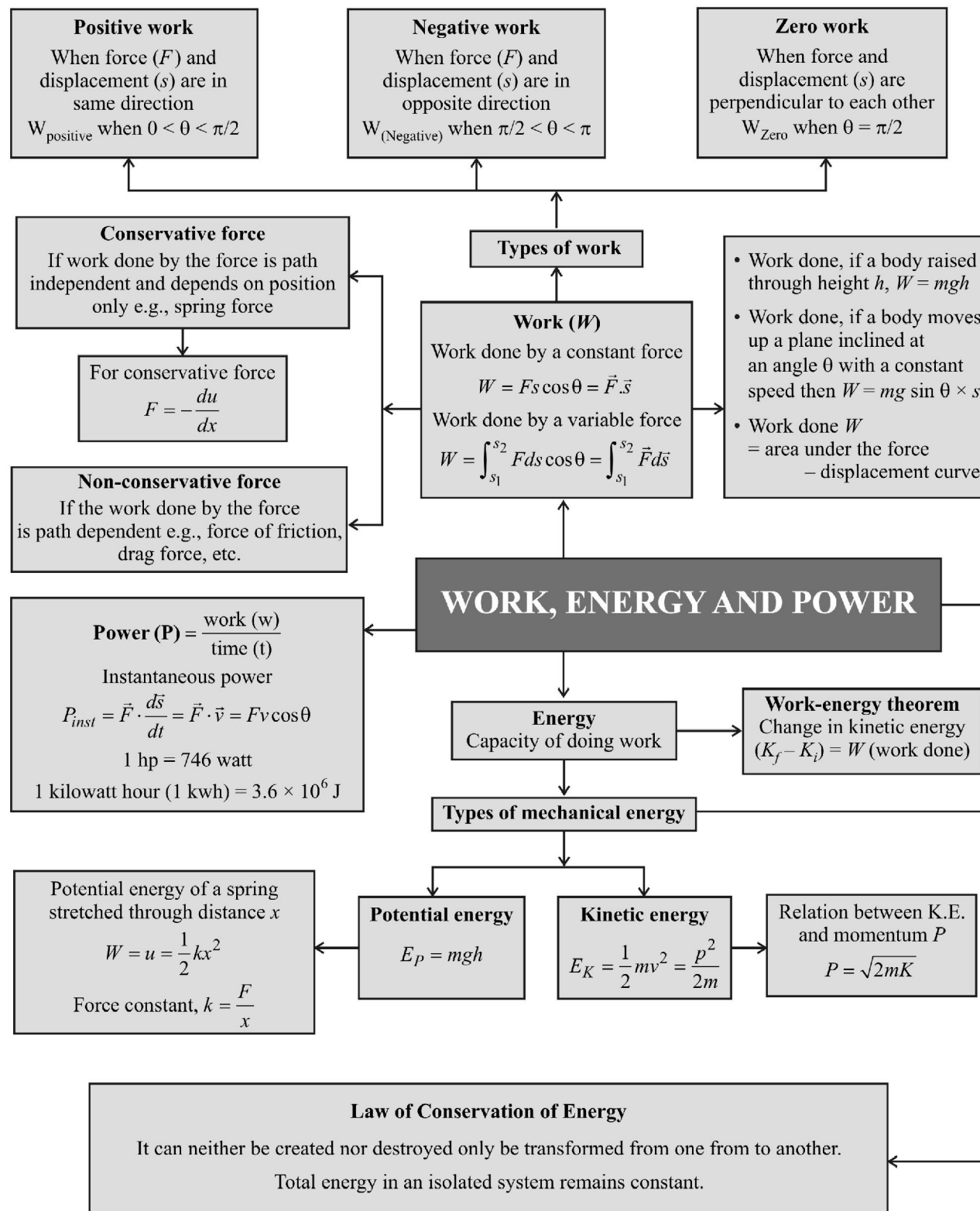
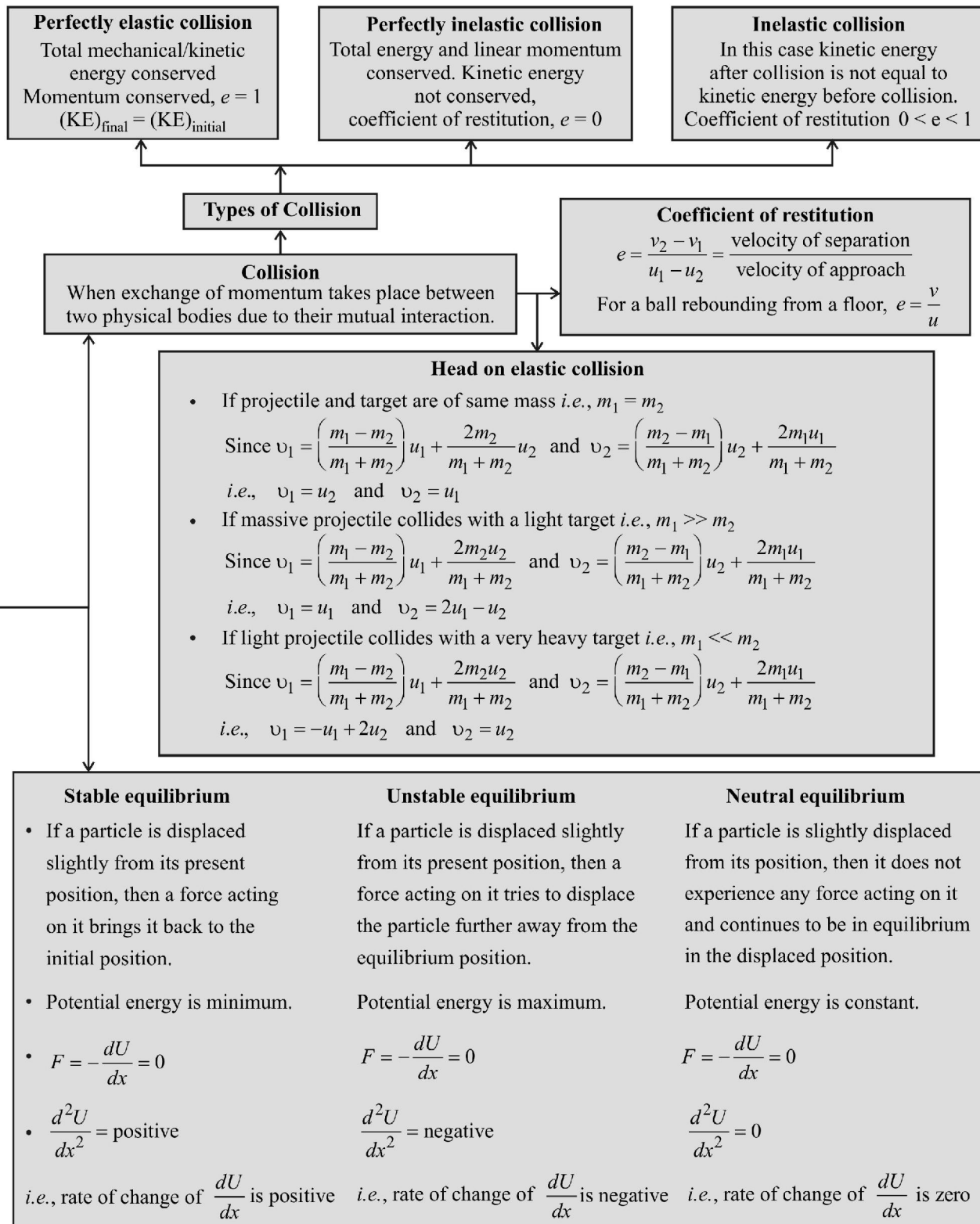
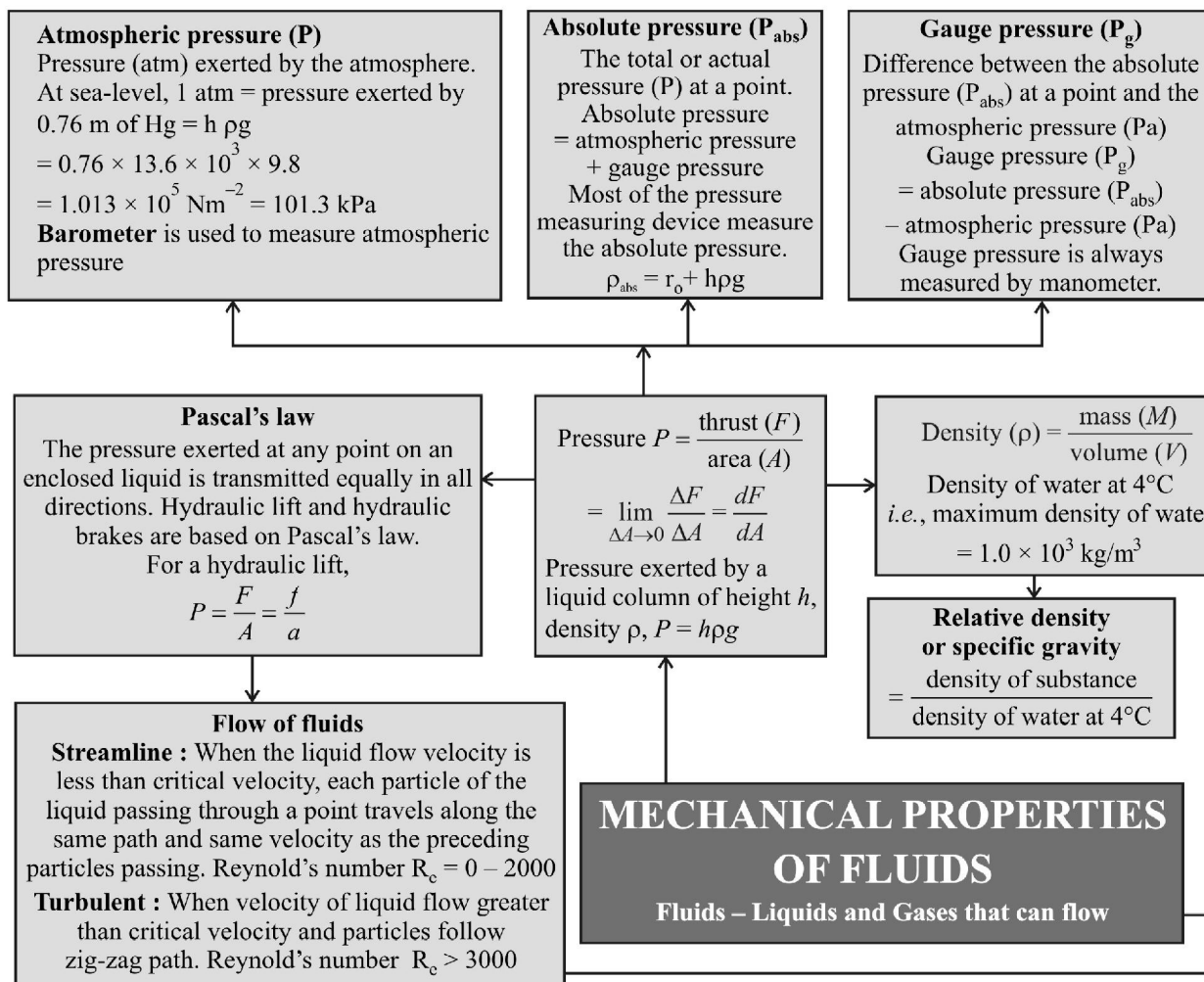


# CHAPTER AT A GLANCE

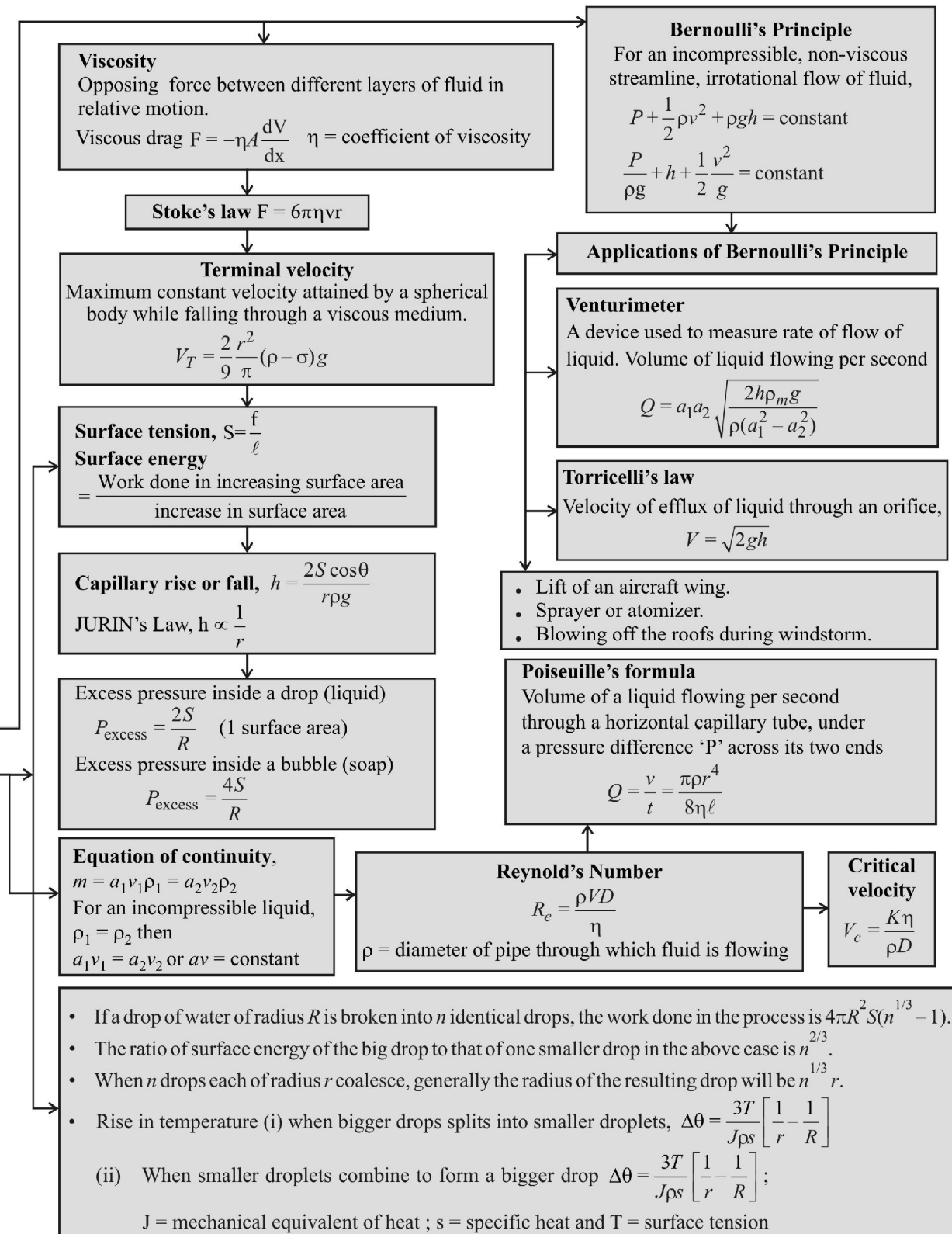




## CHAPTER AT A GLANCE

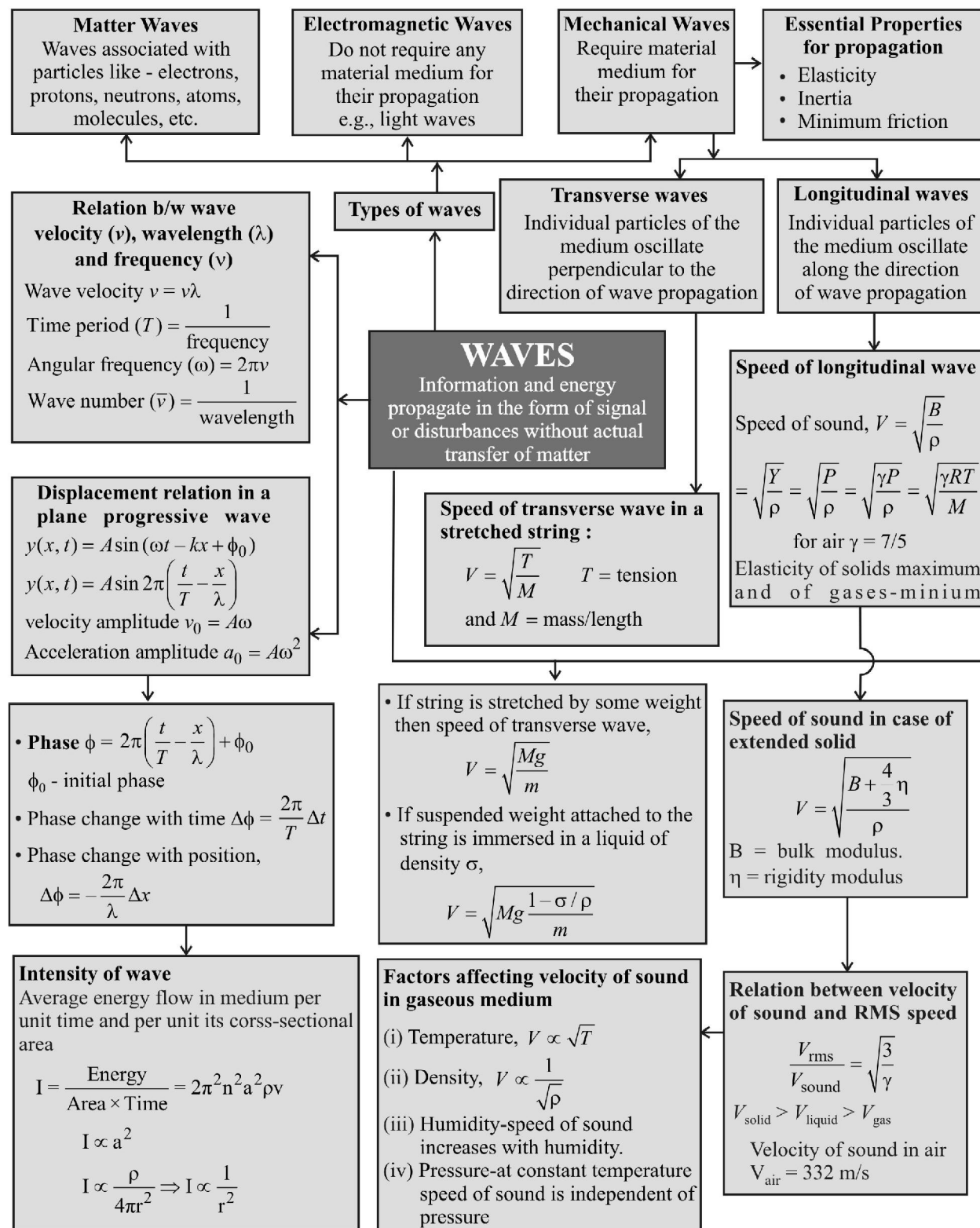


- For a solid body volume and density will be same as that of its constituent substance of equal mass.  
 i.e.  $M_{\text{body}} = M_{\text{sub}}$  then  $V_{\text{body}} = V_{\text{sub}}$  and  $\rho_{\text{body}} = \rho_{\text{sub}}$ .  
 But for a hollow body or body with air gaps  
 $M_{\text{body}} = M_{\text{sub}}$  and  $V_{\text{body}} > V_{\text{sub}}$  then  $\rho_{\text{body}} < \rho_{\text{sub}}$
- If  $m_1$  mass of liquid of density  $\rho_1$  and  $m_2$  mass of liquid of density  $\rho_2$  are mixed then,  
 $M_{\text{mix}} = m_1 + m_2$  and  $V_{\text{mix}} = V_1 + V_2 = \frac{m_1}{\rho_1} + \frac{m_2}{\rho_2}$   $\therefore \rho_{\text{mix}} = \frac{M_{\text{mix}}}{V_{\text{mix}}} = \frac{m_1 + m_2}{\frac{m_1}{\rho_1} + \frac{m_2}{\rho_2}}$   
 If same masses are mixed, i.e.,  $m_1 = m_2 = m$  then  $\rho_{\text{mix}} = \frac{2\rho_1\rho_2}{\rho_1 + \rho_2}$   
 (harmonic mean of individual densities)
- If  $V_1$  volume of liquid of density  $\rho_1$  and  $V_2$  volume of liquid of density  $\rho_2$  are mixed then  
 $V_{\text{mix}} = V_1 + V_2$  and,  $M_{\text{mix}} = m_1 + m_2 = \rho_1 V_1 + \rho_2 V_2$   
 $\therefore \rho_{\text{mix}} = \frac{M_{\text{mix}}}{V_{\text{mix}}} = \frac{\rho_1 V_1 + \rho_2 V_2}{V_1 + V_2}$   
 If same volumes are mixed, i.e.,  $V_1 = V_2 = V$  then  $\rho_{\text{mix}} = \frac{\rho_1 + \rho_2}{2}$ , (arithmetic mean of individual densities)





# CHAPTER AT A GLANCE





**Principle of superposition of waves:**  $Y = Y_1 + Y_2 + \dots + Y_n$

### Stationary waves

- (I) **In string** : Fundamental frequency,  $v = \frac{1}{2l} \sqrt{\frac{T}{m}}$
- (ii) **In organ pipe** :
- (a) Open at both ends (**open organ pipe**)  
fundamental frequency or first harmonic  $v = \frac{v}{2l}$
- (b) Closed at one end (**closed organ pipe**)  $v = \frac{v}{4l}$   
Fundamental frequency or first harmonic

**In open organ pipe**- All (even and odd) harmonics are formed  $n_1 : n_2 : n_3 : \dots = 1 : 2 : 3 : \dots$   
Ratio of overtones = 2 : 3 : 4 : 5 : ...  
Maximum possible wavelength =  $2\ell$

**In closed organ pipe**- Only odd harmonics are present only odd.  $n_1 : n_3 : n_5 : \dots = 1 : 3 : 5 : \dots$   
Ratio of overtones = 3 : 5 : 7  
Maximum possible wavelength =  $4\ell$

**End correction:** Distance of antinode from the open end.  
 $e = 0.6r$ ;  $r$  = radius of pipe

- Effective length in open organ pipe  $\ell' = (\ell + 2e)$
- Effective length in closed organ pipe,  $\ell' = (\ell + e)$

**Resonance tube:** Used to determine velocity of sound in air with the help of a tuning fork of known frequency,  
 $V = 4v(L_1 + 0.3D)$ ;  $V = 2v(L_2 - L_1)$   
End correction =  $0.3D = \frac{L_2 - 3L_1}{2}$   
 $L_1$  &  $L_2$  first and second resonance lengths and  
 $D$  = internal diameter of the resonance tube

### Characteristics of a musical sound.

- (i) **Pitch.** Distinguishing a shrill note from a grave (flat or dull) one. It depends on frequency.
- (ii) **Quality.** Distinguishes between two sounds of same pitch and loudness from one another. It depends on the number or intensity of overtones.
- (iii) **Loudness.** The sensation of hearing which enables us to distinguish between a loud and a faint sound. It depends on intensity.

The unit of loudness of a sound is **bel**. The loudness of a sound of intensity  $I$  is given by  $L = \ell \log_{10} \frac{1}{I_0}$   
where  $I_0$  is threshold of hearing. It is called **Weber-Fechner law**.

- If the prong of a tuning fork is slightly loaded with wax, its frequency of vibration decreases.
- If the prong of a tuning fork is filled slightly, its frequency of vibration increases.

### Doppler Effect in Sound

The change in apparent pitch of sound due to relative motion between the source of sound(s) and the observer (o).

- When the source moves towards the stationary observer,

$$v' = \frac{v}{v - v_s} \times v \quad (v' > v)$$

- When the source moves away from the stationary observer,

$$v' = \frac{v}{v + v_s} \times v \quad (v' < v)$$

- When the observer moves towards the stationary source,

$$v' = \frac{v + v_o}{v} \times v \quad (v' > v)$$

- When the observer moves away from the stationary source,

$$v' = \frac{v - v_o}{v} \times v \quad (v' < v)$$

- When both source and observer move towards each other,

$$v' = \frac{v + v_o}{v - v_s} \times v \quad (v' > v)$$

- When both source and observer move away from each other,

$$v' = \frac{v - v_o}{v + v_s} \times v \quad (v' < v)$$

- When source moves towards observer and observer away from the source,

$$v' = \frac{v - v_o}{v - v_s} \times v$$

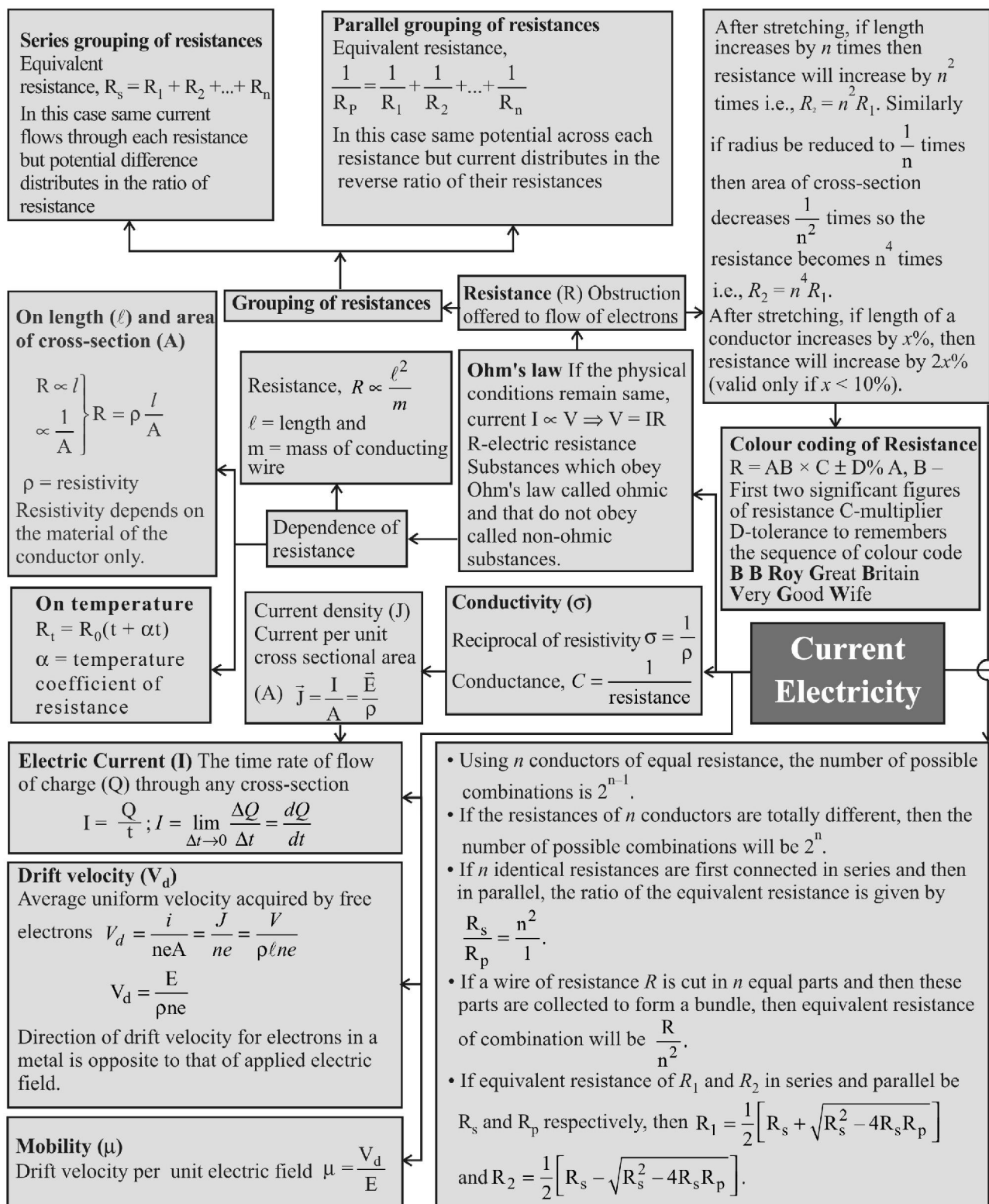
- When source moves away from observer and observer towards the source,

$$v' = \frac{v + v_o}{v + v_s} \times v$$

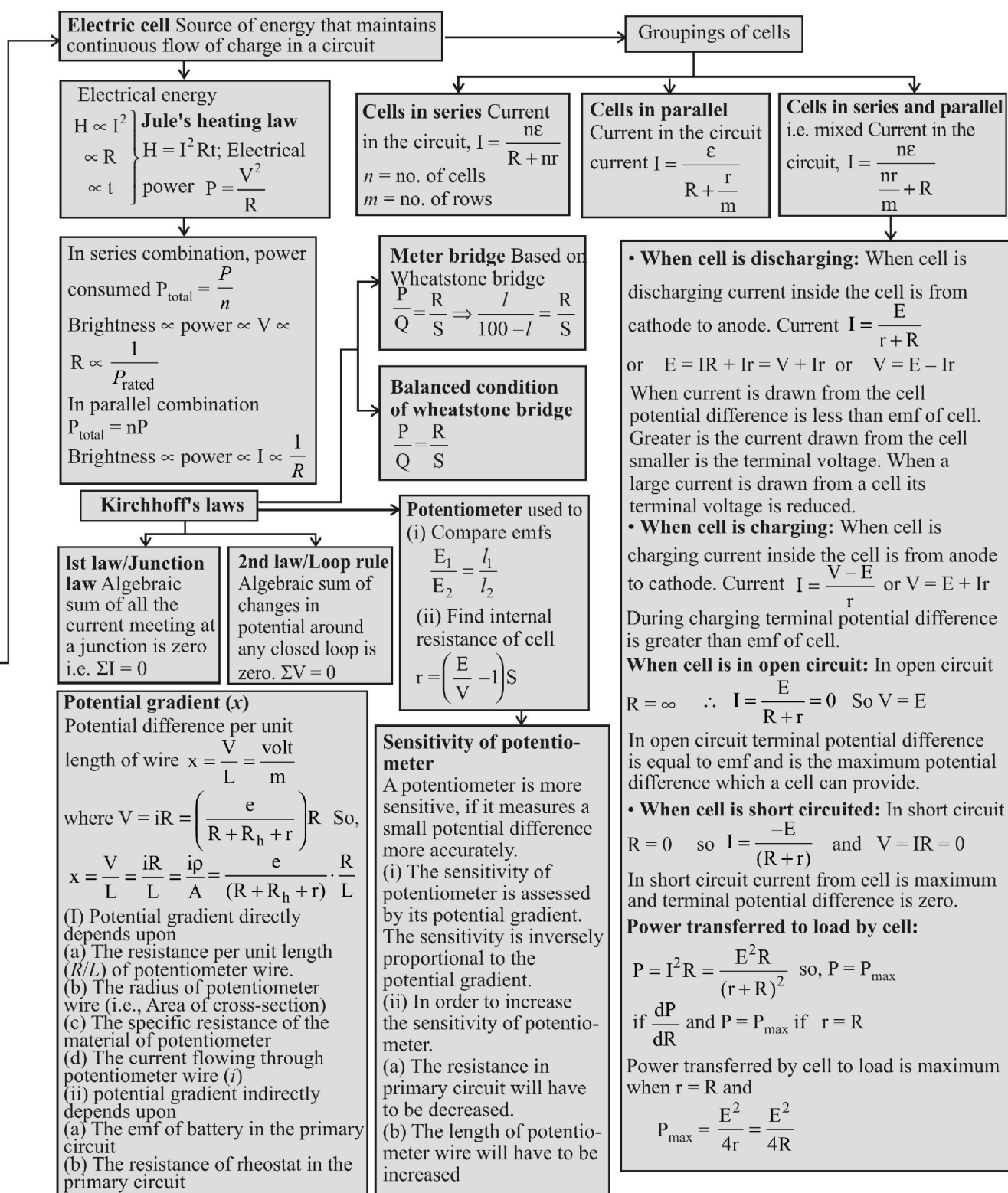
### Beats

Regular variation in intensity of sound with time at a particular position. Difference in frequencies of two superposing waves,  $v_{\text{beat}} = v_1 - v_2$

# CHAPTER AT A GLANCE









# CHAPTER AT A GLANCE

