

A WORLD OF PHYSICS

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Preface

A few decades of experience in teaching science has rather forcefully demonstrated that learning is very much an individual affair, and learning physics, in particular, requires a different way of thinking about everyday experiences than English, or history, or most other subjects. It can be particularly difficult for those who approach the topic with limited motivation. The traditional approach gives a thoroughly sound argument about how things work — that is, a mathematical derivation of an equation is provided — then some effort is made to show that the result is relevant to what is going on in the “outside world”. The present work begins with the “outside world” and looks at how physics can provide answers to questions we may have about that world and how it works.

Students today differ in many respects from those of a century ago. Perhaps the most striking evidence is in numbers. It is scarcely appropriate to compare a high-school student today with a student of the same level in the early 20th century. A century ago, something on the order of 6% of 17-18 year old students graduated from high school. Today, something like 6% of students in the appropriate age range (22 to 26) graduate with Master’s degrees, a fraction that is probably steadily increasing. It seems that everyone is moving up. Subjects that once were reserved for late in college, now are taught in high school. The push continues: sooner and faster, for everyone. Sometimes the advance in level of study is accompanied by advances in the amount of preparation — but sometimes it is not.

Too often, the push for curriculum compression has been accompanied by a watering down of content, leaving the student with a lack of confidence and accomplishment. The premise behind the present textbook has been principally that it helps to see where you are going, by starting with motivation in terms of day to day activities. Then every aid should be given to see that everyone can get there.

Physics has become an integral part of our lives, especially outside the classroom. Like prose, it permeates daily activities. Although for many, this will be a first physics course, for few, if any, will it be the last physics they learn. The student who steps outside the classroom is immersed in a world of physics. The choice is whether one wishes to understand now only what happens but why it happens, offering the possibility of controlling what happens to you or, alternatively, to ignore causes and passively let happen what will. The necessary supporting skills, including mathematics, have improved to the point that doors should be open. All students should be able to follow the arguments presented here as they apply to daily activities encountered, including those we see next week or next year for the first time.

A warning does appear necessary concerning fellow students, both real and hypothetical. Early in Galileo’s career, he became involved in an argument with a Jesuit priest (who attempted to hide his identity by writing under the pen name Sarsi) on the explanation of comets. Galileo was wrong, but he was clever and he was effective in poking fun at his opponent on extraneous details. For example, each writer attempted to give some explanation of the nature of heat, “Sarsi” with a description of cooking eggs.

Galileo wrote:

If Sarsi wants me to believe ... that the Babylonians cooked eggs by whirling them rapidly in slings, I shall do so; but I must say that the cause of this effect is very far from that

which he attributes to it. To discover the truth I shall reason thus: 'If we do not achieve an effect which others formerly achieved, it must be that in our operations we lack something which was the cause of this effect succeeding, and if we lack but one single thing, then this alone can be the cause. Now we do not lack eggs, or slings, or sturdy fellows to whirl them; and still they do not cook, but rather they cool down faster if hot. And since nothing is lacking to us except being Babylonians, then being Babylonians is the cause of the eggs hardening.' And this is what I wished to determine.¹

Each of the characters in our tale represents (in one way or another) a specific individual, real or composite, with different strengths, skills, and backgrounds, but it would be wrong to conclude that any one is a Babylonian, and thus to associate individual characteristics with the role they play.

The electronic format in which this work is published has been chosen to make it available to the largest possible number of those who may be able to take advantage of the material. Feedback to the author will be most welcome. Are there sections that are too obscure, or too pedestrian? Are there missing topics, or out-of-date information? Communication is easier now than it ever has been. Please consider the (small) price of easier access to this material is a responsibility to tell the author, and future authors of similar material, what you want, what works, and what doesn't work.

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¹ *The Controversy on the Comets of 1618* (ed. S. Drake and C.D. O'Malley), Philadelphia, 1960, 301; quoted by Brooke, John, and Cantor, Geoffrey, *Reconstructing Nature*, Oxford, 1998; p. 109.

TABLE OF CONTENTS

		<i>Page</i>
1. The Float	<i>D = R T (P = I V)</i>	1
2. The Model	<i>Scaling</i>	6
3. When You Need A Lift	<i>Simple machines: lever, MA</i>	10
4. Putting the Squeeze On	<i>Pressure and force, damping, hydraulic jack</i>	14
5. The Game	<i>Inertia, motion; weight; relativity; newton</i>	18
6. The Carburetor	<i>Reprise: newton, inertia; Density, floating; Bernoulli's principle; IC engine; carburetor</i>	24
7. Hammers	<i>Inertia vs. weight; motion; lever</i>	29
8. The World Series	<i>Inertia and acceleration; weight; $T = D/R$; third-class lever</i>	35
9. The Parade Route	<i>Inverse square law; vectors as coordinates</i>	39
10. The Walkie-Talkies	<i>Radio vs. sound; frequency bands, wavelengths</i>	45
11. The Teeter-Totter	<i>Balance beams: sum of moments</i>	48
12. The Flag Pole	<i>Tensile strength; vector addition of forces</i>	51
13. Weights and Measures	<i>Vector addition, closed force triangles</i>	55
14. The Sun and Moon	<i>Phases and eclipses</i>	58
15. A Starry Night	<i>Reflector telescope optics; Tropics; plane of ecliptic; appearance of planets</i>	62
16. You Gotta Know the Angles	<i>Vectors and scalars</i>	67
17. Simple Implication	<i>If...then...; symbolic notation; substitution</i>	73
18. Swingers	<i>Proportionality, similar triangles; isochronous pendulums</i>	78
19. Falling Bodies	<i>Kinetic and Potential energy</i>	84
20. Whoa!	<i>Shoe brakes, disk brakes; power brakes</i>	89
21. Light Work	<i>Wiring a lamp circuit; $E = I R$, $P = E I$</i>	93
22. Frictional Reading	<i>Atomic model; definitions; f as accelerating force; $f < \mu w$; static and kinetic coefs.</i>	99
23. Thanksgiving Day	<i>Buoyancy; Pascal and Archimedes</i>	104
24. Unit Factors	<i>Conversion of units; significant figures; application to proportionality problems</i>	111
25. The Bicycle Race	<i>$D = R T$; relative speeds; graphing</i>	121
26. The Ball Turns Round	<i>Spin; friction; gyroscopes, ?</i>	127
27. Back Stage	<i>Force and inertia; acceleration; $f = m a$</i>	131
28. Safe Grounds	<i>Voltage; AC and DC; hot, neutral, and ground; power = $E I = I R$; transformers</i>	136
29. Giving Her a Whirl	<i>Radians, angular velocity, moment</i>	143

	<i>of inertia, angular momentum, K.E.</i>	
30. Branching Out	<i>Series and parallel circuits</i>	149
31. Around the Rainbow	<i>Color addition and subtraction</i>	155
32. Sparks	<i>Static electricity; polarization</i>	159
33. A Close-Up View	<i>Thin lenses: focal length, object and image distance; magnification</i>	166
34. Converging Rays	<i>Principal rays for lenses and mirrors</i>	170
35. Virtual Images	<i>Principal rays; magnification; sign conventions</i>	175
36. Acceleration	<i>Change of velocity; force and acceleration</i>	181
37. Kinematics	<i>Measurement of acceleration; speed and time; distance and time</i>	186
38. Melting Ice and Ice Cream	<i>Colligative properties; ions; entropy and energy in dissolution; change of melting point and boiling point</i>	191
39. The Amusement Park	<i>Free fall: distance and speed; square roots; derivation of kinematic equations</i>	197
40. Round About	<i>Centripetal acceleration</i>	202
41. On and Off the Merry-Go-Round	<i>Inertial and rotating reference frames; centrifugal and Coriolis forces</i>	208
42. Take a Note	<i>Transverse and longitudinal waves; wavelength, frequency, and speed</i>	214
43. The Sounds of Music	<i>Pythagorean scale; chromatic scale; fundamental and overtones; intensity</i>	219
44. Banjos, Organs, and Drums	<i>Standing waves; phase; nodes and antinodes; length and frequency</i>	226
45. The Fireplace	<i>Conduction, convection, radiation; rates of heat transfer</i>	234
46. Solar Heating	<i>Radioactivity; heat</i>	239
47. Temperature Differences	<i>Heat capacity, Dulong and Petit; calorimetry</i>	245
48. Heat Engines	<i>Work; system and surroundings; thermal energy transfer; Carnot's theorem</i>	252
49. Pumping Energy	<i>Proof of maximum efficiency; refrigerators and heat pumps</i>	257
50. Horses Under the Hood	<i>Gasoline and diesel engines</i>	262
51. Turbo's and Tune-Ups	<i>Turbochargers; ignition system; capacitance, inductance, resonant (LC) circuits</i>	268
52. Radio and Television	<i>AM, FM, and TV; rectifiers; resonant circuits</i>	275
53. Atoms and Light	<i>Sizes of atoms; spectroscopic measurements</i>	282

	<i>on electrons; uncertainty principle</i>	
54. Separating Colors	<i>Prisms and gratings; interference and diffraction</i>	289
55. Interference and Diffraction	<i>Reflection; thin films; pinhole and disk; Newton's rings</i>	296
56. The Light Fantastic	<i>Diffraction patterns: edge, single slit, double slit, rectangle; holograms</i>	300
57. Fizzle, Bumps, and Snow Flakes	<i>Nucleation of crystals and gas bubbles</i>	304
58. A Growing Awareness	<i>Doubling times and exponential growth</i>	308
59. Kaboom!	<i>Exponential growth and decay rates</i>	312
60. Soap Box Racers	<i>Relative speeds of hoop and disk, car and sphere</i>	319
61. Torque and Energy	<i>Torque, angular acceleration, rotational energy and speed</i>	322
62. Track and Field	<i>Center of mass in jumping and vaulting, angular momentum, kinetic energy</i>	326
63. Relatively Fast	<i>Principle of relativity; constancy of c; dependence of inertia on energy</i>	330
64. How Long?	<i>Length contraction; time dilation; equivalence principle</i>	335
65. Conservation	<i>Meaning of conservation; conservation laws</i>	341
66. The Fundamental Rules of the Universe	<i>Operational definitions; laws that are valid in all branches of physics</i>	344
Appendix: The International System of Units (SI)		351

“... c’est de la prose? Par ma foi! Il y a plus de quarante ans que je dis de la prose sans que j’en susse rien.”

“...is that prose? ... Good heavens! For more than forty years I have been speaking prose without knowing it.”

Molière, *Le Bourgeois Gentilhomme*