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MCT4C
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Jan 27-10:05 AM

§9.1 Introduction to Vectors

Definition: A scalar quantity is simply an amount such as a dollar figure, speed (45mph or 60km/hr), or a distance (500km).

Definition: A vector is quantity that bears a direction. Hence we can speak of a velocity (45mph[N] or 60km/hr [E]), or a displacement (500km[right]).

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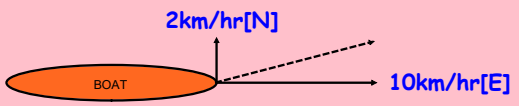
Example: A motor boat is travelling 10km/hr east in a river where there is a current of 2km/hr north. We can draw the vectors that affect this boat.



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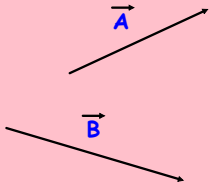
Addition of Vectors:
When given vector addition, attach the vectors according to tail to head. When all the vectors are attached, draw the resultant from the tail of the first to the head of the last. Add vector $\vec{A}$ and $\vec{B}$.



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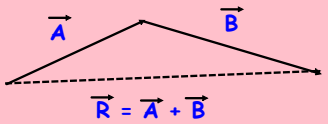
Solution: The polygon Method!



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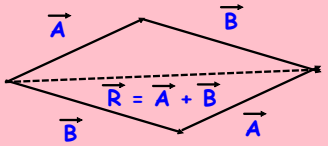
Solution: The parallelogram Method! In this method you make two A vectors and two B vectors such that you create a parallelogram as shown below:



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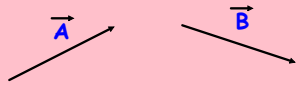
Scalar Multiplication of Vectors:
If a vector is multiplied by a coefficient, simply enlarge that vector by the multiple. Hence, find $2\vec{A} + 3\vec{B}$.



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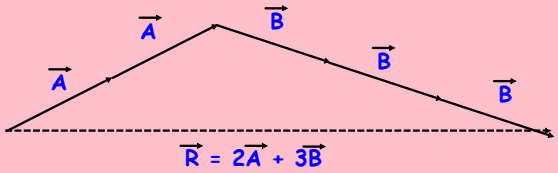
Solution: $2\vec{A} + 3\vec{B}$



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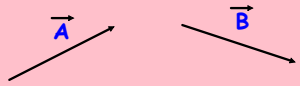
Scalar Multiplication of Vectors:
If a vector is multiplied by a negative coefficient, simply enlarge that vector by the multiple and change the direction of the vector. Hence, find $3\vec{B} - 2\vec{A}$.



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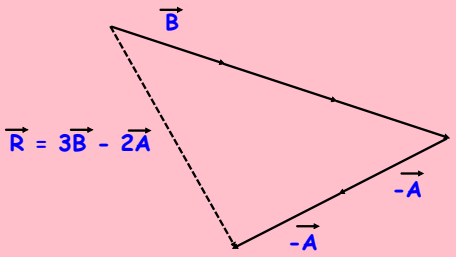
Solution: Find $3\vec{B} - 2\vec{A}$.



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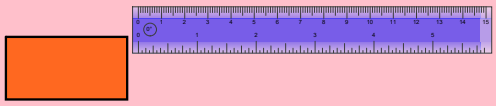
Example: Two snowmobiles are trying to take a car out of a ditch. The first snowmobile pulls the car with a force of 3000N at an angle of 37° while the other pulls with a force of 4500N directly to the right. Find the resultant force and direction of the two snowmobiles. You need a ruler and a protractor to do this.



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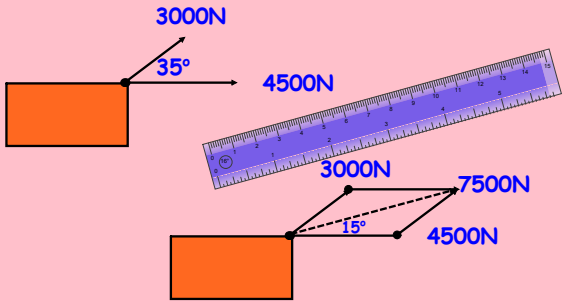
Solution: Once the drawing has been done to scale, we use the parallelogram method to determine the resultant force and angle.



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Example: To avoid a storm, a jet travels 60° north of east from Chicago for 500 km and then turns to a direction of 10° north of east for 600km to Montréal. Find the displacement of Montréal from Chicago.

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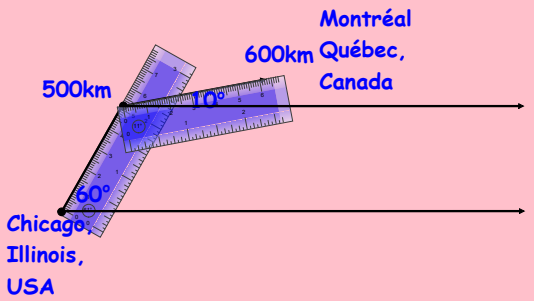
Solution: Let's use the polygon method to solve this problem.



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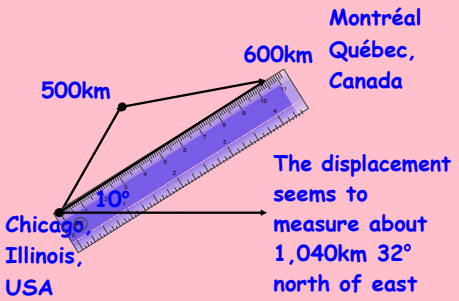
Solution: Now let's make and measure the resultant or displacement vector.



The displacement seems to measure about 1,040km 32° north of east

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END OF §9.1:

Exit Ticket: Complete & hand-In. §9.1 #42, 46. Use rulers and protractors.

Homework:

§9.1 #5-41 every other odd. Use rulers and protractors.

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§9.2 Components of Vectors

As you have observed from §9.1 accuracy is essential when drawing resultant vectors. You may one day take a course called "Drafting" (usually in mechanical engineering or architectural programs) where the purpose of the course is to master the skill of drawing vectors perfectly. We will now look at a more mathematical method of determining these resultant vectors by breaking them into horizontal (x) and vertical (y) components.

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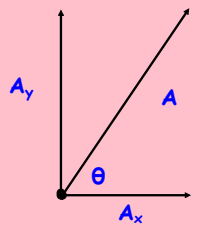
Concept: If we are given a resultant vector A as shown below, we can break it into two vector components using a simple trigonometric argument (recall the terminal arm).



Recall from the terminal arm that:

$\cos\theta = \frac{A_x}{A}$

$A_x = A\cos\theta$

$\sin\theta = \frac{A_y}{A}$

$A_y = A\sin\theta$

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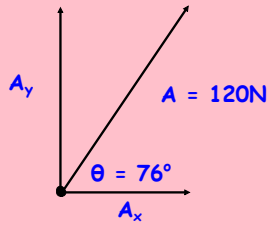
Example: Let's now give A a magnitude of 120N about an angle of 76°. Find the vector components of A.



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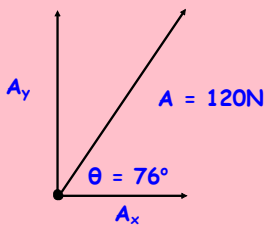

Solution:

$A_x = 120\cos(76°)$
$A_x \approx 29N$

$A_y = 120\sin(76°)$
$A_y \approx 116N$

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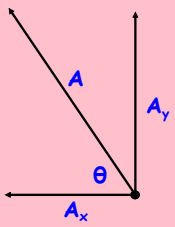
Example: If the resultant vector is in quadrant II then you must use the standard position angle. For example, given a resultant vector A of magnitude 3400km 50° north of west, find the vector components.



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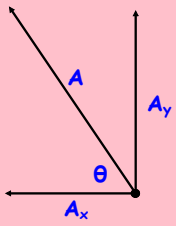

Solution:
Find the standard position angle:

$\theta = (180^\circ - 50^\circ)$
$\theta = 130^\circ$

$A_x = 3400\cos 130^\circ$
$A_x = -2185.5$ km

$A_y = 3400\sin 130^\circ$
$A_y = 2604.6$ km

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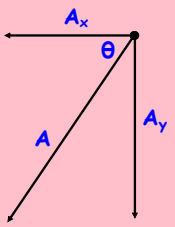
Example: If the resultant vector is in quadrant III then you must again use the standard position angle. For example, give a resultant vector A of magnitude 52230m/s 14° south of wes find the vector components.



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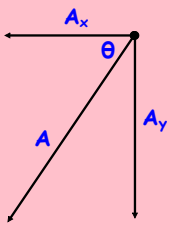

Solution:
Find the standard position angle:

$\theta = (180^\circ + 14^\circ)$
$\theta = 194^\circ$

$A_x = 52230\cos 194^\circ$
$A_x = -50678.5$ m/s

$A_y = 52230\sin 194^\circ$
$A_y = -12635.6$ m/s

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In a nut shell:

1. Place the vector A such that θ is in standard posi

2. Calculate A_x and A_y from $A_x = A\cos\theta$ and $A_y = A\sin$

3. Check the components to see if each is in the cor direction and has a magnitude that is proper for the reference angle.

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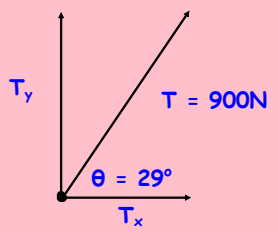
Example: The tension in a cable supporting a sign is shown below. If the magnitude is 900N and the cab makes an angle of 29° with the horizontal, find the components of the tension.



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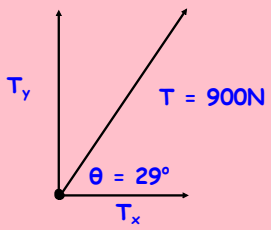

Solution:

$T_x = 900\cos(29°)$
$T_x \approx 787.2N$

$T_y = 900\sin(29°)$
$T_y \approx 436.3N$

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Exit Ticket: Complete & hand-In. §9.2 #28,30

Homework:
§9.2 #5-23 (odd only)

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