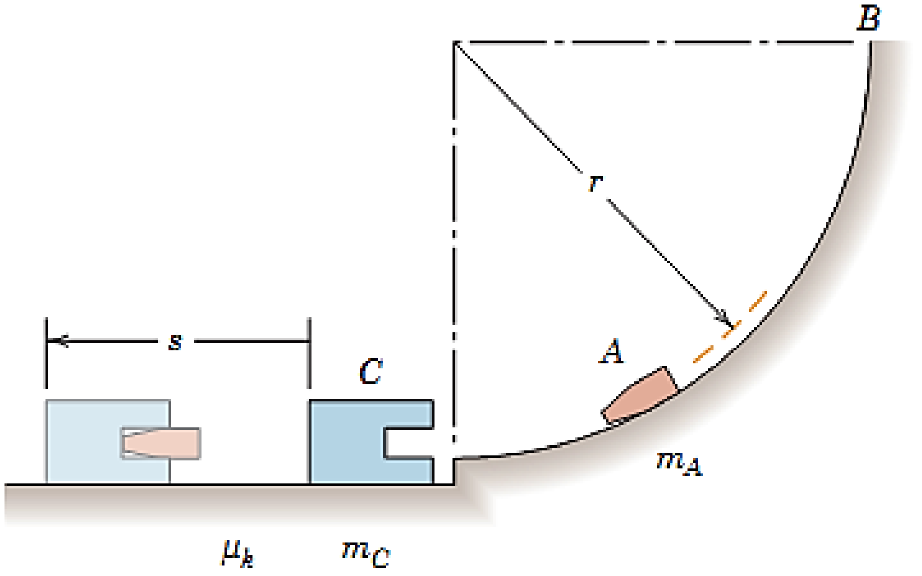
ME 206 – DYNAMICS – SPRING 2017
STUDY PROBLEMS-7a
(PART C. LINEAR IMPULSE-MOMENTUM)

PROBLEM 3/209

The cylindrical plug A of mass m_A is released from rest at B and slides down the smooth circular guide. The plug strikes the block C and becomes embedded in it. Write the expression for the distance s which the block and plug slide before coming to rest. The coefficient of kinetic friction between the block and the horizontal surface is μ_k.



3/209 For plug: $\Delta T + \Delta V_g = 0$; $\frac{1}{2} m_A v^2 - m_A g r = 0$

$v = \sqrt{2gr}$

Plug & block: $\Delta G = 0$; $m_A\sqrt{2gr} = (m_A + m_C)v'$

where v' = velocity of block & plug after impact

Friction force $F = \mu_k (m_A + m_C) g$

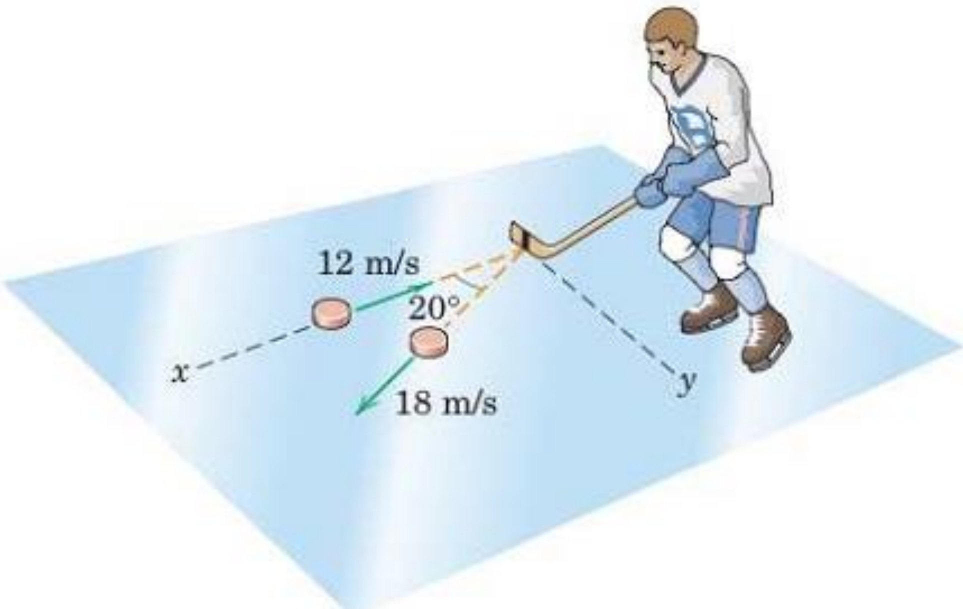
Deceleration $a = F/(m_A + m_C) = \mu_k g$

$v'^2 = 2as$, $s = \left(\frac{m_A}{m_A + m_C}\right)^2 2gr \frac{1}{2\mu_k g} = \frac{r}{\mu_k}\left(\frac{m_A}{m_A + m_C}\right)^2$

PROBLEM 3/211 (6th Ed.)

The ice-hockey puck with a mass of 0.20 kg has a velocity of 12 m/s before being struck by the hockey stick. After the impact the puck moves in the new direction shown with a velocity of 18 m/s. If the stick is in contact with the puck for 0.04 s, compute the magnitude of the average force **F** exerted by the stick on the puck during contact, and find the angle β made by **F** with the x-direction.

Ans. $F = 147.8$ N, $\beta = 12.02°$



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$\int \underline{F}\,dt = \underline{F}t = m\Delta\underline{v}$

$\underline{F} = \frac{0.20}{0.04}\left([18\cos 20°]\underline{i} + [18\sin 20°]\underline{j} - [-12\underline{i}]\right)$

$= 5(18 \times 0.9397\underline{i} + 18 \times 0.3420\underline{j} + 12\underline{i})$

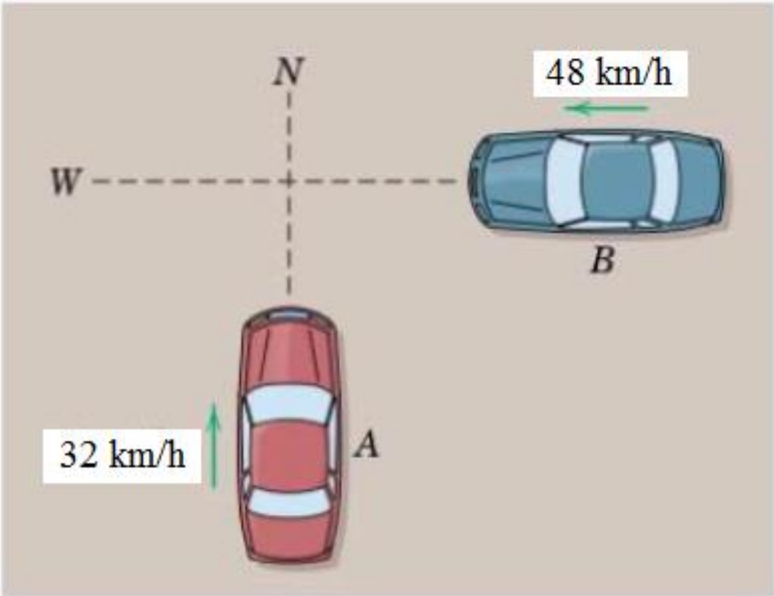
$= 30(4.819\underline{i} + 1.026\underline{j})$ N

$F = 30\sqrt{4.819^2 + 1.026^2} = \underline{147.8 \text{ N}}$

$\beta = \tan^{-1} v_y/v_x = \tan^{-1}\frac{1.026}{4.819} = \underline{12.02°}$

PROBLEM 3/203

Car B weighing 1500 kg and traveling west at 48 km/h collides with car A weighing 1600 kg and traveling north at 32 km/h as shown. If the two cars become entangled and move together as a unit after the crash, compute the magnitude v of their common velocity immediately after the impact and the angle θ made by the velocity vector with the north direction.



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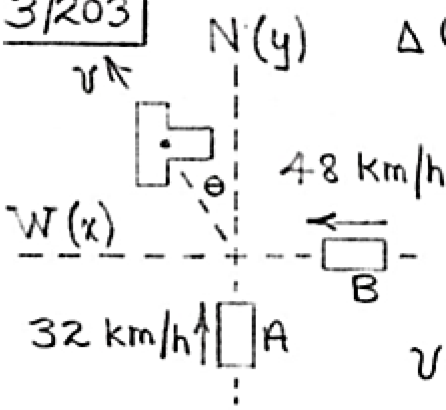

$\Delta G_x = 0: 1500(48) = 3100\, v_x$

$v_x = 23.2$ km/h

$\Delta G_y = 0: 1600(32) = 3100\, v_y$

$v_y = 16.52$ km/h

$v = \sqrt{v_x^2 + v_y^2} = \underline{28.5 \text{ km/h}}$

$\theta = \tan^{-1}\left(\frac{v_x}{v_y}\right) = \tan\left(\frac{23.2}{16.52}\right) = \underline{54.6°}$