a place of mind

FACULTY OF EDUCATION

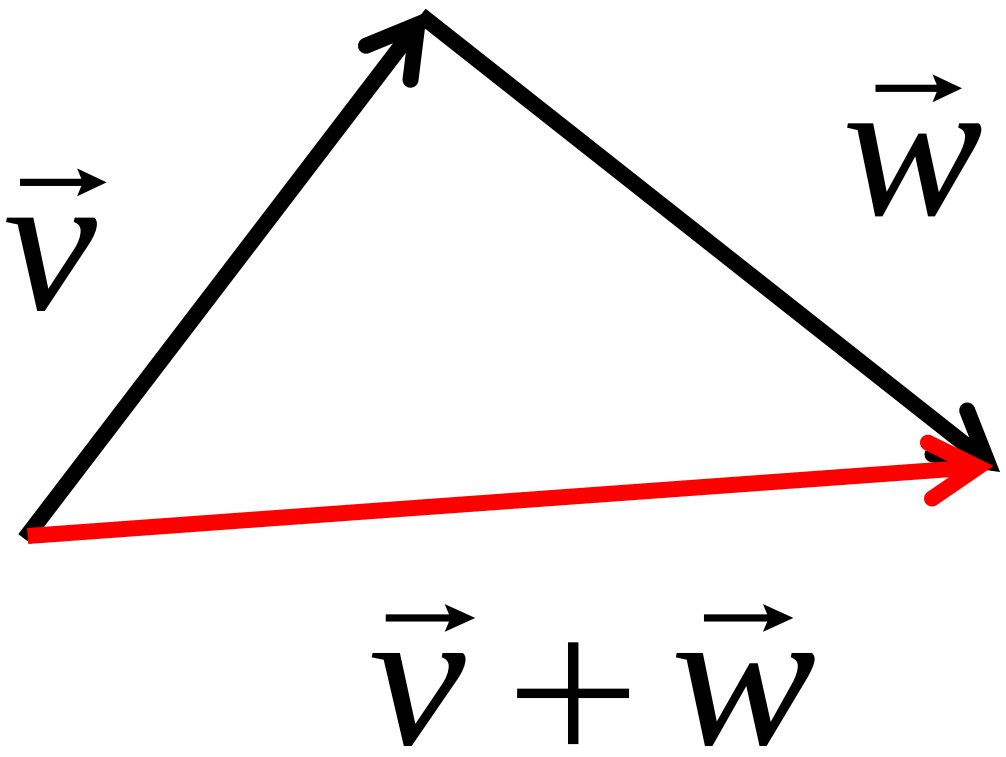
Department of
Curriculum and Pedagogy

Physics
Vector Addition

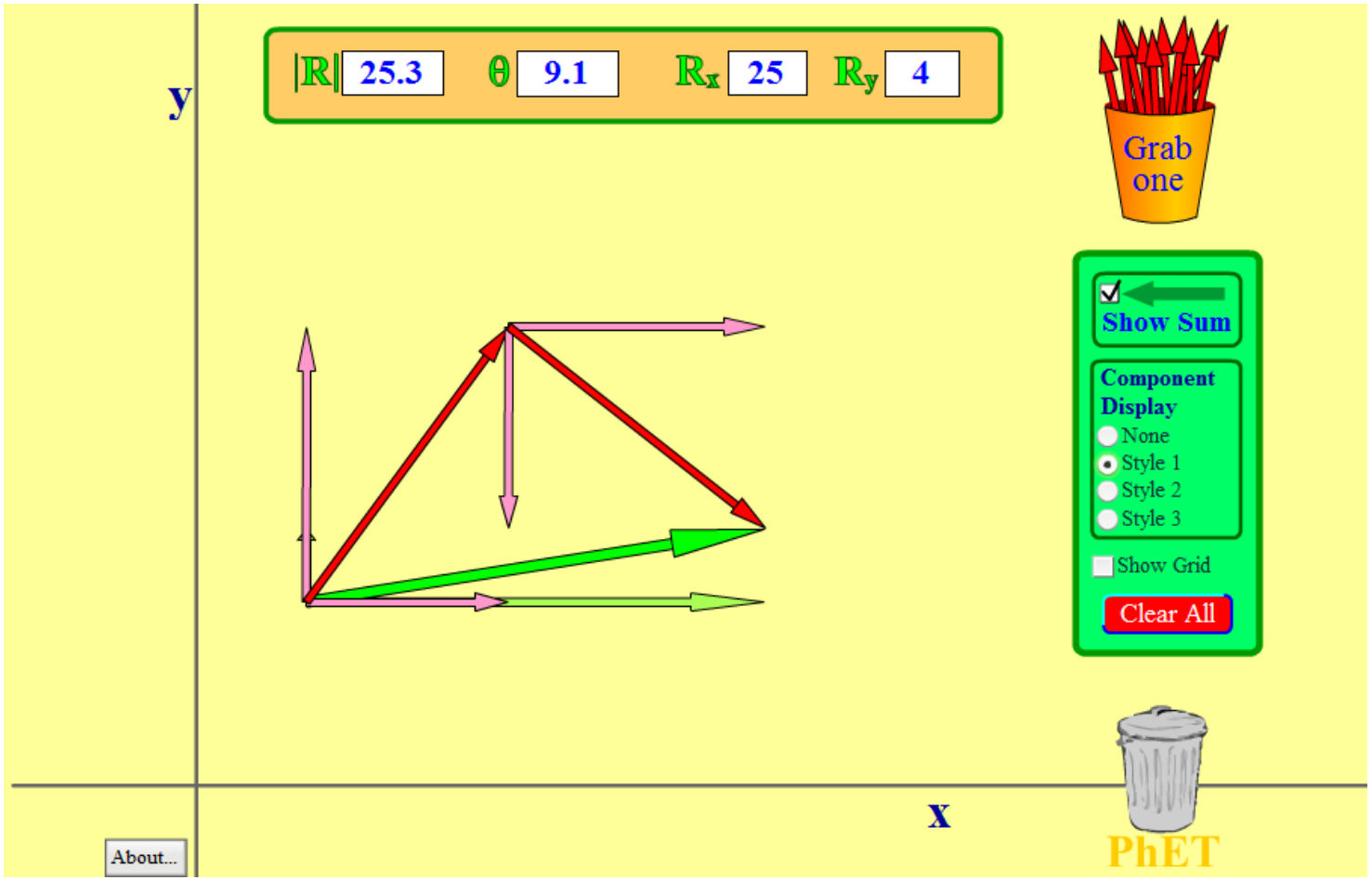
Science and Mathematics Education Research Group

Supported by UBC Teaching and Learning Enhancement Fund 2012-2013

Vector Addition



Vector Addition with PhET

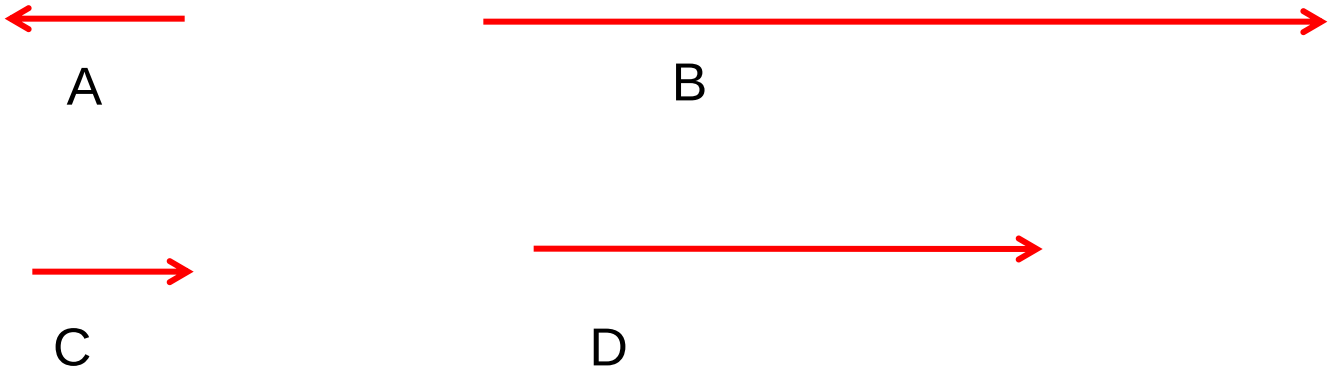


http://phet.colorado.edu/en/simulation/vector-addition

Vector Addition I

When adding two vectors ***v*** and ***w***,

the resulting vector ***v*** + ***w*** will be:



In this question set, any bolded variable is considered a vector.

Solution

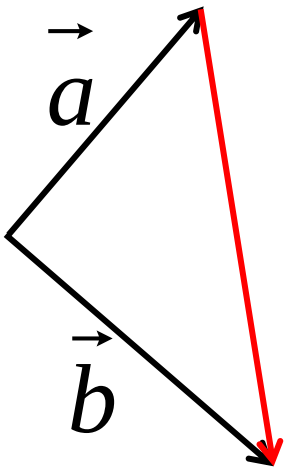
Answer: B

Justification: Vectors are added tip to tail. Since both vectors are pointing to the right, the answer must also point to the right. This eliminates A as a possibility. C represents how much longer vector **w** is than vector **v**, and D is merely a copy of vector **w**. B demonstrates the length of **v + w**.

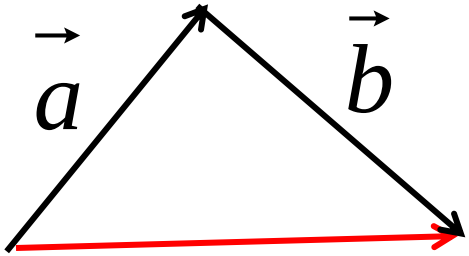
$$\vec{v} + \vec{w}$$

Vector Addition II

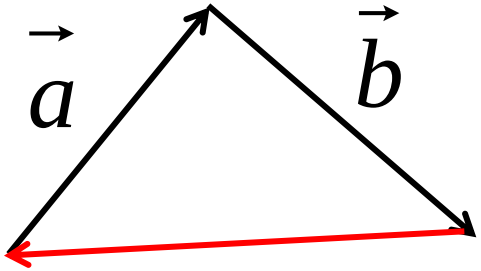
Which image represents the proper procedure for adding vectors **a** and **b**? The red vector is the resultant vector.



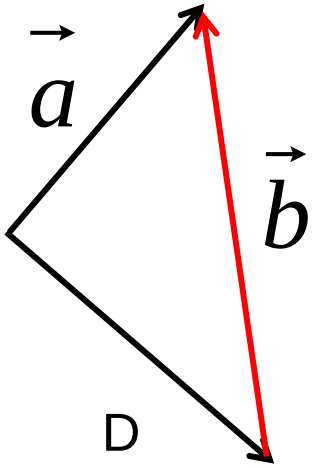
A



B



C



D

Solution

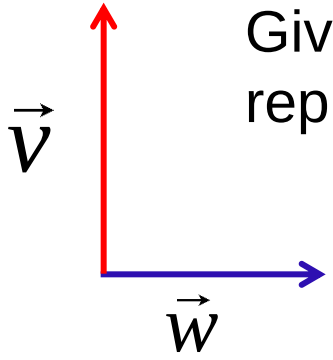
Answer: B

Justification: Vectors are added tip to tail.

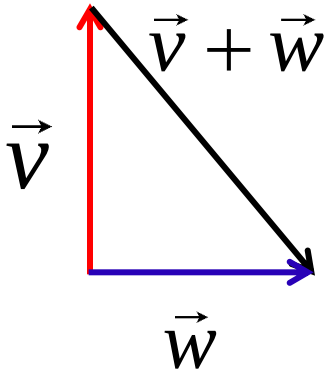
In A and D, the vectors are placed with the tails together, which gives no information about the resultant vector.

In B and C the vectors are placed tip to tail, which is the correct placement. The resultant vector goes from the tail of the first vector to the tip of the final vector. Since the vectors are placed in the order **a** and then **b**, the resultant vector goes from the tail of **a** to the tip of **b**. In C, the resultant vector is going in the opposite direction.

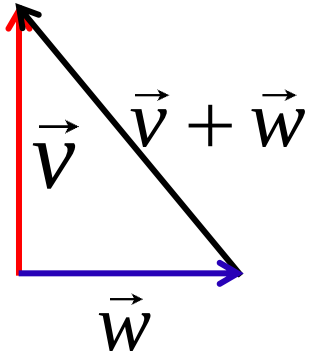
Vector Addition III



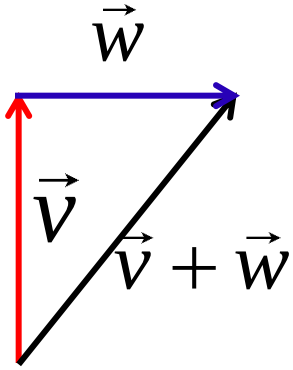
Given **v** and **w**, which diagram correctly represents the sum **v** + **w**, shown in black?



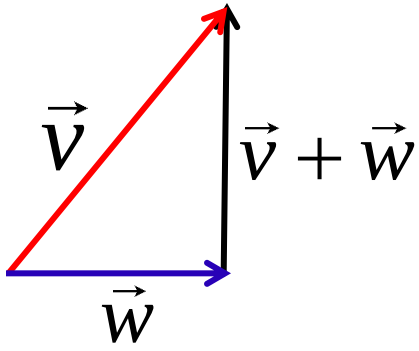
A.



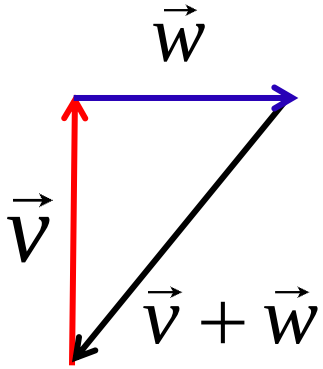
B.



C.



D.



E.

Solution

Answer: C

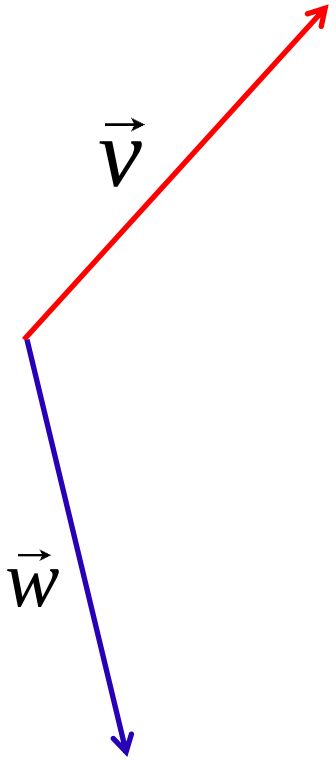
Justification: The first two options, A and B, show the vectors tail to tail. This is how the angle between the two vectors is determined.

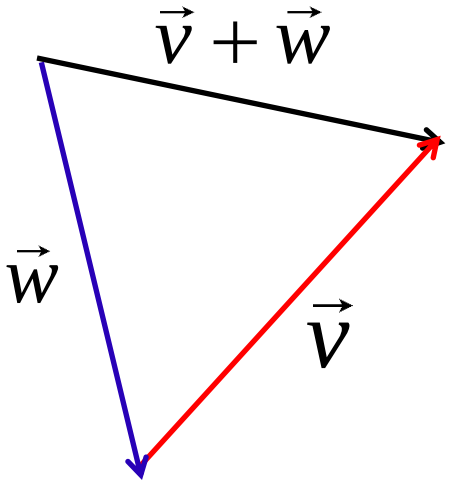
In order to add vectors, they must be placed tip to tail, as in C, D, and E. In C and E the vectors are placed in the proper order, with the tip of **v** connected to the tail of **w**. C is the correct answer because the resultant vector is drawn from the tail of **v** to the tip of **w.**

D shows the vectors in the opposite order, **w** + **v**. This gives the same resultant vector as **v** + **w**, since the resultant vector still travels the same distance v upwards and w to the right.

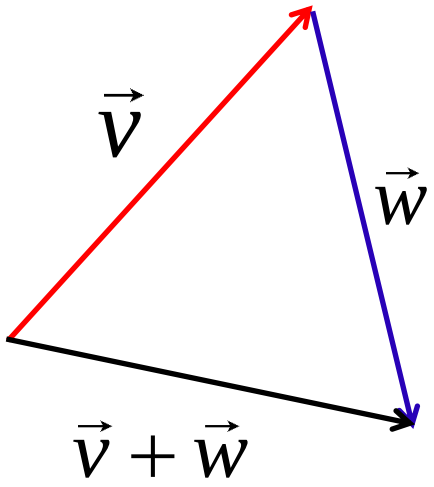
Vector Addition IV

Given **v** and **w** which diagram correctly represents the sum **v + w**?

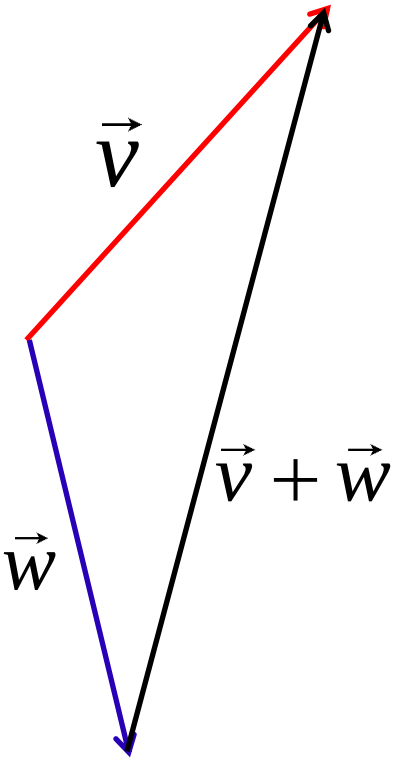




A.



B.



C.

D. Both A and B

Solution

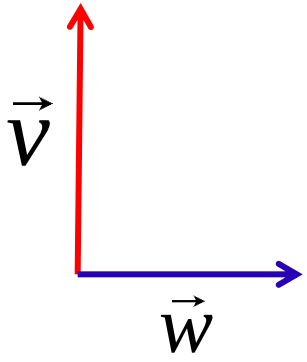
Answer: D

Justification: In diagram C, the vectors are placed tip-to-tip. Since vectors are added tip-to-tail, this is not the right option.

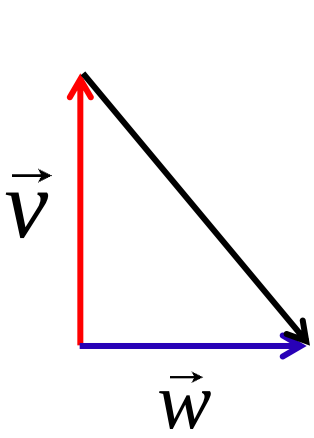
Diagram B represents **v** + **w**, since the vectors are placed tip-to-tail in that order.

Diagram A represents **w** + **v** since the vectors are placed tip-to-tail in that order. However, like scalar addition, the order in which two objects are added does not affect the answer. Therefore, **v** + **w** = **w** + **v**, and both answers are correct.

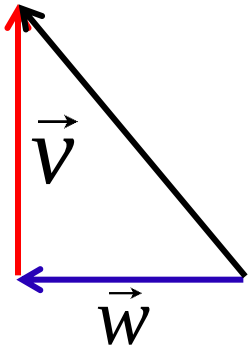
Vector Addition IV



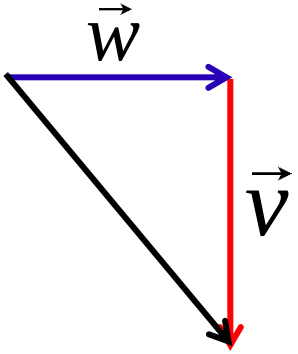
Given **v** and **w**, which diagram correctly represents **v-w**?



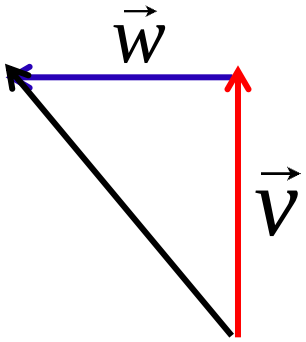
A



B



C



D

E

Both B and D are correct

Solution

Answer: E

Justification: When adding or subtracting vectors, the vectors in question are drawn tip-to-tail, unlike in A. The question is asking for **v**-**w.** The direction of **w** must be reversed, so we can add **v + (-w)** – as it is done in B or add **(-w) + v** – as it is done in D. Therefore, both solutions B and D are correct, making E the correct answer.