Vectors and Equilibrium

1. Nellie Newton dangles
   from a vertical rope
   in equilibrium: $\sum F = 0$.
   The tension in the rope
   (upward vector) has the same
   magnitude as the downward
   pull of gravity (downward vector).

2. Nellie is supported by
   two vertical ropes.
   Draw tension vectors
   to scale along the direction
   of each rope.
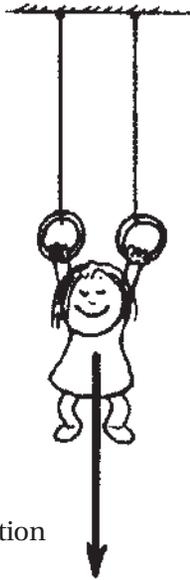
3. This time the vertical ropes
   have different lengths. Draw
   tension vectors to scale for
   each of the two ropes.
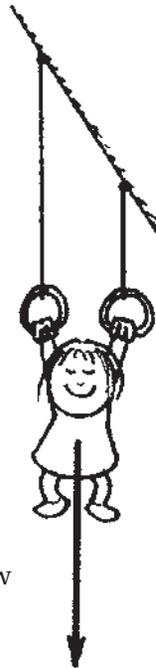
4. Nellie is supported by three
   vertical ropes that are
   equally taut but have
   different lengths. Again,
   draw tension vectors to scale
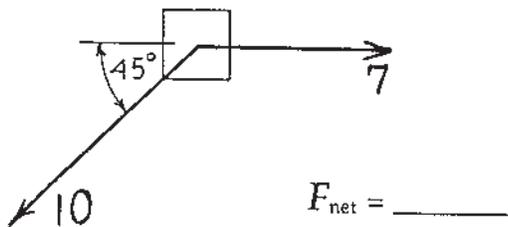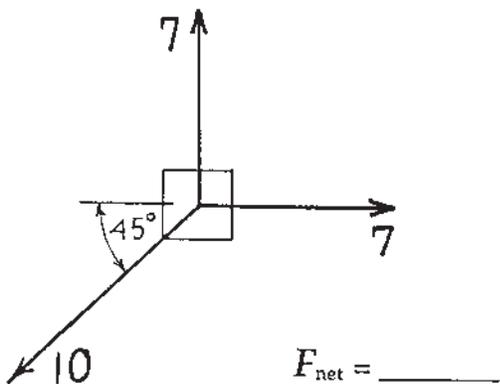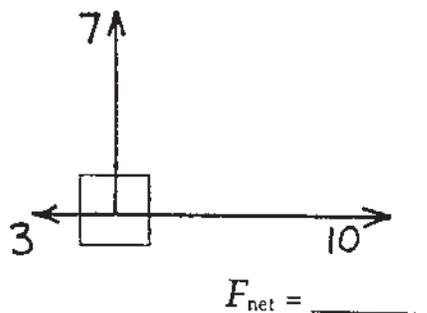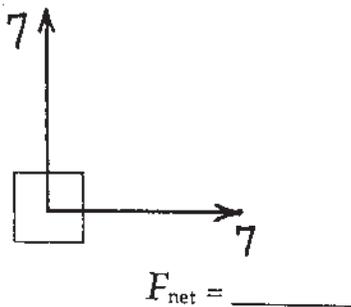   for each of the three ropes.
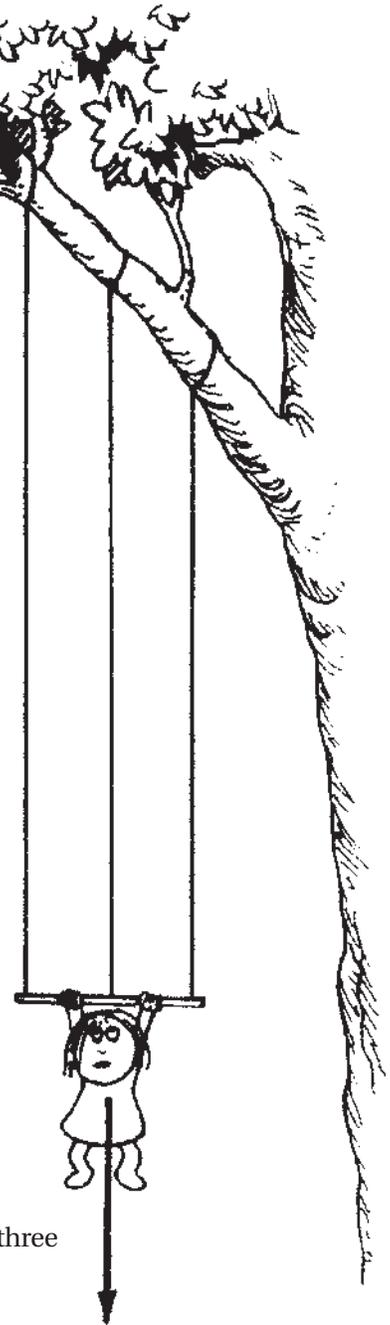
Circle the correct answers.

5. We see that tension in a rope is (dependent on)   (independent of)   the length of the rope. So the length
   of a vector representing rope tension is (dependent on)   (independent of)   the length of the rope.

CONCEPTUAL PHYSICS

Net Force

Fill in the magnitudes of net force for each case.

Box with 4 up and 4 down. $F_{net} =$ _____

Box with 3 left and 4 right. $F_{net} =$ _____

Box with 4 up and 3 right. $F_{net} =$ _____

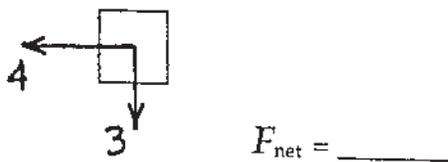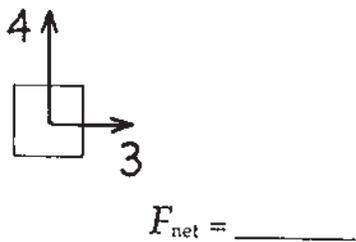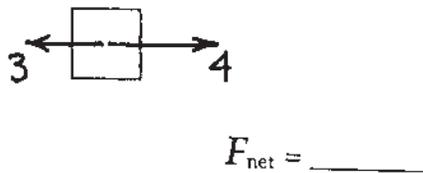Box with 4 left and 3 down. $F_{net} =$ _____

Box with 4 up, 2 left, 5 right. $F_{net} =$ _____

Box with 2 up, 4 left, 5 down. $F_{net} =$ _____

Box with 7 up and 7 right. $F_{net} =$ _____

Box with 7 up, 3 left, 10 right. $F_{net} =$ _____

Box with 7 up, 7 right, 10 at 45°. $F_{net} =$ _____

Box with 7 right, 10 at 45°. $F_{net} =$ _____
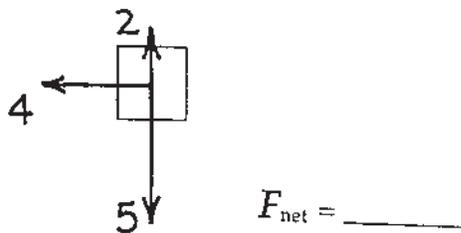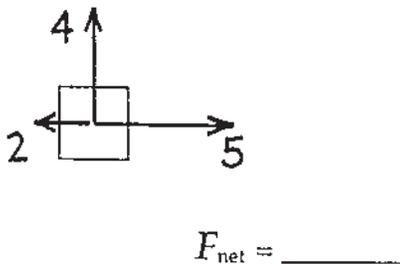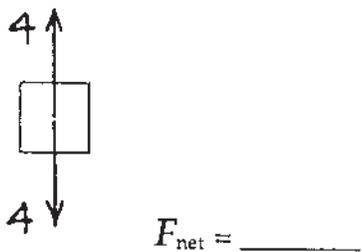
CONCEPTUAL PHYSICS

Vectors and Equilibrium

The rock hangs at rest from a single string. Only two forces act on it, the upward tension **T** of the string, and the downward pull of gravity **W**. The forces are equal in magnitude and opposite in direction.

Net force on the rock is (zero) (greater than zero).

Here the rock is suspended by 2 strings. Tension in each string acts in a direction along the string. We'll show tension of the left string by vector **A**, and tension of the right string by vector **B**. The resultant of **A** and **B** is found by the **parallelogram rule**, and is shown by the dashed vector. Note it has the same magnitude as **W**, so the net force on the rock is
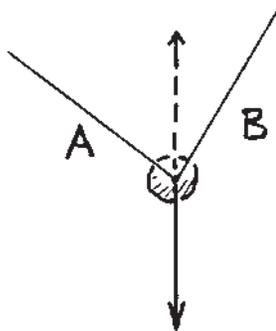
(zero) (greater than zero).

Consider strings at unequal angles. The resultant **A + B** is still equal and opposite to **W**, and is shown by the dashed vector. Construct the appropriate parallelogram to produce this resultant. Show the relative magnitudes of **A** and **B**.
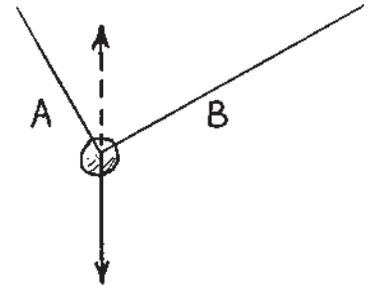
Tension in **A** is (less than) (equal to) (greater than) tension in **B**.
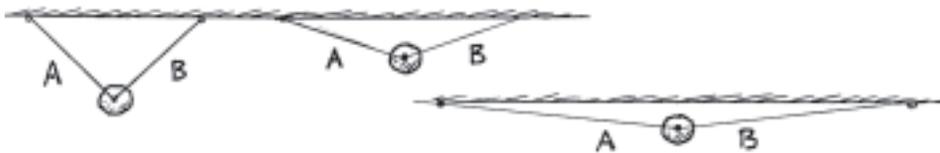
Repeat the procedure for the arrangement below.

Here tension is greater in _____.

No wonder hanging from a horizontal tightly-stretched clothesline breaks it!

Construct vectors **A** and **B** for the cases below. First draw a vector **W**, then the parallelogram that has equal and opposite vector **A + B** as the diagonal. Then find approximate magnitudes of **A** and **B**.

CONCEPTUAL PHYSICS