

짝수 번호 문제 해답

Chapter 1

- 1.2 (a) MLT^{-1} ; (b) ML^4L^{-2} ; (c) MT^{-2}
 1.4 (a) FLT^{-2} ; (b) $FL^{-1}T^{-1}$; (c) $FL^{-3}T$
 1.10 (a) FL^{-1} ; (b) FL^{-3} ; FL
 1.12 LT^{-1} ; $F^0L^0T^0$; LT^{-1}
 1.14 Yes
 1.16 $1/2, -1/2$
 1.18 Dimensionless
 1.20 $7,200 \text{ m}^3/\text{s}$
 1.22 acceleration $\times$ time/velocity = $(LT^{-2})(T)/(LT^{-1}) = L^0T^0$
 frequency $\times$ time = $(T^{-1})(T) = T^0$
 (velocity) 2 /length $\times$ acceleration = $(LT^{-1})^2/(L)(LT^{-2}) = L^0T^0$
 force $\times$ time/momentum = $(F)(T)/(MLT^{-1}) = (F)(T)/(FT^2L^{-1})(LT^{-1}) = F^0L^0T^0$
 density $\times$ velocity $\times$ length/dynamic viscosity = $(ML^{-3})(LT^{-1})(L)/(ML^{-1}T^{-1}) = M^0L^0T^0$
 1.26 (a) 3580 N; (b) 598.6 N
 1.30 1.36
 1.34 9770 N/m^3 ; 996 kg/m^3 ; 0.996
 1.36 $3,290 \text{ N/m}^3$
 1.40 64°C
 1.42 Oxygen
 1.44 1.26 m^3
 1.46 58 kPa
 1.50 893 l/s
 1.52 $1.5 \times 10^{-3} \text{ N} \cdot \text{s}/\text{m}^2$
 1.56 $0.277 \text{ N} \cdot \text{s}/\text{m}^2$
 1.58 $2.05 \times 10^{-5} \text{ N} \cdot \text{s}/\text{m}^2$
 1.60 (a) No; (b) Not correct
 1.62 184
 1.64 $C = 1.43 \times 10^{-6} \text{ kg}/(\text{m} \cdot \text{s} \cdot \text{K}^{1/2})$; 107 K
 1.66 $5.76 \times 10^{-4} \text{ N} \cdot \text{s}/\text{m}^2$
 1.68 $0.300 \text{ N} \cdot \text{s}/\text{m}^2$
 1.70 non-Newtonian
 1.72 286 N
 1.74 0.0883 m/s
 1.76 0.19 m/s
 1.78 151 s^{-1} ; $33,333 \text{ m}^{-2}\text{s}^{-1}$
 1.80 $1.22 \times 10^{-3} \text{ N} \cdot \text{s}/\text{m}$
 1.82 (a) $1.182 \text{ m}^2/\text{rev}$; (b) $0.225 \text{ N} \cdot \text{s}/\text{m}^2$
 1.88 2.73 MPa
 1.90 2.02 GPa

- 1.94 719 kPa (gage)
 1.96 $2.88 \text{ kg}/\text{m}^3$
 1.98 $2.18 \text{ kg}/\text{m}^3$; 154°C
 1.100 718.6 kPa
 1.102 1.06
 1.104 14.1%
 1.108 13 kPa (abs)
 1.110 5.81 kPa (abs)
 1.112 0.060 N/m
 1.114 538 Pa
 1.116 97.9 Pa
 1.118 (a) $\theta = 24.5^\circ$
 1.120 0.00156 m ; Yes.
 1.122 3.00 mm
 1.124 7.49 mm

Chapter 2

- 2.2 59.2 kPa
 2.6 2.39 kPa
 2.8 404 kPa
 2.10 (a) $p = -E_v \ln(1 - \rho_0 gh/E_v)$; (b) 61.4 MPa; (c) 60.6 MPa
 2.12 $p = Kh^2/2 + \gamma_0 h$
 2.18 464 mm
 2.20 63.5%
 2.24 8,794 m
 2.26 443 m
 2.28 60 kPa
 2.32 99.35 kPa (abs)
 2.34 (a) 5.6 m; (b) 60.76 kPa; (c) 150.3 kPa
 2.36 0.095 m
 2.38 1.91 m
 2.40 -3.32 kPa
 2.42 (a) 1.22 m; (b) 0.63 m
 2.44 0.43 m
 2.46 (a) 26.9 kPa; (b) 0.202 m
 2.48 $16.99 \text{ kg}/\text{m}^3$
 2.50 94.9 kPa
 2.54 6.56 m
 2.56 27.52 kPa
 2.58 0.100 m
 2.60 28.68
 2.62 0.212 m
 2.64 0.089 m (down)

- 2.66 $\ell = [d + 11.31 - (d^2 + 18.61d + 128)^{1/2}]/2$
 2.68 159,493.6 N
 2.70 $p(\text{kPa}) = 1.85 \theta$
 2.74 0.00802 N
 2.76 89.62 kN
 2.78 37,166 N
 2.80 375 kN
 2.82 107 kPa
 2.84 7.11 m; No
 2.86 $F_B = \gamma \pi R^3/4$
 2.88 (a) 3.6 m; (b) 48 kN; (c) 0 kN
 2.90 101 Kn
 2.92 373 kN
 2.94 314 kN; 497 kN
 2.96 7 kN
 2.100 1.02 m
 2.102 (a) 2.11 m; (b) 941 kN
 2.104 4519 N
 2.106 426 kN, 2.46 m below surface
 2.108 1.4 m
 2.110 0.146
 2.116 392 kN; 437 kN; Yes
 2.118 135.4 N; 2574 N; 2.29 kN/m²
 2.120 34.32×10^9 N acting 124 m above base
 2.122 64.4 kN
 2.124 24.527 kPa
 2.126 203 kN down
 2.128 3370 lb; 882 lb
 2.130 485 kN
 2.134 0.37 m; no change
 2.136 3,423,630 N; 1,367,452 N
 2.138 236 kN
 2.142 536 N
 2.144 18.9 kPa; 0.208 m³
 2.146 2932 N upward; $l = 1.9$ m to right of point A
 2.148 89.5%
 2.150 2.63 m/s²
 2.152 3374 N/m²; 253 N downward
 2.154 30°
 2.156 $h = a\ell/g$
 2.158 6.04 rad/s
 2.160 1.7 m
 2.162 28.8 kPa

Chapter 3

- 3.2 13.7 m/s
 3.4 -30.0 kPa/m
 3.6 -18.797 kPa/m; 0.795 kPa/m
 3.8 (a) $-2\rho a^2 V_0^2 [1 - (a/x)^2]/x^3$
 (b) $p_0 + \rho V_0^2 [(a/x)^2 - (a/x)^4/2]$
 3.12 12.0 kPa; -20.1 kPa
 3.14 (a) 500 N/m³; (b) 1311 N/m³
 3.20 3.21 N/m²
 3.24 0.57 kN/m²; 61.7 m/s
 3.28 46.5 m/s
 3.32 2.0 m/s

- 3.34 13.9 m
 3.36 58.8 kN/m²
 3.40 9.34 N/s
 3.42 0.334×10^{-3} m³/s
 3.44 15.4 m
 3.46 (a) 0.069 m; 0.452 kN/m²
 3.48 2.45×10^5 kN/m³; 5.50×10^{-6} m³/s
 3.50 0.92 m
 3.52 0.0156 m³/s for any D
 3.54 1.97 m; B above A
 3.56 $D = D_1/[1 - (\pi^2 g D_1^4 z/8Q^2)^{1/4}]$
 3.58 0.94 m
 3.60 2.94 m
 3.62 2.13×10^{-3} m³/s, 23,520 N/m², 22,932 N/m², 588 N/m²
 3.64 (a) 1.1 m; (b) 11.0 m/s; -462 kN/m²
 3.66 135 kPa (gage)
 3.68 6.26 m
 3.70 (a) 1.06×10^{-3} ; (b) 3.02×10^{-3} ; 0.118
 3.72 29.5 Pa
 3.74 0 (gage); 0.146 m
 3.76 (a) 0.0696 m³/s; (b) 0.574 m
 3.78 $H/H_0 = 1/(1 + cx/L)^{1/2}$, where
 $c = 2\gamma_{\text{H}_2\text{O}} d_{\text{max}}/\rho V_0^2$
 3.80 0.0132 m³/s
 3.82 6.84 cm
 3.84 4
 3.86 89.1 kPa
 3.88 0.607 ft³/s; (b) 21.3 ft
 3.90 3.52×10^{-3} m³/s
 3.92 0.131 m
 3.94 $R = 0.998 z^{1/4}$
 3.100 404.5 kPa
 3.102 252 kPa; 114 kPa
 3.104 9.10×10^{-3} m³/s; 57.9 kPa
 3.106 81.1 m³/s; 59.1 m³/s; 62.3 m³/s
 3.108 155 N/m²
 3.112 1.336 m; 0.188 m
 3.116 6.10×10^{-3} m³/s
 3.118 0.026 m
 3.120 1.73 m²/s
 3.122 25.4 m; 6.51 m; -9.59 m

Chapter 4

- 4.2 $\sqrt{9y^2 + 12y + 68}$ m/s
 4.4 $x = y + y^2/2$
 4.8 $x = -2, y = 2$
 4.10 Everywhere; $x^2 + y^2 = \text{constant}$
 4.14 $x = -h(u_0/v_0) \ln(1 - y/h)$
 4.18 10, 9, 6, 4 ft/s
 4.20 $2c^2x^3, 2c^2y^3; x = y = 0$
 4.22 $4x\hat{i} + y\hat{j} + z\hat{k}$
 4.24 (a) 2 m/s²; (b) negative
 4.26 10 m/s²
 4.28 -5.12×10^{10} m/s²; -5.21×10^9
 4.32 720 m/s²; 1440 m/s²; 2160 m/s²

- 4.34 -10.7 m/s^2 ; 1.01
 4.36 $(225x + 150) \text{ m/s}^2$; 0; 150 m/s^2 ; 375 m/s^2
 4.42 2.42 m/s
 4.46 8860 m/s^2 ; 7440 m/s^2
 4.48 3 m/s^2 ; 6 m/s^2 ; $3\hat{s} + 6\hat{n} \text{ m/s}^2$
 4.50 $a_x = 2c^2x(x^2 + y^2)$; $a_y = 2c^2y(x^2 + y^2)$
 4.52 3.20 m/s^2 ; 1.48 m/s^2
 4.54 -67.4 m/s^2 ; -8.42 m/s^2 ; -2.5 m/s^2
 4.56 157.5°F/s
 4.58 -28.4°C/s ; -25.1°C/s
 4.60 (a) 200°C/s ; 100°C/s
 4.62 $5.0 \text{ m}^3/\text{s}$ for each line
 4.64 $2.7 \text{ m}^3/\text{s}$
 4.68 (b) $2 V_0 \hbar b/3$
 4.72 (a) 3000 kg/s ; (b) $3.00 \text{ m}^3/\text{s}$

Chapter 5

- 5.2 20 m/s
 5.4 282.95 kg/s
 5.6 0.028 m
 5.8 1.28 m/s
 5.10 314 m/s
 5.12 -0.0189 kg/s
 5.14 0.202 kg/m^3
 5.16 $1.00 \text{ m}^3/\text{s}$
 5.18 150 liters/s
 5.20 1.1 m/s
 5.22 0.711 ; 0.791 ; 0.837 ; 0.866
 5.24 (a) 6280 kg/s
 5.26 (a) 0.1 kg/s
 (b) $0.16 \text{ kg/m}^3 \cdot \text{s}$
 5.28 1260 min
 5.30 14.8 m/s
 5.32 (a) 58 L/min ; (b) 232 L/min
 5.34 120 N
 5.36 $2.66 \times 10^{-4} \text{ m}^3/\text{s}$
 5.38 64.6 N
 5.40 $0.2 \text{ m}^3/\text{s}$
 5.42 2207 N
 5.44 14 N
 5.46 (a) 6.26 m/s ; (b) 392 N ; (c) 675 N
 5.48 0 N
 5.50 482 N downward
 5.52 85.1 kN
 5.54 $85.1 \text{ m}^3/\text{s}$
 5.56 16.7 N
 5.58 (a) $T_1 = W_1 - 40.9 \text{ N}$; (b) $W_2 + 73.6 \text{ N}$
 5.60 -185 kN ; 45.8 kN
 5.62 44082 N/m ; 18580.6 N/m
 5.64 29.3 kN
 5.66 12.9 kN
 5.68 66.6 N
 5.70 74 N
 5.72 non-uniform = $(4/3)$ uniform
 5.74 (a) 753 N ; (b) 613 N
 5.76 (b) 1020 N
 5.78 40610 N
 5.80 78.5 kN
 5.88 (a) $231 \text{ N} \cdot \text{m}$, 185 rad/s ; (b) $200 \text{ N} \cdot \text{m}$, 160 rad/s ;
 (c) $116 \text{ N} \cdot \text{m}$, 92.5 rad/s
 5.90 30.13 kW
 5.92 (a) 43° ; (b) $73.4 \text{ N} \cdot \text{m/s}$
 5.94 $-3.3 \text{ N} \cdot \text{m/kg}$
 5.96 $-280.8 \text{ N} \cdot \text{m/kg}$
 5.100 0.32 ft ; right to left
 5.102 $0.042 \text{ m}^3/\text{s}$
 5.104 $4.5 \times 10^{-3} \text{ m}^3/\text{s}$
 5.106 $364.7 \text{ N} \cdot \text{m/kg}$
 5.108 $86.2 \text{ N} \cdot \text{m/kg}$; $18 \text{ N} \cdot \text{m/kg}$
 5.110 227 m
 5.112 $2.22 \times 10^6 \text{ W}$
 5.114 $3910.2 \text{ N} \cdot \text{m/s}$
 5.116 Will work for $p_2 = 200 \text{ kPa}$; will not work for
 $p_2 = 300 \text{ kPa}$
 5.118 $0.052 \text{ m}^3/\text{s}$
 5.120 $147.2 \text{ N} \cdot \text{m/kg}$; $1471 \text{ N} \cdot \text{m/s} = 1.5 \text{ W}$
 5.122 (a) 2.999 kW ; (b) 2.98 m
 5.124 0.58
 5.126 1.78 kW
 5.128 (a) 0.9 ; (b) 5 N
 5.132 0.81 m
 5.134 (a) 17.2° , 4.29 m/s ; $558 \text{ N} \cdot \text{m/s}$
 5.136 (a) $0.95 \text{ N} \cdot \text{m/kg}$; (b) $0.68 \text{ N} \cdot \text{m/kg}$
 5.138 $11.6 \text{ N} \cdot \text{m/kg}$; 0.796
 5.140 $16.5 \text{ N} \cdot \text{m/kg}$; 0.85

Chapter 6

- 6.2 $2x, 4xt^2, -2y, 4yt^2$; $V = 0$; $\mathbf{a} = 1.2 - 1.2\hat{j} \text{ m/s}^2$;
 $\mathbf{a} = 1.69 \text{ m/s}^2$
 6.4 (a) 0; (b) $\boldsymbol{\omega} = -(y/2 + z)\hat{i} + (5z/2)\hat{j} - (y/2)\hat{k}$;
 No
 6.6 $\zeta = 3xy^2\hat{k}$; No
 6.8 $u = -\frac{3}{2}x^2 + \frac{x^3}{3} + f(y)$
 6.10 $\dot{\gamma} = \frac{-r_0\omega}{r_0 - r_i}$
 6.12 No
 6.14 (a) 2.24 m/s , -63.4° , $x = y = 0$; (b) 4.12 m/
 76.0° , none
 6.16 No
 6.18 Second one
 6.22 $v = \frac{-y^2}{2x} + f(x)$
 6.24 $v_\theta = -4r\theta - 9r^2 \cos \theta + f(r)$
 6.26 (a) $\psi = \frac{-Ar^2}{2} + C$; (b) $\psi = -A \ln r + C$
 6.30 $19.6y - 100 \text{ kPa}$, where y is m
 6.34 $\psi = 0.6x - 1.2y + C$; $\phi = -1.2x - 0.6y + C$
 6.36 $\phi = A \ln r + Br \cos \theta + C$; $\theta = \pi$, $r = A/B$
 6.38 37 kPa
 6.40 (a) Yes; (b) Yes, $\phi = 0.2(x + y) + C$; (c) 0