = R_2 \times 0.8746$$

$$\therefore \qquad R_2 = \frac{0.8746}{0.2419} R_2 = 3.616 R_2$$

and now resolving the forces vertically,

$$R_2 \sin(15° + 14°) + 1000 = R_1 \cos 14°$$

$$R_2 \times 0.4848 + 1000 = R_1 \times 0.9703 = (3.616\, R_2)\, 0.9703 = 3.51\, R_2 \qquad ...(\because R_1 = 3.616\, R_2)$$

or $$1000 = R_2\,(3.51 - 0.4848) = 3.0252\, R_2$$

$$\therefore \qquad R_2 = \frac{1000}{3.0252} = 330.6 \text{ N}$$

Now consider equilibrium of the wedge. We know that it is in equilibrium under the action of the following forces as shown in Fig. 9.17. (*b*) :

1. Reaction R_2 of the body on the wedge,
2. Force (P) acting vertically downwards, and
3. Reaction R_3 on the vertical surface.

Resolving the forces horizontally,

$$R_3 \cos 14° = R_2 \cos(14° + 15°) = R_2 \cos 29°$$

$$R_3 \times 0.9703 = R_2 \times 0.8746 = 330.6 \times 0.8746 = 289.1$$

$$\therefore \qquad R_3 = \frac{289.1}{0.9703} = 297.9 \text{ N}$$

and now resolving the forces vertically,

$$P = R_3 \sin 14° + R_2 \sin(14° + 15°)$$

$$= (297.9 \times 0.2419) + (330.6 \times 0.4848) = 232.3 \text{ N} \qquad \textbf{Ans.}$$