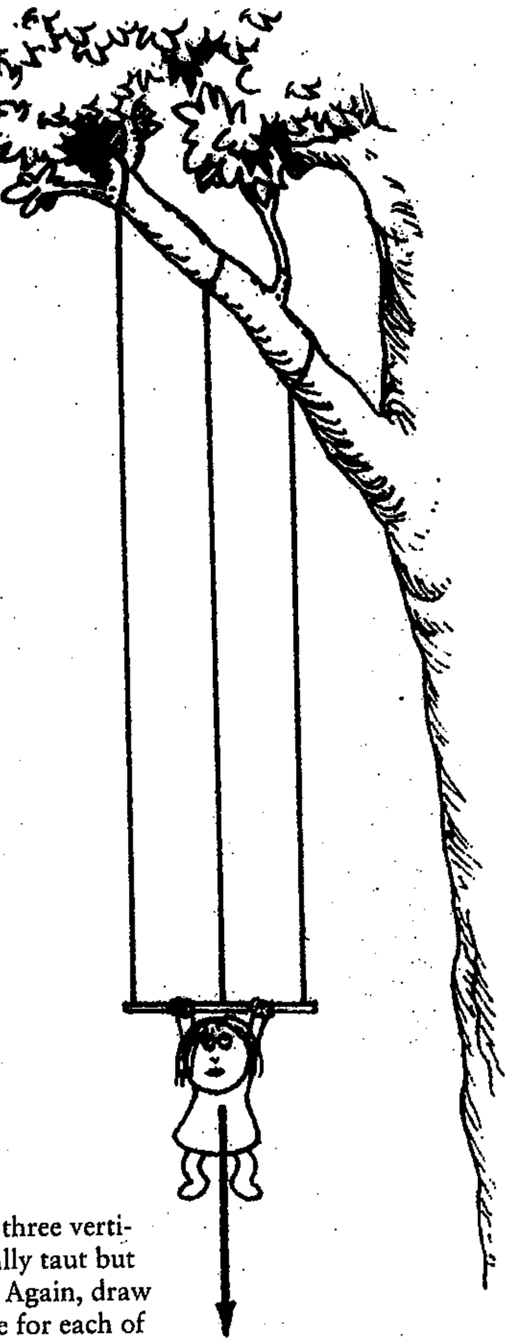
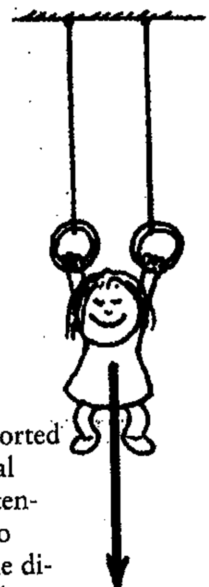
Name ____ Date ____________

Chapter 2: Describing Motion

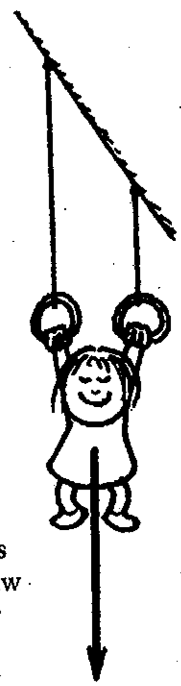
Vectors and Equilibrium

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





1. Nellie is supported by two vertical ropes. Draw tension vectors to scale along the direction of each rope.

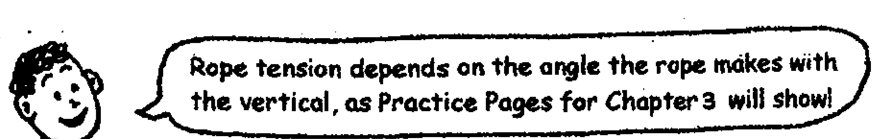


2. This time the vertical ropes have different lengths. Draw tension vectors to scale for each of the two ropes.

3. 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 answer:

4. 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.



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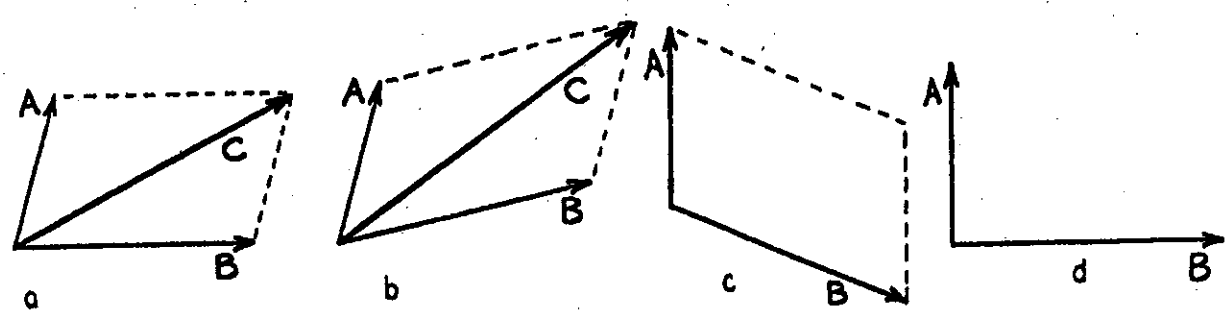
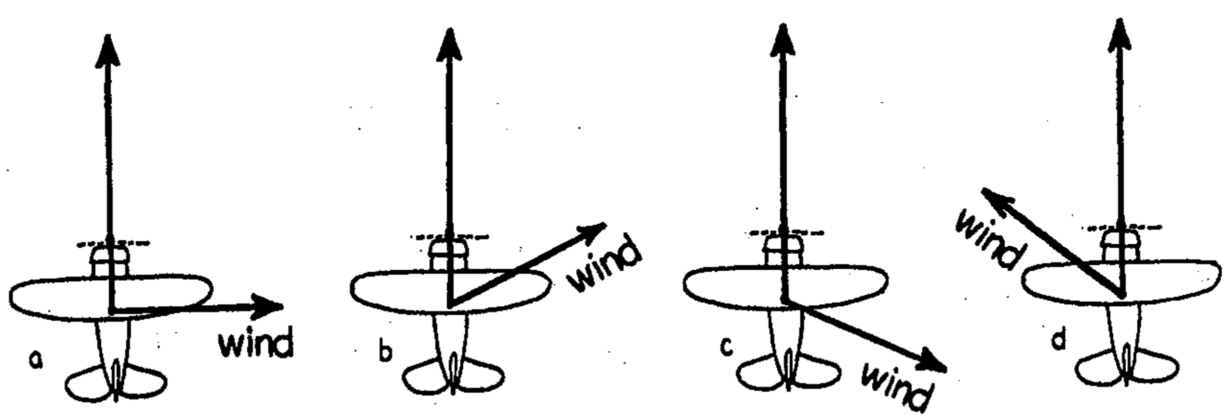
Chapter 3: Newton's Laws of Motion

Vectors and the Parallelogram Rule

1. When vectors A and B are at an angle to each other, they add to produce the resultant C by the *parallelogram rule.* Note that C is the diagonal of a parallelogram where A and B are adjacent sides. Resultant C is shown in the first two diagrams, *a* and *b*. Construct the resultant C in diagrams *c* and *d*. Note that in diagram *d* you form a rectangle (a special case of a parallelogram).



2. Below we see a top view of an airplane being blown off course by wind in various directions. Use the parallelogram rule to show the resulting speed and direction of travel for each case. In which case does the airplane travel fastest across the ground? __________ Slowest? __________



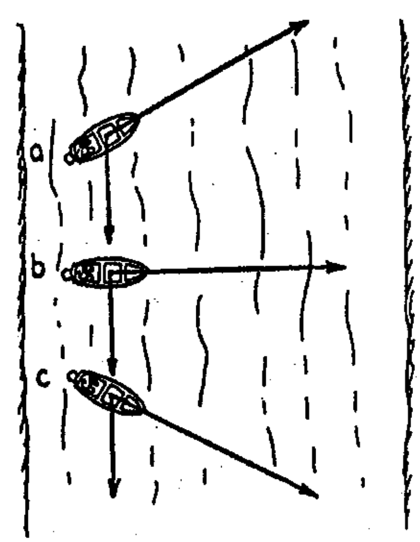
3. To the right we see top views of three motorboats crossing a river. All have the same speed relative to the water, and all experience the same water flow.

   Construct resultant vectors showing the speed and direction of the boats.

   a. Which boat takes the shortest path to the opposite shore? __________

   b. Which boat reaches the opposite shore first? __________

   c. Which boat provides the fastest ride? __________



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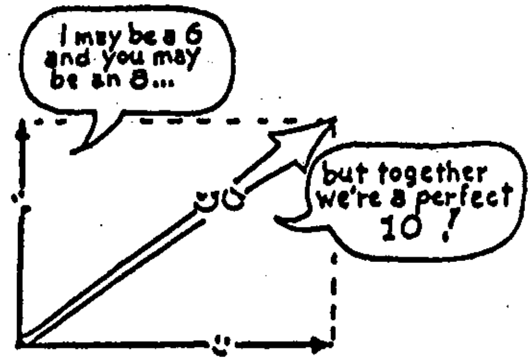
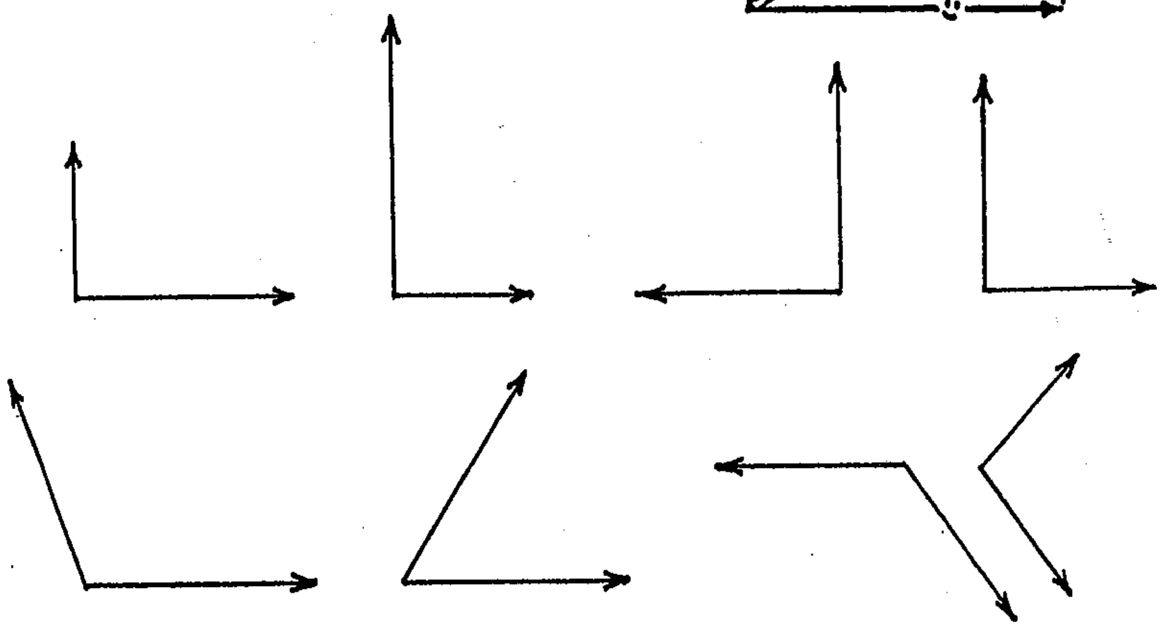
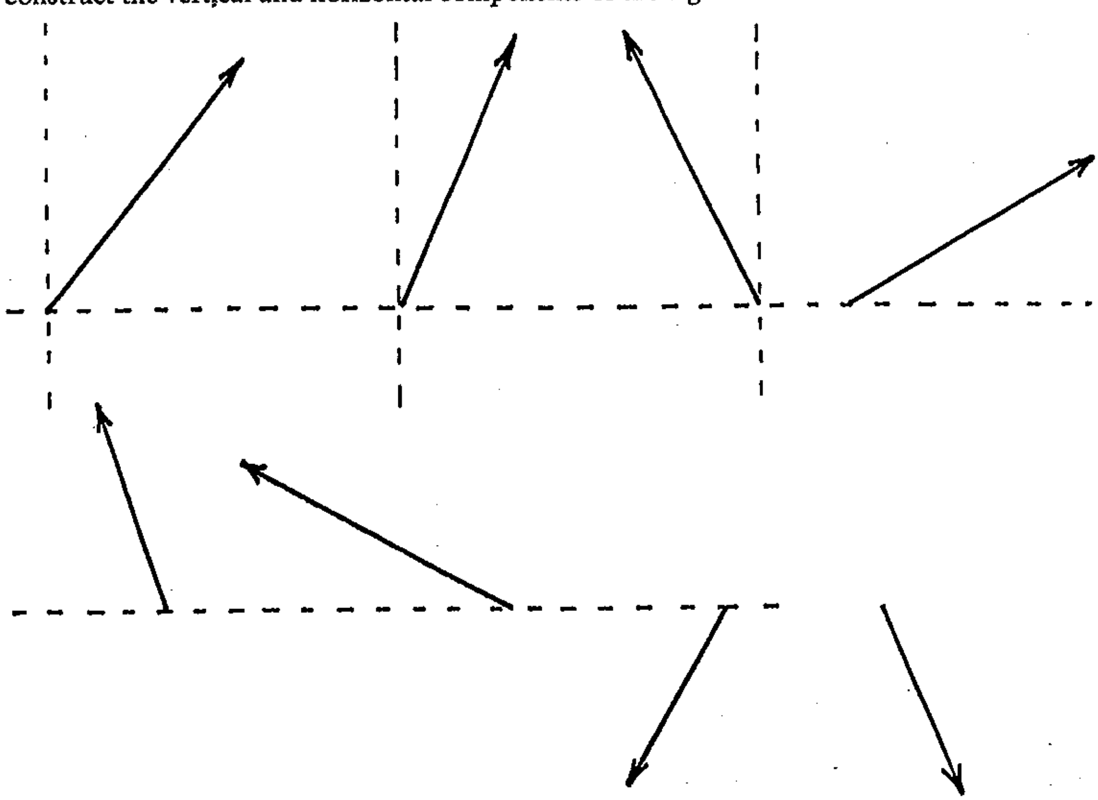
ors

Use the parallelogram rule to carefully construct the resultants for the eight pairs of vectors.





Carefully construct the vertical and horizontal components of the eight vectors.



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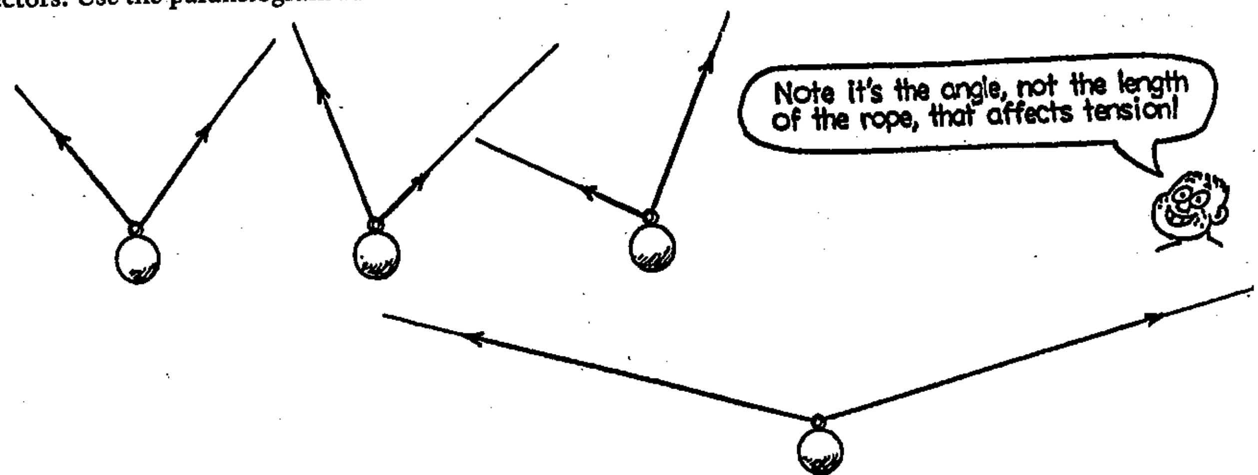
Chapter 3: Newton's Laws of Motion

Force Vectors and the Parallelogram Rule

1. The heavy ball is supported in each case by two strands of rope. The tension in each strand is shown by the vectors. Use the parallelogram rule to find the resultant of each vector pair.



   a. Is your resultant vector the same for each case? ____________

   b. How do you think the resultant vector compares to the weight of the ball?

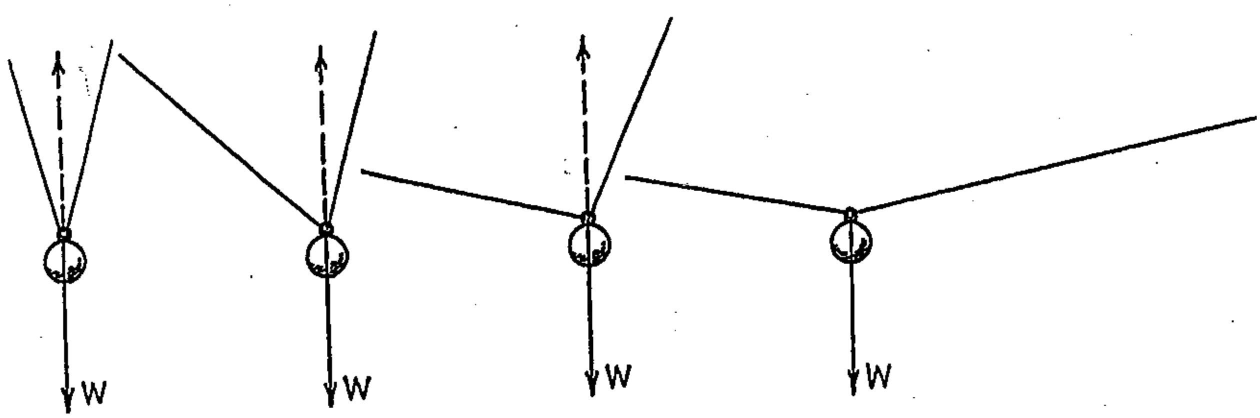
   ____

2. Now let's do the opposite of what we've done above. More often, we know the weight of the suspended object, but we don't know the rope tensions. In each case below, the weight of the ball is shown by the vector W. Each dashed vector represents the resultant of the pair of rope tensions. Note that each is equal and opposite to vectors W (they must be; otherwise the ball wouldn't be at rest).

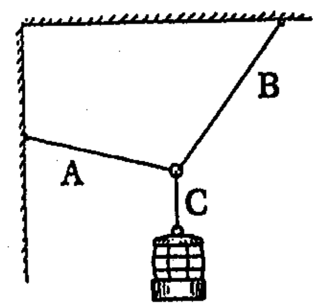
   a. Construct parallelograms where the ropes define adjacent sides and the dashed vectors are the diagonals.

   b. How do the relative lengths of the sides of each parallelogram compare to rope tensions?

   c. Draw rope-tension vectors, clearly showing their relative magnitudes.



3. A lantern is suspended as shown. Draw vectors to show the relative tensions in ropes **A, B,** and **C.** Do you see a relationship between your vectors **A + B** and vector **C**? Between vectors **A + C** and vector **B**?



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F Vector Diagrams

In each case, a rock is acted on by one or more forces. Draw an accurate vector diagram showing all forces acting on the rock, and no other forces. Use a ruler, and do it in pencil so you can correct mistakes. The first two are done as examples. Show by the parallelogram rule in 2 that the vector sum of **A + B** is equal and opposite to **W** (that is, **A + B = −W**). Do the same for 3 and 4. Draw and label vectors for the weight and normal forces in 5 to 10, and for the appropriate forces in 11 and 12.