Physics 131 – Equation Sheet – Fall 2005
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Kinematics – Keeping Track of Position, Velocity, and Acceleration

instantaneous velocity $v_s = ds/dt$ (2.24)
instantaneous acceleration $a_s = dv_s/dt$ (2.26)

Table 2.3 – PSS 2.1 (p56-p57)

$v_{fs} = v_{is} + a_s \Delta t$ (2.18)
$s_f = s_i + v_{is} \Delta t + (1/2)a_s(\Delta t)^2$ (2.20)
$v_{fs}^2 = v_{is}^2 + 2a_s \Delta s$ (2.22)
$s_f = s_i + (1/2)(v_{is} + v_{fs})t$
$s_f = s_i + v_{fs}\, t - (1/2)at^2$

Table 13.1 (p373)

$\omega_f = \omega_i + \alpha \Delta t$
$\theta_f = \theta_i + \omega_i \Delta t + (1/2)\alpha(\Delta t)^2$
$\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

Dynamics (See table 13.2 for relation between linear and rotational dynamics)

Force F Torque $\tau = rF \sin\theta$ (13.14)

Mass m Moment of inertia $I = \sum_i m_i r_i^2$ (13.25)

Newton's 2nd Law: $\vec{F} = m\vec{a} = \frac{d\vec{p}}{dt}$ (4.4, 9.4) $\tau = I\alpha$ (13.26)

Conservation Laws (Energy and Momentum)

Momentum $\vec{p} = m\vec{v}$ (9.3)
Impulse $\Delta p_x = J_x$ (9.8)

Angular momentum $L = I\omega$ (13.55)

Kinetic Energy $K = (1/2)mv^2$ (10.11)

Rotational kinetic energy $K = \frac{1}{2} I\omega^2$ (13.33)

Work $W = \int_{s_i}^{s_f} F_s\, ds$ (11.8)

Power $P = \vec{F} \bullet \vec{v} = \frac{dW}{dt}$ (11.38)

Frictional Force

$f_{s\,max} = \mu_s n$ (5.12)
$f_k = \mu_k n$ (5.13)

Spring Force

$(F_{sp})_s = -k\Delta s$ (10.26)
$U_s = (1/2)k(\Delta s)^2$ (10.36)

Gravitational Force

$U_g = mgy$ (10.12)
$F_{1\text{ on }2} = F_{2\text{ on }1} = Gm_1m_2/r^2$ (12.2)
$U_g = -Gm_1m_2/r$ (12.15)

Circular Motion

$a_r = \frac{v^2}{r}$ (7.14)
$v_t = r\omega$ (13.2)
$a_t = r\alpha$ (13.5)

Parallel Axis Theorem

$I = I_{cm} + Md^2$ (13.29)