

36.29 A heat pump with a $3KW$ compressor has a heating capacity of $50,000 \frac{Btu}{hr}$ and a cooling capacity of $40,000 \frac{Btu}{hr}$. What is the COP when the unit is operated in heating mode?

- A. 1.0
- B. 3.9
- C. 4.9
- D. 5.0

Since we are only interested in the **Coefficient of Performance** when the unit is operated as a **Heat Pump**, select the formula below and ignore the cooling capacity:

$$COP_{HP} = \frac{Q_H}{W}$$

Substitute and solve, converting all units such that they cancel and the *COP* is unitless.

$$COP_{HP} = \frac{Q_H}{W} = \frac{50,000 \frac{Btu}{hr}}{(3KW) (3412 \frac{Btu}{hr \cdot KW})} = 4.9$$

Note the COP for a heat pump is always slightly greater than for the same device operating as a refrigerator under the same conditions because the compressor energy provides useful heating, whereas in cooling mode the waste heat must be rejected and therefore reduces the system efficiency.

Answer C