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Important Formulas on Surface Tension

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List of 17 Important Formulas on Surface Tension

Important Formulas on Surface Tension

1) Force given Surface Tension using Wilhelmy-Plate Method

Open Calculator

$$F = \left(\rho_p \cdot [g] \cdot (L \cdot B \cdot t)\right) + (2 \cdot \gamma \cdot (t + B) \cdot (\cos(\theta))) - (\rho_{fluid} \cdot [g] \cdot t \cdot B \cdot h_p)$$

ex

$$4.2E\hat{}9N = (12.2kg/m^3 \cdot [g] \cdot (50mm \cdot 200mm \cdot 5000mm)) + (2 \cdot 73mN/m \cdot (5000mm + 200mm) \cdot (\cos(15.1^\circ$$

2) Height of Magnitude of Capillary Rise

Open Calculator

$$h_c = \frac{\gamma}{\left(\frac{1}{2}\right) \cdot (R \cdot \rho_{fluid} \cdot [g])}$$

ex

$$12.18518mm = \frac{73mN/m}{\left(\frac{1}{2}\right) \cdot (82mm \cdot 14.9kg/m^3 \cdot [g])}$$

3) Parachor given Surface Tension

Open Calculator

$$P_s = \left(\frac{M_{molar}}{\rho_{liq} - \rho_v}\right) \cdot (\gamma)^{\frac{1}{4}}$$

ex

$$2E\hat{}-5m^3/mol*(J/m^2)\hat{}(1/4) = \left(\frac{44.01g/mol}{1141kg/m^3 - 0.5kg/m^3}\right) \cdot (73mN/m)^{\frac{1}{4}}$$

4) Surface Pressure

Open Calculator

$$\Pi = \gamma_o - \gamma$$

ex

$$0.001Pa = 74mN/m - 73mN/m$$

5) Surface Pressure using Wilhelmy-Plate Method

Open Calculator

$$\Pi = -\left(\frac{\Delta F}{2 \cdot (t + W_{plate})}\right)$$

ex

$$0.001495Pa = -\left(\frac{-0.015N}{2 \cdot (5000mm + 16.9g)}\right)$$

6) Surface Tension for very Thin Plate using Wilhelmy-Plate Method

Open Calculator

fx $$\gamma = \frac{F_{\text{thin plate}}}{2 \cdot W_{\text{plate}}}$$

ex $$73.9645\text{mN/m} = \frac{0.0025\text{N}}{2 \cdot 16.9\text{g}}$$

7) Surface Tension Force given Density of Fluid

Open Calculator

fx $$\gamma = \left(\frac{1}{2}\right) \cdot (R \cdot \rho_{\text{fluid}} \cdot [g] \cdot h_c)$$

ex $$59.90882\text{mN/m} = \left(\frac{1}{2}\right) \cdot (82\text{mm} \cdot 14.9\text{kg/m}^3 \cdot [g] \cdot 10\text{mm})$$

8) Surface Tension given Contact Angle

Open Calculator

fx $$\gamma = (2 \cdot R_{\text{curvature}} \cdot \rho_{\text{fluid}} \cdot [g] \cdot h_c) \cdot \left(\frac{1}{\cos(\theta)}\right)$$

ex $$75.67231\text{mN/m} = (2 \cdot 25\text{mm} \cdot 14.9\text{kg/m}^3 \cdot [g] \cdot 10\text{mm}) \cdot \left(\frac{1}{\cos(15.1^\circ)}\right)$$

9) Surface Tension given Correction Factor

Open Calculator

fx $$\gamma = \frac{m \cdot [g]}{2 \cdot \pi \cdot r_{\text{cap}} \cdot f}$$

ex $$75.33161\text{mN/m} = \frac{0.8\text{g} \cdot [g]}{2 \cdot \pi \cdot 32.5\text{mm} \cdot 0.51}$$

10) Surface Tension given Critical Temperature

Open Calculator

fx $$\gamma_{Tc} = k_o \cdot \left(1 - \left(\frac{T}{T_c}\right)\right)^{k_1}$$

ex $$39487.23\text{mN/m} = 55 \cdot \left(1 - \left(\frac{45\text{K}}{190.55\text{K}}\right)\right)^{1.23}$$

11) Surface Tension given Molar Volume

Open Calculator

$$\gamma_{MV} = [EOTVOS\_C] \cdot \frac{T_c - T}{(V_m)^{\frac{2}{3}}}$$

$$0.003847\text{mN/m} = [EOTVOS\_C] \cdot \frac{190.55\text{K} - 45\text{K}}{(22.4\text{m}^3/\text{mol})^{\frac{2}{3}}}$$

12) Surface Tension given Molecular Weight

Open Calculator

$$\gamma = [EOTVOS\_C] \cdot \frac{T_c - T - 6}{\left(\frac{MW}{\rho_{liq}}\right)^{\frac{2}{3}}}$$

$$50.39563\text{mN/m} = [EOTVOS\_C] \cdot \frac{190.55\text{K} - 45\text{K} - 6}{\left(\frac{16\text{g}}{1141\text{kg/m}^3}\right)^{\frac{2}{3}}}$$

13) Surface Tension given Temperature

Open Calculator

$$\gamma_T = 75.69 - (0.1413 \cdot T) - \left(0.0002985 \cdot (T)^2\right)$$

$$92389.95\text{mN/m} = 75.69 - (0.1413 \cdot 45\text{K}) - \left(0.0002985 \cdot (45\text{K})^2\right)$$

14) Surface Tension of Pure Water

Open Calculator

$$\gamma_w = 235.8 \cdot \left(1 - \left(\frac{T}{T_c}\right)\right)^{1.256} \cdot \left(1 - \left(0.625 \cdot \left(1 - \left(\frac{T}{T_c}\right)\right)\right)\right)$$

$$87854.6\text{mN/m} = 235.8 \cdot \left(1 - \left(\frac{45\text{K}}{190.55\text{K}}\right)\right)^{1.256} \cdot \left(1 - \left(0.625 \cdot \left(1 - \left(\frac{45\text{K}}{190.55\text{K}}\right)\right)\right)\right)$$

15) Total Weight of Plate using Wilhelmy-Plate Method

Open Calculator

$$W_{tot} = W_{plate} + \gamma \cdot (P) - U_{drift}$$

$$0.02015\text{N} = 16.9\text{g} + 73\text{mN/m} \cdot (250\text{mm}) - 15\text{mN/m}$$

16) Total Weight of Ring using Ring-Detachment Method

Open Calculator

$$W_{tot} = W_{ring} + (4 \cdot \pi \cdot r_{ring} \cdot \gamma)$$

$$0.051051\text{N} = 5\text{g} + (4 \cdot \pi \cdot 0.502\text{mm} \cdot 73\text{mN/m})$$

17) Work of Cohesion given Surface Tension

Open Calculator

fx $W_{Coh} = 2 \cdot \gamma \cdot [Avaga\text{-}no]^{\frac{1}{3}} \cdot (V_m)^{\frac{2}{3}}$

ex $9.8E\hat{}7J/m^2 = 2 \cdot 73mN/m \cdot [Avaga\text{-}no]^{\frac{1}{3}} \cdot (22.4m^3/mol)^{\frac{2}{3}}$

Variables Used

- **B** Width of Full Size Bearing Plate *(Millimeter)*
- **f** Correction Factor
- **F** Force *(Newton)*
- $F_{thin\ plate}$ Force on very Thin Plate *(Newton)*
- h_c Height of Capillary Rise/Fall *(Millimeter)*
- h_p Depth of Plate *(Millimeter)*
- k_1 Empirical Factor
- k_o Constant for each Liquid
- **L** Length of Plate *(Millimeter)*
- **m** Drop Weight *(Gram)*
- M_{molar} Molar Mass *(Gram Per Mole)*
- **MW** Molecular Weight *(Gram)*
- **P** Perimeter *(Millimeter)*
- P_s Parachor *(Cubic Meter per Mole (Joule per Square Meter)^(0.25))*
- **R** Radius of Tubing *(Millimeter)*
- r_{cap} Capillary Radius *(Millimeter)*
- $R_{curvature}$ Radius of Curvature *(Millimeter)*
- r_{ring} Radius of Ring *(Millimeter)*
- **t** Thickness of Plate *(Millimeter)*
- **T** Temperature *(Kelvin)*
- T_c Critical Temperature *(Kelvin)*
- U_{drift} Upward Drift *(Millinewton per Meter)*
- V_m Molar Volume *(Cubic Meter per Mole)*
- W_{Coh} Work of Cohesion *(Joule per Square Meter)*
- W_{plate} Weight of Plate *(Gram)*
- W_{ring} Weight of Ring *(Gram)*
- W_{tot} Total Weight of Solid Surface *(Newton)*
- γ Surface Tension of Fluid *(Millinewton per Meter)*
- γ_{MV} Surface Tension of Fluid given Molar Volume *(Millinewton per Meter)*
- γ_o Surface Tension of Clean Water Surface *(Millinewton per Meter)*
- γ_T Surface Tension of Fluid given Temperature *(Millinewton per Meter)*
- γ_{Tc} Surface Tension of Fluid given Critical Temp *(Millinewton per Meter)*
- γ_w Surface Tension of Pure Water *(Millinewton per Meter)*
- ΔF Change in Force *(Newton)*

- **θ** Contact Angle *(Degree)*
- **Π** Surface Pressure of Thin Film *(Pascal)*
- ρ_{fluid} Density of Fluid *(Kilogram per Cubic Meter)*
- ρ_{liq} Density of Liquid *(Kilogram per Cubic Meter)*
- ρ_{p} Density of Plate *(Kilogram per Cubic Meter)*
- ρ_{v} Density of Vapor *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[Avaga-no]**, 6.02214076E23
  Avogadro's number
- Constant: **[EOTVOS_C]**, 0.00000021 Joule/(Kelvin*Mole^(2/3))
  Eotvos constant
- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Gram (g)
  Weight Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Heat Density** in Joule per Square Meter (J/m²)
  Heat Density Unit Conversion
- Measurement: **Surface Tension** in Millinewton per Meter (mN/m)
  Surface Tension Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Molar Mass** in Gram Per Mole (g/mol)
  Molar Mass Unit Conversion
- Measurement: **Molar Magnetic Susceptibility** in Cubic Meter per Mole (m³/mol)
  Molar Magnetic Susceptibility Unit Conversion
- Measurement: **Parachor** in Cubic Meter per Mole (Joule per Square Meter)^(0.25) (m³/mol*(J/m²)^(1/4))
  Parachor Unit Conversion

Check other formula lists

- BET Adsorption Isotherm Formulas
- Freundlich adsorption isotherm Formulas
- Important Formulas of Adsorption Isotherm
- Important Formulas of Colloids
- Important Formulas on Surface Tension
- Langmuir Adsorption Isotherm Formulas

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