Table of mass definitions

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| --- | --- |
|  **System** |  **Formula** |
| Instruments |  |
| Power |  |
| Heat Shield |  |
| Hardware |  |
| Telemetry |  |
| Guidance |  |
| Thermal Control |  |
| Avionics |  |
| Propulsion |  |
| Structure |  |
| Harness |  |
| Fuel |  |

The Solar Probe-Plus spacecraft consists of 11 separate systems and the fuel for the thrusters. All of these systems have to work together to create a functioning spacecraft that can conduct scientific research.

The table to the left shows each system along with the approximate mass of the system represented by a formula. For example, the Heat Shield has a mass of ‘z’, and the Propulsion System has a mass of ‘1/4z’.

The masses of the Instrument, Power and Heat Shield systems have been selected as the reference masses for the other systems in the spacecraft.

**Problem 1** - What is the simplified equation for the total mass of the entire payload?

**Problem 2** - What algebraic fraction represents the sum of the Instrument, Power and Heath Shield Systems to the total mass of the spacecraft?

**Problem 3** - If the mass of the Instrument System is 52 kg, the Power System is 135 kg and the Thermal System is 80 kg, what is the total mass of the spacecraft in kilograms?

**Problem 4** - What percentage of the spacecraft is represented by the sum of the Instrument, Power and heat Shield Systems?

 Exploring Equations with the **Parker Solar Probe**

**Problem 1** - What is the simplified equation for the total mass of the entire payload?

Answer: Add up the equations defining the spacecraft systems by grouping like terms together and simplifying the fractions.

Total mass = 

 = 

**Problem 2** - What algebraic fraction represents the sum of the Instrument, Power and Heath Shield Systems to the total mass of the spacecraft?

Fraction = 

**Problem 3** - If the mass of the Instrument System is 52 kg, the Power System is 135 kg and the Thermal System is 80 kg, what is the total mass of the spacecraft in kilograms?

Answer:

Total mass =  = 531 kilograms

**Problem 4** - What percentage of the spacecraft is represented by the sum of the Instrument, Power and heat Shield Systems?

Answer: The sum of the three systems is x+y+z = (52+135+80) = 267 kilograms.

The percentage of the total mass is then P = 100% (267 kg / 531 kg) = 50%

**Extra Problem: If y = 3x and z=8/5x, write the total mass of the spacecraft in terms of only the Instrument System mass, x. Express the coefficient of x as a fraction, and as a decimal rounded to the nearest hundredth.**

Answer:  =  =  = 9.82x

Answer Key