MCV 4U

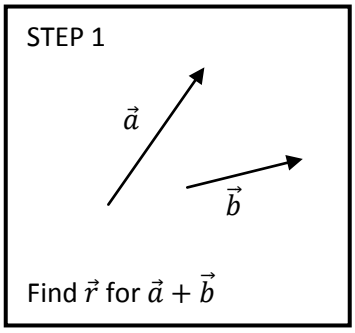
VECTOR LAWS

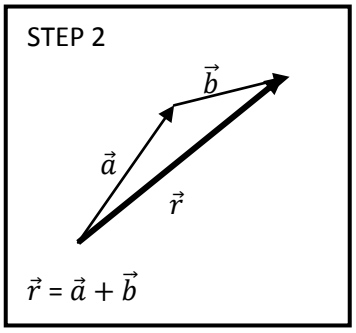
ADDITION OF VECTORS

Two or more vectors may be added together to produce a resultant vector. The following are two common methods used:

① TRIANGLE or HEAD-to-TAIL method.

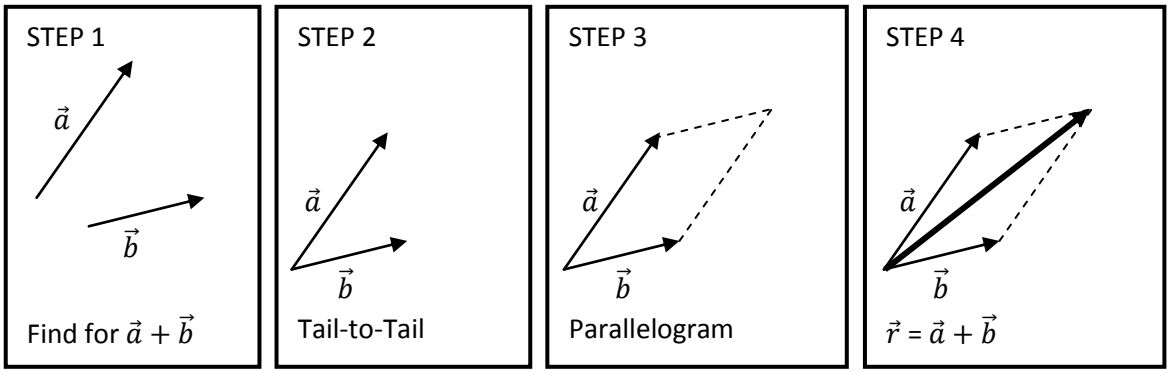
- May be used to add 2 or more vectors.
- Tail of 2nd vector is drawn to head of first vector and so on.
- Resultant $\vec{r}$ is drawn from tail of first vector to head of last vector.
- POLYGON method = when more than 2 vectors are being added.





② PARALLELOGRAM or TAIL-to-TAIL method

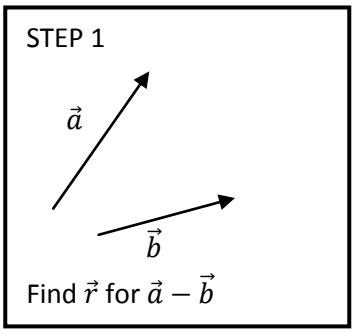
- Used with only 2 vectors.
- Vectors are moved to a common origin and a parallelogram is constructed.
- Resultant $\vec{r}$ is the diagonal of the parallelogram drawn from the common origin.
- Order of addition is NOT important: $\vec{a} + \vec{b} = \vec{b} + \vec{a}$.

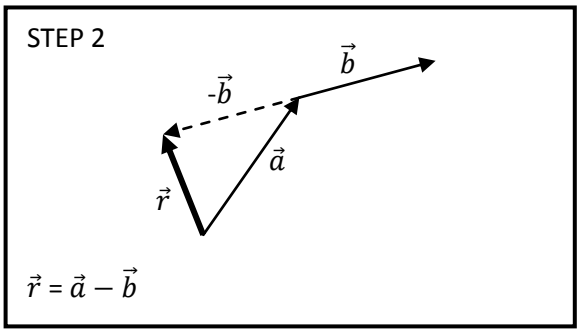


SUBTRACTION OF VECTORS

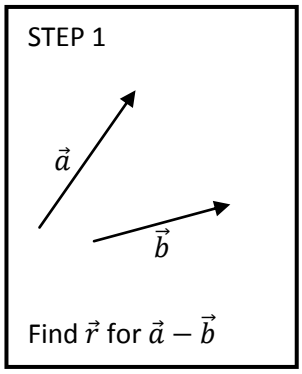
To subtract one vector from another, add the negative of the one to be subtracted. The vector $-\vec{b}$ is simply the vector $\vec{b}$ with its direction reversed. $\vec{a} - \vec{b} = \vec{a} + (-\vec{b})$. Unlike vector addition, order is important in vector subtraction; $\vec{a} - \vec{b} \neq \vec{b} - \vec{a}$.

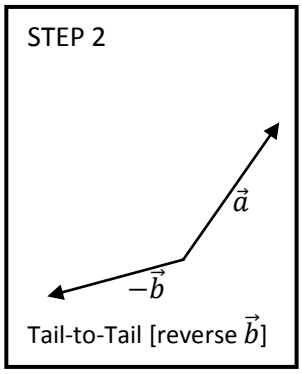
① **TRIANGLE or HEAD-to-TAIL** method [also Polygon Method]

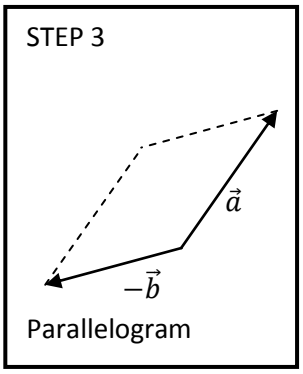


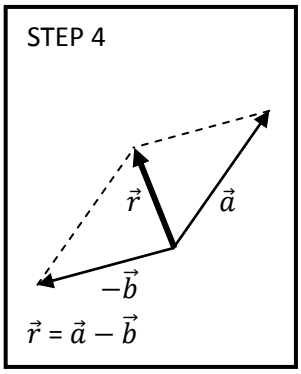


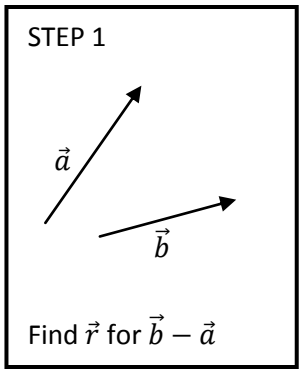
② **PARALLELOGRAM or TAIL-to-TAIL** method [used with only 2 vectors]

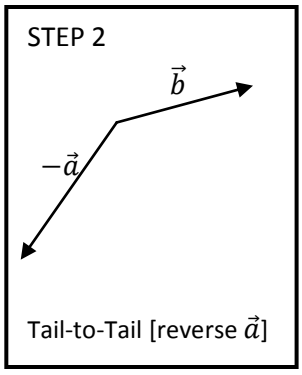


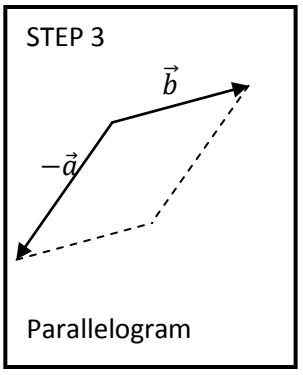


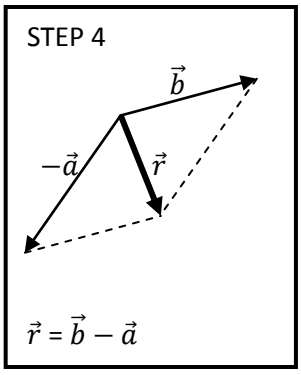








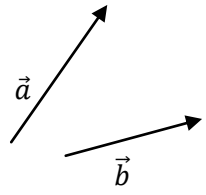




③ **Another TAIL-to-TAIL** method for subtracting vectors

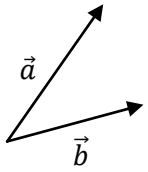
To find the difference between two vectors, it is often simpler to draw the two vectors from the same point **[tail-to-tail].** The vectors to be subtracted are drawn with their tails together but this time without reversing the direction of the second vector. Their difference is found by joining the head of the ***second vector to the head of the first vector***.

STEP 1



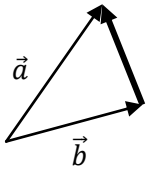
Find $\vec{r}$ for $\vec{a} - \vec{b}$

STEP 2



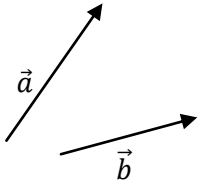
Tail-to-Tail
[$\vec{b}$ not reversed]

STEP 3



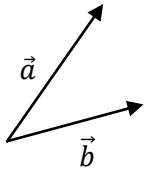
$\vec{r} = \vec{a} - \vec{b}$
$\vec{r}$ drawn from $\vec{b}$ to $\vec{a}$

STEP 1



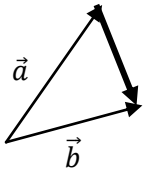
Find $\vec{r}$ for $\vec{b} - \vec{a}$

STEP 2



Tail-to-Tail
[$\vec{a}$ not reversed]

STEP 3



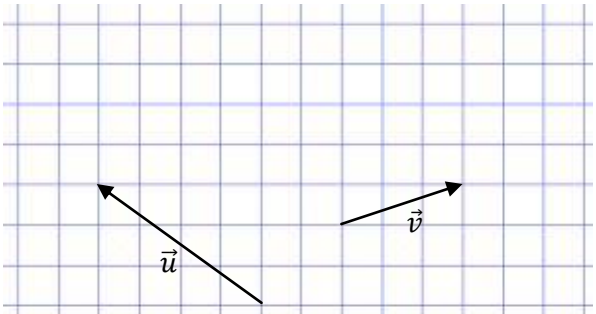
$\vec{r} = \vec{b} - \vec{a}$
$\vec{r}$ drawn from $\vec{a}$ to $\vec{b}$

NOTE that the results are the same as in method ②.

PRACTICE with ADDITION & SUBTRACTION of VECTORS in Two Dimensions

Use the 2 vectors to the right to perform the following vector operations:
Then determine the magnitude and direction of the resultant vector.

1. $\vec{u} + \vec{v}$ using Head-to-Tail method
2. $\vec{u} + \vec{v}$ using Tail-to-Tail method
3. $\vec{v} + \vec{u}$ using Head-to-Tail
4. $\vec{u} - \vec{v}$ using Head-to-Tail
5. $\vec{u} - \vec{v}$ using Tail-to-Tail
6. $\vec{u} - \vec{v}$ using Method ③
7. $\vec{v} - \vec{u}$ using Head-to-Tail
8. $\vec{v} - \vec{u}$ using Tail-to-Tail
9. $\vec{v} - \vec{u}$ using Method ③



Use the 9 boxes below for your 9 solutions.

1	2	3
4	5	6
7	8	9