atmospheric conditions. Use the Properties of Saturated Water and Steam (Pressure) table to obtain the value of h_{fg} at atmospheric pressure.

$$P = 14.7psia$$

$$h_{fg} \approx 970\frac{Btu}{lb}$$

Hint: When making approximations of latent load due to moisture, consider assuming $h_{fg} \approx 1000\frac{Btu}{lb}$ to save time.

Calculate the latent load.

$$\dot{Q}_L = \dot{m}\Delta h = \dot{m}\Delta h_{fg} = \left(12\frac{lb}{hr}\right)\left(970\frac{Btu}{lb}\right) = 11,640\frac{Btu}{hr}$$

Solve for SHR.

$$SHR = \frac{\dot{Q}_S}{\dot{Q}_S + \dot{Q}_L} = \frac{34,120\frac{Btu}{hr}}{34,120\frac{Btu}{hr} + 11,640\frac{Btu}{hr}} = 0.746$$

Answer C

47.15 A $10lb_m$ mass hangs from a spring and damper assembly. The spring has a spring constant of $100\frac{lb_f}{in}$. The damping ratio is 0.6. What is the damped frequency of the system?

A. $6Hz$

B. $8Hz$

C. $10Hz$

D. $12Hz$

Find the natural frequency of the system as though no damping was present. The undamped natural circular frequency is given by the equation below.

$$\omega_n = \sqrt{\frac{kg_c}{m}} = \sqrt{\frac{\left(100\frac{lb_f}{in}\right)\left(12\frac{in}{ft}\right)\left(32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)}{10lb_m}} = 62.2\frac{rad}{s}$$

Find the Damped Natural Frequency which accounts for the damping ratio.

$$\omega_d = \omega_n\sqrt{1-\varsigma^2} = \left(62.2\frac{rad}{s}\right)\sqrt{1-(0.6)^2} = 49.7\frac{rad}{s}$$

Since the answer choices are in Hz, find the corresponding damped *linear* frequency. Note the final units of "cycles per second" is the same as Hz.

$$f_d = \frac{\omega_d}{2\pi} = \frac{49.7\frac{rad}{s}}{2\pi\frac{rad}{cycle}} = 7.9Hz$$

Answer B

47.16 A carnot heat pump operates during winter when the outisde air temperature is $20°F$ and inside temperature is $68°F$. During summer, the unit runs in reverse to provide cooling when the outisde air temperature is $100°F$ and inside temperature is $72°F$. What is the coefficient of performance during summer operation?

A. 3

B. 4

C. 17

D. 19

Recall that a Carnot heat pump has the maximum theorteical Coefficient of Performance based on the temperatures of the reservoirs heat is being removed from and rejected to. In this case, winter operation may be ignored since the question is asking about the COP for summer operation only.

The COP for refrigeration for a carnot cycle is given by:

$$COP_c = \frac{T_L}{T_H - T_L}$$

Temperature units must be absolute (Rankine). The denominator is a temperature differential and therefore may be left in Farenheit.

$$COP_c = \frac{72°F + 460°}{100°F - 72°F} = 19$$

Answer D

47.17 A refrigeration cycle using R-123 operates between $30psia$ and $125psia$ with no subcooling and isenthalpic expansion. What is the quality of the mixture entering the evaporator?

A. 0.20

B. 0.26

C. 0.32

D. 0.38

Look up the R-123 properties table and Pressure Versus Enthalpy Curves for Refrigerant 123. Consider the high pressure side of the refrigeration cycle after the refrigerant passes through the condenser, it is expected to be a saturated liquid at $125psia$. Let this be considered State 3. Use either the table or the chart to determine the enthalpy of saturated liquid, h_f. The table lends itself to slightly higher precision but may take a bit more time. Formal interpolation is not necessary. Beware of the logarithmic scale on the vertical axis if using the P-H chart. Since the expansion process in a typical refrigeration cycle is isenthalpic, the enthalpy after expansion is the same as the enthalpy prior to expansion. Let the low pressure condition after expansion be considered State 4.