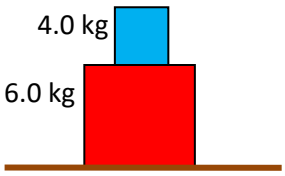
Teacher notes
Topic A

Free body diagrams and Newton's third law

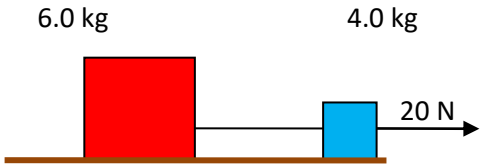
Take $g = 10\,\text{ms}^{-2}$.

Draw free body diagrams for each block. Calculate magnitudes of forces whenever possible. Identify any pairs according to Newton's third law using the same color.

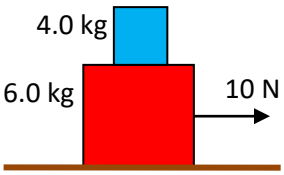
1. Two blocks at rest on top of each other.



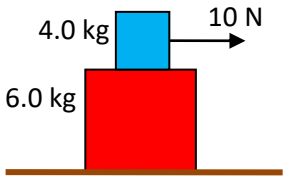
2. The table is frictionless.



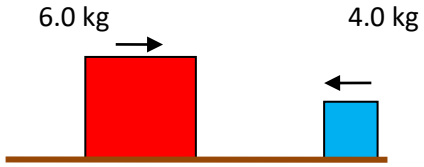
3. There is friction between the 2 blocks. The static coefficient is 0.4. The blocks move as one body. Draw horizontal forces only.



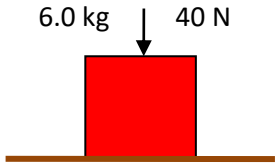
4. There is friction between the 2 blocks. The static coefficient is 0.4. The blocks move as one body. Draw horizontal forces only.



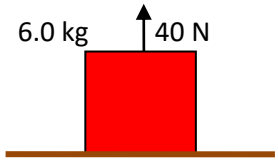
5. The blocks will collide. Label the forces during the collision. Draw horizontal forces only.



6. A 40 N force is acting downwards on the block. Include the floor.



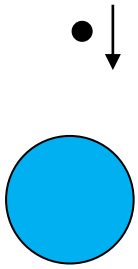
7. A 40 N force is acting upwards on the block. Include the floor.



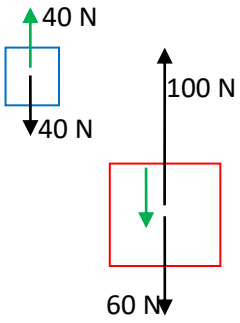
8. A force of 20 N pushes two blocks on a frictionless table. Draw horizontal forces only.

9. A man holds himself in equilibrium by pushing down on the rope. His weight is W = 600 N and the weight of the box is w = 200 N. Draw the forces on (a) the man and (b) the box. Find the magnitude of each of the forces you drew.

10. Stone dropped from a height, falling towards Earth.



1.



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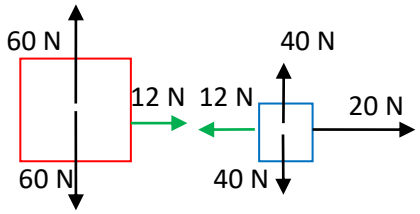
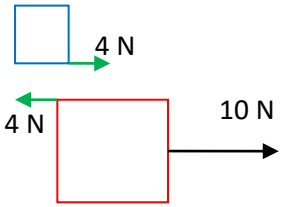
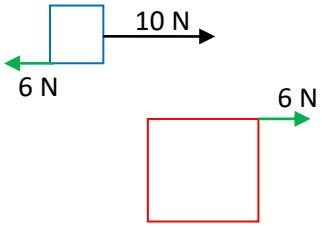


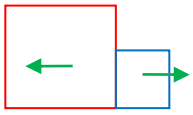
3.



4.



5.



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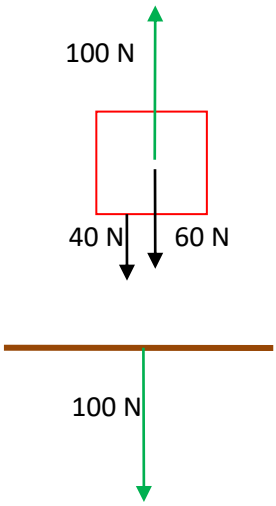
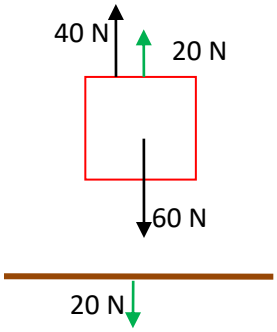
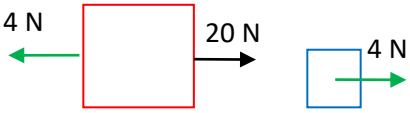


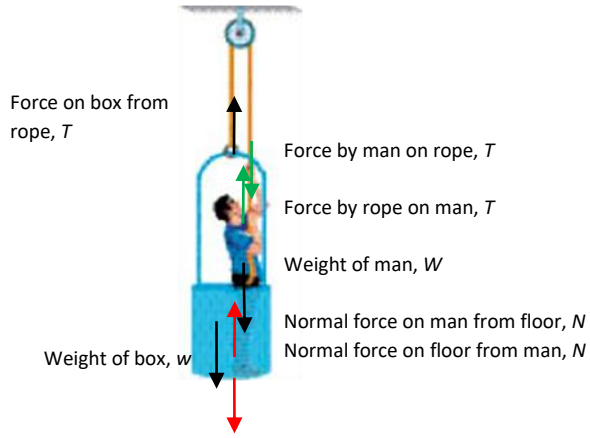
7.



8.



9. The forces are shown in the diagram. Forces in the same color are pairs according to Newton's third law.



Net force on man is $T+N-W=0$, i.e. $T+N=600$.
Net force on box is $T-N-w=0$, i.e. $T-N=200$.
This means $T=400\text{ N}$, $N=200\text{ N}$.

10. The forces are equal in magnitude and opposite in direction and vary as the stone falls.