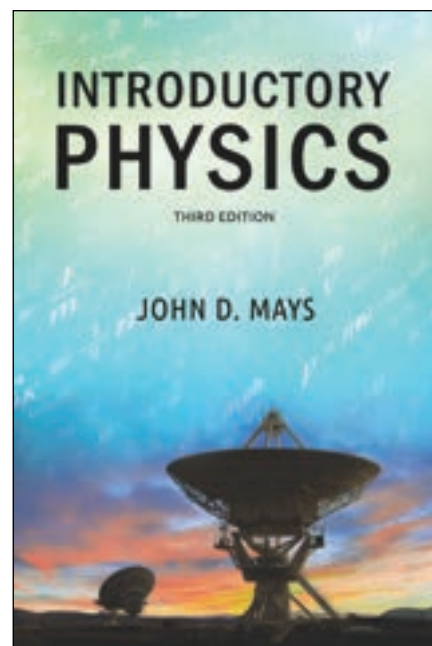


Introductory Physics

All Keys and Sample Answers



Thank you for using *Introductory Physics*. This document contains sample answers to all verbal questions in the text, on quizzes, and on exams. Also included are the solutions to the computations on the quizzes and tests. Solutions to computational exercises in the text are available separately in the solutions manual, available on our website. (Answers to all exercises are found in the book.)

The sample answers in this document are provided to aid in situations in which the adult teacher responsible for conducting the course does not possess a background in this subject, or in which a student is studying independently. The written answers provided here are only samples and should not be considered the only correct responses to the questions.

In environments where there are multiple students in a class or group, it is recommended that students form their own answers to chapter exercises in complete sentences as a homework assignment. These should be graded for completion only, not accuracy. Then in the group setting, students bring their preliminary answers to class where they collaborate with each other and the teacher to improve their answers. The final product is a useful study tool developed by the group. In such a setting, there is little need for the written answers in the present document, but it is provided for the many home study situations in which there is no collaborative group.

Additional information about how this course should be conducted is provided in the textbook introduction and in documents included in the Digital Resources. A full presentation of strategies and techniques for mastery-learning can be found *From Wonder to Mastery*, available from our website.

Thank you!



Would you help make this document better?

Send corrections or suggest online links to videos, activities, or other resources to

info@novarescienceandmath.com

Note: Solutions to computational exercises in the text are available separately in the *Solutions Manual* and in the *Complete Solutions and Answers*, available on our website. (Answers to all exercises are found in the book.)

Note: There is an errata page on our website

<http://www.novarescienceandmath.com/more/errata/>

Contents

Chapter Exercises	4
Chapter 1 Exercises	4
Chapter 2 Exercises	7
Chapter 3 Exercises	10
Chapter 4 Exercises	14
Chapter 5 Exercises	17
Chapter 6 Exercises	19
Chapter 7 Exercises	22
Chapter 8 Exercises	28
Chapter 9 Exercises	30
Chapter 10 Exercises	32
Chapter 11 Exercises	34
Chapter 12 Exercises	36
Chapter 13 Exercises	40
Quizzes	42
Quiz 1	42
Quiz 2	43
Quiz 3	43
Quiz 4	44
Quiz 5	45
Quiz 6	47
Quiz 7	48
Quiz 8	50
Quiz 9	51
Quiz 10	53
Quiz 11	54
Quiz 12	55
Quiz 13	57
Quiz 14	59
Quiz 15	60
Quiz 16	62
Quiz 17	64
Quiz 18	65
Quiz 19	67
Quiz 20	69
Quiz 21	70
Quiz 22	72
Quiz 23	75

Quiz 24	76
Quiz 25	78
Quiz 26	80
Quiz 27	82
Quiz 28	84
Final Exams	87
Fall Semester Final Exam	87
Spring Semester Final Exam	91

Chapter Exercises

Chapter 1 Exercises

Study Questions

1. Distinguish between theories and hypotheses.

A theory is a mental model or explanatory system that attempts to explain the scientific data in a sphere of knowledge. Theories enable us to make new predictions about the natural world. A hypothesis is a prediction based on a theory about what will happen in an experiment. A hypothesis is tested by conducting an experiment that either confirms or disconfirms the theory upon which it is based.

2. Explain why a single experiment can never prove or disprove a theory.

First, theories are models and thus are never proved or disproved at all. Instead they get stronger or weaker based on their ability to explain experimental data.

Because an effective experiment is difficult to perform, the experiment must be replicated by several different experimental teams for any experimental outcome to be regarded as fact. There are many reasons a hypothesis might not be confirmed by a particular experiment, including flaws in the experiment, an incorrect understanding of the theory upon which the hypothesis is based (and thus a faulty hypothesis), or inaccurate or imprecise measurements during the experiment.

3. Explain how an experiment can still provide very valuable data, even if the hypothesis under test is not confirmed.

If an experiment cannot confirm the hypothesis under test, the scientist must first double-check the experiment for flaws and re-examine his or her understanding of the theory to ensure that the hypothesis is a correct statement of what the theory says will happen. But an experiment that is replicated again and again by several different experimental teams with the same results and still cannot confirm the hypothesis under test provides very valuable data, namely a new fact. This new fact is not consistent with the prevailing theory.

The theory may be able to be altered to account for the new fact. But if the theory simply cannot account for the new fact, then the theory has a weakness. If enough of these weaknesses accumulate, then over a long period of time (often decades, or even centuries) the theory might eventually be replaced with a better theory.

4. Explain the difference between truth and facts, and describe the sources of each.

Truth is the way things really are and cannot change. Truth may be known by direct observation, by valid reasoning from true premises or by divine revelation. Revelation may be either Special Revelation (the book of God's Word, the Bible) or General Revelation (the book of God's Works, nature). Truth is true for all time and all people. Scientific facts, on the other hand, are propositions that are supported by a great deal of evidence. They are discovered by observation, experiment, and by making inferences from what we observe or the results of our experiments. Facts are considered to be correct so far as we know. However, facts can change when new information becomes known.

5. State the two primary characteristics of a theory.

A successful scientific theory must account for most or all the known facts, tying them together in a single explanation. Secondly, a successful theory must lead to the formation of new hypotheses that can be tested.

6. Does a theory need to account for all known facts? Why or why not?

No. A useful scientific theory must account for most of the related facts, but no theory ever explains everything perfectly. There are always phenomena that theories do not adequately explain. Still, scientists continue their work in a field hoping eventually to have a theory that explains as many of the facts as possible.

7. It is common to hear people say, “I don’t accept that; it’s just a theory.” What is the error in a comment like this?

In science, theories are all we have. All scientific knowledge is theoretical, or theory-based. There is no scientific statement that can be made apart from the theoretical framework that explains the statement. Theories take a long time to develop and support with experimental facts, and they should not be dismissed simply because they are theories. Theories are the glory of science.

Comment: This discussion about the nature of science and the distinction between the terms truth, fact, and theory, is essential in training our students well and equipping them to live “purposefully and intelligently in the service of God and man,” as one school’s mission statement puts it. The misuse of the term “theory,” by both Christians and non-Christians alike, is one of the primary elements fueling cultural controversies over science in our country. Christian schools have a very important responsibility in this regard: to instruct students on what theories are, how they develop, and the central role they play in all scientific research. For additional resources on responsibly addressing this issue see our book *Teaching Science so that Students Learn Science*.

8. Distinguish between facts and theories.

A theory is a mental model that explains most or all of the facts in a certain sphere of knowledge. A theory becomes stronger by producing successful predictions that are confirmed by experiment. A theory will be gradually weakened if new facts resulting from experiments turn out to be inconsistent with the theory. Facts are propositions supported by a lot of experimental evidence that are correct so far as we know.

9. Distinguish between explanatory variables, response variables, and lurking variables.

The explanatory variable is the variable that is deliberately manipulated by the researchers. As it is manipulated, the researchers monitor the effect this variation has on the response variable. Usually only one explanatory variable is manipulated at a time so that researchers can definitively tell what its effect is on the response variable. A lurking variable is a variable that is affecting the response variable without the researchers being aware of it. Researchers have to study their experimental projects very carefully to minimize the possibility of lurking variables affecting their results.

10. Why do good experiments that seek to test some kind of new treatment or therapy include a control group?

When experimenting on people to try new therapies or medications, researchers divide the patients involved in the study into two groups: the control group and the experimental group. The control group receives no treatment or some kind of standard treatment. The experimental group receives the new treatment being tested. The results of the experimental group are assessed by comparing them to the control group.

11. Explain specifically how the procedure students followed in the Pendulum Experiment satisfies every step of the “scientific method.”

The eight steps of the Scientific Method are below, along with explanations of how the procedure in the Pendulum Lab followed these steps.

1. State the problem. In our class discussion, we suggested possibilities for explanatory variables that could affect the period of a pendulum. We identified the weight, the length of the string, and the starting angle from which the pendulum is released as the three possible explanatory variables.
2. Research the problem. In teams, we discussed the three possible explanatory variables and considered our own experience and knowledge to determine which affect the period of a pendulum.
3. Form a hypothesis. We formed a team hypothesis and documented it in our lab journals.
4. Conduct an experiment. The team tested these three explanatory variables by manipulating one variable while keeping the other two variables constant.
5. Collect data. During the experiment, we recorded all experimental results in our lab journals. We had four tables of data in all, which included the results from 24 separate trials.
6. Analyze the data. After the experiment, we reviewed the data as a team and discussed which potential explanatory

variables affected the period of the pendulum and which did not.

7. Form a conclusion. In our team discussion, we reached a conclusion and afterwards documented it in our lab reports.
8. Repeat the work. During the experiment, we repeated each of the different combinations of variables three times to ensure good, consistent data. We also followed this step by comparing our data with those of other groups.

12. This chapter argues that scientific facts should not be regarded as true. Someone might question this and ask, If they aren't true, then what are they good for? Develop a response to this question?

Scientific facts, though not truth claims, are also important knowledge and are correct so far as we know. They are essential to understanding the natural world around us. Scientific facts allow us to develop theories and make discoveries that enable us to better appreciate, use and steward our planet.

13. Explain what a model is, and why theories are often described as models.

A model is a representation of something else. The model is used to explain how the thing that it represents works. The more accurate the model, the more useful it is. A theory is a model, because it is a representation of how part of the world works.

14. Consider an experiment that does not deliver the result the experimenters expect. In other words, the result is negative because the hypothesis is not confirmed. There are many reasons why this might happen. Consider each of the following elements of the Cycle of Scientific Enterprise. For each one, describe how it might be the driving factor that results in the experiment's failure to confirm the hypothesis.

a. the experiment

The experiment may have been flawed. For example, the equipment might not have been working properly, the calculations may have been incorrect, or the measurement instruments may not have been accurate or precise enough to provide meaningful data.

b. the hypothesis

The hypothesis may have been based on an incorrect understanding of the theory. Maybe the experimenters did not understand the theory well enough, and maybe the hypothesis was not a correct statement of what the theory says will happen.

c. the theory

Finally, there could be a problem with the theory itself. Perhaps the theory can be altered to account for the new fact that the experiment demonstrated, or maybe the theory simply cannot account for the new fact and it has a weakness.

15. Identify the explanatory and response variables in the Pendulum Lab, and identify two realistic possibilities for ways the results may be influenced by lurking variables.

The explanatory variables in the Pendulum Lab were the weight, the length of the string, and the starting angle from which the pendulum is released. The response variable is the period of the pendulum. The results may have been affected by lurking variables such as air friction, moving air in the room, or vibrations/movements at the location where the top of the pendulum was attached.

Chapter 2 Exercises

Ptolemaic Model and Copernican Revolution Study Questions

1. Make a list of all the regions in the Ptolemaic Model in their correct order. (There are 10 of them, and the first nine are called spheres.) For each of the last three regions write a brief description of the meaning of the name.

Sphere 1 – Moon

Sphere 2 – Mercury

Sphere 3 – Venus

Sphere 4 – Sun

Sphere 5 – Mars

Sphere 6 – Jupiter

Sphere 7 – Saturn

Sphere 8 – The Firmament. This region consists of the stars arranged in their constellations according to the zodiac.

Sphere 9 – *The Primum Mobile*. This Latin name means “first mover.” This sphere rotates around the earth every 24 hours and drags all the other spheres with it, making them all move.

Beyond – The Empyrean. This is the region beyond the spheres. The Empyrean is the abode of God, or the gods.

2. Describe why some theologians in the 16th century were strongly opposed to Copernicus’ heliocentric theory.

Many theologians at the time did not understand that Scripture must be interpreted. Thus, they assumed that statements such as “He set the earth on its foundations so that it should never be moved” (Ps 104) and “The sun rises and the sun goes down, and hastens to the place where it rises” (Eccl 1) were literal descriptions of nature. In Copernicus’ model, the earth orbits the sun, not vice versa, and this seemed to these theologians to be in direct contradiction to what Scripture taught.

3. State six features of the Ptolemaic model other than the spheres.

1. All seven of the heavenly bodies are perfectly spherical.
2. All heavenly bodies move in circular orbital regions, called spheres.
3. All the spheres are centered on the earth, so this system is a geocentric system.
4. Corruption and change only exist on earth. All other places in the universe are perfect and unchanging.
5. All the spheres containing the heavenly bodies and all the stars rotate completely around the earth every 24 hours.
6. Epicycles are used to explain retrograde motion.

4. Describe Copernicus’ model of the heavens.

Copernicus proposed a detailed heliocentric model, with the earth rotating on an axis, all the planets moving in circular orbits around the sun, and the moon orbiting the earth. Copernicus’ model used circular orbits, and like the Ptolemaic model, used epicycles to make the model work. Still, Copernicus’ model was much closer to today’s understanding than the Ptolemaic model was.

5. What are some of the “proofs” people used to argue that there was no way that the earth was rotating on an axis?

If you are simply observing from earth, it appears that everything is orbiting around the earth while the earth sits still. The sun and moon appear to rise each day, track across the sky, and set.

It also doesn’t feel at all like the earth is rotating. Eratosthenes had already accurately estimated the circumference of the earth,

so most scientists felt that if something that big were spinning in a circle once a day the people on its surface would be moving very fast. People on earth would have to hang on for dear life to keep from falling off. People used these arguments up until the time of Galileo to prove that there was no way the earth was orbiting the sun and spinning around once a day.

6. For what reason did Copernicus decide to keep his theory private?

Copernicus knew how committed the church theologians were to the Ptolemaic system and did not want to offend them with his ideas. He also did not want to be “hooted off the stage,” as he wrote in *On the Revolutions of the Heavenly Spheres*. So he published his work privately to his close friends in 1514, and it became public at his death in 1543 when one of Copernicus’ admirers got it published.

7. Write a description of the two key observations Tycho made (including dates) that challenged the Ptolemaic system.

First, in 1563 he observed a conjunction between Jupiter and Saturn. A conjunction is when two planets are in a straight line with the earth, so that from earth they appear to be in the same place in the sky. Tycho closely predicted the date for this conjunction using Copernicus’ new heliocentric model. Second, in 1572 he observed what he called a “nova” (what we would now call a supernova) and proved that it was a new star. This discovery was strong evidence that the stars were not perfect and unchanging as Aristotle had thought and as Church doctrine declared.

8. Briefly describe the cosmological model put forward by Tycho.

In Tycho’s model, the sun and moon orbit the earth. All the other planets orbit the sun, which orbits the earth. Tycho was able to avoid controversy since in his model the sun and moon orbit the earth and the earth is stationary, which lines up with a literal reading of the Bible.

9. State Kepler’s first law of planetary motion.

Each of the planetary orbits is an ellipse, with the sun at one focus.

10. This is a bit difficult, but explain retrograde motion and epicycles as well as you can in a few sentences.

The planets all appear to move against the starry background night after night. Retrograde motion is the appearance to observers on earth of a planet “backing up” in its motion relative to the stars. An epicycle is a circular path around a center point, and the center point itself travels on a circular path around something else. The motion of a planet moving on an epicycle is like that of a person in the “tea cup” ride at an amusement park.

11. Explain the two main mistakes individuals made that led to Galileo’s trial.

The theologians made the mistake of assuming that Scripture could be read literally without interpretation. Galileo made the mistake of insisting that his mathematical models were true and that nature needed no interpretation.

12. Explain the actual cause of Galileo’s trial and the results of that trial.

Galileo was tried for violating an injunction not to teach, hold, or defend Copernicus’ system as true. Galileo realized that he had violated this order, and he repented. He lived the final nine years of his life under house arrest as a result of the trial.

13. Describe why Pope John Paul II commended Galileo in 1992.

Galileo was commended for his recognition that the Scriptures do, in fact, require interpretation.

14. Distinguish between Newton’s and Einstein’s theories of gravitation. According to these two geniuses, what is the cause of gravity and what are the effects of gravity?

Newton theorized that every object in the universe pulls on every other object in the universe. In Newton’s model, the gravitational attraction depends on each object having mass, because the force of gravity has both masses in it multiplied together. The effect is that everything in the universe pulls on everything else.

Einstein’s theory explains gravity in terms of the curvature of space around a massive object (that is, an object with mass), such as the sun or a planet. Since Einstein’s theory is about curving space, even phenomena without mass, such as rays of light, are affected by it. In Einstein’s theory, gravity is caused by curvature in space-time, and its effect is that starlight bends as it travels through space when it passes near a massive object such as the sun.

15. The theories reviewed in this chapter suggest that the universe possesses a very deep mathematical structure. What does this structure indicate about where the universe came from?

The fact that the universe, a very complex structure, can be explained using the mathematical principles which humans have developed indicates an intelligence behind things. There must be an outside source that both made the natural world understandable, and gave humans the ability to develop tools that can explain the natural world.

Comment: The fact that mathematics is capable of describing nature so accurately has made many nonbelievers admit to some kind of intelligence behind things. Without some intelligence behind things, you would not expect to find order as we do, only chaos.

16. Describe some of Kepler's scientific achievements, aside from his laws of planetary motion.

In addition to his astronomical discoveries, he made important discoveries in geometry and optics. He figured out some of the major principles of gravity later synthesized by Isaac Newton, and he was the first to hypothesize that the sun exerted a force on the earth.

Course Lesson Schedule Introductory Physics Fall Semester

Lesson Number	Topic	Text Key	Assignment	Notes
1	Welcome; study strategy		Read Study Strategy	
2	Modeling Knowledge	1.1	Read Ch 1	
3	Modeling Knowledge	1.1	Read Ch 1	
4	Cycle of Scientific Enterprise	1.2	Read Ch 1	
5	Cycle of Scientific Enterprise	1.2	Read Ch 1	
6	Quiz 1		Read Pendulum Experiment, App. C	
7	Cycle of Scientific Enterprise	1.2	Ch 1 Exercises	
8	Pendulum Experiment	Ch 1	Read Student Lab Report Handbook (SLRH) Preface to Students and Chapters 1-6 Lab Report	Report due in approx two weeks
9	Scientific Method and Controlling variables in experiments	1.3	Ch 1 Exercises	
10	Quiz 2			Lab report expectations;
11	Measurements, MKS system	2.1.1-2.1.2	Read Ch 2	
12	Unit Conversions	2.1.3	Unit Conversion Exercises	Issue WRG #1
13	Unit Conversions, Accuracy and Precision	2.1.3-2.1.4	Read Ch 2	
14	Quiz 3			
15	Significant digits	2.1.5-2.1.6	Read Unit Conversions Tutorial	
16	Classwork on problems	Ch 2	Unit Conversions Exercises	Issue WRG #2
17	Review and drill			
18	Quiz 4			
19	Motion: velocity and acceleration	2.2.1-2.2.2	Motion Exercises	
20	Motion: velocity and acceleration	2.2.1-2.2.2	Motion Exercises	Issue WRG #3
21	Ptolemaic Model	2.3.1-2.3.6		
22	Quiz 5			
23	Ptolemaic Model	2.3.1-2.3.6		Issue WRG #4
24	Copernican Revolution	2.3.7-2.3.10		
25	Mass, inertia, mass; Newton's Laws of Motion	3.1-3.2.1		Issue WRG #5
26	Computations with Newton's Second Law; Weight	3.2.2-3.2.3	Newton's Second Law Practice Problems	
27	Quiz 6			
28	Weight	3.2.4	Newton's Second Law Practice Problems	
29	Classwork		Newton's Second Law Practice Problems	Issue WRG #6
30	Applications and examples of Newton's laws; How rockets work	3.2.5-3.2.6	Newton's Laws of Motion Study Questions Read Soul of Motion Experiment	
31	Quiz 7			
32	Soul of Motion Experiment		Read SLRH Chapters 6-8; Lab Report	Report due in approx two weeks.
33	Applications and examples of Newton's Laws		Newton's Laws of Motion Study Questions	Issue WRG #7
34	Drill Day 1			
35	Quiz 8	SLRH ch 7		
36	Review answers to NLM Study Questions			
37	The Energy Trail	4.1-4.2.5	Energy Study Questions	Issue WRG #8
38	Calculations with Energy	4.3.1	Energy Calculations Set 1	
39	Quiz 9			
40	Work; Class work on Energy Calculations Sets 2 and 3	4.3.2	Energy Calculations Sets 2 and 3	
41	Class work on Energy Calculations Sets 2 and 3			Issue WRG #9
42	Drill Day 2		Read Hot Wheels Experiment	
43	Quiz 10			
44	Hot Wheels Experiment		Lab Report	
45	Momentum, Law of Conservation of Momentum	5.1-5.2.2		Issue WRG #10
46	Class work Basic Momentum Computations		Basic Momentum Computations	
47	Quiz 11 After: Directionality of momentum; conservation of momentum in elastic collisions: examples of 3 cases	5.2.3-5.2.4		
48	Problem solving with conservation of momentum.	5.2.5	Conservation of Momentum Computations	
49	Class work on Conservation of Momentum Exercises			Issue WRG #11
50	Class work on Conservation of Momentum Exercises		Momentum Study Questions	

51	Quiz 12			
52	Review answers to Momentum Study Questions			
53	Drill and Review			

Course Lesson Schedule Introductory Physics Spring Semester

Lesson Number	Topic	Text Key	Assignment	Notes
1	Conservation of momentum demo with air track. Goal is to get error below 10%.			
2	Begin history of atomic models	6.1-6.2.3		
3	Complete history of atomic models	6.2.3-6.2.4	Atomic model study questions.	
4	Volume units and unit conversions; density	6.3.1-6.3.2	Volume, Mass and Weight Exercises	
5	Quiz 13		Density Exercises	
6	Class work on volume conversion and weight exercises; density exercises			
7	Class work on density exercises		Read Density Experiment	Issue WRG #12
8	Quiz 14		Read 6.4 and make substances family tree (Fig 6.28).	
9	Density Experiment		Lab Report	
10	Discussion of substances and family tree	6.4		Issue WRG #13
11	Continue discussion of substances and family tree	6.4		
12	Quiz 15			
13	Phases of Matter, evaporation, sublimation	6.5	Substances and Phases of Matter Study Questions	
14	Temperature scales, conversions Internal energy, thermal energy, heat	7.1-7.2	Temperature Conversions	Issue WRG #14
15	Quiz 16			
16	Heat transfer processes	7.3		
17	Kinetic theory, heat capacity, thermal conductivity	7.4-7.5.2	Heat Transfer and Kinetic Theory Study Questions	Issue WRG #15
18	Drill Day 3			
19	Quiz 17			
20	Class work on kinetic theory and heat transfer exercises			
21	Distinguishing between heat capacity and thermal conductivity	7.5.3	Specific Heat Capacity and Thermal Conductivity exercises	Issue WRG #16
22	Class work on Specific Heat Capacity and Thermal Conductivity exercises			
23	Quiz 18			
24	Class discussion of answers to Specific Heat Capacity and Thermal Conductivity exercises			
25	Quiz 19			
26	Modeling waves	9.1		Note: Chapter 8 is optional, and normally is not included in a 1-year course for 9 th graders. For older students, or for students with a longer schedule than a standard school year, this chapter may be included. Note also that even with additional class days, the math in Chapter 8 may be very challenging for students in Algebra 1.
27	Examples of wave computations	9.1	Wave Computations	Issue WRG #17
28	Class work on wave computations			
29	Quiz 20			
30	Five Wave Interactions	9.2	Wave Study Questions	
31	Five Wave Interactions	9.2		
32	Drill Day 4			
33	Sound and light; E/M spectrum, range of human hearing and eyesight	9.3-9.4		
34	History of Electricity	10.1.1-10.1.2		
35	Voltaic Pile Day			
36	History of Electricity	10.1.3	Historical Questions	
37	Quiz 21			
38	Static electricity and electric current	10.2-10.3	Static Electricity and Electric Current Study Questions	
39	Van de Graaff generator day			Issue WRG #18
40	Water Analogy	11.1		
41	Quiz 22			
42	Quiz 23			
43	DC Circuits, Ohm's Law, What are Resistors?	11.2.1-11.1.5		
44	Computations with Ohm's Law and Power	11.2.5-11.2.9	Introductory Circuit Calculations	Issue WRG #19
45	Metric prefix tips; Class work on Basic Circuit Exercises	11.2.10		
46	Quiz 24			
47	Series and Parallel circuits; Calculating Equivalent resistance.	11.3.1-11.3.4	Equivalent Resistance Exercises	

48	Kirchhoff's Laws; Solving multi-resistor circuits.	11.3.5-11.3.6	Equivalent Resistance Computations	Issue WRG #20
49	Guided practice on DC Circuit problems	11.3.6		
50	Quiz 25			
51	Class work on DC Circuit Exercises		Multi-Resistor Circuit Calculations Set 1-5	
52	Class work on DC Circuit Exercises			Issue WRG #21
53	Class work on DC Circuit Exercises		Read DC Circuits Experiment	
54	Quiz 26		After quiz: Discuss DC Circuits Experiment	
55	Class work on DC Circuit Exercises			
56	DC Circuits Experiment		Lab Report	Issue WRG #22
57	Fields	12.1	Fields Study Questions	
58	Quiz 27			
59	Ampere's law, Faraday's law	12.2		
60	Solenoids, motors, generators, transformers	12.3	Magnetism Study Questions	Issue WRG #23
61	Review answers to study questions			
62	Quiz 28 (optional)			
63	Review and drill			
64				

Introductory Physics

Weekly Review Guide No. 13

Your assignments this week include the following review tasks:

1. Review last week's quiz and figure out what you lost points for. If you are not clear on how to improve your responses, visit with your instructor about it during the week. Do this before the next quiz.
2. Next, take out all of your review materials (flash cards, etc.) and divide them into two groups. The first group is the information that you know you know very thoroughly and you always get those questions or problems right. The other group is the material you still mess up on. This week, hit hard on the second group. Get down definitions, laws, equations and other items that you are shaky on.
3. Compare your scientist flash cards to the list in Appendix D and update your flashcards. Make sure all the scientists covered so far are represented in your flashcards. Then practice each scientist until your memory is thoroughly refreshed.
4. Go back to the exercises at the end of the Momentum chapter, Chapter 4. Rework problems 2 and 6.
5. Rehearse the conversion factors, constants and prefixes once.
6. Read over the new Objectives List and make sure you can do all the things on it that we have covered so far. Raise a question in class if you are ever in doubt about anything.

New review problems. If you have been keeping up you should be able to work these four problems perfectly on the first try. If you don't get the right answer on the first try, then find two more similar problems and work them for additional practice. Be sure to come to tutorials to get help any time you need it.

1. A crane is used to hoist a steel girder up to the top of a sky-scraper under construction. The girder weighs 2,755 lb. The crane lifts it to the top of the 48th floor, and each floor of the building is 12.0 ft high. How much work was done to lift the girder that far? State your answer in MJ.
2. A beam of photons hits a transparent plastic sheet and travels through to the other side. The plastic sheet is 0.015 in thick. If the speed of light in the plastic is 65.79% of the speed in a vacuum, how long does it take the beam to pass through the plastic? State your answer in ns.
3. A roller coaster car has a mass of 2,895 kg when loaded with people. The car is just arriving at the top of the first hill and is essentially at rest, ready to roll down the hill. The hill is 12.5 m high and the track takes the roller coaster to the very bottom of the hill. Use conservation of energy principles to determine how fast the roller coaster will be moving when it reaches the bottom of the hill.
4. A kid shoots a large marble at a small marble. The small marble is at rest, waiting to be hit by the shooter. The mass of the large marble is 50.00 g and the mass of the small marble is 5.000 g. The kid shoots the marble with a velocity of 4.75 m/s. After the large marble collides with the small one, the velocity of the large marble is 3.89 m/s. What is the velocity of the small marble after this collision occurs?

Answers to computations

1. 2.15 MJ
2. 0.0019 ns
3. 15.7 m/s
4. 8.60 m/s

Introductory Physics

Weekly Review Guide No. 18

Your assignments this week include the following review tasks:

1. Review last week's quiz and figure out what you lost points for. If you are not clear on how to improve your responses, visit with your instructor about it during the week. Do this before the next quiz.
2. Practice four density calculations and four conservation of energy calculations.
3. Review the energy trail (types of energy and conversions).
4. Practice describing the five wave behaviors.
5. Practice describing the three heat transfer processes.
6. Go through all your scientist cards once or twice.
7. Review the types of variables, control groups in experiments, and the scientific method, all from Chapter 1.
8. Read over the new Objectives List and make sure you can do all the things on it that we have covered so far. Raise a question in class if you are ever in doubt about anything.

New review problems. If you have been keeping up you should be able to work these four problems perfectly on the first try. If you don't get the right answer on the first try, then find two more similar problems and work them for additional practice. Be sure to come to tutorials to get help any time you need it.

1. A rectangular metal plate is 3.00 in wide by 8.75 in long by 0.500 in thick. The plate weighs 1.875 lb. Determine the density of the metal plate, and state your answer in g/cm^3 .
2. An electron in an electric field is experiencing a force of $10.55 \mu\text{N}$. Determine how much work it would take to move the electron 356 nm against this force. State your answer in nJ.
3. Neutrons have a mass of 1.675×10^{-24} g. Determine the weight of a neutron.
4. Determine the kinetic energy a neutron has if it is moving at 3.01% of the speed of light.

Answers

1. 3.96 g/cm^3
2. 0.00376 nJ
3. $1.64 \times 10^{-26} \text{ N}$
4. $6.83 \times 10^{-14} \text{ J}$

Introductory Physics

Weekly Review Guide No. 23

This Review Guide outlines how to begin preparing for the final exam. First, details about the exam.

1. The spring semester exam will cover all of the material itemized on the 14 chapter Objectives Lists and the Scientists List from Appendix D.
2. All questions and computations on the spring semester exam will be of comparable style and complexity to those that have appeared on the quizzes during the year. In other words, the exam will be just like your quizzes, just longer.
3. The semester exam period is two hours. This is four times longer than the weekly quizzes. The length of the semester exam is about three times that of the weekly quizzes.
4. The spring semester exam will consist of 25 questions of equal value. Approximately 60% of the questions will entail computations, and approximately 40% will require written/verbal responses. As with the quizzes, proper grammar and spelling will be required.

With only a couple of weeks left before the final exam, you should now revise your review strategy. You now have over 25 quizzes that you can use for review and practice. You also have the review computations on some 20 Review Guides. Reviewing your old quizzes is now the best and most efficient way to prepare. So for the next couple of weeks, spend your review time focusing on reworking computations and rewriting verbal answers on the quizzes.

Recommended study plan:

1. Review all of the old quizzes to make sure you know how to solve every problem and answer every question correctly. Do this early so that you have time to seek clarification during tutoring if you need it. The old quizzes are your primary source of review material. The emphasis on the spring semester exam will be on the spring semester, but material from the fall is covered as well.
2. Review all 14 Objectives Lists to make sure you aren't missing anything in your flash cards. For your convenience, they are all listed together in Appendix B.
3. Go through your technical flash cards several times. Practice stating the laws, the equations, and distinguishing terms from one another.
4. Go through the scientist flash cards a couple of times.
5. Review the conversion factors, constants and prefixes a couple of times.

1. State from memory or calculate the temperature of boiling water in degrees Fahrenheit, degrees Celsius, and kelvins. (5)
2. The density of brass is $8,430 \text{ kg/m}^3$. Determine the mass of a rectangular sample of brass with dimensions $1.00 \text{ in} \times 1.00 \text{ in} \times 1.25 \text{ in}$. (15)
3. Determine the weight, in pounds, of the brass block in the previous problem. (15)
4. Assuming that the speed of sound in air on a hot day is about 351 m/s , how far does the sound from an air raid siren travel in 3.055 ms ? (15)

5. Describe Millikan's experiment and the discoveries that resulted from it. (10)

6. Describe the three processes of heat transfer. (20)

7. Distinguish between refraction, reflection and diffraction. (20)

Useful Information

$$1,609 \text{ m} = 1 \text{ mi}$$

$$0.3048 \text{ m} = 1 \text{ ft (exact)}$$

$$4.45 \text{ N} = 1 \text{ lb}$$

$$T_C = \frac{5}{9}(T_F - 32)$$

$$T_F = \frac{9}{5}T_C + 32$$

$$T_K = T_C + 273.2$$

$$T_C = T_K - 273.2$$

1. The speed of sound in helium is 965 m/s. Determine the wavelength of a 3.5 kHz wave propagating in helium. (20)

2. An alpha particle has a mass of 6.696×10^{-27} kg.
 - a. Determine the acceleration of an alpha particle that accelerates from rest to 1.0000×10^5 m/s in 25.00 s. (10)
 - b. Determine the force required cause this acceleration. (10)
 - c. Determine the work required to apply this same force over a distance of 1.00 mm. (10)
 - d. Determine the kinetic energy the alpha particle has once it reaches the velocity indicated in part (a). (10)

3. Use the water analogy to explain what voltage is and what role it plays in a DC circuit. (15)

4. State the Law of conservation of energy. (10)

5. Distinguish between refraction and diffraction. (10)

6. Tell us about Maxwell. (5)

$$0.3048 \text{ m} = 1 \text{ ft} \quad 1,609 \text{ m} = 1 \text{ mi} \quad 4.45 \text{ N} = 1 \text{ lb}$$

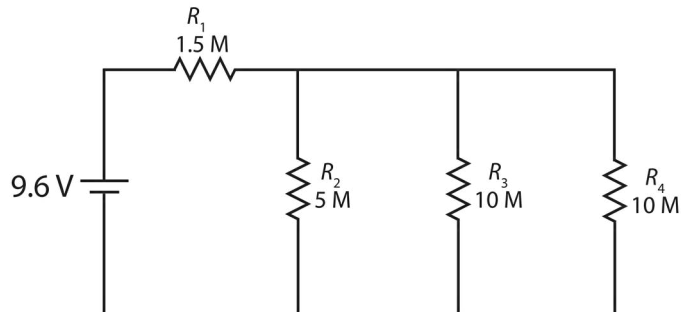
$$v = \lambda f \quad \tau = 1/f$$

Introductory Physics Quiz 28

Responses must be in complete sentences with correct spelling and grammar. For full credit, you must fully show all work and your paper must be neatly and carefully prepared. Point values are shown in parentheses.

1. The highest note on a piano is 4,186 Hz. Assuming the speed of sound in air to be 342 m/s, determine the wavelength and period of this frequency. State the wavelength in millimeters and the period in microseconds. (15)

2. Solve for the voltage, current and power associated with resistor R_3 . As always, use four decimal places for all calculations. (15)



3. Determine the kinetic energy of a baseball thrown at 100.0 mph. The mass of a baseball is 144.3 g. (15)

$$v = \lambda f \quad \tau = 1/f$$

4. State Ampere's law. (15)

5. State Faraday's law of magnetic induction. (15)

6. What is a field? (15)

$$v = \lambda f \quad \tau = 1/f$$

7. Fill in the chart below for the three types of fields we studied. (10)

	Gravitational	Electric	Magnetic
What can cause this type of field?			
What kinds of things will be affected by this kind of field?			

$$v = \lambda f \quad \tau = 1/f$$