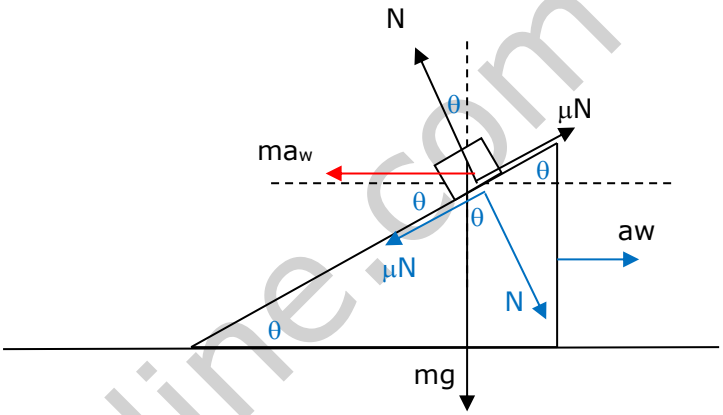
Q- A wedge of mass km is placed on a smooth horizontal surface. The inclined face of the wedge makes an angle θ with the horizontal surface. A small block of mass m is placed on the inclined surface and released. The friction between the block and inclined surface is μ. (a) If the acceleration of the block relative to the wadge is *a*, find acceleration of the wadge. (b) If to a stationary observer the acceleration of the block appears in a straight linen making an angle 45^0 with the horizontal find the angle θ (in terms of k).



(a) As the direction of acceleration of the block relative to the wedge is along the incline, its component in horizontal direction will be a cos θ

If actual acceleration of the block in horizontal direction is a_x and that of the wedge is a_w then for horizontal component of relative acceleration we get

$$a\cos\theta = a_x - (-a_w) \quad \text{---------- (1)}$$

As there is no external force on the system, the internal action and reaction forces are equal in magnitude and opposite in horizontal direction and hence we have

$$m*a_x = km*a_w$$

or $a_x = k*a_w$

Substituting this value of a_x in equation (1) we get

$$a\cos\theta = k*a_w + a_w$$

Gives $a_w = \frac{a\cos\theta}{k+1}$

(b) As the wedge is not moving in vertical direction the vertical component of actual and relative acceleration of the block will be equal and hence the actual acceleration of the particle in vertical direction will be

$$a_y = a\sin\theta$$

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and the direction of motion of the particle (actual, relative to earth) will be given by

$$\tan\phi = \frac{a_y}{a_x} = \frac{a_y}{k\,a_w} = \frac{a\sin\theta\,(k+1)}{k\,a\cos\theta} = \tan\theta\left(\frac{k+1}{k}\right)$$

But according to the question $\phi = 45^0$ hence we get from above equation

$$1 = \tan\theta\left(\frac{k+1}{k}\right)$$

gives $\theta = \tan^{-1}\left(\frac{k}{k+1}\right)$

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