37.29 A Carnot heat pump operates between $20°F$ and $70°F$. What is the coefficient of performance?

A. 0.4

B. 1.4

C. 9.6

D. 10.6

Look up the Carnot Cycle in the reference handbook and find the Coefficient of Performance formulas. A Carnot heat pump operates at the upper limit of COP, which is a function of the temperatures of the hot and cold reservoirs which the heat pump is operating between.

$$COP_{HP,carnot} = \frac{T_H}{(T_H - T_L)}$$

The temperatures must be in absolute terms i.e. Rankine, so add 460 to $°F$ before substituting into the formula. (Technically, there is no need to change to absolute in the denominator since the difference will remain unchanged.)

$$COP_{HP,carnot} = \frac{T_H}{(T_H - T_L)} = \frac{(70 + 460)}{(70 - 20)} = \frac{530R}{50R} = 10.6$$

Answer D