1. CHAPTER OVERVIEW

This lecture provides a "one-shot" revision of the entire Class 11 Physics syllabus, ranging from Kinematics to Thermodynamics. It is designed to bridge foundational concepts from the HSC board level to competitive requirements, focusing on high-weightage formulas, problem-solving shortcuts, and conceptual clarity. Mastering these topics is essential for scoring well in both board exams and entrance tests like JEE/NEET. 1 ...

2. TOPIC-WISE NOTES

A. Kinematics (1D and 2D)

- **Simple Explanation:** Kinematics describes motion without considering its causes. It uses position, velocity, and acceleration to track a particle's path. 5

- **Definitions:**
  - **Distance:** The actual path length traveled by a particle.
  - **Displacement:** The change in the position vector ($r_{final} - r_{initial}$).
- **Formulas:**
  - **Calculus Relations:** $v = \frac{dx}{dt}$, $a = \frac{dv}{dt}$, $a = v\frac{dv}{dx}$ [6] . [6]
  - **Equations of Motion (Constant a):** $v = u + at$; $s = ut + \frac{1}{2}at^2$; $v^2 = u^2 + 2as$.
  - **Projectile Motion:** $T = \frac{2u\sin\theta}{g}$ (Time of flight); $R = \frac{u^2\sin 2\theta}{g}$ (Range); $H = \frac{u^2\sin^2\theta}{2g}$ (Max Height). [7]
- **Solved Example:** A ball is dropped from a 320m tower. Using $h = \frac{1}{2}gt^2$, with $g = 10$, $320 = 5t^2 \Rightarrow t^2 = 64 \Rightarrow t = 8$ seconds. [8] [9]

B. Newton's Laws of Motion (NLM) & Friction

- **Simple Explanation:** NLM explains how forces cause motion. Friction is a contact force that opposes the relative motion between two surfaces. [10] [11]
- **Definitions:**
  - **Newton's Second Law:** The rate of change of momentum is proportional to the applied force ($F = \frac{dp}{dt}$).
  - **Pseudo Force:** An imaginary force applied to a body when observed from a non-inertial (accelerating) frame, equal to $m \times a_{frame}$ in the opposite direction. [12] [13]
- **Laws/Formulas:**
  - **Friction:** Static friction $f_s \leq \mu_s N$; Kinetic friction $f_k = \mu_k N$ [14] [15] .

- **Pulley Acceleration:**
  $a = \frac{\text{Net Pulling Force}}{\text{Total Mass}}$ [16] · [16]
- **Solved Example:** Two masses (10kg and 20kg) on a pulley.
  $a = \frac{(200-100)}{30} = \frac{10}{3}\ \text{m/s}^2$.

C. Work, Power, and Energy

- **Simple Explanation:** Work is done when a force causes displacement. Energy is the capacity to do work, and Power is the rate at which work is done. [17] [18]
- **Definitions:**
  - **Work-Energy Theorem:** The work done by all forces on a body equals the change in its kinetic energy ($W_{net} = \Delta K$).
- **Formulas:**
  - **Work:** $W = \int F \cdot dx$.
  - **Potential Energy (Spring):** $U = \frac{1}{2}kx^2$

- **Vertical Circular Motion:** Min velocity at bottom for full circle = $\sqrt{5gr}$ [19] . [19]

- **Solved Example:** A 10kg mass falls 5m. Work by gravity = $mgh = 10 \times 10 \times 5 = 500$ J. [20]

D. Center of Mass & Collisions

- **Simple Explanation:** Center of mass (COM) is the point where the entire mass of a system is assumed to be concentrated. Collisions involve the interaction of bodies resulting in momentum exchange. [21] [22]
- **Definitions:**
  - **Coefficient of Restitution (e):** The ratio of velocity of separation to velocity of approach ($e = \frac{v_2 - v_1}{u_1 - u_2}$).
- **Formulas:**
  - **COM Location:** $x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$ [23] .

[23]

- **Elastic Collision ($e = 1$):** Both momentum and kinetic energy are conserved. [24]

- **Solved Example:** Two 2kg masses at $x = 0$ and $x = 4$. $x_{cm} = \frac{2(0)+2(4)}{4} = 2$ [25] . [25]

E. Rotational Motion

- **Simple Explanation:** Describes the rotation of a rigid body around a fixed axis. It is the angular equivalent of linear motion. [26] [27]
- **Definitions:**
  - **Moment of Inertia (I):** The rotational inertia of a body ($I = \sum mr^2$). [28]
  - **Torque:** The turning effect of a force ($\tau = r \times F = I\alpha$). [29]

- **Laws:**
  - **Conservation of Angular Momentum:** If net external torque is zero, $L = I\omega$ remains constant. [30]
- **Solved Example:** A disk ($I = \frac{1}{2}mr^2$) rolls down an incline. Acceleration $a = \frac{g\sin\theta}{1+\frac{I}{mr^2}} = \frac{2}{3}g\sin\theta$ [31] . [31]

F. Properties of Matter & Thermodynamics

- **Simple Explanation:** Covers elasticity of solids, heat transfer, and the behavior of gases (KTG). [32] [...]
- **Definitions:**
  - **Young's Modulus:** Ratio of tensile stress to longitudinal strain ($Y = \frac{F/A}{\Delta L/L}$).
  - **Specific Heat (s):** Heat required to raise the temperature of 1g of substance by 1°C ($Q = ms\Delta T$). [35]

- **Formulas:**
  - **Ideal Gas Law:** $PV = nRT$.
  - **First Law of Thermodynamics:** $\Delta Q = \Delta U + \Delta W$ [36] . [36]
  - **Wien's Displacement Law:** $\lambda_m T = b$ (constant). [37]
- **Solved Example:** 10g of ice melts at 0°C. Heat required = $mL = 10 \times 80 = 800$ calories.

3. IMPORTANT DIAGRAMS

1. **Velocity-Time ($\mathbf{v - t}$) Graph:** Label the area under the curve as **Displacement** and the slope as **Acceleration** [38] . [38]
2. **Free Body Diagram (FBD):** For a block on an incline, label $\mathbf{mg \sin \theta}$ (down the plane), $\mathbf{mg \cos \theta}$ (into the plane), **Normal Force ($\mathbf{N}$)**, and **Friction ($\mathbf{f}$)** [39] [40] . [39] [40]

3. **Projectile Trajectory:** Label **Range (R)**, **Max Height (H)**, and **Angle of Projection (θ)** [41][42]. [41][42]
4. **Heating Curve for Ice/Water:** Label the horizontal sections as **Phase Change (Melting/Boiling)** where temperature remains constant. [43] [44]

4. EXAM ALERTS

- **Sign Convention:** In Kinematics, always fix one direction (e.g., downwards) as positive for the entire problem to avoid calculation errors.
- **Constant Acceleration:** You can only use $v = u + at$ if acceleration is **constant**. If a varies with time/ position, use integration.

- **Friction Direction:** Friction doesn't always oppose motion; it opposes **relative motion** or the tendency of motion. [45]
- **Units in Thermo:** Always convert temperature to **Kelvin** when using $PV = nRT$ or radiation laws. [46]
- **Contact Force:** In problems asking for "Contact Force," remember it is the resultant of **both** Normal force and Friction ($F_c = \sqrt{N^2 + f^2}$). [47]

5. QUICK SUMMARY

1. Displacement is a vector; distance is a scalar representing path length.
2. The area of an $a - t$ graph gives the change in velocity.
3. Horizontal velocity in a projectile remains constant if air resistance is ignored.
4. Pseudo force acts opposite to the acceleration of the observer's frame.
5. Limiting friction is the maximum static friction available before motion begins.
6. Work done by a force is zero if it is perpendicular to the displacement.

48 49

7. In an elastic collision, both linear momentum and kinetic energy are conserved.
8. Moment of Inertia depends on the mass distribution and the axis of

rotation.

9. Internal energy of an ideal gas depends only on its temperature.

50

10. The First Law of Thermodynamics is a statement of the law of conservation of energy.