Physics 1210
Homework 1 Written-out Problems

1.
With the upcoming 50th Anniversary of the first human moon landing - July 1969, Apollo 11, your friends are interested in why the astronauts looked so clumsy while walking on the moon (https://www.youtube.com/watch?v=x2adl6LszcE). You approximate your foot as having initial velocity (push off) only being acted on by gravity (return to ground). On earth, the maximum height a push off gives your foot is around 5 cm. On the Moon, gravitational acceleration is about 0.166 times Earth.

a) how high would your foot go off the lunar surface given the same initial velocity?
b) Calculate the the total 'air time' of your foot for such an Earth step and a Moon step and compare these times (by division).
c) With these calculations, explain to your friends in plain language why the astronauts look clumsy.

2.
You are an automotive engineer for *Tesla – Laramie Division* and are tasked with developing the crash response systems on the Roadster model. You know that for a person to survive a sudden stop, the magnitude of the acceleration to stop must be less than 250 m/s^2 .

a) Given that the distance that an airbag covers is typically around 1 meter, what is the maximum initial speed of your car that your airbag will work at if the car instantaneously stops (a.k.a. hits a brick wall). You built the airbag very well and can assume that it deploys instantaneously and provides a constant deceleration (acceleration in the direction opposite the car motion).

b) You notice that, through no fault of your airbag design, this maximum speed is well below the highway speed limit around Laramie and create an automatic breaking system to ensure that you do not hit the wall at a disastrous 129 km/hr (80 mi/hr). You program your breaks to automatically engage 4 seconds before impacts and they provide the entire car with a constant decelerations of 4.5 m/s^2, typical of auto-breaks. With this breaking system, starting at an initial velocity of 129 km/hr, what is the velocity that the car now reaches the brick wall at?

c) Create and hand in plots, using your computer software of choice, of the position versus time, velocity versus time, and acceleration versus time for the Roadster through the full initial velocity, breaking, and collision scenario starting at highway speed, to prove to your colleges that it is safe for humans.