

AP Physics 2 Summer Assignment

Welcome to AP Physics 2! First off congratulations is in order, you survived AP Physics 1! It is not an easy course and you have decided to come back for more! This will be a fun course exploring many more branches of physics, from optics and waves, to electricity and magnetism, to thermodynamics and radiation. This is where the exciting stuff is, prepare to think about the world around you in ways you have never had to think about them before.

This course is giving you the opportunity to grow as a critical thinker, problem solver and communicator. I also don't believe the rumors, this course is not impossibly hard. It does require hard work, but so does anything that is worthwhile. AP Physics is immensely rewarding and exciting, but you do have to take notes, study, and maybe even read the book (torture, I know!). But I promise that if you want to (and only if you actually want it), you can absolutely succeed!

The Assignment

The assignment is broken into 4 parts which will cover fundamental concepts from math and science that we should know already. Most of this should be a refresher. You can also email me and I will do my best to answer.

This assignment is due on the first day of school. You must show all your work in all steps. I highly recommend not waiting until the last minute to start this assignment, but I think we both know that won't happen...

Section	Points Earned	Points Total
Vectors		6
Kinematics		10
Forces		14
Proportionality and Graphing		25
Total		60

Vectors

For each of the following please draw a picture of the vector(s), with all included information before you solve.

1. Vector A has a magnitude of 10 N and is directed 30 degrees above the positive x-axis. Find the x-component and y-component of Vector A **(1 points)**.

2. Vector B has a magnitude of 21 m/s^2 and is directed 45 degrees below the negative x-axis. Find the x-component and y-component of Vector B **(1 points)**.

3. Given Vector C has components $C_x = 6\text{ m/s}$ and $C_y = 8\text{ m/s}$, find the magnitude of Vector C and the angle Vector C makes with the x-axis **(1 points)**.

4. Given Vector D has components $D_x = -3\text{ m}$ and $D_y = 7\text{ m}$, find the magnitude of Vector D and the angle Vector D makes with the x-axis **(1 points)**.

5. Vector E is given by components $E_x = 3\text{ V/m}$ and $E_y = 4\text{ V/m}$, and Vector F is given by components $F_x = -5\text{ V/m}$ and $F_y = 2\text{ V/m}$ **(2 points)**.
 - a. Find the components of the resultant vector $R_1 = E + F$ and $R_2 = E - F$.
 - b. Find the magnitude and direction of the resultant vector $R = E + F$.

Kinematics

Recall that in order to use the kinematic equations, the acceleration of the object must be **constant** and the motion must be **one-dimensional**. If the motion is not 1-D, we can break up the velocity vectors into its **x and y components** and solve each dimension separately (remember that time stays the same between the two dimensions)

1. A car begins from rest and accelerates at a rate of 4 m/s^2 for 5 *seconds*. What is the car's final velocity? **(2 points)**

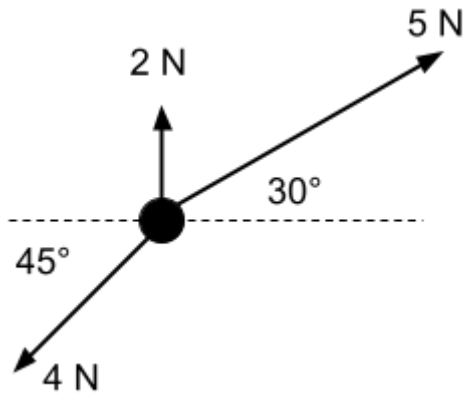
2. A 8500 *kg* train car moving at 2 m/s accelerates at a constant rate of 1 m/s^2 for 18 *seconds*. How far does the train car travel in this time? **(2 points)**

3. A baseball is thrown straight up into the air with an initial velocity of 15 m/s . What maximum height will it reach? **(2 points)**

4. A ball is thrown from the top of a cliff with an initial velocity of 20 m/s at an angle of 30 degrees above the horizontal. The cliff is 50m high. Determine the horizontal distance (range) from the base of the cliff to where the ball lands. **(4 points)**

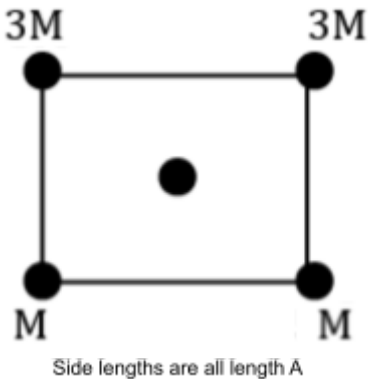
Newton's Laws

1. Calculate the net force in the x-direction and y-direction based on the FBD shown below. Then calculate the resultant acceleration of the object if it has a mass of 2 kg (**7 points**).



2. Four masses are placed at the corners of a square of side length as shown below. Calculate the net gravitational force acting on the center of the square in terms of G , M , and A (**7 points**).

Recall: $F_g = G \frac{m_1 m_2}{r^2}$



Proportionality and Graphing

1. The period (T) of an oscillator is inversely proportional the frequency (f) of the oscillator **(2 points)**.
 - a. Write the equation for the period of an oscillator in terms of frequency.

 - b. As the frequency increases, how does the period change?

2. The capacitance (C) of a parallel plate capacitor is directly proportional to the charge (Q) stored on the plates and is inversely proportional to the voltage (V) across the plates **(3 points)**.
 - a. Write an equation for capacitance (C) in terms of voltage (V) and charge (Q).

 - b. As the voltage across the plates increases, how does the capacitance change?

 - c. If the capacitance is kept constant, and the charge stored on the plates is halved, what happens to the voltage across the plates?

3. The power (P) dissipated in a circuit element is proportional to the square of the voltage (V) across the element and inversely proportional to the resistance (R) of the element **(3 points)**.
 - a. Write an equation for the power (P) dissipated in a circuit element in terms of voltage and resistance).

 - b. As the voltage across the element increases, how does the power change?

 - c. If the power is kept constant, and the resistance of the element is doubled, what happens to the voltage across the element?

4. The voltage (V) across a circuit element is proportional to the current through that element (I) and the resistance of the element (R) **(3 points)**.
- Write an equation for the voltage across a component in terms of current and resistance.
 - As the current across the element increases, how does the voltage change?
 - If the voltage is kept constant, and the resistance of the element is doubled, what happens to the current across the element?
5. The rate of heat transfer (H) through a rectangular slab of material is proportional to the temperature difference (ΔT) from end to end of the slab, the cross sectional area (A) of the slab, and the thermal conductivity of the material (k). It is inversely proportional to the length of the slab (L) that the heat must travel through **(4 points)**.
- Write the equation for the rate of heat transfer (H) through a slab of material.
 - As the length between the ends of the slab increases, how does the rate of heat transfer change?
 - If the temperature difference between the ends of the slab doubles and the cross sectional area also doubles, how does the rate of heat transfer change?
 - If the thermal conductivity of the material is halved and the temperature difference between the ends of the slab triples, how does the rate of heat transfer change?

6. Use the equation $K = \frac{1}{2}mv^2$ to first calculate the kinetic energy of objects of different speeds, all with a mass of 1 kg. Then graph Kinetic Energy (y-axis) vs. Velocity (x-axis) on graph on the left. Next, calculate v^2 by squaring each value for velocity. On the graph on the right, graph Kinetic Energy vs. v^2 . Remember to title each graph and label the axes, including units! **(10 points)**.

v (m/s)	v^2 (m ² /s ²)	Mass (kg)	K (Joules)
1.0		1.0	
2.0		1.0	
3.0		1.0	
4.0		1.0	
5.0		1.0	
6.0		1.0	

