

Physics I: Summary

Book C: Conservation Laws Constrain Interactions

Big Idea: There are three quantities—momentum, energy, and angular momentum—which remain constant for any isolated system.

Other topics and ideas:

1. Mathematics of vectors: components, addition, subtraction, dot product, cross product
2. Applying momentum conservation
3. Forces as rate of momentum transfer, impulse
4. Potential energy for gravitational and spring-like interactions
5. Angular speed, radians
6. Rotational kinetic energy, moment of inertia
7. Thermal energy, specific heat
8. Energy in bonds, latent heat
9. All sorts of conservation of energy applications
10. Power
11. Torque
12. Angular momentum and angular momentum applications

Book N: Newton's Laws are Universal

Big Idea: Newton's three laws:

1. An object at rest stays at rest, and an object in motion maintains that motion, unless acted upon by an external force.
2. $\vec{F}_{\text{net}} = m\vec{a}$.
3. When two objects interact, the force one object exerts on the other is equal and opposite to the force the other object exerts on the first object.

These laws hold anywhere in the universe. They allow tell us how motion and forces are related.

Other topics and ideas:

1. Describing motion: motion diagrams, position, velocity, and acceleration graphs
2. Determining forces from motion
3. Free body and net force diagrams
4. Statics: $\vec{F}_{\text{net}} = 0$ and $\tau_{\text{net}} = 0$

Some Math and Physics Skills

1. Unit conversions
2. Paying attention to units in equations
3. Developing a structured approach to problem solving
4. Writing out your thought process as a way to make you think differently and more deeply about what you're doing
5. Checking formulas by looking at limiting cases
6. Checking numerical answers to see if they make sense
7. Making approximations and estimates

What Next?

- Physics II: More hands-on. Focuses exclusively on digital circuits. (Usually Physics II-type classes cover electricity and magnetism.) Lab intensive.
- Physics III: Quantum Mechanics. Focuses on developing a quantitative and qualitative understanding of what makes quantum mechanics a different sort of physical theory. A little bit of atomic physics. No Lab.
- Physics and Mathematics of Sustainable Energy. Basic physics of all sorts of energy generating and using technologies. Analytic skills for evaluating different technologies, investments, etc. Lab.
- Lots of math courses, some of which have a fairly applied focus.

Some Statistics

- Including the two exams, there were 96 problems assigned this term.
- If you took an average of 15 minutes per problem, you did 24 hours of physics homework.
- If you averaged 30 minutes per problem, you did physics homework for two entire days.
- There are 28 students in the class
- The total number of problems done is thus 2,688.
- Assuming it takes me an average of 20 seconds to grade each problem, this corresponds to almost 15 hours of grading.