Conversions and short formulas

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|---|---|---|---|
| 1 N = 1 kg·m/s$^2$ | 1 J = 1 N·m | 1 Pa = 1 N/m$^2$ = 1 J/m$^3$ | 1 L = 1 x 10$^{-3}$ m$^3$ |
| 1 mL = 1 cm$^3$ | Kelvin = Celsius + 273 | Fahrenheit = (Celsius · ⅘) + 32 | Surface area of a sphere = $4\pi r^2$ |
| Laplace pressure $\Delta p = \frac{2\sigma}{r}$ | Volume of a sphere = $\frac{4}{3}\pi r^3$ | Polymer radius $r_p = r_m\sqrt{N_m}$ | |

Constants

| | | | |
|---|---|---|---|
| Room temp = 23°C | 1 Cal = 1000 cal = 4.18 kJ | Gravitational acceleration g=10 m/s$^2$ | Avogadro's number 6.022 x 10$^{23}$ molecules/mol |
| Boltzmann constant $k_B$ = 1.38 x 10$^{-23}$ J/K | Specific heat of water 4.18 J/g·K | $D_{heat}$ in water 1.4 x 10$^{-3}$ cm$^2$/s | $D_{Ca^{2+}}$ in water 8.0 x 10$^{-10}$ m$^2$/s |

Prefixes

| | | | |
|---|---|---|---|
| giga (G): 10$^9$ | mega (M): 10$^6$ | kilo (k): 10$^3$ | centi (c): 10$^{-2}$ |
| milli (m): 10$^{-3}$ | micro ($\mu$): 10$^{-6}$ | nano (n): 10$^{-9}$ | 1 Å = 10$^{-10}$ m |

| Equation | | Description | Units |
|---|---|---|---|
| $pH = -\log[H^+]$ | $[H^+]$ | Concentration of hydrogen ions | mol/L |
| $Q = mc_p\Delta T$ | $Q$ | Heat | J |
| | $m$ | Mass | g |
| | $c_p$ | Specific heat capacity | J/g·K or J/g·C |
| | $\Delta T$ | Change in temperature | K or °C |
| $U_{int} = ck_BT$ | $U_{int}$ | Interaction energy | J |
| | $c$ | Constant | – |
| | $k_B$ | Boltzmann constant | J/K |
| | $T$ | Phase transition temperature | T |
| $E = \frac{F/A}{\Delta L/L}$ | $E$ | Elastic modulus | Pa |
| | $F$ | Force | N |
| | $A$ | Area over which force is applied | m$^2$ |
| | $\Delta L$ | Change in length | m |
| | $L$ | Initial length | m |
| $E = \frac{U_{int}}{\ell^3}$ | $E$ | Elastic modulus | Pa |
| | $U_{int}$ | Interaction energy | J |
| | $\ell$ | Crosslink distance | m |
| $L = \sqrt{4Dt}$ | $L$ | Distance of diffusion | m |
| | $D$ | Diffusion coefficient | m$^2$/s |
| | $t$ | Time to diffuse | s |

| Equation | | Description | Units |
|---|---|---|---|
| $\phi = \frac{V_{\text{dispersed}}}{V_{\text{total}}}$ | $\phi$ | Volume fraction of dispersed phase | Unitless |
| | $V_{\text{dispersed}}$ | Volume of dispersed phase | L |
| | $V_{\text{total}}$ | Total Volume | L |
| $\mathrm{E} = \frac{\sigma}{R}(\phi - \phi_c)$ | $E$ | Elastic Modulus | Pa |
| | $\sigma$ | Surface tension | N/m |
| | $R$ | Droplet radius | m |
| | $\phi$ | Dispersed phase volume fraction | Unitless |
| | $\phi_c$ | Critical volume fraction (0.64) | Unitless |
| $NaHCO_3 + CH_3COOH \rightarrow NaC_2H_3O_2 + H_2O + CO_2$ | $NaHCO_3$ | Sodium bicarbonate (baking soda) | mol |
| | $CH_3COOH$ | Acetic acid | mol |
| | $NaC_2H_3O_2$ | Sodium acetate | mol |
| | $H_2O$ | Water | mol |
| | $CO_2$ | Carbon dioxide gas | mol |
| $k = k_0 e^{-\Delta u / k_B T}$ | $k$ | Reaction rate | ~ $s^{-1}$ |
| | $k_0$ | Max. reaction rate | ~ $s^{-1}$ |
| | $\Delta u$ | Activation energy | J |
| | $k_B$ | Boltzmann constant | J/K |
| | $T$ | Temperature | K |
| $N(t) = N_0 e^{kt} = N_0 2^{t/\tau}$ where $k = \frac{\ln 2}{\tau}$ | $N(t)$ | Number of microbes at time $t$ | Microbes |
| | $N_0$ | Initial number of microbes | Microbes |
| | $k$ | Rate of growth/death | $s^{-1}$ |
| | $t$ | Time elapsed | s |
| | $\tau$ | Doubling time | s |