

1. Quiz - Make arrangements if you have not written yet.
2. Check - Understanding Concepts: Page 423, #3, 5 and 6 HW
3. Activity: Adding Displacement Vectors - Page 424

4. Communicating Direction
5. Velocity and Average Velocity
6. Chapter 11 Review - Page 442
7. Explore an Issue - Athletes on the Edge

Due Thursday - P3
Due Friday - P4

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11.4 Activity

Adding Displacement Vectors

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Any vector motion we have considered in this chapter has been restricted to forward or backward along a straight line. However, in the real world, motion and direction are seldom this simple. Nearly everywhere you go on any day involves turning and changing direction.

The purpose of this activity is to help you visualize individual displacements and resultant displacements that are not along one straight line. You will use toothpicks or straws to represent displacement vectors with values of 1, 2, and 3 units of length. Each toothpick represents a displacement: $\Delta\vec{d}_1 =$ single length [N], $\Delta\vec{d}_2 =$ double length [E], and $\Delta\vec{d}_3 =$ triple length [S].

Question

What is the resultant displacement of three displacement vectors?

Materials

- 6 toothpicks or 2 straws
- scissors
- tape
- marker or pencil
- lined or graph paper
- ruler
- protractor



Use the toothpicks and scissors with care.

Procedure

- 1 Tape two toothpicks and then three toothpicks end to end. (Alternatively, cut two straws to obtain lengths of approximately 4 cm, 8 cm, and 12 cm.)
- 2 Using a marker, colour one end of each of the “vectors” to represent the arrowhead. For the straws, you may want to colour a small piece of tape placed on the end of each straw.
- 3 Draw a compass symbol near the top of your paper and place an “X” near the left margin, about 10 cm from the top of the paper.
- 4 Place the component vectors in the order $\Delta\vec{d}_1 + \Delta\vec{d}_2 + \Delta\vec{d}_3$, using a head-to-tail procedure starting from position X. Their directions are N, E and S, respectively.
- 5 Place a dot at the head end of the last vector ($\Delta\vec{d}_3$ in this case). Label this point Y.
- 6 Using a ruler, draw an arrow and write a label for each of the three vectors.
- 7 Repeat steps 3 to 6 three separate times, using separate pieces of paper, and placing the vectors in different orders. Remember that $\Delta\vec{d}_1$ always points north, $\Delta\vec{d}_2$ points east, and $\Delta\vec{d}_3$ points south.

Analysis

- (a) For each arrangement of vectors, draw the resultant displacement. Remember to include an arrowhead to indicate the direction, from X to Y.
- (b) For each combination of displacement vectors:
 - Measure and record the size (length) of the resultant displacement.
 - Using the protractor and compass directions, devise a method to report the direction of the resultant displacement.
 - Record each resultant displacement in a table.

- (c) What do you notice about the final position of all the displacement vector additions?
- (d) What do you notice about the length of each of the resultant displacements?
- (e) Using your answers to these Analysis questions, answer the initial question.
- (f) Compare your answers with those of other people. How did others communicate the direction of their resultant displacement?