

[Physical Chemistry Division course information](#)

[To see one equation after another](#)

[To see one equation after another with explanations](#)

$$PV = nRT$$

$$P = \frac{nRT}{V - nb} - \frac{n^2 a}{V^2} = \frac{RT}{V_m - b} - \frac{a}{V_m^2}$$

$$u = \sqrt{\frac{3RT}{M}}$$

$$\alpha = \frac{1}{V} \left(\frac{\delta V}{\delta T} \right)_P$$

$$\kappa_T = -\frac{1}{V} \left(\frac{\delta V}{\delta P} \right)_T$$

$$C_v = \left(\frac{dq}{dT} \right)_v$$

$$C_{vm} = \frac{1}{n} \left(\frac{dq}{dT} \right)_v$$

$$W = - \int_{x_1}^{x_2} F dx = - \int_{x_1}^{x_2} \frac{F}{A} A dx = - \int_{V_1}^{V_2} P_{ex} dV$$

$$C_p = \left(\frac{\delta H}{\delta T} \right)_p ; H = U + PV$$

$$\Delta_{mix} S = -R(n_A \ln X_A + n_B \ln X_B)$$

$$\mu = \left(\frac{\delta T}{\delta P} \right)_H$$

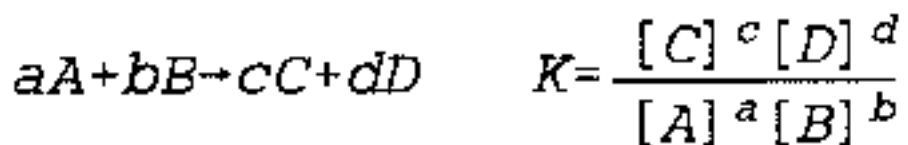
$$dS = \frac{dq_{rev}}{T}$$

$$\Delta_{mix}S = -R(n_A \ln X_A + n_B \ln X_B)$$

$$\frac{dP}{dT} = \frac{\Delta_{\phi}H}{T\Delta_{\phi}V}$$

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$$\Delta_{rxn}H(T_2) - \Delta_{rxn}H(T_1) = \int_{T_1}^{T_2} \Delta_{rxn}C_p dT$$



$$\Delta_f G^\phi = -RT \ln K_a \text{ (formation)}$$

$$H = \left(\frac{\delta \frac{G}{T}}{\delta \frac{1}{T}} \right)_p$$

$$\frac{d \ln K_a}{dT} = \frac{\Delta_{rxn} H^\phi}{RT^2}$$

$$F = c + 2 - p$$

$$n_1 d\mu_1 + n_2 d\mu_2 = 0$$

$$\mu = \frac{m_A m_B}{m_A + m_B}$$

$$\mu = \frac{m_A m_B}{m_A + m_B}$$

$$t_{\frac{1}{2}} = \frac{\ln 2}{k}$$

$$\frac{d \ln k}{dT} = \frac{E_a}{RT^2}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

$$k = A e^{-\left(\frac{E_a}{RT}\right)}$$

$$k = A e^{-\left(\frac{E_a}{RT}\right)}$$

$$\frac{1}{v} = \frac{1}{v_{\max}} + \frac{K_m}{v_{\max}} \frac{1}{[S]}$$

$$\lambda = \frac{h}{mv} \quad v \text{ is velocity}$$

$$[\hat{a}, \hat{x}] f(x) = \hat{a}\hat{x}f(x) - \hat{x}\hat{a}f(x)$$

1. Ideal Gas Law

$$PV=nRT$$

P is the pressure

V is the volume

n is the amount of gas

R is the Real Gas constant, with units appropriate for the units of pressure, volume, temperature, and amount of gas.

T is the temperature (in Kelvin because an [absolute scale](#) is necessary.)

Noggle- 3

2. The Van Der Waals Equation

$$P = \frac{nRT}{V-nb} - \frac{n^2a}{V^2} = \frac{RT}{V_m - b} - \frac{a}{V_m^2}$$

The constant a accounts for the attractive forces between gas molecules; PV=nRT assumed there were no attractions whatsoever.

The constant b accounts for the volume taken up by the gases; PV=nRT assumed gases to be points of infinitesimally small volume.

V(m) is volume divided by amount in moles

Noggle- 5

3. The Root Mean Square Speed of a Gas

$$u = \sqrt{\frac{3RT}{M}}$$

u is the root-mean-square speed

R is the Real Gas constant, with units appropriate for the units of pressure, volume, temperature, and amount of gas.

T is the temperature M is the molar mass

Noggle- 32

4. The Coefficient of Thermal Expansion

$$\alpha = \frac{1}{V} \left(\frac{\delta V}{\delta T} \right)_P$$

alpha is the coefficient of thermal expansion

V is the volume

delta V is the change in volume

delta T is the change in temperature P is the pressure and it is held constant

Noggle- 59

5. The Isothermal Compressibility

$$\kappa_T = -\frac{1}{V} \left(\frac{\delta V}{\delta P} \right)_T$$

kappa(T) is the isothermal compressibility

V is the volume

delta V is the change in volume

delta P is the change in pressure

T is the temperature, and it is held constant.

Noggle- 71

6. Heat Capacity at Constant Volume

$$C_v = \left(\frac{dq}{dT} \right)_v$$

C(v) is the heat capacity at constant volume

q is the quantity of heat given off

T is the temperature

V is the volume

Noggle- 71

7. Molar Heat Capacity

$$C_{vm} = \frac{1}{n} \left(\frac{dq}{dT} \right)_v$$

C_{vm} is the molar heat capacity (constant volume)

n is moles

Noggle- 72

8. Work of Pressure

$$W = - \int_{x_1}^{x_2} F dx = - \int_{x_1}^{x_2} \frac{F}{A} A dx = - \int_{V_1}^{V_2} P_{ex} dV$$

F is force

x is a one dimensional coordinate

A is area

V is volume

P_{ex} is the pressure which opposes expansion

Noggle- 81

9. Heat Capacity

$$C_p = \left(\frac{\delta H}{\delta T} \right)_P ; H = U + PV$$

C_p is Heat Capacity at Constant Pressure

H is enthalpy

P is pressure

U is internal energy

V is volume

T is the temperature

Noggle- 86

10. Entropy of Mixing for Two Gases

$$\Delta_{mix} S = -R(n_A \ln X_A + n_B \ln X_B)$$

Delta (mix) S is the entropy of mixing for two gases

n is moles

R is the real gas constant

X is the mole fraction of the gas

Noggle- 136

11. Joule-Thompson Coefficient

$$\mu = \left(\frac{\delta T}{\delta P} \right)_H$$

mu is the Joule Thompson coefficient

H is the enthalpy

P is the preasure

T is the temperature

Noggle- 109

12. Equation for Entropy, Heat, and Temperature

$$dS = \frac{dq_{rev}}{T}$$

rev indicates the equation is valid only for a reversible process

q is the heat

S is the entropy

T is the temperature

Noggle- 128

13. Equation 13 was a repeat of 10- This space available for a different equation.

14. Clapeyron Equation

$$\frac{dP}{dT} = \frac{\Delta_{\phi}H}{T\Delta_{\phi}V}$$

Delta phi X is the heat required at constant pressure and constant temperature, to effect a phase change

P is pressure

T is temperature

Delta phi V is the change in molar volume

Noggle- 175

15. 2



16. Change in Enthalpy with Temperature and Change in Heat Capacity with Temperature

$$\Delta_{rxn}H(T_2) - \Delta_{rxn}H(T_1) = \int_{T_1}^{T_2} \Delta_{rxn}C_p dT$$

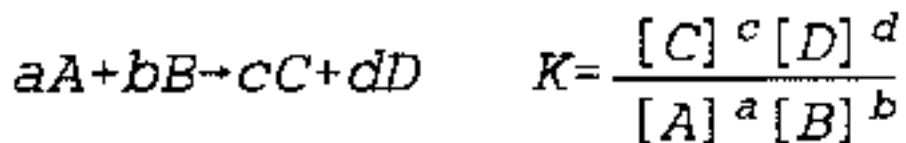
Delta (rxn) H(T) is the change in the enthalpy of a reaction at a specified temperature

Cp is the heat capacity at a constant pressure

T is the temperature

Noggle- 280

17. Law of Mass Action(the reaction equality is the Van't Hoff Equation)



Small case variables (a,b,c,d) are stoichiometric coefficients

Large case variables (A,B,C,D) are chemical species

C and D are products, and A and B are reactants

K(a) is the thermodynamic equilibrium constant

Notice that what involves addition and subtraction in one equation relates to multiplication and division in the other

18. K(a) is the thermodynamic equilibrium constant

$$\Delta_f G^\phi = -RT \ln K_a (\text{formation})$$

Delta(f)G phi is the standard free energy of formation

K(a) is the thermodynamic equilibrium constant

R is the Real Gas constant

T is temperature

Noggle- 291

19. Enthalpy, Free Energy, and Temperature at Constant Pressure

$$H = \left(\frac{\delta G}{\delta \frac{1}{T}} \right)_p$$

G is Free Energy

H is enthalpy

P is pressure

T is temperature

Noggle- 295

20. Thermodynamic Equilibrium, Enthalpy, and Temperature

$$\frac{d \ln K_a}{dT} = \frac{\Delta_{rxn} H^\phi}{RT^2}$$

Delta(rxn)H(phi) is the change in enthalpy from the reaction

K(a) is thermodynamic equilibrium

T is temperature

21. Gibbs' Phase Rule

$$F = c + 2 - p$$

c is the number of components (I think this means c different 'types' of components--hey, components is a nebulous word, so I'll try to find an example of what it means)

F is the degrees of freedom

p is the number of phases

Noggle- 339

22. Gibbs-Duhem Equation

$$n_1 d\mu_1 + n_2 d\mu_2 = 0$$

d mu is the change in chemical potential

n is the number of moles

Noggle- 356

23. Reduced Mass

$$\mu = \frac{m_A m_B}{m_A + m_B}$$

mu is the reduced mass

m is the mass of one of the two objects

Noggle- 1057

24. 11 was a repeat--PChem24.gif is available for a new equation

25. Half Life Equation

$$t_{\frac{1}{2}} = \frac{\ln 2}{k}$$

t is time

k is the "half life constant" (no specific name found)

Noggle- 521

26. Arrhenius Activation Energy Equation

$$\frac{d \ln k}{dT} = \frac{E_a}{RT^2}$$

E(a) is the Arrhenius activation energy

k is the "rate constant" (no specific name found)

R is the Real Gas constant T is the temperature *Noggle- 528*

27. The Integrated form of the
Arrhenius Activation Energy Equation

$$\ln k = \ln A - \frac{E_a}{RT}$$

E(a) is the Arrhenius activation energy

k is the "rate constant" (no specific name found)

R is the Real Gas constant

T is the temperature

Noggle- 528

28. Arrhenius Equation Solved for k

$$k = A e^{-\left(\frac{E_a}{RT}\right)}$$

E(a) is the Arrhenius activation energy

k is the "rate constant" (no specific name found)

R is the Real Gas constant

T is the temperature

Noggle- 529

29. A repeat of an equation
PChem29.gif is now available for a new equation

30. Michaelis-Menton Equation

$$\frac{1}{v} = \frac{1}{v_{\max}} + \frac{K_m}{v_{\max}} \frac{1}{[S]}$$

v is the velocity of the overall (biochemical) reaction

v(max) is the [maximum velocity](#) the reaction could achieve

K(m) is the Michaelis constant

[S] is the substrate concentration

Noggle- 582

31. DeBroglie Equation

$$\lambda = \frac{h}{mv} \quad v \text{ is velocity}$$

Lambda is wavelength of the object

h is Planck's constant

m is the mass of the object

v is the velocity of the object

Noggle- 614

32. Definition of the Commutator

$$[\hat{d}, \hat{x}] f(x) = \hat{d}\hat{x}f(x) - \hat{x}\hat{d}f(x)$$

x and d are operators, as signified by the "carrot" symbol

f(x) is a generic function

[d,x] represents the commutator of variables d and x

Noggle- 618

An absolute scale places zero at the lowest value possible.

For the hypothetical biochemical reaction, velocity depends on the concentration of substrate-- $v(\max)$ occurs at infinite substrate concentration.