Physic 1201

TEST 2 FORMULA SHEET

Vectors

$$magnitude A = A = |\vec{A}|$$

$$\vec{A}+\vec{B} = \vec{B}+\vec{A}$$

$$(\vec{A}+\vec{B})+\vec{C} = \vec{A}+(\vec{B}+\vec{C})$$

$$\vec{A} = \vec{A}_x + \vec{A}_y$$

$$A_x = A\cos q$$

$$A_y = A\sin q$$

$$\tan q = A_y / A_x$$

$$A = \sqrt{A_x^2 + A_y^2}$$

$$R_x = A_x + B_x$$

$$R_y = A_y + B_y$$

$$\vec{A}\cdot\vec{B} = AB\cos q_{AB}$$

Newton's Laws

1st: $\sum \vec{F} = 0$

2nd: $\sum \vec{F} = m\vec{a}$

3rd: $\vec{F}_{12} = -\vec{F}_{21}$

$$\sum F_x = ma_x$$

$$\sum F_y = ma_y$$

$$\sum F_\perp = ma_\perp = m\frac{v^2}{R}$$

$$\vec{w} = m\vec{g}$$

Kinematics – 1 dimension

$$v_{ave} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$

$$a_{ave} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$$

$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$$

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x - x_0 = \frac{v_0 + v}{2}t$$

Constants and Math

$$g = 9.8(m/s^2)$$

$$G = 6.67\times10^{-11}(Nm^2/kg^2)$$

$$ax^2 + bx + c = 0$$

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

$$\sin^2 q + \cos^2 q = 1$$

$$\sin = opp/hyp$$

$$\cos = adj/hyp$$

$$\tan q = \frac{\sin q}{\cos q}$$

Kinematics – 2 dimensions

$$v_{ave} = \frac{\Delta\vec{r}}{\Delta t}$$

$$\vec{v} = \lim_{\Delta t \to 0} \frac{\Delta\vec{r}}{\Delta t}$$

$$v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$

$$v_y = \lim_{\Delta t \to 0} \frac{\Delta y}{\Delta t}$$

$$\vec{a}_{ave} = \frac{\Delta\vec{v}}{\Delta t}$$

$$\vec{a} = \lim_{\Delta t \to 0} \frac{\Delta\vec{v}}{\Delta t}$$

$$\vec{a}_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t}$$

$$\vec{a}_y = \lim_{\Delta t \to 0} \frac{\Delta v_y}{\Delta t}$$

$$a_\perp = v^2 / R$$

$$v = \frac{2pR}{t}$$

Forces

$$F_k = m_k N$$

$$F_s \le m_s N$$

$$F_{spring} = -kx$$

$$w = mg$$

$$F_g = G\frac{m_1 m_2}{r^2}$$

$$g = \frac{Gm_E}{R_E^2}$$

Work, Energy and Power

$$K = \frac{1}{2} m v^2$$

$$W = \vec{F} \cdot \vec{s} = Fs \cos q_{Fs}$$

$$W_{tot} = \Delta K = K_2 - K_1$$

$$U_{grav} = mgh$$

$$U_{grav} = -\frac{GMm}{r}$$

$$U_{spring} = \frac{1}{2} k x^2$$

$$W_{grav} = -\Delta U_{grav}$$

$$W_{spring} = -\Delta U_{spring}$$

$$E_{mech} = K + U$$

$$W_{other} = \Delta U + \Delta K$$

$$P = \frac{\Delta W}{\Delta t} = F_{\parallel} v$$

Rotational Impulse and Momentum, Torque

$$L = Iw$$

$$L = p r_{\perp} = m v r_{\perp} = m w r_{\perp}^2$$

$$L = \sum m w r_{\perp}^2$$

$$J_q = \Gamma (t_2 - t_1) = \Gamma \Delta t$$

$$J_q = \Delta L$$

$$\sum \Gamma = I a = I \frac{\Delta w}{\Delta t} = \frac{\Delta L}{\Delta t}$$

$$\Gamma = Fl = Fr \sin q$$

$$a_{\perp} = v^2 / R$$

$$v = \frac{2pR}{t}$$

Rotational Kinematics

$$w_{ave} = \frac{q_2 - q_1}{t_2 - t_1} = \frac{\Delta q}{\Delta t}$$

$$w = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t}$$

$$a_{ave} = \frac{w_2 - w_1}{t_2 - t_1} = \frac{\Delta w}{\Delta t}$$

$$a = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t}$$

$$w = w_0 + a t$$

$$q = q_0 + w_0 t + \frac{1}{2} a t^2$$

$$w^2 = w_0^2 + 2a (q - q_0)$$

$$q - q_0 = \frac{w_0 + w}{2} t$$

Rotational Inertia and Energy

$$I = \sum_{i=1}^{n} m_i r_i^2$$

$$I_{solid\_cylinder} = \frac{1}{2} M R^2$$

$$I_{thin\_walled\_cyl} = M R^2$$

$$I_{sphere} = \frac{2}{5} M R^2$$

$$K = \frac{1}{2} I w^2$$

Rotational and Linear Motion

$$s = qR$$

$$v_{\parallel} = wR$$

$$a_{\parallel} = aR$$

$$a_{\perp} = \frac{v_{\parallel}^2}{R} = w^2 R$$

$$t = 2p / w$$

Impulse, Momentum and CM

$$\vec{p} = m\vec{v}$$

$$\vec{J} = \vec{F}(t_2 - t_1) = \vec{F} \Delta t$$

$$\vec{J} = \Delta \vec{p}$$

$$\vec{P} = \vec{p}_1 + \vec{p}_2$$

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

$$X = \frac{m_1 x_1 + m_2 x_2 + \ldots}{m_1 + m_2 + \ldots}$$

$$Y = \frac{m_1 y_1 + m_2 y_2 + \ldots}{m_1 + m_2 + \ldots}$$

$$V_x = \frac{m_1 v_{1x} + m_2 v_{2x} + \ldots}{m_1 + m_2 + \ldots}$$

$$V_y = \frac{m_1 v_{1y} + m_2 v_{2y} + \ldots}{m_1 + m_2 + \ldots}$$

$$A_x = \frac{m_1 a_{1x} + m_2 a_{2x} + \ldots}{m_1 + m_2 + \ldots}$$

$$A_y = \frac{m_1 a_{1y} + m_2 a_{2y} + \ldots}{m_1 + m_2 + \ldots}$$

$$\sum \vec{F}_{ext} = M\vec{A}$$

Equilibrium

$$\sum F_x = 0$$

$$\sum F_y = 0$$

$$\sum_{any\_axis} \Gamma = 0$$

$$X_{cog} = \frac{w_1 x_1 + w_2 x_2 + \ldots}{w_1 + w_2 + \ldots}$$

$$Y_{cog} = \frac{w_1 y_1 + w_2 y_2 + \ldots}{w_1 + w_2 + \ldots}$$