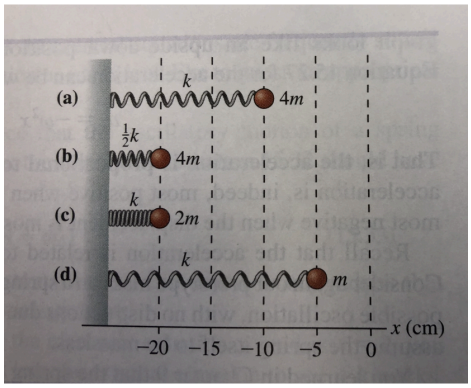
MZUNI Timeline

Chapter 1

- 1.0 introduction to lenses
- 1.1 Kinematics (speed)
- 1.2 Momentum
- 1.3 Energy
- 1.4 Forces (dynamics and work)
- 1.5 Kinematics (acceleration) (day 3)
- 1.6 Energy: Kinetic, and Gravitational Potential, Thermal Energy
- 1.7 Forces affect Momentum and Work (day 4)
- 1.8 Motivating and Applying Lenses in Mechanics
- 1.9 Scaling: What changes as things get larger?

Chapter 2

- 2.0 Work
- 2.1 Power
- 2.2 Units
- 2.3 Graphical Analysis of Kinematics
- 2.4 Vectors and Direction
- 2.5 Dynamics Protocol and More Directions
- 2.6 Springs: Force and Stored Energy
- 2.7 Potential Energy Diagrams
- 2.8 SHO, Energy Conservation, and VsotF = ma discussion
    - Examples:
    - Find speed given displacement
    - Find acceleration given displacement
    - Show horizontal SHO acts same in force (a) and energy as vertical in gravity
    - Find ratios of energy and at the equilibrium point, speed and momentum (below).



- 2.9 Update and Summary on Lens Method

Chapter 3

- 3.0 Changing Reference Frames
- 3.1 Elastic Collisions in 1D
    - Work on a gas heats it up as a result of collisions with the moving wall
- 3.2 Friction

Chapter 4

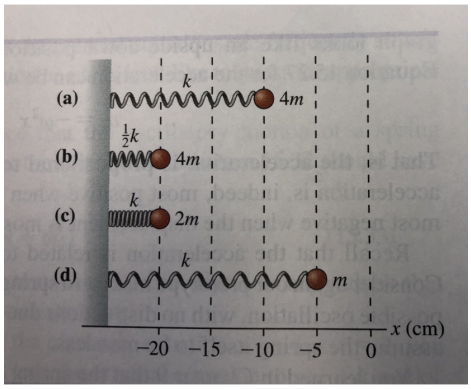
- 4.0 Intro to Rotation (4 lenses)
- 4.1 Direction of Rotation
- 4.2 Rotation and Tangential Motion
- 4.3 Torque, Work, Power
- 4.4 Moment of Inertia
- 4.5 Moments of Inertia of Solid Bodies
- 4.6 Intro to Statics
- 4.7 Angular Momentum Conservation
- 4.8 Update and Summary of Lens Method

Chapter 5 Hydraulics

- 5.0 What makes a fluid?
- 5.1 Pressure = F/A
- 5.2 Hydraulics and work
- 5.3 Fluids have momentum and energy
- 5.4 Archimedes' Principle and flotation
- 5.5 Bernoulli's Equation is the fluid Energy Balance
- Pelton Wheel

Chapter 6 Central Forces

- 6.0 Centripetal Acceleration
- 6.1 Ubiquitous Inverse Square Law
- 6.2 Universal Gravity
- 6.3 Loop the Loop: circular motion in the vertical plane
- 6.4 Astro Gravitational Potential Energy and Escape Speed
- 6.5 Kepler's Laws
- 6.6 SHO derivation of equation of motion, eigenfunction and eigenvalue
    - Given the sinusoidal displacement of a mass on a spring, estimate the velocity and then the acceleration by qualitatively looking at the slopes.
        - Does the acceleration satisfy the original equation of motion?



    - If you double the amplitude, what does it do to:
        - Frequency?
        - Maximum speed? And kinetic energy?
        - Maximum acceleration.
    - Rank speed, frequency, energy momentum, etc at right.
    - Energy as a function of time.
- 6.7 Resonance (without equations)
- 6.8 Traveling Waves, Wave equations and how to solve for them.
- 6.9 Interference (superposition), and with 2D interference patterns.

Chapter 7

- 7.0 Intro to Linear System of Masses
- 7.1 Rotational Systems
- 7.2 Center of Mass

- 7.3 Parallel Axis Theorem

Chapter 8

- 8.0 Introduction to Components
  - SHO is the projection of circular motion onto a plane
- 8.1 Components, Work, Torque, Statics, Momentum
  - What is the necessary pressure for the crane to pick up the car?
- 8.2 Inclined Plane
- 8.3 Conical Pendulum
- 8.4 Angular Momentum of a Point Mass
- 8.5 Angular Momentum, Stability, Precession

New **Chapter 9**

- 9.0 Trigonometry
- 9.1 Two Derived Equations (presently 9.6, should I make this the new 9.2?)
- 9.2 The small angle approximation, pendulum oscillator
  - Calculate speed, height, and theta
  - Calculate the discrepancy between pendulum and perfect SHO
  - Derive the natural frequency of a swinging solid body pivoting around a pivot attached anywhere on the body.
- 9.3 The time dependent SHO
  - Super Position: Asin(wt) + Bcos(wt)
    - Find A and B using initial conditions
  - Using phase constant, phi.
    - Find A and phi using initial conditions .

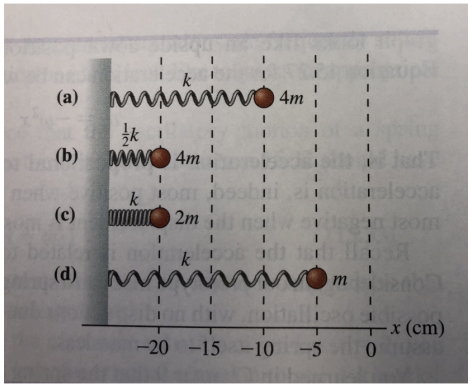
Cal Poly

Chapter 1

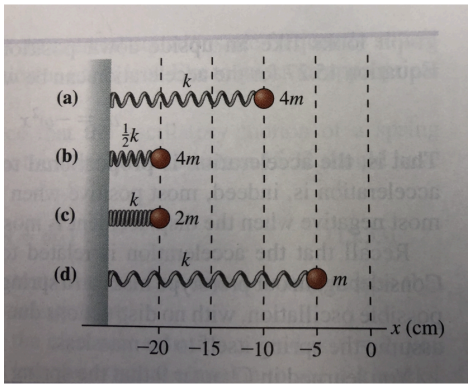
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- 1.3 Energy
- 1.4 Forces (dynamics and work)
- 1.4 ~~Kinematics (speed)~~
- 1.5 Phases of Matter
- 1.6 Kinematics (acceleration)
- 1.7 Energy: Kinetic, and Gravitational Potential, Thermal Energy
    - E=mcdt and cal = 4.2 J
- 1.8 Forces affect Momentum and Energy
- 1.9Lens, Motivation, Application
- 1.Ten Scaling: What changes as things get larger?
- 1.Eleven. P=F/A, Hydraulics chapter 1? sooner?

Chapter 2

- 2.0 Work
- 2.1 Power
    - Heat (Conduction, Convection, Radiation)
    - Entropy, Irreversible Processes
- 2.2 Units
- 2.3 Graphical Analysis of Kinematics
- 2.4 Vectors and Direction
- 2.5 Dynamics Protocol and More Directions



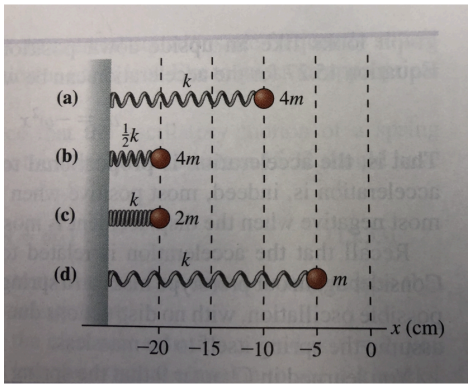
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Chapter 3

- 3.0 Changing Reference Frames
- 3.1 Elastic Collisions in 1D
    - Pelton Wheel
    - Particle collision causes pressure
    - Work on a gas heats it up as a result of collisions with the moving wall
- 3.2 Friction
    - Friction heating something
- 3.3 Ideal Gas Law, Temperature-kinetic energy, and PV diagrams
- 3.4 SHO derivation of equation of motion, eigenfunction and eigenvalue
    - Given a mass on a spring, find the displacement as a function of time, and then the velocity and then the acceleration by taking the derivatives.
        - Does the acceleration satisfy the original equation of motion?



-
    - Where is the mass when it has maximum speed? Does this make sense with an energy lens?
- If you double the amplitude, what does it do to:
    - Maximum speed? And kinetic energy?
    - Maximum acceleration
    - Period
- Rank speed, frequency, energy momentum, etc at right.
- Thermal Expansion of solids and liquids

- 3.5 Resonance (without equations)
- 3.6 Phase Changes, Phase Diagrams, latent heat, Le Chatelier's Principal.
- Mean Free Path and thermal conductivity
- Degrees of Freedom and Specific Heat

Chapter 4

- 4.0 Intro to Rotation (4 lenses)
- 4.1 Direction of Rotation
- 4.2 Rotation and Tangential Motion
- 4.3 Torque, Work, Power
- 4.4 Moment of Inertia
- 4.5 Moments of Inertia of Solid Bodies
    - Rotating object heats water
- 4.6 Intro to Statics
- 4.7 Angular Momentum Conservation
- 4.8 Update and Summary of Lens Method

Chapter 5

- 5.0 Centripetal Acceleration
- 5.1 Ubiquitous Inverse Square Law

- 5.2 Universal Gravity
- 5.3 Loop the Loop: circular motion in the vertical plane
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- 6.2 Center of Mass
- 6.3 Parallel Axis Theorem

Chapter 7

- 7.0 Introduction to Components
    - SHO is the projection of circular motion onto a plane
- 7.1 Components, Work, Torque, Statics, Momentum
    - 3D kinetic gas and the ideal gas law
    - What is the necessary pressure for the crane to pick up the car?
- 7.2 Inclined Plane
- 7.3 Conical Pendulum
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- 8.3 SHO, and projection of circular motion
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    - Super Position: Asin(wt) + Bcos(wt)
        - Find A and B using initial conditions
    - Using phase constant, phi.
        - Find A and phi using initial conditions

Chapter 9: Gas Laws

- 9.0 Ideal gas law
- 9.1 Support from Kinetic Theory
- 9.2 Heat Engines Videos, different cycles.
    - https://www.youtube.com/watch?v=FASFi5syKaw&
- 9.3 Thermodynamics
    - 3 laws
- 9.4 PV diagrams
- 9.5 Heat Pumps, Air Conditioners

We leave out the following because it's not in the Cal Poly curriculum: Traveling Waves, Interference, and with 2D interference patterns.