AP Physics I
General Course Expectations &
Summer Assignment 2025

Contact:

Greetings, I am Mr. Ruser, and I will be your AP Physics I instructor for the 2025-2026 school year. I will work with you over the course of this year and have high hopes that, with determination and hard work, each of you will pass the AP Physics 1 exam. You may contact me throughout the summer with any questions. Throughout this course, I will gladly work with you to meet the challenge, *provided you are willing to put in sincere effort*. If you have any issues with the work, please contact me.

Email: ***jruser@scspk12.org***

General Course Expectations:

- The summer work is worth five (5) typical homework assignments, and the first exam for this course is based on the summer work.
- I understand that there will be three (3) mandatory Saturday Test Prep sessions that I am expected to attend. *Dates TBD.*
- I understand that the AP Exam in May is free to students and is mandatory. If, for any reason, I do not take the test, I will not receive AP credit for the course, and I will be charged to cover the cost of the returned test.

Signature:

I have read the General Course Expectations *above and previewed the summer work assignment. I understand the stated expectations for the course. I commit to completing the summer assignment, and I realize the consequences of not completing the work with sincere effort.*

Student Name (print) **Student Email (print clearly)** **Student Signature** **Date**

Parent/Guardian Name (print) **Parent/Guardian Email (print clearly)** **Parent/Guardian Signature** **Date**

AP Physics I

Attached:

1) "Summer Assignment 2025 Introduction"
2) "The Expectations for the First Days of School"
3) *College Board* AP Physics I "Table of Information"
4) "Math and Vector Practice" #1-24

1) Summer Assignment 2025 Introduction

Math and Vector Practice *(attached)*:
Expected time to complete assignment: *2-3 days.*
This packet is a math preview/review to practice valuable skills that will be highly useful throughout the AP Physics course. *AP Physics I requires **strong** proficiency in algebra, basic trigonometry and some geometry.* In addition to understanding science concepts and exploring the physical world, physics applies the mathematics you have been learning! The following assignment includes mathematics problems that are considered routine in AP Physics I. This includes knowing several key metric system conversion factors and how to employ them.

Another important skill in physics is understanding vectors. This may be new to many of you. The attached vector practice contains brief tutorials and example/practice problems.

Credit for this Summer Assignment

This summer assignment will be worth the value of five regular homework assignments. *Full* credit can only be awarded for work turned in on the **first** day of class.

In addition, the content of your first exam in week one will be based on the mathematics work you find in this assignment. Success on the exam will be improved with sincere effort on this summer assignment.

Collaboration regarding the work is encouraged. Use the Internet for reference material. However, *do not copy work from another student*. This is to maintain your own integrity and reputation, and it's for your own benefit regarding the content.

Investing & Using an AP Review Book

To help ensure success in this course, it is expected you would use an AP Review book. We will use pieces of one as a resource. Exact book TBD.

Internet Resources to Explore

Log on to the following three sites. You will be expected to use them as resources throughout the year. Others may be added, but these are sufficient to start.

- learnapphysics.com
  Click on Physics 1 & 2 on the top navigation and then on any topic under Physics 1 on the following page to explore video lectures and multiple-choice practice banks.

- aplusphysics.com/ap1/ap1-supp.html
  Click on any of the topics at the bottom of the page to view practice problems.

- hippocampus.org
  Click on Physics to explore video presentations, video lessons from *KhanAcademy*, and simulations.

- phet.colorado.edu
  Click on any of the Java simulations that are available here to make sure you are able to use them.

The Expectations for the First Days of School

What is due on the first day of school?

- Math and Vector Practice Assignment
  - Complete all questions in the packet.
  - You may attach extra paper if there is not enough space in the packet to show your work.

What if I don't get all the problems or don't understand the instructions?

- Do the best you can, use available resources, and show work and effort to receive credit. I do not expect you to get ***all*** the problems in this class at first, but I do expect you to give an ***honest effort*** to all the problems we attempt.
- Email/text questions or concerns to Mr. Ruser using one of the methods on the front page.
- Come to class the first days, *and perhaps after school for help*, with any questions to resolve these issues prior to the first test.

What should you be prepared for on the first days of class?

- Class Binder:
  3-ring binder w/ *graph-paper* notebook included
  - You will receive lots of material all year. The only way to successfully stay organized is to have a 3-ring binder and put these materials in it in chronological order.
  - All laboratory work, challenges and notes should be maintained in a *graph-paper* notebook included in your binder. This will serve as a record of your work in class. This is in preparation for the expectation of college laboratory work.

- All summer work is due the first day of class.

- On Day 1, we will use and discuss your summer work.

- There will be a math/vector exam covering the summer work in week one of class. This will be your first and likely easiest test of the year. Be sure you spend time working to understand the material.

- Currently there is some churn as to required materials, so I will place a "TBD" here to indicate that there may be other materials required.

ADVANCED PLACEMENT PHYSICS 1 EQUATIONS, EFFECTIVE 2015

CONSTANTS AND CONVERSION FACTORS			
Proton mass,	$m_p = 1.67 \times 10^{-27}$ kg	Electron charge magnitude,	$e = 1.60 \times 10^{-19}$ C
Neutron mass,	$m_n = 1.67 \times 10^{-27}$ kg	Coulomb's law constant,	$k = 1/4\pi\varepsilon_0 = 9.0 \times 10^{9}$ N•m^2/C^2
Electron mass,	$m_e = 9.11 \times 10^{-31}$ kg	Universal gravitational constant,	$G = 6.67 \times 10^{-11}$ m^3/kg•s^2
Speed of light,	$c = 3.00 \times 10^{8}$ m/s	Acceleration due to gravity at Earth's surface,	$g = 9.8$ m/s^2

UNIT SYMBOLS							
meter,	m	kelvin,	K	watt,	W	degree Celsius,	°C
kilogram,	kg	hertz,	Hz	coulomb,	C		
second,	s	newton,	N	volt,	V		
ampere,	A	joule,	J	ohm,	Ω		

PREFIXES		
Factor	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

VALUES OF TRIGONOMETRIC FUNCTIONS FOR COMMON ANGLES							
θ	0°	30°	37°	45°	53°	60°	90°
$\sin\theta$	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1
$\cos\theta$	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0
$\tan\theta$	0	$\sqrt{3}/3$	3/4	1	4/3	$\sqrt{3}$	∞

The following conventions are used in this exam.

I. The frame of reference of any problem is assumed to be inertial unless otherwise stated.
II. Assume air resistance is negligible unless otherwise stated.
III. In all situations, positive work is defined as work done on a system.
IV. The direction of current is conventional current: the direction in which positive charge would drift.
V. Assume all batteries and meters are ideal unless otherwise stated.

Math & Vector Practice Assignment

Be sure to read all directions throughout the packet. All work must hand-written and be completed on the pages below in the areas provided or on notebook paper. *Calculators should be avoided for this section of the work*. No physics is needed for this assignment. Work must be legible. Retain this hard copy and take photos / capture images to place in a document to be uploaded into Google Classroom when that is available for AP Physics 1. *If any of these problems or concepts give you trouble, I urge you to use the resources listed above or others to help you master these prerequisite skills before the first day of school.*

Scientific Notation Review

Solve the following. Final answers should be in scientific notation.

1) $(5.0\times10^{-8})(2.9\times10^{2})$

2) $6.000\times10^{-11}\,\dfrac{1.00\times10^{26}}{2.00\times10^{7}}$

Unit Conversions Review

3) Finish the *SI* prefix table below. Follow the example of the *centi*- prefix. You should be familiar with these.

Symbol	Name	Numerical Equivalent
n		
μ		
m		
c	centi	10^{-2}
k		
M		
G		

Example for #4-6:

140 kilometers is how many centimeters?

$$\frac{140\ \cancel{\text{km}}}{1}\ \text{X}\ \frac{1000\ \cancel{\text{m}}}{1\ \cancel{\text{km}}}\ \text{X}\ \frac{100\ \text{cm}}{1\ \cancel{\text{m}}} = 1.4 \text{ x } 10^{7}\ \text{cm}$$

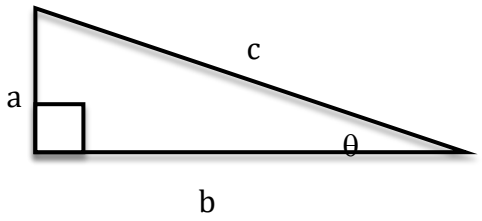
4) 16.7 kilograms is how many grams?

5) 8.99×10^{9} seconds is how many years?

6) 2.998×10^{8} m/s is how many kilometers per hour?

Trigonometry Review

Use the figure below to answer problems 7-10. Simplify as much as you can.



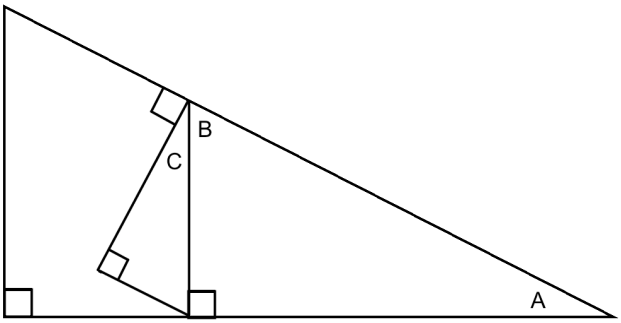
7) Find *c* if given *a* and *b*.

8) Find *a* if given *b* and *c*.

9) Find *b* if given *a* and θ.

10) Find θ if given *b* and *c*.

11) Using the properties of triangles, prove that $\angle A \cong \angle C$ in the drawing below.

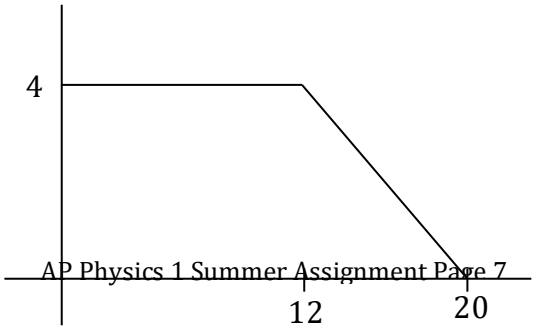


Answer:

Area Review

12) What is the area under the curve at the right?

_____



Algebra Review

Solve the following equations for the given variable and conditions. Simplify if needed.

Example: $2x + xy = z$. Solve for x.

$x(2+y) = z$

$$\boxed{x = \frac{z}{2+y}}$$

13) $v_f^2 = v_i^2 + 2ad$

A.) Solve for v_i.

B.) Solve for d.

14) $d_f = d_i + v_o t + \frac{1}{2}at^2$

A.) Solve for v_o.

B.) Solve for t, if $v_o = 0$.

15) $a_c = \frac{v^2}{r}$ Solve for v.

16) $\frac{1}{2}mv_f^2 + mgh_f = \frac{1}{2}mv_i^2 + mgh_i$ Solve for h_f , if $h_i = 0$ and $v_f = 0$.

17) $m_1 v_{i,1} + m_2 v_{i,2} = m_1 v_{f,1} + m_2 v_{f,2}$. Solve for v_{f2} , if $v_{i,1} = 0$.

18) $T = 2\pi\sqrt{\frac{L}{g}}$. Solve for g.

Miscellaneous

Simplify without using a calculator. Remember to show all of your work.

19) $\frac{1}{4}+\frac{1}{6}$

20) $\frac{1}{3}+\frac{1}{18}$

21) Consider $z = \frac{x}{y}$, $c = ab$, $l = m - n$, or $r = \frac{s^2}{t^2}$.

a.) As x increases and y stays constant, z _____.

b.) As y increases and x stays constant, z _____.

c.) As x increases and z stays constant, y _____.

d.) As a increases and c stays constant, b _____.

e.) As c increases and b stays constant, a _____.

f.) As b increases and a stays constant, c _____.

g.) As n increases and m stays constant, l _____.

h.) As l increases and n stays constant, m _____.

i.) If s is tripled and t stays constant, r is multiplied by _____.

j.) If t is doubled and s stays constant, r is multiplied by _____.

Vectors

Most of the quantities in physics are vectors. ***<u>This makes proficiency in vectors extremely important</u>***.

Magnitude: Size or extent. The numerical value. Answers questions like *"how big?"* or *"how much?"*

Direction: Alignment or orientation of any position with respect to any other position. Answers questions like *"which way?"* and *"relative to what point of reference?"*

Scalars: A physical quantity described by a single number and units. A quantity described by **<u>magnitude only.</u>**

Examples: time, mass and temperature *(they do not have a direction associated with them)*

Vectors: A physical quantity with **<u>both a magnitude and a direction</u>**. A directional quantity.

Examples: velocity, acceleration, force *(you need to know how big and in which direction)*

Notation: $\vec{A}$ or $\overrightarrow{\quad A \quad}$ <u>Length</u> of the arrow is <u>proportional to the vector's magnitude</u>. <u>Direction</u> the arrow points <u>is the direction of the vector</u>.

Negative Vectors

Negative vectors have the same magnitude as their positive counterpart. They are just pointing in the opposite direction.

$\vec{A}$ $\qquad$ $-\vec{A}$

Vector Addition and Subtraction

Think of it as vector addition only. The result of adding vectors is called the <u>resultant</u>. $\vec{R}$

$\vec{A}+\vec{B}=\vec{R}$ $\qquad$ $\vec{A}$ + $\vec{B}$ = $\vec{R}$

So if ***A*** has a magnitude of 3 and ***B*** has a magnitude of 2, then ***R*** has a magnitude of 3+2=5.

When you need to subtract one vector from another, think of the one being subtracted as being a negative vector. Then add them.

$\vec{A}-\vec{B}$ is really $\vec{A}+\left(-\vec{B}\right)=\vec{R}$ $\qquad$ $\vec{A}$ + $-\vec{B}$ = $\vec{R}$

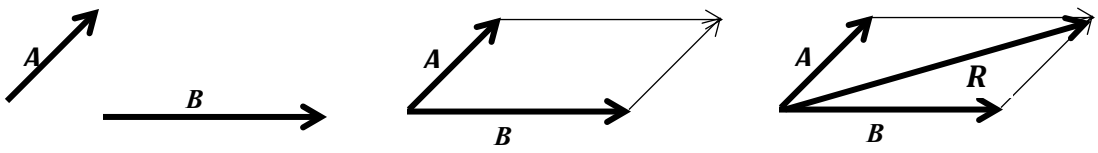
A negative vector has the same length as its positive counterpart, but its direction is reversed.
So if ***A*** has a magnitude of 3 and ***B*** has a magnitude of 2, then ***R*** has a magnitude of 3+(-2)=1.

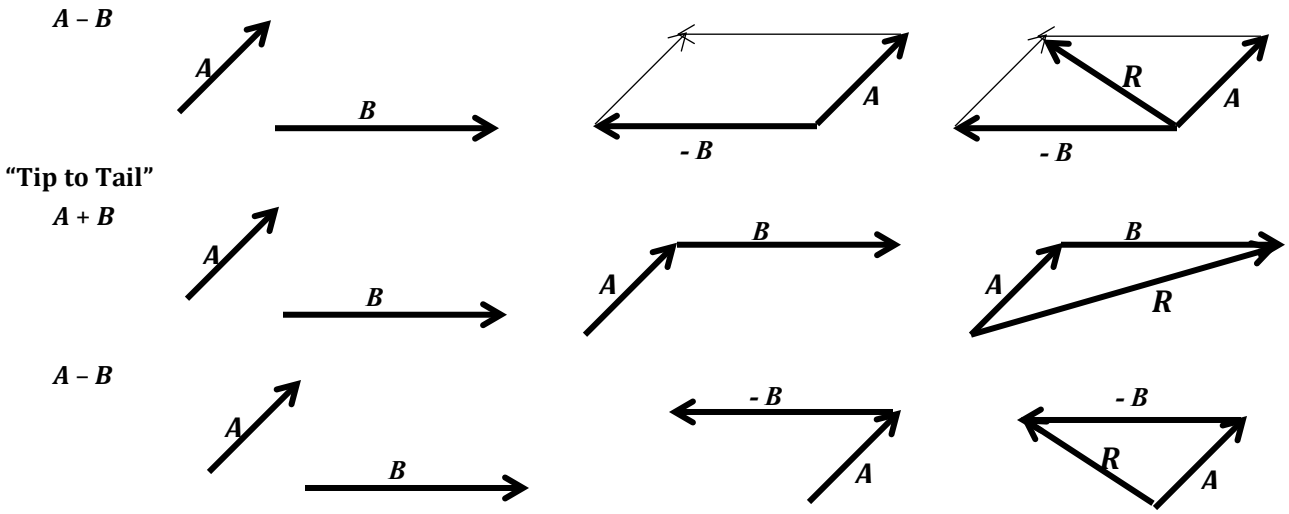
<u>This is very important</u>. In physics, a negative number does not always mean a smaller number. Mathematically, –2 is smaller than +2. But, in physics, these numbers have the same magnitude (size), they just point in different directions (180° apart).

There are two methods of adding vectors

Parallelogram

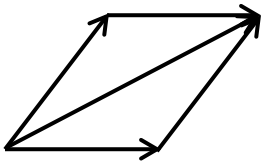
A + B





Both methods arrive at the exact same solution since either method is essentially a parallelogram. It is useful to understand both systems. In some problems, one method works better than the other.

22) Draw the resultant vector using the parallelogram method of vector addition *(just DRAW them, no calculations here).*

Example 

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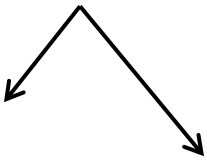
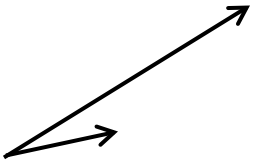
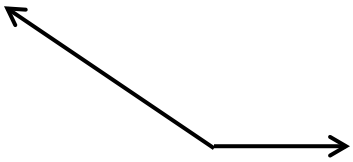
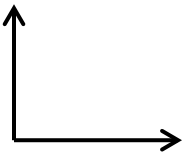
d. 

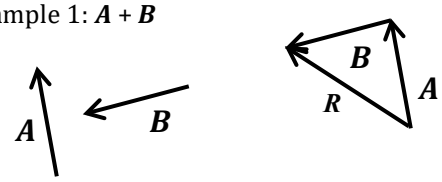
a. 

c. 

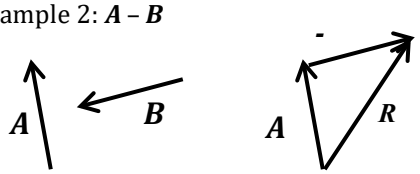
e. 

23) Draw the resultant vector using the "tip to tail" method of vector addition. Label the resultant as vector ***R.***

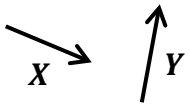
Example 1: ***A*** + ***B***



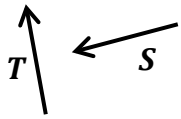
Example 2: ***A*** – ***B***



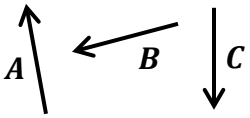
a. ***X*** + ***Y***



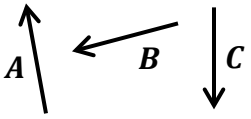
b. ***T*** – ***S***



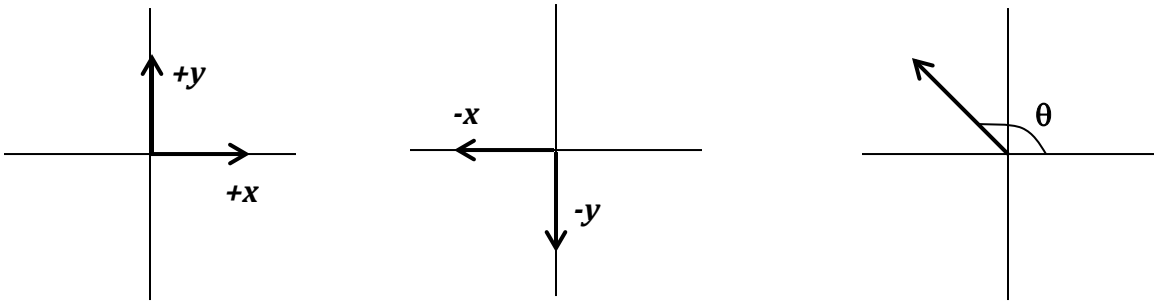
c. ***A*** + ***B*** + ***C***



d. ***A*** – ***B*** – ***C***



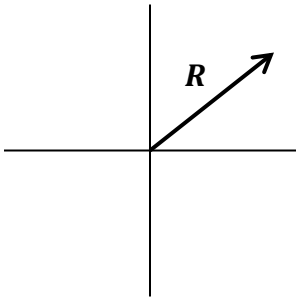
Direction: What does positive or negative direction mean? How is it referenced? The answer is the coordinate axis system. **In physics, a coordinate axis system is used to give a problem a frame of reference.** Positive direction is a vector moving in the positive ***x*** or positive ***y*** direction, while a negative vector moves in the negative ***x*** or negative ***y*** direction. This also applies to the ***z*** direction, which will be used sparingly in this course.

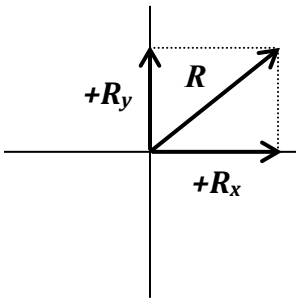


What about vectors that don't fall on the axis? You must specify their direction using degrees measured from East. "East" is the same as the positive X-axis in this case.

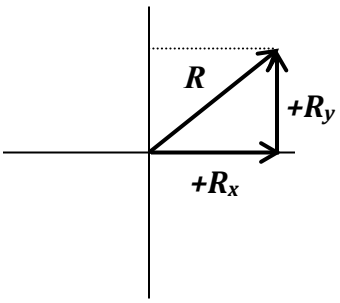
Component Vectors

A resultant vector is a vector resulting from the sum of two or more other vectors. Finding the components is the reverse of finding a resultant. Component vectors are the vectors that are parallel to the x- and y-axes that, when added together, equal the resultant. *(NOTE: this is true at least for now…just wait until rotation!)*





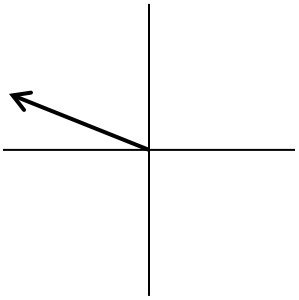
or



Any vector can be described by an ***x***-axis vector and a ***y***-axis vector, which when summed together, mean the exact same thing. The advantage is you can then use plus and minus signs for direction instead of the angle.

24) For the following vectors draw the component vectors along the ***x*** and ***y*** axes.

a.



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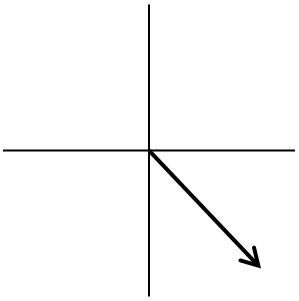
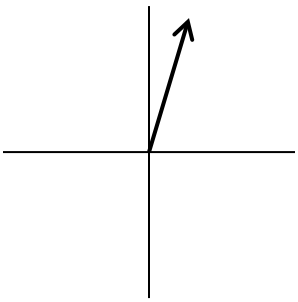
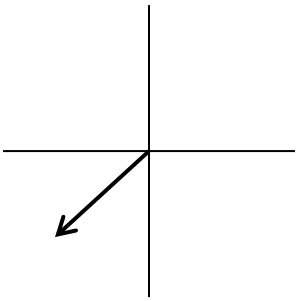


b.



d.



Note: The quadrant that a vector is in determines the sign of the ***x*** and ***y*** component vectors.