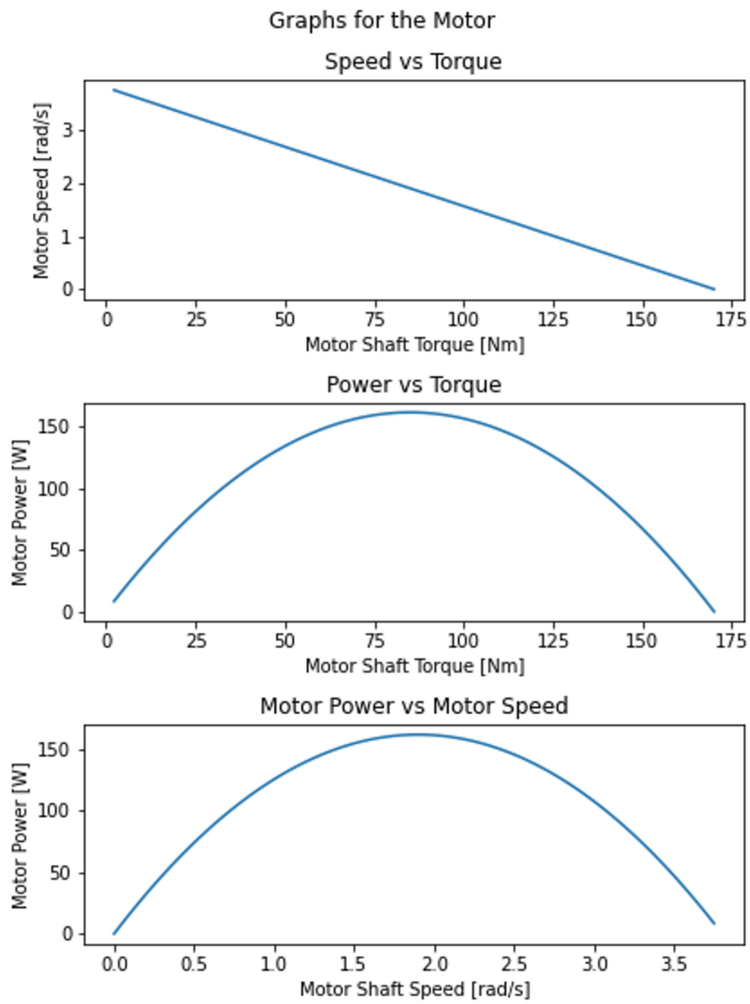
1. The main advantage of having the acceleration value stored in a separate dictionary is that it reduces the chance for a mistake being made in the case that the number 3.72 has to be input manually each time it is needed in a calculation. A typing error of just a single number could result in the code still executing, but with wildly inaccurate calculations that might never be realized by the user. By storing it in a dictionary, if there are any typing errors when calling the variable, the code simply won't run. If I had the choice though, I would probably just save it as a regular float variable rather than a dictionary just for the sake of simplicity and because I am more familiar with those types of variables.

2.
```
result = F_gravity(110,rover,planet)
print(result)
```

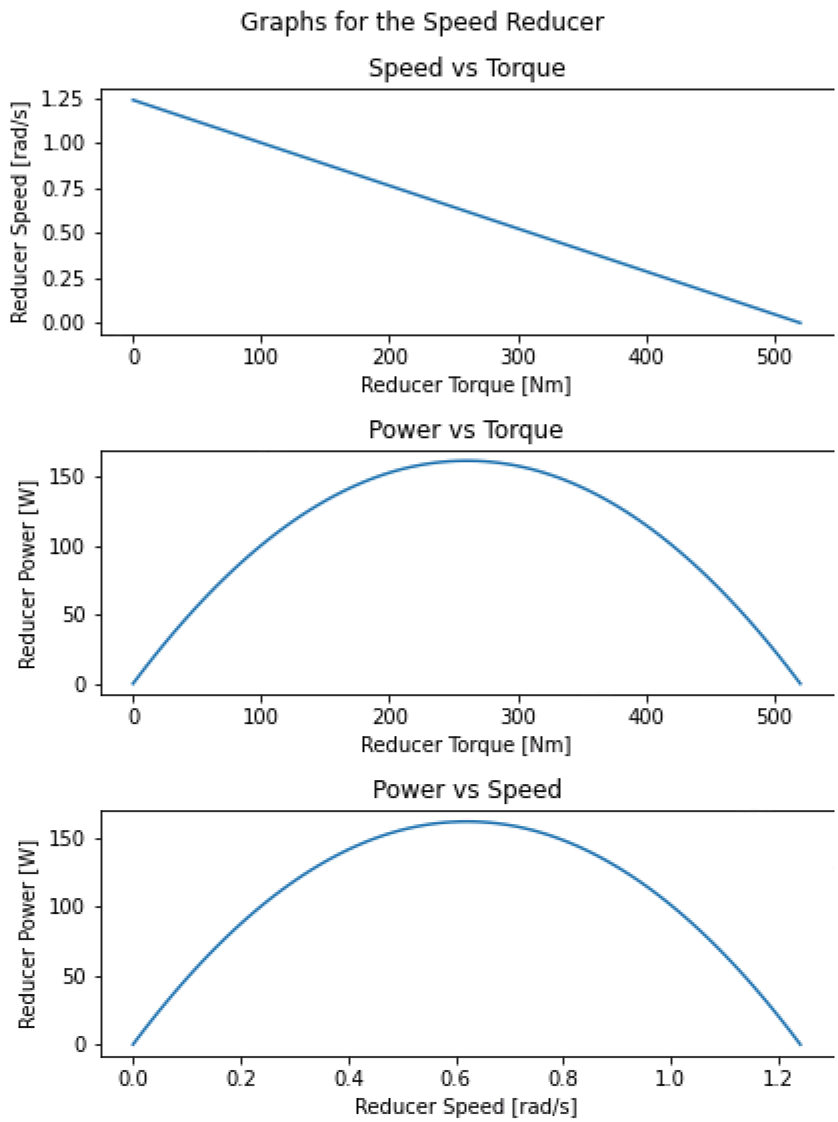
```
Exception: Inputs for terrain angles must be between -75 and +75 degrees
```

Attempting to input a terrain angle of 110 degrees resulted in the console displaying the above error message. This is to be expected because we explicitly coded in this exception to only allow user inputs between -75 and 75 degrees. It makes practical sense because it would be unrealistic to actually attempt to navigate the rover up or down such steep slopes in practice.

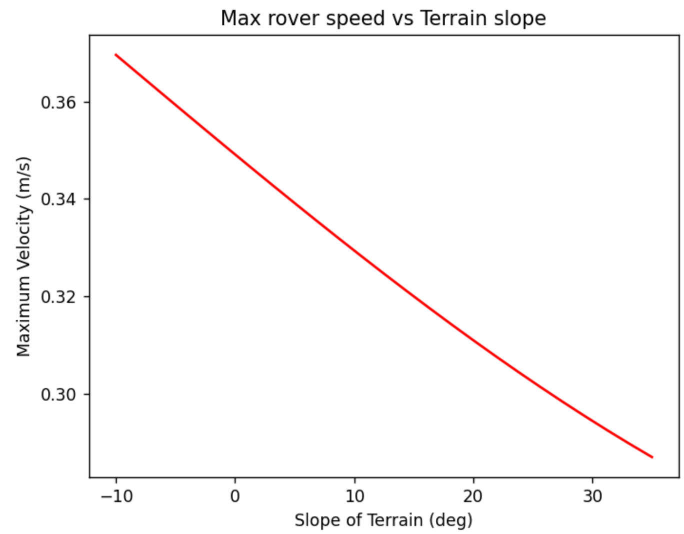


3.

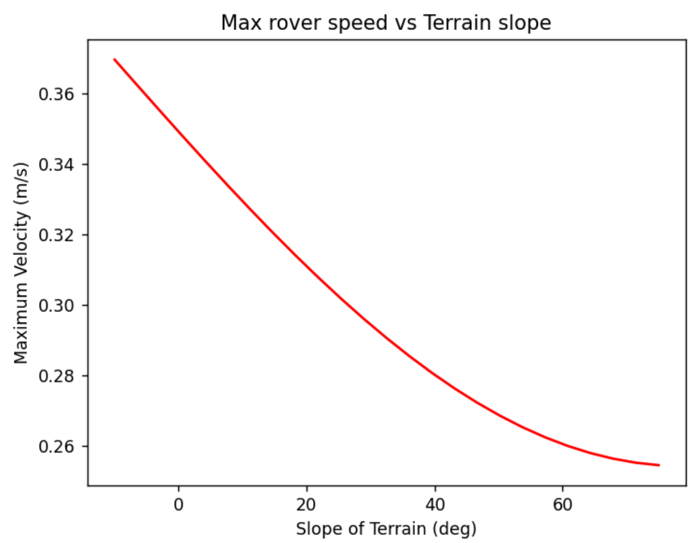
The maximum power out of the motor shaft is about 161.5 W, which occurs at a motor shaft speed of 1.89 rad/s. These values were determined by finding the maximum power in the power array and then using its index to find the corresponding speed. These values are validated visually by the speed vs power graph, where it can be seen the power output is at its maximum a little above 150 W at right before x = 2.



4. The speed reducer works by taking a high speed/low torque input and converting to a low speed/high torque output. As can be seen in the Power vs Speed graph above, reducing the speed initially results in an increase in overall power input until a certain point, where then continuing to reduce the speed actually results in lower power outputs. This shows that there is a peak efficiency angular speed of roughly 0.6 rad/s.

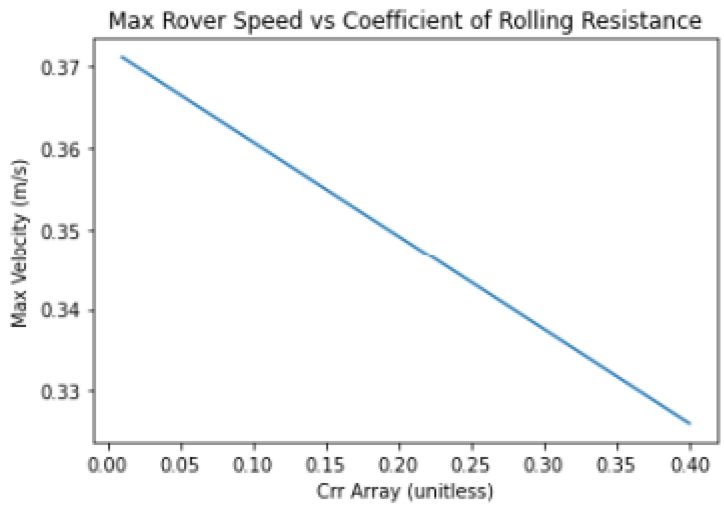
5. 

Reviewing the graph above, as the terrain angle increases the max velocity of the rover decreases, showing a negative trendline and inversely proportional relationship. What is interesting to note is that the relationship is technically non-linear, where the maximum velocity of the rover decreases at a declining rate, but at smaller angles lower than roughly 35 degrees the trendline is approximately linear.

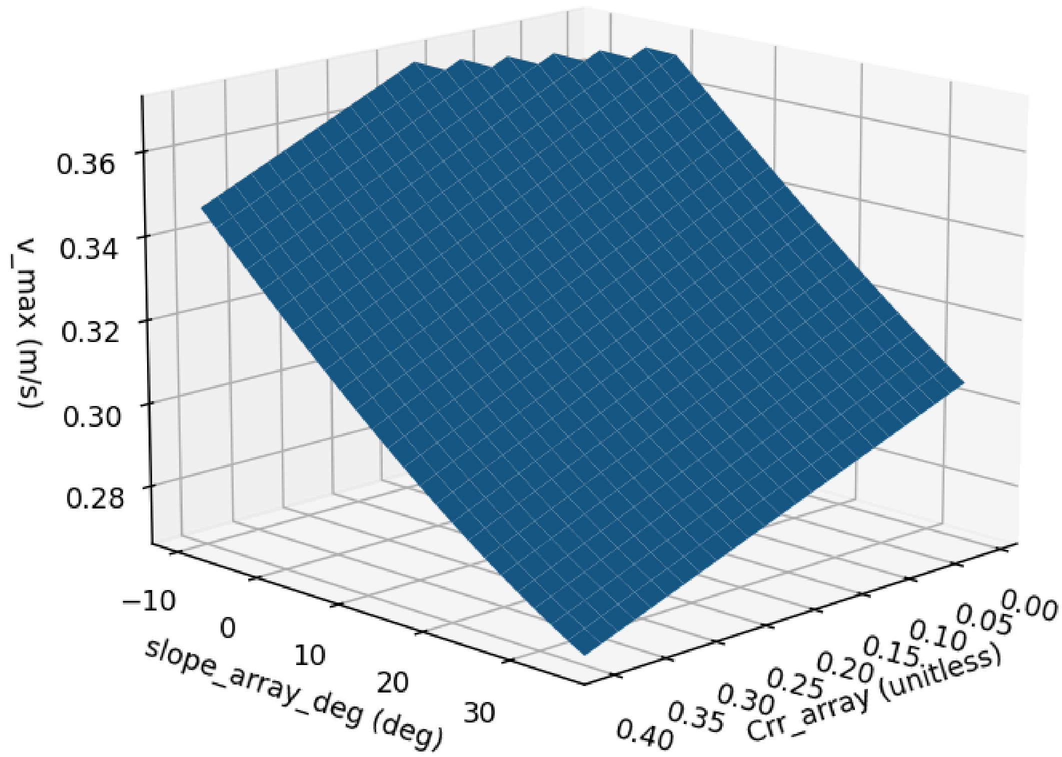


As seen in this second graph, with a larger terrain slope domain, the nonlinear behavior becomes increasingly apparent at higher angles. This is due to the sine term present in the calculation of gravity applied on the rover. With constant incremental changes in the input angle, the value of the sine term will change less as the angle increases. These trends also make intuitive sense from a physical perspective, since as the terrain slope increases, the rover will need to fight against a greater component of gravity to propel itself forward, and the resulting lower acceleration will lead to a lower maximum velocity.

6.



As can be seen in the graph above, the most apparent trend is that the max velocity of the rover has an inversely proportional and linear relationship with the coefficient of rolling resistance. This makes sense physically because we intuitively know that if a surface provides more resistance, then the rover will experience a greater force opposing its direction of travel and therefore reach lower accelerations, and in turn lower max velocities. The linearity of the data is also to be expected considering the equation for the rolling resistance force is Frr = Crr * Fn, which demonstrates a proportional, linear relationship, where Crr is the independent variable and Fn is the slope of the line.



7.

As can be seen in the top portion of the graph, it is not appropriate to operate the rover on downhill slopes that have very low coefficients of rolling resistance (firm ground). This is because the lack of the opposing forces of gravity and rolling resistance results in the rover never reaching a terminal velocity and instead continuing to accelerate. In a real scenario, this would lead to it reaching unsafe speeds where damage would become more likely. This is why the top of the graph appears more jagged since it has excluded the unfeasible data points above that threshold.

Between the two factors, terrain slope seems to be more dominant in determining the max rover speed, since an increase in its value results in a greater drop in max velocity compared to Crr. In other words, the partial derivative of max velocity with respect to terrain slope has a greater negative value than the partial derivative with respect to Crr, and therefore changes in the terrain have a greater effect on the velocity.