Equation Sheet

[**Chapter 2**](#_7143hbzewx4s) **2**

[**Chapter 3**](#_j54l9wyj5231) **2**

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[**Chapter 7**](#_a0rd6bk655dk) **6**

[**Chapter 8**](#_nylx6c9a3hc6) **6**

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[**Chapter 10**](#_714jfwxsu8p5) **8**

# Chapter 2

| 2.5a | Potential energy between two atoms |  |  |
| --- | --- | --- | --- |
| 2.5b | Force between two atoms |  |  |
| 2.9 | Attractive energy between two atoms |  |  |
| 2.11 | Repulsive energy between two atoms |  |  |
| 2.13 | Force of attraction between two isolated ions |  | Z= Valence values  The exponent of |
| 2.16 | Percent ionic character |  | is electronegativity for electronegative element, is for electropositive  Figure 2.9 |

# Chapter 3

| 3.1 | Unit cell edge length, FCC (Face-centered cubic) |  | R is atomic radius |
| --- | --- | --- | --- |
| 3.3 | Atomic packing factor |  | volume of atoms in a unit cell  total unit cell volume |
| 3.4 | Unit cell edge length, BCC (body-centered cubic) |  |  |
| 3.8 | Theoretical density of a metal |  | n is number of atoms with unit cell  A is atomic weight |

# Chapter 12

|  | Catio to Anion ratio |  | radius of ion |
| --- | --- | --- | --- |
| 12.1 | Density of a ceramic material |  | the number of formula units within the cell  = The sum of all different cations atomic weight  = The sum of all different anions atomic weight  cell volume |

# Chapter 4

| 4.1 | Number of vacancies per unit volume |  | The equilibrium number of vacancies  The total number of atomic sites (per cubic meter)  the energy required for the formation of a vacancy (J/mol or eV/atom)  Boltzmann constant, (1.38e-23 J/(atom\*K) or 8.62e-5 eV/(atom\*K))  temperature in Kelvin |
| --- | --- | --- | --- |
| 4.3a | Composition in weight percent wt% |  |  |
| 4.5a | Composition in atomic percent at% |  |  |

# Chapter 5

|  | Interdiffusion zone |  | k = constant  D = diffusion constant  t = time |
| --- | --- | --- | --- |
| 5.1 | Diffusion flux |  | M = mass of material diffusion |
| 5.2 | Fick’s first law |  | C = Concentration / composition  x = distance |
| 5.4b | Fick’s second law |  |  |
| 5.5 | Fick’s second law constant surface composition |  |  |
| 5.8 | Diffusion Constant |  | Table 5.2 for and  R is the gas constant |

# Chapter 6

| 6.1 | Engineering stress |  |  |
| --- | --- | --- | --- |
| 6.2 | Engineering strain |  | is gauge length, prior to loading |
| 6.5 | Hooke’s law |  |  |
|  | Poisson’s ratio |  |  |
| 6.11 | Percent elongation |  | is the final length |
| 6.12 | Percent reduction in area |  |  |
| 6.15 | True stress |  | is current area |
| 6.16 | True strain |  |  |
| 6.19 |  |  | is the strain-hardening exponent  is a material constant |
| 6.20 | Tensile strength |  | is the Brinell hardness |
|  | Resilience |  | in the elastic region |

# Chapter 7

| 7.2 | Resolved Shear Stress |  | is the angle between the tensile axis and the normal to the slip plane  is the angle between the tensile axis and the slip direction |
| --- | --- | --- | --- |
| 7.7 | Yield strength |  | is average grain size  and are material constants |
| 7.9 | Average grain size (during grain growth) |  | is a material constant  is time passed  is a constant but normally |

# Chapter 8

| 8.1 | Maximum Stress at tip of elliptically shaped crack |  | = tip radius  = applied stress  2a is crack length of an internal crack  a is crack length of a surface crack |
| --- | --- | --- | --- |
|  | Critical stress for crack propagation |  | is specific surface energy  When the crack propagates |
| 8.5 | Plane strain fracture toughness |  | Y is a constant |
| 8.11 | Mean stress |  |  |
| 8.12 | Stress range |  |  |
| 8.13 | Stress amplitude |  |  |
| 8.14 | Stress ratio |  |  |
| 8.21 | Creep rate (Constant temperature) |  |  |
| 8.22 | Creep rate |  |  |

# Chapter 9

| 9.1a | Lever rule, 2 phases |  | is our concentration in question  is the concentration of the liquid phase  is the concentration of the phase |
| --- | --- | --- | --- |
| 9.1b | Lever rule, 2 phases |  |  |
| 9.20 | Mass fraction of pearlite, for a *hypoeutectoid* (left of eutectoid point) steel |  | is our concentration in question |
| 9.21 | Mass fraction of proeutectoid α ferrite phase, for a *hypoeutectoid* steel |  |  |
| 9.22 | Mass fraction of pearlite, for *hypereutectoid* (right of eutectoid point)steel |  | is our concentration in question |
| 9.23 | Mass fraction of proeutectoid cementite (), for a *hypereutectoid* steel |  |  |

# Chapter 10

| 10.17 | Fraction of transformation (Avrami equation) |  | y is the fraction of transformation  t is time  k and n are constants |
| --- | --- | --- | --- |
|  | Rearranged |  |  |
|  | Rearranged |  |  |
| 10.18 | Transformation rate | rate = | is the time for half the transformation to be completed |