IB Physics
Summer Assignment
Part One

Google Classroom Code HL: m4lnicu
Google Classroom Code SL: 2r3uv6v

Please send an email to *chris.bromley@tpsri.org* with your responses to each of the following questions by **July 31, 2024 at 11:59pm EST**. Any assignments turned in after that time will be considered late and will receive only half credit, incomplete or inaccurate work will be graded accordingly. Please enter **IB Physics 2024-2026** as the subject of your email.

1. What is your name? (see I am starting out easy)
2. Which level of IB Physics, HL or SL, are you planning on taking?
3. What are the names of your parents/guardians, and how should they be contacted if the need arises during the course of the year (provide email addresses/phone numbers)?
4. What Math courses have you completed at the high school level? Please include the year you took them and level of course (CP, honors, etc)
5. Which Science courses have you completed at the high school level? Please include the year you took them and level of course (CP, honors, etc)
6. What career path do you see for yourself? If you do not have a path in mind, what types of things interest you?

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Part B - Basic Information

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The second part of the IB Physics Summer Assignment is a set of problems based on a number of topics that you should have already covered in other courses, primarily in the subjects of Chemistry and Mathematics. Sections A through D are to be completed without a calculator, while sections E through G are to be done with the aid of a calculator. All material will be due on the first day of classes. We will not be reviewing this material in class, though worked out solutions will be posted following the first day of classes. The material will be assessed during our second class, The exact date will be announced once the exact daily schedule is finalized. Please note that the test will be entirely non-calculator. Any trigonometric problems on the assessment will be limited to the special angles (30°, 45°, 60°, 90°, etc).

The Topics in the Summer Assignment

A: Unit Conversions
B: Significant Figures
C: Scientific Notation
D: Quadratic Formula
E: Trigonometry
F: Volume/Surface Area
G: Density

A: Unit Conversions

Throughout the scientific community the metric system provides the standard units for every measurable quantity. This is a wonderful system that is based on the number 10. It is vastly superior to the English system that is used in this country. We will be doing everything in the metric system. It is important that you are able to quickly convert between different magnitudes of measurements (ex. Milligrams to decigrams) when solving problems.

Please complete each of the following conversions. Since we have not learned the different units that we will be using throughout this course, all of these problems will be based on the standard unit of length, the meter (abbreviated ‘m’)

1. 35 mm to dm
2. 204 km to hm
3. 340 nm to cm
4. 0.87 m to mm
5. 6.2 Mm to dam
6. 0.35 µm to km
7. 23.56 cm to m
8. 79.4 dm to mm
9. 23.5 nm to µm
10. 45 hm to cm
11. 0.0089 m to mm
12. 0.023km to hm
13. 12000 mm to hm
14. 0.34 µm to nm
15. 4,000,000 nm to dm
16. 4.50 m to km
17. 34.93 dam to Mm
18. 3 Gm to mm
19. 12.90 cm to mm
20. 5600 Mm to Gm

B: Significant Figures (Significant Digits)

First significant figures and significant digits are the same thing. Different authors might interchange the terms and I know that I do. The concept of significant digits is very important in the laboratory setting. They are used to show not only the value of the measurement but also the accuracy of the value. All problems done in IB Physics must contain proper significant figures. Please complete the following problems based on determining the number of significant figures and mathematical calculation involving significant figures.

Determine the number of significant figure in each of the following examples

1. 234.9
2. 303.80
3. 0.0034
4. 0.230500
5. 34000
6. 2.00×10^{3}
7. 7.02×10^{23}
8. 100
9. 12.0003
10. 0.02

Please complete the following calculations using proper significant figures

1. 3.2 + 0.34
2. 47.6 – 32.7
3. 15 * 3
4. 200 / 15
5. 30.0 * 40
6. 10.00 + 3.4
7. 100.0 + 3
8. 25.0 * 16.0
9. 200 – 49
10. $1500 / 1.0 \times 10^{1}$

C: Scientific Notation

During the course of our study of physics we will be dealing with very large quantities (the mass of the sun) and very small quantities (the wavelength of a green light). Scientific Notation is a way of writing both large and small numbers without going insane. Honestly, writing 27 zeros in a problem takes up a lot of space and bad things happen if you miss one. It is also very useful in significant figures, how can you tell if a measurement of one hundred is accurate to the tens or hundreds place? Using scientific notation can solve that problem.

Please put the following values into scientific notation.

1. 23000
2. 2
3. 3400
4. 0.00045
5. 0.0012

Please put the following values into standard form.

1. 2.3×10^{3}
2. 4.5×10^{-5}
3. 1.2×10^{6}
4. 1.0×10^{-2}
5. 9.8×10^{0}

Please complete the following problems. in scientific notation.

1. $4.5 \times 10^{-3} / 9.0 \times 10^{5}$
2. $5.0 \times 10^{2} * 7.0 \times 10^{3}$
3. $7.2 \times 10^{13} / 7.2 \times 10^{12}$
4. $2.5 \times 10^{-34} * 8.0 \times 10^{45}$
5. $4.2 \times 10^{8} / 1.4 \times 10^{-6}$
6. $2.34 \times 10^{8} + 5.23 \times 10^{7}$
7. $9.70 \times 10^{4} + 7.40 \times 10^{5}$
8. $3.8 \times 10^{-2} - 2.3 \times 10^{-3}$
9. $6.9 \times 10^{-9} + 5.6 \times 10^{-9}$
10. $7.65 \times 10^{5} – 3.2 \times 10^{4}$

D: Quadratic Formula

The Quadratic Formula is a very useful mathematical equation for solving for the roots of a second degree polynomial. Luckily many things in this world follow some form or a parabolic arc (including a penny thrown off the empire state building), so using this formula will be of great benefit.

Derive the quadratic formula form the equation $ax^2 + bx + c = 0$

Solve for the values of x, please make sure that your answer is simplified and if necessary rationalized.

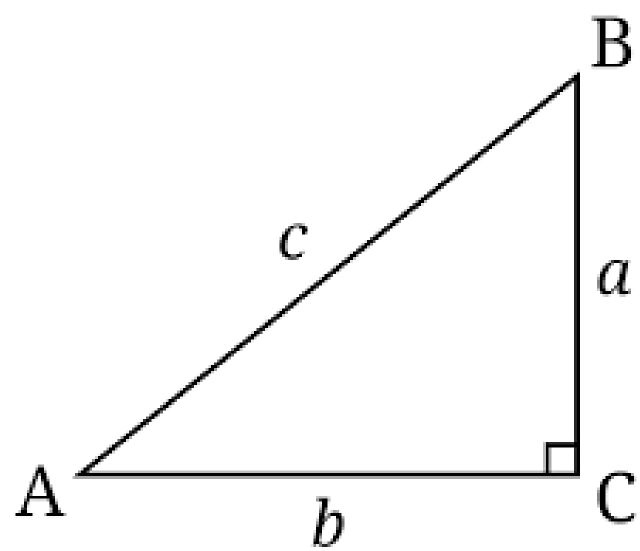
1. $-3x^2 - 4x + 16 = 0$
2. $\sqrt{5}x^2 + 2x + 1 = 0$
3. $-16x^2 + 32x + 1024 = 0$
4. $-\sqrt{3}x^2 + \sqrt{2}x + 6 = 0$
5. $21x^2 - 44x - 15 = 0$

E: Trigonometry

Most objects do not move exactly parallel to either the x or the y axis. Because of this it is often much easier to look at only the components of vectors. You will find that many of the quantities that we will encounter (velocity, acceleration, force, etc) will be vectors and will need to be separated into the x and y components. To do this we will be using the basic rules of right angle trigonometry.

Solve the following triangles
In each case the measure of C is 90°.

1. B = 30°, a = 12 m
2. A = 45°, c = 30 cm
3. B = 15°, b = 10 cm
4. A = 60°, a = 15 m



Please solve each of the following trigonometric word problems. For these problems and only these you may use a calculator; however you must still show all of your work.

1. A flagpole's shadow measures 3.2 m. From the end of the shadow to the top of the flagpole the angle of elevation is 30°. What is the height of the flagpole?

2. Your cat is trapped on a tree branch 6.5 meters above the ground. Your ladder is only 6.7 meters long. If you place the ladder's tip on the branch, what angle will your ladder make with the ground?

3. One of the tallest freestanding structures in the world is the 533-meter tall CN tower in Toronto, Ontario. Suppose that at a certain time of day it casts a shadow 1100 meters long on the ground. What is the angle of elevation of the sun at that time of day?

4. A submarine at the surface of the ocean makes an emergency dive, its path making an angle of 21° with the surface. If it goes for 300 meters along its downward path, how deep will it be? What horizontal distance is it from its starting point? How many meters must it go along its downward path to reach a depth of 1000 meters

5. The Great Pyramid of Cheops in Egypt has a square base 230 meters on each side. The faces of the pyramid make an angle of 51°50' with the horizontal. How tall is the pyramid? What is the shortest distance you would have to climb up a face to reach the top? Suppose that you decide to make a model of the pyramid by cutting four triangles out of cardboard and gluing them together. What must the angles of the triangles be? Show that the ratio of the answer for the shortest distance you would have to climb to half the length of the base is very close to the Golden Ratio, $(\sqrt{5} + 1)/2$.

F: Volume/Surface area

In Physics it is often very important to be able to calculate the volume and surface areas of the object we are studying. You will find this occurs often when we study Gravitational and Rotational motion. During this course we will be only dealing with the standard shapes, I will leave the irregular shapes to Calculus. The following problems are to refresh your memory on the equations need to find the volumes and surface areas of these shapes. You may use a calculator on this section of problems.

1. A ring is a right cylinder of radius r_1 with a cylindrical hole of radius r_2. The ring has a height of h. Find the surface area and volume if r_1 = 12 meters, r_2 = 6 meters and the height is 8 meters. Write a formula using r_1, r_2, and h, that will find the surface area and volume for any ring where $0 < r_2 < r_1$.

2. A cube with edges 1 foot long has a cylindrical hole with a diameter of 4 inches drilled through one of its faces. The hole is drilled perpendicular to the face and goes completely through to the other side. Find the surface areas and the volume of this shape.

3. A right cone with a base of radius 4 inches and a regular pyramid with a square base both have a slant height of 5 inches. Both the solids have the same surface area. Find the length of the base edge of the pyramid. Find the difference in their volumes.

4. An Elizabethan collar is used to prevent an animal form irritating a wound. The shape is a cone where the top has been removed. The larger diameter is 16 inches

and the smaller is 6 inches. The angle between the opening with the 16 inch side and the side of the collar is 53°. Find the surface area of the collar.

5. Tennis balls are stored in a cylindrical tube with a height of 8.625 inches and a radius of 1.43 inches. The circumference of a tennis ball is 8 inches, and three tennis balls are in each container. Find the volume of a single tennis ball and then find how much empty space is in a full container.

6. A snowman is made using three balls of snow with diameters 25 centimeters, 35 centimeters, and 45 centimeters. The smallest weighs about 1.2 kilograms. Find the total volume, surface area, and mass of the snowman.

G: Density

The density of a material greatly affects the physics of that material. You will see this in the sections in Gravitational and Rotational problems as well as in Vibrations and Waves. The calculation of density is done the same way as in Chemistry. Please solve the following problems; you may use your calculator on these problems. All answers should be in scientific notation and have units of kg/m^3.

1. A given material has a mass of 65.0g and a volume of 12.0 cm^3. What is this material's density?

2. A 45.0 cm^3 sample of gold (density of gold is 19.3 g/ cm^3) will have what mass?

3. Mercury is the substance found in many older thermometers. It was used because it has a density of 13.5 g/ cm^3, which is very high for a liquid. What is the volume of a 25.0g sample of this liquid?

4. A block of lead has dimension 2.00cm x 3.00 cm x 8.00 cm. If the density of lead is 11.3g/ cm^3 what is the mass of this block?

5. A slab of iron (density 7.87 g/ cm^3) has a mass of 2.34kg. What is the volume in liters of this slab?

6. A 10.0 kg sample of silver is molded into a perfect cube. What are the dimensions of the cube given silver has a density of 10.5 g/ cm^3.