PHYS 1200 EQUATION SHEET

Use only these equations on Preps

Units & prefixes 1 mile = 1.609 km 1 ft = 0.3048 m 1 inch = 2.54 cm 1 kg = 2.20 lb

1 km = 1000 m (k = 1000) 1 m = 100 cm (c = 0.01) 1 m = 1000 mm (m = 0.001) M = 10^6

Vectors $\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$ $|\vec{C}| = C = \sqrt{C_x^2 + C_y^2}$

Average speed, velocity, acceleration

$\Delta\vec{x} = x_f - x_i$ $\Delta t = t_f - t_i$ $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$ $\bar{v} = \frac{d}{\Delta t}$ $\bar{\vec{v}} = \frac{\Delta\vec{x}}{\Delta t}$ $\bar{\vec{a}} = \frac{\Delta\vec{v}}{\Delta t}$

Total distance, displacement, and time for *n* intervals

$d_{1n} = d_1 + d_2 + \ldots + d_n$ $\Delta\vec{x}_{1n} = \Delta\vec{x}_1 + \Delta\vec{x}_2 + \ldots + \Delta\vec{x}_n$ $\Delta t_{1n} = \Delta t_1 + \Delta t_2 + \ldots + \Delta t_n$

Kinematics: constant acceleration in 1D

$\Delta\vec{x} = \frac{1}{2}\left(\vec{v}_i + \vec{v}_f\right)\Delta t$ $\Delta\vec{x} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$ $\vec{v}_f = \vec{v}_i + \vec{a}\Delta t$ $v_f^2 = v_i^2 + 2\vec{a}\Delta\vec{x}$ $g = 9.81\ \text{m/s}^2$

Kinematics: constant acceleration in 2D

$\Delta\vec{x} = \frac{1}{2}\left(\vec{v}_{ix} + \vec{v}_{fx}\right)\Delta t$ $\Delta\vec{x} = \vec{v}_{ix}\Delta t + \frac{1}{2}\vec{a}_x\Delta t^2$ $\vec{v}_{fx} = \vec{v}_{ix} + \vec{a}_x\Delta t$ $v_{fx}^2 = v_{ix}^2 + 2\vec{a}_x\Delta\vec{x}$

$\Delta\vec{y} = \frac{1}{2}\left(\vec{v}_{iy} + \vec{v}_{fy}\right)\Delta t$ $\Delta\vec{y} = \vec{v}_{iy}\Delta t + \frac{1}{2}\vec{a}_y\Delta t^2$ $\vec{v}_{fy} = \vec{v}_{iy} + \vec{a}_y\Delta t$ $v_{fy}^2 = v_{iy}^2 + 2\vec{a}_y\Delta\vec{y}$

Forces & torques $\vec{F}_{\text{net}\,x} = m\vec{a}_x$ $\vec{F}_{\text{net}\,y} = m\vec{a}_y$ $F_G = mg$ $F_K = \mu_K F_N$ $F_S \le \mu_S F_N$

$F_E = k\,\Delta x$ $\vec{\tau}_{\text{net}} = I\vec{\alpha}$ $\tau = F\,r\sin\theta$ $I = I_{cm} + Md^2$

Work, energy, power $K_T = \frac{1}{2}mv^2$ $K_R = \frac{1}{2}I\omega^2$ $U_G = mgy$ $U_E = \frac{1}{2}kx^2$ $E = K + U$

$W = F\,\Delta x\,\cos\theta$ $W_{\text{net}} = K_f - K_i$ $W_{\text{NC,net}} = E_f - E_i$ $P = \frac{W}{\Delta t} = \frac{E_{\text{used}}}{\Delta t}$

Conservation: $E_i = E_f$

Linear & Angular Momentum $\vec{p} = m\vec{v}$ $\vec{J} = \vec{F}_{\text{net}}\,\Delta t$ $\vec{J} = \Delta\vec{p}$ $\vec{L} = I\vec{\omega}$

Conservation: $\vec{p}_i = \vec{p}_f$ $\vec{L}_i = \vec{L}_f$

Rotational kinematics

$$\Delta\vec{\theta} = \tfrac{1}{2}\left(\vec{\omega}_{\mathrm{i}} + \vec{\omega}_{\mathrm{f}}\right)\Delta t \qquad \Delta\vec{\theta} = \vec{\omega}_{\mathrm{i}}\,\Delta t + \frac{1}{2}\vec{\alpha}\,\Delta t^2 \qquad \vec{\omega}_{\mathrm{f}} = \vec{\omega}_{\mathrm{i}} + \vec{\alpha}\,\Delta t \qquad \omega_{\mathrm{f}}^2 = \omega_{\mathrm{i}}^2 + 2\vec{\alpha}\,\Delta\vec{\theta}$$

$1\ \text{rev} = 2\pi\ \text{rad}$

Circular motion, rolling $\quad s = r\,\Delta\theta \quad v = r\,\omega$ (radians only) $\quad a_{\mathrm{c}} = \dfrac{v^2}{r}$

Oscillations $\quad T = 2\pi\sqrt{\dfrac{m}{k}} \quad T = 2\pi\sqrt{\dfrac{L}{g}} \quad f = \dfrac{1}{T} \quad T = \dfrac{1}{f}$

Waves & sound $\quad \lambda = \dfrac{v}{f} \quad v = \sqrt{\dfrac{F_T}{\mu}} \quad \mu = \dfrac{m}{L} \quad f_{\mathrm{O}} = f_{\mathrm{S}}\left(\dfrac{v \pm v_{\mathrm{O}}}{v \pm v_{\mathrm{S}}}\right)$ d

Standing waves

both ends fixed/open: $\quad f_n = n\dfrac{v}{2L} \quad \lambda_n = \dfrac{2L}{n} \quad n = 1, 2, 3, \ldots$

one end free/open $\quad f_n = n\dfrac{v}{4L} \quad \lambda_n = \dfrac{4L}{n} \quad n = 1, 3, 5, \ldots$

both: $\quad f_n = n f_1$

Interference

same frequency, constructive $\quad |r_2 - r_1| = n\lambda \quad n = 0, 1, 2, \ldots$

same frequency, destructive $\quad |r_2 - r_1| = \left(n + \frac{1}{2}\right)\lambda \quad n = 0, 1, 2, \ldots$

different frequencies: beat frequency $\quad f_b = |f_2 - f_1|$