Generic Vector Problems

1. A small child is lost in the woods. From his initial starting point, he wanders 500 m east, then 200 m north, then 200 m east then 600 m south then 300 m west.
   a. Graphically represent his wanderings to find his final displacement vector.

   b. Algebraically calculate his final displacement vector (unit vector form.)

   c. Algebraically calculate the magnitude and direction of his displacement vector.

2. Vector A is $5\mathbf{i} + 8\mathbf{j} - 7\mathbf{k}$ and vector B is $3\mathbf{i} - 4\mathbf{j} + 2\mathbf{k}$.
   a. What is $\vec{A} + \vec{B}$?

   b. What is $\vec{A} - \vec{B}$?

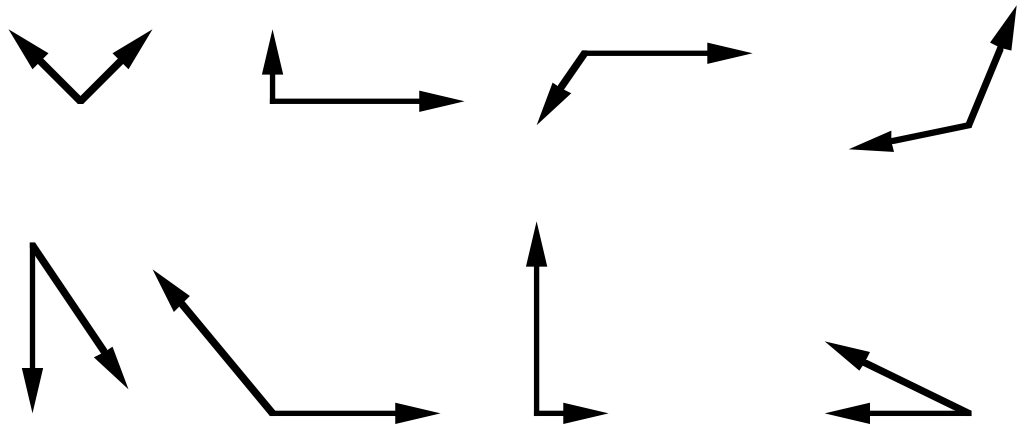
   c. What is $3\vec{A}$?

   d. What is the magnitude of $\vec{B}$? (usually written as $|\vec{B}|$, or simply B)

3. A ball is thrown with an initial velocity of 30 m/s at an angle of 35° up from the horizontal.
   a. What is this velocity in unit-vector form?

   b. If you added a velocity of 40 m/s straight down ($-40\mathbf{j}$), what is the final velocity?

4. Add these vectors. Clearly mark the resultant vector.



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5. A car's velocity vector is given by 30**i** + 40**j**. Give a vector that has the same magnitude, but is perpendicular to the first vector, and in the **i-j** plane.

6. Sketch each of the following vectors and give it in magnitude and direction form.
   a. 5**i** + 10**j** b. –6**i** + 8**j** c. 300**i** + 100**j** d. 45**i** – 23**j**

7. Sketch each of the following vectors and give it in unit-vector form.
   a. 250 m/s @ 30° b. 17 m/s^2 @ 120° c. 5 m @ –65° d. 75 m/s @ 200°

8. What are the properties of two vectors **a** and **b** such that
   a. **a** + **b** = **c** and a + b = c;

   b. **a** + **b** = **a** – **b**;

   c. **a** + **b** = **c** and $a^2 + b^2 = c^2$?

9. Prove the Pythagorean Theorem. *(On separate sheet of paper.)*

10. Prove the Law of Cosines. *(On separate sheet of paper.)*

Answers:

*1 b) 400**i** – 400**j** c) 566 @ –45° 2. a) 8**i** + 4**j** – 5**k** b) 2**i** + 12**j** – 9**k** c) 15**i** + 24**j** – 21**k** d) 5.39*
*3 a) 24.6**i** + 17.2**j** m/s b) 24.6**i** – 22.8**j** 5) –40**i** + 30**j** 6 a) 11.2 @ 63.4°*
*b) 10 @ 127° c) 316 @ 18.4° d) 51 @ –27° 7 a) 217**i** + 125**j** m/s b) –8.5**i** + 14.7**j** m/s^2*
*c) 2.1**i** – 4.5**j** m d) –70.5**i** – 25.7**j** m/s 8 a) **a** ∥ **b** b) b = 0 c) **a** ⊥ **b***