8.01 & 8.02: Classical Mechanics and Electricity & Magnetism Walter Lewis, Massachusetts Institution of Technology, Fall 1999 and Spring 2002

1	Section 1				
	1.1	Powers of Ten. Units, Dimensions, Measurements, Uncertainties, Dimensional Analysis, Scal-			
		ing Arguments	3		
	1.2	1D Kinematics, Speed, Velocity, Acceleration	3		
	1.3	Vectors, Dot Products, Cross Products, 3D Kinematics	3		
	1.4	3D Kinematics, Free Falling Reference Frames	3		
	1.5	Circular Motion, Centrifuges Moving, Reference Frames, Perceived Gravity	3		
	1.6	Newton's Laws	3		
	1.7	Weight, Perceived Gravity, Weightlessness Free Fall, Zero Gravity in Orbit (Misnomer)	3		
	1.8	Friction	3		
	1.9	Part 1 Summary	3		
	1.5	Tait I Julillary	_		
2	Sect	ion 2	4		
	2.1	Hooke's Law, Springs, Simple Harmonic Motion, Pendulum, Small Angle Approximation	4		
	2.2	Work, Kinetic Energy, Potential Energy, Conservative Forces, Conservation of Mechanical			
		Energy, Newton's Laws of Universal Gravitation	4		
	2.3	Non-Conservative Forces, Resistive Forces, Air Drag, Terminal Velocity	4		
	2.4	Potential Energy, Energy Considerations to Derive Simple Harmonic Motion	4		
	2.5	Escape Velocities, Bound and Unbound Orbits, Circular Orbits, Various Forms of Energy, Power	4		
	2.6	Momentum, Conservation of Momentum, Center of Mass	4		
	2.7	Collisions, Elastic and Inelastic, Center of Mass Frame of Reference	4		
	2.8	Impulse, Rockets	4		
	2.9	Part 2 Summary			
	2.9	rait 2 Sullillary	4		
3	Sect	ion 3	5		
	3.1	Rotating Rigid Bodies, Moment of Inertia, Parallel Axis and Perpendicular Axis Theorem,			
		Rotational Kinetic Energy, Fly Wheels, Neutron Stars, Pulsars	5		
	3.2	Angular Momentum, Torques, Conservation of Angular Momentum, Spinning Neutron Stars,			
	0	Stellar Collapse	5		
	3.3	Torques, Oscillating Bodies, Hoops	5		
	3.4	Kepler's Laws, Elliptical Orbits, Satellites, Change of Orbits, Ham Sandwich	5		
	3.5	Doppler Effect, Binary Stars, Neutron Stars and Black Holes	5		
	3.6	Rolling Motion, Gyroscopes, Very Non-intuitive	5		
	3.7	Static Equilibrium, Stability, Rope Walker	5		
	3.8	Elasticity, Young's Modulus	5		
	3.9	Fluid Mechanics, Pascal's Principle, Hydrostatics, Atmospheric Pressure, Over Pressure in	Ú		
	5.9		_		
	2 10	Lungs and Tires	5		
	5.10	Hydrostatics, Archimedes' Principle, Fluid Dynamics, What Makes Your Boat Float?, Bernoulli's	_		
	2 1 1	Equation	5		
	3.11	Part 3 Summary	5		
4	Sect	ion 4	6		
4	4.1	Simple Harmonic Oscillations, Energy Considerations, Torsional Pendulum			
	4.1	Forced Oscillations, Normal Modes, Resonance, Natural Frequencies, Musical Instruments	6		
		· · · · · · · · · · · · · · · · · · ·	6		
	4.3	Heat, Thermal Expansion	6		
	4.4 4.5	Kinetic Gas Theory, Ideal Gas Law, Isothermal Atmosphere, Phase Diagrams, Phase Transitions The Wonderful Quantum World, Breakdown of Classical Mechanics	6		

5	Section 5		7
	5.1 Electric Charges and Forces, Coulomb's Law, Polarization		7
	5.2 Electric Field Lines, Superposition, Inductive Charging, Induced Dipoles		
	5.3 Electric Flux, Gauss' Law, Examples		
	5.4 Electrostatic Potential, Electric Energy, Equipotential Surfaces		
	5.5 E= -grad V, Conductors, Electrostatic Shielding (Faraday Cage)		
	5.6 High-voltage Breakdown, Lightning, Sparks, St-Elmo's Fire		
	5.7 Capacitance, Electric Field Energy		
	5.8 Polarization, Dielectrics, Van de Graaff Generator, Capacitors		
	5.9 Electric Currents, Resistivity, Conductivity, Ohm's Law		
	5.10 Batteries, Power, Kirchhoff's Rules, Circuits, Kelvin Water Dropper		
	5.11 Magnetic Fields, Lorentz Force, Torques, Electric Motors (DC)		
	5.12 Section 5 Review		
	5.12 3000,000 0 100,000 0 1 1 1 1 1 1 1 1 1 1	•	•
6	Section 6		8
	6.1 Moving charges in B-fields, Cyclotrons, Mass Spectrometers, LHC		8
	6.2 Biot-Savart, div $B=0$, High-voltage Power Lines, Leyden Jar revisited		
	6.3 Ampere's Law, Solenoids, Kelvin Water Dropper (revisited)		
	6.4 Electromagnetic Induction, Faraday's Law, Lenz Law, SUPER DEMO		
	6.5 Motional EMF, Dynamos, Eddy Currents, Magnetic Braking		
	6.6 Displacement Current, Synchronous Motors, Explanation Secret Top		
	6.7 Magnetic Levitation, Human, Superconductivity, Aurora Borealis		
	6.8 Inductance, RL Circuits, Magnetic Field Energy		
	6.9 Magnetic Materials, Dia- Para-, Ferromagnetism		
	6.10 Maxwell's Equations, 600 Daffodil Ceremony		
	6.11 Section 6 Review		
			·
7	Section 7		9
	7.1 Transformers, Car Coils, RC Circuits		9
	7.2 Driven LRC Circuits, Metal Detectors		9
	7.3 Traveling Waves, Standing Waves, Musical Instruments		9
	7.4 Destructive Resonance, Electromagnetic Waves, Speed of Light		9
	7.5 Poynting Vector, Oscillating Charges, Polarization, Radiation Pressure		9
	7.6 Snell's Law, Index of Refraction, Huygen's Principle, Illusion of Color		9
	7.7 Polarizers, Malus' Law, Light Scattering, Blue Skies, Red Sunsets		9
	7.8 Rainbows, Fog Bows, Haloes, Glories, Sun Dogs		9
	7.9 Section 7 Review		9
8	Section 8		10
	8.1 Double-slit Interference, Interferometers		_
	8.2 Diffraction, Gratings, Resolving Power, Angular Resolution		
	8.3 Doppler Effect, Big Bang, Cosmology		

- 1.1 Powers of Ten. Units, Dimensions, Measurements, Uncertainties, Dimensional Analysis, Scaling Arguments
- 1.2 1D Kinematics, Speed, Velocity, Acceleration
- 1.3 Vectors, Dot Products, Cross Products, 3D Kinematics
- 1.4 3D Kinematics, Free Falling Reference Frames
- 1.5 Circular Motion, Centrifuges Moving, Reference Frames, Perceived Gravity
- 1.6 Newton's Laws
- 1.7 Weight, Perceived Gravity, Weightlessness Free Fall, Zero Gravity in Orbit (Misnomer)
- 1.8 Friction
- 1.9 Part 1 Summary

- 2.1 Hooke's Law, Springs, Simple Harmonic Motion, Pendulum, Small Angle Approximation
- 2.2 Work, Kinetic Energy, Potential Energy, Conservative Forces, Conservation of Mechanical Energy, Newton's Laws of Universal Gravitation
- 2.3 Non-Conservative Forces, Resistive Forces, Air Drag, Terminal Velocity
- 2.4 Potential Energy, Energy Considerations to Derive Simple Harmonic Motion
- 2.5 Escape Velocities, Bound and Unbound Orbits, Circular Orbits, Various Forms of Energy, Power
- 2.6 Momentum, Conservation of Momentum, Center of Mass
- 2.7 Collisions, Elastic and Inelastic, Center of Mass Frame of Reference
- 2.8 Impulse, Rockets
- 2.9 Part 2 Summary

- 3.1 Rotating Rigid Bodies, Moment of Inertia, Parallel Axis and Perpendicular Axis Theorem, Rotational Kinetic Energy, Fly Wheels, Neutron Stars, Pulsars
- 3.2 Angular Momentum, Torques, Conservation of Angular Momentum, Spinning Neutron Stars, Stellar Collapse
- 3.3 Torques, Oscillating Bodies, Hoops
- 3.4 Kepler's Laws, Elliptical Orbits, Satellites, Change of Orbits, Ham Sandwich
- 3.5 Doppler Effect, Binary Stars, Neutron Stars and Black Holes
- 3.6 Rolling Motion, Gyroscopes, Very Non-intuitive
- 3.7 Static Equilibrium, Stability, Rope Walker
- 3.8 Elasticity, Young's Modulus
- 3.9 Fluid Mechanics, Pascal's Principle, Hydrostatics, Atmospheric Pressure, Over Pressure in Lungs and Tires
- 3.10 Hydrostatics, Archimedes' Principle, Fluid Dynamics, What Makes Your Boat Float?, Bernoulli's Equation
- 3.11 Part 3 Summary

- 4.1 Simple Harmonic Oscillations, Energy Considerations, Torsional Pendulum
- 4.2 Forced Oscillations, Normal Modes, Resonance, Natural Frequencies, Musical Instruments
- 4.3 Heat, Thermal Expansion
- 4.4 Kinetic Gas Theory, Ideal Gas Law, Isothermal Atmosphere, Phase Diagrams, Phase Transitions
- 4.5 The Wonderful Quantum World, Breakdown of Classical Mechanics

- 5.1 Electric Charges and Forces, Coulomb's Law, Polarization
- 5.2 Electric Field Lines, Superposition, Inductive Charging, Induced Dipoles
- 5.3 Electric Flux, Gauss' Law, Examples
- 5.4 Electrostatic Potential, Electric Energy, Equipotential Surfaces
- 5.5 E= -grad V, Conductors, Electrostatic Shielding (Faraday Cage)
- 5.6 High-voltage Breakdown, Lightning, Sparks, St-Elmo's Fire
- 5.7 Capacitance, Electric Field Energy
- 5.8 Polarization, Dielectrics, Van de Graaff Generator, Capacitors
- 5.9 Electric Currents, Resistivity, Conductivity, Ohm's Law
- 5.10 Batteries, Power, Kirchhoff's Rules, Circuits, Kelvin Water Dropper
- 5.11 Magnetic Fields, Lorentz Force, Torques, Electric Motors (DC)
- 5.12 Section 5 Review

- 6.1 Moving charges in B-fields, Cyclotrons, Mass Spectrometers, LHC
- 6.2 Biot-Savart, div B=0, High-voltage Power Lines, Leyden Jar revisited
- 6.3 Ampere's Law, Solenoids, Kelvin Water Dropper (revisited)
- 6.4 Electromagnetic Induction, Faraday's Law, Lenz Law, SUPER DEMO
- 6.5 Motional EMF, Dynamos, Eddy Currents, Magnetic Braking
- 6.6 Displacement Current, Synchronous Motors, Explanation Secret Top
- 6.7 Magnetic Levitation, Human, Superconductivity, Aurora Borealis
- 6.8 Inductance, RL Circuits, Magnetic Field Energy
- 6.9 Magnetic Materials, Dia- Para-, Ferromagnetism
- 6.10 Maxwell's Equations, 600 Daffodil Ceremony
- 6.11 Section 6 Review

- 7.1 Transformers, Car Coils, RC Circuits
- 7.2 Driven LRC Circuits, Metal Detectors
- 7.3 Traveling Waves, Standing Waves, Musical Instruments
- 7.4 Destructive Resonance, Electromagnetic Waves, Speed of Light
- 7.5 Poynting Vector, Oscillating Charges, Polarization, Radiation Pressure
- 7.6 Snell's Law, Index of Refraction, Huygen's Principle, Illusion of Color
- 7.7 Polarizers, Malus' Law, Light Scattering, Blue Skies, Red Sunsets
- 7.8 Rainbows, Fog Bows, Haloes, Glories, Sun Dogs
- 7.9 Section 7 Review

- 8.1 Double-slit Interference, Interferometers
- 8.2 Diffraction, Gratings, Resolving Power, Angular Resolution
- 8.3 Doppler Effect, Big Bang, Cosmology