

Answers to questions

1. (a) $\frac{\rho g w h^2}{2}$ (b) $\frac{\rho g w h^3}{6H}$
2. $\frac{A_1}{A_2} \left(1 - \frac{A_1}{A_2} \right)$
3. (a) 9.91 m/s 19.81 kg/s (b) 0.0 3.0 (c) 2.94 MPa/m
4. (a) 0.29 kg/s -68.9 kJ/kg (b) 368.5 K 205.5 kPa (c) 167 %
5. (a) 415.0 K (b) 236.9 J/K/s
6. (b) 0.0957 m³/kg 722.5 K 5514 kPa 2235 K -505.2 kJ/kg
(c) 694.8 kJ/kg 1039 kJ/kg
7. (a) $\frac{a_1}{a_2} = \frac{T_2}{T_1} = 2$ (b) $M = 8m$
8. (a) $\frac{ma^2}{2}$ (b) $\frac{3ma^2}{4}$ (c) $\ddot{\theta} = \frac{2g}{3a}$
9. (a) $R_P = \left(\frac{GM}{\omega^2} \right)^{1/3}$ (c) $mv_P R_P = mv_A R_A \quad \frac{mv_P^2}{2} - \frac{GMm}{R_P} = \frac{mv_A^2}{2} - \frac{GMm}{R_A}$
(d) $\frac{v_2 - v_A}{v_2} = 1 - \sqrt{\frac{2}{x+1}}$
10. (a) $\dot{\mathbf{r}} = \hat{\mathbf{e}}_r + \sqrt{3}\hat{\mathbf{e}}_\theta \quad \ddot{\mathbf{r}} = -3\hat{\mathbf{e}}_r + 3\sqrt{3}\hat{\mathbf{e}}_\theta$ (b) $\frac{4m}{3\sqrt{3}}$
11. (a) $ky + 3\lambda\dot{y} = 2\lambda\dot{x}$ (b) 16.98 mm (c) 0.118 N
12. (b) $\omega^2 = (7 \pm \sqrt{17}) \frac{k}{8m}$ 0.64 -0.39 (c) $x_1 = \frac{(k - m\omega^2)2ky}{\Delta} \quad x_2 = \frac{2k^2y}{\Delta}$