Q- A firecracker, of mass 16 grams, explodes into two pieces (one of 4 grams and the other of 12 grams). The 4 gram piece has velocity just after the explosion of 10 m/s to the left. Find the velocity of the other piece just after the explosion.
(Requested by Jay F)

As there is no external force acting on the system, its momentum remains conserved. Thus applying law of conservation of linear momentum we have

Final momentum of the system = initial momentum of the system

Or $m_1\vec{v}_1 + m_2\vec{v}_2 = (m_1 + m_2)\vec{v}_0$

Or $\vec{v}_2 = \frac{(m_1+m_2)\vec{v}_0 - m_1\vec{v}_1}{m_2}$

Substituting values we get (initial velocity is zero)

$$\vec{v}_2 = \frac{(m_1+m_2)*0 - 0.004*10\,\hat{\imath}}{0.0012} = -3.33\,\hat{\imath}\,m/s$$

Thus the other part will move with velocity 3.33 m/s to the right.

Q- Consider a conical pendulum with an 80 kg bob on a 10.0 m wire making an angle of = 30° with the vertical.
(a) Determine the horizontal and vertical components of the force exerted by the wire on the pendulum.
(b) What is the radial acceleration of the bob?

(a). Let the force exerted by the string is T then the component of this force in vertical direction will be Mg cos θ upward and in horizontal direction it will be Mg sin θ.
The vertical component of the Tension T cos θ. As the bob is vertically in equilibrium net force in vertical direction is zero and thus we may write

T cos θ - Mg = 0

Gives T cos 30^0 = 80.0*9.8

Or T = 80.0*9.8 / cos 30^0

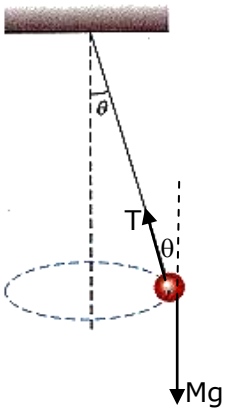
Or T = 80.0*9.8 / 0.866 = 905 N

Hence the horizontal component of the force

T sin 30^0 =905*0.500 = 453 N

And vertical component of the force

T cos 30^0 = Mg = 80.0*9.8 = 784 N



(b). The radial acceleration of the bob (horizontal)

a = F/m = T sin 30^0 / M = 340/80 = 4.25 m/s^2