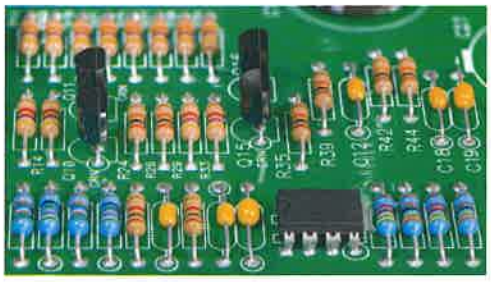
AP PHYSICS 1



2023 SUMMER ASSIGNMENT PROBLEMS

AP PHYSICS 1 SUMMER ASSIGNMENT DIRECTIONS:

** Please register for the AP Physics 1 Summer 2023 Course on Canvas. This course is for posting announcements, materials and information relevant to the AP Physics 1 course and for facilitating communication during the summer months.

You can self-enroll in the course using the URL:
https://jerichoschools.instructure.com/enroll/LLHX4M.

Or, you can sign up at: **https://jerichoschools.instructure.com/register**
and use the following join code: **LLHX4M**

Read the summer assignment on vectors and unit conversions (posted in the Canvas summer course module and on the school's website), including the solved problems in the packet. Then, do the problems in the summer assignments problems packet. Many of the problems are similar to the sample problems in the reading assignment. When doing the problems, keep in mind that there are often many ways to do a physics problem, so the methods shown in the reading assignment may be different than yours or your friend's. However, regardless of how the problem is done, everyone should come up with the same (or close!) answer.

***You will need a metric ruler, a protractor and a scientific calculator for the summer assignment as well as throughout the course!**

- **When requested, diagrams should be drawn and labeled neatly.** Diagrams should be large enough so that the angles and vectors are clearly seen. (It is better to make a diagram larger than necessary rather than too small.) Unless directed otherwise, diagrams do not have to be to scale. All vector diagrams should have vector magnitudes and appropriate angles labeled. Be sure to include arrows on all vectors!

- **Do all calculations and diagrams in pencil.**

- **Solutions to the problems should include the equation(s) used, the substitution step (where the numbers are plugged in) and the answer.** Units must be on all steps of the solution, not just the answers! Check your answers with the answer key, which will also be posted in the Canvas Summer Course.

- **Do not worry about significant figures.** However, a good rule to remember is that your answer should be taken out 1 or 2 places after the decimal or to have 2 or 3 significant figures (refer to the Summer Assignments sample problems). Answers that are not accurate enough or are taken out too many decimal places can lose points on the AP exam.

- **Rounding is taken into account.** If your answer does not exactly match the answer key, but is close, it is probably correct. If your answer is significantly off from the answer key, you may want to check your work again.

The summer assignment will be collected and graded! All summer assignments should be ready to be submitted **the first day of school!** Points will be deducted for assignments handed in or submitted late!

- If you choose to work on your summer assignment on an electronic device, you will be able to submit your summer assignment on Canvas under Assignments.
- If you prefer paper copies, you can submit the Summer Assignment Packet when school starts.
- Extra paper copies of the summer assignment can be picked up in Room 306.
- Quizzes will be given during the first week to assess each student's understanding of the material in the summer assignment.

It is definitely advisable to work on the summer assignment in groups so that you may learn from each other and help teach each other as well. However, there is a difference between "working together" and copying someone else's work. Since all students will be evaluated independently once classes begin, it is advisable that everyone work to the best of his/her abilities on the summer assignment (and during the course of the year). If you have any questions about the summer assignment, you can email me through the Canvas summer course or at **physixchick@aol.com** (preferred method of communication).

Enjoy the summer!

Sincerely,
Ms. Engelhardt
Ms. Christiansen
Mr. Erlagen

VECTOR ALGEBRA

RULES:

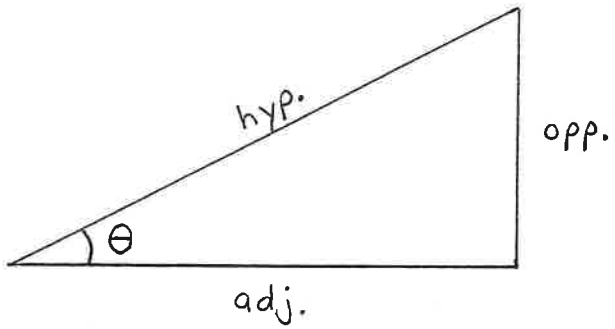
1. 0° = same direction: ADD (maximum resultant)
2. 180° = opposite direction: SUBTRACT (minimum resultant)
3. Vectors at right angles (90°): use the pythagorean theorem & SOHCAHTOA

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

$$\cos\theta = \frac{ADJ}{HYP}$$

$$\sin\theta = \frac{OPP}{HYP}$$

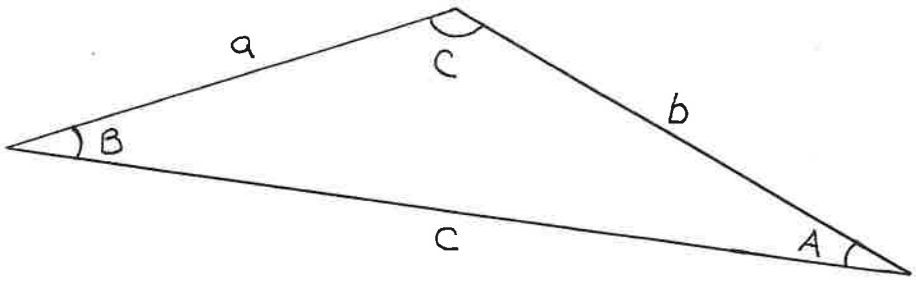
$$\tan\theta = \frac{OPP}{ADJ}$$



4. Vectors at "other" angles: use Laws of sines and cosines:

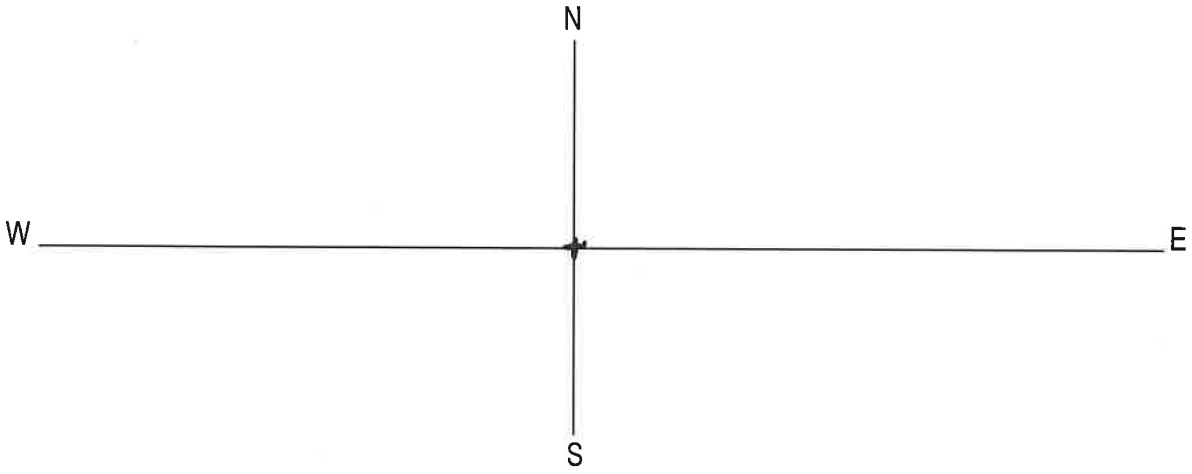
$$c^2 = a^2 + b^2 - (2ab\cos C)$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

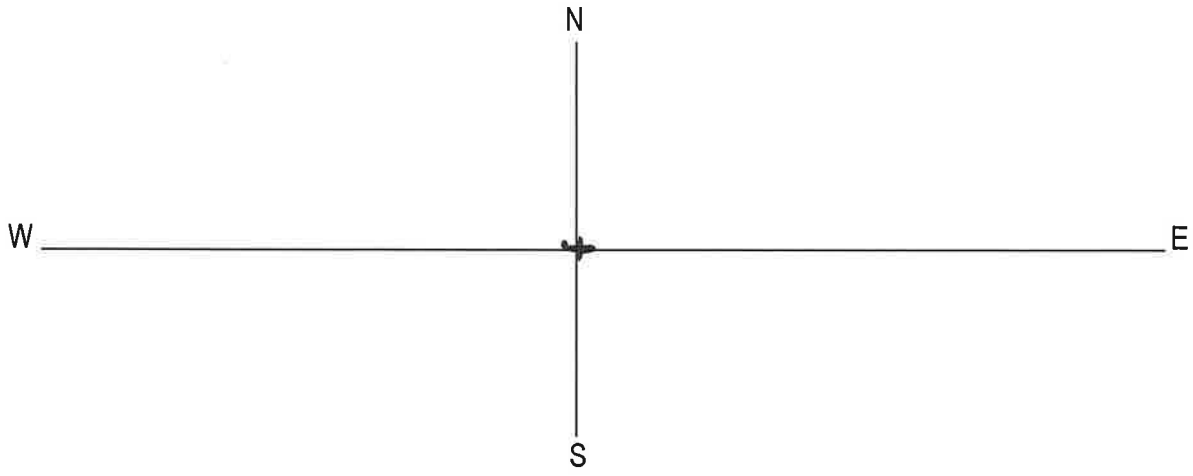


For each of the following problems, **show all work**, including the equation and substitution with units.

1. A small plane flies due west with a speed of 86 m/s while a tailwind blows due west at 28 m/s. Using a scale of **1.0 cm = 20 m/s**, draw and label a vector diagram (including the resultant) on the axis below and calculate the magnitude and direction of the plane's resultant velocity.

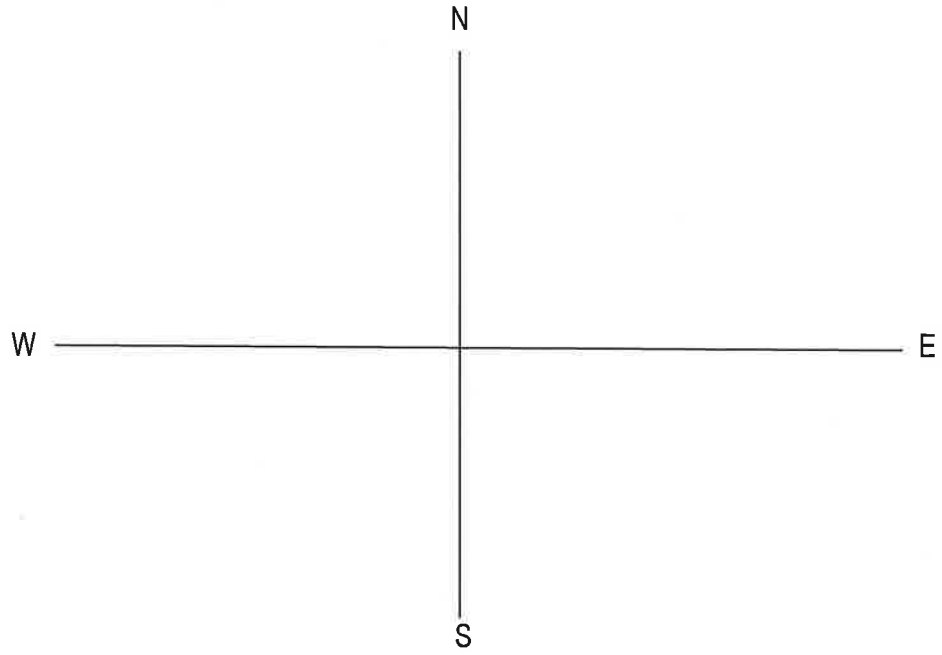


b. On the trip back, the plane flies due east at 78 m/s while the wind now blows due west at 36 m/s. Using the same scale as part (a), draw and label a vector diagram (including the resultant) on the axis below and determine the magnitude and direction of the plane's resultant velocity.

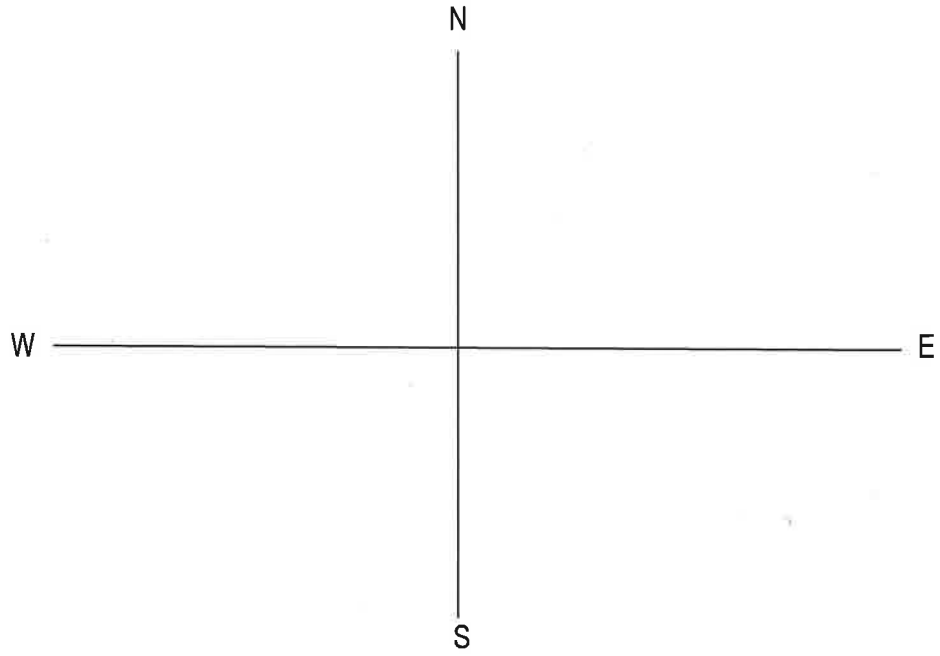


2. Force **A** has a magnitude of 45 N and is directed due east. Force **B** has a magnitude of 39 N and is directed due north.

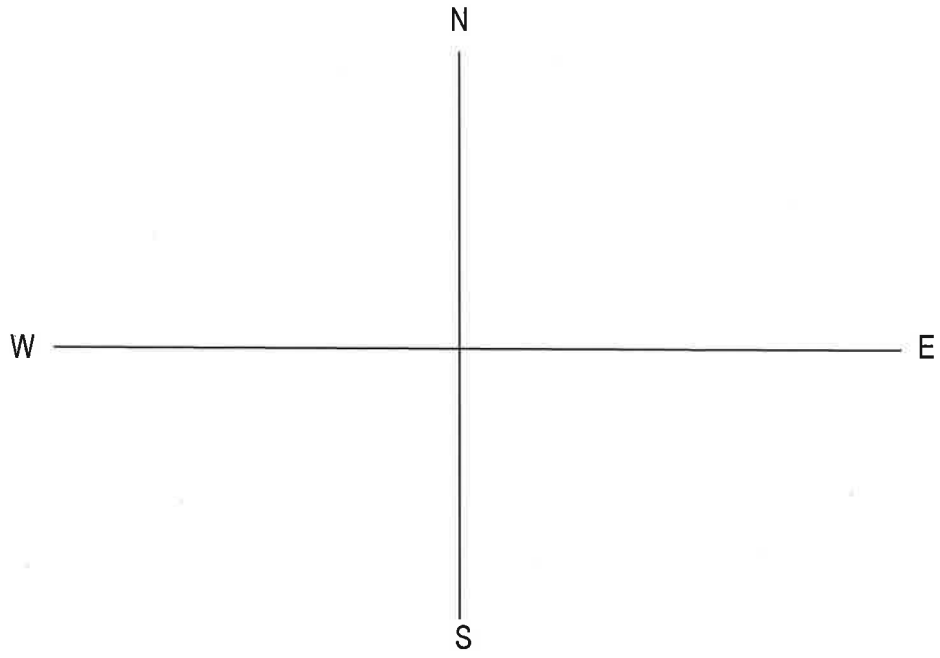
(a) Calculate the magnitude and direction (including a specific directional angle θ) of **A + B**. Include a labeled vector diagram in your solution.



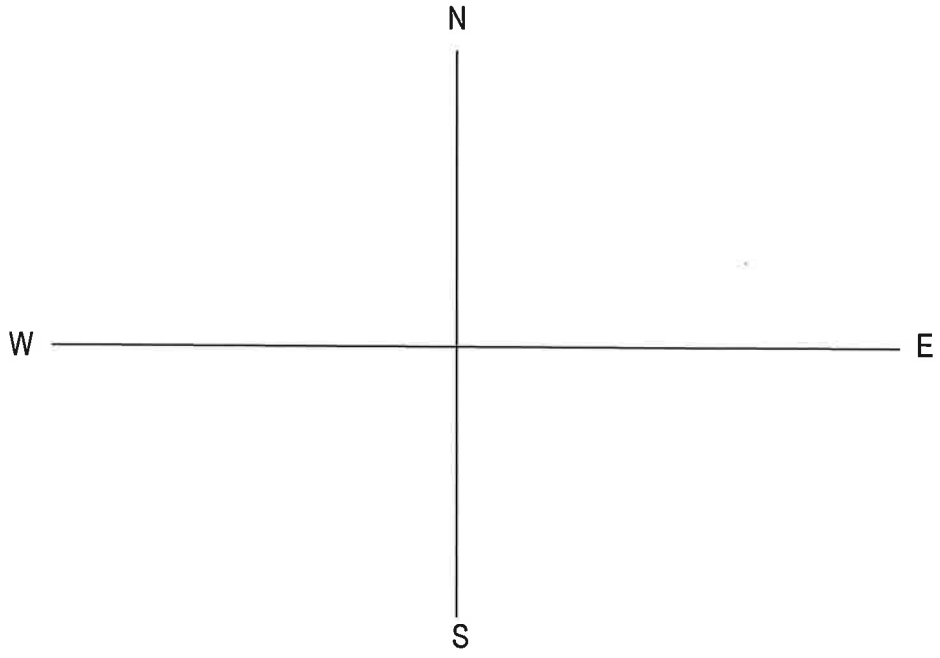
(b) Calculate the magnitude and direction (including a specific directional angle θ) of **A – B**. Include a labeled vector diagram in your solution.



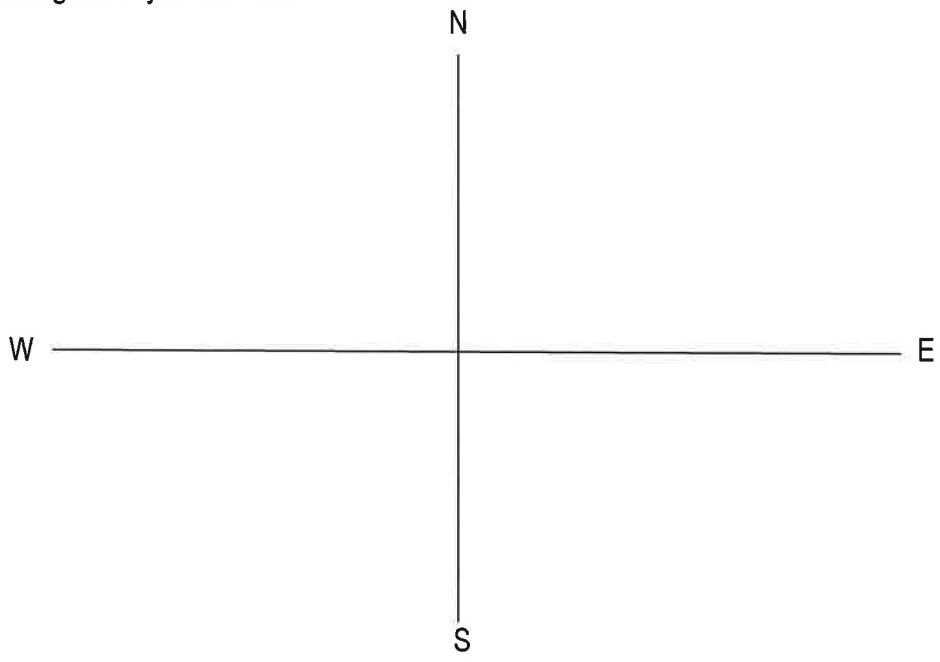
3. A woman hikes 1850 meters due east, then 650 meters due west, and finally 2120 meters due south. Draw and label a vector diagram (including the resultant) and calculate the magnitude and direction (including a specific directional angle, θ) of the woman's resultant displacement, relative to her starting point.



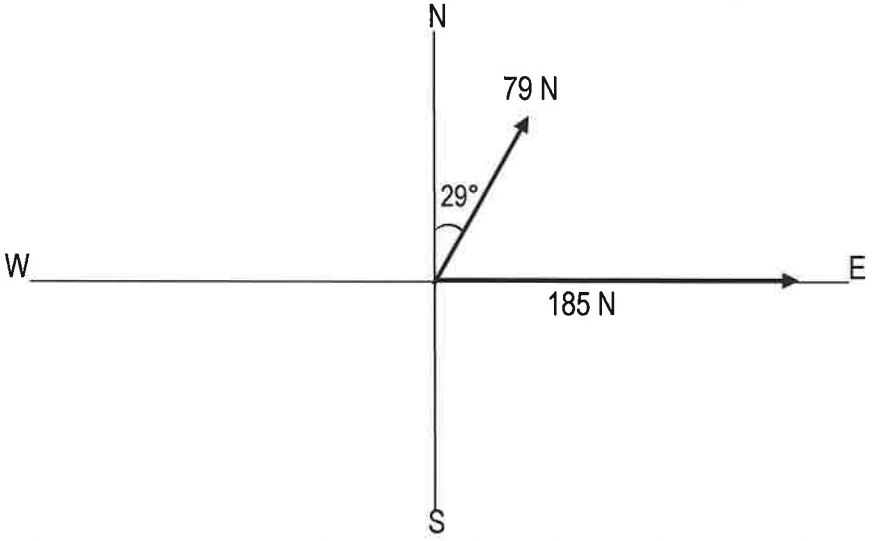
4. A bug crawls 22 cm due north, then 15 cm due west, the 7 cm due south and finally 12 cm due west. Draw and label a vector diagram (including the resultant) and calculate the magnitude and direction of the bug's resultant displacement. Include a specific directional angle θ in your answer.



5. A ship traveling at a velocity of 38 m/s at an angle of 32° south of west is acted on by a wind blowing at a velocity of 15 m/s at an angle of 26° east of north. Draw and label a vector diagram (including the resultant) and calculate the magnitude and direction of the ship's resultant velocity. Include a specific directional angle θ in your answer.



6. Two forces of 79 N and 185 N act on an object, as shown in the diagram below.



Calculate the magnitude and direction (measured from the x axis) of the resultant force **and** the equilibrant force.

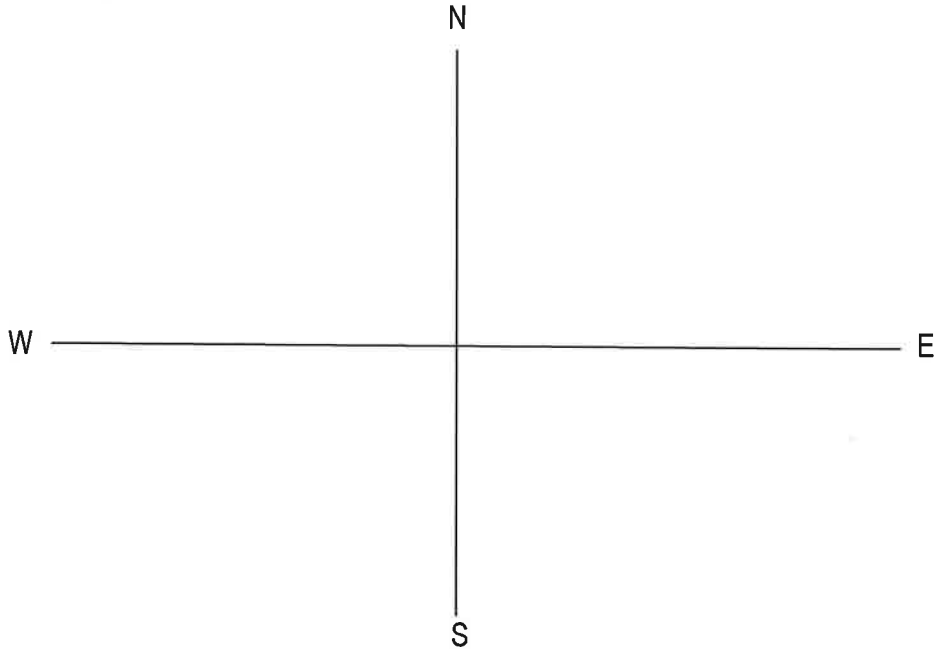
Resultant force = _____

Equilibrant force = _____

7. Two forces act on an object.

   Force **A** = 46 N due west
   Force **B** = 163 N directed 56° east of north

   Calculate the magnitude and direction (including a specific angle θ) of **A + B**. Include in your answer a labeled vector diagram.



VECTOR COMPONENTS

EQUATIONS:

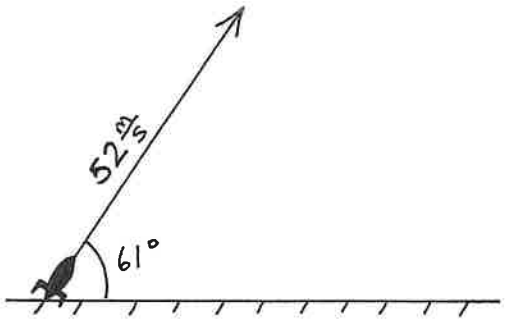
$A_x = A \cos \theta$

$A_y = A \sin \theta$

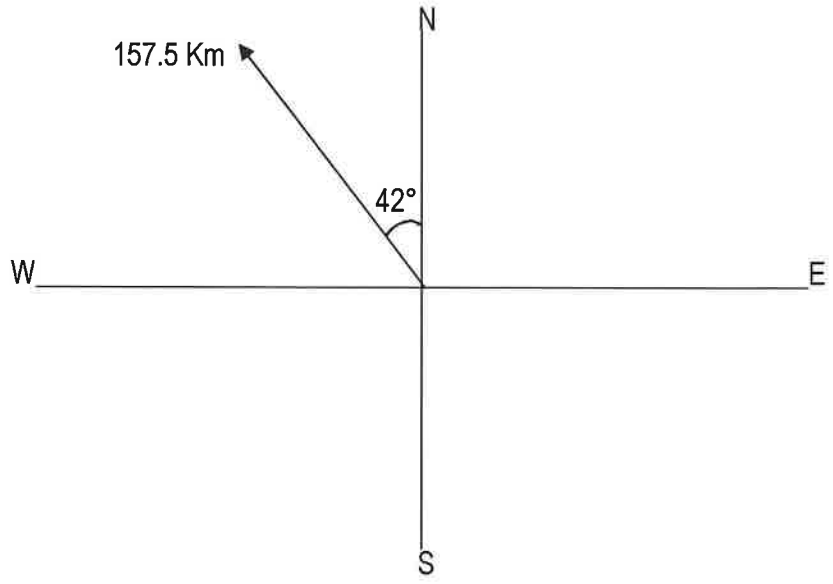
} **These equations are valid if θ is measured from the x axis!**

PROBLEMS: For each of the following problems, **show all work**, including the equation and substitution with units.

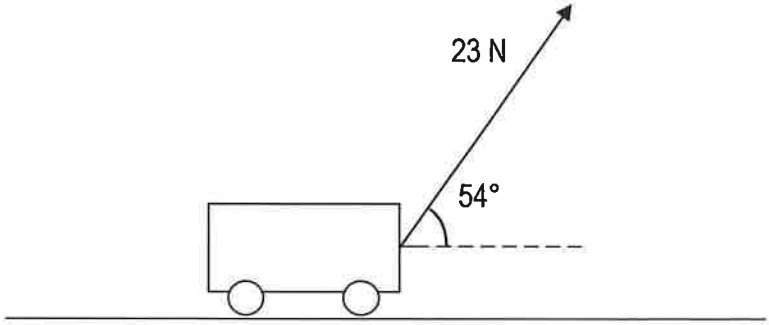
1. A toy rocket is launched upward at a velocity of 52 m/s at an angle of 61° relative to the level ground. Draw and label the components on the diagram below and calculate the magnitudes of the vertical and horizontal components of the velocity.



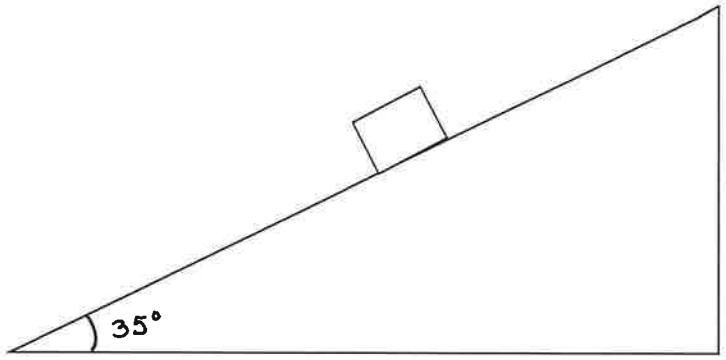
2. A plane is flown 157.5 km in a direction 42° west of north. Draw and label the components on the diagram below and calculate the magnitudes of the western and northern components of the plane's displacement.



3. A wagon is pulled by a 23 N force applied to the handle, which makes an angle of 54° with respect to the ground. Draw and label the components on the diagram below and calculate the magnitudes of the vertical and horizontal components of the applied force.



4. A block whose weight is 85 N is placed on a 35° incline, as shown below.



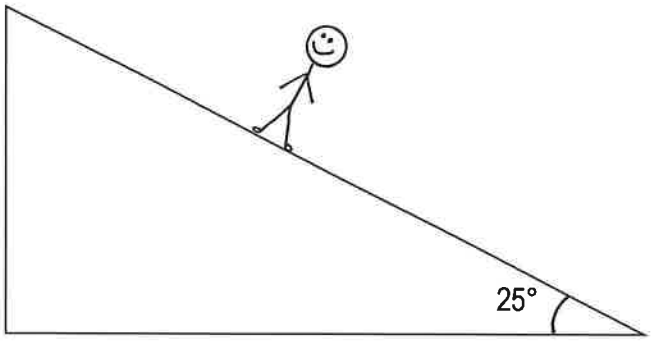
(a) Draw and label the components of the block's weight that are parallel and perpendicular to the incline and calculate the magnitude of each component.

(b) If the angle of the incline is increased, how would the magnitudes of the parallel and perpendicular components be affected, if at all? (increases, decreases, remains the same)

Parallel Component _____

Perpendicular Component _____

5. A person weighing 752 N stands on a 25° incline, as shown below. Draw and label the components of the person's weight that are parallel and perpendicular to the incline and calculate the magnitude of each component.



COMPONENTS METHOD PROBLEMS

1. A person drives 12.6 Km in a direction 51° west of north, then 4.7 Km due south and finally 8.2 Km at 33° north of east. Calculate the magnitude and direction of the person's resultant displacement. Include a specific directional angle in your answer.

2. Three forces act on a body. The magnitudes and directions are as follows:

Force A = 55 N, 49° west of south
Force B = 26 N, 28° west of north
Force C = 84 N, 33° south of east

(a) Calculate the magnitude and direction of **–A + B + C**. Include a specific directional angle in your answer.

(b) Calculate the magnitude and direction of **+A – B + C**. Include a specific directional angle in your answer.

3. A man jogs 935 meters at 26° south of west, then 662 meters due west and then 730 meters at 41° south of east. The fourth part of his jog is unknown. The man ends up back at his starting point. Calculate the magnitude and direction of the fourth part of the man's jog.

4. A woman bikes 2.3 Km due east, then 1.6 Km at 35° east of north and continues for an unknown distance in an unknown direction. She ends up in a location that is 1.2 Km at 10° west of south of where she started. Calculate the magnitude and direction of the third part of her bike trip. Include a specific directional angle in your answer.

UNIT CONVERSIONS

1 mile = 1.609 km	**1 mile = 5280 feet**
1 km = 0.6214 mile (mi)	**1 Newton (N) = 0.2248 lbs**
1 meter (m) = 3.281 ft	**1 lb = 4.448 Newton (N)**
1 inch = 2.54 cm	**1 kg = 0.0685 slug**
1 m^3 = 1000 L	**1 ton = 2000 lbs**

PROBLEMS: Using the factor-label method (dimensional analysis) and the given conversion factors (and any others you may know), convert the following quantities. Be sure to **show all work**, including how the units canceled out!

1) 1,760,000 inches = _____ km

2) 885 N = _____ lbs

3) 5500 inches/sec = _____ km/hr

4) 66,000,000 m/week = _____ ft/sec

5) 2.44×10^{-2} km/hr = _____ in/sec

6) 3.0×10^{8} m/s = _____ mi/hr

7) 1.44×10^{3} lbs/ft^2 = _____ N/m^2

8) 2.55×10^{-3} slugs/m^3 = _____ g/ft^3

9) 6.27×10^4 in^2 = _____ km^2

10) 0.00225 km^3 = _____ ft^3

ANSWER KEY

Vector Algebra

1. a) R = 114 m/s west
   b) R = 42 m/s east
2. a) R = 59.55 N, 40.9° N of E (or 40.9° cc)
   b) R = 59.55 N, 40.9° S of E (or 319.1° cc)
3. R = 2436.06 m, 60.5° S of E (or 299.5° cc)
4. R = 30.89 cm, 60.9° W of N (or 150.9° cc)
5. R = 26.5 m/s, 14.5° S of W (or 194.5° cc)
6. R = 233.75 N, 17.2° N of E (17.2° cc)
   E = 233.75 N, 17.2° S of W (or 197.2° cc)
7. R = 127.49 N, 45.6° N of E (45.6° cc) or 44.4° E of N

Vector Components

1. A_x = 25.21 m/s, A_y = 45.48 m/s
2. Western component (A_x) = 105.39 Km
   Northern component (A_y) = 117.05 Km
3. A_x = 13.52 N, A_y = 18.61 N
4. a) Perpendicular component = 69.63 N, Parallel component = 48.75 N
   b) Parallel component increases, perpendicular component decreases
5. Perpendicular component = 681.54 N, Parallel component = 317.81 N

Components Method

1. R = 8.23 Km, 69.3° N of W (or 110.7° cc)
2. a) R = 100.63 N, 7.6° N of E (or 7.6° cc)
   b) R = 112.58 N, 68.6° S of E (or 291.4° cc)
3. 1301.99 m, 43.1° N of E (or 43.1° cc)
4. 4.24 Km, 36° S of W (or 216° cc)

Unit Conversions

1. 44.7 Km
2. 199 lbs
3. 502.9 Km/hr
4. 358 ft/sec
5. 2.67×10^{-1} in/sec
6. 6.71×10^{8} mi/hr
7. 6.9×10^{4} N/m^2
8. 1.05 g/ft^3
9. 4.05×10^{-5} Km^2
10. 7.9×10^{7} ft^3