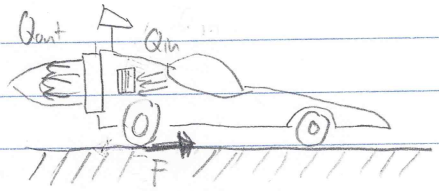
20-P-MOM-DY-38

A jet powered car combines the power of a jet engine and a traditional internal combustion engine to achieve high velocities. The internal combustion engine provides the thrust force $F_c = 1500N$. The jet engine intakes air at a rate of $Q_{in} = 195\ kg/s$ and ejects a fuel and air mixture at $Q_{out} = 200\ kg/s$. Assuming the car starts at rest, determine the highest velocity achievable if the drag force is $F = 10v^2$, m of vehicle = 4000kg. [not Q, relative to jet $v = 9000\ m/s$] Find acceleration instead at $t = 5s$, $v = 500\ km/h$



Solution: $\Sigma F_x = m\frac{dv}{dt} - v_e\frac{dm_e}{dt} + v_i\frac{dm_i}{dt}$

$v_e = 9000 \quad v_i = v \quad m = 4000 - 5t$

$1500 - 10v^2 = (4000 - 5t)\frac{dv}{dt} - 9000(200) + v(195)$

$\frac{dv}{dt} = a$

$v = 138.9\ m/s$

$a = 397.48\ m/s$