👟 Unit 1
Kinematics

- Vector vs. Scalar: Vectors include **directions**
- Displacement vs. Distance
- Velocity vs. Speed: Velocity is a vector. ALWAYS include direction for velocity.
- Acceleration (also a vector)
- Linearization
- **Big Four Equations**
  - $V_x = V_{xo} + at$
  - $\Delta x = V_o t + 1/2\ at^2$
  - $V_x^2 = V_o^2 + 2a(\Delta x)$
  - $\Delta x = 1/2\ t(V_{xo} + V_x)$
- Projectile Motion
- Position-Time Graphs
- Velocity-Time Graphs (slope of position graph)
- Acceleration-Time Graphs (slope of velocity graph)
- Acceleration due to Gravity ($g = 9.8$ m/s^2)

🌀 Unit 2
Dynamics

- Equilibrium: net force is **equal to 0**
- Newton's 1st Law
  - Law of Inertia
- Newton's 2nd Law
  - Force = mass x acceleration
- Newton's 3 ← Especially $\Sigma F=ma$
  - Third Law Force Pairs (equal and opposite)
- **Friction Ff = F$_n$μ**
  - Coefficient of friction (μ)
- Ramps/Inclined Planes
  - Know how to create free body diagram with angles
- Force Body Diagrams
- Force and Net Force

🚀 Unit 3
Circular Motion & Gravitation

- Centripetal Force: **not** a force, just an expression for the net force
  - $Fc = mv^2/r$
- Centripetal Acceleration
  - $Ac = v^2/r$
- Universal Gravitation
- Uniform Circular Motion: **constant speed** (magnitude of velocity is constant)
- Combos with Forces, Energy, Simple Harmonic Motion, Rotation
- Inertial mass vs. Gravitational mass
  - How do you find each one experimentally?

⚡ Unit 4
Energy

- Work ($W = Fd$)
  - Parallel: (+) Work
  - Antiparallel: (-) Work
- Work = **Change** in Energy
- PEg, PEs, 2 kinds of KE
  - PEg = mgh
  - PEs = $(½) kx^2$
  - KE = $(½) mv^2$
  - KEr = $(½) I\omega^2$ (rotational motion)
- Mechanical Energy: the **sum** of a system's kinetic and potential energy
- Power ($P = W/t$) or ($P = Fv$)
- Conservation of Energy
- Bar Charts, Graphs & Diagrams

⛳ Unit 5
Momentum

- Momentum ($p=mv$)
- The **direction** of momentum is the same as the direction of motion
- Impulse ($J = Ft$)
- F vs t graphs (impulse = area under curve)
- Conservation of Momentum
- Center of Mass
- Combo with Energy, Rotational, Forces
- Collisions (Inelastic vs. Elastic)
  - **Elastic** → Kinetic Energy and Momentum are conserved
  - **Inelastic** → Momentum is conserved
- The velocity of the center of mass in a closed system is constant

🎸 Unit 6
Simple Harmonic Motion

- Spring & Pendulum
- Energy relationships
- F, a, v, x ← Diagrams & Graphs
- Combo with Forces, UCM, Energy, Rotational
- **Hooke's Law (F = kx)**
- **Period Equations**
- What affects the period of a **pendulum**?
  - $T = 2\pi(\sqrt{l}/\sqrt{g})$
  - L is the length of a pendulum
  - g is the gravitational field
- What affects the period of a mass on a **spring**?
- $T = 2\pi(\sqrt{m}/\sqrt{k})$
  - m is the mass attached to the spring
  - k is the spring constant → a higher spring constant is indicative of a stiffer spring

🎡 Unit 7
Torque & Rotational Motion

- Rotational Kinematics (θ, ω, α)
  - **Same** as Unit 1 Big 4 equations, but with new symbols
  - Remember $x = \theta R$, $v = \omega R$, $a = \alpha R$
- Torque & Moment of Inertia ($\Sigma\tau = I\alpha$)
- Torque: a force applied to a point on an object about the **axis of rotation** (not the center of mass)
- **Net Torque** causes angular acceleration
- Rotational KE and Conservation of Energy
- Angular Momentum & Conservation of Momentum
- Angular "**Impulse**"

💯 FRQ Tips

FRQ Breakdown:
- Experimental Design: Tests ability to design and analyze lab data.
- Quantitative & Qualitative Translation: Tests ability to translate between quantitative and qualitative reasoning.
- Paragraph Argument: Tests ability to make a coherent argument in a physics phenomenon.
- Short-Answer (2): Tests skills not highlighted in other questions.

Solving Tips:
- Does this equation model the correct observations?
- Are the variables showing a direct or indirect relationship?
- Cite info from the problem
- Bring in Basic Physics
- Describe how the info works with the Physics
- Answer the question with a claim

FRQ BREAKDOWN: FRQ TIPS: Qualitative/Quantitative Translation (25 minutes, 60%), Paragraph Argument Short Answer (15 minutes, 40%)