

AP Physics Summer Assignment
Mr. Kohlman
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Due at the start of our first class meeting

If you have questions this summer, my email is: jkohlman@fredericksburgacademy.org.

Hello! I am excited to have the opportunity to teach you AP Physics this year. This course is an exploration of how the stuff that makes up our world and universe interact. It's also an exploration into how scientists solve problems, with an emphasis on using rigorous theory to make testable predictions. It's a tough class, but it's going to make you tough too! It is an important class, and I hope it's one you remember for reasons beyond the skills and content you will learn.

The summer assignment is in five sections, detailed below.

1. Bookmark our class Google Drive folder:

<https://goo.gl/5Djd7X>

You need to be signed in to an FA Google account in order to access.

2. Read *The Uncertainty of Science* by Feynman and write a one-page reflection paper.

Before writing this reflection, check that:

- You've read the full 16-page article.
- You've spent some personal time wrestling with multiple ideas you found the most interesting, challenging, or meaningful.
- You've discussed what you've read with someone else.
- You've re-read the article.
- You've mulled over your thoughts on the article a few days.

The reflection paper is your writing on the ideas you found most interesting, challenging, or meaningful after putting serious thought into what you've read. Do not worry about covering everything Feynman discusses, just pay attention to the two or three ideas that have resonated the most with you. That said, be prepared on the first day of school to discuss all the ideas presented in the article, and bring any notes you've taken so you can remember main points easily.

The reflection paper is not a summary, it is not an opinion piece, and it is not a list of ideas with which you agree or disagree. I am instead looking to see that you have understood some of the nuances of science that Feynman discusses. There may be single paragraphs or sentences you end up reading multiple times, sometimes days apart. I urge you to find someone to talk to as you wrestle with and explore this reading. Sometimes just hearing yourself speak can help solidify something, but often hearing ideas back from someone helps you recognize something new.

The paper should be single spaced. Please hand in a printed copy of your paper on the first day of class. This should take considerable time to read, reflect upon, and write.

Reading: <http://people.westminstercollege.edu/faculty/ccline/courses/hon221/feynman.pdf>

3. Complete the five math problems at the end of this document.

There are three common mathematical techniques for solving systems of equations in AP Physics: substitution, elimination, and graphing. You will be solving the first four problems three times, once for each technique. Please bring hard copies of your solutions to class. (Keep in mind a solution is your full work. An answer is the final number. I don't just want answers, I want solutions.). You may graph on your computer if you'd like, but I do need to see the actual graphs for each problem. You are welcome to email me over the summer with questions after you have read the review guide below and watched the review videos.

4. Complete the Kahn Academy introduction to Displacement, Velocity, and Time.

This includes seven short videos and three text readings. When you are finished, take the two practice quizzes (4 questions each). On our first day of class you should be able to understand and use the following terms: vector, scalar, reference frame, position, distance, distance travelled, displacement, average velocity, average speed, instantaneous speed, instantaneous velocity. There will be a quiz on the first day of class that will cover terminology and basic application. Note: You do not need to understand the concept of acceleration at this stage.

Kahn Academy Link: <https://www.khanacademy.org/science/physics/one-dimensional-motion#displacement-velocity-time>

5. Check out a few of these physics Youtube channels:

Veritasium: <https://www.youtube.com/user/1veritasium>

60 Symbols: <https://www.youtube.com/user/sixtysymbols>

Physics Girl: <https://www.youtube.com/user/physicswoman>

Minute Physics: <https://www.youtube.com/user/minutephysics>

Smarter Every Day: <https://www.youtube.com/user/destinws2>

Practical Engineering: <https://www.youtube.com/user/gradyhillhouse>

For the Allure of Physics: https://www.youtube.com/channel/UClSRiiRVQuDfgxI_QN_Fmw/featured

I'll leave it up to you to decide how many you want to watch. If you don't like one, move on to another. Be ready to share something neat you learned.

Review:

Substitution: Solve one equation for any chosen variable, and substitute (or “plug in”) this equation into the second wherever the chosen variable appears. Next, solve for the second variable and use that knowledge to solve for the first.

Solving for x and y using substitution:

$$2x - 3y = -2$$

$$4x + y = 24$$

Choosing the second equation, we will solve for y:

$$y = 24 - 4x$$

Next, we substitute the right hand expression into the first equation everywhere that y appears:

$$2x - 3(24 - 4x) = -2$$

Upon solving this expression we find $x = 5$. We then back-solve for y:

$$y = 24 - 4(5)$$

Therefore, $y = 4$

Elimination: The goal of elimination is to add the left hand sides of two equations and the right hand sides, and upon setting these equal, eliminating one of the variables. To do this one equation typically needs to have each term multiplied by some factor.

Solving for x and y using elimination:

$$2x - 3y = -2$$

$$4x + y = 24$$

We first recognize we can make the y-terms equal and opposite by multiplying each term in the second equation by 3:

$$12x + 3y = 72$$

Now we add the left sides of both equations, add the right sides of both equations, and set these equal:

$$2x - 3y + 12x + 3y = -2 + 72$$

Simplifying,

$$2x + 12x = -2 + 72$$

We then find $x = 5$ upon solving. Solving for y:

$$4(5) + y = 24$$

$$y = 4$$

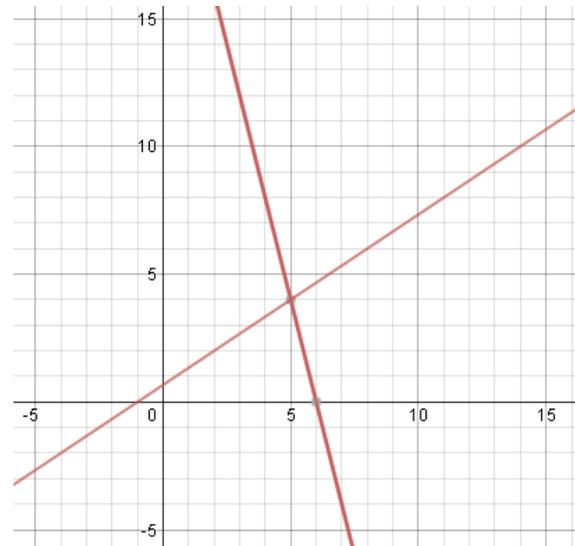
Graphing: You can use graph paper if you wish. I recommend using an online graphing calculator or spreadsheet software such as Excel or Open Office Calc. In any case, express both equations as functions, and find the point of intersection.

Solving for x and y using graphing:

$$2x - 3y = -2$$

$$4x + y = 24$$

The only point in which these two functions are equal is at $x = 5$ and $y = 4$



Optional tutorials:

Substitution method: <https://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/systems-with-substitution/v/solving-systems-by-substitution-1>

Elimination method: <https://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/solving-systems-addition-elimination/v/solving-systems-by-elimination>

Graphical Method: <https://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/systems-through-examples>

Math Problems

Problem 1. Solve the following system of equations three ways: substitution, elimination, and graphing.

$$x + 4y = 19$$

$$-x + 2y = 5$$

Problem 2. Solve the following problem three ways: substitution, elimination, and graphing.

The school that Stefan goes to is selling tickets to a choral performance. On the first day of ticket sales the school sold 5 adult tickets and 8 student tickets for a total of \$49. The school took in \$27 on the second day by selling 3 adult tickets and 4 student tickets. Find the price of an adult ticket and the price of a student ticket.

Problem 3. Solve the following problem three ways: substitution, elimination, and graphing.

A river boat traveled 24 miles downstream, then turned back and returned to its starting position. The trip downstream took 3 hours. The trip back took 6 hours. What is the speed of the river current? What would be the speed of the boat in still water?

Hint 1: When travelling downstream, the boat was aided by the river, so the total speed is a sum. When travelling upstream the boat had to fight against the river, so the total speed is a difference.

Hint 2: Speed = distance / time

Problem 4. Solve the following problem three ways: substitution, elimination, and graphing.

The senior classes at High School A and High School B planned separate trips to New York City. The senior class at High School A rented and filled 1 van and 6 buses with 372 students. High School B rented and filled 4 vans and 12 buses with 780 students. Each van and each bus carried the same number of students. How many students can a van carry? How many students can a bus carry?

Problem 5. Looking back on problem #3, suppose now that the river speed was equal to the boat speed, both 6 mph. **A.** How much time would it take to travel 24 miles downstream? **B.** How much time would it take to travel 24 miles back upstream? Explain your solutions; you do not need to solve multiple ways.

“But Mr. Kohlman, how will I know if I’m right?” If your answers agree using all three methods, then there’s a pretty good chance you got it. You can always check with another student or email me. I am happy to help you, do not hesitate! Please watch the tutorials on the review page as well.