AP PHYSICS C SUMMER '10 WORK PACKET

Welcome to the world of AP Physics C.
AP Physics C is a college level class that will be both conceptually and mathematically challenging. This work packet is designed to give you a jump-start towards understanding the math required to solve physics problems. The more effort you put forward now the easier first semester will be for you. This packet will be graded as your first homework assignment. It is okay to find it difficult just do your best.

Everything in this packet will be covered in class!!!

You will be using Blackboard for the entire year.
To find Blackboard go to www.arundelhigh.org.
Scroll down to the web resource section.
Click on the Blackboard icon.
Username: g.lwist
Password: g.lwist
Click on Honors Physics 1st semester-Wist.
Browse through to become familiar with its arrangement.

Good Luck,

Ms. Wist
lwist@aacps.org

Scratch Paper

AP PHYSICS C SUMMER '10 WORK PACKET

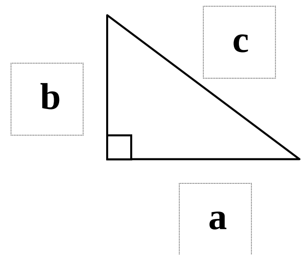
Name: ______________________________

Date: _______________ Pd: ____

Use the attached resource pages and the internet to complete and/or derive the following problems. Record answers in this packet and attach all work on a separate piece of paper.

Pythagorean Theorem ~ $a^2 + b^2 = c^2$

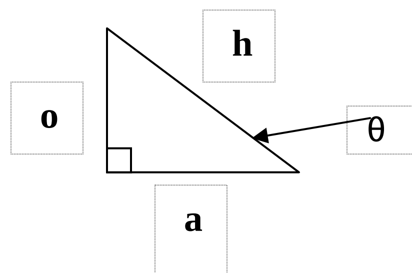
Solve for the unknown information
Round to the nearest tenth.



1. a = 9, b = 9, c = _______
2. a = 4 , b = _______, c = 12
3. a = 4 , b = 6, c = _______
4. a = _______, b = 20, c = 25
5. a = _______, b = 10, c = 13

Trigonometry ~ Solve for the unknown.

Round to the nearest tenth.



SOH CAH TOA

$\sin\theta = \frac{o}{h}$ $\cos\theta = \frac{a}{h}$ $\tan\theta = \frac{o}{a}$

$o = h\sin\theta$ $a = h\cos\theta$ $o = a\tan\theta$

$h = \frac{o}{\sin\theta}$ $h = \frac{a}{\cos\theta}$ $a = \frac{o}{\tan\theta}$

1. θ = 50^0, o = _____, a = 10, h = _____

$o = 10\tan 50^0 = 11.9$ $h = \frac{10}{\cos 50^0} = 15.6$

2. θ = 60^0, o = _____, a = _____, h = 2
3. θ = 37^0, o = 6, a = _____, h = _____
4. θ = 50^0, o = _____, a = _____, h = 13
5. θ = 53^0, o = _____, a = 12, h = _____
6. θ = 18^0, o = _____, a = _____, h = 10
7. θ = 56^0, o = 6, a = _____, h = _____
8. θ = 21^0, o = 9, a = _____, h = _____
9. θ = 22^0, o = _____, a = _____, h = 10
10. θ = 45^0, o = _____, a = _____, h = 17

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Date: _____________ Pd: ____

Use the attached resource pages and the internet to complete and/or derive the following problems. Record answers in this packet and attach all work on a separate piece of paper.

<u>Manipulating Formulas</u> ~ Solve for the variable.

$v = \frac{x}{t}$ $t = \frac{x}{v}$ $x = vt$

$x = vt + x_o$ $v =$ ____________, $t =$ ____________, $x_o =$ ____________

$a = \frac{v}{t}$ $v =$ ____________, $t =$ ____________

$v = v_o + at$ $v_o =$ ____________, $a =$ ____________, $t =$ ____________

$a = \frac{F}{m}$ $F =$ ____________, $m =$ ____________

<u>CHALLENGING MANIPULATIONS</u>

$x = x_o + v_o t + \frac{1}{2} at^2$

$x_o =$ ____________________,

$v_o =$ ____________________,

$a =$ ____________________,

$t =$ ____________________ (quadratic formula)

$v^2 = v_o^2 + 2a(x - x_o)$

$v =$ ____________________,

$v_o =$ ____________________,

$a =$ ____________________,

$x =$ ____________________,

$x_o =$ ____________________

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Name: ______________________________

Date: ______________ **Pd:** ____

Use the attached resource pages and the internet to complete and/or derive the following problems. Record answers in this packet and attach all work on a separate piece of paper.

Vector Addition Problems

HARD

1. A girl delivering newspapers covers her route by traveling 3.00 blocks west, 4.00 blocks north, then 6.00 blocks east. What is her resultant displacement magnitude and direction?

2. A quarterback takes the ball from the line of scrimmage, running backward for 10.0 yards, and then runs to the right parallel to the line of scrimmage for 15.0 yards. At this point, he throws a 50.0-yard forward pass straight downfield, perpendicular to the line of scrimmage. What is the magnitude of the football's resultant displacement?

HARDER

3. A car travels 20 km due north and then 35 km in a direction 60^{0} west of north. Find the magnitude and direction of the resultant displacement vector that gives the net effect of the car's trip.

4. A hiker begins a trip by first walking 25.0 km southeast from her base camp. On the second day she walks 40.0 km in a direction 60.0^{0} north of east, at which point she discovers a forest ranger's tower. What is the magnitude and direction of the resultant displacement of the ranger's tower to the base camp?

5. While exploring a cave, a spelunker starts at the entrance and moves the following distances. She goes 75.0 m north, 250 m east, 125 m at an angle 30.0^{0} north of east, and 150 m south. Find the resultant displacement from the cave entrance.

HARDEST

6. Indiana Jones is trapped in a maze. To find his way out, he walks 10.0 m, makes a 90.0^{0} right turn, walks 5.00 m, makes another 90.0^{0} right turn, and walks 7.00 m. What is his displacement from his initial position?

7. Instructions for finding a buried treasure include the following: Go 75 paces at 240.0^{0}, turn to 135.0^{0} and walk 125 paces, then travel 100 paces at 160.0^{0}. Determine the resultant displacement from the starting point.

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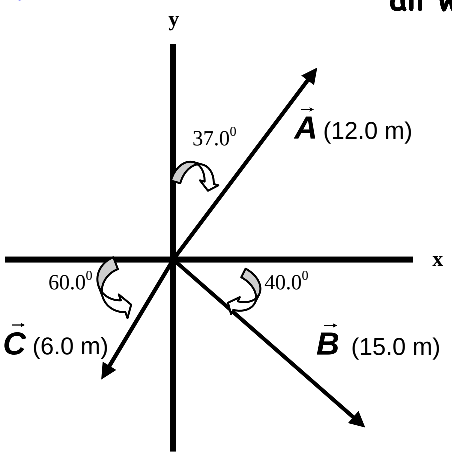

For the vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ shown above, find the scalar products

a) $\vec{A} \cdot \vec{B}$

b) $\vec{B} \cdot \vec{C}$

c) $\vec{A} \cdot \vec{C}$

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Name: ______________________________

Date: _______________ Pd: _____ Page 5 of 5

Use the attached resource pages and the internet to complete and/or derive the following problems. Record answers in this packet and attach all work on a separate piece of paper.

Manipulating equations in a way you may never have done before.

If $x = at^n$ then $x' = nat^{n-1}$

Example: **$x = 5t^3$ then $x' = (3)(5)t^{3-1}$ which becomes $x' = 15t^2$**

Try the following:

1. $x = 2t^4$ $\quad x' = (\_\_\_)(\quad)t^{\_\_-1}$ $\quad x' = \_\_\_\_ t^{\_\_}$
2. $x = 15t^6$ $\quad x' = (\_\_\_)(\quad)t^{\_\_\_}$ $\quad x' = \_\_\_\_ t^{\_\_}$
3. $x = 75t^5$ $\quad x' = (\_\_\_)(\quad)t^{\_\_\_}$ $\quad x' = \_\_\_\_ t^{\_\_}$

If $x = at^n + bt^n + ct^n$ then $x' = nat^{n-1} + nbt^{n-1} + nct^{n-1}$

Example: **$x = 5t^2 + 2t + 10$ becomes $x = 5t^2 + 2t^1 + 10t^0$**

~ ~ ~ (Special note $t^0 = 1$ and $t^1 = t$) ~ ~ ~

then $x' = (2)(5)t^{2-1} + (1)(2)t^{1-1} + (0)(10)t^{0-1}$
which becomes $x' = 10t^1 + 2t^0 + 0$
simplified $x' = 10t + 2$

Try the following:

1. $x = 2t^4 + 12t^2 + 5$ $\quad x' =$

2. $x = 25t^2 + 45t + 5$ $\quad x' =$

3. $x = 10t^8 + 2t^4 + 10$ $\quad x' =$

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Introduction to Equation Editor

In this activity you will learn how to use Equation Editor to type professional-looking equations in a document.

Note: the process below works almost the same for Corel Word Perfect. If you don't have Word of Word Perfect, you will have to complete this assignment on one of the school's computers.

Contact me WELL BEFORE the lab's due date if you are having problems with this process.

1. Check to see if you version of Microsoft Word has the Equation Editor installed.
   - Open a new blank document in Word.
   - Click Insert on the menu bar at the top of the screen. On the list that appears, click Object.
   - On the box that opens up, scroll through the list of object types to locate Microsoft Equation 3.0 and click OK.
   - If you don't see Microsoft Equation 3.0 listed, you will need to install it as follows. If it is already there proceed to step 4 of these instructions.

2. Install Equation Editor as follows. (Some steps may be different in some versions of Windows. See number 3 below.)
   - Close Word if it's still open. Have your Office CD in a drive.
   - On your Start button, click on Settings and then on the Control Panel.
   - Double-click on Add or Remove Programs.
   - Scroll through the list of programs until you find Microsoft Office and click on it. Click the Change button or click Add/Remove.
   - Select Add or Remove Features.
   - Click the small + next to the Office Tools item.
   - Click on the icon next to Equation Editor, select Run from my computer, and then click the Update Now button.

3. In some versions of Window, simply inserting the Office CD into a drive will cause it to auto-start and allow you to Add Features.

4. Once you have Equation Editor available, you should make a convenient button for it on your toolbar. Follow these steps.
   - If you haven't already, open a new blank document in Word.
   - Click Tools on the menu bar at the top of the screen and then click Customize.
   - On the box that opens, click on the Commands tab and then click Insert on the categories list.
   - Scroll through the list of commands until you find Equation Editor.
   - Drag the Equation Editor icon (a square root symbol over a Greek letter alpha) up to any of your toolbars at the top of the screen to a position you like and let it go.
   - Close the Customize box.
   - Now when you click on the new button, it will automatically insert an empty equation box into your document.

5. Use the Equation Editor to type the following equations into your document. Type them *exactly* as shown.

$$K = \frac{1}{2}mv^2 \qquad F = \frac{Gm_1m_2}{r^2} \qquad n_1 \sin\theta_1 = n_2 \sin\theta_2 \qquad T = 2\pi\sqrt{\frac{l}{g}} = 2(3.14)\sqrt{\frac{1.5m}{9.80\frac{m}{s^2}}} = 2.46s$$

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SUMMER '10
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Resource Information

SI UNITS

SI Units are the standard units of measurements accepted in science.
Below are three of the base units used in Physics.

Starting SI Base Units		
Base Quantity	**Base**	**Symbol**
Length	**Meter**	**m**
Mass	**Kilogram**	**kg**
Time	**Seconds**	**s**

Below are the prefixes used with the basic and derived SI units.
Derived units are a combination of base units
such as velocity is meters per second or m/s

Prefixes Used with SI Units			
Scientific Notation	**Prefix**	**Symbol**	**Example**
10^{-15}	femto-	f	femtosecond (fs)
10^{-12}	pico-	p	picometer (pm)
10^{-9}	nano-	n	nanometer (nm)
10^{-6}	micro-	μ	microgram (μ g)
10^{-3}	milli-	m	milliamps (mA)
10^{-2}	centi-	c	centimeter (cm)
10^{-1}	deci-	d	deciliter (dL)
10^{3}	kilo-	k	kilometer (kg)
10^{6}	mega-	M	megagram (Mg)
10^{9}	giga-	G	gigameter (Gm)
10^{12}	tera-	T	terahertz (THz)

Scientific Notation

$M \times 10^n \qquad 1 \le M < 10$

"M" represents the multiplier
The multiplier is always greater than or equal to one or less than ten.

Mathematically, **10** is the base of the exponent and ***"n"*** is the exponent.

If ***"n"*** equal +4 then **10** is raised to the **positive** fourth power.
10^4 is the same as **10 x 10 x 10 x10**
If ***"M"*** equals 3 and ***"n"*** equals 4 then
3×10^4 equals 3 x **10 x 10 x 10 x10**, which equals **30,000**

If ***"n"*** equal -4 then **10** is raised to the **negative** fourth power.
10^{-4} is the same as **.1 x .1 x .1 x.1**
If ***"M"*** equals 3 and ***"n"*** equal -4 then
3×10^{-4} equals 3 x **.1 x .1 x .1 x.1**, which equals **.0003**

Standard Notation

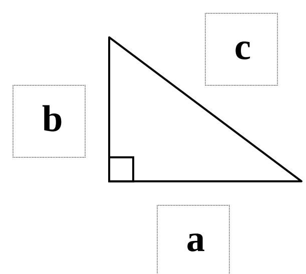
Standard Notation is writing a number in decimal form.

Instead of 8.5×10^6 meters in scientific notation this number would be written as 8,500,000 meters in standard notation.

Instead of 6.0×10^{-2} seconds in scientific notation this number would be written as 0.06 seconds in standard notation.

Pythagorean Theorem

Pythagorean's basic formula
$a^2 + b^2 = c^2$



Example:

a = ______ , b = 3 , c = 5

$a^2 + (3)^2 = (5)^2$
$a^2 + (9) = (25)$
$a^2 = 16$
$a = 4$

Significant Digits Rules:

1. Nonzero digits ARE significant.
2. Final zeros after a decimal point ARE significant.
3. Zeros between two significant digits ARE significant.
4. Zeros used only as placeholders are NOT significant.

There are two cases in which numbers are considered EXACT, and thus, have an infinite number of significant digits.

1. Counting numbers have an infinite number of significant digits.
2. Conversion factors have an infinite number of significant digits.

Examples:

5.0 g has two significant digits.

14.90 g has four significant digits.

0.0 has one significant digit.

300.00 mm has five significant digits.

5.06 s has three significant digits.

304 s has three significant digits.

0.0060 mm has two significant digits (6 & the last 0)

140 mm has two significant digits (1 & 4)

Rounding Rules:

1. When the leftmost digit to be dropped is < 5, that digit and any digits that follow are dropped. Then the last digit in the rounded number remains unchanged.

   8.7645 rounded to 3 significant digits is 8.76

2. When the leftmost digit to be dropped is > 5, that digit and any digits that follow are dropped, and the last digit in the rounded number in increased by one.

   8.7676 rounded to 3 significant digits is 8.77

3. When the leftmost digit to be dropped is 5 followed by a nonzero number, that digit and any digits that follow are dropped. The last digit in the rounded number increases by one.

   8.7519 rounded to 2 significant digits is 8.8

4. If the digit to the right of the last significant digit is equal to 5, and 5 is followed by a zero or no other digits, look at the last significant digit. If it is odd, increase it by one; if it is even, do not round up.

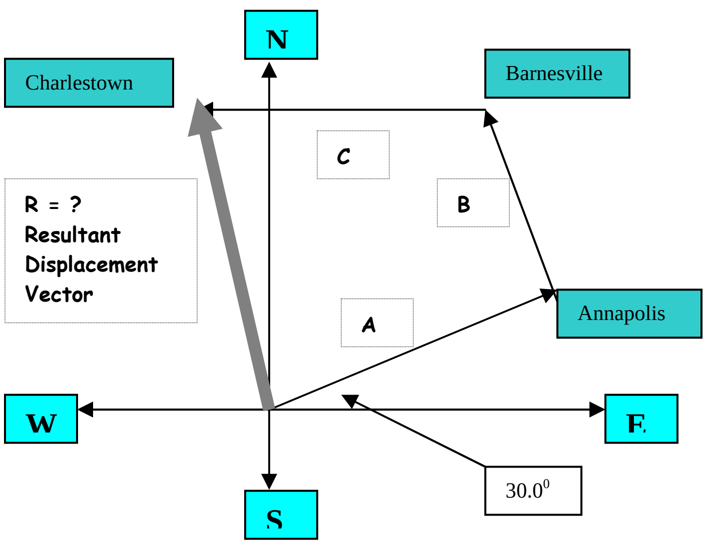
   92.350 rounded to 3 significant digits is 92.4
   92.25 rounded to 3 significant digits is 92.2

Vector Addition with XY Components

Physical quantities that have both numerical and directional properties are represented by vectors. Some examples of vector quantities are force, displacement, velocity, and acceleration. Numerical and directional can be referred to as magnitude and direction. Instead of saying vector A, vectors are represented in bold print such as **A**.

Example:

A commuter airplane starts from an airport and takes the route shown below. It first flies 175 km in a direction 30.0^0 north of east to the city of Annapolis following route **A**. Next, it flies 150 km in a direction 20.0^0 west of north to Barnesville following route **B**. Finally, it flies 190 km due west to Charlestown following route **C**. Find the location of Charlestown to the location of the starting point to be labeled route **R** which is the resultant displacement.



Bold Print letters are vectors

$\mathbf{R} = \mathbf{A} + \mathbf{B} + \mathbf{C}$

Non-bold letters are magnitudes

$R \neq A + B + C$

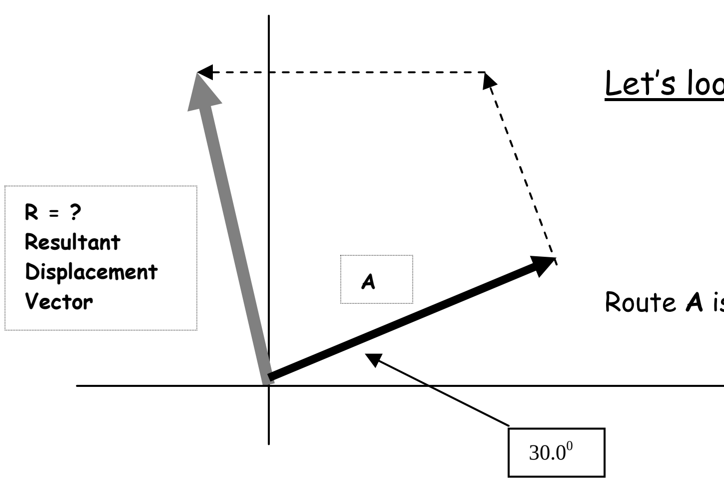
$R \neq 175\text{ km} + 150\text{ km} + 190\text{ km}$

"$\neq$" **this symbol means "not equal to"**

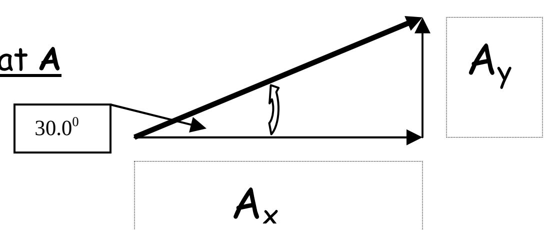
Magnitude's XY Components

$R_x = A_x + B_x + C_x$

$R_y = A_y + B_y + C_y$



Let's look at **A**

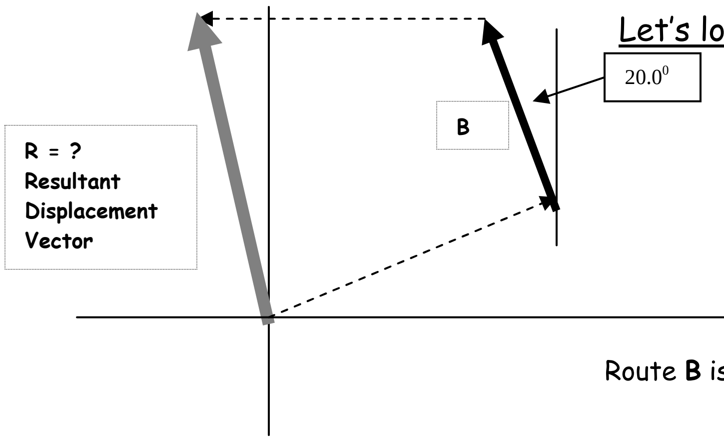


Route **A** is 175 km in a direction 30.0^0 north of east

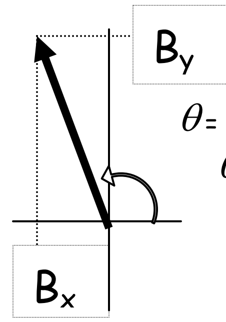
$A = 175\text{ km}$ $\quad \theta = 30.0^0$

$A_x = A\cos\theta$ $\quad A_y = A\sin\theta$

$A_x = 175\cos(30.0^0)$ $\quad A_y = 175\sin(30.0^0)$



Let's look at **B**



$\theta = 90.0^0 + 20.0^0$

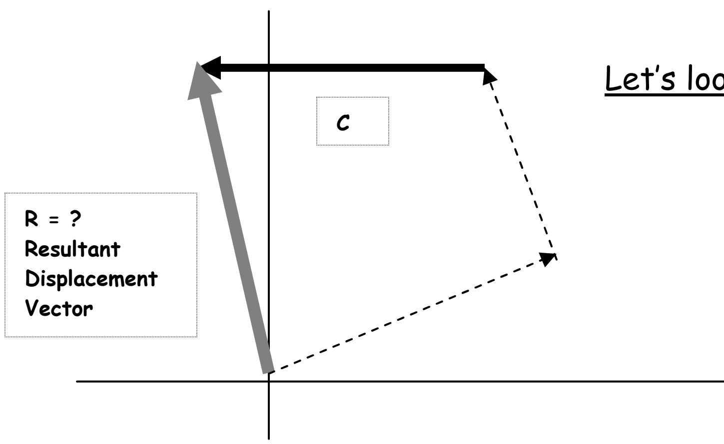
$\theta = 110.0^0$

Route **B** is 150 km is a direction 20.0^0 west of north

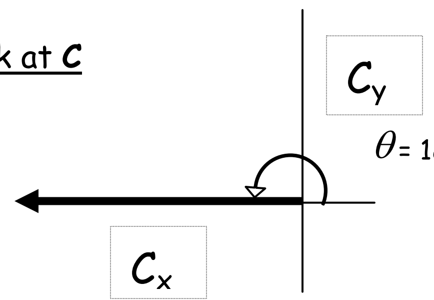
$B = 150$ km $\qquad \theta = 110.0^0$

$B_x = B\cos\theta \qquad B_y = B\sin\theta$

$B_x = 150\cos(110.0^0) \quad B_y = 150\sin(110.0^0)$



Let's look at ***C***



$\theta = 180.0^0$

Route ***C*** is 190 km due west

$C = 190$ km $\qquad \theta = 180.0^0$

$C_x = C\cos\theta \qquad C_y = C\sin\theta$

$C_x = 190\cos(180.0^0) \quad C_y = 190\sin(180.0^0)$

Vector Addtion

R = A + B + C

Remember Magnitudes cannot be added

$R \neq A + B + C$

Summary of XY Components

$A_x = 175\cos(30.0^0) \quad A_y = 175\sin(30.0^0)$

$B_x = 150\cos(110.0^0) \quad B_y = 150\sin(110.0^0)$

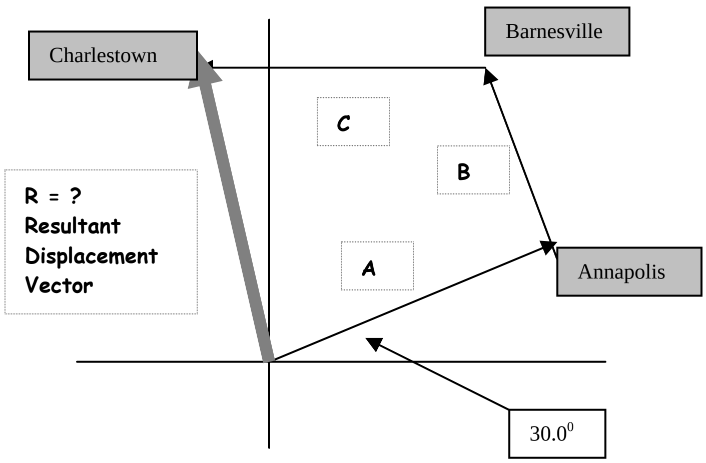
$C_x = 190\cos(180.0^0) \quad C_y = 190\sin(180.0^0)$

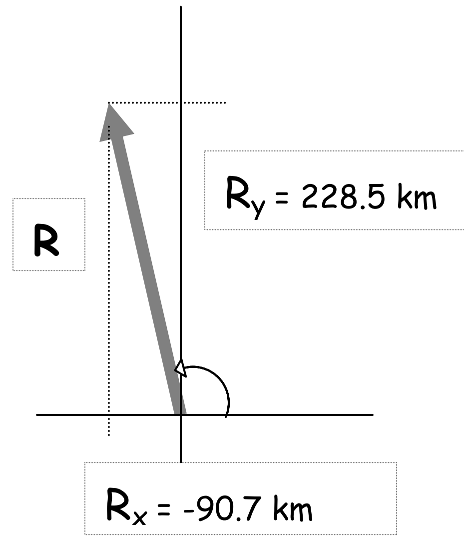
Magnitudes of XY Components

$R_x = A_x + B_x + C_x \qquad R_x = 175\cos(30.0^0) + 150\cos(110.0^0) + 190\cos(180.0^0) = -90.7\text{km}$

$R_y = A_y + B_y + C_y \qquad R_y = 175\sin(30.0^0) + 150\sin(110.0^0) + 190\sin(180.0^0) = 228.5\text{km}$

$R_x = -90.7\text{km} \quad R_y = 228.5\text{km}$



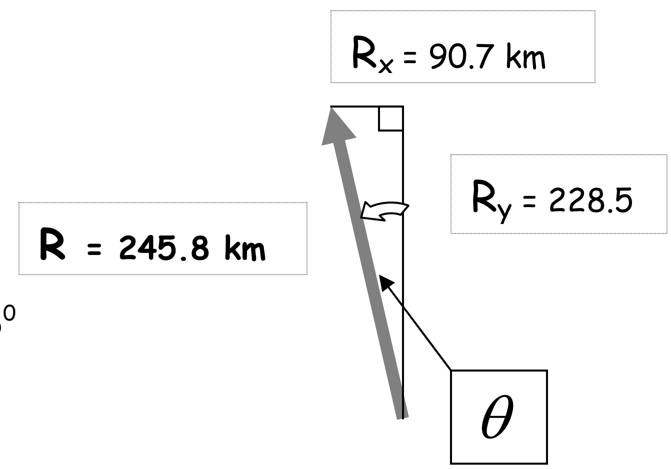


Pythagoreans Theorem

$R^2 = R_x^2 + R_y^2 = (-90.7)^2 + (228.5)^2$

$R^2 = 60438.7$

R = 245.8 km



Trigonometry

$\theta = \tan^{-1}(o/a)$

$o = R_x = (90.7)$

$a = R_y = 228.5$

$\theta = \tan^{-1}(90.7/228.5) = 21.6^0$

Conclusion

Find the location of Charlestown to the location of the starting point.
Route **R**, the airplane's resultant displacement.

Short flight to Charlestown would be to fly Route **R**
245.8 km in a direction 21.6^0 west of north

Products of Vectors

We have seen how addition of vectors naturally from the problem of combining displacements, and we will use vector addition for calculation may other vector quantities later. We also express many physical relationships concisely by using *products* of vectors. Vectors are not ordinary numbers, so ordinary multiplication is not directly applicable to vectors. We will define two different kinds of products of vectors. The first, called the scalar product, yields a result that is a scalar quantity. The second, the vector product, yields another vector.

Scalar Product

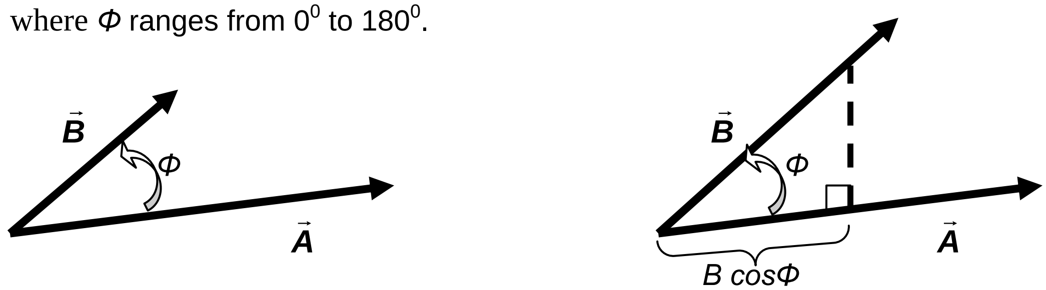
The **scalar product** of two vectors, $\vec{A}$ and $\vec{B}$ is denoted by $\vec{A}\cdot\vec{B}$. Because of this notation, the scalar product is also called the **dot product.**

To define the scalar product $\vec{A}\cdot\vec{B}$ of two vectors $\vec{A}$ and $\vec{B}$, we draw the *two* vectors with their tails at the same point (Figure 1a). The angle between their directions is Φ as shown; the angle Φ always lies between 0^0 and 180^0. (As usual, we use Greek letters for angles.) Figure 1b shows the projection of the vector $\vec{B}$ onto the direction of $\vec{A}$; this projection is the component of $\vec{B}$ parallel to $\vec{A}$ and is equal to $B\cos\Phi$. (We can take components along any direction that's convenient, not just the *x*- and *y*-axes.) We define $\vec{A}\cdot\vec{B}$ to be the magnitude of $\vec{A}$ multiplied by the component of $\vec{B}$ parallel to $\vec{A}$. Expressed as an equation,

$$\vec{A}\cdot\vec{B} = AB\cos\Phi = |\vec{A}|\,|\vec{B}|\cos\Phi$$

(definition of the scalar (dot) product)

where Φ ranges from 0^0 to 180^0.



(a) (b)

Figure 1 (a) Two vectors drawn from a common starting point to define their scalar product $\vec{A}\cdot\vec{B} = AB\cos\Phi$, (b) $B\cos\Phi$ is the component of $\vec{B}$ in the direction of $\vec{A}$, and $\vec{A}\cdot\vec{B}$ is the product of the magnitude of $\vec{A}$ and this component.