



Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces & more Special Cases

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List of 21 Important Formulas in Gas Radiation. Radiation Exchange with Specular Surfaces & more Special Cases

Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces & more Special Cases 🛂

1) Diffuse Radiation Exchange from Surface 1 to Surface 2

Open Calculator $q_{1->2} = (J_{1D} \cdot A_1 \cdot F_{12}) \cdot (1 - \rho_{2s})$

 $(43 \text{W}/\text{m}^2 \cdot 100 \text{m}^2 \cdot 0.59) \cdot (1 - 0.45)$

2) Diffuse Radiation Exchange from Surface 2 to Surface 1

Open Calculator 🚰 fx $|\mathbf{q}_{2 ext{-}>1} = \mathbf{J}_{\mathrm{2D}}\cdot\mathbf{A}_{2}\cdot\mathbf{F}_{\mathrm{21}}\cdot(\mathbf{1}-\mathbf{
ho}_{\mathrm{1s}})|$

 $423.94W = 44W/m^2 \cdot 50m^2 \cdot 0.41 \cdot (1 - 0.53)$

3) Diffuse Radiosity

 $\mathbf{f}_{\mathbf{z}} \left[\mathrm{J}_{\mathrm{D}} = \left(\left(\mathbf{\epsilon} \cdot \mathrm{E}_{\mathrm{b}}
ight) + \left(
ho_{\mathrm{D}} \cdot \mathrm{G}
ight)
ight]$

 $(0.95 \cdot 700 \text{W/m}^2) + (0.5 \cdot 0.80 \text{W/m}^2)$

4) Direct Diffuse Radiation from Surface 2 to Surface 1

fx $\mathbf{q}_{2 ext{-}>1} = \mathbf{A}_2 \cdot \mathbf{F}_{21} \cdot \mathbf{J}_2$

 $ext{ex} 1004.5 ext{W} = 50 ext{m}^2 \cdot 0.41 \cdot 49 ext{W/m}^2$





Open Calculator

Open Calculator

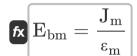
5) Emissive Power of Blackbody through Medium



Open Calculator

 $extbf{ex} \left[459.2997 ext{W/m}^2 = [ext{Stefan-BoltZ}] \cdot \left((300 ext{K})^4
ight)
ight]$

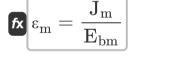
6) Emissive Power of Blackbody through Medium given Emissivity of Medium



Open Calculator

 $ext{ex} 265.9574 ext{W/m}^2 = rac{250 ext{W/m}^2}{0.94}$

7) Emissivity of Medium given Emissive Power of Blackbody through Medium



Open Calculator

 $0.943396 = rac{250 \mathrm{W/m^2}}{265 \mathrm{W/m^2}}$

8) Energy Emitted by Medium

fx
$$J_{\mathrm{m}} = \epsilon_{\mathrm{m}} \cdot E_{\mathrm{bm}}$$

Open Calculator

ex $249.1 \mathrm{W/m^2} = 0.94 \cdot 265 \mathrm{W/m^2}$



Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces 4/10 & more Special Cases Formulas

9) Energy Leaving Surface 1 that is Transmitted through Medium

 $E_{Leaving} = J_1 \cdot A_1 \cdot F_{12} \cdot \tau_m$

Open Calculator

ex $2339.35 ext{J} = 61 ext{W/m}^2 \cdot 100 ext{m}^2 \cdot 0.59 \cdot 0.65$

10) Initial Radiation Intensity

Open Calculator

 $\mathbf{f}_{\lambda \mathrm{o}} = rac{\mathbf{I}_{\lambda \mathrm{x}}}{\exp(-(lpha_{\scriptscriptstyle{1}} \cdot \mathrm{x}))}$ $\mathbf{ex} \ 919.4156 \mathrm{W/sr} = \frac{638 \mathrm{W/sr}}{\mathrm{exp}(-(0.42 \cdot 0.87 \mathrm{m}))}$

11) Monochromatic Absorption Coefficient if Gas is Non-Reflecting

fx $lpha_{\lambda}=1- au_{\lambda}$

0.4 = 1 - 0.6

Open Calculator

12) Monochromatic Transmissivity

fx $| au_{\lambda} = \exp(-(lpha_{\lambda} \cdot \mathrm{x}))|$

Open Calculator

 $0.693919 = \exp(-(0.42 \cdot 0.87 \text{m}))$

13) Monochromatic Transmissivity if Gas is Non Reflecting 🗗

fx $au_{\lambda}=1-lpha_{\lambda}$

Open Calculator

0.58 = 1 - 0.42







Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces & more Special Cases Formulas... 5/10

14) Net Heat Exchange in Transmission Process 🛂

fx $m q_{1 ext{-}2~transmistted} = A_1 \cdot F_{12} \cdot au_{
m m} \cdot (J_1 - J_2)$

Open Calculator 🗗

 $\mathbf{ex} \left[460.2 \mathrm{W} = 100 \mathrm{m}^2 \cdot 0.59 \cdot 0.65 \cdot (61 \mathrm{W/m}^2 - 49 \mathrm{W/m}^2)
ight]$

15) Net Heat Lost by Surface

fx $q = A \cdot ((\epsilon \cdot E_b) - (\alpha \cdot G))$

10) Not Hout East by Guillage C

Open Calculator 🖸

 $\texttt{ex} \left[33423.75 \text{W} = 50.3 \text{m}^2 \cdot ((0.95 \cdot 700 \text{W/m}^2) - (0.64 \cdot 0.80 \text{W/m}^2)) \right]$

16) Net Heat Lost by Surface given Diffuse Radiosity

 $\mathbf{q} = \left(rac{\epsilon \cdot A}{
ho_D}
ight) \cdot \left(\left(E_b \cdot (\epsilon +
ho_D)
ight) - J_D
ight)$

Open Calculator 🖸

 $33411.27 \mathrm{W} = \left(\frac{0.95 \cdot 50.3 \mathrm{m}^2}{0.5}\right) \cdot \left((700 \mathrm{W/m}^2 \cdot (0.95 + 0.5)) - 665.4 \mathrm{W/m}^2 \right)$

17) Radiation Intensity at given Distance using Beer's Law

 $I_{\lambda \mathrm{x}} = I_{\lambda \mathrm{o}} \cdot \exp igl(- igl(lpha_{\lambda} \cdot \mathrm{x} igr) igr)$

Open Calculator

18) Reflectivity given Specular and Diffuse Component

ex $638.4055 \text{W/sr} = 920 \text{W/sr} \cdot \exp(-(0.42 \cdot 0.87 \text{m}))$

fx $\rho = \rho_{\mathrm{s}} + \rho_{\mathrm{D}}$

0.0 - 0.4 + 0.0

Open Calculator

0.9 = 0.4 + 0.5



19) Temperature of Medium given Emissive Power of Blackbody

 $ext{T}_{m} = \left(rac{ ext{E}_{bm}}{ ext{[Stefan-BoltZ]}}
ight)^{rac{1}{4}}$

Open Calculator

 $oxed{ex} 261.4621 ext{K} = \left(rac{265 ext{W/m}^2}{ ext{[Stefan-BoltZ]}}
ight)^{rac{1}{4}}$

20) Transmissivity given Specular and Diffuse Component

fx $au=(au_{
m s}+ au_{
m D})$

Open Calculator

 $\boxed{0.82 = (0.24 + 0.58)}$

21) Transmissivity of Transparent Medium given Radiosity and Shape Factor

 $au_{
m m} = rac{{
m q}_{ ext{1-2 transmistted}}}{{
m A}_{ ext{1}} \cdot {
m F}_{ ext{12}} \cdot ({
m J}_{ ext{1}} - {
m J}_{ ext{2}})}$

Open Calculator 🗗

 $oxed{ex} 0.649718 = rac{460 \mathrm{W}}{100 \mathrm{m}^2 \cdot 0.59 \cdot (61 \mathrm{W/m}^2 - 49 \mathrm{W/m}^2)}$



Variables Used

- A Area (Square Meter)
- A₁ Surface Area of Body 1 (Square Meter)
- A₂ Surface Area of Body 2 (Square Meter)
- Eb Emissive Power of Blackbody (Watt per Square Meter)
- E_{bm} Emissive Power of Blackbody through Medium (Watt per Square Meter)
- **E**Leaving Energy Leaving Surface (Joule)
- F₁₂ Radiation Shape Factor 12
- F₂₁ Radiation Shape Factor 21
- **G** Irradiation (Watt per Square Meter)
- Initial Radiation Intensity (Watt per Steradian)
- I_{Ax} Radiation Intensity at Distance x (Watt per Steradian)
- J₁ Radiosity of 1st Body (Watt per Square Meter)
- **J**_{1D} Diffuse Radiosity for Surface 1 (Watt per Square Meter)
- J₂ Radiosity of 2nd Body (Watt per Square Meter)
- **J**_{2D} Diffuse Radiosity for Surface 2 (Watt per Square Meter)
- J_D Diffuse Radiosity (Watt per Square Meter)
- **J**_m Radiosity for Transparent Medium (Watt per Square Meter)
- **q** Heat Transfer (Watt)
- q_{1->2} Heat Transfer from Surface 1 to 2 (Watt)
- **q**1-2 transmistted Radiation Heat Transfer (Watt)
- q_{2->1} Heat Transfer from Surface 2 to 1 (Watt)
- T_m Temperature of Medium (Kelvin)





- X Distance (Meter)
- α Absorptivity
- α_λ Monochromatic Absorption Coefficient
- ε Emissivity
- ε_m Emissivity of Medium
- P Reflectivity
- ρ_{1s} Specular Component of Reflectivity of Surface 1
- ρ_{2s} Specular Component of Reflectivity of Surface 2
- PD Diffuse Component of Reflectivity
- ρ_s Specular Component of Reflectivity
- τ Transmissivity
- τ_D Diffuse Component of Transmissivity
- τ_m Transmissivity of Transparent Medium
- τ_s Specular Component of Transmissivity
- τ_λ Monochromatic Transmissivity





Constants, Functions, Measurements used

- Constant: e, 2.71828182845904523536028747135266249
 Napier's constant
- Constant: [Stefan-BoltZ], 5.670367E-8 Kilogram Second^-3 Kelvin^-4 Stefan-Boltzmann Constant
- Function: **exp**, exp(Number) Exponential function
- Measurement: Length in Meter (m)
 Length Unit Conversion
- Measurement: Temperature in Kelvin (K)
 Temperature Unit Conversion
- Measurement: Area in Square Meter (m²)
 Area Unit Conversion
- Measurement: Energy in Joule (J)
 Energy Unit Conversion
- Measurement: Power in Watt (W)
 Power Unit Conversion
- Measurement: Heat Flux Density in Watt per Square Meter (W/m²)
 Heat Flux Density Unit Conversion
- Measurement: Radiant Intensity in Watt per Steradian (W/sr)

 Radiant Intensity Unit Conversion





Check other formula lists

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- Important Formulas in Gas Radiation, Radiation Exchange with Specular Surfaces & more Special • Radiation System consisting of Cases C
- Important Formulas in Radiation Heat Transfer 🚰
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