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IB Physics SL & HL Formula Sheet

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Fundamental Constants

Symbol	Quantity	Approximate Value
g	Free fall acceleration (Earth's surface)	$9.8\ m\ s^{-2}$
G	Gravitational constant	$6.67\ \times\ 10^{-11}\ N\ m^2\ kg^{-2}$
N_A	Avogadro's constant	$6.022\ \times\ 10^{23}\ mol^{-1}$
R	Gas constant	$8.31\ J\ K^{-1}\ mol^{-1}$
k_B	Boltzmann's constant	$1.38 \times 10^{-23}\ J\ K^{-1}$
σ	Stefan-Boltzmann constant	$5.67 \times 10^{-8}\ W\ m^{-2}\ K^{-4}$
k	Coulomb constant	$8.99 \times 10^{9}\ N\ m^2\ C^{-2}$
ε_0	Free space permittivity	$8.85 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$
μ_0	Free space permeability	$4\pi \times 10^{-7}\ T\ m\ A^{-1}$
c	Speed of light in a vacuum	$3.00 \times 10^{8}\ m\ s^{-1}$
h	Planck's constant	$6.63 \times 10^{-34}\ J\ s$
e	Elementary charge	$1.60 \times 10^{-19}\ C$
m_e	Electron rest mass	$9.110 \times 10^{-31}\ kg = 0.000549u = 0.511\ MeV\ c^{-2}$
m_p	Proton rest mass	$1.673 \times 10^{-27}\ kg = 1.007276u = 938\ MeV\ c^{-2}$
m_n	Neutron rest mass	$1.675 \times 10^{-27}\ kg = 1.008665u = 940\ MeV\ c^{-2}$
u	Unified atomic mass unit	$1.661 \times 10^{-27}\ kg = 931.5\ MeV\ c^{-2}$
S	Solar constant (Earth's surface)	$1.36\ \times 10^{3}\ W\ m^{-2}$
R_0	Fermi Radius	$1.20\ \times 10^{-15}\ m$

Metric Prefixes

Symbol	Prefix	Value
P	peta-	10^{15}
T	tera-	10^{12}
G	giga-	10^{9}
M	mega-	10^{6}
k	kilo-	10^{3}
h	hecto-	10^{2}
da	deca-	10^{1}
d	deci-	10^{-1}
c	centi-	10^{-2}
m	milli-	10^{-3}
μ	micro-	10^{-6}
n	nano-	10^{-9}
p	pico-	10^{-12}
f	femto-	10^{-15}

Geometry and Trigonometry Equations

Circumference (circle)	$C = 2\pi r$
Area (triangle)	$A = \frac{1}{2}(bh)$
Area (circle)	$A = \pi r^2$
Curved Surface Area (cylinder)	$A = 2\pi rh$
Surface Area (sphere)	$A = 4\pi r^2$
Volume (sphere)	$V = \frac{4}{3}\pi r^3$
Volume (cylinder)	$V = \pi r^2 h$
Volume (prism)	$V = Ah$
Volume (cuboid)	$V = lwh$
Trigonometric relationships	$\tan\theta = \frac{sin\theta}{cos\theta}$ $\sin^2\theta + \cos^2\theta = 1$
Vector Components	$A_H = Acos\theta$ $A_V = Asin\theta$ A_H = horizontal component of vector A, A_V = vertical component of vector A, θ = the angle relative to the horizontal

Unit Conversions

1 radian (rad)	$\frac{180°}{\pi}$
Temperature (K)	Temperature (℃) + 273
1 light year (ly)	$9.46 \times 10^{15}\ m$
1 parsec (pc)	$3.26\ ly$
1 astronomical unit (AU)	$1.50 \times 10^{11} m$
1 kilowatt-hour (kWh)	$3.60\ \times 10^{6}\ J$
hc	$1.99 \times 10^{-25}\ J\ m = 1.24 \times 10^{-6}\ eV\ m$

Uncertainty Calculations

Addition and Subtraction	$If: y = a \pm b$ $then: \Delta y = \Delta a + \Delta b$
Multiplication and Division	$If: y = \frac{ab}{c}$ $then: \frac{\Delta y}{y} = \frac{\Delta a}{a} + \frac{\Delta b}{b} + \frac{\Delta c}{c}$
Exponentiation	$If: y = a^n$ $then: \frac{\Delta y}{y} = \left\lvert n\frac{\Delta a}{a}\right\rvert$

Where a, b, c and y are quantities with absolute uncertainties Δa, Δb, Δc and Δy

Theme A: Space, Time and Motion	
A.1 Kinematics	
Uniform Acceleration Equations	$v = u + at$; $s = ut + \frac{1}{2}at^2$; $v^2 = u^2 + 2as$; $s = \frac{v+u}{2}t$ v = final velocity, u = initial velocity, a = acceleration, t = time, s = displacement
A.2 – Forces & Momentum	
Friction	$F_f \leq \mu_s F_N$; $F_f = \mu_d F_N$ F_f = frictional force, F_N = normal reaction force, μ_s = static friction coefficient, μ_d = dynamic friction coefficient
Hooke's Law for Springs	$F_H = -kx$ F_H = restoring force, k = spring constant, x = displacement from equilibrium
Drag Force in Fluids (Stokes' Law)	$F_d = 6\pi\eta rv$ F_d = drag force, η= viscosity of fluid, r = radius of cross section, v = relative motion to fluid
Buoyant Force	$F_b = \rho Vg$ F_b = buoyant force, ρ = density of displaced fluid, V = volume of displaced fluid, g = gravitational field strength
Force of Gravity (Weight)	$F_g = mg$ F_g = gravitational force, m = mass of object, g = gravitational field strength
Definition of Momentum	$p = mv$ p = momentum, m = mass, v = velocity
Impulse	$J = F\Delta t$ J = impulse, F = net force, Δt = time interval
Newton's Second Law	$F = ma = \frac{\Delta p}{\Delta t}$ F = net force, m = mass, a = acceleration, Δp = change in momentum, Δt = time interval
Centripetal Acceleration	$a = \frac{v^2}{r} = \omega^2 r = \frac{4\pi^2 r}{T^2}$ a = acceleration, v = speed, r = radial distance, ω = angular speed, T = period
Relationship between Tangential and Angular Velocity	$v = \frac{2\pi r}{T} = \omega r$ v = tangential velocity, r = radial distance, T = period, ω = angular velocity
A.3 – Work, Energy, and Power	
Definition of Work	$W = Fs\cos\theta$ W = work done, F = force, s = displacement, θ = angle between force and displacement
Definition of Kinetic Energy	$E_K = \frac{1}{2}\text{mv}^2 = \frac{p^2}{2m}$ E_K = kinetic energy, m = mass, v = speed, p = momentum
Gravitational Potential Energy in a Uniform Field	$\Delta E_p = mg\Delta h$ ΔE_P = change in gravitational potential energy, m = mass, g = gravitational field strength, Δh = change in height
Definition of Elastic Potential Energy	$E_H = \frac{1}{2}k\Delta x^2$ E_H = elastic potential energy, k = spring constant, Δx = compression or expansion of spring
Power	$P = \frac{\Delta W}{t} = Fv$ P = power, ΔW= work done, t = time, F = force, v = velocity
Efficiency	$\eta = \frac{useful\ work\ out}{total\ work\ in} = \frac{useful\ power\ out}{total\ power\ in}$ η = efficiency
A.4 Rotational Mechanics	
HL Definition of Torque	$\tau = Fr\sin\theta$ τ = torque, F = force, r = radial distance to force, θ = angle between force and radial vector
HL Angular Acceleration Equations	$\Delta\theta = \frac{(\omega_i + \omega_f)}{2}t$ $\quad \omega_f = \omega_i + \alpha t$ $\quad \Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$ $\quad \omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ $\Delta\theta$ = angular displacement, ω_i = intial angular speed, , ω_2 = final angular speed, α = angular acceleration, t = time
HL Moment of Inertia	$I = \Sigma mr^2$ I = moment of inertia, m = mass, r = radial distance
HL Newtons Second Law (Rotational)	$\tau = I\alpha$ τ = net torque, I = moment of inertia, α = angular acceleration
HL Definition of Angular Momentum	$L = I\omega$ L = angular momentum, I = moment of inertia, ω = angular velocity
HL Change in Angular Momentum	$\Delta L = \tau\Delta t$ $\quad \Delta L = \Delta(I\omega)$ ΔL = change in angular momentum, τ = net torque, t = time, I = moment of inertia, ω= angular speed
HL Rotational Kinetic Energy	$E_k = \frac{1}{2}I\omega^2 = \frac{L^2}{2I}$ E_k = rotational kinetic energy, I = moment of inertia, ω = angular speed, L = angular momentum

A.5 Special Relativity		
HL	**Galilean Transformations**	$x' = x - vt \qquad t' = t \qquad u' = u - v$ x, u, t = position, speed, and time in first reference frame, x', u', t' = position, speed, and time in second reference frame, v = relative velocity of second reference frame to first reference frame
HL	**Relativistic Transformations**	$x' = \gamma(x - vt) = \gamma\left(t - \frac{vx}{c^2}\right) u' = \frac{u - v}{1 - \frac{uv}{c^2}}$ x, u = position and speed in first reference frame, x', u' = position and speed in second reference frame, γ = Lorentz factor, v = relative velocity of second reference frame to first reference frame
HL	**Lorentz Factor**	$\gamma = \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$ γ = Lorentz factor, v = speed, c = speed of light
HL	**Spacetime interval**	$(\Delta s)^2 = (c\Delta t)^2 - \Delta x^2$ Δs = spacetime interval, c = speed of light, Δt = time between events according to observer, Δx = distance between events acc. to observer
HL	**Time Dilation**	$\Delta t = \gamma \Delta t_0$ Δt = relativistic time, γ = Lorentz factor, Δt_0 = proper time
HL	**Length Contraction**	$\mathrm{L} = \frac{\mathrm{L}_0}{\gamma}$ L = relativistic length, γ = Lorentz factor, L_0 = proper length
HL	**Space-time diagram angle**	$\tan\theta = \frac{v}{c}$ θ = angle between axes of inertial frames of reference, v = relative speed of frames of reference, c = speed of light

Theme B: The Particulate Nature of Matter	
B.1 – Thermal Energy Transfers	
Density	$\rho = \frac{m}{V}$ ρ = density, m = mass, V = volume
Average Kinetic Energy of an Ideal Monatomic Gas	$\bar{E}_k = \frac{3}{2}k_bT$ $\bar{E}_k$ = average kinetic energy, k_b = Boltzmann's constant, T = temperature in Kelvin
Specific and Latent Heat	$Q = mc\Delta T$; $Q = mL$ Q = heat, m = mass, c = specific heat capacity, L = specific latent heat
Thermal Conduction	$\frac{\Delta Q}{\Delta t} = kA\frac{\Delta T}{\Delta x}$ $\frac{\Delta Q}{\Delta t}$ = rate of heat transfer, k = conductivity constant, A = cross-sectional area, ΔT = temperature difference, Δx = length of object
Stefan-Boltzmann Law	$L = \sigma A T^4$ L = luminosity/power, σ = Stefan-Boltzmann constant, A = surface area, T = temperature in Kelvin
Brightness as a Function of Distance	$b = \frac{L}{4\pi d^2}$ b = brightness/intensity, L = power of source, d = distance from source
Wien's Law	$\lambda_{max}T = 2.9 \times 10^{-3}\, mK$ λ_{max} = peak wavelength of blackbody, T = temperature in Kelvin
B.2 – Greenhouse Effect	
Definition of Emissivity	$emissivity = \frac{power\ radiated\ per\ unit\ area}{\sigma T^4}$ σ = Stefan-Boltzmann constant, T = kelvin temperature
Definition of Albedo	$albedo = \frac{total\ scattered\ power}{total\ incident\ power}$
B.3 – Ideal Gas Model	
Definition of Pressure	$P = \frac{F}{A}$ F = force, A = area
Amount in Moles	$n = \frac{N}{N_A}$ n = amount in moles, N = number of particles, N_A = Avogadro's Constant
Combined Gas Law	$\frac{PV}{T} = constant$ P = pressure, V = volume, T = temperature
Ideal Gas Equation of State	$PV = nRT = Nk_BT$ pressure = P, V = volume, n = amount in moles, R = gas constant, T = temperature in Kelvin, N = number of particles, k_b = Boltzmann's constant
Pressure of an Ideal Gas	$P = \frac{1}{3}\rho v^2$ P = pressure, ρ = density, v = average particle speed
Internal Energy of an Ideal Gas	$U = \frac{3}{2}nRT = \frac{3}{2}Nk_BT$ U = internal energy, n = number of moles, R = gas constant, T = temperature in Kelvin, N = number of particles, k_b = Boltzmann's constant
B.4 - Thermodynamics	
HL **First Law of Thermodynamics**	$Q = \Delta U + W$ Q = heat added, ΔU = change in internal energy, W = work done by the gas
HL **Work Done by a Gas**	$W = P\Delta V$ W = work done by the gas, P = pressure, ΔV = change in volume
HL **Change in Internal Energy of an Ideal Gas**	$\Delta U = \frac{3}{2}nR\Delta T = \frac{3}{2}Nk_B\Delta T$ ΔU = change in internal energy, n = moles, R = gas constant, ΔT = change in temperature, N = number of particles, k_b = Boltzmann's constant
HL **Entropy – Macroscopic Formula**	$\Delta S = \frac{\Delta Q}{T}$ ΔS = change in entropy, ΔQ = heat transferred, T = temperature in Kelvin
HL **Entropy – Microscopic Formula**	$S = k_B \ln \Omega$ S = entropy, k_b = Boltzmann's constant, Ω = number of microstates
HL **Adiabatic Change of State Formula**	$PV^{\frac{5}{3}} = constant$ P = pressure, V = volume
HL **Efficiency**	$\eta = \frac{useful\ work}{input\ energy}$ η = efficiency
HL **Carnot Efficiency**	$\eta_{carnot} = 1 - \frac{T_c}{T_h}$ η_{carnot} = Carnot efficiency, T_c = temperature of cold reservoir, T_c = temperature of hot reservoir

B.5 – Electric Circuits	
Definition of Electrical Current	$I = \frac{\Delta Q}{\Delta t}$ I = electrical current, q = charge, t = time
Potential Difference (Voltage)	$V = \frac{W}{q}$ V = potential difference, W = work, q = charge
Definition of Resistance	$R = \frac{V}{I}$ R = resistance, V = potential difference, I = current
Resistivity	$\rho = \frac{Rl}{A}$ ρ = resistivity, R = resistance, l = length, A = cross-sectional area
Electrical Power	$P = VI = I^2R = \frac{V^2}{R}$ P = power, V = potential difference, I = current, R = resistance
Series Circuit Relationships	$I = I_1 = I_2 = \ldots$ $V = V_1 + V_2 + \ldots$ $R_s = R_1 + R_2 + \ldots$ I = current in the circuit, V = total voltage across all elements, $I_1, I_2/V_1, V_2$ = current/voltage in circuit elements, R_s= equivalent resistance, R_1, R_2 = resistances of circuit elements
Parallel Circuit Relationships	$I = I_1 + I_2 + \ldots$ $V = V_1 = V_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ I = total current to parallel elements, V = voltage in each parallel branch, R_P = equivalent resistance, R_1, R_2 = resistances of circuit elements
Model of Internal Resistance	$\varepsilon = I(R + r)$ ε = emf, I = current, R = resistance of external circuit, r = internal resistance

Theme C: Wave Behaviour

C.1 – Simple Harmonic Motion

	Defining Equation of SHM	$a = -\omega^2 x$ a = acceleration, ω = angular frequency, x = displacement
	Relationship between Period and Frequency	$T = \frac{1}{f} = \frac{2\pi}{\omega}$ T = period, f = frequency, ω = angular frequency
	Period of a Mass-Spring System	$T = 2\pi\sqrt{\frac{m}{k}}$ T = period, m = mass, k = spring constant
	Period of a Pendulum	$T = 2\pi\sqrt{\frac{l}{g}}$ T = period, l = length, g = gravitational field strength
HL	**Displacement as a Function of Time**	$x = x_0 \sin(\omega t + \phi)$ x = displacement, x_0 = max displacement, ω = angular frequency, t = time, ϕ = phase angle
HL	**Velocity as a Function of Time**	$v = \omega x_0 \cos(\omega t + \phi)$ v = velocity, ω = angular frequency, x_0 = max displacement, t = time, ϕ = phase angle
HL	**Velocity as a Function of Position**	$v = \pm\omega\sqrt{(x_0^2 - x^2)}$ v = velocity, ω = angular frequency, x_0 = max displacement, x = displacement
HL	**Total Energy in SHM**	$E_T = \frac{1}{2}m\omega^2 x_0^2$ E_T = total energy, m = mass, ω = angular frequency, x_0 = max displacement
HL	**Potential Energy as a Function of Position**	$E_p = \frac{1}{2}m\omega^2 x^2$ Ep = potential energy, m = mass, ω = angular frequency, x = displacement

C.2 – Travelling Waves

	Wave Equation	$v = f\lambda = \frac{\lambda}{T}$ v = wave speed, f = frequency, λ = wavelength, T = period of oscillation

C.3 – Refraction, Diffraction, Superposition and Interference

	Snell's Law	$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$ n = index of refraction, θ = angle between normal and the ray, v = speed of wave
	Constructive Interference Condition	$path\ difference = n\lambda$ n = integer number, λ = wavelength
	Destructive Interference Condition	$path\ difference = (n + \frac{1}{2})\lambda$ n = integer number, λ = wavelength
	Two Source Interference	$s = \frac{\lambda D}{d}$ s = fringe spacing, λ = wavelength, D = distance between sources and screen, d = distance between sources
HL	**Angle between Peak and Primary Minimum in Single-Slit Diffraction**	$\theta = \frac{\lambda}{b}$ θ = angle, λ = wavelength, b = slit width
HL	**Multi-Slit Interference**	$n\lambda = d\sin\theta$ n = order, d = slit spacing, λ = wavelength, θ = angle

C.5 – Doppler Effect

	Doppler Effect for Electromagnetic Waves	$\frac{\Delta f}{f} = \frac{\Delta\lambda}{\lambda} \approx \frac{v}{c}$ f = frequency, Δf = frequency shift, λ = wavelength, $\Delta\lambda$ = wavelength shift, v = relative speed, c = speed of light
HL	**Doppler Effect for Mechanical Waves**	$Moving\ source: f' = f\left(\frac{v}{v \pm u_s}\right)$ $Moving\ observer: f' = f\left(\frac{v \pm u_o}{v}\right)$ f' = observed frequency, f = emitted frequency, u_s = speed of moving source, u_o = speed of moving observer, v = wave speed

Theme D: Fields

D.1 Gravitational Fields

	Newton's Law of Gravitation	$F = \frac{Gm_1 m_2}{r^2}$ F = gravitational force, G = gravitational constant, m_1, m_2 = mass, r = distance
	Gravitational Field Strength	$g = \frac{F}{m} = G\frac{M}{r^2}$ g = gravitational field strength, F = gravitational force, m = mass of object in field, M = mass of object creating field
HL	**Potential Energy of a Two-Mass System**	$E_p = -\frac{Gm_1 m_2}{r}$ E_p = gravitational potential energy, G = gravitational constant, M = mass, r = distance
HL	**Gravitational Potential**	$V_g = -\frac{GM}{r}$ V_g = gravitational potential, G = gravitational constant, M = mass, r = distance
HL	**Relationship between Field and Potential**	$g = -\frac{\Delta V_g}{\Delta r}$ g = gravitational field strength, $\frac{\Delta V_g}{\Delta r}$ = rate of change of potential
HL	**Work Done on a Mass Moving Across a Change in Potential**	$W = m\Delta V_g$ W = work done, m = mass, ΔV_g = change in gravitational potential
HL	**Escape Velocity**	$v_{esc} = \sqrt{\frac{2GM}{r}}$ v_{esc} = escape speed, G = gravitational constant, M = central mass, r = distance from centre of central mass
HL	**Orbital Speed**	$v_{orbital} = \sqrt{\frac{GM}{r}}$ $v_{orbital}$ = orbital speed, G = gravitational constant, M = central mass, r = distance from centre of central mass

D.2 – Electromagnetic Fields

	Coulomb's Law	$F = \frac{kq_1q_2}{r^2}, k = \frac{1}{4\pi\varepsilon_0}$ F = force, k = Coulomb's constant, q_1, q_2 = charge, r = distance, ε_0 = free space permittivity
	Definition of Electric Field Strength	$E = \frac{F}{q}$ E = electric field strength, F = electric force, q = charge
	Field Between Parallel Plates	$E = \frac{V}{d}$ E = electric field strength, V = voltage across plates, d = plate separation
HL	**Potential Energy of a Two-Charge System**	$E_p = \frac{kQq}{r}$ E_p = potential energy, k = Coulomb's constant, q_1, q_2 = charge, r = distance
HL	**Electric Potential**	$V_e = -\frac{kQ}{r}$ V_e = electric potential, k = Coulomb's constant, Q = charge, r = distance
HL	**Relationship between Field and Potential**	$E = -\frac{\Delta V_e}{\Delta r}$ E = electric field strength, $\frac{\Delta V_e}{\Delta r}$ = rate of change of electric potential
HL	**Relationship between Potential Energy and Potential**	$W = q\Delta V_e$ W = work done, q = charge, ΔV_e = change in electric potential

D.3 – Motion in Electromagnetic Fields

	Magnetic Force on a Moving Charge	$F = qvBsin\theta$ F = magnetic force, q = charge, v = velocity, B = magnetic field strength, θ = angle between field and velocity
	Magnetic Force on a Current-carrying wire	$F = BILsin\theta$ F = magnetic force, I = current, L = length, θ = angle between field and current
	Force Between Parallel Wires	$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{r}$ $\frac{F}{L}$ = force per unit length, μ_0 = free space permeability, I_1, I_2 = current, r = separation distance

D.4 – Electromagnetic Induction

HL	**Definition of Magnetic Flux**	$\Phi = BAcos\theta$ Φ = magnetic flux, B = magnetic flux density, A = area, θ = angle between normal to area and field
HL	**Faraday's and Lenz's Laws**	$\varepsilon = -\frac{N\Delta\Phi}{\Delta t}$ ε = induced emf, N = turns, $\Delta\Phi$ =change in magnetic flux, Δt = change in time
HL	**Motional EMF**	$\varepsilon = BvL$ ε = induced motional emf, B = magnetic flux density, v = velocity, L = length

Theme E: Nuclear and Quantum Physics		
E.1 – Atomic Structure		
Energy of an Electromagnetic Wave		$E = hf$ E = energy, h = Planck's constant, f = frequency
HL	**Nuclear Radius Approximation**	$R = R_0 A^{\frac{1}{3}}$ R = nuclear radius, R_0 = Fermi radius, A = nucleon number
HL	**Energy Levels of the Bohr Model of the Hydrogen Atom**	$E = -\frac{13.6}{n^2} eV$ E = energy, n = energy level
HL	**Quantized Angular Momentum of the Bohr Model of the Hydrogen Atom**	$mvr = \frac{nh}{2\pi}$ m = electron mass, v = speed, r = orbital radius, n = energy level, h = Planck's constant
E.2 – Quantum Physics		
HL	**Maximum Kinetic Energy of a Photoelectron**	$E_{max} = hf - \Phi$ E_{max} = maximum kinetic energy, h = Planck's constant, f = photon frequency, Φ = work function
HL	**De Broglie Wavelength**	$\lambda = \frac{h}{p}$ λ = wavelength, h = Planck's constant, p = momentum
HL	**Compton Effect**	$\lambda_f - \lambda_i = \Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta)$ λ_f = final wavelength, λ_i = initial wavelength, h = Planck's constant, m_e = electron mass, c = speed of light, θ = scattering angle
E.3 – Radioactive Decay		
Mass-Energy Equivalence		$\Delta E = \Delta mc^2$ ΔE = energy, Δm = mass
HL	**Radioactive Decay**	$N = N_0 e^{-\lambda\tau}$ N = parent nuclide count at time t, N_0 = nuclide count at t = 0, λ = decay constant, t = time
HL	**Activity**	$A = \lambda N = \lambda N_0 e^{-\lambda\tau}$ A = activity, λ = decay constant, N = parent nuclei count, N_0 = parent nuclide count at t = 0, t = time
HL	**Half-Life**	$T_{\frac{1}{2}} = \frac{ln2}{\lambda}$ $T_{\frac{1}{2}}$ = half life, λ = decay constant
E.5 – Stellar Properties & Processes		
Parsec Definition		$d(parsec) = \frac{1}{p(arc - second)}$ d = distance in parsecs, p = parallax angle in arcseconds