Second Exam
chapter 7

$$X_{cm} = \frac{m_A X_A + m_B X_B}{m_A + m_B}$$

System made up of two particles in one dimenion

$$X_{cm} = \frac{m_A X_A + m_B X_B + m_C X_C + \cdots}{m_A + m_B + m_C + \cdots}$$

System made up of more than two particles in one dimenion

For X-axis:

$$X_{cm} = \frac{m_A X_A + m_B X_B + \cdots}{m_A + m_B}$$

System Particles in two dimensions

For y-axis:

$$y_{cm} = \frac{m_A y_A + m_B y_B + \cdots}{m_A + m_B}$$

Symmetrical Extended objects

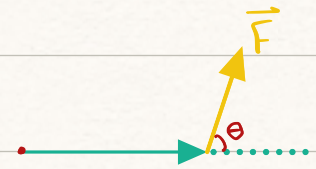
the position of x_{cm} is that geomitric center of the object

Chapter 8

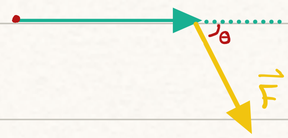
$\tau = r F \sin\theta$ r: distance between force and required point

(N · m)

Counterclockwise ⟶ Positive torque



clockwise ⟶ negative torque



Torque is not effective:

- If the force and distance are parallel or antiparallel
- If the force acts directly on the pivot point

chapter 9

Translational Equilibrium $\Sigma F = 0$

Rotational Equilibrium $\Sigma \tau = 0$

mechanical advantage $MA = \dfrac{\text{Output force}}{\text{input force}}$

$F = K \, \Delta L$ Hooks Law

$$\Delta L = \frac{1}{E}\frac{F}{A} L_0$$ ← orginal lenght

E depends on the type of the material

E (N/m^2)

$$\text{stress} = \frac{F}{A} = \frac{N}{m^2}$$

$$\text{Strain} = \frac{\Delta L}{L_0}$$

$$\text{Strain} = \frac{1}{E}\,\text{Stress}$$

$$\text{Shear strain} = \frac{1}{G}\,\text{shear stress}$$

G = shear modulus (N/m^2)

$$B = -\frac{\Delta P}{(\Delta V/V_0)}$$

B = Bulk modulus

chapter 10

$$\rho = \frac{m}{V}$$

(kg/m^3) (g/cm^3)

$$SG = \frac{\text{density of the material}}{\text{density of the water}}$$

$\rho_{water} = 1000\ kg/m^3$

$= 1\ g/cm^3$

$$P = \frac{F}{A} = \text{Pascal}$$

$$P = \rho_F g h$$

$$P_{atm} = 1.013 \times 10^5 \, Pa$$

$1 \, bar = 1 \times 10^{-5} \, Pa \implies 1 \, P_{atm} = 1.013 \, bar$

$$P = P_G + P_{atm}$$

absolute Pressure

$760 \, mmHg = 1 \, atm = 1.013 \times 10^5 \, Pa = 1.013 \, bar$

$P_{tot} = P_{atm} + P$ Pascal Principle

$$\text{mechanical advantage} = \frac{F_{out}}{F_{in}} = \frac{A_{out}}{A_{in}}$$

$MA > 1$ good lever

$MA < 1$ not good lever

$$F_B = \rho_f \Delta h A g$$

$F_B = m_f g$ (Archimedes Principle)

weight of dismPlaced fluid

$V_{obj} = V_{displaced\ water}$.

$$F_R = (\rho_f - \rho_o)\, vg$$

Resultant force ← density of object

If $\rho_f > \rho_o \Rightarrow F_R \uparrow$ and object floats
If $\rho_f < \rho_o \Rightarrow F_R \downarrow$ and object sinks
If $\rho_f = \rho_o \Rightarrow$ object hangs in the fluid in equilibrium.

Partial submersion

$$\frac{\rho_o}{\rho_f} = \frac{V_s}{V}$$

$$A_1 V_1 = A_2 V_2$$ Continuity equation

If fluid is incompressible $\Rightarrow \rho$ is constant

A small → V large
A large → V small

Bernoulli's Equation

$$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$$

Torricelli's theorem

$$v_1 = \sqrt{2gh}$$

Poiseuilli equation

$$Q = \frac{\pi R^4 (P_1 - P_2)}{8 \eta L}$$

R = radius

η = coefficient of viscosity ($\frac{N \cdot s}{m^2} = Pa \cdot s$)

Q : volume flow rate (m^3/s)

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