SPH4U - Grade 12 Physics Formula Sheet

General Stuff

$\frac{a}{sinA} = \frac{b}{sinB} = \frac{c}{sinC}$ $a^2 = b^2 + c^2 - 2(b)(c)cosA$ $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

$\vec{F}_{net} = m\vec{a}$ $\vec{F}_g = m\vec{g}$ $F_f = \mu_f F_N$

Uniform Circular Motion

$\overrightarrow{a_c} = \frac{v^2}{r}$ $\overrightarrow{a_c} = 4\pi^2 rf^2$ $\overrightarrow{a_c} = \frac{4\pi^2 r}{T^2}$ $v = \frac{2\pi r}{T}$

$\sum\vec{F} = m\overrightarrow{a_c}$ $F_c = \frac{mv^2}{r}$

Work & Energy

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

$E_e = \frac{1}{2}k\Delta x^2$ $\vec{F}_x = k\Delta\vec{x}$ $T = 2\pi\sqrt{\frac{m}{k}}$

Momentum & Collisions

$\vec{p} = m\vec{v}$ $\Delta\vec{p} = \vec{F}\Delta t$

$m_1\vec{v}_{i_1} + m_2\vec{v}_{i_2} = m_1\vec{v}_{f_1} + m_2\vec{v}_{f_2}$ $\frac{1}{2}m_1\vec{v}_{i_1}{}^2 + \frac{1}{2}m_2\vec{v}_{i_2}{}^2 = \frac{1}{2}m_1\vec{v}_{f_1}{}^2 + \frac{1}{2}m_2\vec{v}_{f_2}{}^2$

$\vec{v}_f = \frac{m_1\vec{v}_{i_1} + m_2\vec{v}_{i_2}}{m_1 + m_2}$

$\vec{v}_{f_1} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)\vec{v}_{i_1} + \left(\frac{2m_2}{m_1 + m_2}\right)\vec{v}_{i_2}$ $\vec{v}_{f_2} = \left(\frac{m_2 - m_1}{m_1 + m_2}\right)\vec{v}_{i_2} + \left(\frac{2m_1}{m_1 + m_2}\right)\vec{v}_{i_1}$

$\vec{v}_{f_1} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)\vec{v}_{i_1}$ $\vec{v}_{f_2} = \left(\frac{2m_1}{m_1 + m_2}\right)\vec{v}_{i_1}$

Gravitational, Electric, and Magnetic Fields

$G = 6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2}$ $k = 8.99 \times 10^9 \frac{N \cdot m^2}{C^2}$

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

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

$F_g = \frac{Gm_1m_2}{r^2}$ $\vec{g} = \frac{Gm_p}{r^2}$ $v = \sqrt{\frac{Gm_p}{r}}$

7.2 $F_E = \frac{kq_1q_2}{r^2}$

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7.3 $\vec{F}_E = q\vec{\varepsilon}$ $\vec{\varepsilon} = \frac{kq_2}{r^2}$

7.4 $\Delta E_E = -q\varepsilon\Delta d$ $V = \frac{E_E}{q}$ $\Delta V = \frac{\Delta E_E}{q}$ $\varepsilon = -\frac{\Delta V}{\Delta d}$

7.5 $V = \frac{kq\Delta d}{r^2}$ $V = \frac{kq}{r}$ $E_E = \frac{kq_1q_2}{r}$ $\Delta E_E = E_{Ef} - E_{Ei}$

$\Delta E_E = \frac{kq_1q_2}{r_f} - \frac{kq_1q_2}{r_i}$

$F_M = qvB \sin\theta$ $F_M = ILB \sin\theta$ $I = \frac{q \cdot N}{\Delta t}$ $q = Ne$

The Wave Nature of Light

$c = 3.00 \times 10^8 \frac{m}{s}$

$v = f\lambda$ $f = \frac{1}{T}$ $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $n = \frac{\lambda_1}{\lambda_2}$ $\frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2}$ $\sin\theta_c = \frac{n_2}{n_1}$

9.3 $|P_nS_1 - P_nS_2| = \left(n - \frac{1}{2}\right)\lambda$ $\sin\theta_n = \frac{\left(n-\frac{1}{2}\right)\lambda}{d}$ $\sin\theta_n = \frac{x_n}{L}$ $\frac{x_n}{L} = \frac{\left(n-\frac{1}{2}\right)\lambda}{d}$

9.5 $\sin\theta_m = \frac{m\lambda}{d}$ $\sin\theta_n = \frac{\left(n-\frac{1}{2}\right)\lambda}{d}$

$x_m = \frac{mL\lambda}{d}$ $x_n = \frac{\left(n-\frac{1}{2}\right)L\lambda}{d}$ $\Delta x = \frac{L\lambda}{d}$

10.1 $2t = \frac{\left(m+\frac{1}{2}\right)\lambda}{n_{film}}$ $2t = \frac{n\lambda}{n_{film}}$ $\Delta x = L\left(\frac{\lambda}{2t}\right)$

10.2 $\sin\theta_m = \frac{\left(m+\frac{1}{2}\right)\lambda}{w}$ $\sin\theta_n = \frac{n\lambda}{w}$

$y_m = \frac{\left(m+\frac{1}{2}\right)L\lambda}{w}$ $y_n = \frac{nL\lambda}{w}$ $\Delta y = \frac{L\lambda}{w}$

10.3 $d = \frac{1}{N}$

Revolutions in Modern Physics: Quantum Mechanics & Special Relativity

$1eV = 1.602 \times 10^{-19} J$ $h = 6.63 \times 10^{-34}\, J \cdot s$

$\Delta t_m = \frac{\Delta t_s}{\sqrt{1-\frac{v^2}{c^2}}}$ $L_m = L_s\sqrt{1 - \frac{v^2}{c^2}}$ $p = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}}$ $m_m = \frac{m_s}{\sqrt{1-\frac{v^2}{c^2}}}$

$E_{total} = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$ $E_{rest} = mc^2$ $E_{total} = E_K + E_{rest}$

$W = e\Delta V$ $E_{photon} = hf = \frac{hc}{\lambda}$ $E_k = hf - hf_0$ $E_k = hf - W$

$p_{photon} = \frac{hf}{c} = \frac{h}{\lambda}$