Arthur He

HOMEWORK ASSIGNMENT #1

1. A new three-stage rocket for delivering small payloads to low-Earth orbit is being analyzed. It has these characteristics:

I_{sp} stage 1	300 s
I_{sp} stage 2	350 s
I_{sp} stage 3	400 s
Payload mass	1500 kg
Structure mass stage 1	10,000 kg
Structure mass stage 2	7500 kg
Structure mass stage 3	7500 kg
Propellant mass stage 1	50,000 kg
Propellant mass stage 2	40,000 kg
Propellant mass stage 3	35,000 kg

Complete the following table:

	Initial Mass	**Final Mass**	**ΔV**
Stage 1	151500 kg	101500 kg	1178.4 m/s
Stage 2	91500 kg	51500 kg	1972.8 m/s
Stage 3	44000 kg	9000 kg	6225.4m/s

What is the <u>total ΔV</u> for the 3-stage rocket booster? 9376.6 m/s

Compare the payload mass to the gross lift of mass (initial mass of the entire rocket).

Payload mass is 1/101 of the mass of the entire rocket.

Hint: start at the top (stage 3) using the following steps:

Stage 3 initial mass includes stage 3 structure mass, stage 3 propellant mass and the payload mass. What is the total initial mass for stage 3? Assuming all propellant is consumed, what is the final mass for stage 3? ΔV for stage 3?

Stage 2 initial mass includes stage 2 structure mass, stage 2 propellant mass and stage 3 total initial mass. Assuming all propellant is consumed, what is the final mass for stage 2? ΔV for stage 2?

Stage 1 initial mass include stage 1 structure mass, stage 1 propellant mass and stage 2 total initial mass. Assuming all propellant is consumed, what is the final mass for stage 1? ΔV for stage 1?

2. Given the following relationships:

1 furlong = 40 rods
1 rod = 16.5 ft
1 fortnight = 14 days
1 day = 24 hr (use this equivalency although it is not exact)

Convert 1 furlong/fortnight to m/s.

1furlong/1fortnight * 40rods/1furlong * 16.5ft/1rod * .3048meter/1foot * 1fortnight/14days * 1day/24hours * 1hour/60minutes * 1minute/60seconds = .000166 m/s = 1.66 * 10^-4 m/s