Equation sheet for Exam 3

You may write on this (front and back) and bring it with you to the exam. Additional notes are not allowed.

Constants

$g = 9.81$ m/s $\quad G = 6.67\times10^{-11}\,\dfrac{\text{N}\cdot\text{m}^2}{\text{kg}^2}$

Chapter 1-3 equations

velocity: $\bar{v} = \dfrac{\Delta x}{\Delta t}$ $\quad v = \lim\limits_{\Delta t\to 0}\dfrac{\Delta x}{\Delta t}$ $\quad v = \dfrac{dx}{dt}$ $\quad$ if v constant: $x = x_0 + vt$

acceleration: $\bar{a} = \dfrac{\Delta v}{\Delta t}$ $\quad a = \lim\limits_{\Delta t\to 0}\dfrac{\Delta v}{\Delta t}$ $\quad a = \dfrac{dv}{dt}$

if a constant: $v = v_0 + at$ $\quad x = x_0 + v_0 t + \dfrac{1}{2}at^2$ $\quad v^2 = v_0^2 + 2a\left(x - x_0\right)$ $\quad \bar{v} = \dfrac{v_0 + v}{2}$

vectors: $x = l\cos\theta$ $\quad y = l\sin\theta$ $\quad l = \sqrt{x^2 + y^2}$ $\quad \theta = \arctan\dfrac{y}{x} + 180°$?

projectiles: $x = x_0 + v_{0,x}t$ $\quad y = y_0 + v_{0,y}t + \dfrac{1}{2}a_y t^2$ $\quad R = \dfrac{v_0^2\sin 2\theta_0}{g}$

Chapter 4-5 equations

Newton's 2nd law: $\sum \mathbf{F} = m\mathbf{a}$ $\quad F_G = mg$

Newton's 3rd law: $F_{GP} = -F_{PG}$

friction: $F_{fr} = \mu_k F_N$ $\quad F_{fr} \le \mu_s F_N$

circular motion: $a_{cent} = \dfrac{v^2}{r}$ $\quad F_{cent} = \dfrac{mv^2}{r}$ $\quad v = \dfrac{2\pi r}{T}$ $\quad f = \dfrac{1}{T}$ $\quad v^2 = rg\tan\left(\theta_{bank}\right)$

gravity: $F_G = \dfrac{Gm_1m_2}{r^2}$ $\quad g = \dfrac{Gm_E}{r_E^2}$ $\quad m_E = 5.98\times10^{24}\,\text{kg}$ $\quad r_E = 6.38\times10^{6}\,\text{m}$

Chapter 6-7 equations

work: $W = F_{\|}d = Fd\cos\theta$

energy: $KE = \dfrac{1}{2}mv^2$ $\quad W_{net} = \Delta KE$ $\quad PE_G = mgy$ $\quad E_{total} = KE + PE_G + PE_{el} + \cdots$

spring: $F = -kx$ $\quad PE_{el} = \dfrac{1}{2}kx^2$

power: $P = \dfrac{\Delta E}{\Delta t}$ $\quad \bar{P} = F\bar{v}$

momentum: $\mathbf{p} = m\mathbf{v}$ $\quad \sum \mathbf{F} = \dfrac{\Delta \mathbf{p}}{\Delta t}$ $\quad KE = \dfrac{\mathbf{p}^2}{2m}$

all collisions: $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$

elastic collisions: $v_{1i} - v_{2i} = v_{2f} - v_{1f}$ $\quad v_{app} = v_{sep}$

center of mass: $x_{CM} = \dfrac{m_1x_1 + m_2x_2}{m_1 + m_2}$