QUIZ#5- CHAPTER 5
DATE: 23/10/17

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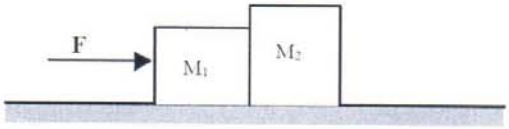
Two blocks of masses $M_1 = 2.0$ kg and $M_2 = 4.0$ kg are in contact with each other and move on a frictionless horizontal surface under the action of a horizontal force $F = 80$ N as seen in the figure.

(a) Calculate the acceleration of the blocks.
(b) Calculate the force that M_1 exerts on M_2.
(c) Calculate the force that M_2 exerts on M_1.
Hint: Draw free body diagram for each block



$F_{net,x} = (M_1 + M_2)\,a$

a) $F = (M_1 + M_2)\,a$

$$a = \frac{F}{M_1+M_2} = \frac{80}{6} = \boxed{13.3\ m/s^2}$$

b)

$$F_{21} = M_2 a = 4 \times 13.3 = \boxed{53.2\ N}$$

c) $F - F_{12} = M_1 a \Rightarrow F_{12} = F - M_1 a$

$$F_{12} = 80 - 2 \times 13.3 = \boxed{53.4\ N}$$

Note that the two forces F_{12} and F_{21} are equal in magnitude and opposite in direction. They are action - reaction pair

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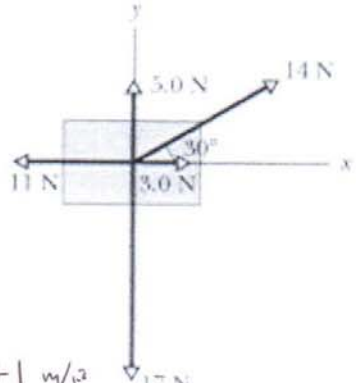
The figure shows an overhead view of a block of mass 10 kg acted upon by five forces. Calculate the magnitude and direction of the acceleration of the block.



$\vec{F}_{net} = m\,\vec{a}$

$F_{net,x} = m\,a_x$

$14\cos 30^\circ + 3 - 11 = 10\,a_x \Rightarrow a_x = 0.41\ m/s^2$

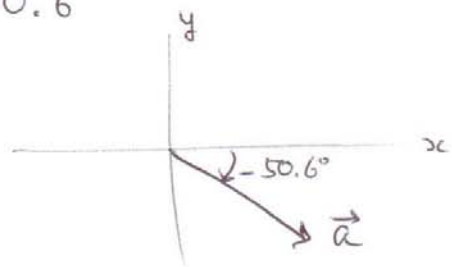
$F_{net,y} = m\,a_y$

$5 + 14\sin 30^\circ - 17 = 10\,a_y \Rightarrow a_y = -0.5\ m/s^2$

$\vec{a} = 0.41\,\hat{i} - 0.5\,\hat{j}\ m/s^2$

$|\vec{a}| = \sqrt{(0.41)^2 + (-0.5)^2} = \boxed{0.65\ m/s^2}$

$\theta = \tan^{-1}\left(\frac{-0.5}{0.41}\right) = -50.6^\circ$



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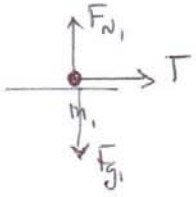
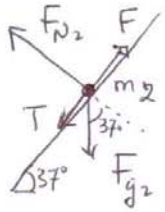
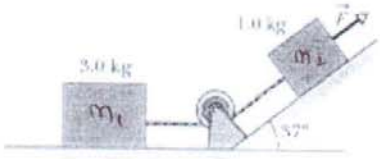
Consider the two blocks shown in the figure pulled by a force F = 20 N.
(a) Draw a free body diagram for each block.
(b) Write Newton's second law for each block.
(c) Calculate the acceleration on the blocks.

a)







b) m_1: $F_{net,x} = m_1 a$ $\quad F_{net,y} = 0$

$$T = m_1 a \quad -(1) \qquad F_{N_1} - F_{g_1} = 0$$

m_2: $F_{net,x} = m_2 a$ $\quad F_{net,y} = 0$

$$F - T - m_2 g \sin 37^\circ = m_2 a \quad -(2) \qquad F_{N_2} - m_2 g \cos 37^\circ = 0$$

$$F - m_1 a - m_2 g \sin 37^\circ = m_2 a$$

$$F - m_2 g \sin 37^\circ = (m_1 + m_2) a$$

$$a = \frac{F - m_2 g \sin 37^\circ}{m_1 + m_2} = \frac{20 - 5.9}{4} = \boxed{3.5\ m/s^2}$$