# Test01: Additional Problems/Solutions

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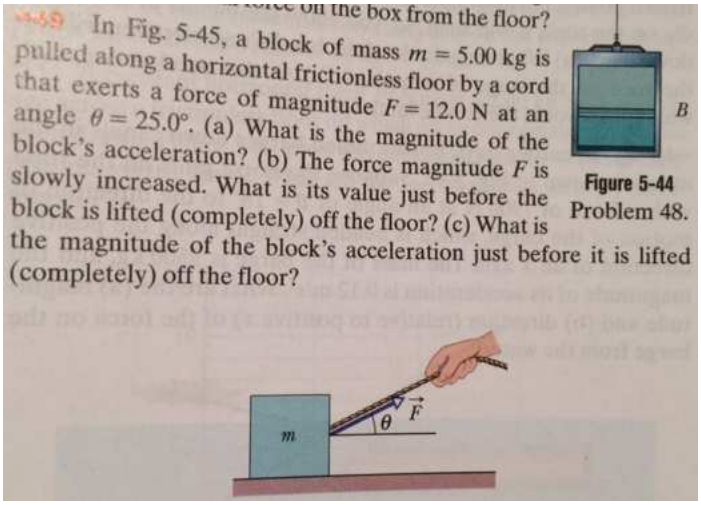


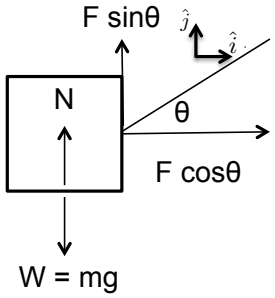


**Solution for Ch5:49** Given m = 5 kg, F = 12.0 N and $\theta = 25°$ and the floor is frictionless. Free body diagram is shown. The magnitude of the force is steadily increased (to say F′), the block loses contact (N→0) at that instant and let the acceleration be a′. Note that angle is kept the same.

$$a) \quad F\cos\theta\,\hat{i} = ma\,\hat{i}$$
$$a = F\cos\theta/m$$
$$= 12\cos 25°/5$$
$$\boxed{= 2.18\ m/s^2}$$

$$b, c) \quad (F'\sin\theta + N - mg)\,\hat{j} = 0 \quad N \to 0$$
$$F' = mg/\sin\theta$$
$$= 5(9.8)/\sin 25°$$
$$\boxed{= 115.9\,N}$$
$$a' = F'\cos\theta/m$$
$$\boxed{= 21\,m/s^2}$$

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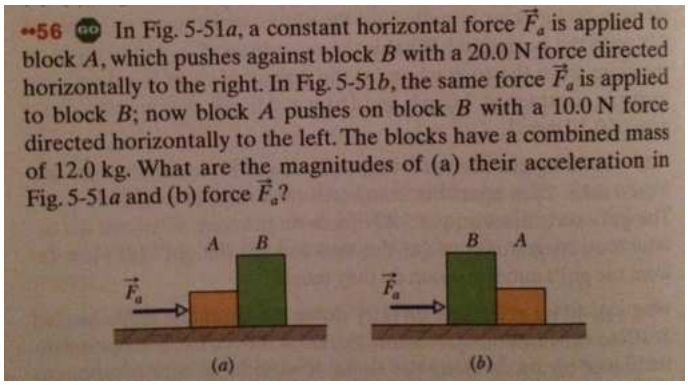
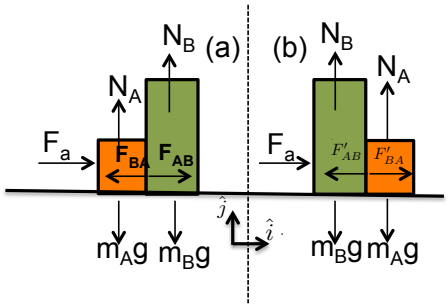
**Solution for Ch5:56** Given quantities are $F_{AB} = 20$ N for fig (a) and $F'_{AB} = 10$ N for fig (b). $m_A + m_B = 12$ kg. No friction on any surface. Let's call the contact surface between A and B as the "boundary". The applied force $F_a$ is being "used up" to overcome interia at the boundary.

In case (a), the inertia to overcome is small and therefore contact force ($F_{AB} = F_{BA}$=20 N) larger. In case (b) it's the opposite. The same applied force has to overcome more inertia (larger mass) which causes more of the applied force to be "used up" thus making the contact force ($F'_{AB} = F'_{BA}$=10 N) smaller.

But the total inertia (ie, sum of masses) is the same in both cases. We can conclude that the system has to have same acceleration in both cases.




The inertia ($m_A$) in case (a) is half the inertia ($m_B$) in case (b). Why? Because $F_{AB}/F'_{AB}$=2. If $m_B = 2\,m_A$ and $m_A + m_B = 12$ kg, then $m_A = 4$ kg and $m_B = 8$ kg. The acceleration can be found using $F_{AB} = m_A\,a$ for case (a) or $F'_{AB} = m_B\,a$ in case (b)

| | |
|---|---|
| *a)* $F_{AB} = m_A a\,\hat{i}$ | *b)* $F'_{AB} = m_B a\,\hat{i}$ |
| $a = (10\,N)/(4\,kg)$ | $a = (20\,N)/(8\,kg)$ |
| $\boxed{= 2.5\ m/s^2}$ | $\boxed{= 2.5\ m/s^2}$ |

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