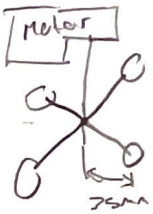
Chapter 17:

FBD



11) Given

$d = 25mm$ or $0.025m$

20 rpm

linear velocity

$V = \frac{75}{100} \times \frac{2\pi \times 20}{60} = 0.157 m/s$

$F_D = \rho A V^2$

$= \frac{1}{2}(1.225)(490.87E-6m)(0.157 m/s)^2$

$F_D = 14.82E-6 m$

$F = 4 \times 14.82E-6m$

$F = 59.284E-6$

$\rho_{AIR} = 1.225 kg/m^3$

$A = \frac{\pi}{4} d^2 = \frac{\pi}{4} \times (0.025)^2$

$A = 490.87E-6 m$

4 cups

$L = 75mm$ or $0.075m$

Total Torque (T) $= F \times L = 59.284E-6 \times 0.075M$

$T = 4.446E-6 N \cdot m$

14) Given

$V = 150 mph$

$d = 2in$ or $0.0508m$

$h = 32in$

$= 0.812s$

$r = 25.4E-3$

$2Rods = 2 \times 32 in = 64in$ or $1.6256m$

$A = 2\pi r(r+h) = 2\pi \times 25.4E-3(25.4E-3 + 1.6256m)$

$= 0.2634 m$

$V = 67.056 m/sec$

$F_D = 2 \times 1/2 \rho V^2 A$

$= 2 \times 1/2 \times 1.225 kg/m^3 \times 67.056 m/sec \times 0.2634m$

$F_D = 21.604 lbF$

16) Given

$V = 100 mph = 44.704 m/s$

$\rho_{AIR} = 1.225$

$w = 9in$ $l = 60in$

$l/w = 60/9 = 6.67$

$C_d = 1.22$

$A = 60 \times 9 = 540 in = 13.716 M$

$F_D = (1/2)(C_d) \rho V^2 A = 1/2(1.22)(1.225) \times 44.704^2 \times 13.716 m$

$F_D = 20.483 lbF$

Chapter 17:

26) Given
Displaced by ship = 125 tons
Resistance Ratio = 0.006
T = 77°F

$\frac{R}{\Delta} = 0.006$

$\Delta = 125 \times 2240 = 2.8E5$

$R = 0.006 \times 2.8E5 = 1680$ lb

Power required to overcome drag (P)

$P = 1680 \text{ lb} \times 50 \text{ ft/s} = 8.4E4$ lb-ft/s or 152.72 hp

30) Given
$C_L = 1.4m$
$b = 6.8m$
$V = 200 \text{ km/h}$ or 55.55 m/s
$\alpha = 10°$

$F_D = C_D\left(\frac{\rho V^2}{2}\right)A$

$F_L = C_L\left(\frac{\rho V^2}{2}\right)A$

$Area = c \cdot b = 1.4m \times 6.8m = 9.52 m^2$

$C_D = 0.05$

$C_L = 0.9$

a) ρ_{Air} @ 20°C = 1.202 kg/m³

$F_D = 0.05\left(\frac{1.202 \text{ kg/m}^3 \times (55.55)^2}{2}\right) \times 9.52m$

$F_D = 882.72 N$

$F_L = 0.9\left(\frac{1.202 \text{ kg/m}^3 \times (55.55 \text{ m/s})^2}{2}\right) \times 9.52m$

$F_L = 15889.9 N$

b) ρ_{Air} @ 10,000m = 0.4135 kg/m³

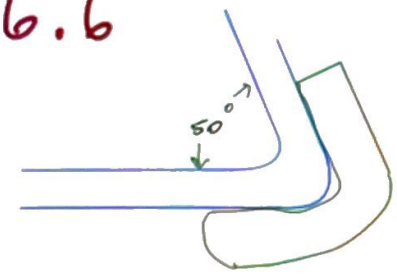
$F_D = 0.05\left(\frac{0.4135 \times (55.55)^2}{2}\right) \times 9.52$

$F_D = 303.68 N$

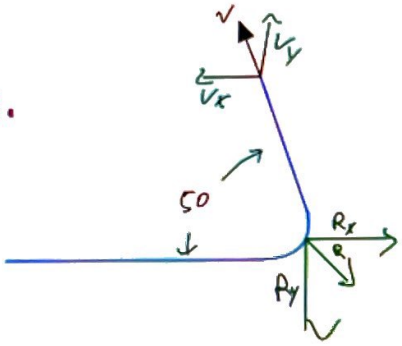
$F_L = 0.9\left(\frac{0.4135 \times (55.55)^2}{2}\right) \times 9.52$

$F_L = 5466.3 N$

16.6



home work
daniel E.



Find F_x and F_y

$A = 2.35\ in^2 = 0.0205\ ft^2$

$V = 22\ ft/sec$

@ 180°F
$\rho = 1.88\ slug/ft^3$
$\gamma = 60.6\ lb/ft^3$

Flow rate (Q)
$Q = VA$
$Q = 22\ ft/sec \cdot 0.0205\ ft^2$
$Q = 0.451\ ft^3/sec$

Find velocity directions:

$V_x = V \cdot \cos(50) = 22\ ft/sec \cdot \cos(50) = 14.14\ ft/sec$

$V_y = V \cdot \sin(50) = 22\ ft/sec \cdot \sin(50) = 16.85\ ft/sec$

$R_x = \rho \cdot Q \cdot \Delta V_x$

$R_y = \rho \cdot Q \cdot \Delta V_y$

$(\Delta V = V_2 - V_1)$

$V_1 = 22\ ft/sec\ \vec{i}$

$R_x = 1.88\ slug/ft^3 \cdot 0.451\ ft^3/sec\ (14.14\ ft/sec - 22\ ft/sec)$

$0.84788\ slug/sec\ (-7.86\ ft/sec)$

$R_x = -7.86\ N$

80

$\boxed{F_x = 7.86\ N}$

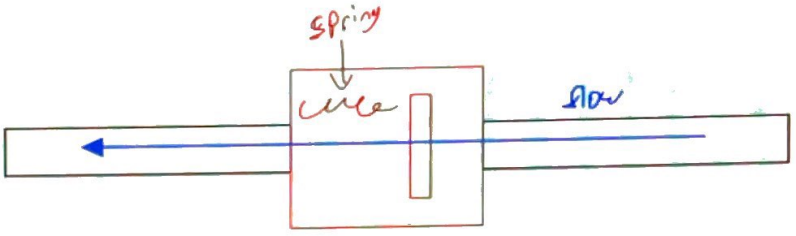
$R_y = 1.88\ slugs/ft^3 \cdot 0.451\ ft^3/sec^2\ (16.85\ ft/sec - 0)$

$0.84788\ slug/sec\ (16.85\ ft/sec)$

$R_y = 14.287\ N$

$\boxed{F_y = 14.287\ N}$

16.11



$1 gal \Rightarrow 0.1337 ft^3$

$1 min = 60 sec$

$$Q = \frac{100 \text{ gal/min} \mid 1 \text{ min} \mid 0.1337 \text{ ft}^3}{\mid 60 \text{ sec} \mid 1 \text{ gal}} = 0.223 \text{ ft}^3/\text{sec}$$

flow rate

$Q = VA$

$V = \frac{Q}{A}$

Force

$For = \rho \cdot Q \cdot \Delta v$

lin Schcg

$A = 0.00600 \text{ ft}^2$

$\rho^{@80^\circ} = 1.93 \text{ slug/ft}^3$

$$V = \frac{0.223 \text{ ft}^3/\text{sec}}{0.006 \text{ ft}^2} = 37.167 \text{ ft/sec}$$

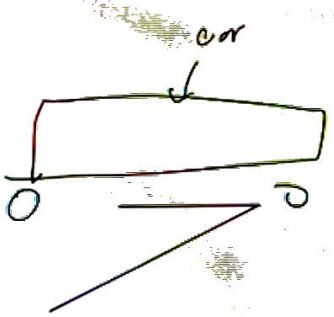
Plug and chug

$F = \rho \cdot Q \cdot \Delta V$

$F = 1.93 \text{ slug/ft}^3 \cdot 0.223 \text{ ft}^3/\text{sec} \; (37.167 + 37.167)$

$= 31.99 N$

16.20



a) Stationary

$F = \rho \cdot Q \cdot \Delta v$

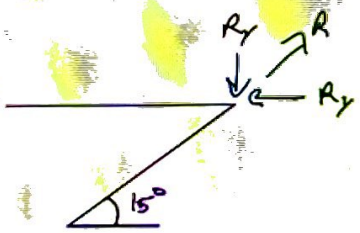
Area:

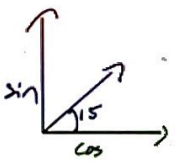
$A = \frac{\pi}{4} L^2$

$A = \frac{\pi}{4} \cdot 0.2\,m^2 \Rightarrow 0.0314\ m^2$

$\rho @ 25° = 997\ kg/m^3$

$L = 200\,mm \Rightarrow 0.2\,m$





flowrate:

$Q = v \cdot A$

$= 30\,m/sec \cdot 0.0314\,m^2$

$= 0.942\ m^3/sec$

$x = \cos(15)$

$y = \sin(15)$

$R_x = \rho Q \Delta v_x \quad \Delta v = (v_2 - v_1)$

$997\ kg/m^3 \cdot 0.942\ m^3/sec\ (30 - (30 \cdot \cos(15))$

$R_x = 960\ N$

$R_y = \rho Q \Delta v_y$

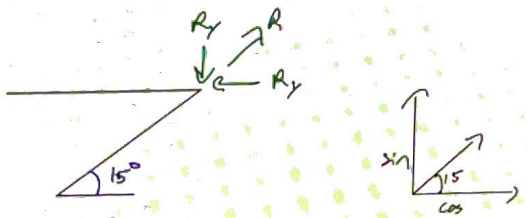
$= 997 \cdot 0.942\ [30 - (30 \cdot \sin(15))$

$= 20,882\ N$

B) moving @ 12 m/sec

$V_x = 30 \cdot \cos 15 = 28.98$

$V_y = 30 \cdot \sin 15 = 7.764$



Final Velocity : $V_{car} = 12 m/sec$

$\Delta V_x = 28.98 m/sec - 12 m/sec$

$= 16.98 m/sec \; V_x$

$\Delta V_r = \sqrt{16.98^2 + 7.764^2} = 18.67 m/sec$

V_{sc}

$F = \rho \cdot Q \cdot \Delta V$

$= 997 kg/m^3 \cdot 0.942 m^3/sec \; (30 m/sec - 18.67 m/sec)$

$= 10,640.84 N$