AP Physics 1 - Summer Skills Review

Overview & Instructions

This summer assignment is an overview of some essential skills you need for AP Physics 1. The class is an algebra-based course and therefore requires a proficiency in algebra, trigonometry, and geometry. You will use these concepts frequently throughout the entire year in addition to the new material you will be learning. This assignment exercises the mathematical concepts the course most frequently uses but is not exhaustive.

The topics covered are:

- Using the metric system
- Algebraically manipulating physics formulas (no values, just variables)
- Right triangle geometry (trigonometry)

The following questions are meant to exercise each of these areas. It is assumed that you have already learned these concepts in previous classes. However, it may be that you need a review on these topics if you are struggling to reach the correct solution. Because of this, each section will begin with a list of tips/guidelines to get you started. In addition, there will be a list of online resources (including relevant videos) that will give you a more detailed overview of the problems.

This assignment needs to be completed by the first day of school: August 14 2024. On that date you will hand in your work. You will be given an opportunity to make corrections. **Please complete this assignment on paper.**

If you have any questions about completing the assignment, feel free to contact me at: burnsca@cpsboe.k12.oh.us

Section 1: Using the Metric System

One of the most important skills in physics is the ability to easily convert between units within the metric system. In general, the standard units we will use are meters, kilograms, and seconds. All other units are built from these three measurements for distance, mass, and time, respectively. However, we are often called to convert between different measurements in a process called dimensional analysis. We will do this frequently throughout the year. The videos below may prove helpful.

https://www.youtube.com/watch?v=w0nqd_HXHPQ
https://www.youtube.com/watch?v=uHaKyNplino
https://www.youtube.com/watch?v=YAY8toXKUIY

The following is a prefix table for unit conversions within the metric system. These are the prefixes that most frequently appear within our science questions. Use the AP Physics Reference Sheet to complete the table below.

Prefix	Symbol	Scientific Notation
tera	T	10^{12}
giga		
mega		
kilo		
-	-	10^{0}
deci	d	10^{-1}
centi		
milli		
micro		
nano		

Note that these prefixes do not need to be memorized. They will be provided to you on the AP Physics 1 exam formula sheet. That said, you will see them so frequently you will know them handily by May.

When using unit conversion (dimensional analysis), always remember to:

1) Set up the conversion ratio to cancel out the original unit and convert to the desired unit. This means if the unit you are converting from is in the numerator, the conversion ratio should be set up with this unit in the denominator. This will cancel out the unit you are converting. Keep doing this until you get to the units you want for your answer.
2) Always label units for each step. This will help ensure you do not make mistakes.
3) Cross out units that have been canceled out and make sure that your final answer has been correctly converted to the new unit.

EXAMPLE 1.3

Converting between Metric Units

The density of iron is $7.86\ \mathrm{g/cm^3}$ under standard conditions. Convert this to kg/m^3.

Strategy

We need to convert grams to kilograms and cubic centimeters to cubic meters. The conversion factors we need are $1\ \mathrm{kg} = 10^3\mathrm{g}$ and $1\ \mathrm{cm} = 10^{-2}\mathrm{m}$. However, we are dealing with cubic centimeters $(\mathrm{cm^3} = \mathrm{cm} \times \mathrm{cm} \times \mathrm{cm})$, so we have to use the second conversion factor three times (that is, we need to cube it). The idea is still to multiply by the conversion factors in such a way that they cancel the units we want to get rid of and introduce the units we want to keep.

Solution

$$7.86\frac{\cancel{\mathrm{g}}}{\cancel{\mathrm{cm}}^{\,3}} \times \frac{\mathrm{kg}}{10^3\,\cancel{\mathrm{g}}} \times \left(\frac{\cancel{\mathrm{cm}}}{10^{-2}\mathrm{m}}\right)^3 = \frac{7.86}{(10^3)(10^{-6})}\,\mathrm{kg/m^3} = 7.86 \times 10^3\,\mathrm{kg/m^3}$$

Significance

Remember, it's always important to check the answer.

1. Be sure to cancel the units in the unit conversion correctly. We see that the gram ("g") in the numerator in 7.86 g/cm^3 cancels the "g" in the denominator in the first conversion factor. Also, the three factors of "cm" in the denominator in 7.86 g/cm^3 cancel with the three factors of "cm" in the numerator that we get by cubing the second conversion factor.
2. Check that the units of the final answer are the desired units. The problem asked for us to convert to kilograms per cubic meter. After the cancellations just described, we see the only units we have left are "kg" in the numerator and three factors of "m" in the denominator (that is, one factor of "m" cubed, or "m^3"). Therefore, the units on the final answer are correct.

Carry out the following conversions using dimensional analysis. Show all your work!

1) Convert 28 km to cm.

2) 578 nanoseconds to seconds

3) 1700 kilometers to meters

4) 96 micrograms to grams

5) Convert 85 cm/min to m/s

6) How many seconds are in a year?

7) Convert the speed of light 3.0×10^8 m/s to km/day

Section 2: Algebraically Manipulating Physics Formulas

It often becomes handy, and in some cases essential, to rearrange equations in physics. The good news is that the AP exam will provide you with almost every equation you will need. The bad news is that sometimes you need to solve for a specific variable in that equation that requires you to rearrange the equation. Even more importantly, sometimes you will work on physics problems that do not have any values included at all and you are required to have a general sense of cause-and effect that a properly rearranged equation may convey.

Mastering this process will make your life in AP Physics *a lot* easier. Otherwise, you will frequently find you produce math errors and/or incorrect solutions. Remember this important point: variables are numbers too, so you should treat them just like numbers when rearranging equations. The same rules for addition, subtraction, multiplication, division, squaring, square rooting, etc. still apply.

Below are a couple videos on the topic:

https://www.youtube.com/watch?v=chmHzxfM3L0
https://www.youtube.com/watch?v=quD1deDkNr0

Solve the following equations for the quantity indicated.

1) $a = \frac{F}{m}$ Solve for m m=F/a

2) $m_1v_1=m_2v_2$ solve for v_2

3) $K = \frac{1}{2}mv^2$ solve for m

4) $y = \frac{1}{2}at^2$ Solve for t

5) $x = v_0 t + \frac{1}{2} a t^2$ Solve for v_o

6) $a = \frac{v_f - v_0}{t}$ Solve for v_f

7) $F = k \frac{m_1 m_2}{r^2}$ Solve for r

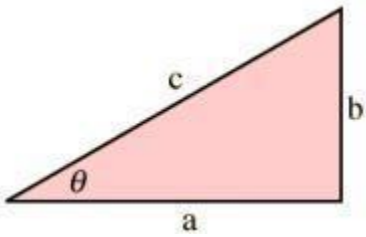
8) $F = k \frac{m_1 m_2}{r^2}$ Solve for m1

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

10) $sin\theta = \frac{a}{b}$ solve for θ

Section 3: Right Triangle Geometry (Trigonometry)

In conjunction with vectors (which we will cover in the first week of class), we will use triangle geometry extensively within the class. As such, it becomes very handy to be well-versed with your basic trigonometric relationships, including inverse functions. If you don't know SOH CAH TOA like the back of your hand, now would be a great time to reinforce that knowledge.



Below are some basic videos on the topic:

https://www.youtube.com/watch?v=Ylix5mlXNCo
https://www.youtube.com/watch?v=znR9tW4AiZI
https://www.youtube.com/watch?v=15VbdqRjTXc&t=1s

sin θ= cos θ= tan θ= $a^2+b^2=c^2$

For the triangle above, use right triangle trigonometry and the Pythagorean Theorem to solve the following problem. Make sure your calculator is in **degree** mode.

1) $\theta = 55^o$ and $c = 32$ m, solve for *a* and *b*.

2) $\theta = 45^o$ and $a = 15$ m/s, solve for *b* and *c*.

3) $b = 17.8$ m and $\theta = 65^o$, solve for *a* and *c*.

4) $a = 250$ m and $b = 180$ m , solve for θ and *c*.

5) $a = 25$ cm and $c = 32$ cm, solve for *b* and θ.

6) $b = 104$ cm and $c = 65$ cm, solve for *a* and θ.