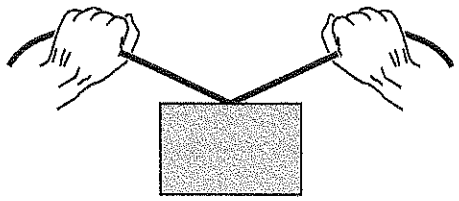
1. A person pulls equally hard on two strings that are attached to a block as shown at right. Assume that the strings have negligible mass and that they remain taut and form the same angle with the horizontal at all times.



a. Draw an arrow to indicate the direction of the acceleration of the block for each of the four motions listed below.

| Block speeds up while moving downward | Block slows down while moving downward | Block speeds up while moving upward | Block slows down while moving upward |
|---|---|---|---|
| | | | |

b. Draw an arrow to indicate the direction of the net force for each of the four motions.

| Block speeds up while moving downward | Block slows down while moving downward | Block speeds up while moving upward | Block slows down while moving upward |
|---|---|---|---|
| | | | |

Explain the reasoning you used to determine the direction of the net force for each of the four motions.

c. Draw and label a free-body diagram for the block for each of the four motions. Indicate the relative magnitudes of the forces by the relative lengths of the force vectors. *Draw all diagrams to the same scale.*

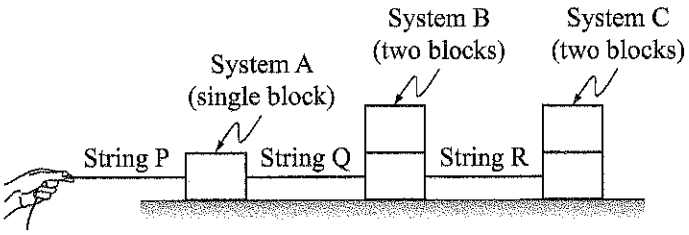
| Block speeds up while moving downward | Block slows down while moving downward | Block speeds up while moving upward | Block slows down while moving upward |
|---|---|---|---|
| | | | |

2. Consider the following statement made by a student about each of the four motions in problem 1.

"The magnitude of the force exerted by the block on an individual string is the same as the magnitude of the force exerted by that string on the block. They are a third law force pair. So I don't understand why the block doesn't move at constant speed if that is true."

The student has correctly identified a Newton's third law (action-reaction) force pair. Explain why this does not mean that the block must move at constant speed.

3. Five *identical* blocks, each of mass $m$, are pulled across a table as shown. Use the approximations that the table is frictionless and the strings are massless.




a. Describe the motion of each of the systems A, B, and C.

b. Draw vectors below to represent the acceleration of each system.

| Acceleration vector for system A | Acceleration vector for system B | Acceleration vector for system C |
|---|---|---|
| | | |

c. Draw and label separate free-body diagrams for systems A, B, and C.

| Free-body diagram for system A | Free-body diagram for system B | Free-body diagram for system C |
|---|---|---|
| | | |

d. Rank the magnitudes of the *net forces* on systems A, B, and C. Explain.

e. Write expressions for the tension in strings P and R in terms of $T_Q$, the tension in string Q. Show all your work.