

AP Physics 2

Summer Assignment (2021)

Dumont High School - Ms. Alesandro



All questions and concerns related to this assignment should be directed to **Ms. Alesandro** on or before Tuesday, June 22, 2021.

If any concerns should arise over the summer, please email **both** the teacher and the supervisor listed below:

Teacher: Ms. Alesandro – dalesandro@dumontnj.org

Supervisor of Mathematics & Science:

Ms. Warnock – dwarnock@dumontnj.org

Weight: This assignment will count as your first quiz grade.

Deductions: 10% deduction per day late

Due Date: Friday, September 10, 2021

AP Physics 2 - Formula Sheet:

<https://apcentral.collegeboard.org/pdf/physics-2-equations-sheet-2020.pdf>

AP Physics

Marking Period Grade Percentages:

A student will receive 7 credits for successfully completing course work. The following criteria are used to determine the grade for each marking period.

Tests - 50% of the grade

Tests will be given once or twice in each unit and will assess the students' knowledge and ability to apply topics from that unit. Tests will always be announced.

Quizzes - 15% of the grade

Quizzes will be given approximately twice per unit, and will usually be a take-home assignment. Quizzes will consist of 1 or 2 free response questions that challenge the students to apply content learned in class.

Labs - 15% of the grade

Labs can be formal or informal. Informal labs will consist of an in class procedure, data collection, and a brief worksheet. Formal labs will consist of an in class procedure, data collection, and a formal lab report including outlining all steps of the scientific method and an in depth analysis of data and content.

Cumulative Exam - 20% of the grade

There will be a cumulative exam given at the end of each marking period that will be cumulative up to that point in the content. Each cumulative exam will be constructed similar to the AP Exam and is intended to help prepare students for the College Board AP Exam they will take in May.

Finals and Yearly Average:

Each quarterly marking period average will count for 22.5% the the overall yearly average and the "final" will count for 10%. Since students will be taking a MP4 cumulative as well as the Collegeboard AP Exam, their "final" will consist of an independent research project that will be presented to the class at the end of June.

College Board - AP Physics Exam

This exam will be administered in early-mid May. The results of this exam will not affect your final grade in this class, but your score on this may be requested by colleges.

The AP Physics exam is a 3 hour long test consisting of

- * 90 minute multiple-choice section (50 questions)
 - 45 single select
 - 5 multi select
- * 90 minute free-response questions (5 questions)
 - 1 experimental design question
 - 1 quantitative/qualitative translation question
 - 3 short answer questions, one requiring a paragraph length Argument.

- * The MC section accounts for half your exam score, and the FRQ section accounts for the other half.

AP Physics - Units of Study:

AP Physics-1

Unit 1: Motion and Kinematics
Unit 2: Dynamics: Newton's Three Laws and Friction
Unit 3: Circular Motion and Gravitation
Unit 4: Work and Energy
Unit 5: Impulse and Momentum
Unit 6: Simple Harmonic Motion
Unit 7: Rotational Kinematics, Torque, and Angular Acceleration
Unit 8: Rotational Energy and Momentum

AP Physics-2

Unit 1: Fluid Statics & Dynamics
Unit 2: Thermodynamics
Unit 3: Electric Force, Field, and Potential
Unit 4: Electric Circuits
Unit 5: Magnetism and Electromagnetic Induction
Unit 6: Optics
Unit 7: Quantum, Atomic, and Nuclear Physics

AP Physics 2

Summer Assignment

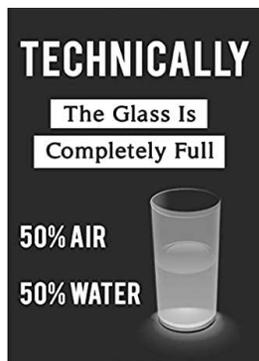
2021-2022



Since this is your second year taking physics, you already have background knowledge of kinematics, Newton's laws, and energy transformations. You also have strong math and reasoning skills, can construct an accurate free body diagram, and are an overall logical thinker.

In this summer assignment:

You will do a few **review problems** that will solidify content you already learned last year.



You will then be watching a few **videos**, conducting a **virtual experiment**, and reading a ScienceNews **article** that will introduce you to a topic in Unit 1 of AP Physics 2 - Fluids (buoyancy).

Part 1: Review Problems

Show all necessary work - either on this doc, or on separate paper and attach a picture or scan of your work.

Kinematics

- 1) A large firecracker explodes under a soda can, sending it straight upward with an initial speed of 7.27 m/s. Neglecting air resistance, find...
 - a) the can's maximum height.
 - b) the first time at which it reaches a height of 1.00 meters.
 - c) the velocity at that time.

Dynamics

- 2) A 4.2 kg object is being accelerated horizontally to the right across a rough surface by means of a rope that is angled 30° above the horizontal. The force of tension in the rope is 5.7N, and the coefficient of kinetic friction between the object and the floor is 0.21.
 - a) Free-body-diagram this object. (Include all 4 forces that act on the object and show components where necessary.)
 - b) Calculate the magnitude and the direction of the net force and the acceleration of the object.
 - c) Is this object in equilibrium? If so, why? If not, why - and what adaptation will put it in equilibrium?

Energy Transformation

- 3) A 5.00 kg mass attached to a horizontal spring oscillates back and forth in simple harmonic motion with an amplitude of 0.20 m. If the spring has a force constant of 75.0 N/m.
 - a) Explain the changes in energy as the system oscillates.
 - b) Calculate the potential energy of the system at its maximum amplitude.
 - c) Calculate the speed of the object as it passes through its equilibrium point.

Part 2: Buoyancy (videos)

Watch these videos and answer the corresponding questions.

Archimedes' Principle

<https://www.youtube.com/watch?v=ijj58xD5fDI&t=67s> (3 min)

- 1) What did the king of Sicily summon Archimedes to investigate?
- 2) What did Archimedes realize in the bathtub and explain how this was able to be used to solve the king's problem.
- 3) According to the story, was the king cheated?

Science at home - How is it possible for a heavy ship to float on water?

<https://www.youtube.com/watch?v=4tnPfnuY42I> (4 min 53 sec)

- 1) The clay ball and the clay boat had the same mass, the same volume, and therefore the same density. Explain why then the ball was completely submerged in the water and sank, but the boat stayed afloat. (note- the density of water is 1g/ml)

At home experiment - Floating and Sinking Eggs

<https://www.youtube.com/watch?v=K2ugHgIngN0> (1 min 35 sec)

- 1) What is added to the water in order to make the egg float? Why does this work?
- 2) Explain how to submerged, but not sink, an egg in water? What must you strive to do?

Part 3: Buoyancy (virtual lab)

Read the background information, do the virtual lab, and then use the information you gained from the videos and the background information to answer the following questions about your collected data.

Background information:

Archimedes' principle is the physical law of buoyancy, discovered by the ancient Greek mathematician and inventor Archimedes, that states that any body completely or partially submerged in a fluid at rest is acted upon by an **upward buoyant force**, which is **equal in magnitude** to the **weight of the fluid displaced by the body**.

The volume of displaced fluid is **equivalent to** the volume of an object fully immersed in a fluid or to that fraction of the volume below the surface for an object partially submerged in a liquid.

The buoyant force on a ***floating*** body is equivalent in magnitude to the weight of the floating object and is opposite in direction; the object neither rises nor sinks.

Example: A ship that is launched sinks into the ocean until the weight of the water it displaces is just equal to its own weight. As the ship is loaded, it sinks deeper, displacing more water, and so the magnitude of the buoyant force continuously matches the weight of the ship and its cargo.

Procedures and Data collection:

Go to this site, manipulate the simulation to gather the data needed to complete the following table, and then answer the corresponding lab questions.

<https://www.thephysicsaviary.com/Physics/Programs/Labs/ForceBuoyancy/>

Trial	Location	Bottle Mass	Fluid	Bottle Volume	Weight of bottle before submerged	Apparent weight of bottle after submerged	Submerge or Float?
1	Earth	1,000 g	Fresh Water	500 ml			
2	Earth	1,000g	Liquid Mercury	500 ml			
3	Moon	1,000g	Fresh Water	500 ml			

4	Earth	100g	Fresh water	500 ml			
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Lab Questions:

- 1) Why did the weight of the bottle appear to change as it begins to submerge in the liquid?

- 2) Compare trials 1 and 2. Explain how changing the fluid from fresh water to liquid mercury changed your results. Explain why this happened?

- 3) Compare trials 1 and 3. Explain how bringing this experiment to the moon changed your results. Explain why this happened?

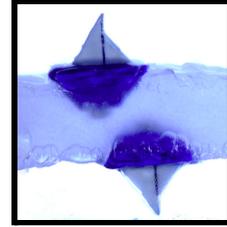
- 4) Compare trials 1 and 4. Explain how decreasing the mass of the bottle changed your results. Explain why this happened?

- 5) a) What is the magnitude of the buoyant force in each trial?
 - b) - How does the buoyant force compare to the weight of the object it is *floating*?
 - How does the buoyant force compare to the weight of the object if it *gets completely submerged*?

Part 4: Inverted Buoyancy?

How can a toy boat float up-side-down?

Read this ScienceNews article, that explains how this boat is floating up-side-down on a layer of suspended fluid.



<https://www.sciencenewsforstudents.org/article/how-physics-lets-a-toy-boat-float-upside-down>

To get a better understanding, also watch this 12 minute video that explains it in greater detail. It gets pretty technical, but it's really cool! (I like this guy's channel. You might consider subscribing to him.)

<https://www.youtube.com/watch?v=gMAKamGliMc&t=584s> (12 min 32 sec)

Now, in a few sentences, do your best to explain how and why the toy boat can float up-side-down on this suspended fluid layer.