Dynamics physics equations

Dynamics is the name it gives to traffic rules. It's something you'd think would be one of the first things that needs to be understood, but it hasn't been completely locked up until very recently. This is said that the rules have not changed much and are relatively predictable, at least on a large scale. Someone once told me that all you need to know about the Dynamics exam is: and everything else can be derived from it. I never knew if they were right, I also learned these, just in case: If you're already familiar with the equations, you might want to move on to the next section, otherwise I'll explain where they come from and how to use them. When dealing with measurements, you can use scalar or vector quantities. Scalar quantities: They only have a dimension. Energy, length, mass, speed, temperature and time are all scaly quantities. Vector quantities: Have both size and direction Displacement, Force, Speed, Acceleration and Instant Speed are all vector quantities. Sometimes it may seem that speed and speed are the same thing (often equal to each other), but they are actually a little different. Speed is how fast something happens, it doesn't matter if it moves up, down, left or right, all that matters is how far it travels at a certain time. Probably the best way to think about speed is if you think or ordinary x, u-axis. If the body moves horizontally in a straight line at a speed of 10, then it stops and goes in the exact opposite direction, at a speed of 10 apparently there has been a change, but the speed does not reflect this. The speed before it turns is the same as after. However, the speed is not the same. If we say that the speed at which to start is the same as the speed: 10 , then when the body moves exactly in the opposite direction, at the same speed, the speed will be -10 . Isaac Newton was smart. We should thank him for gravity (I should probably add that he discovered, did not invent, otherwise people will start blaming him every time they fall). The things Newton is best known for (apart from the apple incident) are his laws of movement: a particle will remain at rest or continue with its movement unless it is acted on with external force. The force on an object is equal to its mass multiplied by its acceleration (). Each action has an equal and opposite reaction. It's all right, but what do these laws mean? 1. A particle shall remain at rest or continue with its movement, unless it has acted with external force. This means that if an external force does not act on a particle, it will not change the movement in any way. If there was no friction or air resistance, then a particle moving at 5 would last indefinitely. Obviously in real life this does not happen as there is a resistance and friction, so it is almost impossible not to have an external force on a moving particle. However, if you think of a stationary particle, it makes much more sense. If no force is applied to a stationary particle, it does not move. 2. The force on an object shall be equal to its mass multiplied by its acceleration. Simply known as , this is probably one of the most fundamental formulas in Dynamics. It's one of those that appears everywhere in Dynamics and is a really good idea to learn. It's not hard to understand. It makes sense that if something has a larger mass, it will take more power to give it the same acceleration as something with less mass. 3. Each action has equal and opposite reactions This law basically means that if you press against a wall, it pushes you back, which is a really good job because otherwise you will go straight through! Constant acceleration formulas They go with so many different names that it is difficult to cope sometimes. You may have heard them as kinematic equations, motion equations, SUVAT equations, or maybe you haven't heard of them at all. First of all, let's consider them: (1) (2) (3) (4) (5) There may seem a lot to remember there, but believe me, it is not as difficult as it seems. Like these equations, they're extremely important in Dynamics. SUVAT Equation 1 As you probably already know, the time-divided speed is equal to acceleration and the time-multiplied speed is equal to displacement. This means that at a speed relative to the time schedule, the slope of the line is equal to the acceleration and the area below the line is equal to the displacement. If you have initial speed and final speed, the graph will look something like this: The graph shows u vs t as I said, the slope of the line is equal to the acceleration . So. Rearranging this to make the object gives us our first formula for constant acceleration: SUVAT equation 2 Ok, so one down, only four to go! We know that the area below the graph is equal to the displacement. So we know that multiplication gives us the lower rectangle of the area and divided into 2, gives us the upper triangle. This gives us: Now we know that in order to be able to rearrange this to give and then replace this in our equation with displacement. That's what we have. If we simply multiply the bracket that gives us the second formula: For those of you who like to find mathematics where you can, you may be interested to know that this is an integral part of . If this makes no sense to you, why not go look in the wonderful integration section, where everything will become clear! SUVAT equation 3 Now those of you who are keen on spotting patterns may have noticed that this equation looks a lot like the last one. This is because it looks a lot like One. Those of you who have decided not to go to the Integration page may regret this now. If you rearrange to make the object you get: Now you just need to integrate this result in terms of time to give you our 3rd equation: SUVAT equation 4 We have already found that the area below the graph (equal to offset) is equal: If we multiply in the bracket we get: which is the same as: Finally, we just factored it in to give : SUVAT Equation 5 We can rearrange to make the object: Then we just replace this value in our previous equation: , which gives us: which can be simplified, and then eventually give us the final form of And that's it! These equations are definitely worth learning, as they are useful over and over again. There are several rules, for example, they can be used only in cases where there is constant acceleration. This means that if acceleration is something like 12 MS-2 they are fine, but if the acceleration is on the lines of 12 MS-2 then they will not work as the acceleration varies by . What drag A lot of dynamics is done by ignoring air resistance, and while this makes things much easier to deal with it is always worth knowing what it will affect it will have. For each object moving in a liquid, the drag force on it can be calculated using: the density of the fluid (998.2071 kg m for water at 30 degrees and 1.204 kg for air) is the speed of the object, is the transverse area of the objects and is the resistance factor. The resistance factor is a number that refers to how aerodynamic the object is, and the cube also has a sphere that has . An object that falls to Earth will eventually reach a speed at which the force of gravity is pulled. This is called terminal speed, and you can get an expression for it by e aligning the drag force to and then rearranging for: For a person who falls into the air (top) we have a 70kg, 0.5m area and a resistance factor of about 0.8 (a rough guess somewhere around a cube or cylinder angle) we get a final speed of about 53m s (which turns out to be a pretty good estimate). Movement on a flat surface This is the simplest example in dynamics. The body moves on a flat surface in a straight line. For example: 1. The Rev is driving your car when suddenly the engine stops working! If he travels with 10 ms-1 and his delay is 2 ms-2 how long will it take the car to rest? Okay, it's always a good idea with problems like that to list the things you know. We've been given initial speed, acceleration, . We also know that if the car is going to end up resting, that speed should be 0ms-1. We want to understand the time, i.e. Personally, I find best to expose this information so: u = 10ms-1v = 0 ms-1a = -2 ms-2t = ? We can see which equation we need. In this case, we can see that the equation we want is . We rearrange this to make the object, giving us finally, we put the numbers in the equation: . 2. Michael stepped on the road, 30 meters from where the engine stops working. Rev's glasses have fallen off and he can't see Michael. Will the car stop in time to miss michael's hit? Once again, it is best to expose all the information we have: u = 10 ms-1 v = 0 ms-1 a = -2 ms-2 t = 5 s = ? m This time we want to find displacement, so we have to choose an equation with this. I'il use. I could have used it or, however, since we don't have time, but instead we invented it ourselves, every mistake made in previous calculations will be transferred to this one. I'm going to rearrange the equation again, this time to give it as an object. It's a good habit to log in, it may not make much difference now whether you rearrange the equation before or after pasting numbers, but with more complex formulas it can get really messy if you don't rearrange it first. Also in exam situations, if you make a mistake, you can still get method marks if the examiner can see what you have done. Anyway, it gives us to put the numbers in the equation it gives us: so Michael won't get hit! No, not In the above example, friction is completely ignored. In the real world, we can't do that (very lucky because we're going to fall all the time and people will think we're drunk). So we better look at the situation with the rub. The coefficient of friction is given to the symbol μ. The resultant force of the weight balances the weight of the vehicle (so as not to pass through the road). The force due to friction is μ (or μN). 3. Rev's car broke down on the M1. He's got to push it into the hard shoulder. The car weighs 5,000N. Rev can be pushed around 1800N. Will rev be able to push the car to the hard shoulder? Okay, first of all, in a situation like this, it's a good thing to draw something about what's going on. A diagram of the force to show what is happening in example 3. From this we know that in order for the car to move, roar must be pressed with force at least μR. By simply multiplying the friction coefficient by the resultant force, we find that the friction force is 3000N, so rev will not be able to push the car to the side of the road. 4. Body builder happens to pass by and in an attempt to ease congestion on an increasingly busy M1, he decides to help. With both bodies and Revies, what will be the acceleration of the car? NB - Take the mass of the vehicle to be So, the same situation as before, only this time the forces do not balance and so there will be acceleration. We'il get it from the smart Isaac Newton, . Remember that in order to find the common strength you need to take the trig of strength. So it is (3200 + 1800) – 3000. This leaves a total force of 2000N. Again, we need to rearrange the formula to give as an object this time. That's what he gives us. Placing the numbers in we get: a = 3.9 ms-2 (2 s.f.) It is quite similar to the movement on a flat surface, only one or two more variables... And we're not going to talk about rev's car anymore, as I'm not sure it's going to go up a hill! Anyway, I'm afraid I've strayed a little off the track. Presenting an inclined plane or slope, as most of us know, means that you will have to smear your trigonometry. On the other hand, you'il understand why people have been trying to break into you for years! As long as you're familiar with the good old order of operations, you need to get better. So let's start with an easy example. Oblique plane example In the photo above shows us a block sitting on a slope. A good place to start with this (probably the only place to start if you want a chance in hell to get anywhere with a question) is to solve the forces. Supposing the block is at rest, we know it is in equilibrium, so the horizontal forces must be equal and you need the vertical forces (unless it is one of these wonderful levitation blocks). Projectile Motion Projectile are not completely different from moving in a straight line, only that instead of a body moving from left to right, it moves up or down aswell. First, let's look at a typical example of projectiles: The ball is thrown at an angle of 30°. It has an initial speed of 20ms-1. Find the maximum height that will reach the ball. Well, as usual, we draw up a diagram: Project proposal for example Now let list what we know: u = 20 sin30 ms-1 v = 0 ms-1 a = -9.81 ms-2 s = ? m Now we select one of the kinematic formulas, the one that will give us the result in the most direct way is: and rearrange the subject: Then finally put the numbers in the equation: and the answer comes out: Isn't it hard? Questions about projectiles sometimes seem quite difficult, but if you remember to use only trigonometry to find the x and y components, you will not go too wrong. Sometimes you will know the maximum height, but some other component will be missing. For example, when the ball is in the air... Again, this is not a problem, you just have a look at what you know and use the formulas to work out the rest of the rest.

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