

The final exam will be comprehensive with approximately 34% on the material from this study sheet. Three problems will be on material from this sheet and the remaining 66% will be from the material covered on the two previous study sheets. There will be two problems on the exam similar to problems on the midterms. You will be allowed one $8\frac{1}{2} \times 11$ " sheet of notes. You should spend half your time understanding the theory covered in your lecture notes and half working problems. The problems are a very important part of preparing for an exam. These should include problems that have not been assigned. The exam will involve thinking NOT MEMORIZATION; therefore, you should get a good night's sleep before the exam and come prepared to think. CRAMMING WILL NOT HELP.

Chapter 10

Define or state as the case may be:

- angular momentum
- conservation of angular momentum
- rotational equations of motion
- conjugate momentum (e.g., p_x is the momentum conjugate to x and $p_x = \partial E / \partial \dot{x}$)
- translational invariance
- time reversal invariance

Know and Understand:

- How to find the sum of the torques on an object that is accelerating.
- when and how to use conservation of angular momentum.
- how torque and angular momentum are related.
- how momentum conservation follows from translational invariance, and energy conservation follows from time reversal invariance.
- when and how to use conservation of angular momentum.
- how torque and angular momentum are related.
- know when \vec{L} and $\vec{\omega}$ point in the same direction.
- how to find a conserved momentum from the energy equation.

Chapter 12

Define or State:

- Kepler's three laws,
- Newton's law of gravitation,
- conic section,
- gravitational field

e) the rotational kinetic energy in terms of L , i.e., $K = \frac{L^2}{2mr^2}$

Know & Understand:

- how to derive Kepler's third law.
- how and when to use Newton's law of gravitation.
- why the moon doesn't hit the earth. Is it falling from the sky?
- when we write $E = \frac{1}{2}mv^2 + U(r)$, which components of the momentum are conserved.
- Why the gravitational force on a mass goes to zero as the mass approaches the center of a spherical planet.

Chapter 13

Define or state:

- a) simple harmonic motion (SHM)
- b) the mathematical form of any force that will cause SHM
- c) Amplitude, Angular frequency, period, linear frequency
- d) phase
- e) phase relations between position, velocity, and acceleration.
- f) conservation of energy in SHM
- g) damping constant
- h) under-damped, critically-damped, and over-damped
- i) natural frequency of a damped oscillator
- j) resonant frequency of a forced oscillator.

Know and understand:

- 1) how to derive the equations for SHM.
- 2) given a force, determine the period of an oscillator.
- 3) given an initial condition, determine the phase of the oscillator.
- 4) find the position, velocity, and acceleration as a function of time.
- 5) how to sum forces and torques to prove a system will undergo simple harmonic motion.
- 6) that the amplitude of a damped harmonic oscillator decays exponentially.
- 7) what happens when an oscillator is driven at its resonant frequency.