PHYSICS 161, Spring 2003

Discussion Quiz , Tuesday, March 11

Q1). Two block A and B of masses m_A and m_B are placed in contact with each other on a frictionless horizontal surface. $m_A > m_B$. A constant force $\vec{F}_0$ is applied to block A.

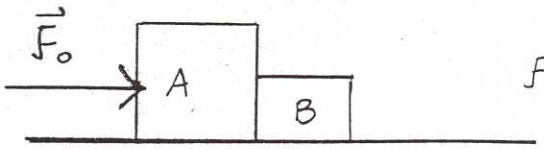
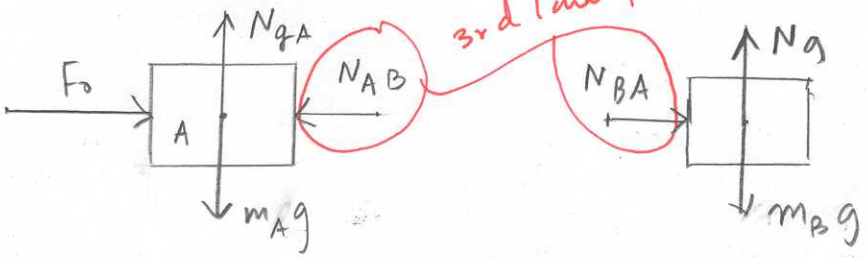


Fig 1.

a). Draw a separate free body diagram for each block. Label all all the forces.



b). Write down the $\Sigma F_x = ma_x$ equation for each block.

A: $\Sigma F_x = m_A a_x$

$$F_0 - N_{AB} = m_A a$$

$\Sigma F_y = m_B a_x$

$$N_{BA} = m_B a$$

a_x same for A & B.

$$\vec{N}_{AB} = -\vec{N}_{BA}$$

c):Take m_A, m_B, and $\vec{F}_0$ to be known quantities. In part (b) you should have gotten two equations with two unknowns. Solve for the acceleration a_x.

$F_0 - N_{AB} = m_A a$

$N_{BA} = m_B a$

$\Rightarrow F_0 - m_B a = m_A a$

$F_0 = m_B a + m_A a$

$F_0 = (m_B + m_A) a$

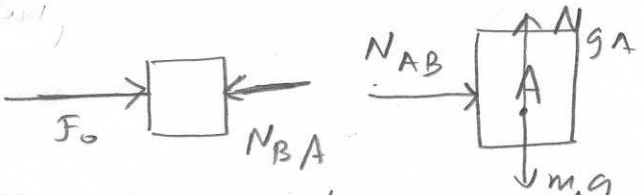
$\Rightarrow$ $a = F_0 / (m_B + m_A)$

d). Now suppose the order of the blocks is switched (as shown in figure below) such that the blocks are in contact but the force $\vec{F}_0$ is applied on block B.

(i). Is the acceleration of the block now less than, greater than or the same as before? Give brief but correct reason.

The same as before. $a = F_0 / (m_B + m_A)$.

(ii) Is the normal force the blocks apply on each other less than, greater than or the same as before? Give complete reason.



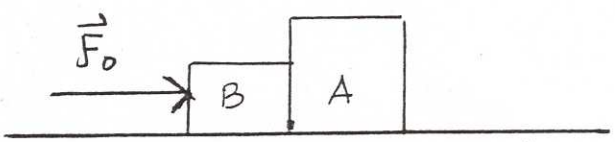


Fig 1d.

Now, N_{AB} is greater than that in the previous case because a is the same & $N_{AB} = m_A a$ & $m_A > m_B$

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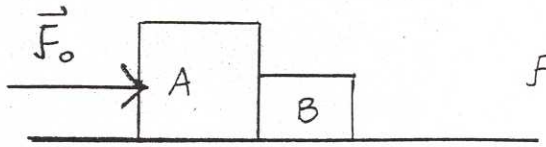
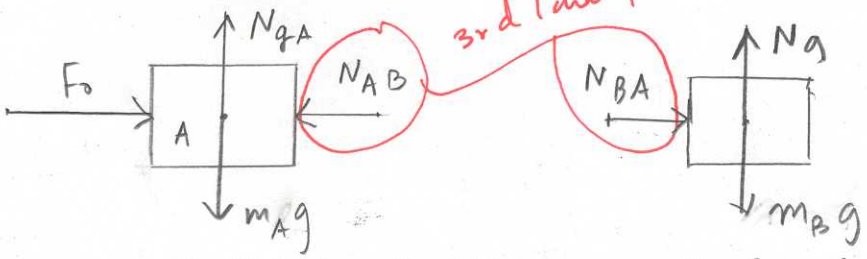


Fig 1.

a). Draw a separate free body diagram for each block. Label all all the forces.



b). Write down the $\Sigma F_x = ma_x$ equation for each block.

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$\vec{N}_{AB} = -\vec{N}_{BA}$

c):Take m_A, m_B, and $\vec{F}_0$ to be known quantities. In part (b) you should have gotten two equations with two unknowns. Solve for the acceleration a_x.

$F_0 - N_{AB} = m_A a$

$N_{BA} = m_B a$

$\Rightarrow F_0 - m_B a = m_A a$

$F_0 = m_B a + m_A a$

$F_0 = (m_B + m_A) a$

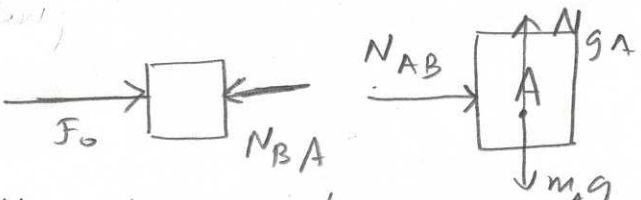
$\Rightarrow \boxed{a = F_0 / (m_B + m_A)}$

d). Now suppose the order of the blocks is switched (as shown in figure below) such that the blocks are in contact but the force $\vec{F}_0$ is applied on block B.

(i). Is the acceleration of the block now less than, greater than or the same as before? Give brief but correct reason.

The same as before. $a = F_0 / (m_B + m_A)$.

(ii) Is the normal force the blocks apply on each other less than, greater than or the same as before? Give complete reason.



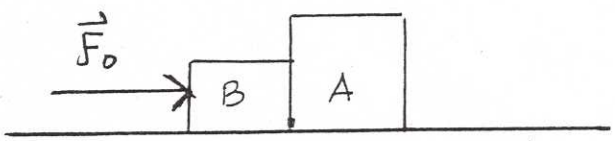


Fig 1d.

Now, N_{AB} is greater than that in the previous case because a is the same & $N_{AB} = m_A a$ & $m_A > m_B$

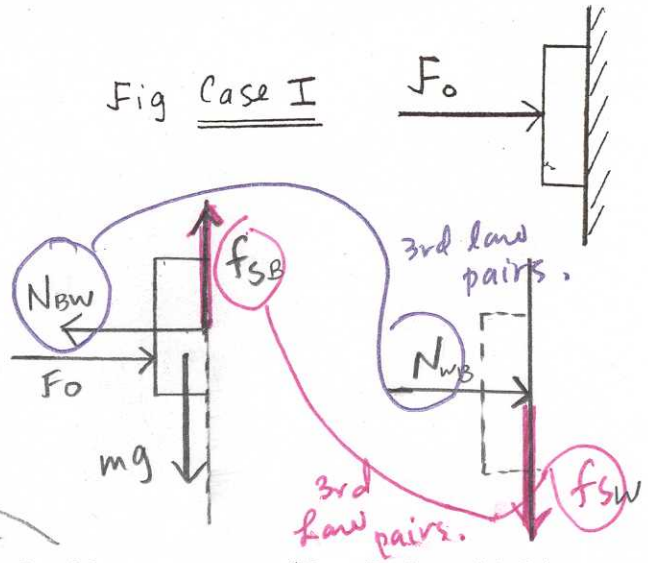
PHYSICS 161, Spring 2003

Discussion Quiz , Friday, March 14

Q1). A book is being held at rest against the wall as shown in Fig Case 1 below. A horizontal force F_0 acts on the book. The coefficient of friction between the wall and the book is μ_s.

a). Draw a free body diagram for the book ONLY. Label all all the forces.

Fig Case I



b). Now on a separate diagram, show **all** the forces the book applies on the wall. Label all the forces appropriately.

c). List all the pairs of forces that are third law partners. (Recall that third law partners are forces that are equal in magnitude and opposite in direction due to Newton's 3rd Law.)

$\vec{N}_{BW} = -\vec{N}_{WB}$ — 3rd law pair

$\vec{f}_{SB} = -\vec{f}_{SW}$ — 3rd law pair.

e). Is the magnitude of the force of friction on the book such that: (i) F_s exactly equal to $\mu_s F_N$; (ii) $F_s < \mu_s F_N$; (iii) $F_s > \mu_s F_N$; (iv) not enough information to decide, it could be (i), (ii) or (iii); (v) not enough information to decide between (i) and (ii) but (iii) is certainly ruled out. Make a choice between (i) thru (v).

(v). ✓

f). Now suppose that the force F_0 has the same magnitude as in the previous parts but now is applied at an angle as shown below. μ_s is still the same as in Case I. The book is being held at rest as before. **Draw a free body diagram for the book ONLY and state if the magnitude of the frictional force on the book is less than, greater than or equal to that in Case I? Give complete reason.**

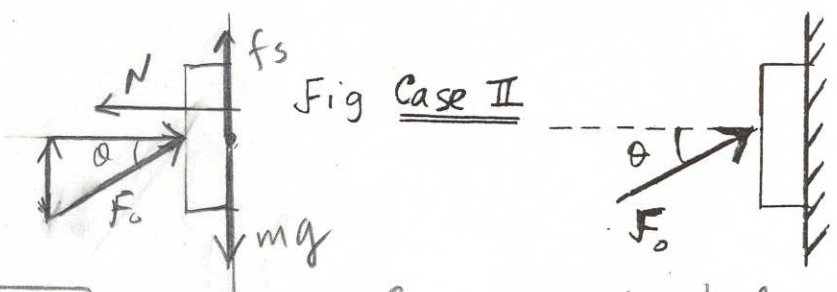
Now f_s is less than case I because in the y-direction

$\Sigma F_y = ma_y$

$f_s + F_0 \sin\theta - mg = 0$

$\Rightarrow$ $f_s = mg - F_0 \sin\theta$.

Fig Case II



before, $f_s = mg$ to balance forces in y-direction.