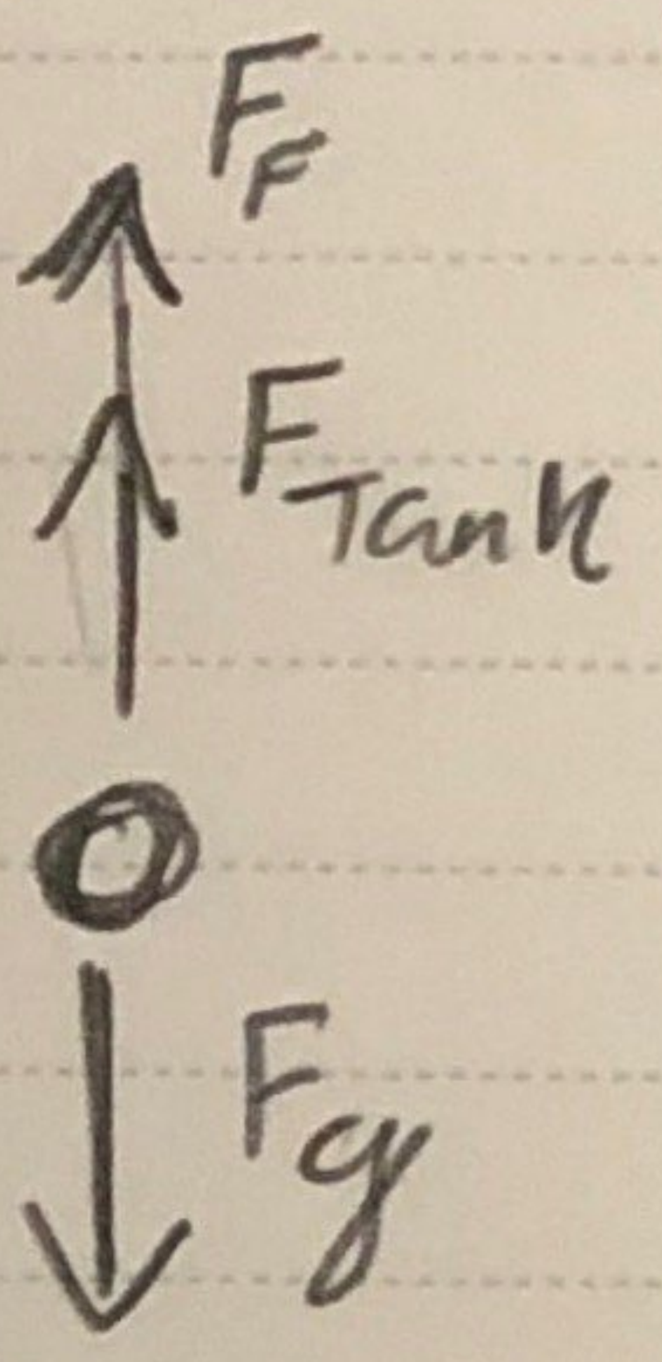
Free Body Diagram



F_F = Friction of air

F_{Tank} = m·a of super critical CO_2

F_g = m·a of gravity

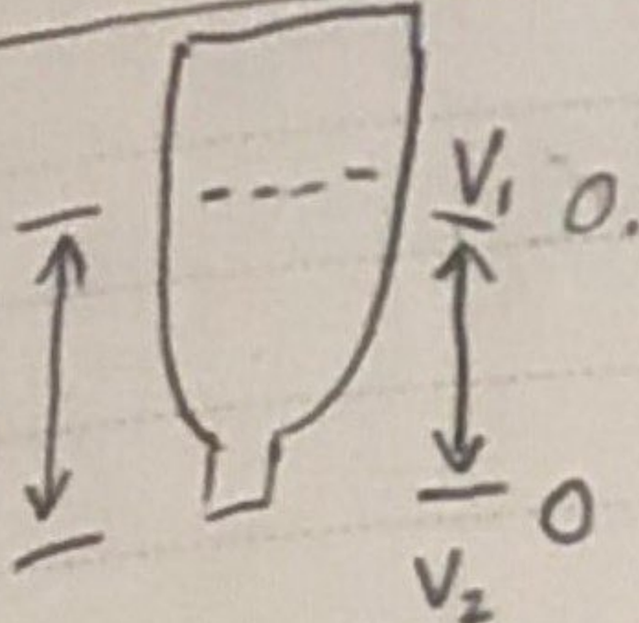
$V_0 = 5\ m/s \downarrow$

(Assumption simplification
movement only in Z)

P Date: 1)

(Bernoulli's Equation)

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g Z_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g Z_2$$



$$P_1 + \frac{1}{2}\cancel{\rho V_1^2} + \rho g Z_1 = P_2 + \cancel{\rho g Z_2} + \frac{1}{2}\rho V_2^2$$

$$8\text{ Mpa} + (\rho g Z_1) = (0.1013\text{ Mpa}) + \frac{1}{2}\rho V_2^2$$

$$7.898\text{ MPa} + \left(322.42\ \frac{kg}{m^3}\frac{m}{s^2}m\right) = \frac{1}{2}\left(131.6\ \frac{kg}{m^3}\right)V_2^2$$

$$7.898\times10^6\ \frac{kg}{m/s^2}\quad \frac{kg}{m/s^2}$$

$$120035.295\ \frac{m^2}{s^2} = V_2^2$$

$$\boxed{V = 346.45\ m/s}$$

$$\dot{m} = \rho A V$$

$\varnothing = 0.25$ in or 6.35mm

$A = 0.00003167\ m^2$

$$\dot{m} = (131.6\ kg/m^3)(0.00003167\ m^2)(346.45\ m/s)$$

$$\boxed{\dot{m} = 1.4439\ kg/s}$$

(Atm)

$P_2 = 0.101325$ Mpa
$= 101325$ pa

$1\text{ Pa} = \frac{N}{m^2} = \frac{kg\frac{m}{s^2}}{m^2}$

$P_1 = 1160\text{ psi} = 8\text{ Mpa}$

$\rho = \cancel{773}\ 131.6\ kg/m^3$

$V_1 = 0$

$V_2 = \sqrt{2gh} = 1.9798\ \frac{m}{s}$

$V = 0.64L = 0.00064\ m^3$

$\rho \cdot V = m$

$0.0842\ kg = m$

2) $F = ma$

$$\text{Time} = \frac{0.0842\ kg}{1.443\ kg}\ s = 0.0583\ s$$

$$A = \frac{V_1 + V_0}{t} = \frac{346.45\ m/s}{0.0583\ s}$$

(Neglecting Initial velocity)

$A = 5942.5\ m/s^2$

(Tank)

$F = m \cdot A$

$F = 500.36\left(kg\frac{m}{s^2}\right)$

2) $F = ma$

Date:

(Neglecting Initial Velocity)

$F_{Tank} = (0.0842\,kg)(5942.5\,m/s^2)$

$F_{Tank} = 500.36\ kg\,\frac{m}{s^2}$

Body

$F_{Body} = (5\,kg)(9.8\,m/s^2)$

$F_{Body} = 49\ kg\,\frac{m}{s^2}$

$F_{Tank} > F_{Body}$

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3) Impulse

$J = F(\Delta t)$

N·s or $kg\,\frac{m}{s}$

Momentum

$\Sigma P = mV$

$kg \cdot m/s$

Parachute

Avg speed

$4.47\,m/s - 7.59$

(Tank)

$\Sigma P = (0.0842\,kg)(346.45\,m/s)$

$\Sigma P = 29.171\ kg\,(m/s)$

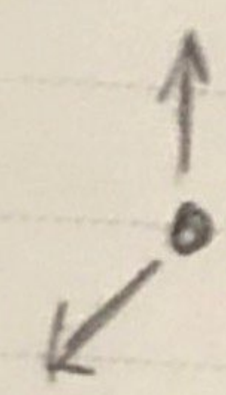
Time

$T = 0.0583\,s$

From 2

(Body)

$\Sigma P = (5\,kg)(5\,m/s)$



$\Sigma P_L = 25\ kg\,m/s$

$\Sigma P = (5\,kg)(7\,m/s)$

$\Sigma P_U = 35\ kg\,m/s$

$\Sigma P = 25 \sim 35\ kg\,m/s$

$\boxed{P_{Body} \approx P_{Tank}}$

Date:

(Energy Equation)

ΣE (Closed System $0 = \Delta M$)

$$(W_{in} - W_{out}) + (Q_{in} - Q_{out}) = \Delta U + \Delta KE + \Delta PE$$

(Tank) calculator Energy Equation

~~$\Delta E = P * \Delta V$~~

~~Pressure Volume~~

1 Psi = ~~6894 N/m^2~~

~~1 L = 0.001 m^3~~

~~1160 psi = 7997040 N/m^2~~

~~0.64 L = 0.00064 m^3~~

~~$E = (7997040\ N/m^3)(0.00064\ m^3) = 5118.105\ N$~~

$E = 5118.105\ kg\ \frac{m}{s^2}$

$J = N \cdot m$

(Tank)

$E = P(V)$

1160 Psi = 7997918 Pa or N/m^2

0.64 L = 0.00064 m^3

$E(J) = (Pa)(m^3)$

$N = kg \frac{m}{s^2}$

$E = (7997918\ N/m^2)(0.00064\ m^3)$

$$\boxed{E = 51186.67\ N \cdot m \text{ or } J}$$

Date:

(Body)

$$\Delta KE = \frac{1}{2} m (v_2^2 - v_1^2)$$
$$\Delta PE = mg(z_2 - z_1)$$

$5\ \frac{m}{s}$ $\quad Z = 3m$

$$\Delta E = \cancel{\Delta U}^{0} + \Delta KE + PE$$

$$\Delta E = \frac{1}{2}(5kg)(5\ \tfrac{m}{s})^2 + (5kg)(9.8\ \tfrac{m}{s^2})(3m)$$

$$62.5\ kg\frac{m^2}{s^2} + 147\ kg\frac{m^2}{s^2}$$

$$\Delta E = 209.5\ kg\frac{m^2}{s^2}$$

$$\Delta E = 209.5\ N{\cdot}m$$

$$\boxed{\begin{gathered} E_{tank} > E_{Body} \\ 51186.67\ N_m > 209.5\ N{\cdot}m \end{gathered}}$$