PHYSICS 1

FINAL REVIEW

CHAPTER 3

Work: $W = (F\cos\theta)\Delta x = \vec{F} \cdot \overrightarrow{\Delta x}$ (J)

Power: $P = \frac{W}{\Delta t} = F \cdot v$ (J/s or W)

ENERGY: E= K + UG + UEL

- Kinetic energy: $K = \frac{1}{2}mv^2 (J)$
- Potential energy: $U_g = mgh$ (J)
  - With h is the distance from potential origin to obj position.
- Elastic energy: $\mathrm{U}_{\mathrm{el}} = \frac{1}{2}k\mathrm{x}^2 (J)$
  - k is force constant or spring constant (N/m)
  - x is spring deformation (m)
  - Equilibrium position: x = 0

KINETIC ENERGY THEOREM:

$$W_{net} = \Delta K = K_f - K_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

Potential Energy:

mgh

$$W_{\text{gravity}} = -\Delta U_g = U_{\text{gi}} - U_{\text{gf}}$$

Work done by spring:

$$W = -\Delta U_{el} = \frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2$$

CONSERVATIVE VS NONCONSERVATIVE

- Conservative force: gravity, elastic
- Nonconservative force: friction, resistance,…

Note: Work of resistive forces are always negative

Conservation of energy theorem: (Định luật bảo toàn cơ năng)
(use for conservative system)

$$E_i = E_f$$

$$=> \quad K_i + U_{gi} + U_{eli} = K_f + U_{gf} + U_{elf}$$

Energy with nonconservative force

$$W_{nc} = \Delta E = \left(K_f + U_f\right) - (K_i + U_i)$$

CHAPTER 4

Linear momentum: (động lượng)

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

Impulse:

$$I = \Delta\vec{p} = \int d\,\vec{p} = \int_{t_i}^{t_f} \vec{F}\,\Delta t$$

Conservation of linear momentum:

$$\overrightarrow{p_i} = \overrightarrow{p_f}$$

TWO TYPES OF COLLISIONS:

Inelastic collision: Kinetic energy is not conserved

$$E_{lost} = \Delta K$$

Elastic collision: both momentum and kinetic energy are conserved

$$K_i = K_f$$

CHAPTER 5

Notation	Linear Translational	Angular Rotational
Basic quantities	x (m) v (m/s) a (m/s^2)	θ (rad) ω (rad/s) α (rad/s^2)
Basic formula	a const $v = v_0 + at$ $x = x_0 + v_0 t + \frac{1}{2}at^2$ $v^2 - v_0^2 = 2a\Delta x$	α const $\omega = \omega_0 + \alpha t$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$ $\omega^2 - \omega_0^2 = 2\alpha\Delta\theta$
Inertia	mass: m (kg)	Moment of inertia Rotational inertia ❖ $I = \sum mR^2$ (kg×m^2) ❖ $I = \ldots$

Notation	Linear Translational	Angular Rotational
Speeding up **Slowing down**	**a·v** $\vec{a}\cdot\vec{v}$	**α·ω** $\vec{\alpha}\cdot\vec{\omega}$
Force **vs** **Torque**	Newton's 2nd law: $\vec{F} = m\vec{a}$ (N)	$\vec{\tau}=\vec{r}\times\vec{F}$ or $\tau = Fd$ (d: moment/lever arm) Newton's 2nd law: $\vec{\tau}=I\times\vec{\alpha}$ (N·m)
Convention of **(+) direction**	y up x to the right	Counterclockwise

Notation	Linear Translational	Angular Rotational
Energy **$E = K + U$**	**$K = \frac{1}{2}mv^2$ (J)(eV)** **$U_g = mgh$ (y up, 0 at …)** **$U_{el} = \frac{1}{2}kx^2$ (J)(eV)**	**$K = \frac{1}{2}I\omega^2$ (J)(eV)**
Work	$W = \vec{F}\cdot\Delta\vec{x}$ or $\int_{x_i}^{x_f} \vec{F}(x)\cdot d\vec{x}$ (J)(eV)	$W = \vec{\tau}\cdot\Delta\vec{\theta}$ or $\int_{\theta_i}^{\theta_f} \vec{\tau}(\theta)\cdot d\vec{\theta}$ (J)(eV)
Power	$P=\frac{W}{\Delta t}=\vec{F}\cdot\vec{v}$ (J/s)(W)	$P=\frac{W}{\Delta t}=\vec{\tau}\cdot\vec{\omega}$ (J/s)(W)
Momentum	$\vec{p}=m\vec{v}$ (kg·m/s)	$\vec{L} = \vec{r}\times\vec{p}$ $\vec{L}=I\vec{\omega}$ (kg·m²/s)

Notation	Linear Translational	Angular Rotational
Impulse	$\vec{I}=\Delta\vec{p}=\vec{F}\Delta t=\int_{t_i}^{t_f}\vec{F}(t)dt$ ❖ $\vec{F}_{net}=\frac{\Delta\vec{p}}{\Delta t}$ or $\frac{d\vec{p}}{dt}$	$\vec{I}=\Delta\vec{L}=\vec{\tau}\Delta t=\int_{t_i}^{t_f}\vec{\tau}(t)dt$ ❖ $\vec{\tau}_{net}=\frac{\Delta\vec{L}}{\Delta t}$ or $\frac{d\vec{L}}{dt}$
Momentum conservation	$\vec{F}_{net}=\vec{0} \Rightarrow \Delta\vec{p}=\vec{0}$ ⇨ $\sum\vec{p}_i=\sum\vec{p}_f$ ⇨ $\sum m_i v_i=\sum m_f v_f$	$\vec{\tau}_{net}=\vec{0} \Rightarrow \Delta\vec{L}=\vec{0}$ ⇨ $\sum\vec{L}_i=\sum\vec{L}_f$ ⇨ $\sum I_i\omega_i=\sum I_f\omega_f$

Pure rotation relationship:

$$s=R\theta$$

$$v=R\omega$$

a_T

$$a_T=R\alpha$$

a_R

$$a_R=\frac{v^2}{R}$$

$$a=\sqrt{a_T^2+a_R^2}$$

Rolling motion relationship:

$$s_{cm}=R\theta$$

$$v_{cm}=R\omega$$

$$a_{cm}=R\alpha$$

Total kinetic energy (translation + rotation)

$$K=\frac{1}{2}I_{cm}\omega^2+\frac{1}{2}Mv_{cm}^2$$