SPH3U – Grade 11 Physics Formula Sheet

Prefixes

$\eta = x\ 10^{-9}$ $\mu = x\ 10^{-6}$ $m = x\ 10^{-3}$ $k = x\ 10^{3}$ $M = x\ 10^{6}$ $G = x\ 10^{9}$

Trigonometry

Quadratic Equation

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Right Angle Triangle (SOH CAH TOA & Pythagorean Theorem)

$$sin\theta = \frac{opposite}{hypotenuse} \quad cos\theta = \frac{adjacent}{hypotenuse} \quad tan\theta = \frac{opposite}{adjacent} \quad c^2 = a^2 + b^2$$

Non-Right Angle Triangle (Sine & Cosine Law)

$$\frac{a}{sinA} = \frac{b}{sinB} = \frac{c}{sinC}$$

$$a^2 = b^2 + c^2 - 2 \cdot b \cdot c \cdot cosA$$
$$b^2 = a^2 + c^2 - 2 \cdot a \cdot c \cdot cosB$$
$$c^2 = a^2 + b^2 - 2 \cdot a \cdot b \cdot cosC$$

Error

$$\%\ Error = \frac{|measured\ value - accepted\ value|}{accepted\ value} x\ 100\%$$

$$\%\ Difference = \frac{|value_1 - value_2|}{\left(\frac{value_1 + value_2}{2}\right)} x\ 100\%$$

Kinematics

$$\vec{v}_{avg} = \frac{\Delta\vec{d}}{\Delta t} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i}$$

$$\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{t_f - t_i}$$

$$\vec{a}_g = 9.8\frac{m}{s^2}[down]$$

$$\Delta\vec{d} = \frac{(\vec{v}_f + \vec{v}_i)}{2}\Delta t$$

$$\vec{v}_f = \vec{v}_i + \vec{a}\Delta t$$

$$(\vec{v}_f)^2 = (\vec{v}_i)^2 + 2\vec{a}\Delta d$$

$$\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$$

$$\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}(\Delta t)^2$$

Dynamics (Forces)

$\vec{F}_{net} = \sum Forces$ $\vec{F}_{net} = m\vec{a}$ $\vec{F}_g = m\vec{g}$ $\vec{g} = 9.8\frac{N}{kg}[down]$

$F_k = \mu_k F_N$ $F_s = \mu_s F_N$ $F = \frac{Gm_1m_2}{d^2}$ $G = 6.67 \times 10^{-11}\frac{N \cdot m^2}{kg^2}$

Work, Energy, Power and Society

$W = \vec{F}\Delta\vec{d}cos\theta$ $\Delta E_g = mg\Delta h$ $\Delta E_k = \frac{1}{2}mv^2$ $E_m = E_g + E_k$ $W = \Delta E$

$P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t}$ $efficiency = \frac{E_{out}}{E_{in}}\, x\; 100\%$

$Q = mc\Delta T$ $Q_f = mL_f$ $Q_v = mL_v$ $Q_{lost} + Q_{gained} = 0$

$T_K = T_C + 273$ $d = \frac{m}{V}$ ← (density)

$A = A_0\left(\frac{1}{2}\right)^{\frac{t}{h}}$ $E = mc^2$

$m_{electron} = 9.11 \times 10^{-31}kg$ $m_{proton} = 1.673 \times 10^{-27}kg$ $m_{neutron} = 1.675 \times 10^{-27}kg$

$m_{electron} = 0.000549\, u$ $m_{proton} = 1.007276\, u$ $m_{neutron} = 1.008665\, u$ $1\, u = 1.66 \times 10^{-27}kg$

Waves and Sound

$f = \frac{1}{T}$ $T = \frac{1}{f}$ $f = \frac{N}{\Delta t}$ $T = \frac{\Delta t}{N}$ $v = f\lambda$ $c = 3.00 \times 10^8\, \frac{m}{s}$

$\mu = \frac{m}{L}$ $v = \sqrt{\frac{F_T}{\mu}}$ $v_{sound} = 331.4\frac{m}{s} + \left(0.606\ \frac{m/s}{°C}\right) x\; T$ $M = \frac{airspeed\ of\ object}{local\ speed\ of\ sound}$

$L_n = \frac{(2n-1)}{4}\lambda$ $L_n = \frac{n\lambda}{2}$ $f_{beat} = |f_2 - f_1|$ $f_{obs} = \left(\frac{v_{sound} + v_{detector}}{v_{sound} + v_{source}}\right) f_{source}$

Electricity

$P = \frac{\Delta E}{\Delta t}$ $V = \frac{\Delta E}{Q}$ $I = \frac{Q}{\Delta t}$ $Q = Ne$ $V = IR$ $P = IV = I^2R = \frac{V^2}{R}$

$1kW \cdot h = 3.6 \times 10^6\, J$ $e = 1.602 \times 10^{-19}\, C$ $1\, eV = 1.602 \times 10^{-19}\, J$ $1C = 6.2 \times 10^{18}\, electrons$

Series Circuit	Parallel Circuit
$V_T = V_1 + V_2 + V_3 + \cdots$	$V_T = V_1 = V_2 = V_3 = \cdots$
$I_T = I_1 = I_2 = I_3 = \cdots$	$I_T = I_1 + I_2 + I_3 + \cdots$
$R_T = R_1 + R_2 + R_3 + \cdots$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$

Electromagnetism

$$\frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{N_P}{N_S}$$