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Refrigeration and Air Conditioning Formulas

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List of 12 Refrigeration and Air Conditioning Formulas

Refrigeration and Air Conditioning

Air Refrigeration Cycles

1) Compression or Expansion Ratio

Open Calculator

fx $$r_p = \frac{P_2}{P_1}$$

ex $$25 = \frac{10E6Pa}{4E5Pa}$$

2) COP of Bell-Coleman Cycle for given Compression Ratio and Adiabatic Index

Open Calculator

fx $$COP_{theoretical} = \frac{1}{r_p^{\frac{\gamma-1}{\gamma}} - 1}$$

ex $$0.662917 = \frac{1}{(25)^{\frac{1.4-1}{1.4}} - 1}$$

3) COP of Bell-Coleman Cycle for given Temperatures, Polytropic Index and Adiabatic Index

Open Calculator

$$\mathrm{COP_{theoretical}} = \frac{\mathrm{T_1} - \mathrm{T_4}}{\left(\frac{\mathrm{n}}{\mathrm{n}-1}\right) \cdot \left(\frac{\gamma-1}{\gamma}\right) \cdot ((\mathrm{T_2} - \mathrm{T_3}) - (\mathrm{T_1} - \mathrm{T_4}))}$$

$$0.601693 = \frac{300\mathrm{K} - 290\mathrm{K}}{\left(\frac{1.52}{1.52-1}\right) \cdot \left(\frac{1.4-1}{1.4}\right) \cdot ((356.5\mathrm{K} - 326.6\mathrm{K}) - (300\mathrm{K} - 290\mathrm{K}))}$$

4) Energy Performance Ratio of Heat Pump

Open Calculator

$$\mathrm{COP_{theoretical}} = \frac{\mathrm{Q_{delivered}}}{\mathrm{W_{per\ min}}}$$

$$0.6 = \frac{5571.72\mathrm{kJ/min}}{9286.2\mathrm{kJ/min}}$$

5) Heat Absorbed during Constant Pressure Expansion Process

Open Calculator

$$\mathrm{Q_{Absorbed}} = \mathrm{C_p} \cdot (\mathrm{T_1} - \mathrm{T_4})$$

$$10.05\mathrm{kJ/kg} = 1.005\mathrm{kJ/kg*K} \cdot (300\mathrm{K} - 290\mathrm{K})$$

6) Heat Rejected during Constant pressure Cooling Process

Open Calculator

$$\mathrm{Q_R} = \mathrm{C_p} \cdot (\mathrm{T_2} - \mathrm{T_3})$$

$$30.0495\mathrm{kJ/kg} = 1.005\mathrm{kJ/kg*K} \cdot (356.5\mathrm{K} - 326.6\mathrm{K})$$

7) Relative Coefficient of Performance

Open Calculator

fx $$\mathrm{COP_{relative}} = \frac{\mathrm{COP_{actual}}}{\mathrm{COP_{theoretical}}}$$

ex $$0.333333 = \frac{0.2}{0.6}$$

8) Theoretical Coefficient of Performance of Refrigerator

Open Calculator

fx $$\mathrm{COP_{theoretical}} = \frac{\mathrm{Q_{ref}}}{\mathrm{W}}$$

ex $$0.6 = \frac{600\mathrm{kJ/kg}}{1000\mathrm{kJ/kg}}$$

Air Refrigeration Systems

9) Initial Mass of Evaporant Required to be Carried for given Flight Time

Open Calculator

fx $$\mathrm{M_{ini}} = \frac{\mathrm{Q_r} \cdot \mathrm{t}}{\mathrm{h_{fg}}}$$

ex $$53.53982\mathrm{kg} = \frac{550\mathrm{kJ/min} \cdot 220\mathrm{min}}{2260\mathrm{kJ/kg}}$$

10) Local Sonic or Acoustic Velocity at Ambient Air Conditions

Open Calculator

fx $$a = \left(\gamma \cdot [R] \cdot \frac{T_i}{MW}\right)^{0.5}$$

ex $$340.0649\text{m/s} = \left(1.4 \cdot [R] \cdot \frac{305\text{K}}{0.0307\text{kg}}\right)^{0.5}$$

11) Ram Efficiency

Open Calculator

fx $$\eta = \frac{(p_2') - P_i}{P_f - P_i}$$

ex $$0.866667 = \frac{150000\text{Pa} - 85000\text{Pa}}{160000\text{Pa} - 85000\text{Pa}}$$

12) Temperature Ratio at Start and End of Ramming Process

Open Calculator

fx $$T_{ratio} = 1 + \frac{v_{process}^2 \cdot (\gamma - 1)}{2 \cdot \gamma \cdot [R] \cdot T_i}$$

ex $$1.202801 = 1 + \frac{(60\text{m/s})^2 \cdot (1.4 - 1)}{2 \cdot 1.4 \cdot [R] \cdot 305\text{K}}$$

Variables Used

- **a** Sonic Velocity *(Meter per Second)*
- **C_p** Specific Heat Capacity at Constant Pressure *(Kilojoule per Kilogram per K)*
- **COP_{actual}** Actual Coefficient of Performance
- **$COP_{relative}$** Relative Coefficient of Performance
- **$COP_{theoretical}$** Theoretical Coefficient of Performance
- **h_{fg}** Latent Heat of Vaporization *(Kilojoule per Kilogram)*
- **M_{ini}** Initial Mass *(Kilogram)*
- **MW** Molecular Weight *(Kilogram)*
- **n** Polytropic Index
- **P_1** Pressure at Start of Isentropic Compression *(Pascal)*
- **p_2'** Stagnation Pressure of System *(Pascal)*
- **P_2** Pressure at End of Isentropic Compression *(Pascal)*
- **P_f** Final Pressure of System *(Pascal)*
- **P_i** Initial Pressure of System *(Pascal)*
- **$Q_{Absorbed}$** Heat Absorbed *(Kilojoule per Kilogram)*
- **$Q_{delivered}$** Heat Delivered to Hot Body *(Kilojoule per Minute)*
- **Q_r** Rate of Heat Removal *(Kilojoule per Minute)*
- **Q_R** Heat Rejected *(Kilojoule per Kilogram)*
- **Q_{ref}** Heat Extracted from Refrigerator *(Kilojoule per Kilogram)*
- **r_p** Compression or Expansion Ratio

- **t** Time in Minutes *(Minute)*
- T_1 Temperature at Start of Isentropic Compression *(Kelvin)*
- T_2 Ideal Temp at End of Isentropic Compression *(Kelvin)*
- T_3 Ideal Temp at End of Isobaric Cooling *(Kelvin)*
- T_4 Temperature at End of Isentropic Expansion *(Kelvin)*
- T_i Initial Temperature *(Kelvin)*
- T_{ratio} Temperature Ratio
- $v_{process}$ Velocity *(Meter per Second)*
- **w** Work Done *(Kilojoule per Kilogram)*
- $W_{per\ min}$ Work Done per min *(Kilojoule per Minute)*
- **γ** Heat Capacity Ratio
- **η** Ram Efficiency

Constants, Functions, Measurements used

- Constant: **[R]**, 8.31446261815324
  Universal gas constant
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Minute (min)
  Time Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Kilojoule per Minute (kJ/min)
  Power Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per K (kJ/kg*K)
  Specific Heat Capacity Unit Conversion
- Measurement: **Latent Heat** in Kilojoule per Kilogram (kJ/kg)
  Latent Heat Unit Conversion
- Measurement: **Rate of Heat Transfer** in Kilojoule per Minute (kJ/min)
  Rate of Heat Transfer Unit Conversion
- Measurement: **Specific Energy** in Kilojoule per Kilogram (kJ/kg)
  Specific Energy Unit Conversion

Check other formula lists

- **Refrigeration and Air Conditioning Formulas**

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