TASK 2

In the two figures below we use the x position provided in the experiment max and min of the list “["alpha_dist"]”, which uses a state x value of 0 and an end x value of 1000 [m]. In the second figure we set a start distance of 0 and an end distance of 100 [m] for comparison. In the initial value we see the values being interpolated are all less than 150 and can be seen as red stars on the chart. The function then takes these position measurements and intipolates out to 1000 using a cubic function. Using this function the graph interpolates to degreed of 800000 based on the five points provided for reference. This large discrepancy is a result of the error from the initial measurements being magnified durign intoiplations.

Figure 2.1: Angle[deg] vs x[m]

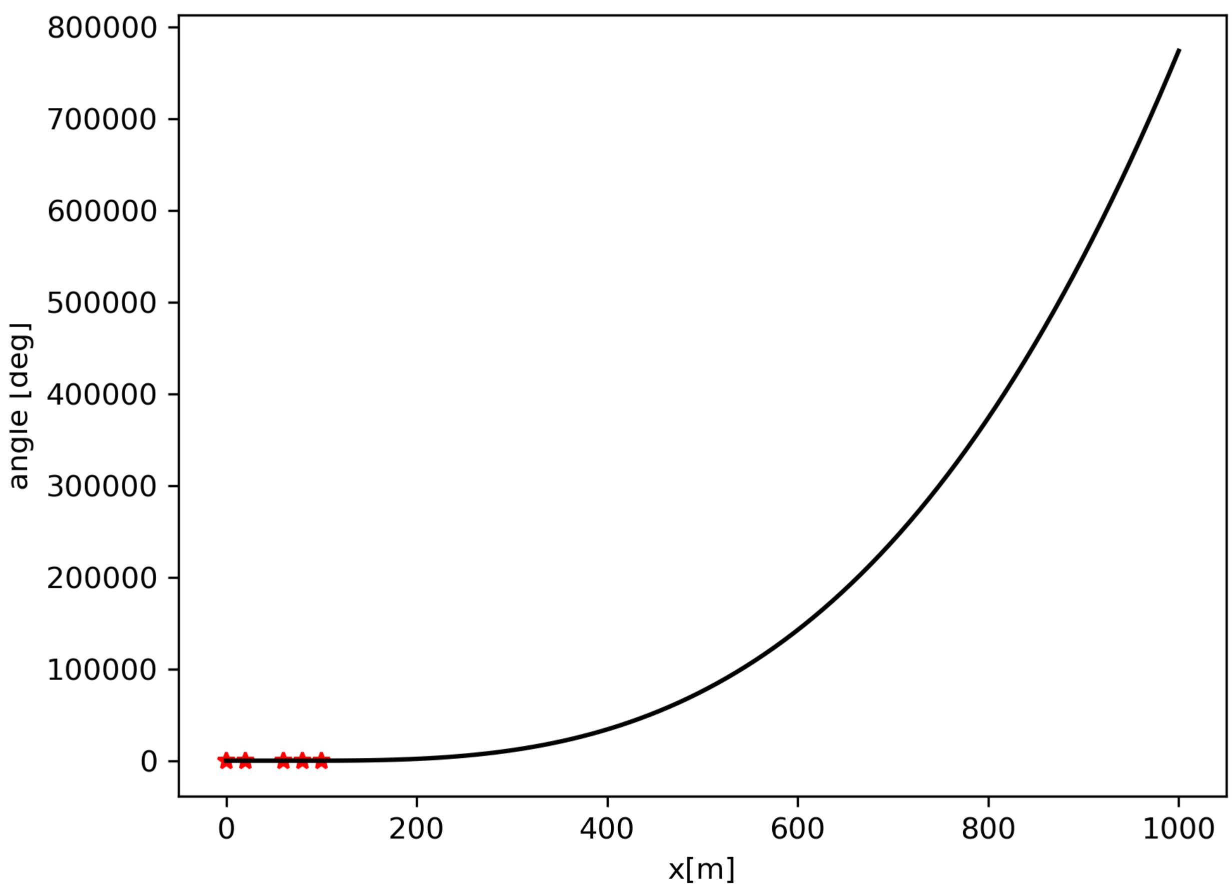
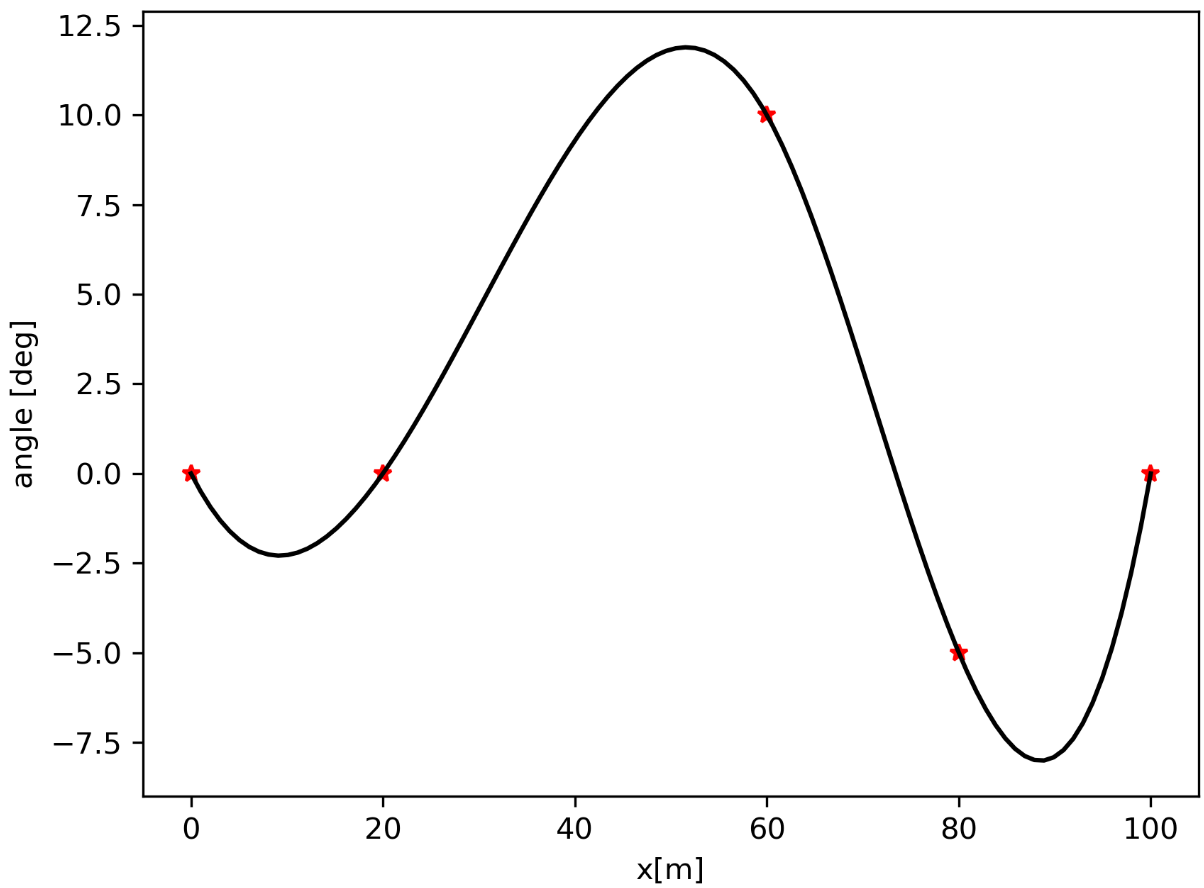


Figure 2.2: Angle[deg] vs x[m] with end conditions



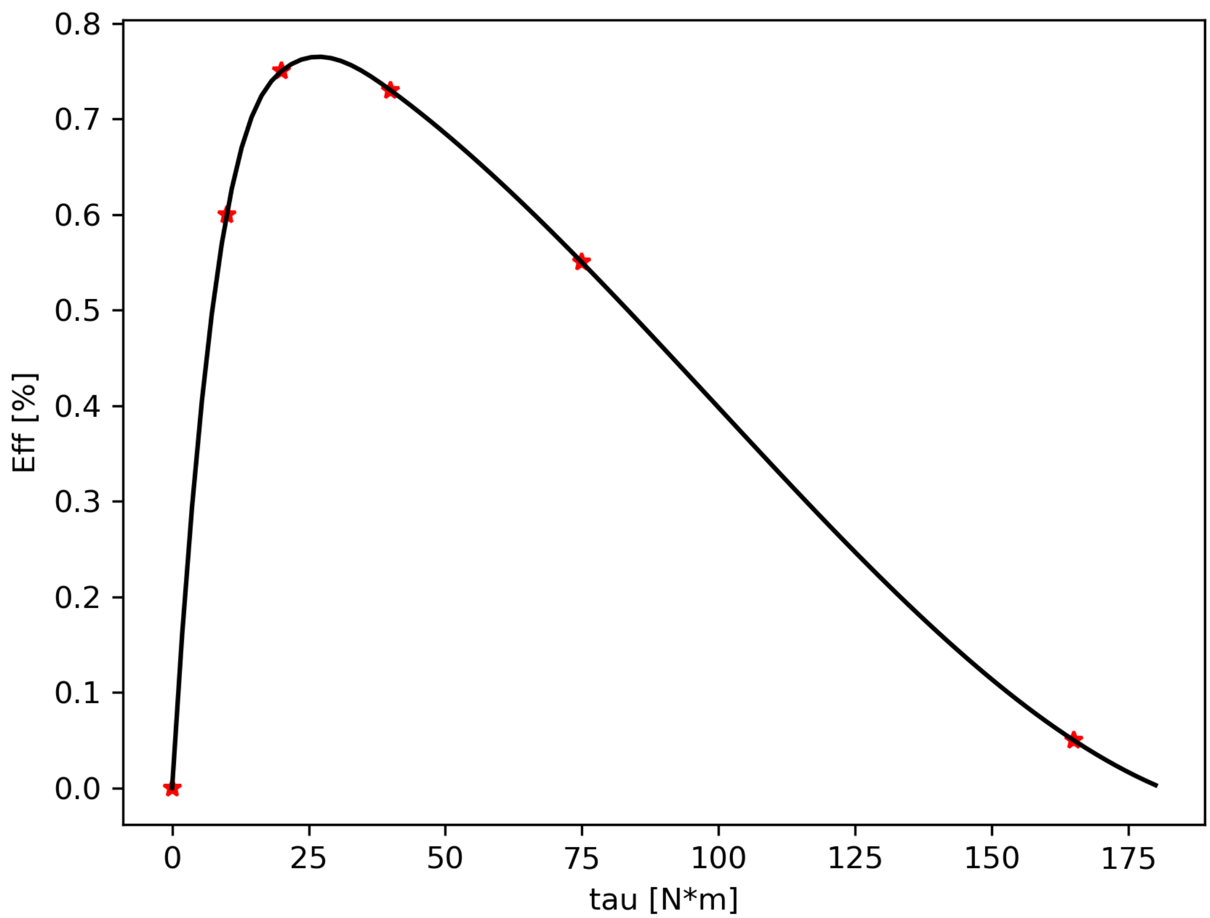
Closer look at 1-100 for testing

TASK 5

Please include a copy of your figure and an explanation of what you are observing in your write-up. 5.6

In the figure below we see a graph of the battery efficiency vs torque using the initial conditions set by the constant in motor [torque_stall] as the max and motor [torque_noload] as the min. Both of which can be found in the rover dictionary. We see that the motor rapidly increases in efficiency until tau equals approximately 25 when it gradually starts decreasing until it meets the stall torque specified by the rover. This means that the most efficient torque the apply to the ore is ~ 25 N*m where the efficiency is 75%. In practice, the measce tha optime tource to maximise battery power is ~25 %.

Figure 5.1: Eff[%] vs tau[N*m] with end conditions



<u>TASK 8</u>

Table 8.1 using end_event dictionary

completion _time	**distance _traveled**	**max_velocity**	**average_ velocity**	**battery_energy**	**batt_energy_per_ distance**
110.60081	0.15199	0.46449	0.45112	48355.50901	967.11018

Figure 8.1: Motor Position/Velocity/Power[m] vs time[s] using end_event dictionary

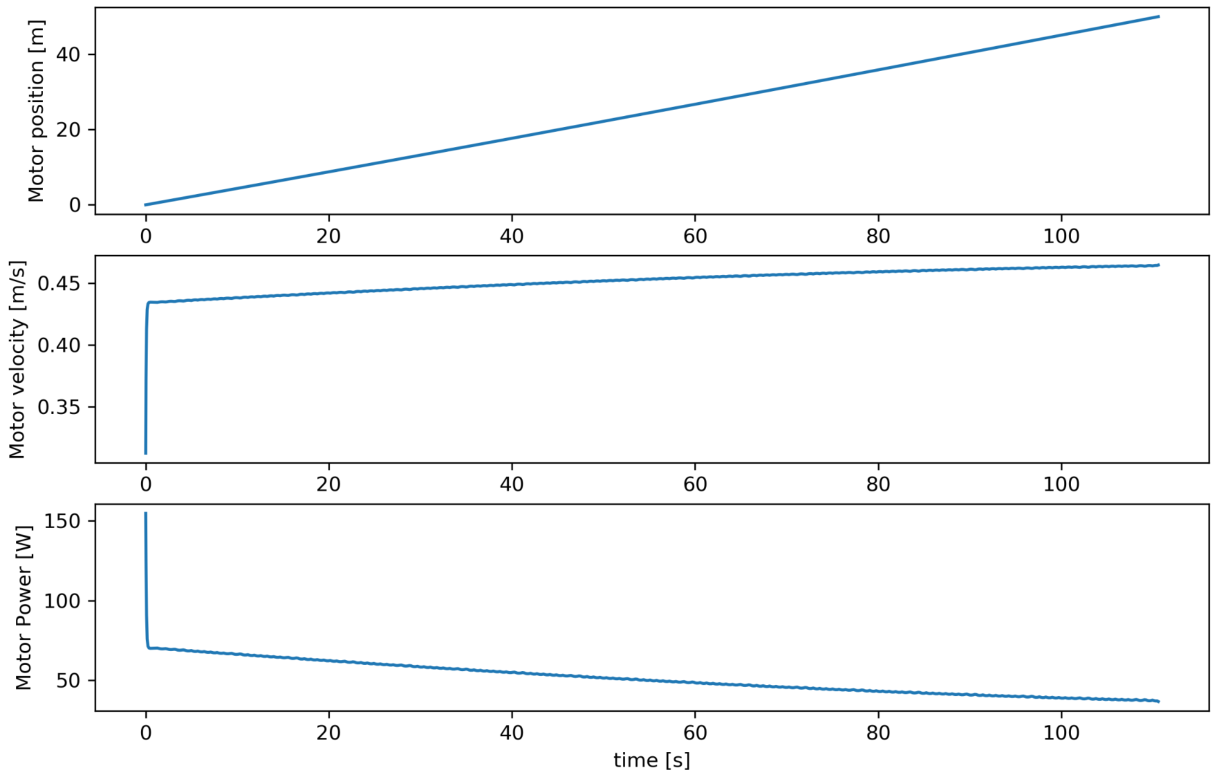
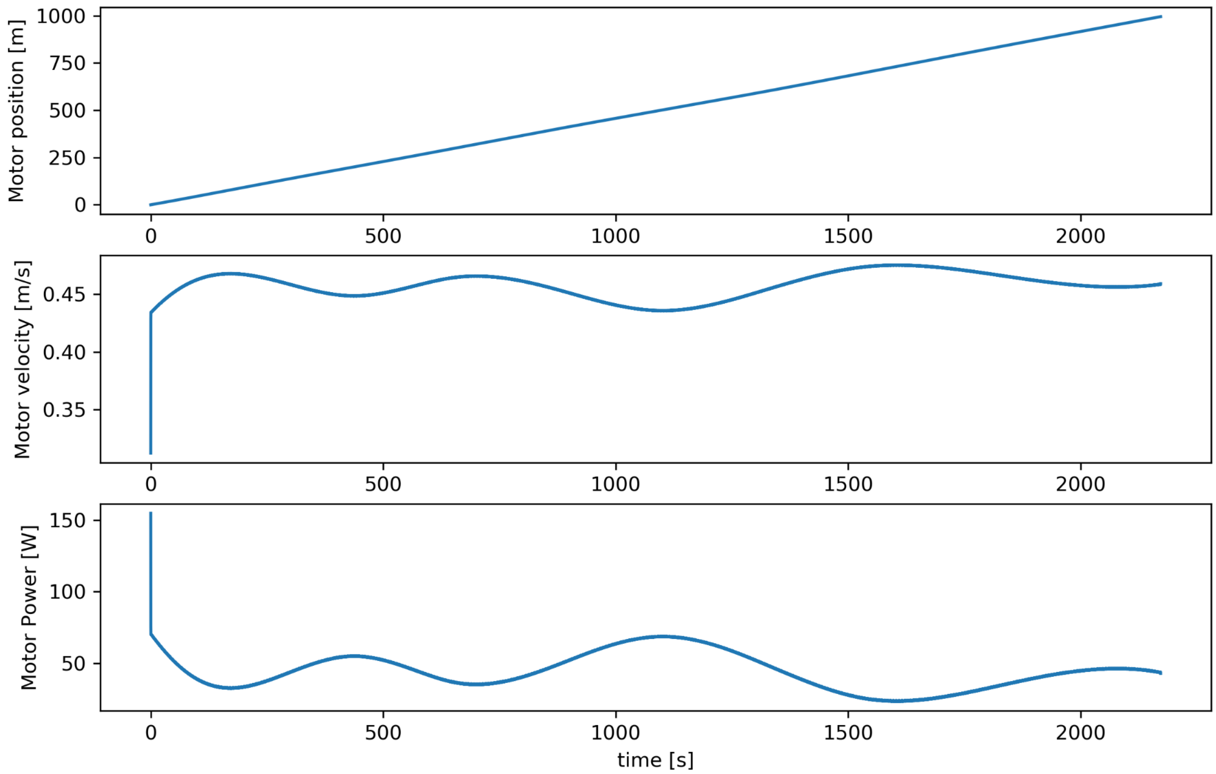


Table 8.2 using end_event in Task 8

completion_time	distance_traveled	max_velocity	average_velocity	battery_energy	batt_energy_per_distance
2171.97589	0.14655	0.47523	0.45768	870778.72726	875.154410

Figure 8.2: Motor Position/Velocity/Power[m] vs time[s] using end_event in Task 8



For the set of graphs that were interpolated, we used the initial values in define_expirement, however, changed the end_event values given in the Task 8 description per graph. For both graphs, the Motor Position vs Time again has a positive linear relationship. For the second graph on the second set, the Motor Velocity vs. Time graph is not linear, however. This is due to the fact that when the terrain angles are interpolated, the terrain angle values oscillate up and down. As the terrain angle increases, the rover velocity decreases because it's having to fight a greater gravitational force. For the Motor Power vs Time graph, the power has an inverse relationship to the motor velocity. This is due to the fact that as the terrain angle increases, the power output must also increase to try and maintain the rover velocity. The rover would need to output less power when the terrain angle is smaller because there wouldn't be as much opposing gravitational force.

The reason the bottom two graphs of the two sets look very different is because the first set of graphs have extremely smaller end values. This causes the graphs to be cut off much sooner and “zoomed in”. When looking at the bottom two graphs of the first set, we can see that the relationship purely increases/decreases because it hasn't reached the point of descent.

TASK 9

The unit for power is Watts, or Joules/second, and the unit for energy is measured in Joules, or Watts*second. In order to obtain the total energy consumed by the rover battery pack from t=0 to $t=t_f$, the integral of the power consumed by the battery must be taken. In this particular case, Simpson's Rule was used to integrate the power consumed by the battery. Notice in the code that the integral is then multiplied by six. This is due to the fact that there are a total of six wheels on the rover, and the energy consumed by the battery comes from each wheel.

Using the conditions defined by experiment1 (in define_experiment.py), the calculation total battery consumption comes out to be 0.4836e6 [J], which is considerably less than the 0.9072e6 [J] battery pack that is provided by the boss. Thus, the rover can be equipped with the battery pack to successfully run on mars.