University Physics 1 and 1A:

Equation Sheet for Exam 3 or Final

Equations

$x = x_o + v_{ox}t + \frac{1}{2}a_x t^2$

$v = v_{ox} + a_x t$

$v_x^2 = v_{ox}{}^2 + 2a_x(x - x_o)$

$x - x_o = \frac{1}{2}(v_{ox} + v_x)t$

$a_{centripetal} = \dfrac{v^2}{r}$

$\sum \vec{F} = m\vec{a}$

$f_s \leq \mu_s |\vec{N}|$

$f_k = \mu_k |\vec{N}|$

$W = \int \vec{F} \cdot d\vec{x}, \quad$ for constant force $W = \vec{F} \cdot \vec{d}$

$U_{grav} = mgh$

$U_{spring} = \frac{1}{2}kx^2$

$K = \frac{1}{2}mv^2$

$E = U_{grav} + U_{spring} + K$

$E_{final} = E_{init} + W_{non-cons}$

$\vec{r}_{com} = \dfrac{\sum \vec{r}_i m_i}{\sum m_i} \qquad \vec{r}_{com} = \dfrac{\int \vec{r}\, dm}{\int dm}$

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

$\vec{J} = \int \vec{F}\, dt = \vec{F}_{avg}\Delta t = \Delta \vec{p}$

$\vec{F} = \dfrac{GMm}{r^2}(-\hat{r})$

$U_g = -\dfrac{GMm}{r}$

Math

dot products:

$\vec{A} \cdot \vec{B} = |\vec{A}|\,|\vec{B}| \cos\theta = A_x B_x + A_y B_y + A_z B_z$

for a quadratic equation of the form

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

Uncertainties

Addition or Subtraction:

For $Q = x + y - z + C_1$

$\Delta Q = \Delta x + \Delta y + \Delta z$

Multiplication or Division: For $Q = C_1 xy/z$

$\dfrac{\Delta Q}{Q} = \dfrac{\Delta x}{x_{avg}} + \dfrac{\Delta y}{y_{avg}} + \dfrac{\Delta z}{z_{avg}}$

Powers: For $Q = C_1 x^m y^n$

$\dfrac{\Delta Q}{Q} = |m|\dfrac{\Delta x}{x_{avg}} + |n|\dfrac{\Delta y}{y_{avg}}$

For other functions, follow the general rule—pick values to make Q as large as possible then subtract the average value of Q.

Units and Constants

$g = 9.8 \text{ m/s}^2 = 32 \text{ ft/s}^2$

1 mile = 1609 m   1 inch = 2.54 cm

1 metric ton = 1000 kg

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