1 — DIY Rocket

Over the holidays, you got bored and decided to build a makeshift rocket at home to see if you could get to space. You repurposed and modified the 200L gas tank from your parents' really big truck (they probably didn't need it anyways) and fill it with a 50-50 mixture of potassium nitrate and sugar. Sugar has a molecular weight of 2×10^{-23} kg.

nitrate. The sugar molecules exit the bottom of the rocket with a speed of 2000 m/s.	
a)	What is the momentum of a single sugar molecule when it exits the rocket?
b)	Momentum always must be conserved. What is the change in momentum of the rocket for each sugar molecule that has been ejected?
c)	What is the change in momentum of the rocket per second of ejecting fuel?
d)	The change in momentum over time of an object is equal to the force being exerted on it. What is the force propelling the rocket upwards?

Now consider the fact that as the fuel is being ejected from your rocket, the mass of the rocket is changing. It initially weighed 500kg without any fuel in it, but after you added the fuel, it weighed 3100kg.	
	Are there any other forces acting on the rocket? What is the net force acting on it and its acceleration? (Hint: write the mass of the rocket as a function of time)
f)	How long will the rocket be able to eject fuel before it runs out?

g) What is the maximum height that you will be able to reach?