Gravitation Class 11 Topic Tree

Here's a comprehensive list of the **formulas, symbols, expressions, units, and dimensional formulas** from the chapter on **Gravitation**:

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1. Newton's Law of Universal Gravitation

- **Formula**: $F = G\frac{m_1 m_2}{r^2}$
- **Symbols**:
  - F = Gravitational Force
  - G = Gravitational Constant
  - m_1, m_2 = Masses of two objects
  - r = Distance between the centers of the two objects
- **Unit of Force (F)**: Newton (N) or $\mathrm{kg\ m/s^2}$
- **Dimensional Formula of Force (F)**: $[M^1L^1T^{-2}]$
- **Unit of G**: $\mathrm{N\ m^2/kg^2}$ or $\mathrm{m^3/kg\ s^2}$
- **Dimensional Formula of G**: $[M^{-1}L^3T^{-2}]$

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2. Gravitational Constant

- **Formula**: $G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$
- **Symbols**:
  - G = Gravitational Constant
- **Unit of G**: $\mathrm{N\ m^2/kg^2}$
- **Dimensional Formula of G**: $[M^{-1}L^3T^{-2}]$

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3. Acceleration Due to Gravity

- **Formula**: $g = \frac{GM}{R^2}$
- **Symbols**:
  - g = Acceleration due to gravity
  - G = Gravitational constant
  - M = Mass of the Earth
  - R = Radius of the Earth
- **Unit of g**: $\mathrm{m/s^2}$
- **Dimensional Formula of g**: $[M^0L^1T^{-2}]$

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4. Gravitational Potential Energy

- **Formula**: $U = -G\frac{m_1 m_2}{r}$

- **Symbols**:
  - U = Gravitational Potential Energy
  - G = Gravitational constant
  - m_1, m_2 = Masses of two objects
  - r = Distance between the two objects
- **Unit of** U: Joules (J)
- **Dimensional Formula of** U: $[M^1L^2T^{-2}]$

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5. Gravitational Potential

- **Formula**: $V = -\frac{GM}{r}$
- **Symbols**:
  - V = Gravitational Potential
  - G = Gravitational constant
  - M = Mass of the object
  - r = Distance from the object
- **Unit of** V: $\mathrm{J/kg}$ or $\mathrm{m^2/s^2}$
- **Dimensional Formula of** V: $[M^0L^2T^{-2}]$

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6. Orbital Velocity

- **Formula**: $v = \sqrt{\frac{GM}{r}}$
- **Symbols**:
  - v = Orbital Velocity
  - G = Gravitational constant
  - M = Mass of the central body (e.g., Earth)
  - r = Radius of orbit
- **Unit of** v: $\mathrm{m/s}$
- **Dimensional Formula of** v: $[M^0L^1T^{-1}]$

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7. Escape Velocity

- **Formula**: $v_e = \sqrt{\frac{2GM}{R}}$
- **Symbols**:
  - v_e = Escape Velocity
  - G = Gravitational constant
  - M = Mass of the celestial body
  - R = Radius of the celestial body
- **Unit of** v_e: $\mathrm{m/s}$
- **Dimensional Formula of** v_e: $[M^0L^1T^{-1}]$

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8. Kepler's Third Law

- **Formula**: $T^2 \propto r^3$ or $T^2 = \frac{4\pi^2}{GM}r^3$

- **Symbols**:
  - T = Orbital period
  - r = Average radius of orbit
  - G = Gravitational constant
  - M = Mass of the central object
- **Unit of** T: Seconds (s)
- **Dimensional Formula of** T: $[M^0 L^0 T^1]$

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9. Force Between Two Masses (for small distances)

- **Formula**: $F = m \cdot g$
- **Symbols**:
  - F = Force
  - m = Mass of the object
  - g = Acceleration due to gravity
- **Unit of** F: Newton (N)
- **Dimensional Formula of** F: $[M^1 L^1 T^{-2}]$

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10. Potential Energy in Earth's Gravitational Field

- **Formula**: $U = mgh$
- **Symbols**:
  - U = Gravitational potential energy
  - m = Mass of the object
  - g = Acceleration due to gravity
  - h = Height above the Earth’s surface
- **Unit of** U: Joules (J)
- **Dimensional Formula of** U: $[M^1 L^2 T^{-2}]$

These formulas cover the key expressions and their corresponding dimensional forms, units, and symbols used in the **Gravitation** chapter.