NS 280: Week #7 Handout, 2002.03.10
by Douglas Leonard

Overheads Not in Reader

René Descartes (1596-1650)

Rules For Philosophical Investigations
- Break up problems into simple parts.
- Attack simple first, then move to complex.
- Accept as true only that which can not be doubted.
  → Theory of motion built around interactions among single corpuscles (atoms).
  → Devises an entire cosmology based on corpuscular interactions.
  → Laws of Motion foreshadow Newton.

A mechanistic universe.
- Recognizes straight-line motion is fundamental, circular motion is forced (unnatural)

Announcements

- Reminder: Book reviews are due at the beginning of class on Monday, March 25.
  To aid in the production of great book reviews, there will be no weekly writing assignment due on Monday, March 25. Rather, the weekly assignments for week 7 (this week) and week 9 (the week after spring break) may be combined and handed in together as one assignment on Monday, April 1.

Assignment for Monday, March 25

This assignment is the heaviest we will directly confront on the mathematical end of things in this course, but it is essential that you work through the problems that are assigned. Learning to speak some of the language of the natural philosophy of Isaac Newton is crucial to understanding the power of his ideas. If things seem to go by quickly in class, take solace in the fact that it is all presented here in the text by Paul Hewitt as well; read it slowly, and carefully, looking at the “sample questions” as you go to test your understanding. Then try the assigned problems; if you
don’t get them right away, don’t give up! Really work at them; talk to your classmates; and then, if things still are uncertain in your mind, stick around after class (on March 25th), when there will be an extra help session for anyone that wants it on any/all of these problems.

•Reader: p. 127 - 133. Paul Hewitt, “Newton’s First Law of Motion”, from Conceptual Physics. Read about Newton’s statement of Galileo’s Law of Inertia, the subtle difference between mass and weight, and the principle of relative motion. (Note that the bottom line of p. 129 is cutoff from both the figure caption and the Answers to the sample questions. The missing words from the caption of Fig. 3-6 is: “...will continue without change”; the missing line from the answer to question 2 is: “... is not.”

•Reader: p. 136 - 143. Paul Hewitt, “Newton’s Second Law of Motion: Force and Acceleration”, from Conceptual Physics. This section discusses that crucial equation that explains it all, \( F = ma \). Be sure to pay close attention!

•Reader: p. 147 - 157. Paul Hewitt, “Universal Gravitation”, from Conceptual Physics. This chapter starts with the falling apple, and how Newton tied its motion to the “falling” of the moon in its orbit. From there, read the description of how the universal gravitational constant, \( G \), was ultimately measured. (Note that Hewitt has, I believe, a small typo on p. 152: when discussing von Jolly’s method of measuring \( G \), he inadvertently says: “The gravitational force \( F \) between the lead masses...”. I believe he means to say: “The gravitational force \( F \) between the lead mass and the mercury sphere...”, since von Jolly actually used a spherical container of mercury as the second mass, not a lead ball.

•Optional Reading: Last year’s Reader, p. 160 - 178. From Abell’s text. Goes through the full derivation of Newton’s version of Kepler’s 3rd law, for those desiring it. It also provides a nice summary of Newton’s (and Kepler’s) laws.

Weekly Thought Question

Answer these “Think and Explain” Questions from the Reader:
• p. 135 #1, 2, and 10.
• p. 146 #1, 3, and 4. Here’s a hint for solving #3: You will want to use ratios here to solve this. That is, consider the truck before (“b”) and after (“a”) its load is reduced. Since the force is the same, and the mass has changed, we can solve for the new acceleration. That is:

\[
F_b = F_a \\
m_b \times a_b = m_a \times a_a
\]

where \( a \) and \( b \) represent “after” and “before” the load was reduced. Can you take it from here?
• p. 158 #1, 4, and 10. Answer carefully and completely!