Revisions are shown in red.

Question 26, p. 25

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 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.
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. \(1.2 \times 10^6\)
- B. \(1.0 \times 10^6\)
- C. \(1.0 \times 10^5\)
- D. \(8.3 \times 10^4\)

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:

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

THE CORRECT ANSWER IS: A
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: \( k = 1.4 \)
\[ T_{2,i} = (80^\circ F + 460)(10)^{0.4/1.4} \]
\[ T_{2,i} = 1,043^\circ R \]

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

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

\[ W_{\text{comp}} = 18,402 \text{ hp} \]

Fan: 
\[ T_{2,i} = (540^\circ R)(1.3)^{0.4/1.4} \]
\[ T_{2,i} = 582.0^\circ R \]

\[ W_{\text{fan}} = \left( 400 \frac{\text{lbm}}{\text{sec}} \right) \left( 0.24 \frac{\text{Btu}}{\text{lbm} \cdot \circ \text{R}} \right) \left( 582.0 - 540 \right)^\circ \text{R} \left( 60 \frac{\text{sec}}{\text{min}} \right) \left( \frac{1}{0.85} \right) \left( \frac{\text{hp} \cdot \text{min}}{42.44 \text{ Btu}} \right) \]

\[ W_{\text{fan}} = 6,711.78 \text{ hp} \]

\[ W_{\text{total}} = W_{\text{comp}} + W_{\text{fan}} = 18,402 \text{ hp} + 6,712 \text{ hp} = 25,114 \text{ hp} \]

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.

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

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 \(= (4.5) \text{ cfm } (\Delta h)\) 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 = \((4.5) \text{ cfm } (\Delta h)\); solve for \(\Delta h\)  
\[
\Delta h = \frac{164,335}{4.5(3,600)} = 10.14\text{ Btu/lb}
\]
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.
Solution 47, p. 76

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

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

Specific gravity, \( SG = 1.03 \)

Depth, \( h = 165 \text{ ft} \)

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

Velocity, \( v = 34.5 \text{ mph} \times \frac{1 \text{ hr}}{3,600 \text{ sec}} \times \frac{5,280 \text{ ft}}{1 \text{ mile}}
\]
\[
= 50.6 \text{ ft/sec}
\]

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

Stagnation pressure
\[
P = 73.65 \text{ psi} + 17.76 \text{ psi}
\]
\[
= 91.41 \text{ psi}
\]

THE CORRECT ANSWER IS: D

Solution 64, p. 86

The third line should read as follows:

\[
\text{Mass of coal/day} = \text{power} \times \text{heat rate} / \text{HHV}
\]