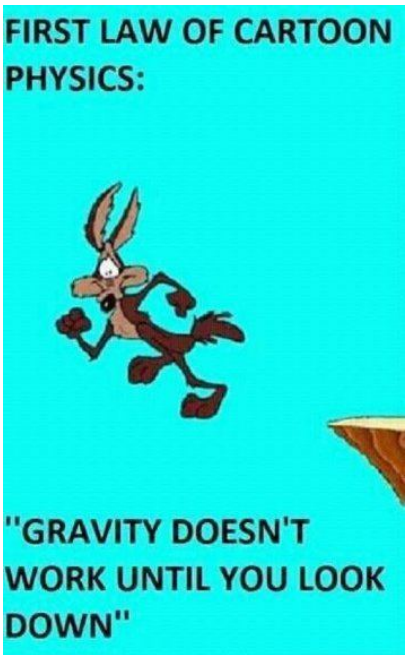
Honors Physics Summer Assignment
Miss Kachmarski



Skills Review:

- **Solving Equations**
- **Describing Relationships**
- **Dimensional Analysis**
- **Scientific Notation and Significant Figures**
- **Trigonometry**
- **Reading Graphs**

Welcome to Honors Physics! Over the summer, I am asking you to complete this packet as a math review. All of the math concepts found in this packet resemble what we will be using everyday in class. This assignment will be graded on effort as a homework assignment and is due the first day of class. Please join our Google Classroom and submit your assignment there. You will have a quiz on the material contained in this packet on the second day of class, which will count for 20 points.

I have also included a reference guide to help you with parts of the assignment. If you have any questions about the material over the course of the summer, please feel free to reach out to me. I look forward to seeing you all in the fall!

Honors Physics Summer Assignment

Directions: Answer each question below to the best of your ability. Please show your work in the space provided below each question and circle your final answers. Be sure to use units throughout your work and in final answers where necessary.

Skill 1 - Solving Equations

You will frequently need to manipulate an equation to solve for an unknown. Often the "givens" in Physics will not be numbers; rather they will be variables (letters). It is important that you know how to solve for any variable in an equation.

Example: Solve the equation for t: $v_f = v_i + at^2$

Answer: $t = \sqrt{\frac{v_f - v_i}{a}}$

Directions: Solve the following equations for the variables listed below:

1. Solve for V_2. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

2. Solve for R_{eq}. $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

3. Solve for a. $y_f = y_i + v_i t + \frac{1}{2} a t^2$

4. Solve for r. $F = k\frac{q_1 q_2}{r^2}$

5. Solve for v_i. $v_f{}^2 = v_i{}^2 + 2a\,\Delta x$

6. Solve for v_f. $Ft = mv_f + mv_i$

7. Solve for $v_{i,2}$. $m_1 v_{i,1} + m_2 v_{i,2} = \left(m_1 + m_2\right) v_f$

8. Solve for a. $v_f{}^2 = v_i{}^2 + 2a\left(x_f - x_i\right)$

9. Solve for v. $mgh = \frac{1}{2}mv^2$

10. Solve for v_f. $\frac{1}{2}mv_f{}^2 + mgh_f = \frac{1}{2}mv_i{}^2 + mgh_i$

11. Solve for t. $y_f = y_i + v_i t + \frac{1}{2}at^2$

Systems of Equations

12. How many equations are needed to solve for 1 variable?_____ 2 variables?_____ 3 variables?_____

Use the equations in each problem to solve for the specified variable in the given terms. Smplify.

13. $F_f = \mu F_N$ and $F_N = mg\cos\theta$. Solve for μ in terms of F_f, m, g, and θ.

14. $F_c = ma_c$ and $a_c = \frac{v_t^2}{r}$. Solve for r in terms of F_c, m, and v.

15. $v_f = v_i + at$ and $v_f^2 = v_i^2 + 2a(x_f - x_i)$. Solve for x_f in terms of x_i, v_f, a, and t.

Skill 2 - Describing Relationships

It is important that you understand what an equation physically means in this course. Therefore, you must be able to describe the relationships between given variables in a formula.

Example: $a_c = \frac{v_t^2}{r}$

In the above equation, a_c equals the centripetal acceleration of an object moving in a circle with radius of r and moving around a circle with a tangential velocity of v.

(a.) In the equation above, what is the relationship between centripetal acceleration (a_c) and tangential velocity (v_t)?

Answer: The centripetal acceleration of the object is directly proportional to the square of the object's tangential velocity.

(b.) In the equation above, what is the relationship between centripetal acceleration and the radius of the circular path in which the object is traveling?

Answer: The centripetal acceleration of the object is inversely proportional to the radius of the circular path in which the object is traveling.

Use the follow for questions 16-18:

In the equation below, F equals the electric force between two charges placed a distance r apart. Q_1 is the magnitude of the first charge, q_2 is the magnitude of the second charge and k is Coulomb's constant.

$$F = k\frac{q_1 q_2}{r^2}$$

16. In the equation above, what is the relationship between the electric force and Coulomb's constant?

17. In the equation above, what is the relationship between the electric force and the distance between the charges?

18. In the equation above, what is the relationship between the electric force and the magnitude of the first charge?

Variable Relationships: Use the equation to predict how one variable affects another variable.

19. In the equation, $F = \frac{Gm_1m_2}{r^2}$ if m_1 increases by a factor of 2, what will be the factor of change in F?

20. In the equation, $F = \frac{Gm_1m_2}{r^2}$ if r increases by a factor of 2, what will be the factor of change in F?

21. In the equation, $F = \frac{Gm_1m_2}{r^2}$ if r increases by a factor of 2, m_1 increases by a factor of 2, and m_2 increases by a factor of 2, what will be the factor of change in F?

Skill 3 - Dimensional Analysis

It is important that you understand how to convert from one unit to another using conversion factors. You must know metric prefixes in order to do this. I have provided reference sheets in case you have forgotten these.

Example: How many centimeters are in 0.098 kilometers?

100 cm = 1 m

1 km =1000 m

$$\frac{0.098\ km}{1} \times \frac{1000\ m}{1\ km} \times \frac{100\ cm}{1\ m} = 9800\ cm$$

22. Convert 450 km/hr to m/s.

23. Convert 60 mi/hr to m/s (1 mile = 1.609 km).

24. Convert 5 years to seconds.

25. Convert 8.99×10^9 seconds to years.

26. Convert 4008 g to kg.

27. Convert 0.77 m to cm.

28. Convert 8.8×10^{-8} m to mm.

29. Convert 25.0 μm to m.

30. Convert 2.65 mm to m.

31. Convert 8.23 m to km.

32. If a projectile travels 3.00×10^{3} feet in one second, how far will it travel in 18 minutes?

33. Sixty-two months is equivalent to how many seconds?

34. A car consumes 25.00 gallons of fuel when driving a distance of 400.0 km. How many gallons will it consume when driving 250.0 miles?

35. Light travels 186 000 miles/s. How long is a light year in meters? (1 light year is the distance light travels in one year)

Skill 4 - Scientific Notation and Significant Figures

Scientific Notation - There are things in physics that are very, very large (like the mass of a planet in kilograms, for example) or very, very small (like the mass of an electron in kilograms, for example). You must be able to recognize that a number is in scientific notation and know how to deal with it.

Directions: Compute the following. Final answers should be in scientific notation.

36. $(5.0\times10^{-8})(2.9\times10^{2})$

37. $(3.25\times10^{4}) + (7.4\times10^{3})$

38. $(4\times10^{-3})(-5\times10^{5})$

39. $(2.3\times10^{-3})/(1.0\times10^{-5})$

40. $(4\times10^{8})^{1/2}$

The following are ordinary physics problems. Place the answer in scientific notation when appropriate and simplify the Do your best to cancel units, and attempt to show the simplified units in the final answer (be sure that your calculator is in degree mode).

41. $$T_s = 2\pi \sqrt{\frac{4.5\times 10^{-2}\text{kg}}{2.0\times 10^{3}\frac{\text{kg}}{\text{s}^2}}}$$

42. $K = \frac{1}{2}\left(6.6 \times 10^{2} kg\right)\left(2.11 \times 10^{4} \frac{m}{s}\right)^{2}$

43. $1.33 \sin(25.0^{\circ}) = 1.50 \sin\theta$

Skill 5 – Trigonometry

Not everything in physics is simply straight up and down or left and right. In the real world, we need to deal with angles. This is where trigonometry and the Pythagorean Theorem come in handy. I have the basics below in case you have not done this in your math classes yet.

There are 3 trig functions that you will use on a regular basis in physics problems: **sine**, **cosine** and **tangent**.

An easy way to remember them is by using "SOH CAH TOA" Note: (See below) the opposite side is the side opposite the reference angle θ; the hypotenuse is the longest side opposite the right angle. The adjacent side is the one that makes up part of the reference angle θ and is not the hypotenuse.

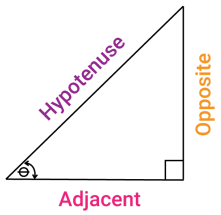
SOH-CAH-TOA

$$\text{Sine}(\theta) = \sin(\theta) = \frac{opposite}{hypotenuse} \qquad \text{Cosecant}(\theta) = \csc(\theta) = \frac{1}{\sin(\theta)} = \frac{hypotenuse}{opposite}$$

$$\text{Cosine}(\theta) = \cos(\theta) = \frac{adjacent}{hypotenuse} \qquad \text{Secant}(\theta) = \sec(\theta) = \frac{1}{\cos(\theta)} = \frac{hypotenuse}{adjacent}$$

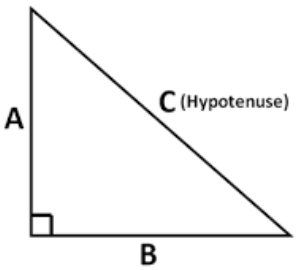
$$\text{Tangent}(\theta) = \tan(\theta) = \frac{opposite}{adjacent} \qquad \text{Cotangent}(\theta) = \cot(\theta) = \frac{1}{\tan(\theta)} = \frac{adjacent}{opposite}$$

$$\sin(\theta) = \frac{y}{r} \qquad \cos(\theta) = \frac{x}{r} \qquad \tan(\theta) = \frac{y}{x}$$



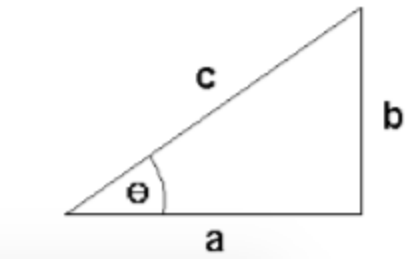
The Pythagorean Theorem is another formula that you will use frequently in physics.

Pythagorean Theorem



$$A^2 + B^2 = C^2$$

Using the generic triangle to the right, Right Triangle Trigonometry and the Pythagorean Theorem, solve the following. Use the trig table below to answer the following questions. Do not use a calculator.

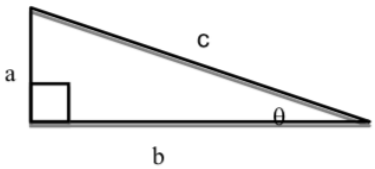


θ	0°	30°	45°	60°	90°
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined

44. θ = 60° and c = 32 m, solve for a and b.

45. b = 65 cm and c = 104 cm, solve for a and θ.

Use the figure to the right to answer the following problems. Simplify as much as you can.



46. Find c if given a and b.

47. Find c if given b and θ.

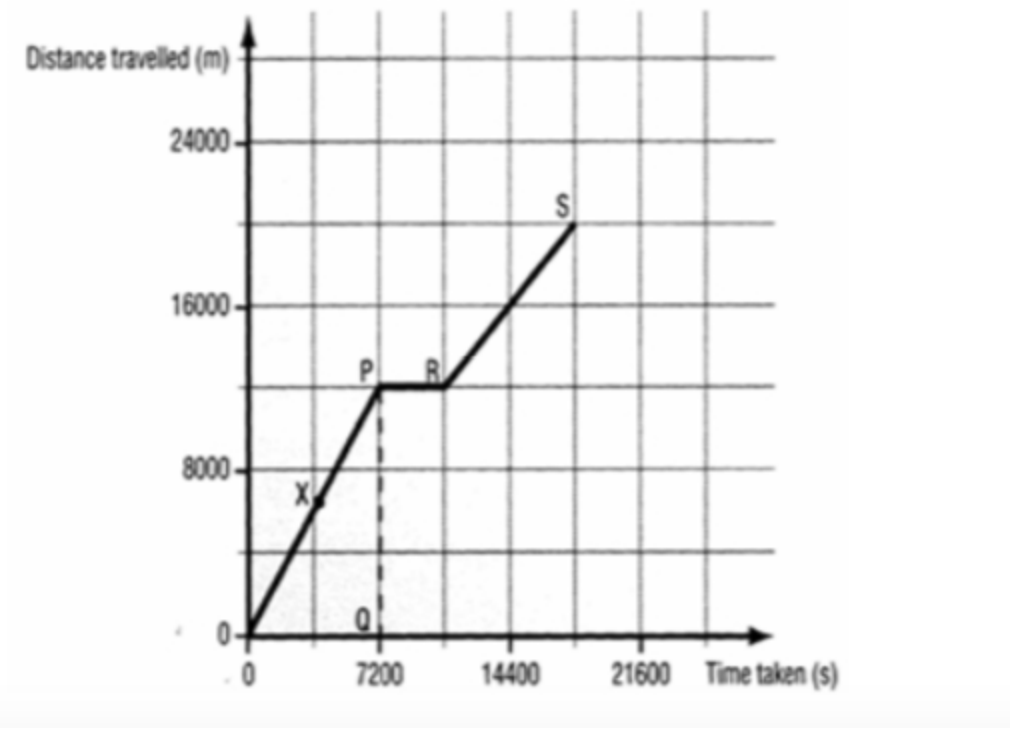
48. If a = 2.0 and c = 7.0, what is b?

49. If a = 12.0 and θ = 30°, what is b?

Skill 6 – Reading Graphs

You must be able to pull out and explain information about data from an experiment just by looking at a graph of this data. This will include recognizing relationships and trends in the data.

Graph 1: Distance a Person Walked vs. Time



Answer the following questions using the graph above.

50. At what position did the person start?

51. What was the position of the person at 2 hours?

52. What was the position of the person at 4.5 hours?

53. Approximately, at what time (in seconds) did the person reach 4,000 meters?

54. Approximately, at what time (in seconds) did the person reach 14,000 meters?

55. At what time, in seconds, did the person reach its maximum position?

56. Describe the motion of the person from point P to point R. How long (in hours) did they do this for?

57. Rank the speed of the person during the following intervals (1 = least, 3 = greatest). Explain how you determined this.
_____From X to P _____From P to R _____From R to S