MZUNI Timeline

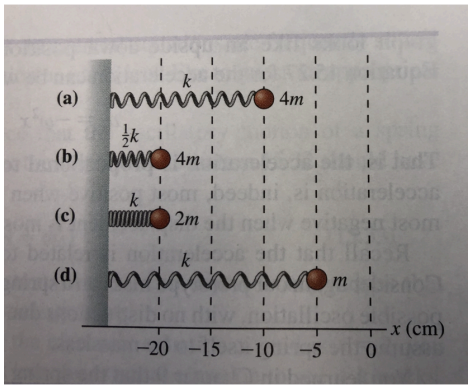
Chapter 1

- 1.0 introduction to lenses
- 1.1 ~~Momentum~~ 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?
- 1.Ten. P=F/A, Hydraulics chapter 1? sooner?

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

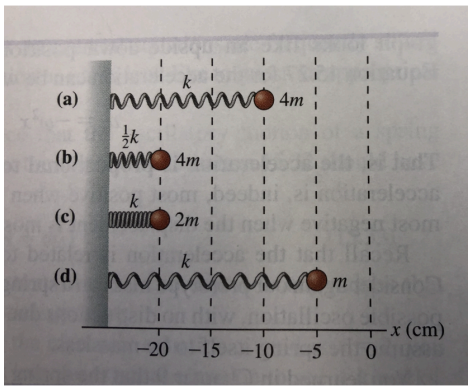


- 2.7 SHO, Energy Conservation, and VsotF = ma discussion
  - Examples:
  - Find speed given displacement
  - Find acceleration given displacement

        - Show horizontal SHO acts same in force (a) and energy as vertical in gravity
        - Rank energy and at the equilibrium point, speed and momentum (at right).
    - 2.8 Potential Energy Diagrams
    - 2.9 Update and Summary on Lens Method

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?



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        - 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
- 5.4 Astro Gravitational Potential Energy and Escape Speed
- 5.5 Kepler's Laws

Chapter 6

- 6.0 Intro to Linear System of Masses
- 6.1 Rotational Systems
- 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

- 7.4 Angular Momentum of a Point Mass
- 7.5 Angular Momentum, Stability, Precession

New **Chapter 8**

- 8.0 Trigonometry
- 8.1 Two Derived Equations (presently in chapter 7)
- 8.2 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.
- 8.3 SHO, and projection of circular motion
- 8.4 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

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.

Cal Poly

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- 1.5 Phases of Matter
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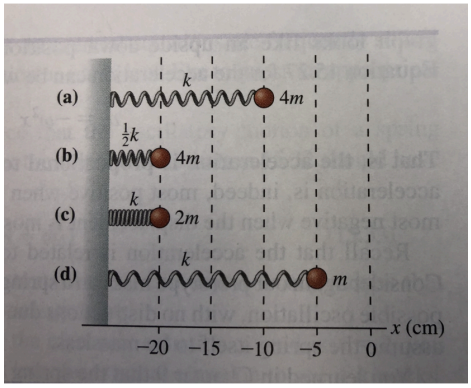
    - E=mcdt and cal = 4.2 J
- 1.8 Forces affect Momentum and Energy
- 1.9Lens, Motivation, Application
- 1.Ten Scaling: What changes as things get larger?
- 1.Eleven. P=F/A, Hydraulics chapter 1? sooner?

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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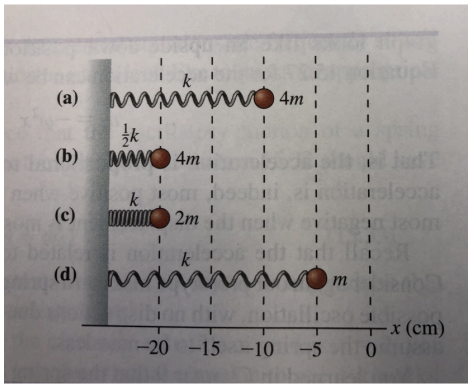

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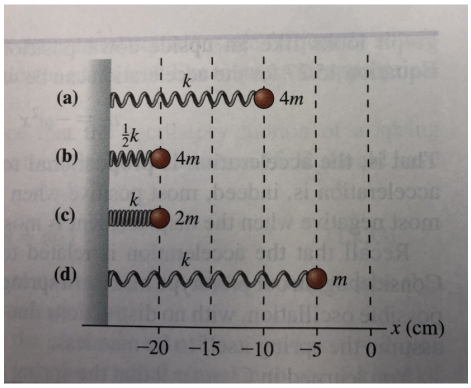

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