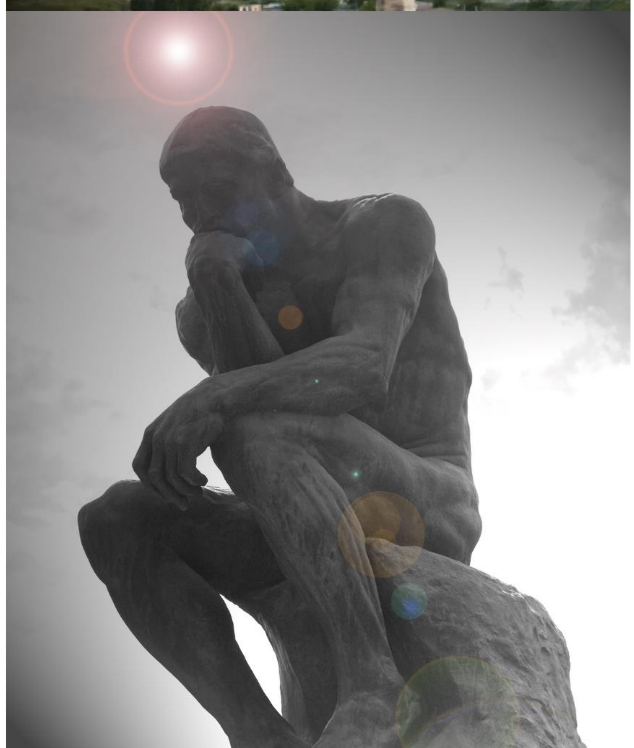
Why Things Rise or Fall



BY : AERODYNAME

CIRCA 2020 EST 2013

ABSTRACT

To the reader;

Aerodynamic is a pseudonym in order to protect my career considering that writing this paper will surely get me banned by my regulating body and I will not be allowed to practice my profession anymore.

I am qualified to speak on this subject; I am a Chemical Engineer from ABET accredited North American University. I recently was tested and certified for the fundamentals of my profession from the NCEES (National Council of Examiners for Engineering and Surveying). Disclosing anymore would put my real identity at risk and despite having recently proven my competency in an international test and at a worldwide acclaimed university, questioning the current dogma would get me banned under the current regulatory body I am registered under, regardless of whether or not I am competent.

Today "Science", claims to foster open discussion but does not tolerate questioning of its Saints such as "Saint" Isaac Newton. This is the perfect time to release this paper as we are seeing that same blind devotion in the followers of "Saint Fauci". The followers of him have complete apathy towards more qualified dissenting experts on the subject.

I will make this document as simple to understand as possible. That way the information is available to all of those smart enough to understand it and not hidden behind professional lingo (i.e. Black's Law Dictionary, etc.).

Historical context.

Why do things Fall? Like everyone else, I was told as a child that no one had properly answered that question until an apple unfortunately fell on the "brilliant" head of Sir Isaac Newton. 1642 to 1726 AC. The explanation is known all too well given that it is repeatedly told to us from an early age.

Why do things Rise? I was not academically introduced to the man who answered that question until much later in life. His name was Archimedes and he answered why things rise close to 300 years before Christ, 287BC-212BC. The Archimedes principle is an extremely essential concept for more applications that you can imagine. The applications of this concept can range from estimating the composition of metal alloys to even lighter-than-air flight.

A critical thinker should be perplexed by the fact that the answers to those *two very similar questions* are nearly 2000 years apart. History seems to be the most unreliable of sources. I always found it very difficult to believe that the answer to those *two very similar questions* is not **one** in the same. I believe that Archimedes work has been corrupted over the years, just like this work will inevitably be corrupted also. I believe Archimedes also answered the question of why things fall nearly 250 years B.C. but most his work has been lost or changed, probably during the burning of Alexandria. Regardless of whether or not he answered that question, the fact is I do in this paper. I have successfully engineered the perfect answer to why things fall and rise based largely on Archimedes' remaining works and my advanced understanding of physics, chemistry and mathematics.

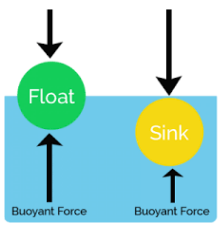
I can confidently say, that Sir Isaac Newton was so incredibly wrong on his answer to why things fall, that I can only think of one word and that is "fraud". I hope that after reading this paper you can come to the same conclusion.

Introduction

Archimedes when asked *why things rise*, he would simply answer ***"density"*** . For that is the correct answer to that question. The Archimedes principle is that which governs the motion of helium balloons, hot air balloons, submarines, etc. The principle states that the upwards force of an object immersed in a fluid is equal to that of **weight** of the fluid it displaces. Simply put, if an object is less dense that the medium is in it will rise. The force at which it will rise is mathematically expressed as the following.

$$F_{bouyancy} = \rho_{fluid} * V_{displaced} * g$$

For a fully submerged object, for example humans or any other physical object in air, the amount of volume the object displaces is equal to the volume of the object. $V_{disp}=V_{object}$. Also floating objects are partially submerged and therefore the resultant force is practically zero at floating rest.



The previous explanation has been good enough for everybody so far; kids and academics alike. This explanation of why things rise being solely based on the density of the object and the density of the medium it is in, has always been sufficient for everyone.

Yet, when asked *why things fall*, Isaac newton came up with much more elaborate answer. One that required the assumption of the mass of the earth, and the creation of a constant which conveniently cannot be measured in lab and can only be measured at the most massive of scales, the cosmic scale. Rendering the constant as purely theoretical and impossible to measure on a repeatable lab scale as science has always demanded. In a way, Isaac Newton was a pioneer in turning science into the faith-based phenomenon that it is now. Newton was the first to come up with theories that necessitated having faith in him and could not be simply tested by anybody.

It is a common misconception that Isaac Newton is credited with finding $g = 9.81\ m/s^2$. The truth is, long before the times of Newton, people knew about the fall rate of objects that is why *the constant g* is included on the formula for the Archimedes principle, which was a known concept thousands of years before Newton. Thanks to the knowledge of the fall rate of solid objects, which is easily observable, humans have been able to build infrastructure such as cathedrals, bridges, aqueducts, and other infrastructure for thousands of years. The study of static forces and dynamic forces is much older than the times of Isaac Newton. What Isaac Newton is truly credited with "discovering" is the reason as to *why things fall*. For which he came up with the most intricate and peculiar of explanations. He said that matter attracts matter but only if matter is heavy enough to be significant. Basically he said that unlike your everyday objects, the earth is the only object big enough within our range to affect us in any noticeable matter. He invented, fabricated, and imagined the following equation and constant, in much the same manner that J.K. Rowling dreamt up the wizarding world of Harry Potter.

$$F = G\frac{m_1 m_2}{r^2}$$

He quite literally manufactured the G constant= $6.67\text{x}10^{-11}m^3/(kg*s^2)$, and assumed the mass of the earth which still today not proven, in order to get *$g=9.81m/s^2=G*m_{earth}/r^2$, where ,r =radii of the earth.*

This sort of "science" can only be compared to that of science fiction and fantasy writers.

<u>My Response & Statement</u>

The truth is the only factor which governs the *vertical motion of matter* is ***density.***

Both Newton and Archimedes think of mass wrong and not at all as it truly behaves in nature. We have often been taught to think of density, ρ, as mass over volume. Although this is mathematically correct, the proper way to express the relationship between density, volume and mass is the following:

$$m = \rho \int dV$$

Expressing mass in this way the truth becomes clearer, that mass is a variable dependent on volume of object, the true constant in an element or compound is ***density***. In other words, if we were observing and plotting the mass of a $1m^3$ sphere, we would integrate its density over its volume and plot the mass as we go from the center of the sphere which is at 0% volume integration, to the outer shell of the sphere which is at 100% volume integration. *Mass* would be on the left axis (y-axis) and *Volume* on the right axis (x-axis), both would change but the density of the object will be the slope of the curve and will remain constant, if the sphere is made out of a uniform material.

For example, assuming a $1m^3$ water sphere it would look a bit like the following graph (**fig.1A**). The slope would equal the density, which is the only thing that truly remains constant.

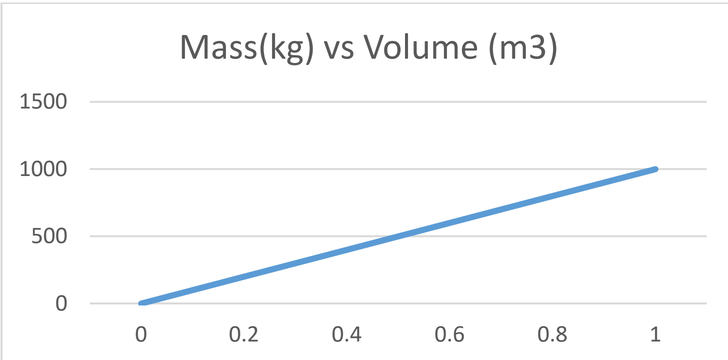


Figure 1A. MASSvsVOLUME $1m^3$ H_2O Sphere

Understanding the statement above is crucial to fully understand how matter behaves. Manly because how matter behaves in a vertical direction is solely dictated by the density value of the object and the density value of medium it is in, nothing else. Density is the only value constant in every element or stable chemical compound, meaning under the same conditions, a single hydrogen molecule (H_2) has the *same density* as a balloon holding a million hydrogen molecules, but they **do not** have the same mass nor volume, yet they both rise in air.

The LAW of MATTER.

*If the object is <u>denser than the medium</u> it is in, it will **<u>fall.</u>***

*If the object is <u>less dense than the medium</u> it is in, it will **<u>rise.</u>***

In this paper I will prove without room for doubt that what we think as the "force of gravity" and "Buoyancy Force" are actually *one single force*. A "*density force*" (my name) is the name of the force that determines and dictates the vertical motion of any physical object (matter) at free fall. This force governs the vertical interaction between different forms of matter (i.e. Immiscible fluids) and the direction of the force is solely dictated by the difference in density between the object and the surrounding fluid (medium).

The Resultant vertical force of an object at free fall; is what I call The ***FORCE OF DENSITY*** and it is written as such.

$$\overrightarrow{F_R} = \overrightarrow{F_\rho} = V_o * g * (\rho_m - \rho_o) \qquad \text{Equation 1}$$

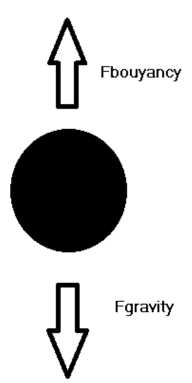
Where V_o= volume of the object; g = 9.81 m/s^2; $\rho_m = \text{density of medium};\ and\ \rho_o = \text{density of object}$.

Equation 1 is not only mathematically true and applicable to real life but also the direction is self-determinant. If the density value of the object is *greater than* the density value of the medium is in, the term inside the brackets will be *negative,* and if the density value of the object is *lesser than* the density value of the medium is in, the term inside the bracket will be *positive*. If the difference between the densities is *negative* then the value of the resultant force will be a *negative* term, indicating the direction of the force is *downwards.* This is consistent with real life observations such as stone in either air or water; where the stone density would be heavier than the medium and thus it *falls*. If the difference between the densities is *positive*, then the resultant force will also be *positive,* indicating the direction of the force is *upwards.* This is also consistent with real life observation such as a helium balloon in either air or water; where the helium balloon is much lighter than air (Mostly N_2) and thus it *rises.*

Therefore, using this formula is not just the proper mathematical description of the vertical force experienced by matter but it is also a more convenient method than the traditional method which unnecessarily separates **The FORCE Of DENSITY** into two forces, Force of Buoyancy and Force of Gravity.

Equation 1 is just as accurate as the traditional method because it is mathematically equivalent to the traditional method but simplified, and displayed in the matter in which it should be displayed. The following is the mathematical **proof** of their **equivalency**.

The traditional method equation for an object on free fall is the following:



Assuming up is positive and down is negative. & F_R=Resultant Force

$$\overrightarrow{F_R} = \overrightarrow{-F_g} + \overrightarrow{F_B}$$

$$\overrightarrow{F_R} = -mg + V_{displaced} * \rho_m * g$$

But we know that the volume displaced for a fully immersed object is $V_{displaced}=V_{object}$, similarly we also know it to be true that the mass of the object is equal to :

$\boldsymbol{m_{object}} = \boldsymbol{\rho \int dV = \rho * V_{object}}$ **;** Therefore we substitute into the equation and we get:

$$\overrightarrow{F_R} = -\rho_{object} * V_{object} * g + V_{object} * \rho_m * g$$

Which by grouping like terms equals **Equation 1**

$$\overrightarrow{F_R} = \overrightarrow{F_\rho} = V_o * g * (\rho_m - \rho_o)$$

Similarly, **Equation 1** can be simplified further to obtain only the acceleration of the observed object, and this is how it is obtained.

$$\overrightarrow{F_R} = \overrightarrow{F_\rho} = V_o * g * (\rho_m - \rho_o)$$

$$\overrightarrow{F_R} = m * \overleftarrow{a}_{object} = V_o * g * (\rho_m - \rho_o)$$

$$\overrightarrow{F_R} = V_o * \rho_o * \overleftarrow{a}_{object} = V_o * g * (\rho_m - \rho_o)$$

$$\overleftarrow{a}_{object} = \frac{V_o * g * (\rho_m - \rho_o)}{V_o * \rho_o}$$

$$\overleftarrow{a}_{object} = g * \frac{(\rho_m - \rho_o)}{\rho_o} \qquad \textbf{EQ 2}$$

This is equation will be called **EQ 2** and it is **instrumental** in the experiments needed to prove that the *constant g* is indeed the *constant fall rate of matter in empty space* and not the constant acceleration due to the gravitational pull of the earth as Isaac Newton claimed.

EQ 2 shows that the rate and direction at which a material either rises or falls is solely **depended** on a difference between the density of the medium and the density of the object. Therefore answering the question asked on the title page. According to **EQ 2,** the rate at which a material rises or falls is **independent** its volume or amount of the material (mass). Meaning that helium rises at certain rate in water and another in air whether it is a single helium atom or whether it is a millions of helium atoms occupying the shape of a balloon. In other words, matter rises or falls by virtue of their own innate physical properties and not because of dimensions such as volume, radius or overall mass like Newton proposed.

A simple plug in experiment into **EQ 2** shows that it is true for all observable phenomena such as air balloon in air, helium balloon in air, rocks in air, lead in water, etc. It also explains why feathers and exhaled air balloons do not fall as quickly as a stone, given they are much closer in density to the air than a stone. A stone , since it is far denser than air , it falls at such a rate as to nearly render the density of the medium(air) *negligible* and thus a stone falls at a rate relatively close to g=9.81 m/s^2 . On the other hand, an exhaled air balloon, given that it is mostly Air with a higher CO_2 content, falls slowly in air because it is only a little bit denser as a whole than the air around it.

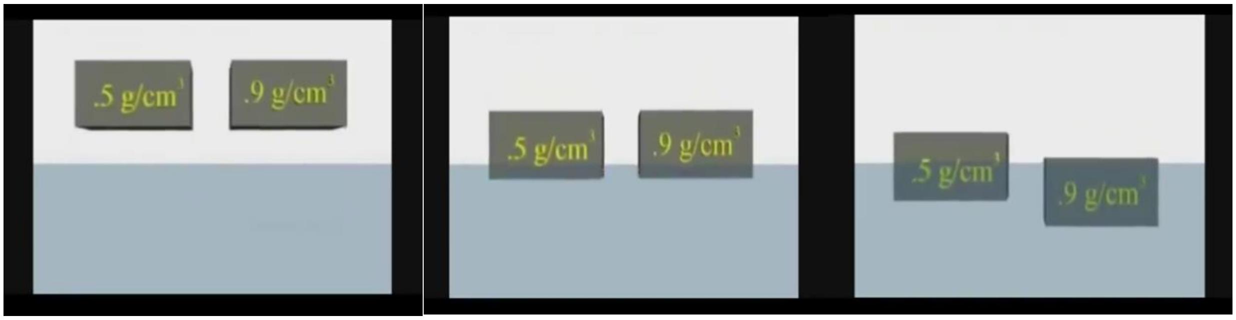
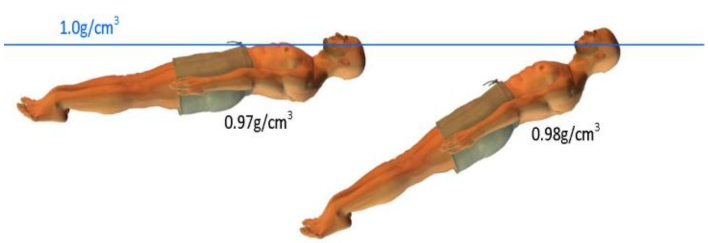
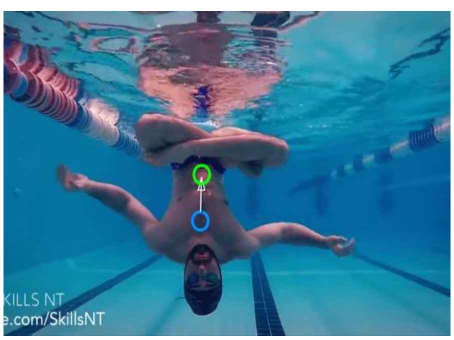


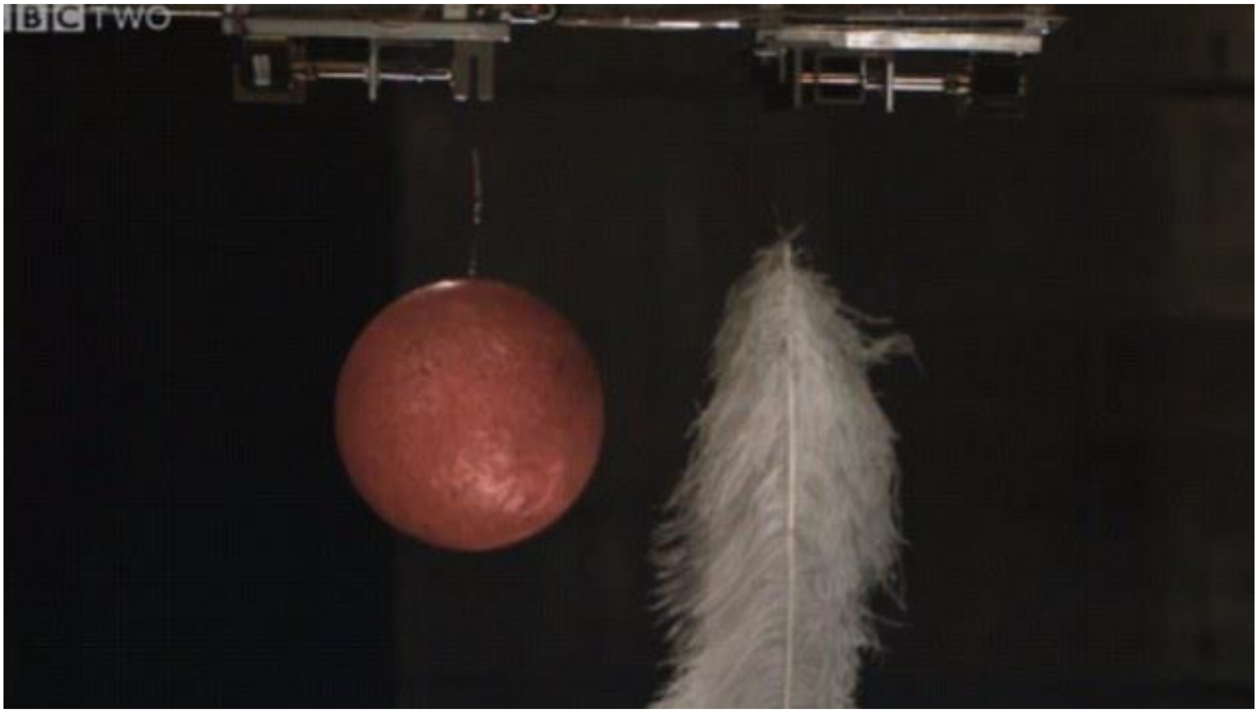
Fig 1B. Fall of two different density blocks from air to water (1g/cm^3)





Humans are very close in density to water, thus they make a great example of my principle. Most humans sink relatively slow in water, but some babies and people with relatively high body fat ratios can float with relative ease. There are also floating techniques that can help a human float in water. The material humans are made out of sinks slowly in water and the center of mass for that material is at the belly button, which is where we experience the sinking. However, when we take lots of air into our lungs, our lungs change density and become less dense than the water and thus start pulling us up. There are floating techniques that help us align the pull from out belly button with the pull of our lungs and help us float. Other techniques help us float by group the pulls close together and using a slight kicking motion to keep our legs afloat. Similarly, you may have noticed that if we take in a lot of air into our lungs, descending becomes very difficult but if we purposely exhaled all the air in our lungs we start to descend quite rapidly.

<u>The Brian Cox Experiment – The Vacuum Experiment</u>



The most misunderstood yet most important experiment on the subject is the Brian Cox Experiment . It is an experiment for which I will provide the link , and where he drops a bowling ball and a feather from the same height and records it using a high-speed camera (slow motion capture).As repeatable observed phenomena shows, in air, the bowling ball falls much faster than the feather, but in a vacuum as demonstrated by the experiment they fall at the same rate.

The biggest fallacy of the experiment is the assumptions that Brian Cox makes, he believes that this experiment proves gravity because since the air is removed and the medium is now a vacuum (empty space), thus there is no resistance from the medium and thus no buoyancy force and the only observable force left should be gravity and thus they both fall at the same rate.

But ⋯ and a big But if you notice my formulas can precisely and mathematically explain without failure the observable phenomena in the vacuum.

Because in a *Vacuum*, the medium is *nothing*, the medium is *empty space*, and *the density of empty space is 0.* Then think of matter as *occupied space.*

If we plug in a density of 0 for the medium into Equation **EQ 2**. The equation becomes the following mathematical limit question:

$$\lim_{\rho_m \to 0} \overleftarrow{a}_{object} = g * \frac{(0 - \rho_o)}{\rho_o}$$

$$\lim_{\rho_m \to 0} \overleftarrow{a}_{object} = g * \frac{-\rho_o}{\rho_o} = -g = -9.81\ \frac{m}{s^2}$$

Therefore density cancels out and; $\overleftarrow{a}_{object} = -g = -9.81\ \frac{m}{s^2}$

This means that according to the math of the equation **EQ 2** all matter falls at the *constant acceleration g* in *empty space* regardless of the object' s density. The limit evaluations shows us that as the density of the medium approaches Zero (in a vacuum) then the observed object' s rate of fall approaches *g=9.81 m/s²*.

Therefore, since both the feather and the bowling ball are ***infinitely denser*** than empty space, which has a density of 0, then they both fall at the *constant fall rate of matter in empty space.*

Matter is infinitely denser than empty space.

Therefore, the Vacuum experiment is **proving** without a doubt that *g=9.81 m/s² is the constant fall rate of matter in empty space* as proven by the equal fall rate of a feather and bowling ball in empty space.

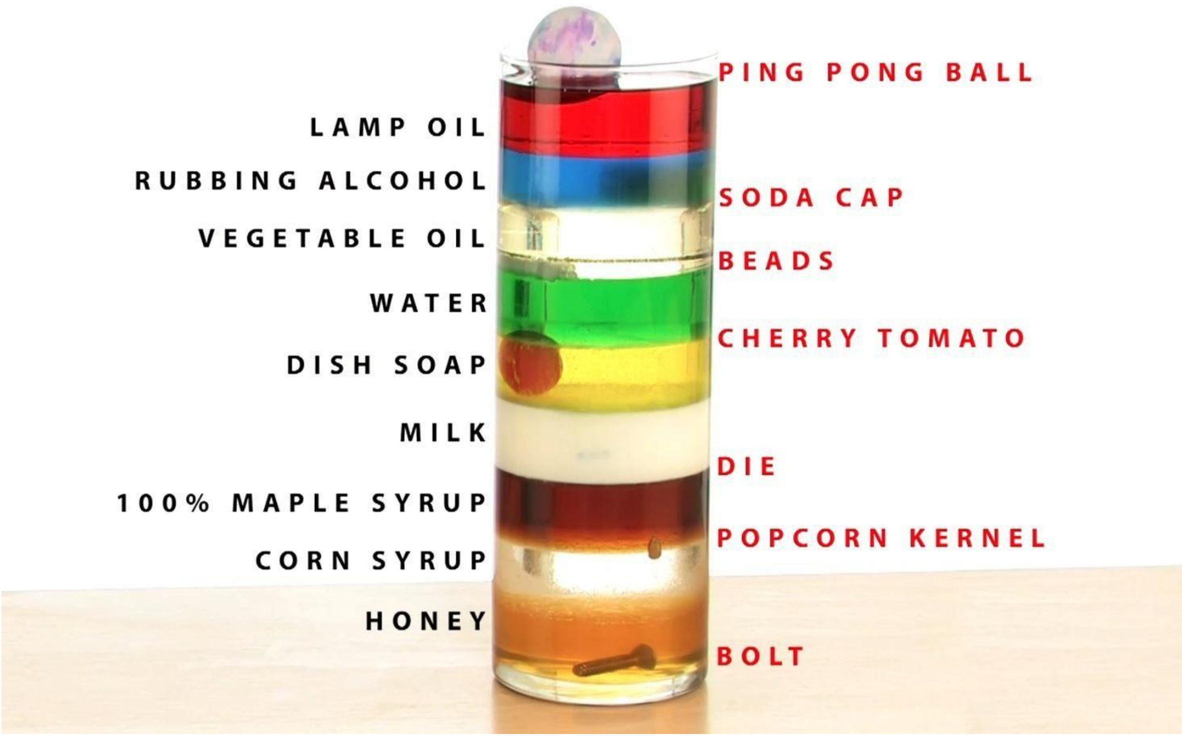
There are two ways to obtain the value of *the constant g* according to **EQ 2.** One is using multiple runs of an object or various objects which densities are known, and observing and recording their fall rate or rising rate in different mediums which densities are also known. In the experiment, the observed acceleration and direction must be recorded and by plugging the observed acceleration into a y-axis and the densities into the x-axis, then simple data analysis can be used to obtain *the constant g*, which would be the only value constant throughout all the experiments with different densities. The other way to obtain *the constant g*, is the Brian Cox' s Vacuum experiment, given that by making the medium in the experiment *empty space*, then *the constant g* becomes the *observed acceleration*.

Thank you Brian Cox, I would have never secured the funds for such an experiment, but I have your blessed naïve ignorance to thank for proving my equations to be *mathematically true* with your experiment**.**

Conclusion

Here is where I ask the reader to reconsider their previous beliefs. I do not know why something so simple has been purposely hidden in plain sight for all these years but the fact remains that it has.

The world we live in has rules and the rule that determines whether an object falls or rises , **it is not** the size of the earth or how much it weighs , **it is** clearly the *density* of the object and the *density* of the medium it is in, nothing more .



I sometimes wonder if the apple had not fallen on Newton' s head and instead had fallen in a bucket of water; if he would have then figured out the reason why the apple *truly fell* and then never would have come up with such an absurd theory such as the theory of gravity. Maybe he would have wondered how the apple' s gravity was magically turned off as soon as it hit the water, given that apples float and all, maybe then he would have noticed that what made the apple fall was not "gravity" but the *density differential* between the air and the apple, nothing else.

"In an insane world, a sane man must appear insane."

APPENDIX A – ADVANCED EXAMPLE

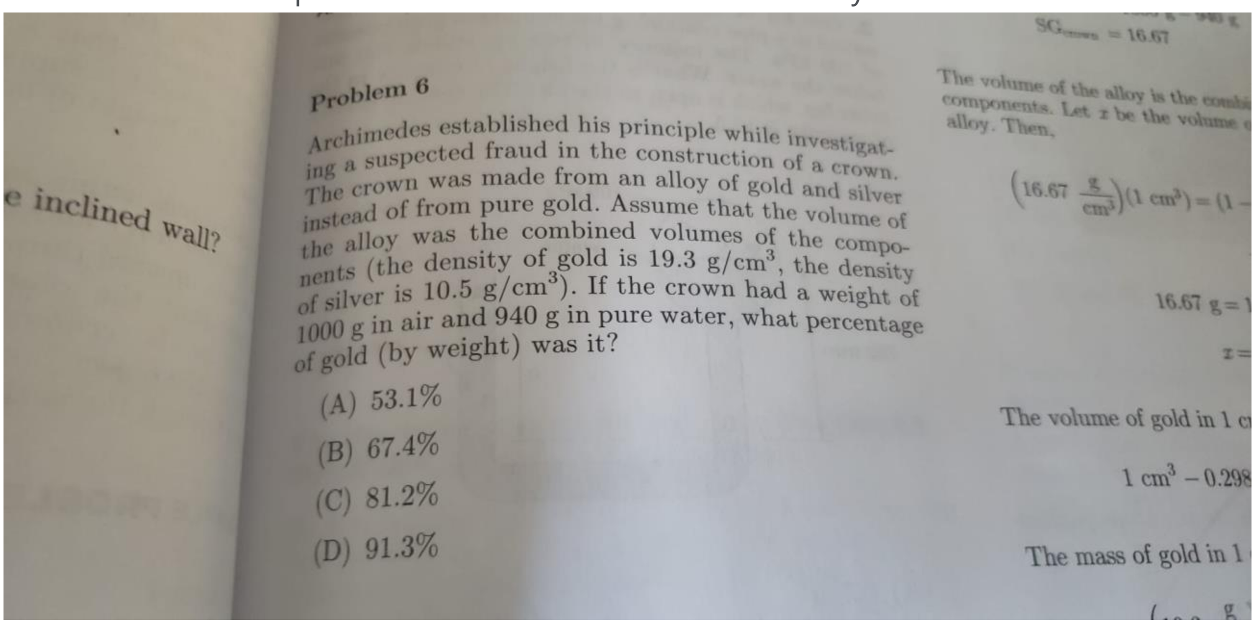
Extra for keen readers

Archimedes crown –Advanced example

Whoever reads this far deserves to know the story of *Archimedes crown* and for those who do know the story and made it this far deserve the mathematical application of the equations in such an example and compared to traditional engineering methods of tackling the *Archimedes ' crown* example.

The story says that Archimedes was asked by the king to figure out if a crown he had made had as much gold content as he had asked from the jeweler. However, the king did not want to smelt the crown down to find out. So he asked Archimedes to figure out a way to tell the fraction of gold in the crown without smelting it down or destroying it.

The following is an example from *Fundamentals of Engineering Review Manual 3rd Edition.* It is an example based on the same Archimedes story.



e inclined wall?

Problem 6

Archimedes established his principle while investigating a suspected fraud in the construction of a crown. The crown was made from an alloy of gold and silver instead of from pure gold. Assume that the volume of the alloy was the combined volumes of the components (the density of gold is 19.3 g/cm^3, the density of silver is 10.5 g/cm^3). If the crown had a weight of 1000 g in air and 940 g in pure water, what percentage of gold (by weight) was it?

(A) 53.1%

(B) 67.4%

(C) 81.2%

(D) 91.3%

$SG_{crown} = 16.67$

The volume of the alloy is the combi… components. Let x be the volume o… alloy. Then,

$\left(16.67\ \frac{g}{cm^3}\right)(1\ cm^3) = (1 -$ …

16.67 g = 1…

The volume of gold in 1 c…

1 cm^3 − 0.298…

The mass of gold in 1 …

The traditional method and the method put forth by this book as a solution is far less practical and also unnecessarily complicated compared to the method I put forth in the previous pages. Furthermore, the book expects you to assume the density of the air is negligible but it should not since taking the air density into account actually has a small but noticeable change in the answer. In my opinion the book asks you to assume the air density is negligible because their unnecessarily complicated method would be even more complicated if one attempted to be accurate. However , with the method proposed by *Aerodynamic(me)* the air density is actually quite easy to add to the calculations and thus much quicker and accurate. I suspect that

Archimedes, during his time, used my method or a close variation of it, as it is far more intuitive and easy to use than the method proposed by modern academia. However, if he did use *my method,* it would mean it is *his method.*

SOLUTION (MY METHOD)

This 1st attempt we must assume density of air is negligible and replaced by 0 because the book asks us to, and we must in order to get an answer that fits the multiple choices.

$$\overrightarrow{F_R} = \overrightarrow{F_\rho} = V_{crown} * g * (\rho_{medium} - \rho_{crown})$$

$V_{crown} * g * (\rho_{air} - \rho_{crown}) = 1000g$ **(1)**

$V_{crown} * g * (\rho_{water} - \rho_{crown}) = 940g$ **(2)**

Using linear algebra and assuming $\rho_{air} = 0$ like the book wants us to do. We get the following:

$$\frac{-\rho_{crown}}{(\rho_{water} - \rho_{crown})} = \frac{1000}{940}$$

$$-940 * \rho_{crown} = 1000 * \rho_{water} - 1000 * \rho_{crown}$$

$$60 * \rho_{crown} = 1000 * \rho_{water}$$

$$\rho_{crown} = \frac{100}{6} * \rho_{water}$$

$\rho_{crown} = \frac{100}{6}\rho_{water}$. **Since the** $\rho_{water} = 1\frac{g}{cm^3}$

Then…

$$\rho_{crown} = \frac{100}{6}\rho_{water} = 16.67\ \frac{g}{cm^3}$$

Since the question ask for the mass fraction of gold and we know the density of the crown.
Then if we express the volume fraction of gold as **x cm³** then, then the volume fraction of silver would be **(1-x) cm³** for every **1 cm³ of crown**. Then every 1 cm³ of crown weighs the following expressed in volume fraction of gold.

$$16.67\ \frac{g}{cm^3}(1\ cm^3) = x\ cm^3\left(19.3\ \frac{g}{cm^3}\right) + (1cm^3 - x\ cm^3)\left(10.5\frac{g}{cm^3}\right)$$

$$16.67\ = 19.3x - 10.5x + 10.5$$

$$6.17 = 8.8x$$

$$x = 0.7011\ cm^3\ of\ gold\ per\ 1\ cm^3\ of\ crown$$

However the question asks for the mass fraction of gold we must do the following

$$\boldsymbol{m_{gold}} = \mathbf{19.3}\frac{\boldsymbol{g}}{\boldsymbol{cm^3}} * (\mathbf{0.7011}\ \boldsymbol{cm^3}) = \mathbf{13.53123}\ \boldsymbol{g} \approx \mathbf{13.53}\ \boldsymbol{g}$$

And we know 1 cm^3 of crown weighs $\boldsymbol{m_{crown}} = \mathbf{16.67}\frac{\boldsymbol{g}}{\boldsymbol{cm^3}} * (\mathbf{1}\ \boldsymbol{cm^3}) = \mathbf{16.67}\ \boldsymbol{g}$

Therefore the mass fraction of gold in the crown is

$$\boldsymbol{x_{gold}} = \frac{\boldsymbol{m_{gold}}}{\boldsymbol{m_{crown}}} = \frac{\mathbf{13.53}\ \boldsymbol{g}}{\mathbf{16.67}\ \boldsymbol{g}} = \mathbf{.8117} \approx \mathbf{81.2\%}$$

The answer is ***C.***

SOLUTION (TRADITIONAL METHOD)

At one point the book refers to the term “Specific gravity” and it can be solved expressed as *SG.* What I found curios was that this term even though called specific “gravity” it was mathematically expressed as *ratio of densities* and it was expressed this way in the book:

$$SG_{crown} = \frac{\rho_{crown}}{\rho_{water}} = \frac{100}{6} = 16.67$$

Kind of hits you in the face ⋯ and lends even more credence to my theory.

On another part the book refers to ρ_{crown} like the “*density of the crown in air*”. Which is curious because the density of the crown is independent of the medium surrounding it. The book says that, in order to assume the density of the air is negligible by basically saying the *weight* of the crown in air is equal to *weight* of the crown in empty space⋯ but the problem statement itself acknowledges that the *weight measured by scale* is different depending on the *medium surrounding it*. The book is obviously doing this because taking the air density into account would be even more unnecessarily complicated than it already is. Using the book’s method , adding the air density into the equations would be very hard and not as easily simplified as the book did at times. However, with my method the air density or the density of any other medium can be easily taken into account without any complication.

The reader can make their own conclusions.

The following pictures are the way the book does it**:**

Solution

Archimedes' principle states that the buoyant force on a submerged object is equal to the weight of the displaced fluid. If V is the volume of the crown and ρ_{crown} is its average density in air, then

$$F_b = \rho_{\text{water}} g V$$

The weight of the crown in air is

$$W = \rho_{\text{crown}} g V$$

The ratio of W to F_b gives the specific gravity of the crown, SG_{crown}.

$$\frac{W}{F_b} = \frac{\rho_{\text{crown}}}{\rho_{\text{water}}} = \text{SG}_{\text{crown}}$$

The buoyant force is also the difference between the weight in air and the weight in water (assuming the buoyant force in air to be negligible). If W' is the weight in water, then

$$F_b = W - W'$$

Notice how the book says the density of the crown in air, as if the density of the crown depends on the medium is in⋯?

But,

$$\frac{W}{F_b} = \frac{W}{W - W'} = \mathrm{SG_{crown}}$$

$$\frac{W}{W - W'} = \frac{mg}{mg - m'g} = \frac{m}{m - m'}$$

$$= \frac{1000\ \mathrm{g}}{1000\ \mathrm{g} - 940\ \mathrm{g}}$$

$$\mathrm{SG_{crown}} = 16.67$$

The volume of the alloy is the combined volumes of the components. Let x be the volume of silver in 1 $\mathrm{cm^3}$ of alloy. Then,

$$\left(16.67\ \frac{\mathrm{g}}{\mathrm{cm^3}}\right)(1\ \mathrm{cm^3}) = (1 - x)\left(19.3\ \frac{\mathrm{g}}{\mathrm{cm^3}}\right) + x\left(10.5\ \frac{\mathrm{g}}{\mathrm{cm^3}}\right)$$

$$16.67\ \mathrm{g} = 19.3\ \mathrm{g} - \left(8.8\ \frac{\mathrm{g}}{\mathrm{cm^3}}\right)x$$

$$x = 0.2989\ \mathrm{cm^3}$$

The volume of gold in 1 $\mathrm{cm^3}$ is

$$1\ \mathrm{cm^3} - 0.2989\ \mathrm{cm^3} = 0.7011\ \mathrm{cm^3}$$

The mass of gold in 1 $\mathrm{cm^3}$ is

$$\left(19.3\ \frac{\mathrm{g}}{\mathrm{cm^3}}\right)(0.7011\ \mathrm{cm^3}) = 13.53\ \mathrm{g}$$

The mass of alloy in 1 $\mathrm{cm^3}$ is 16.67 g.

The percentage of gold in the crown is

$$\frac{13.53\ \mathrm{g}}{16.67\ \mathrm{g}} = 0.812 \quad (81.2\%)$$

Answer is C.

You can make up your mind as to which method you find more efficient or intuitive, but in my experience, mine is much faster and can actually be accurate.

Lastly, I have attached the real solution with air density taken into account and how you would do the same experiment with any other medium or an object closer in density to air for which air density cannot be ignored easily like the book wants you to do.

True Solution (Air density taken into account)

I will now show you what the real answer to that question is if we do not ignore the density of air as we are so often told to do. This way hopefully the reader understand how much easier is to actually account for the density of air with my method compared to how much more difficult it would be to include the density of the air into the method proposed by the book.

$$V_{crown} * g * (\rho_{air} - \rho_{crown}) = 1000g \qquad (1)$$

$$V_{crown} * g * (\rho_{water} - \rho_{crown}) = 940g \qquad (2)$$

Using linear algebra and knowing $\rho_{air} = 1.1515 \frac{g}{cm^3}$ We get the following

$$\frac{\rho_{air} - \rho_{crown}}{(\rho_{water} - \rho_{crown})} = \frac{1000}{940}$$

$$940 * \rho_{air} - 940 * \rho_{crown} = 1000 * \rho_{water} - 1000 * \rho_{crown}$$

$$60 * \rho_{crown} = 1000 * \rho_{water} - 940 * \rho_{air}$$

$$60 * \rho_{crown} = 1000 \frac{g}{cm^3} - 940 * 0.001225 \frac{g}{cm^3}$$

$$60\rho_{crown} = 1000 \frac{g}{cm^3} - 1.1515 \frac{g}{cm^3}$$

$$\rho_{crown} = \frac{998.85}{60} = 16.647 \frac{g}{cm^3} \approx 16.65\ g/cm^3$$

$$16.65 \frac{g}{cm^3}(1\ cm^3) = x\ cm^3 \left(19.3 \frac{g}{cm^3}\right) + (1cm^3 - x\ cm^3)\left(10.5 \frac{g}{cm^3}\right)$$

$$16.65 = 19.3x - 10.5x + 10.5$$

$$6.15 = 8.8x$$

$$x = 0.6989\ cm^3\ of\ gold\ in\ 1\ cm^3\ of\ crown$$

$$m_{gold} = 19.3 \frac{g}{cm^3} * (0.6989\ cm^3) = 13.488\ g \approx 13.49\ g$$

And we know 1 cm^3 of crown weighs $\boldsymbol{m_{crown}} = \mathbf{16.65}\,\frac{g}{cm^3} * (\mathbf{1}\ \boldsymbol{cm^3}) = \mathbf{16.65}\ \boldsymbol{g}$

Therefore, the mass fraction of gold in the crown is

$$x_{gold} = \frac{m_{gold}}{m_{crown}} = \frac{\mathbf{13.49}\ g}{\mathbf{16.65}\ g} = .\mathbf{8100} \approx \mathbf{81.0}\%$$

This would be the actual weight percent of gold in the crown.