Calculus 2

Project on Complex Motion 5a

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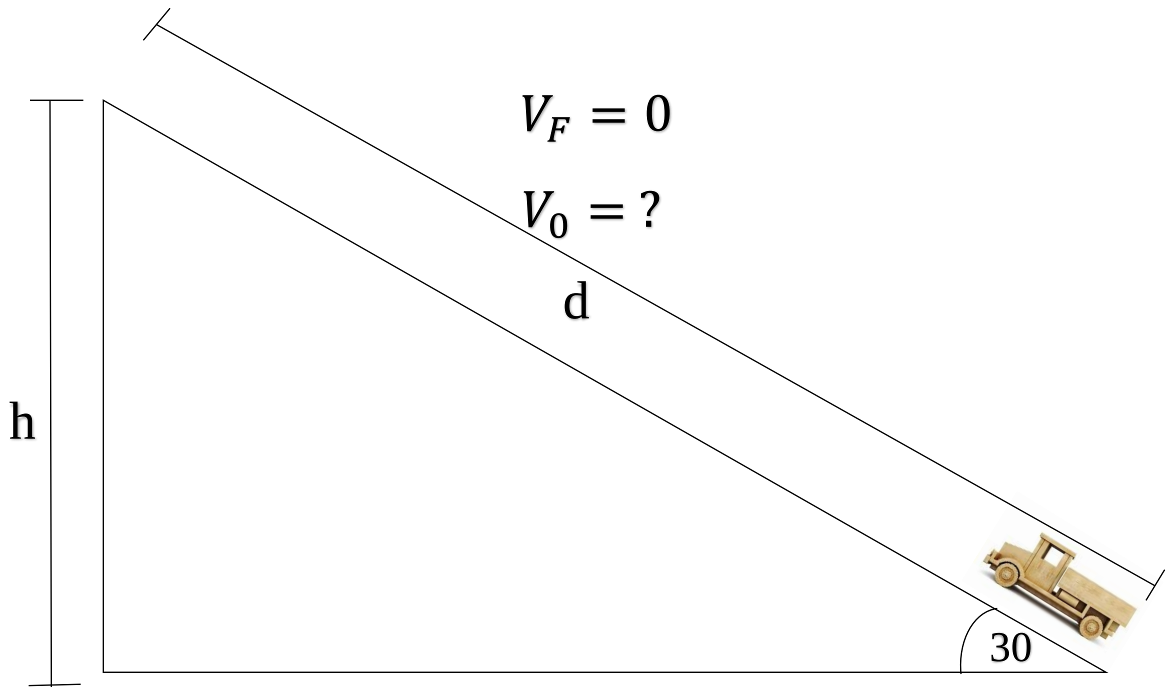
Question*: How hard do I have to push a toy truck from the floor up a 30-degree incline to make it reach the top of the table at zero speed?*

My project group and I decided that this question would be the best suited for the group, as it is a physics related question and we have all had the good fortune of taking a physics class. We are taking the approach of using the much-loved kinematics equations to complete this project, but will also include figures, tables, and graphs to help prove our knowledge gained from this class. Let’s begin.

First, I want to begin by illustrating a quick figure of what exactly we are trying to find.

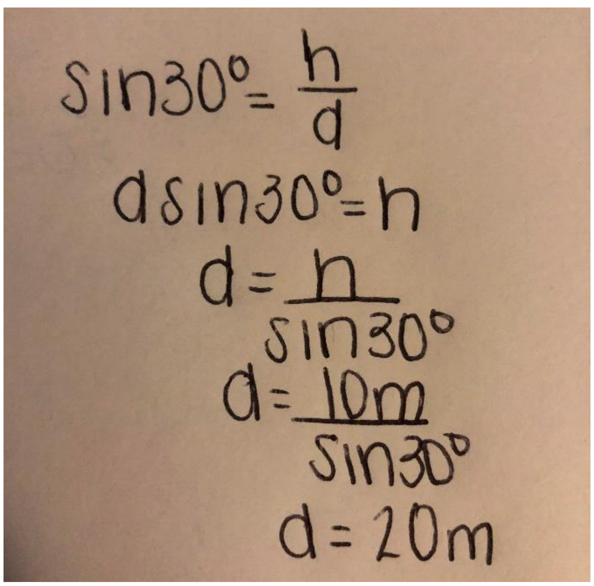


The quantity that we are trying to find is the initial velocity a person should push the toy truck to make it reach the top exactly as it stops. So, as it is, we are assuming to find V-initial with the knowledge that V-final should equal 0. To do this, we will be using a few simple kinematics equations that we believe will achieve our goal.

Kinematics Equations Used In Project

1. $d = \frac{1}{2}(V_F + V_0) * t$
2. (V_F)^2 $= (V_0)$^2 $+ 2(a)(d)$

As it is assumed, the gravity is the force of acceleration on earth, which is approximately 9.81 $\frac{m}{s^2}$. This is the acceleration that we will use to describe "a". Due to the truck going uphill, we will then make the acceleration negative. The height of the ramp that the toy truck is traveling on is not stated in the problem, but is crucial to solving the question given, so we have decided to give "h" the quantity of 10m long.



We will now derive an equation to find our "d".

$$V_F^2 = V_0^2 + 2(a)(d)$$

$$V_F = 0$$

$$0 = V_0^2 + 2(a)(d)$$

$$-V_0^2 = 2(a)(d)$$

$$V_0^2 = -2(a)(d)$$

$$V_0 = \sqrt{-2(a)(d)}$$

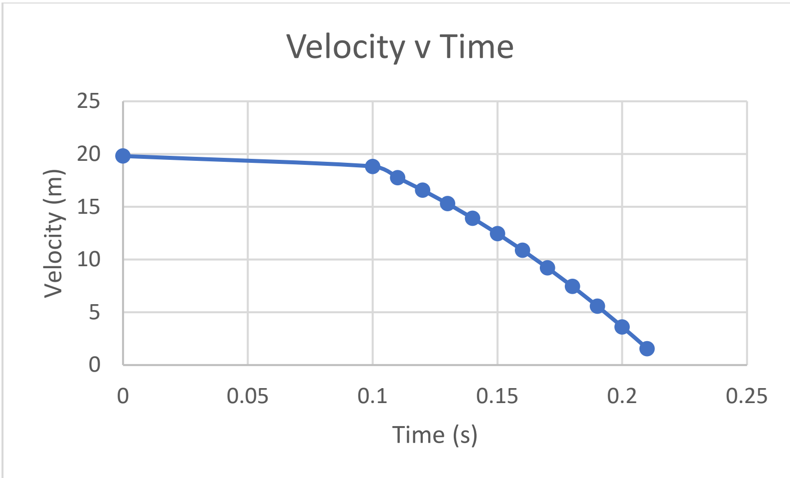
$$V_0 = \sqrt{-2(-9.81\,m/s^2)\left(\frac{h}{\sin 30^\circ}\right)}$$

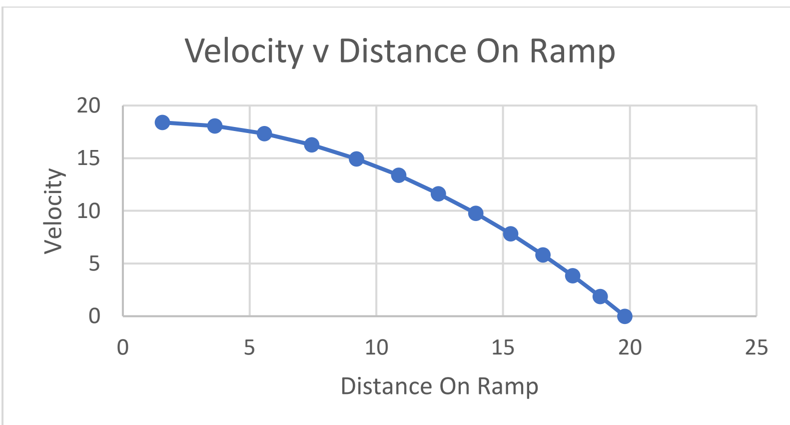
$$V_0 = \sqrt{392.4\,\frac{m^2}{s^2}}$$

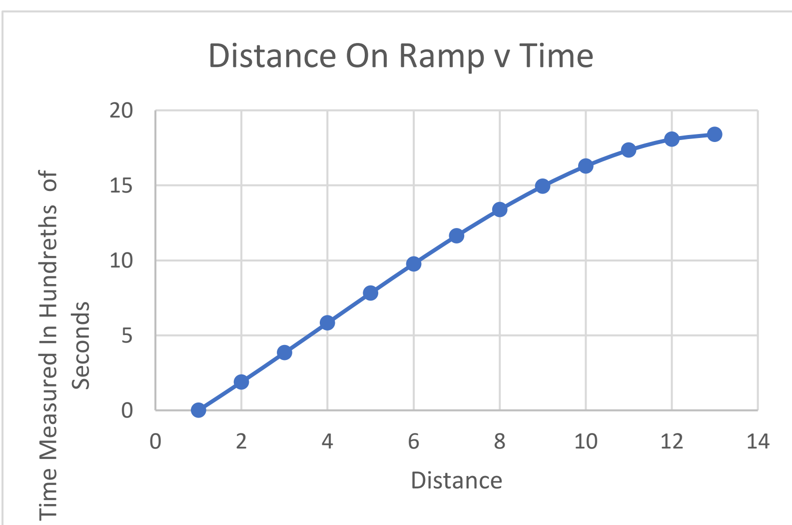
$$V_0 = 19.81\,m/s$$

Next, we will plug this value into our kinematics equation to find our V-initial. Now, for further evidence and a better worked problem that can contain multiple velocities and distances, I will provide an excel graph that better depicts both of these variables.

Acceleration $\frac{m}{s^2}$	Time (s)	Velocity of Toy Truck	Distance On Ramp
-9.81	0	19.81	0
-9.81	0.1	18.829	1.8829
-9.81	0.11	17.7499	3.835389
-9.81	0.12	16.5727	5.824113
-9.81	0.13	15.2974	7.812775
-9.81	0.14	13.924	9.762135
-9.81	0.15	12.4525	11.63001
-9.81	0.16	10.8829	13.371274
-9.81	0.17	9.2152	14.937858
-9.81	0.18	7.4494	16.27875
-9.81	0.19	5.5855	17.339995
-9.81	0.2	3.6235	18.064695
-9.81	0.21	1.5634	18.393009







To conclude, the project was attainable through physics equations and through the use of Microsoft excel. Thank you.