

Test 1

Calculated Values

$$v = -385.823 \text{ ms}^{-1}$$

$$s = 8.755\text{s} \text{ (4sf)}$$

From Graph

$$v = -385.347 \text{ ms}^{-1}$$

$$s = 8.7\text{s}$$

The program is giving the expected results to a reasonable degree of accuracy.

Test 2

(calculated) Weight = 19620 N

Calculated Values

$$a = 0$$

$$t = 10\text{s}$$

From Graph

$$a = 0$$

$$t = 9.9\text{s}$$

Test 3a

(calculated) Time it takes for fuel to run out = 30s

(from graph) Time it takes for fuel to run out = 30s

(calculated) a after fuel runs out = -9.81 ms^{-2}

(from graph) a after fuel runs out = -9.81 ms^{-2}

(calculated) fuel mass after fuel runs out = 0 kg

(from graph) fuel mass after fuel runs out = 0 kg

The program is giving the expected results

When the thrust is 51000 N, the final fuel mass is 0kg. This is as expected.

When the thrust is -50000N, the final fuel mass is 1150 kg. This is as expected.

Test 3b

Peak height is 3.7206×10^4 m

The potential energy at this height is 182495430 J

Velocity at impact is -853.942 ms^{-1}

The kinetic energy at this velocity is 182304234.8 J

These values are as expected.

Test 4a

Max height is reached at 45.5s

Velocity at this time is -3.56369 ms^{-1}

Acceleration at this time is -9.80555 ms^{-2}

Velocity is almost zero which is as expected. Also, the acceleration is almost 9.81 ms^{-2} which is as expected

Test 4b

Terminal velocity without fuel is 121.3 ms^{-1}

The final velocity is -121.3 ms^{-1}

The final acceleration is $9.11586 \times 10^{-4} \text{ ms}^{-2}$

The final velocity has the same magnitude as the terminal velocity, and the final acceleration is almost zero. As a result, the program is working.

When fuel runs out, the thrust becomes zero, as a result the acceleration will change suddenly as one of the forces on the lander will no longer be present.