Vectors and Two Dimensional Motion

Essential idea: Some quantities have direction & magnitude, others have magnitude only, and this understanding is the key to correct manipulation of quantities. This topic will have broad applications across multiple fields within physics & other sciences.

Name some vector quantities

velocity, acceleration, displacement, force

Graphic representation of a vector quantity

tip ← tail

Attributes (general characteristics) of a vector

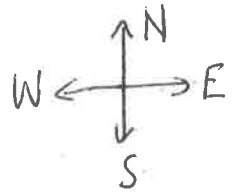
1. magnitude (numerical value w/units)
   Represented by length of arrow
2. direction
   Represented by angle

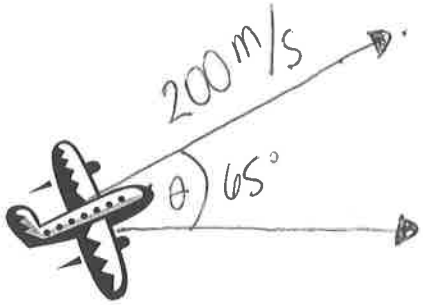
Drawing Vectors

1. draw a frame of reference and choose a scale
2. mark angle
3. draw the vector to scale

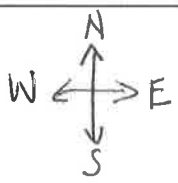
Draw the following vectors. State the scale used.

plane flies at 200 m/s, 65° north of east.

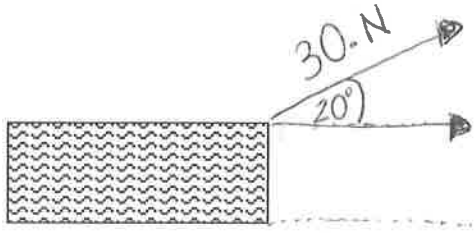




2. A dog walks east for 20. m.



3. A box is dragged with a force of 30. N at an angle of $20.^0$ with the horizontal.



Adding Vectors

Component Vector: one of the vectors to be added

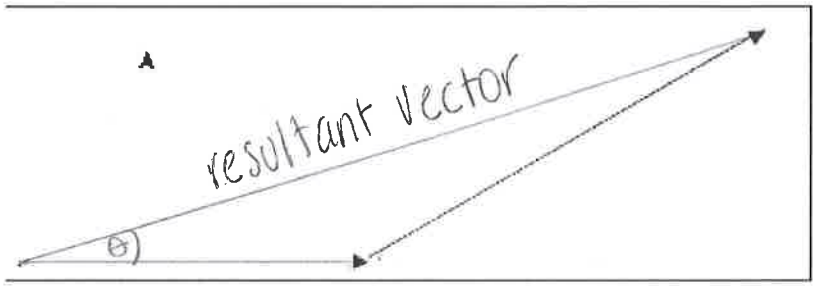
Resultant Vector: sum of the component vectors

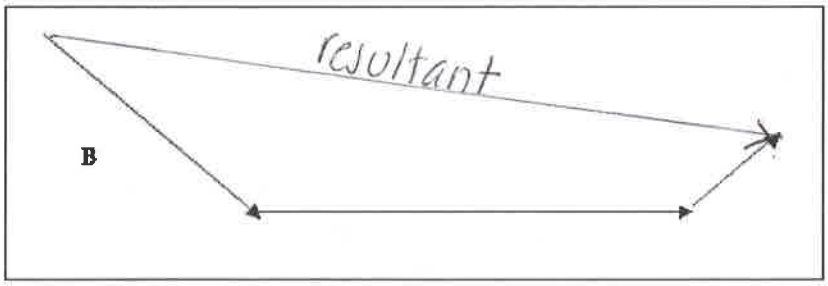
Components ⊖ ⟷ ⊕ **Addition of Components** **Resultant**

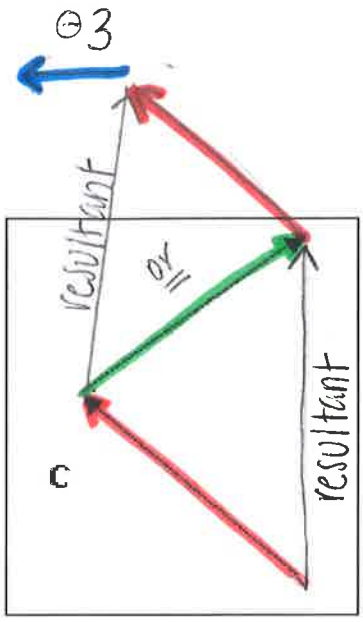
1)

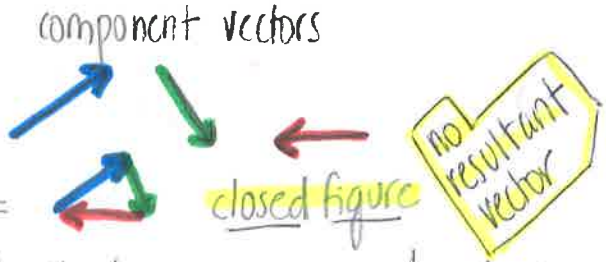
2)

3). Draw the following vectors.









4. When adding vectors . . .
   a) component vectors can be moved if you don't change mag. or direction.
   b) component vectors can be placed in any order tip to tail
   c) resultant vector drawn from tail to tip.
   d) If component vectors form a closed figure, then the resultant vector = ∅

5. A resultant vector is determined by finding its magnitude and direction.

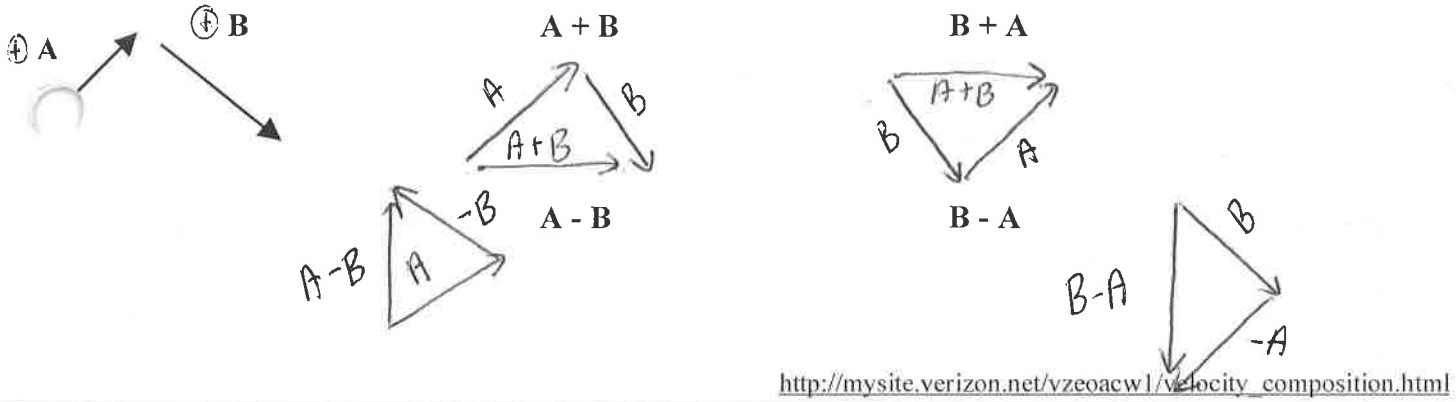
6. Which angle represents the direction of the resultant vector?

   angle of origin

7. Compare the placement of the component vectors with the placement of the resultant vector.

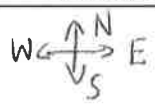
   Component vectors: tip to tail

   Resultant vector: tail to tip



http://mysite.verizon.net/vzeoacw1/velocity_composition.html

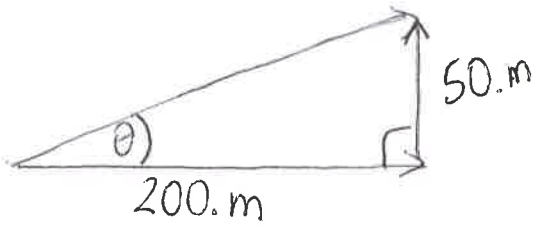
3. A man walks 200. m east and then walks 50. m north.



a) How far has he walked?

b) Where is he in relation to where he started?

Graphical Method ← protractors, rulers, to scale



Mathematical Method

Magnitude: $a^2 + b^2 = c^2$

$(200.m)^2 + (50.m)^2 = c^2$

Direction: $\tan\theta = \frac{opp}{adj} = \frac{50.m}{200.m}$

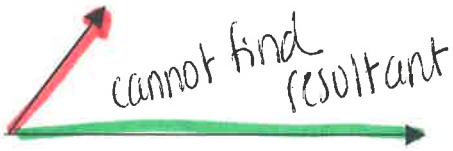
$\theta = 14°$

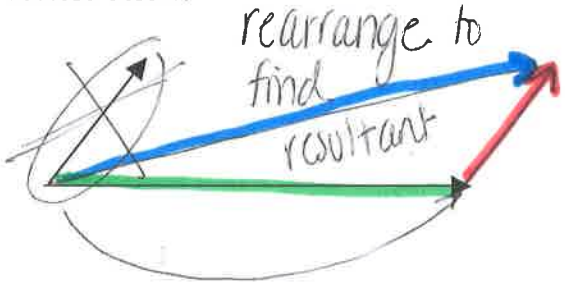
Resultant: 210 m @ 14° north of east

Concurrent Vectors

Concurrent Vectors: component vectors placed tail to tail or tip to tip

Sketch the resultant of the concurrent vectors below.





Conclusion: place vectors tip to tail before finding resultant vector