Final Exam Review Notes

Chapter 2
- Secs. 2-5 and 2-6: Motion in One Dimension with Constant Acceleration
- Sec 2-7: Free-fall

Chapter 4
- Projectile Motion (all sections)

Chapter 5
- Newton's Second Law (Sec 5-3)

Chapter 6
- Sec. 6-3: Equilibrium
  - $\sum F_x = 0$ and $\sum F_y = 0$ … apply these.
  - Problems like:
    - traffic light (done in class)
    - Prob. 65, HW
    - #3, Practice Exam 2
    - Example 6-5
    - Active Example 6-2
- Sec. 6-1: Friction Forces
  - $f_s \leq \mu_s N$
  - $f_k = \mu_k N$
  - Problems like:
    - Example 6-3.
    - Car on flat circular road (#2, Practice Exam 2)
    - Car on *banked* circular road
    - Prob. 2, HW
- Sec. 6-5: Circular Motion
  - Problems like:
    - Car on flat circular road (#2, Practice Exam 2)
    - Car on *banked* circular road
    - Ball on string, swung in horizontal circle (done in class)
    - #4, Practice Exam 2

Chapter 8
- Conservation of Energy (Sec 8-3)

  ❖Could be conservation of energy *without* a spring or *with* a spring!
  - Conservation of Energy Without Spring:
    - $E_f = E_i$ (if no nonconservative forces doing work)
    - $E_i = K_i + U^i_{grav} = \frac{1}{2}mv_i^2 + mgy_i$
    - $E_f = K_f + U^f_{grav} = \frac{1}{2}mv_f^2 + mgy_f$

      } Note: no K_{rot} for this exam… just K_{trans}
    - Problems like:
      - person on slide (done in class)
      - #8, Practice Exam 2
      - #17, Practice Exam 2
      - Example 8-7

- Conservation of Energy With Spring:
  - $E_f = E_i$ (if no nonconservative forces doing work)
  - $E_i = K_i + U^i_{grav} + U^i_{spring} = \frac{1}{2}mv_i^2 + mgy_i + \frac{1}{2}kx_i^2$
  - $E_f = K_f + U^f_{grav} + U^f_{grav} = \frac{1}{2}mv_f^2 + mgy_f + \frac{1}{2}kx_f^2$
  - Problems like:
    - Example 8-8 (similar to example done in class)
    - #9, Practice Exam 2
    - #10, Practice Exam 2
    - #11, Practice Exam 2
    - Prob. 18, HW

Chapter 9

- Conservation of Linear Momentum and Collisions (Secs 9-4, 9-5, 9-6)
  - Collisions
    - 2 broad categories: *head-on* and *glancing*
    - head-on collisions:
      - elastic: $\vec{p}$ conserved, K conserved
        - $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ (p cons.)
        - $v_{1i} + v_{1f} = v_{2i} + v_{2f}$ ("other" eq.... derived in class)
        - Problems like:
          - #15, Practice Exam 2
          - 2 billiard balls, equal masses (done in class)
          - 2 billiard balls, different masses (done in class)
          - Prob. 35, HW
      - inelastic: $\vec{p}$ conserved, K not
        - $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ (p cons.)
      - completely inelastic: $\vec{p}$ conserved, K not, objects stick together
        - $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$ (p cons.)
        - Problems like:
          - railroad cars (done in class)
          - two gliders on air track, one with "pin", other with "wax cylinder" (done in lab)
          - Prob. 23, HW
    - glancing collisions:
      - $\vec{p}$ still conserved, but *can't* write: $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$!
      - Instead, write $\vec{p}$ conservation as:
        - $p_{xi} = p_{xf}$
        - $p_{yi} = p_{yf}$
      - Problems like:
        - #18, Practice Exam 2
        - Example 9-6 (done in class)

Chapter 10

- Sec. 10-6: Conservation of Energy
    - If no nonconservative forces doing work, total mechanical energy is conserved, but now (if object rolling without slipping) there are *two* kinds of *K*. So conservation of energy says, in most general case:

      $$K^i_{trans} + K^i_{rot} + U^i_{grav} + U^i_{spring} = K^f_{trans} + K^f_{rot} + U^f_{grav} + U^f_{spring}$$

      $$\frac{1}{2}Mv_i^2 + \frac{1}{2}I\omega_i^2 + Mgy_i + \frac{1}{2}kx_i^2 = \frac{1}{2}Mv_f^2 + \frac{1}{2}I\omega_f^2 + Mgy_f + \frac{1}{2}kx_f^2$$
    - Problems like:
        - Example done in book, pp. 293-294
        - Example of object (hoop?) rolling down ramp (done in class)
        - Example 10-6
        - Prob. 60, end of chapter (given on take-home quiz)
        - #6, Practice Exam 3
- Sec. 10-2: Rotational Motion with Constant Angular Acceleration
    - use 4 facts:
        - $\omega = \omega_0 + \alpha t$
        - $\theta = \theta_0 + \frac{1}{2}(\omega_0 + \omega)t$
        - $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
        - $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
    - Problems like:
        - Example 10-1
        - Active Example 10-1
        - #1, Practice Exam 3
        - #2, Practice Exam 3
        - Prob. 20, HW

Chapter 11

- Sec 11-3: Equilibrium
    - Now *two* kinds (as contrasted with Sec. 6-3): translational *and* rotational:
        - $\sum F_x = 0$ and $\sum F_y = 0$ … translational equil.
        - $\tau_{net} = 0$ (about *any* axis)… rotational equi.
    - Problems like:
        - #16, Practice Exam 3
        - Active Example 11-1
        - Example 11-4
        - Active Example 11-2
        - Prob. 22, HW
        - Prob. 23, HW
- Secs 11-6 and 11-7: Conservation of Angular Momentum
    - L conserved if net external torque is zero. (Law of Conservation of Angular Momentum)
    - Problems like:
        - Example 11-10
        - Active Example 11-4
        - #17, Practice Exam 3
        - Prob. 63, HW

Chapter 12

- Sec 12-5: Energy Conservation
  - Once again, total mechanical energy is conserved if no nonconservative forces doing any work (Law of Conservation of Energy). But *this* time, use *corrected* formula for gravitational potential energy (corrected to be valid when not close to surface of Earth or surface of other planet, moon, etc):
    - $U_{grav} = -G\frac{mM_E}{r}$ (for gravitational potential energy due to *Earth*. If want gravitational potential energy due to some *other* planet or moon, replace M_E with mass of *that* planet or moon)
    - So conservation of energy becomes:

$$K_i + U_{grav}^i = K_f + U_{grav}^i$$
$$\frac{1}{2}mv_i^2 - G\frac{mM_E}{r_i} = \frac{1}{2}mv_f^2 - G\frac{mM_E}{r_f}$$

  - Problems like:
    - #11, Practice Exam 3
    - Prob. 47, HW
    - Prob. 58, HW
    - Example 12-6
    - Active Example 12-2

- Sec 12-1: Newton's Law of Universal Gravitation
  - $F_{grav} = G\frac{m_1 m_2}{r^2}$
  - Problems like:
    - #10, Practice Exam 3
    - Example 12-1
    - Prob. 8, HW

Chapter 13

- Sec. 13-4: Mass on Spring (Simple Harmonic Motion)
  - $\omega = \sqrt{\frac{k}{m}}$
  - $T = 2\pi\sqrt{\frac{m}{k}}$
  - Problems like:
    - #12, Practice Exam 3
    - Example 13-4
    - Active Example 13-2
    - Problems at end of chapter

Chapter 14

- Sec 14-6: The Doppler Effect
  - $f' = f\left(1 \pm \frac{u}{v}\right)$ (stationary source, moving observer)
  - $f' = f\left(\frac{1}{1 \mp \frac{u}{v}}\right)$ (moving source, stationary observer)
  - Problems like:
    - #15, Practice Exam 3
    - Example 14-5
    - Example 14-6
    - Prob. 34, HW
    - Prob. 35, HW
    - Prob. 40, HW
    - Prob. 46, HW

Chapter 16

- Calorimetry (with no phase change)… Sec 16-5

Chapter 17

- Calorimetry (with phase change)… Secs 17-5 and 17-6
- Ideal Gas Law: Sec 17-1

Chapter 18

- First Law of Thermodynamics: Sec 18-2