Exam 3 formulas

To be given on exam

Continued from exams 1 & 2

$g = 9.80\ \text{m/s}^2$

If $ax^2 + bx + c = 0, \quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

For constant a:

$$x = x_o + v_o t + \frac{1}{2} a t^2$$

$$v^2 = {v_o}^2 + 2a\left(x - x_o\right)$$

gravity: $w = mg$, $PE_g = mgy$

friction: $f = \mu N$ (or $f \leq \mu N$, for static friction)

springs: $F = -kx$, $PE_s = ½\, kx^2$

$P = F_{//} v = Fv\cos\theta$

New for exam 3

arc length: $s = r\theta$

tangential $v = r\omega$

$a_c = v^2/r$

gravity: $F = \dfrac{GMm}{r^2}$, $PE_g = -\dfrac{GMm}{r}$

$G = 6.67 \times 10^{-11}\ \text{N·m}^2/\text{kg}^2$

$R_{earth} = 6.38 \times 10^{6}\ \text{m}$

$M_{earth} = 5.98 \times 10^{24}\ \text{kg}$

$M_{sun} = 1.99 \times 10^{30}\ \text{kg}$

$I_{sphere} = (2/5)\ MR^2$

$I_{hoop} = MR^2$

$I_{disk} = ½\ MR^2$

$I_{rod\ (center)} = (1/12)\ ML^2$

$I_{rod\ (end)} = (1/3)\ ML^2$

To be memorized

Continued from exams 1 & 2

Definition: $v_{ave} = \langle v \rangle = \frac{\Delta x}{\Delta t}$

Definition: $a_{ave} = \langle a \rangle = \frac{\Delta v}{\Delta t}$

For constant *a*:

$$v = v_o + at$$

$$v_{ave} = \langle v \rangle = \frac{v_i + v_f}{2}$$

Newton's 2nd Law: $\sum \vec{F} = m\vec{a}$

Newton's 3rd Law: $\vec{F}_{12} = -\vec{F}_{21}$

Definition: $W = F_{//}\,\Delta x = F\cos\theta\,\Delta x$

Definition: $KE = ½\, m\, v^2$

<u>Colton conservation of energy</u>: $E_{before} + W_{net} = E_{after}$

<u>Hess conservation of energy</u>: $KE_i + PE_i + W_{in} = KE_f + PE_f + W_{out}$

Definition: $P = \Delta E/\Delta t$

New for exam 3

Definition of momentum: $p = mv$

Conservation of momentum: $\sum p_{before} = \sum p_{after}$ (if no outside force)

Angular kinematics: replace x with θ, v with ω, and a with α in all the kinematics formulas

Quick derivation of satellite velocity: $\frac{GMm}{r^2} = m\frac{v^2}{r}$

Period: $T = 2\pi r/v$

Definition of torque: $\tau = r_\perp F = rF_\perp = rF\sin\theta$

Moment of inertia for point mass: $I = mr^2$

$I_{tot} = I_1 + I_2 + \ldots$

Angular KE: $KE = ½\, I\, \omega^2$

Newton's 2nd Law for torques: $\sum \tau = I\alpha$

Definition of angular momentum: $L = rp_\perp = rp\sin\theta$, also $L = I\omega$