Chapter 6 Equations

Work & Kinetic & Potential Energies:

$W = Fd\cos\theta$, $\mathrm{KE} = \frac{1}{2}mv^2$, $\mathrm{PE}_{\mathrm{gravity}} = mgy$, $\mathrm{PE}_{\mathrm{spring}} = \frac{1}{2}kx^2$.

Conservation or Transformation of Energy:

"work-KE theorem" $\Delta\mathrm{KE} = W_{\mathrm{net}}$, **or use conservation law** $\Delta\mathrm{KE} + \Delta\mathrm{PE} = W_{\mathrm{NC}}$.

Power:

$P_{\mathrm{ave}} = \frac{W}{t}$, or use $P_{\mathrm{ave}} = \frac{\mathrm{energy}}{\mathrm{time}}$.

Chapter 5 Equations

Centripetal Acceleration:

$a_R = \frac{v^2}{r}$, towards the center of the circle.

Circular motion:

speed $v = \frac{2\pi r}{T} = 2\pi r f$, frequency $f = \frac{1}{T}$, where T is the period of one revolution.

Gravitation:

$F = G\frac{m_1 m_2}{r^2}$; $g = \frac{GM}{r^2}$, where $G = 6.67 \times 10^{-11}$ Nm^2/kg^2;

Orbits:

$\frac{v^2}{r} = g = \frac{GM}{r^2}$; $v = \sqrt{\frac{GM}{r}}$.

Chapter 4 Equations

Newton's Second Law:

$\vec{F}_{\mathrm{net}} = m\vec{a}$, which means $\Sigma F_x = ma_x$ and $\Sigma F_y = ma_y$.

Static friction (magnitude):

$f_s \le \mu_s N$ or $F_{\mathrm{fr}} \le \mu_s F_N$.

Kinetic or sliding friction (magnitude):

$f_k = \mu_k N$ or $F_{\mathrm{fr}} = \mu_k F_N$.

Gravitational force near Earth:

$F_G = mg$, downward.

Acceleration Equations

$\bar{v} = \frac{\Delta x}{\Delta t}$, $\Delta x = x - x_0$, slope of $x(t) = v(t)$.

$\bar{a} = \frac{\Delta v}{\Delta t}$, $\Delta v = v - v_0$, slope of $v(t) = a(t)$.

For constant acceleration in one-dimension:

$\bar{v} = \frac{1}{2}(v_0 + v)$, $v = v_0 + at$, $x = x_0 + v_0 t + \frac{1}{2}at^2$, $v^2 = v_0^2 + 2a(x - x_0)$.

Vectors

Written $\vec{V}$ or $\mathbf{V}$, described by magnitude=V, direction=θ or by components (V_x, V_y).

$V_x = V\cos\theta, \quad V_y = V\sin\theta,$

$V = \sqrt{V_x^2 + V_y^2}, \quad \tan\theta = \frac{V_y}{V_x}.$ θ is the angle from $\vec{V}$ to $+x$-axis.

Addition: $\mathbf{A} + \mathbf{B}$, head to tail. Subtraction: $\mathbf{A} - \mathbf{B}$ is $\mathbf{A} + (-\mathbf{B})$, $-\mathbf{B}$ is $\mathbf{B}$ reversed.

Trig summary

$\sin\theta = \frac{(\text{opp})}{(\text{hyp})}, \quad \cos\theta = \frac{(\text{adj})}{(\text{hyp})}, \quad \tan\theta = \frac{(\text{opp})}{(\text{adj})}, \quad (\text{opp})^2 + (\text{adj})^2 = (\text{hyp})^2.$

$\sin\theta = \sin(180^\circ - \theta), \quad \cos\theta = \cos(-\theta), \quad \tan\theta = \tan(180^\circ + \theta), \quad \sin^2\theta + \cos^2\theta = 1.$