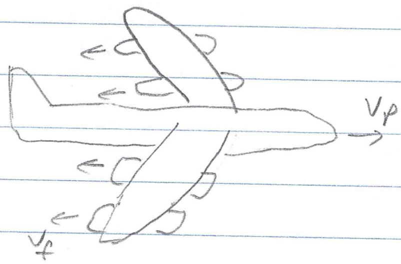
20-P-MOM-DY-39

A four engine plane plane is flying at a constant velocity 750 km/h. During the flight two of the engines shut down due to malfunction. Each engine ejects a combination of fuel and air at a velocity $v_f = 500 \, m/s$ relative to the plane. Assuming the loss of mass due to fuel consumption is negligible, determine the new constant velocity of the plane if the drag force $F = C v^2$.

$v_p =$



Solution: $v_e = v_p + v_{e/p}$

$v_p = 750 \, km/h = 208.3 \, m/s$

$v_e = 208.3 \, m/s - 500 \, m/s = -291.67 \, m/s$

$\sum F_x = \frac{dm}{dt}(v_B - v_A)$ $\quad C v^2 = -4 \frac{dm}{dt}(v_e - 0)$ $\quad C = 0.0269 \frac{dm}{dt}$

After two engines shut down

$v_e = v_p + v_{e/p} \Rightarrow v_e = v_p - 500 \, m/s$

$\sum F_x = \frac{dm}{dt}(v_B - v_A)$ $\quad 0.0269 \frac{dm}{dt} v_p^2 = -2 \frac{dm}{dt}(v_p - 500)$

$0.0269 v_p^2 + 2 v_p - 1000 = 0$

$\text{root} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = 159.18 \, m/s = v_p$