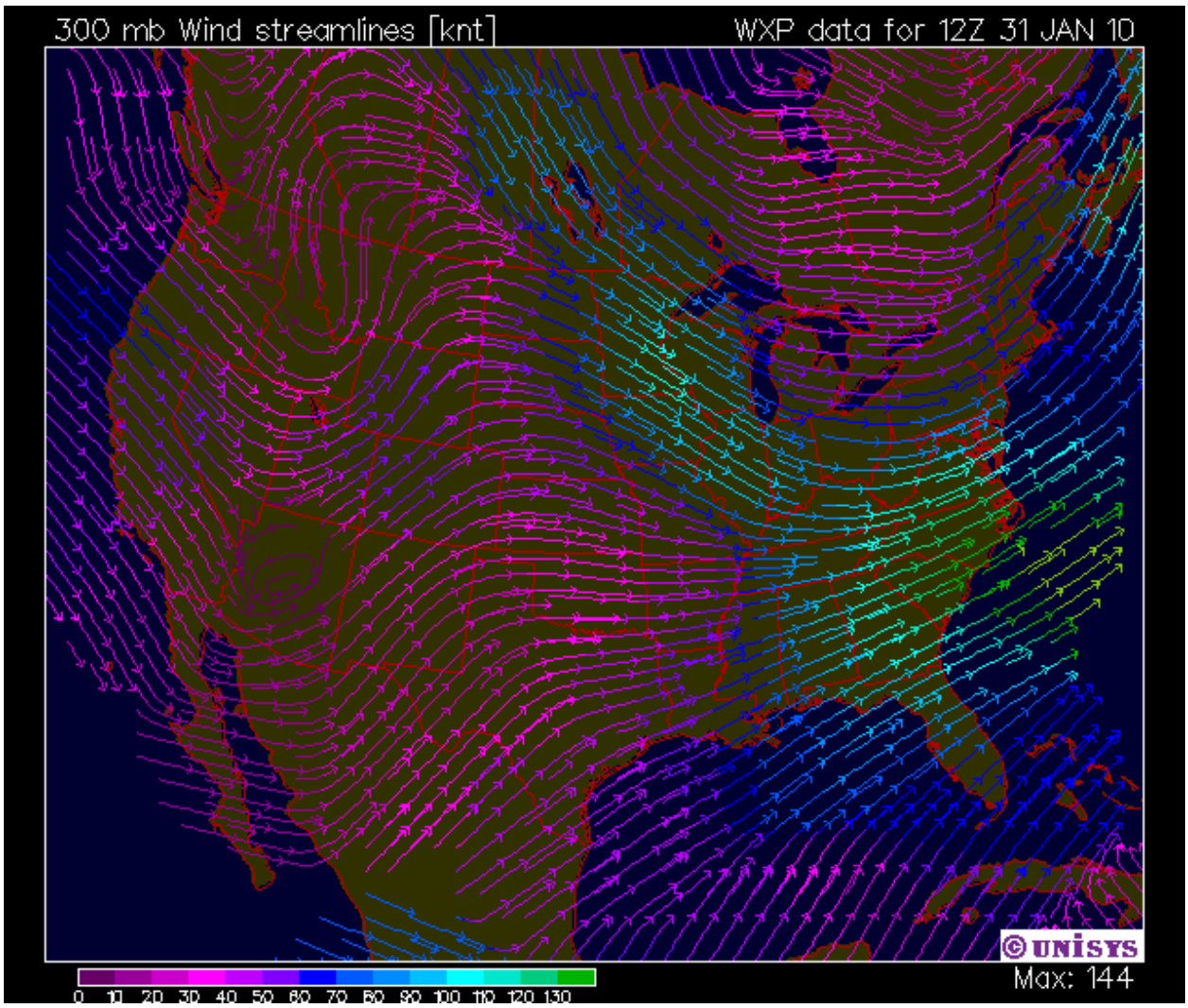
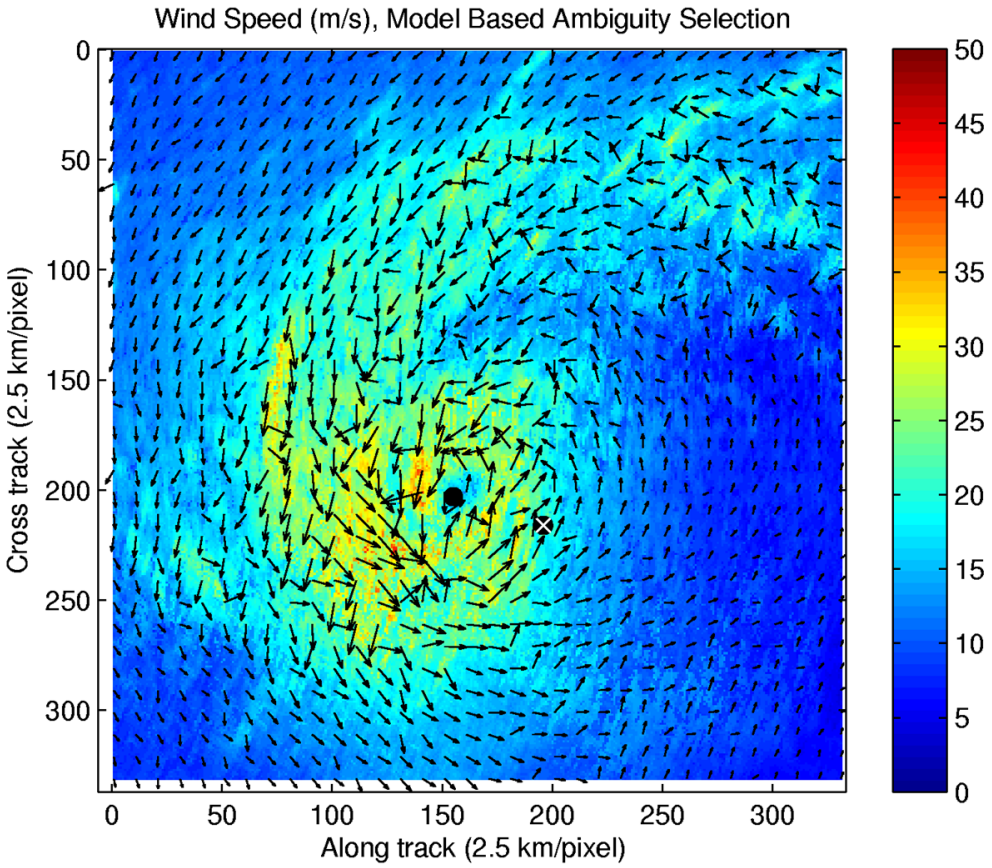
Vectors & Scalars

Scalars: these quantities have only magnitude.
Ex. 2.0kg, 5.0m/s
Ex. mass, speed, distance, time

Vectors: these quantities have magnitude and direction.
Ex. position, displacement, velocity, acceleration.
Ex. 15km[E], 30m/s[E30^{0}N]


300 mb Wind streamlines [knt]
WXP data for 12Z 31 JAN 10
©UNISYS
0 10 20 30 40 50 60 70 80 90 100 110 120 130
Max: 144

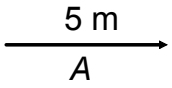

Wind Speed (m/s), Model Based Ambiguity Selection
Cross track (2.5 km/pixel)
Along track (2.5 km/pixel)
0
50
100
150
200
250
300
0
5
10
15
20
25
30
35
40
45
50

Graphical Representation of Vectors

Vectors are represented by ***arrows***.

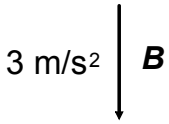
- The ***length*** of the arrow corresponds to the magnitude of the vector.
- The ***direction in which the arrow points*** represents the direction of the vector.

Vector ***A*** or $\overrightarrow{A}$ has a magnitude of 5 m and is directed to the right:



$\vec{A}$

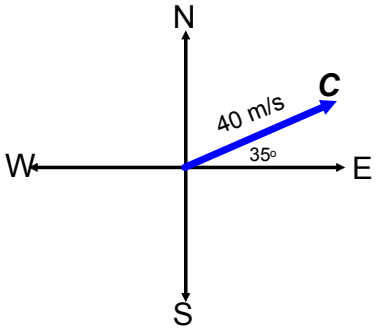
Vector ***B*** or $\overrightarrow{B}$ has a magnitude of 3 m/s² and is directed downward:



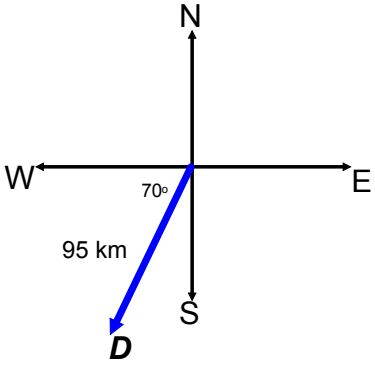
Vector ***C*** or $\overrightarrow{C}$ represents a vector of 40 m/s E35°N or 35° NofE

reference

reference

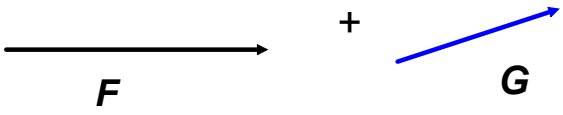


Vector ***D***, or $\overrightarrow{D}$ represents a vector of 95 km, W70°S:

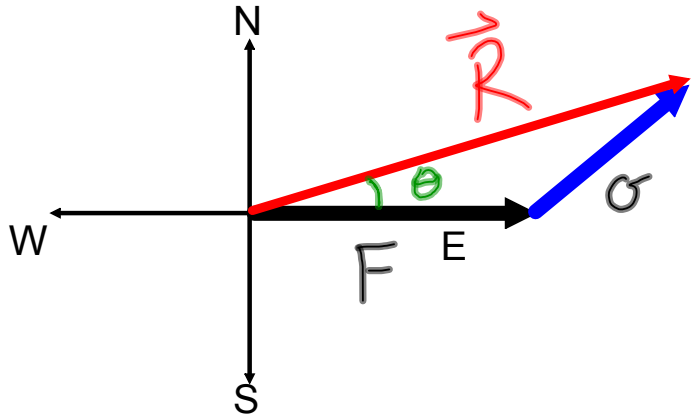


Adding Vectors Graphically

Method #1: Tip-To-Tail Method



To add vectors graphically, they must first be ***lined up tip-to-tail.***



The vector sum of ***F*** and ***G*** is the vector, ***R***. It connects the tail of the first arrow to the tip of the last arrow.

Why is the letter ***R*** used for the vector sum?

Physicists call the vector sum the ***resultant vector*** *or the* ***resultant****.*

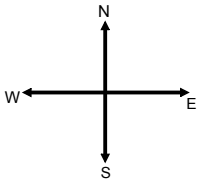
Why is the graphical method not considered the best method to use when adding vectors?

If the vectors are not drawn precisely, your final answer will not be accurate.

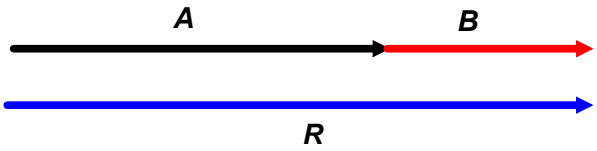
Examples - Graphing Analysis of Vectors

*Let the magnitudes of vector **A** and vector **B** be 8.0 m and 6.0 m, respectively.*

☆ Choose a scale. Let 1.0 cm = 1.0 m



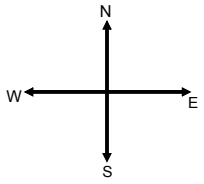
a) If vector ***A*** and vector ***B*** are both directed East, what is the angle between the vectors? What is the magnitude and direction of their resultant?

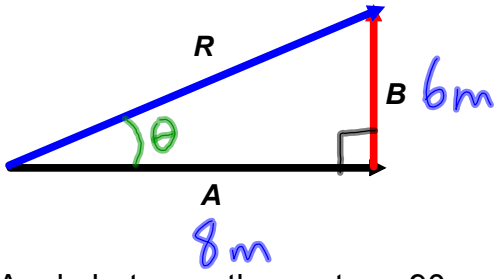


Angle between vectors: 0°

R = 14 m, East
= 14 m, right
= + 14 m

b) If vector ***A*** is directed East and vector ***B*** is directed North, what is the angle between the vectors? What is the magnitude and direction of their resultant?

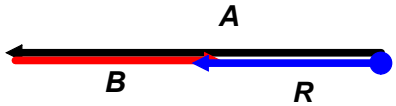




Angle between the vectors: 90°

R = 10. m, [E29°N]
= 10. m, 29°N of E
= 10. m, 29° above the +x axis

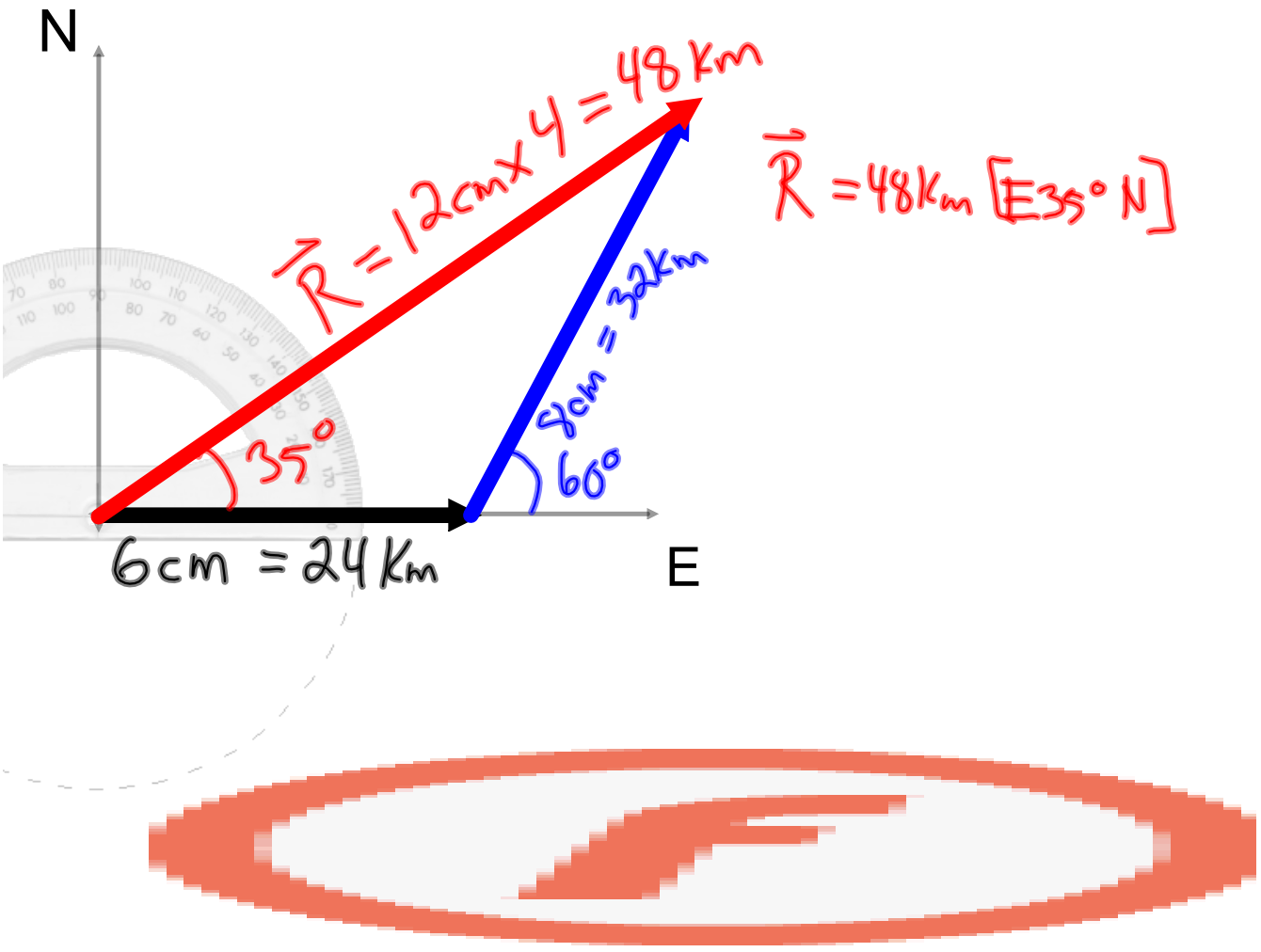
c) If Vector ***A*** is directed West and vector ***B*** is directed East, what is the magnitude and direction of their resultant?



R = 2.0 m, West
= -2.0 m, East

Example 1: Find the resultant displacement if vector ***A*** = 24 km [E] and vector ***B*** = 32 km [E60°N].

Scale: Let 1.0 cm = 4.0 km



Class Work: Resultant Vectors Worksheet - Part 1

Resultant Vectors Worksheet - Solutions

#1) 1:4, 29 km [E58S]

#2) 1:1, 5.4 m/s [E50N]

#3) 1:5, 42.5 m [W30N]

#4) 1:2, 20.4 m [W70N]

#5) 1:10, 127 km [E42N]

#6) 1:300, 2800 km [W45S]

PRACTICE PROBLEMS

8. An airplane flies with a heading of [N58°W] from Sydney, NS to Newcastle, NB, a distance of 618 km. The airplane then flies 361 km on a heading of [E35°S] to New Glasgow, NS.

(a) Determine the airplane's displacement for the trip.

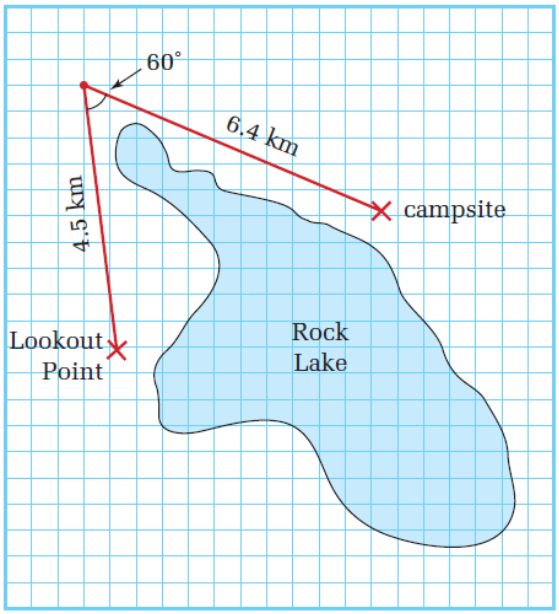
(b) In what direction will the plane have to fly in order to return directly to Sydney?

9. A canoeist starts from her campsite, paddles 3.0 km due north, and then 4.0 km due west.

(a) Determine her displacement for the trip.

(b) In what direction would she have to head her canoe in order to paddle straight home?

10. From a lookout point, a hiker sees a small lake ahead of her. In order to get around it, she walks 4.5 km in a straight line toward the end of the lake. She turns right making a 60° angle with her original path, and walks to a campsite that is 6.4 km in the new direction. Determine her displacement from the lookout point when she has reached the campsite. (See the map on the right.)



11. A boat heads out from port for a day's fishing. It travels 21.0 km due north to the first fishing spot. It then travels 30.0 km[W30.0°S] to a second spot. Finally, it turns and heads [W10.0°N] for 36.0 km.

(a) Determine the boat's displacement for the entire journey.

(b) In what direction should the boat point so as to head straight to its home port?

19. A person walks 3.0 km[S] and then 2.0 km[W], to go to the movie theatre.

(a) Draw a vector diagram to illustrate the displacement.

(b) What is the total displacement?

20. A person in a canoe paddles 5.6 km[N] across a calm lake in a time of 1.0 h. He then turns west and paddles 3.4 km in 30.0 minutes.

(a) Calculate the displacement of the canoeist from his starting point.

(b) Determine the average velocity for the trip.

21. A cyclist is moving with a constant velocity of 5.6 m/s[E]. He turns a corner and continues cycling at 5.6 m/s[N].

(a) Draw a vector diagram to represent the change in velocity.

(b) Calculate the change in velocity.

22. A cyclist travels with a velocity of 6.0 m/s[W] for 45 minutes. She then heads south with a speed of 4.0 m/s for 30.0 minutes.

(a) Calculate the displacement of the cyclist from her starting point.

(b) Determine the average velocity for the trip.

27. A jogger runs 15 km[N35°E], and then runs 7.5 km[N25°W]. It takes a total of 2.0 hours to run.

(a) Determine the displacement of the jogger.

(b) Calculate the jogger's average velocity.