

Activity Instructions

Part 1: Weight Reduction

Part 1.1 – Baseline Subsystem Weights

- Using Table 1, calculate the **mass (kg)** of each subsystem:

Mass (kg) = Mass Fraction × Total mass/100 (I think we shouldn't give the formula it's easy)

- Fill in the table below:

Subsystem	Mass (kg)	Baseline Primary Material
Body Non-structural		Mild Steel (Note: ignored glass and interior)
Body Structure		Mild Steel
Front Suspension		Steel
Rear Suspension		Steel
Braking		Cast iron
Powertrain		Cast Iron (engine block) %60 + Steel (transmission parts) %40
Fuel & Exhaust		Steel
Steering		Steel
Tires & Wheels		Steel
Electrical		Copper
Cooling		Aluminum
Bumpers		Steel
Closures		Mild Steel
Total Weight:		



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Part 1.2 – Material Mass in the Baseline Vehicle

1. Break down the baseline vehicle by **material type**.
2. Sum the total mass for each material.

Material	Mass (kg)
Mild Steel	
Steel	
Cast Iron	
Aluminum	
Copper	

Part 1.3 – Lightweight Redesign

Focus only on the three heaviest subsystems:

1. Body Non-structural
2. Body Structure
3. Powertrain (steel parts only)

Replace steel in these subsystems with the lightweight material assigned to your group.

Group Assignments:

- Group 1 → High Strength Steel (HSS)
- Group 2 → Advanced High Strength Steel (AHSS)
- Group 3 → Aluminum
- Group 4 → Magnesium
- Group 5 → Carbon Fiber Composites (CFRP)



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Step 3.1 Calculate new Masses

Note: Use the coefficient from table 2.

Step 3.2 Calculate Mass Reduction

Step 3.3 Calculate Redesign Cost

Subsystem	Old Mass (kg)	Old Cost (USD)	New Mass (kg)	New Cost (USD)
Body Non-structural				
Body Structure				
Powertrain (Steel)				



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Part 2: Fuel Reduction and CO2 calculations

Part 2.1 Fuel Consumption Calculation

To calculate total fuel saved by reducing the mass use the following formula:

Fuel Saved (L) = Mass Impact Factor (MIF) × Mass Reduction (kg) × Total Lifetime Distance (km)

$$MIF = 0.28 \left(\frac{L}{100km100kg} \right) = 0.000028$$

$$Total\ Lifetime\ Distance = 250000\ km$$

Part 2.2 GHG Emission Saved

To calculate saved greenhouse gas emissions use following formula

GHG Emissions Saved = Fuel Saved (liters) × Emission Factor

$$Emission\ Factor: 2.82 \left(\frac{kg \times CO_2-eq}{liter} \right)$$



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Part 3 – Summary

Fill in the final results:

- Total weight reduction: _____ kg
- New total vehicle weight: _____ kg
- Total redesigned vehicle cost: \$_____ USD
- Total Fuel saved in lifecycle: _____ L
- Total GHG saved in lifecycle: _____ $kg * CO_2 - eq$