ERRATA for

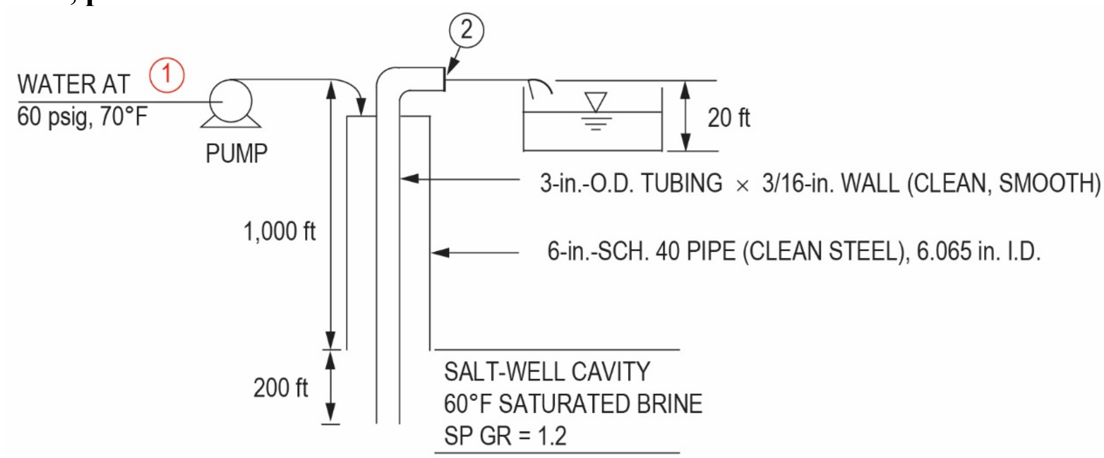
PE Mechanical Engineering: Thermal and Fluid Systems Practice Exam

ISBN: 978-1-947801-08-0

Errata posted 04/01/2024

Revisions are shown in red.

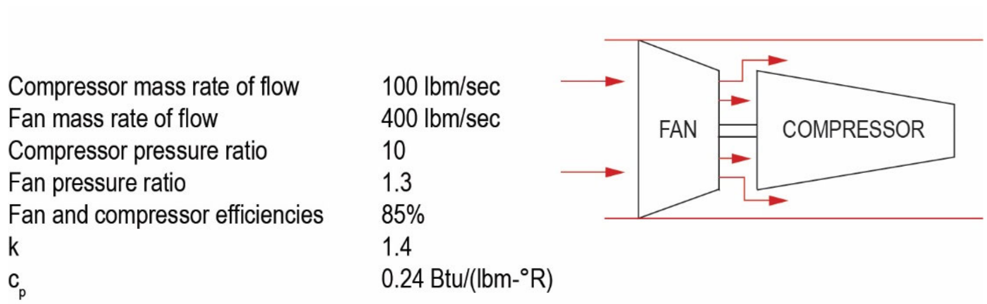
Question 26, p. 25



Question 28, p. 27

A turbofan engine is operating on a test stand at sea level with an ambient temperature of 80°F and an ambient pressure of 14.7 psia. Known data for the fan-compressor portion are shown in the figure. The input power (hp) required to drive the combined fan-compressor is most nearly:

- ○ A. 19,400
- ○ B. 25,100
- ○ C. 87,100
- ○ D. 112,000



Question 32, p. 28

A centrifugal pump is sized to deliver 200 gpm of liquid with a specific gravity of 0.7 and a total differential head of 60 ft.

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Question 34, p. 29

Leaving-Air Temperature
55.0°F db/47.3°F wb
55.0°F db/50.8°F wb
55.0°F db/53.2°F wb
55.0°F db/54.1°F wb

Question 43, p. 36

- A. 1.2×10^6
- B. 1.0×10^6
- C. 1.0×10^5
- D. 8.3×10^4

Question 47, p. 37

A submarine is traveling straight and level at a speed of 34.5 mph.

Question 72, p. 51

A boiler produces 150-psia saturated steam at 20,000 lbm/hr. Additionally, a 4% bottom blowdown is directed to a flash tank for auxiliary steam purposes. The heat transfer (Btu/hr) in the heat exchanger is most nearly:

Solution 26, p. 68

The last line of the solution should be:

$$\text{whp} = \frac{105.88\text{ ft }(50\text{ gal/min})(0.13368\text{ ft}^3\text{/gal})(62.4\text{ lb/ft}^3)}{33{,}000\text{ ft-lb/(min-hp)}} = 1.34\text{ hp}$$

THE CORRECT ANSWER IS: A

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Solution 28, p. 69

Compressor:

$$\frac{T_{2,i}}{T_1} = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

$$T_{2,i} = T_1\left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

For air: k = 1.4

$$= (80°F + 460)(10)^{0.4/1.4}$$

$$T_{2,i} = 1{,}043°R$$

$$W_{comp} = \frac{\dot{m}c_p(T_{2,i} - T_1)}{\eta}$$

c_p = 0.24 Btu/(lbm-°R)

$$W_{comp} = \left[\left(100\frac{\text{lbm}}{\text{sec}}\right)\left(0.24\frac{\text{Btu}}{\text{lbm-°R}}\right)(1{,}043 - 582)°R\right]\left(\frac{60\text{ sec}}{\text{min}}\right)\left(\frac{1}{0.85}\right)\left(\frac{\text{hp-min}}{42.44\text{ Btu}}\right)$$

$$W_{comp} = 18{,}402\text{ hp}$$

Fan:

$$T_{2,i} = (540°R)(1.3)^{0.4/1.4}$$

$$= 582.0°R$$

$$W_{fan} = \left(400\frac{\text{lbm}}{\text{sec}}\right)\left(0.24\frac{\text{Btu}}{\text{lbm-°R}}\right)(582.0 - 540)°R\left(\frac{60\text{ sec}}{\text{min}}\right)\left(\frac{1}{0.85}\right)\left(\frac{\text{hp-min}}{42.44\text{ Btu}}\right)$$

$$= 6{,}711.78\text{ hp}$$

$W_{total} = W_{comp} + W_{fan}$ = 18,402 hp + 6,712 hp = 25,114 hp

THE CORRECT ANSWER IS: B

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Solution 34, p. 71

LAT db is given as 55°F.
LAT wb is calculated.
EAT db is calculated.

$$\text{EAT} = \text{Mixed Air Temperature (MAT)} = \frac{78^\circ\text{F}(2{,}900\ \text{cfm}) + 92^\circ\text{F}(700\ \text{cfm})}{3{,}600\ \text{cfm}} = 80.7^\circ\text{F db}$$

From sea level psychrometric chart at 80.7°F db: MAT wb = 66.2°F; h_{ma} = 30.99 Btu/lb

From sea level psychrometric chart at 78°F db; rh = 45%; h_{ra} = 28.5 Btu/lbm

At outdoor air conditions of 92°F db/76°F wb, h = 39.4 Btu/lb

Q_T for outdoor air = (4.5) cfm (Δh) where cfm = 700 and h = $h_{oa} - h_{ra}$
= (4.5)(700)(39.4 – 28.5) = 34,335 Btu/hr

Q_T for system = SH + LH + OA = 90,000 + 40,000 + 34,335 = 164,335 Btu/hr

Q_T for system = (4.5) cfm (Δh); solve for Δh

$$\Delta h = \frac{164{,}335}{4.5(3{,}600)} = 10.14\ \text{Btu/lb}$$

Therefore, leaving air h = 30.9 – 10.14 = 20.76 = h_{la}

From sea level psychrometric chart at h = 20.76 Btu/lb and 55°F db: 50.8°F wb

EAT = 80.7°F db/66.2°F wb; LAT = 55°F db/50.8°F wb

THE CORRECT ANSWER IS SHOWN ABOVE.

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Solution 47, p. 76

Stagnation pressure, $p = \rho g(SG)h + \frac{1}{2}\rho(SG)v^2$

Density of water, $\rho = 62.4\ \text{lbm}/\text{ft}^3$

Specific gravity, SG = 1.03

Depth, h = 165 ft

$$\begin{aligned} p_1 &= \rho g(SG)h \\ &= 62.4\frac{\text{lbm}}{\text{ft}^3} \times \left(\frac{1}{32.174}\right)\frac{\text{slug}}{\text{lbm}} \times 32.174\frac{\text{ft}}{\text{sec}^2} \times 1.03 \times 165\ \text{ft} \\ &= 10{,}604\ \text{lbf}/\text{ft}^2 \\ &= 73.65\ \text{psi} \end{aligned}$$

$$\begin{aligned} \text{Velocity,}\ v &= 34.5\ \text{mph} \times \frac{1\ \text{hr}}{3{,}600\ \text{sec}} \times \frac{5{,}280\ \text{ft}}{1\ \text{mile}} \\ &= 50.6\ \text{ft/sec} \end{aligned}$$

$$\begin{aligned} p_2 &= \frac{1}{2}\rho(SG)v^2 \\ &= \frac{1}{2} \times 62.4\frac{\text{lbm}}{\text{ft}^3} \times \left(\frac{1}{32.174}\right)\frac{\text{slug}}{\text{lbm}} \times 1.03 \times \left(50.6\frac{\text{ft}}{\text{sec}}\right)^2 \\ &= 2{,}557\ \text{lbf}/\text{ft}^2 \\ &= 17.76\ \text{psi} \end{aligned}$$

Stagnation pressure

$$\begin{aligned} P &= 73.65\ \text{psi} + 17.76\ \text{psi} \\ &= 91.41\ \text{psi} \end{aligned}$$

THE CORRECT ANSWER IS: D

Solution 64, p. 86

The third line should read as follows:

Mass of coal/day = power × heat rate / HHV