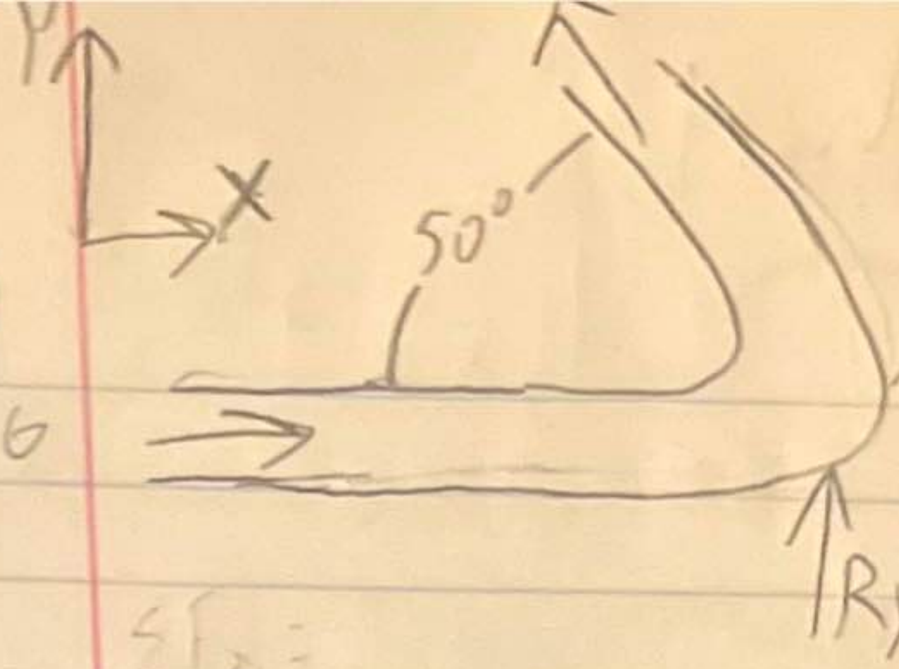
HW 9

Logan Roby

16.6



180°F

$Q = 22\frac{ft}{s} \times 2.95in^2 \times \frac{ft^2}{144in^2}$ $A = 2.95in^2$

$V_1 = 22 FT/S$

$\rho = 1.88 slugs/ft^3$

$Q = A \cdot V \times \frac{1ft^2}{144in^2}$

$Q = .4507 ft^3/s$

$\Sigma F_x = \rho Q(V_{2x} - V_{1x})$

$-R_x = \rho Q(-\cos 50 \cdot V - V_1)$

$R_x = 1.88 \frac{slug}{ft^3} \times .4507 \frac{ft^3}{s}\left(22\frac{ft}{s}\cos 50 + 22\frac{ft}{s}\right)$

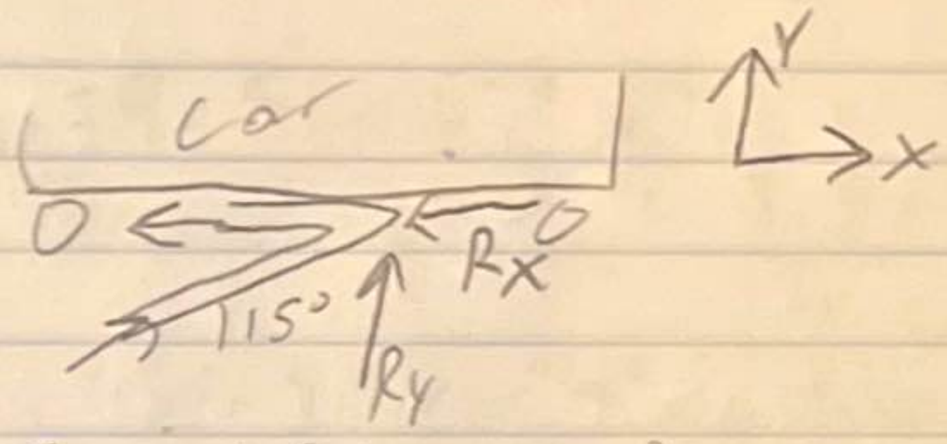
$\boxed{R_x = 30.62 lbs}$

$\Sigma F_y = \rho Q(\sin 50 V_2 - 0)$

$R_y = 1.88 \frac{slugs}{ft^3} \times .4507 \frac{ft^3}{s}\left(\sin 50\, 22\frac{ft}{s}\right)$

$\boxed{R_y = 14.28 lbs}$

16.20



$D = .2m$

$A = \frac{\pi}{4}D^2 = \frac{\pi}{4}(.2m)^2$

$A = .0314 m^2$

a) $\Sigma F_x = \rho Q(V_{2x} - V_{1x})$

$-R_x = \rho Q(-V - \cos 15\, V)$

$R_x = 1000\frac{kg}{m^3} \times .9425\frac{m^3}{s}\left(30\frac{m}{s} + 30\frac{m}{s}\cos 15°\right)$

$\boxed{R_x = 55.59 kN}$

$V = 30 m/s \quad Q = VA$

$Q = 30\frac{m}{s} \times .0314 m^2$

$Q = .9425 m^3/s$

$\rho = 1000 kg/m^3$

$\Sigma F_y = \rho Q(V_{2y} - V_{1y}) \quad V_{2y} = 0$

$R_y = 1000\frac{kg}{m^3} \times .9425\frac{m^3}{s}\left(0 - \sin 15\, 30\frac{m}{s}\right)$

$\boxed{R_y = -7.32 kN \text{ or } 7.32 kN \text{ down}}$

b) $R_x = \rho Q V_1$

$R_x = 1000\frac{kg}{m^3} \times .9425\frac{m^3}{s}(16.98\frac{m}{s})$

$V_1 = V_1 \cos 15 - V_{wr}$

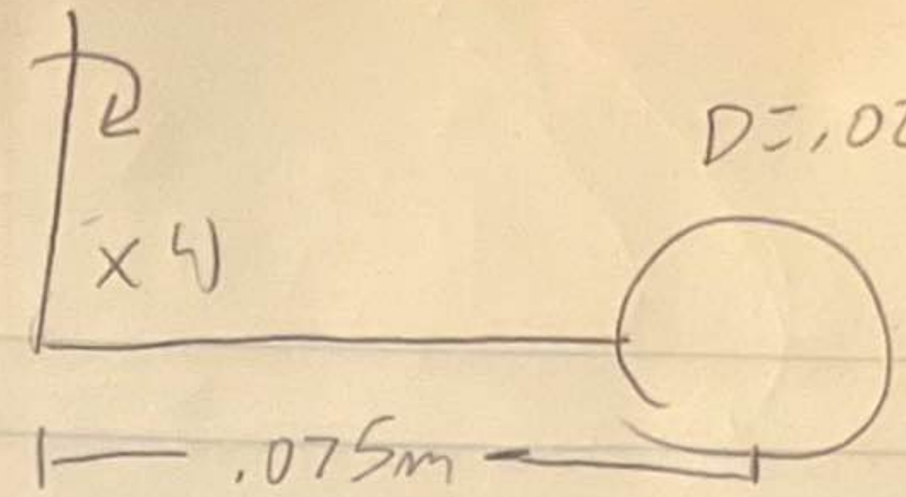
$V_1 = 30\frac{m}{s}\cos 15 - 12\frac{m}{s}$

$V_1 = 16.98\frac{m}{s}$

$\boxed{R_x = 16 kN}$

R_y would not change

17.11



D = .025m

$A = \frac{\pi}{4} D^2$

$A = \frac{\pi}{4} (.025m)^2$

$A = 4.91 \times 10^{-4} m^2$

$C = 2\pi r$ $C = 2\pi .075m$

$C = .4712m$

$.4712 \times 20 = 9.425 \frac{m}{min} \times \frac{1 min}{60 sec}$

20 RPM

$\rho_{AIR} = 1.164 kg/m^3$

$\rho_{GAS} = 680 kg/m^3$

$\nu_{air} = 1.6 \times 10^{-5} m^2/s$

$\nu_{gas} = 4.22 \times 10^{-7} m^2/s$

a) $Re_{air} = \frac{VD}{\nu_{AIR}} = \frac{.157 m/s \times .025m}{1.6 \times 10^{-5} m^2/s}$ $.157 m/s = V$

$Re_{air} = 245.3 \Rightarrow C_D = 1.35$

$F_D = C_D A \frac{\rho V^2}{2}$

$C_D = 1.35$ Table 17.1

$F_D = 1.35 \times 4.91 \times 10^{-4} m^2 \frac{(.157 m/s)^2 \times 1.164 kg/m^3}{2}$

$F_D = 9.51 \times 10^{-6} \times 4 = F_D = 3.8 \times 10^{-5} N$

$Torque = F_D \times r = 3.8 \times 10^{-5} N \times .075m$

$\boxed{Torque = 2.85 \times 10^{-6} N}$

b) $F_D = 1.35 \times 4.91 \times 10^{-4} m^2 \times \frac{(.157 m/s)^2 \times 680 kg/m^3}{2}$

$F_D = 5.56 \times 10^{-3} N \times 4 = .0222 N \times .075$

$\boxed{Torque = 1.67 \times 10^{-3} N}$

17.26 $R_{TS}/\Delta = .06$ $V = 50 ft/s$

$P_E = R_{TS} \cdot V$ $P_E = 16,800 lbs \times 50 \frac{ft}{s}$

$P_E = 8.4 \times 10^5 \frac{ft \cdot lbs}{s} \times \frac{1 HP}{550 \frac{ft \cdot lbs}{s}}$

$\boxed{P_E = 1527.27 HP}$

long ton = 2240 lbs

$\times 125$

$\Delta = 2.8 \times 10^5 lbs$

$R_{TS} = .06 \times \Delta$

$R_{TS} = .06 \times 2.8 \times 10^5 lbs$

$\boxed{R_{TS} = 16,800 lbs}$