

$$\dot{Q}_t = 4.5cfm\Delta h = 4.5(7000)(33.1 - 22) = 349,650 \frac{Btu}{hr}$$

Since the heat removed from the air is added to the chilled water flowing in the coil, set the total cooling of the air equal to the heating of the water, using the sensible heating rule of thumb for water. Solve for the unknown leaving water temperature.

$$\dot{Q}_t = \dot{Q}_w = 500gpm\Delta T$$

$$\Delta T = \frac{349,650}{(500)(60)} = 11.7^\circ F$$

$$\Delta T = LWT - EWT = LWT - 46^\circ F = 11.7^\circ F$$

$$LWT = 57.7^\circ F$$

Answer B

44.17 During a chiller plant upgrade, an oversized fixed speed pump, producing $200gpm$ and $80ft$ of total dynamic head with a 70% pump efficiency and 80% motor efficiency, is replaced with a duplex parallel pump set with variable frequency drives. The two replacement pumps provide $60gpm$ each at $45ft$ TDH which is sufficient to meet operational demands. The new pump efficiency is 75% and the new motor efficiency is 93%. The system operates continuously 24 hours per day 365 days per year. The average cost of electricity is $\$0.12/kWh$. What are the annual savings?

- A. \$3100
- B. \$4100
- C. \$4900
- D. \$5500

Make a table to organize the given information for the two scenarios:

	Existing	New
Qty of Pumps	1	2
Flow Rate	$200gpm$	$2 \times 60gpm$
TDH	$80ft$	$45ft$
Pump Efficiency	70%	75%
Motor Efficiency	80%	93%
Run Hours	7/24/365	7/24/365
Electricity Rate	$\$0.12/kW \cdot hr$	$\$0.12/kW \cdot hr$

Calculate the **Hydraulic Horsepower** for both scenarios:

$$WHP = \frac{Q\Delta h}{3960}$$

$$WHP_1 = \frac{(200)(80)}{3960} = 4.04hp$$

$$WHP_2 = \frac{(2)(60)(45)}{3960} = 1.36hp$$

Apply the pump and motor efficiencies to determine the electrical power demand, and convert units to *KW*:

$$P = \frac{WHP}{\eta_p \eta_m}$$

$$P_1 = \frac{(4.04hp)}{(.7)(.8)} \left(.7457 \frac{KW}{hp} \right) = 5.38KW$$

$$P_2 = \frac{(1.36hp)}{(.75)(.93)} \left(.7457 \frac{KW}{hp} \right) = 1.46KW$$

Calculate the reduction in electrical demand:

$$Demand\ Reduction = 5.38KW - 1.46KW = 3.92KW$$

Apply the annual run hours and electricity rate to determine the annual cost savings:

$$Cost\ Savings = (3.92KW) \left(24 \frac{hrs}{day} \right) \left(365 \frac{days}{yr} \right) \left(\frac{\$0.12}{kW \cdot hr} \right) = \$4120$$

Answer B