

Chapter 6

The points to Ch. 6 are understanding energy, its different forms, and the conservation of energy.

Work	$W = F d \cos \theta$
Kinetic Energy	$K = \frac{1}{2} m v^2$
Gravitational Potential Energy	$U_g = m g h$
Elastic Potential Energy	$U_e = \frac{1}{2} k x^2$
Work-Energy Principle	$W = \Delta K$
Conservation of Energy	$E_1 = E_2$
Power	$P = W/t$

Remember that the energy in the expression for conservation of energy can include kinetic energy, potential energy, and even work done by dissipative forces.

We also introduced Hooke's Law for springs: $F = -k x$
This leads us back to some definitions from Ch. 5:

Period, time to complete one cycle	
Frequency, number of cycles per unit time	$f = 1/T$

We skipped section 6-2.

Chapter 7

The key to Ch. 7 is remembering that *momentum is always conserved in collisions*.

Momentum	$\mathbf{p} = m \mathbf{v}$
Newton's Second Law	$\Sigma \mathbf{F} = \Delta \mathbf{p} / \Delta t$
Conservation of Momentum	$\mathbf{p}_i = \mathbf{p}_f$

If a collision is *elastic*, it also conserves energy, so we can use Eq'n 7-7:

$$v_{1i} - v_{2i} = v_{2f} - v_{1f}$$

It may also be useful to remember that conservation of momentum is just another way of saying that the motion of the center of mass of a system remains unchanged by a collision.

$$x_{cm} = \Sigma (m_i r_i) / \Sigma m_i$$

We skipped sections 7-9 and 7-10.

Chapter 8

Here, we introduce equations for kinematic motion similar to those for Ch. 2.

<i>Rotation</i>	<i>Translation</i>	<i>Definition</i>	<i>Relation (rad)</i>
$\theta = (1/2) \alpha t^2 + \omega_o t + \theta_o$	$x = (1/2) a t^2 + v_o t + x_o$		$s = \theta r$
$\omega = \alpha t + \omega_o$	$v = a t + v_o$	$\omega = \Delta\theta/\Delta t$	$v = \omega r$
$\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$	$v^2 = v_o^2 + 2a(x - x_o)$	$\alpha = \Delta\omega/\Delta t$	$a_t = \alpha r$
centripetal acceleration:		$a_r = v^2/r = \omega^2 r$	
angular frequency:		$\omega = 2\pi f$	

We also introduce torque:

and the rotational form of Newton's Second Law: $\tau = r F \sin \theta$
where I is the moment of inertia (analogous to mass). $\Sigma \tau = I \alpha$

We skimmed sections 8-6 to 8-8 and skipped section 8-9.

Chapter 9

Chapter 9 is simply the application of Newton's Second Law (in linear and angular form) to statics problems, which are situations where nothing is being accelerated. To tackle a statics problem, remember that:

- 1) $\Sigma F = 0$ in each direction
- 2) $\Sigma \tau = 0$ about every possible pivot

We skipped sections 9-5 to 9-8.

Chapter 10

Chapter 10 introduces us to fluids. We first defined:

Density	$\rho = m/V$
Pressure	$P = F/A$

Recall that among the myriad of units for pressure, the most useful are the pascal and the atmosphere. Also remember the difference between absolute and gauge pressure.

Then we examined a few useful principles:

Change of pressure with depth:	$P = \rho g h$
Pascal's Principle	$P_{in} = P_{out}$
Archimedes' Principle	$F_{bouyant} = \rho_{fluid} V_{displaced} g$
Equation of Continuity	$A_1 v_1 = A_2 v_2 = \Delta V / \Delta t$

We skipped sections 10-8 to 10-13.

Chapter 11

The energy of an oscillating spring can be written a number of ways:

$$E = \frac{1}{2} k A^2 = \frac{1}{2} m v_0^2 = \frac{1}{2} m v^2 + \frac{1}{2} k x^2$$

From Newton's Second Law, most oscillators produce an equation of the form

$$a = - C x$$

which has solutions of the form

$$x = A \cos \omega t, \quad \text{where } \omega^2 = C$$

For the spring:

$$\begin{aligned} a &= - (k/m) x \\ \omega &= (k/m)^{1/2} \\ T &= 2 \pi (m/k)^{1/2} \end{aligned}$$

For the simple pendulum:

$$\begin{aligned} a &= - (g/L) x \\ \omega &= (g/L)^{1/2} \\ T &= 2 \pi (L/g)^{1/2} \end{aligned}$$

Other useful expressions you need to know:

general velocity of a wave	$v = \lambda f$
velocity of a wave on a cord	$v = (F_T L/m)^{1/2}$
harmonic wavelengths of a cord	$\lambda_n = 2L/n$
harmonic frequencies of a cord	$f_n = vn/(2L) = n f_1$
dissipation of intensity	$I \propto 1/r^2$
dissipation of amplitude	$A \propto 1/r$
Law of Reflection	$\theta_i = \theta_r$

Chapter 12

This chapter is mostly a review of the last part of Chapter 11 and an application to sound waves and musical instruments. We only covered sections 12-1, 12-2, 12-5, 12-7, and 12-8 in any depth.

New material is limited to:

intensity in decibels	$\beta_2 - \beta_1 = 10 \log (I_2/I_1)$
beat frequency	$f_{beat} = \Delta f$
Doppler effect	$\Delta\lambda/\lambda = v_{source}/v_{wave}$