Sections 8.4, 8.5, and 8.6 cover various practical applications of the integral, primarily in physics and economics. Instead of introducing this material with reading and discussion assignments, we will have **group presentations** on topics from each section.

Preparing and Giving the Presentation

1. Read and discuss the relevant section (or portion of a section) of the textbook.
2. Solve your assigned presentation problem. An asterisk indicates a challenge problem.
3. Write up your solution (only one per group) and turn it in on the day that you present.
   - Your written solution will count as a quality solution. (+1) for challenge problem.
4. Create and rehearse your presentation. (Time yourselves!)
5. Outline your presentation on the board, *before* class starts, on the day of your presentation.
6. Present your topic, in a 7-10 minute oral presentation, in which each group member speaks.
   - Explain the physics or economics background and why an integral is appropriate in this situation; then explain the solution to your assigned problem.
   - The oral presentation will count towards your grade like a quality solution.
   - Graded for: clarity of delivery, depth of conceptual explanations, correctness of content.

1. Presentation Problems

Each group of students will present one or two of the eight application topics below. I will email the class to solicit input on the assignment of groups and topics. Once you have been assigned a topic, choose one of the presentation problems for your topic, listed below. You will receive a grade for the written solution of your problem as well as for the oral presentation of your problem. If you choose a challenge problem, the written solution receives a bonus, but the oral presentation does not.

8.4 (Nov 10) Density: 14 or 18*; Center of Mass: 22 or 26*
8.5 (Nov 13) Work: 12 or 24*; Pressure: 26a* or 30; Energy: KE-1*; Gravitation: G-1*
8.6 (Nov 15) Income Stream: 18 or 34*; Consumer/Producer Surplus: 36*

Note. For kinetic energy and gravitation, some outside research will be needed in order to prepare an adequate discussion of the background in the presentation. This will be taken into account in the grading of the presentation. See the back of this page for the kinetic energy and gravitation problems.

2. Practice Problems

After hearing the presentations on a given section, you will have an opportunity to start the practice problems in class. The practice problems are due at the beginning of the next class.

P 8.4 (due Nov 13) Density: 5, 9, 13, 16, 17, 19; Center of Mass: 8, 21, 24, 25, 27
P 8.5 (due Nov 15) Work: 4, 5, 11, 13, 15, 17; Force and Pressure: 7, 28, 31, 32, 33
P 8.6 (due Nov 17) Income Stream: 10, 11, 21, 23, 25; Consumer/Producer Surplus: 39, 41

3. Quality Solutions

Choose **two** of the following problems (not both on the same topic) to write up nicely, as quality solutions. These are due at the beginning of class **Nov 17**, which is the first class after we have finished all the presentations. *All of these are challenge problems* and will receive the (+1) bonus.

QS 8.4: Density: 32, 34 Center of Mass: 28, 30
QS 8.5: Work: 36, 38; Pressure: 34; Energy: KE-2; Gravitation: G-2 or G-3.
QS 8.6: Income Stream: 32; Consumer/Producer Surplus: 40

Kinetic Energy. The kinetic energy E of a particle of mass m moving at a speed v is $E = \frac{1}{2}mv^2$.

KE-1. **Presentation:** Find the kinetic energy of a thin uniform rod of mass 10 kg and length 6 m rotating, like a helicopter blade, about an axis perpendicular to the rod at its midpoint, with an angular velocity of 2 radians per second. (Hint: The speed v of an object traveling with angular velocity ω, in radians per unit time, in a circle of radius r is $v = r\omega$. Why does this make sense?)

KE-2. **QS:** Find the kinetic energy of a phonograph record of uniform density, mass 50 gm and radius 10 cm rotating at $33\frac{1}{3}$ revolutions per minute. (See hint in previous problem.)

Gravitation. The force F of gravitational attraction between two particles of mass m_1 and m_2 at a distance r apart is $F = Gm_1m_2/r^2$, where G is a constant called the universal gravitational constant.

G-1. **Presentation:** What is the force of gravitational attraction between a thin uniform rod of mass M and length ℓ and a particle of mass m lying in the same line as the rod at a distance a from one end? (You should get $GMm/(a(a+\ell))$ for your final answer.)

G-2. **QS:** Two long, thin, uniform rods of lengths ℓ_1 and ℓ_2 lie on a straight line with a gap between them of length a. Suppose their masses are M_1 and M_2, respectively. What is the force of gravitational attraction between the two rods? (Hint: Use the answer from the presentation problem.)

G-3. **QS:** Find the gravitational force exerted by a thin uniform ring of mass M and radius a on a particle of mass m lying on a line perpendicular to the ring through its center. Assume m is at a distance y from the center of the ring.