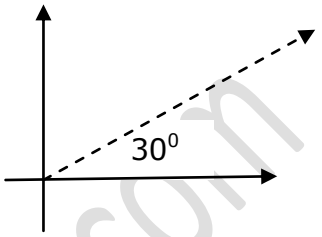
Q- A truck was traveling north when, at intersection, collided with a car traveling east. The speed limit on both roads entering the intersection is 50 km/h. The two vehicles remained joined together after the collision. The skid marks leading from the intersection 20 m at an angle of 30^o north of east before stopping. The truck weighed 1200 kg and the car weighed 600 kg. The coefficient of kinetic friction for a rubber tire skidding on dry pavement is 0.80. Find the velocity of car and the truck before collision.



Mass of the truck $m_1 = 1200$ kg
Mass of the car $m_2 = 600$ kg

Let the speed of truck before collision v_1 =?
And speed of car before collision v_2 =?

The frictional force on the combined mass is given by

$F = \mu*(m_1+m_2)g = 0.80*(1200 + 600) = 14400$ N

Using work energy rule the speed of the combined mass just after collision is given by

Decrease in kinetic energy = work done against friction

$\frac{1}{2} (m_1 + m_2) v^2 = F*s$

Or $\frac{1}{2} (1200 + 600)*v^2 = 14400*20$

Gives $v = 17.9$ m/s.

Using the law of conservation of linear momentum the speed of the vehicles just before the collision can be calculated as the components of momentum in east and north direction will be same as that of the two cars separately. Thus we have

$m_1v_1 = (m_1+m_2)\ v \sin 30^0$

Or $v_1 = (m_1+m_2)\ v \sin 30^0 / m_1$

Or $v_1 = (1200+600)*17.9*0.50/1200 = 13.42$ m/s

And $m_2v_2 = (m_1+m_2)\ v \cos 30^0$

Or $v_2 = (m_1+m_2)\ v \cos 30^0 / m_2$

Or $v_2 = (1200+600)*17.9*0.866/600 = 46.5$ m/s