Concept map — Classical Mechanics

Region labels: 1, 2, 3, 4, 5, 6

- Scattering Problems
- Newton's Laws
  - benefits from the use of
- Conservative Vector Field Equations
  - Derivation
- Conservation Laws
  - which finds deeper meaning in light of → Noether's Theorem
  - which gives useful results including
- Viral Theorem
- Taylor's ω-Equation
  - Derivation → Center of Mass Motion
  - Derivation → Angular Momentum for Many Particles under Central Forces
- Reduced Mass
- determine the change in orbit due to an impulse
- Central Force Problems
  - which benefit from defining the
  - Derivation → Effective Potential
  - and is particularly useful for studying the
- Kepler Problem
- Conic Sections
- Arbitrary Potential Oscillation Period
- find the period of oscillation for an arbitrary potential
- Gauge Invariance
  - Derivation
  - which exhibits
- Wikipedia Angular Momentum Equation
- Convective Derivative Derivation
- EM Lagrangian
  - Derivation
- which involves the
- which relates to the theory of
- Euler Angles
- calculate the angular velocity from description of the motion
- when combined with equations for the 4-potential, give the
- Fermat's Principle
  - which is based on
  - solve for ray paths in geometric optics
  - which is relevant beyond dynamics to
  - solve the brachistochrone problem
- Lagrangian Dynamics
  - uses
  - centers around the
- Euler-Lagrange Eq.'s
  - which allow us to
  - find the equilibrium configuration
  - approximate the motion for small oscillations
  - show that the motion decouples for small oscillations
  - find the equations of motion
  - and analyze them to
  - solve for trajectories exactly
  - which explains
- with the help of
- Lagrange Multipliers
  - Derivation
  - find the forces of constraint
  - and in the case of
- Nonholonomic Constraints
  - one can
  - find when an object loses contact with a surface (ladder problem and ball problem)
- Center of Percussion
- Calculus of Variations
- Invariance of the Lagrangian
  - which is the same condition as
  - Derivation → Invariance of the Hamiltonian
- Hamilton's Eq.'s
  - come from
- Generalized Momentum
- Hamilton-Jacobi Eq.
- based on
- Hamiltonian Dynamics
  - Derivation
- Intermediate Axis Theorem
- Parallel Axis Theorem
- Accelerated Coordinate Systems
- General Fictitious Forces Eq.
- find deflection of falling objects on earth
- Poisson Bracket
- Legendre Transformation
- Approximating Systems of ODEs as Perturbations
- Condition of Canonicity
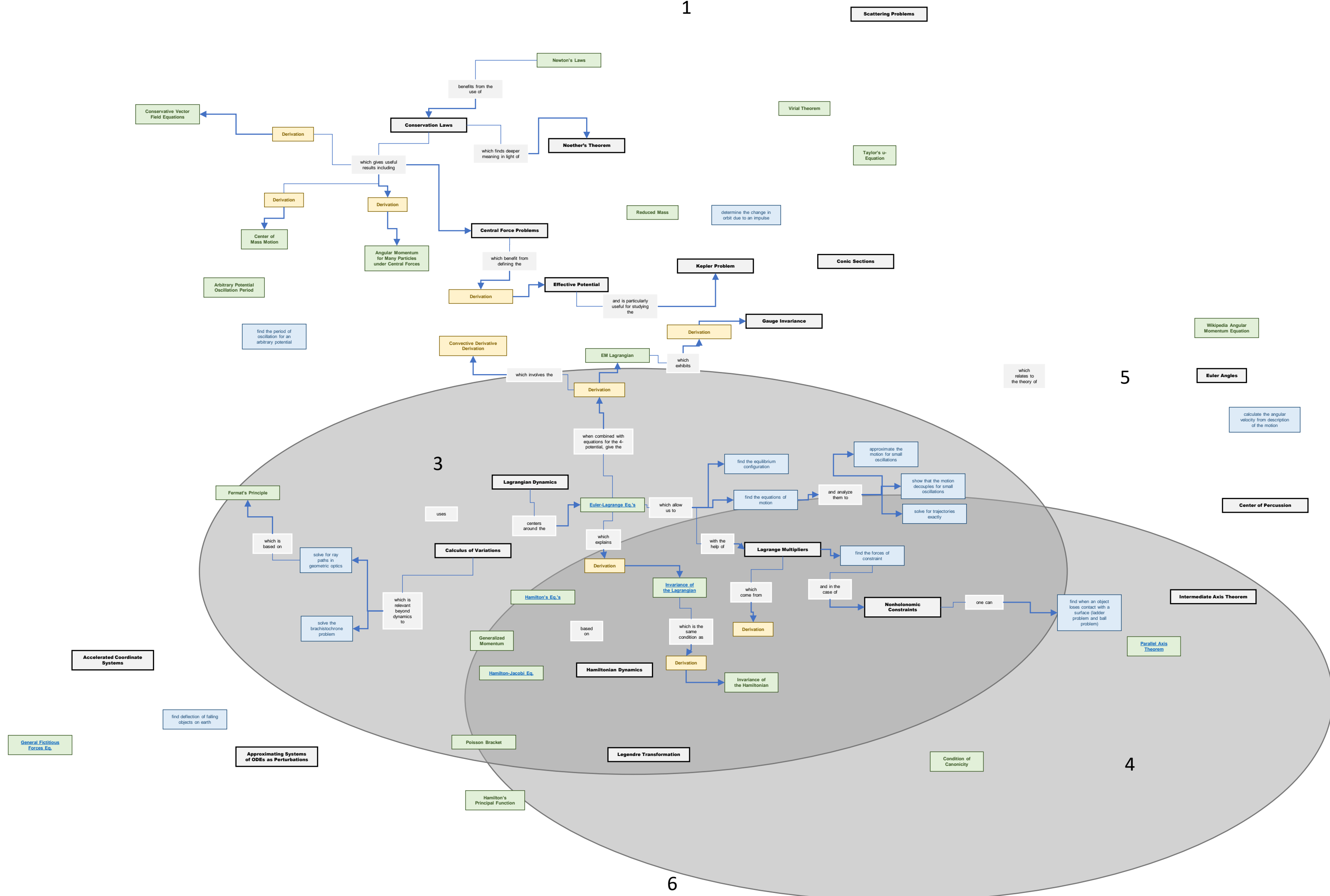- Hamilton's Principal Function

Legend:
- Concepts and Definitions
- Equations
- Example Problems
- Derivations