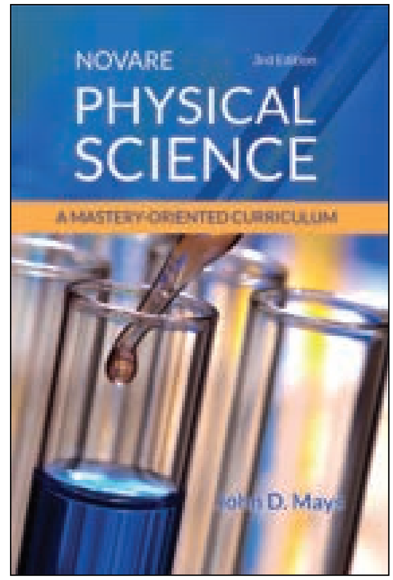
Novare Physical Science

Keys and Sample Answers to Verbal Questions



Thank you for using *Novare Physical Science*. 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.

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 on the Resource CD. A full presentation of strategies and techniques for mastery learning can be found in *From Wonder to Mastery*, available from our website.

Thank you!

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Contents

Chapter Exercises

Chapter 1

Learning Check 1.1

1.1.1 Describe the three basic things the universe is composed of.
The universe is composed of matter, energy and intelligence. Matter is all substances composed of atoms, energy is what holds everything together and what allows all processes to happen, and intelligence is the order that governs the laws of physics and chemistry.

1.1.2 Give an example of how intelligence is evident in nature.
In the laws of physics, simple equations can accurately describe behaviors of nature, for example, the regular movement of the planets. In the laws of chemistry, simple equations describe chemical reactions. A third example is in the DNA of living things that governs the way they grow.

`The fact that mathematics is capable of describing nature so accurately has made many non-believers admit to some kind of intelligence behind things. Without some intelligence behind things, we would not expect to find order as we do, only chaos. Also, a favorite question among philosophers has been, Why is there something rather than nothing?`

1.1.3 In the list below some things are clearly the result of human intelligence and some are the result of the intelligence embedded in the laws of nature by God. Explain which is the case for each item.
An artist's painting: The human intelligence of the artist is making the painting, but of course the intelligence of God is what allows the paint to act as paint, and God's intelligence is the source of the artists's intelligence.

The arrangement of pieces of confetti on the floor at a party: The laws of physics determined where the pieces of paper would land. Those laws are from God.

The shape of a wadded up piece of paper: The paper was wrinkled according to the laws of physics. There was no human intelligence involved in the shape of that paper. Therefore it was God's intelligence that was behind the shape of the paper because it was governed by the laws of physics.

The design of the pages in a book: This is accomplished by human intelligence but again all human intelligence derives from God. No person lives independently of God.

The arrangement of all the leaves in a tree: This is clearly the result of God's intelligence embedded in nature and the laws of nature.

`Note: For additional fascinating study, search the internet for "Fibonacci Numbers" and "The Golden Mean." See how many things in nature follow basic mathematical formulas and patterns.`

The sound of a cello string when it is plucked: Humans formed the cello and the cello string, and humans chose the materials that the cello string would be made from. The materials have their properties because God made the world with those properties in those materials. God is the ultimate source of that sound but humans, using intelligence God gave them, chose materials as artists and craftsmen that would have the pleasing sound they wished the cello to have.

The arrangement of the keys on the computer keyboard: Clearly human intelligence arranged the keys on the computer keyboard, but language comes from God. Humans use language because God, a language user, has gifted us with language so that we can have fellowship with him. So the order in language ultimately comes from God, even though it is human language and humans arrange the computer keys.

Learning Check 1.2

1.2.1 Explain why scientists can claim that atoms exist, even though atoms cannot be seen.
Scientists have inferred the existence of atoms through many experiments. Atoms cannot be seen so their existence must be inferred.

1.2.2 Describe the locations of the three types of subatomic particles found in atoms.
Two of the subatomic particles are found in the nucleus. These are the proton and the neutron. The third subatomic particle is the electron which is found in a layered cloud around the nucleus.

1.2.3 Describe which subatomic particles have charge and which do not. For those that do, identify which kind.
Protons and electrons have charge. The charge on protons is positive. The charge on electrons is negative. Neutrons have no charge.

Note: Benjamin Franklin was the first to identify the two types of charge with the terms positive and negative. Benjamin Franklin conducted many experiments with electricity. His research is an interesting topic for further study.

1.2.4 Compare the weights of the three subatomic particles.
The proton and the neutron weigh about the same, although the neutron weighs slightly more. The electron weighs about 2000 times less than protons and neutrons.

1.2.5 Explain what ions are and how they form.
Ions are atoms that have a net charge. Ions form when atoms gain or lose electrons. It is easy for most atoms to gain or lose one or more electrons, so most atoms form ions pretty easily. (The exception is the Noble Gases in column 18 of the periodic table).

Note: Remember, by “net” we mean an imbalance of charge that makes the overall atom either positive or negative. When you add up the charges of all charged particles, you may have zero charge (if there is an equal number of positives and negatives), or a greater number of either positive or negative, which makes the atom an ion.

Learning Check 1.3

1.3.1 State at least five facts about electrons.

1. Electrons are strange.
2. Electrons act like waves and they also act like particles.
3. There is no way to know precisely where an electron is and where it is going at the same time.
4. Every electron in an atom has a specific amount of energy.
5. Electrons are arranged in atoms in orbitals or shells.
6. Electrons with the same amount of energy are placed in the same orbital inside an atom.

Notes:

#3 This is the conclusion of the famous Heisenberg Uncertainty Principle, named after Werner Heisenberg. When Einstein first heard this he refused to believe it, saying “God doesn’t play dice.” But after seeing the evidence, he accepted it.

#6 Each electron in the first shell has the same amount of energy. Those in the second shell have the same amount, as do those in the third, and so on, with increasing energy the higher you go.

1.3.2. Describe the shapes of the first five electron orbitals in atoms.
The first two are spheres, one nested inside the other. The next three are in pairs shaped like dumbbells or hamburger buns, with the three pairs oriented in different directions.

Learning Check 1.4

1.4.1 Describe the atomic models proposed by Dalton, Thompson, Rutherford, and Bohr.

- Dalton proposed that the atom was an indivisible particle that all things were made of. He proposed that all atoms of the same element were identical and that different types of atoms combined together to form compounds.
- J.J. Thompson discovered the electron. His atomic model (the "plum pudding model) envisioned atoms like watermelons with a region of positive charge, and in this region of positive charge the negative electrons were embedded like seeds in a watermelon.
- In Rutherford's atomic model, atoms were envisioned to be mostly empty space. In the center of the empty space was the tiny atomic nucleus which held all the positive charge. The electrons were outside the nucleus in a large cloud surrounding the nucleus.
- In Bohr's atomic model, the electrons orbit the nucleus like planets going around the sun. The electrons are in orbits according to how much energy they have, with lower energies in orbits close to the nucleus and higher energy electrons in orbits farther away from the nucleus.

1.4.2 Describe the additional features included in the quantum model.
In the quantum model, electrons are in orbitals rather than orbits. The quantum model describes the shapes of these orbitals and they have different shapes depending on how much energy the electrons have in their orbitals.

1.4.3 Why did one scientist use the silly language of Jabberwocky to describe electrons?
This was because describing electrons as particles is misleading. Electrons have particle properties and wave properties, so that scientist proposed that it would be better to describe the electrons using nonsense language so that we don't develop wrong ideas about what electrons are like. The scientist proposed that we call electrons slithy toves and that when we say what they do we can just say that they "gyre and gimble in the wabe."

Note: This would be a great time to reread the poem by Lewis Carroll.

Everything we know about atoms indicates that the atomic world is a very strange world. Not only do the electrons have particle properties and wave properties, but protons and neutrons do as well. The more we learn about the way atoms are the harder it is for us to describe them. Quantum physics or atomic physics is a difficult subject, so describing atoms in more detail at this level is hard to do. However we want students to understand that our models of atoms are simply that—models. But we want students to have an accurate, if simplified, understanding of what our models say. So we should not imply that atoms are like the solar system or that protons, electrons, and neutrons are simply particles. We should always remind students that our models of atoms are only pictures, pictures we use to try to describe very complicated things.

Chapter 1 Exercises

1. Describe J.J. Thompson's contributions to the development of the atomic model.
Thompson discovered the electron. His atomic model was the first atomic model that showed that atoms had smaller parts inside them and we're not indivisible as John Dalton had thought. His model was called the plum pudding model because it he envisioned atoms to be like a pudding with lumps inside. The pudding was positively charged material and the lumps where the electrons.

2. When scientists say that atoms are mostly empty space, what do they mean?
If an atom were as large as a stadium, the nucleus in the center would be the size of the head of a pin. With the nucleus as tiny as a pin and the stadium containing nothing except a few electrons that are tinier than the protons in the nucleus, the rest of the atom contains nothing.

3. Describe the particles found in the nucleus of atoms.
The nucleus contains protons and neutrons. Protons have a positive charge and neutrons have no charge. Protons and neutrons are approximately the same size, but neutrons weigh slightly more.

4. What determines where the electrons are in an atom?
The amount of energy an electron has determines where it is. Electrons are in orbitals in atoms. Different orbitals hold electrons with different amounts of energy.

5. Why was John Dalton's atomic model so important?
John Dalton published his atomic model in 1803. It was the first fully scientific atomic model. Dalton's model had several main points. He proposed that atoms are indivisible, that they combine together in ratios to form compounds, and that all atoms of a given element were alike. After Dalton published his model, other scientists began exploring in more depth what atoms were like.

6. Describe the three basic ingredients the universe is made of.
The universe is composed of matter, energy and intelligence. Matter is all substances composed of atoms, energy is what holds everything together and what allows all processes to happen, and intelligence is the order that governs the laws of physics and chemistry.

7. What are some of the properties of electrons?
Electrons have properties of waves and also have properties of particles. Electrons have certain amounts of energy and the energy they possess determines where they are inside atoms. Electrons are very strange and mysterious to us, and it is a mistake to speak of them strictly as if they were particles.

8. What are some examples from nature that indicate that an intelligent creator made the world?
An important example is the existence of the laws of nature: the laws of physics and chemistry. A second example is in the intelligence displayed in nature by the intelligence of people. Third, the order and structure of the laws of physics and chemistry lend themselves to mathematical modeling. A fourth example is seen in the beautiful and orderly way that living things operate in nature so that each thing follows the laws that govern the way it lives and grows, such as the organ systems in our bodies, or trees growing the way trees always grow.

9. Describe the atomic model proposed by Ernest Rutherford.
Rutherford proposed that atoms contain a tiny nucleus surrounded by a much larger cloud where the electrons existed. In the nucleus was all of the atom's positive charge and most of the atom's weight. The electrons, which carried the atom's negative charge, were in the cloud outside the nucleus. The nucleus is extremely tiny compared to the size of the atom, and most of the atom is empty space.

10. What are orbitals?
Orbitals are the regions where the electrons are inside atoms. Different orbitals correspond to different amounts of energy, and electrons with different amounts of energy are arranged in different orbitals. The first two orbitals in any atom are spherically shaped. The next three sets of orbitals after that are shaped sort of like hamburger buns. There are other orbitals with higher energies outside of these low-energy orbitals.

Resources
The American Chemical Society has some nice multimedia pages that provide additional illustrations to concepts in this chapter. Go to http://www.middleschoolchemistry.com

- Proton, Neutrons and Electrons:

http://www.middleschoolchemistry.com/multimedia/chapter4/lesson1

- NOVA ScienceNOW, Amazing Atoms: http://youtu.be/xqNSQ3OQMGI

Chapter 2

Learning Check 2.1

2.1.1 Make a list of several tasks that require energy to perform. Include tasks that would be accomplished by machines, by animals, and by humans.
Students may list any task that answers this question. Tasks accomplished by machines might include digging holes, lifting equipment, vehicles that transport goods from one place to another, or any other task accomplished by a machine. Tasks accomplished by animals might include digging holes, burying nuts, building nests, flying, or chasing prey. Tasks accomplished by humans could include lifting, running, cutting wood, or carrying baggage. The point of this question is that all tasks require energy to perform and such tasks are accomplished by every living thing.

2.1.2 Identify three processes that occur in nature—but not involving animals or humans—in which energy is involved.
Again students might answer this question any number of ways. The only requirement is that the answer does not include references to animals or humans. Thus, answers should involve plants or inanimate objects. Students can cite examples such as the movement of the waves and oceans, the flow of water in rivers, the motion of planets, the growth of plants, the movement of trees in the wind, the growth of trees, the rotation of the earth, the tides caused by the moon, or any other process in nature in which movement or growth is involved.

Learning Check 2.2

2.2.1 List the four (or five) major locations where we find the universe's energy.

1. Energy in the light and heat from all the stars. This light is called electromagnetic radiation.
2. Energy in the cosmic microwave background. This is also electromagnetic radiation but it is the energy left over from the original creation event, an event known as the Big Bang.
3. The kinetic energy of all the moving galaxies. The galaxies and stars are moving away from one another and they are rotating. All this motion represents kinetic energy.
4. The gravity that pulls all the stars and galaxies and objects in the galaxies together. Just like the energy in a bent bowstring when it is pulled back ready to shoot an arrow, there is energy in objects that are held apart in a gravitational field.
5. A possible fifth location for energy is in 'dark energy,' that scientists suspect might be filling the universe. There is not very much evidence yet to be sure that dark energy actually exists.

Note: To help understand how gravity contains energy, students should consider the energy it takes to lift an object here on planet earth. If a heavy object such as the piano is lifted high above the ground, there is a lot of energy in that piano. This is called potential energy and we discuss it in the next section of the text. If this piano is released, it falls toward the earth and its energy is converted into kinetic energy. We study that in the next section as well. The point of discussing gravitational energy here is simply to recognize that since the universe is a large place with many large objects, there is a lot of energy in the gravitational attractions that exist between all these objects.

2.2.2 How does the energy from the sun get to us here on earth?
Energy from the sun travels through space in the form of electromagnetic radiation. Electromagnetic radiation consists of waves of energy. We can sense this energy as visible light and heat that we can feel.

Note: We study electromagnetism later in more detail but students should already be getting used to the fact that electromagnetic radiation is a form of energy with both wave-like and particle-like characteristics. When we think of electromagnetic radiation as particles, the name we use for these particles is photons.

2.2.3 What process in the sun is producing the sun's energy? Describe this process.
The process is called fusion. The gravity in the sun pulls together the hydrogen atoms of which the sun is made. The hydrogen atoms collide with such force that they fuse together and release energy in the form of light and heat.

Learning Check 2.3a

2.3a.1 Explain the purpose of a photovoltaic cell.
The purpose of a photovoltaic cell is to convert sunlight directly into electricity.

Note: Here is a nice video showing how photovoltaic cells work:

https://vimeo.com/14581443

2.3a.2 Why is light said to have a dual nature?
Light has properties of waves and particles.

Note: Scientists use terms such as *wave packet*, *photons*, or *quanta* to describe light.

2.3a.3 What does it mean to say that energy and light are quantized?
Energy and light come in small lumps called quanta. Like water, light comes in small packets. The smallest piece of water is a single molecule of H_2O. The smallest piece of energy or light is one quantum of energy.

Note: Albert Einstein first proposed this in 1905. The term *quanta* may be preferred over *photon* because the word *photon* sounds similar to *proton* and *neutron*, and could give the imprecise idea that light is simply a particle.

2.3a.4 Explain what the electromagnetic spectrum is.
The electromagnetic spectrum is all the possible wavelengths of electromagnetic wave energy. The wavelengths range from approximately 1000 meters to .001 nanometers in length. The visible spectrum is a small range of electromagnetic radiation in the middle of the electromagnetic spectrum with wavelengths a little shorter than one micrometer.

Note: Light is simply energy with a wavelength in the visible spectrum. Light, microwaves, FM radio signals, the signals transmitted by wireless computer networks, satellite signals, and X-Rays are all basically the same thing: electromagnetic radiation at different wavelengths.

2.3a.5 Identify, in order by wavelength, eight regions in the electromagnetic spectrum, and six colors in the visible spectrum.

- AM Radio
- FM Radio
- Microwaves
- Infrared Light
- Visible Light
- Ultraviolet Light
- X-Rays
- Gamma Rays

Visible Spectrum: Red, Orange, Yellow, Green, Blue, Violet

Note: Answers are in order by wavelength, from longest to shortest.

2.3a.6 Why is shorter-wavelength electromagnetic radiation more harmful to humans than longer wavelength radiation?
The energy in the electromagnetic waves increases as the wavelength gets shorter, and higher energy radiation such as ultraviolet light and X-rays can cause damage to human tissues.

`Note: Movies love to use this fact, suggesting that such radiation could cause mutations that grant superpowers. But the truth is that exposure to high energy radiation usually either destroys tissue or causes cancer. At the time of this writing, researchers are investigating whether radiation from cell phones can be dangerous. So far, research has not shown that is.`

Learning Check 2.3b

2.3b.1 What is mass?
Mass is a measure of how much matter there is in a given substance.

`Note: In Chapter 10, mass is discussed in its relation to` *`inertia`*`. There, inertia is defined as a property of matter that causes any object to prefer its current state of motion. We use mass to measure inertia.`

2.3b.2 Consider throwing a golf ball and a table tennis ball. If you throw them at the same speed, which one has more kinetic energy, and why?
The golf ball has more mass, and therefore it has more kinetic energy than the table tennis ball.

`Note: We discussed internally whether to call this ball a "ping pong ball" or "table tennis ball." The general axiom of always using the most accurate expression throughout this text led to the adoption of "table tennis ball" since that is the official name of USA Table Tennis. "Ping Pong" is a brand name from the mid-20th century.`

2.3b.3 Describe one way we are able to use the kinetic energy found in nature to generate electricity.
Wind turbines are a way of capturing kinetic energy and converting it into electrical energy for our use. Each molecule of moving air possesses kinetic energy and even though each molecule possesses only a small amount of kinetic energy, when many molecules move together much kinetic energy is present. The large blades of wind turbines are able to capture this kinetic energy from many moving molecules at once and convert it into electricity.

`Turbines that harness ocean currents are another fascinating renewable energy source whereby kinetic energy in nature is used to generate electricity.`

Learning Check 2.3c

2.3c.1 When talking about different forms of energy, what does the term potential mean?
The word ‘potential’ indicates that this is stored energy that might be used or released in the future.

2.3c.2 What is gravitational potential energy?
Gravitational potential energy is the energy in the gravitational attraction between objects.

2.3c.3 How can the water in a lake behind a dam be used to generate electricity?
Behind a dam, the water of a river forms a very deep lake. Since the water is deep there is much gravitational potential energy in the water. This water can then be allowed to flow through hydro electric turbines which generate electricity.

2.3c.4 Why is water stored in water towers?
Energy is required to pump water up into a water tower. But once the water is in the water tower, the gravitational potential energy of the water is used to maintain the pressure in water pipelines. The energy required to pump the water up into the water tower is stored in the gravitational potential energy of the water once it is in the water tower.

2.3c.5 What is chemical potential energy?
Chemical potential energy is the energy stored in the molecular bonds of atoms in molecules and compounds.

2.3c.6 Describe three drawbacks associated with using fossil fuels for electrical energy production.
The first drawback is pollution. The burning of fossil fuels creates carbon dioxide which pollutes the atmosphere. Nearly all climate scientists believe that the release of carbon dioxide is leading to severe climate change which threatens us in the future. The second drawback is the risk of an oil spill. There have been many oil spills in the past and they are devastating to the environment. The third drawback is the risk of having our fuel supplies interrupted in the event of a war or natural disaster.

2.3c.7 Explain how fossil fuels are used to produce electricity.
To produce electricity, fuel is burned in a boiler to produce steam. The steam is then used to spin a steam turbine, and the turbine is connected to a an electrical generator.

`How a steam turbine works (such as in a power plant)`

`https://www.youtube.com/watch?v=SPg7hOxFItI`

`How a reciprocating steam engine works (such as in a steam locomotive)`

`http://youtu.be/ESfSG2OlQYQ and http://youtu.be/g8LrAsL4oH0`

Learning Check 2.3d

2.3d.1 What is the source of the earth's thermal energy?
The earth's thermal energy is caused by nuclear decay and radioactivity in the center of the earth. Nuclear decay inside the earth causes temperatures hotter than the surface of the sun.

2.3d.2 Why might the use of geothermal energy not be practical in many parts of the world?
The molten rock from the heat inside the earth is far below the surface in most parts of the world. However, in mountainous regions the molten rock is close enough to the surface to be accessed by geothermal energy plants. In regions that are not mountainous, geothermal energy is not practical.

`Here is a video about a town that is using its special location to generate power for all the people using geothermal energy.`

`http://dsc.discovery.com/tv-shows/other-shows/videos/energy-365-technology-basics-geothermal-town.htm`

Learning Check 2.3e

2.3e.1 Explain the difference between the nuclear processes of fusion and fission.
In fusion, protons are joined together and energy is released in the process. This is the process occurring in the sun. In nuclear fission, a neutron splits the nucleus of a uranium atom releasing more neutrons which split more uranium atoms. This chain reaction releases energy. This is the process used in nuclear power plants.

`Fusion and fission explained`

`http://youtu.be/3rn339v_Q-w`

2.3e.2 Explain how nuclear reactions can be used to produce electricity.
The heat released by a nuclear reaction is used to boil water and make steam. The steam is then used to drive a steam turbine, which powers an electric generator.

2.3e.3 Describe three drawbacks associated with nuclear power.
The first drawback is the fact that nuclear waste is deadly radioactive. At present, there is no really good way of eliminating this dangerous nuclear waste. The second problem is the possibility of nuclear material falling into the wrong hands. Terrorists or rogue nations can use nuclear waste to manufacture nuclear weapons. The third problem is the possibility of a nuclear disaster. There have been several nuclear incidents in recent history but the worst ones have all occur outside the united states.

Sample Course Lesson Schedule Novare Physical Science Fall Term

Lesson No.	Topic	Text Key	Assignment	Notes
1	Welcome			
2	The Three Most Basic Things	1.1		
3	Class work	1.1	Learning Check 1.1	
4	Atoms, electrons	1.2, 1.3		
5	Class work	1.2, 1.3	LC 1.2, 1.3	
6	Development of Atomic Theory	1.4	LC 1.4	
7	Class work on Ch 1 Exercises		Chapter 1 Exercises	
8	Quiz 1			Class discussion Ch 1 Exercises after quiz
9	What Is Energy?	2.1	LC 2.1	
10	Where Is the Energy?	2.2	LC 2.2	
11	Mass; Sources and Forms of Energy	p. 23; 2.3	LC 2.3a, b	
12	Quiz 2	p. 28		Discuss turbines after quiz
13	Sources and Forms of Energy	2.3	LC 2.3c, 2.3 d	
14	Class work	2.3	LC 2.3e, Chapter 2 Exercises	
15	Class discussion Ch 2 Exercises	2.3		
16	Experimental Investigation #1	p. 40–41		Lab set up
17	Quiz 3		Read Getting Started with Experiments, p. 34–39	Discuss lab journals after quiz
18	Experimental Investigation #1	p. 40–41	EI 1 lab report	Taking data
19	Law of Conservation of Energy	3.1	LC 3.1	
20	Mass-Energy Equivalence	3.2	LC 3.2	
21	Quiz 4	3.3		Begin 3.3 after quiz
22	Heat and Heat Transfer	3.3	LC 3.3	
23	Work	3.4	LC 3.4	
24	Internal Energy	3.5	LC 3.5	
25	Class work	Ch 3	Ch 3 Exercises	
26	Quiz 5			Continue class work Ch 3 Exercises after quiz
27	Discuss Ch 3 Exercises			
28	Experimental Investigation #2	p. 58–59		
29	Experimental Investigation #2	p. 58–59	EI #2 Lab Report	
30	Why Are There Laws of Nature; Order and Structure in Nature	4.1, 4.2	LC 4.1, 4.2	
31	Quiz 6			Class work on LC 4.2 after quiz
32	Nature Was Designed with Us in Mind	4.3	LC 4.3	
33	Class work on Ch 4 Exercises			
34	Quiz 7	Ch 4		After quiz class discussion Ch 4 Exercises
35	The Four Forces	5.1		
36	Inverse Square Laws	p. 79		
37	The Four Forces	5.1	LC 5.1	
38	Three Types of Fields	5.2		
39	Quiz 8	Ch 5		Continue 5.2 after quiz
40	Three Types of Fields	5.2	LC 5.2	
41	Class work on Ch 5 Exercises	Ch 5		
42	Experimental Investigation #3	p. 94–95	EI #3 Lab Report	
43	Class discussion Ch 5 Exercises	Ch 5		
44	Quiz 9			Continue class discussion Ch 5 Exercises after quiz
45	Atoms, Molecules and Crystals	6.1		
46	Atoms, Molecules and Crystals; Counting Atoms in Crystals	6.1, p. 101	LC 6.1	
47	The Substances Family Tree	6.2		
48	Quiz 10	6.3		Begin 6.3 after quiz
49	Elements	6.3		
50	Elements	6.3	LC 6.3	
51	Compounds	6.4	LC 6.4	
52	Mixtures and Solutions	6.5	LC 6.5	
53	Quiz 11			Begin class work on Ch 6 Exercises after quiz
54	Class work on Ch 6 Exercises	Ch 6		
55	Class discussion Ch 6 Exercises			
56	Experimental Investigation #4	p. 116–117		
57	Experimental Investigation #4	p. 116–117	EI #4 Lab Report	
58	Quiz 12			
59	Science Is Model Building	7.1	LC 7.1	
60	The Cycle of Scientific Enterprise	7.2		
61	The Cycle of Scientific Enterprise	7.2		
62	Class work on LC 7.2		LC 7.2	
63	Quiz 13			Class discussion LC 7.1 & 7.2 after quiz
64	Facts and Theories	7.3	LC 7.3	
65	Experiments and the Scientific Method	7.4	LC 7.4	
66	Truth	7.5-7.8	LC 7.5/6	
67	Class work on Ch 7 Exercises	Ch 7		

68	Quiz 14			Continue class work after quiz
69	Class discussion Ch 7 Exercises			

Sample Course Lesson Schedule   Novare Physical Science   Spring Term

Lesson Number	Topic	Text Key	Assignment	Notes
1	Science and Measurement	8.1	Learning Check 8.1	
2	The International System of Units	8.2	LC 8.2	
3	Metric Prefixes	8.3	LC 8.3	
4	Class discussion LC 8.3	8.3		
5	Unit Conversions; Math Principles	8.4; p. 149		
6	Unit Conversions	8.4		
7	Class work LC 8.4	8.4	LC 8.4	
8	Quiz 15	8.5		Begin 8.5 after quiz
9	Class work LC 8.5			
10	Class work Ch 8 Exercises	Ch 8		
11	Experimental Investigation #5	p. 162-163	EI #5 Lab Report	
12	Quiz 16	9.1		Begin 9.1 after quiz
13	Physical Properties	9.1	LC 9.1	
14	Temperature, Pressure and Volume	9.2		
15	Temperature, Pressure and Volume	9.2	LC 9.2	
16	Phases of Matter	9.3		
17	Quiz 17		LC 9.3	Continue 9.3 Phases of Matter after quiz
18	Calculating Density; Problem solving methods	9.4; p. 180		
19	Class work on LC 9.4		LC 9.4	
20	Chemical Properties	9.5	LC 9.5	
21	Quiz 18			Begin class work on Ch 9 Exercises
22	Class work Ch 9 Exercises	Ch 9	Ch 9 Exercises	
23	Experimental Investigation #6	p. 190–191	EI #6 Lab Report	
24	Experimental Investigation #7	p. 192–193		
25	Experimental Investigation #7	p. 192–193	EI #7 Lab Report	
26	Quiz 19	10.1		Begin 10.1 after quiz
27	Finish 10.1; Velocity	10.1, 10.2	LC 10.1, 10.2	
28	Acceleration	10.3	LC 10.3	
29	Class work on LC 10.2, 10.3			
30	Inertia and Newton's Laws of Motion	10.4	LC 10.4	
31	Quiz 20			Class work LC 10.4 after quiz
32	Class work LC 10.4 & Ch 10 Exercises	Ch 10		
33	Class work Ch 10 Exercises	Ch 10	Ch 10 Exercises	
34	Quiz 21			Class discussion Ch 10 Exercises after quiz
35	Experimental Investigation #8	p. 220–221	EI #8 Lab Report	
36	Tools for Chemistry	11.1		
37	Tools for Chemistry	11.1	LC 11.1	
38	How Compounds Form	11.2	LC 11.2	
39	Quiz 22			Class work LC 11.2 after quiz
40	Chemical Reactions	11.3		
41	Chemical Reactions	11.3	LC 11.3	
42	Class work LC 11.3	11.3		
43	Class work Ch 11 Exercises	Ch 11	Ch 11 Exercises	
44	Quiz 23	Ch 11		Class discussion Ch 11 Exercises
45	Experimental Investigation #9	p. 244–247		
46	Experimental Investigation #9	p. 244–247		
47	Experimental Investigation #9	p. 244–247	EI #9 Lab Report	
48	What is a Wave?	12.1	LC 12.1	
49	Types of Waves	12.2	LC 12.2	
50	Class work LC 12.1, LC 12.2	12.2		
51	Common Behaviors of Waves	12.3		
52	Common Behaviors of Waves	12.3		
53	Class work on LC 12.3	12.3	LC 12.3	
54	Quiz 24			Demonstrations after quiz
55	Sound and Human Hearing	12.4		
56	Class work on LC 12.4	12.4	LC 12.4	
57	Class work Ch 12 Exercises	Ch 12	Ch 12 Exercises	
58	Experimental Investigation #10	p. 266–267	EI #10 Lab Report	
59	Quiz 25			Demonstrations after quiz
60	The Nature of Electricity	13.1	LC 13.1	
61	Static Electricity	13.2	LC 13.2	
62	Class work on LC 13.2			
63	How Electric Current Works	13.3		
64	How Electric Current Works	13.3	LC 13.3	
65	DC Electric Circuits and Ohm's Law	13.4		
66	Class work on LC 13.4	13.4	LC 13.4	
67	Series and Parallel Circuits	13.5	LC 13.5	
68	Class work on LC 13.5			
69	Quiz 26			Demonstrations after quiz
70	Class work on Ch 13 Exercises	Ch 13	Ch 13 Exercises	

71				
72	Experimental Investigation #11	p. 292–295		
73	Experimental Investigation #11	p. 292–295	EI #11 Lab Report	
74	Quiz 27			Demonstrations after quiz
75	Magnetism and Its Cause	14.1	LC 14.1	
76	Ampère’s Law	14.2	LC 14.2	
77	Faraday’s Law of Magnetic Induction	14.3	LC 14.3	
78	Quiz 28			Demonstrations after quiz
79	Class work on LC 14.2 and LC 14.3	14.3		
80	Class work on Ch 14 Exercises	Ch 14	Ch 14 Exercises	
81	Class discussion Ch 14 Exercises			
82	Experimental Investigation #12	p. 310–311	EI #12 Lab Report	
83	Quiz 29 (Optional)			
84	Class work completing EI #12 report			

Physical Science
Weekly Review Guide No. 23
Distribute on Spring Term Lesson 50

Your assignments this week include the following review tasks:

1. Review your most recent quiz and determine what you lost points for. If you are not clear on how to improve your responses on your quiz, visit with your instructor about it during the week. Do this before the next quiz. Remember, every quiz is an important study tool for the next quiz.

2. Take out Quizzes 13–17. Look at the questions on the quizzes, but not your answers; keep the answers covered up. Practice writing answers to question 2 on each quiz. If your current average in the class is less than 90, then you should practice your answers by actually writing them down; don't just recite them.

3. Go though the Chapter 1, 2, and 3 Objectives Lists and make sure you are ready to address any of the items listed. Look up any items you are not sure about and rehearse the flash cards on them.

4. Use the RIF method to review stating Newton's Laws of Motion.

5. Go through your history flash cards.

Review Computations

1. A precision machine in a lab adds fluid to a mixture at a rate of 12.5 μL/hr. Convert this flow rate into L/yr.

2. A shell in the muzzle of an anti-aircraft gun accelerates at a rate of 18,880 m/s^2. The shell starts from rest and is in the gun muzzle for 25 ms. How fast is the shell moving when it leaves the muzzle of the gun? (This velocity is called the *muzzle velocity*.)

3. A force of 0.0175 mN is applied to a small plastic part with a mass of 750 μg. Determine the acceleration of the plastic part.

4. What force is necessary to accelerate a rocket with a mass of 1,750,000 kg at a rate of 5.95 m/s^2? Compute your result in newtons, and then convert it to meganewtons.

Answers

1. 0.1095 L/yr
2. 472 m/s
3. 23.3 m/s^2.
4. 10.4 MN

Physical Science
Weekly Review Guide No. 25
Distribute on Spring Term Lesson 60

Your assignments this week include the following review tasks:

1. Review your most recent quiz and determine what you lost points for. If you are not clear on how to improve your responses on your quiz, visit with your instructor about it during the week. Do this before the next quiz. Remember, every quiz is an important study tool for the next quiz.

2. Take out Quizzes 20–23. Look at the questions on the quizzes, but not your answers; keep the answers covered up. Practice writing answers to question 2 on each quiz. If your current average in the class is less than 90, then you should practice your answers by actually writing them down; don't just recite them.

3. Go though the Chapter 7, 8, and 9 Objectives Lists and make sure you are ready to address any of the items listed. Look up any items you are not sure about and rehearse the flash cards on them.

4. Go through all of your vocab flash cards.

5. Use the RIF method to practice stating Newton's Laws of Motion.

6. Use the RIF method to review what acids, bases and salts are.

7. Use the RIF method to review redox reactions.

Review Computations

1. A greyhound can run at 16.93 m/s. How far does the dog run in 30 seconds? State your answer in feet.

2. A certain fuel tank holds 25,000 gallons of fuel. Convert this value into cubic meters.

3. If the greyhound above starts from rest and achieves full speed in 0.658 seconds, what is the dog's acceleration?

4. A certain rectangular salt crystal is 2 mm × 2 mm × 4.5 mm and has a mass of 36.21 mg. Determine the density of this crystal and state your result in g/cm^3.

Answers

1. 1,665 ft
2. 94.6 m^3
3. 25.7 m/s^2
4. 2.01 g/cm^3

Physical Science
Weekly Review Guide No. 27: *The Last One*
Distribute on Spring Term Lesson 70

You have been working through review exercises all year, and now we are just a few short weeks from the end of the school year. If you have been working through the review exercises each week, you should be very familiar with the material presented in the text, and you should be able to answer just about any question from any previous quiz.

For the next few weeks until the end of school, focus on the following review tasks:

1. Take out all of your quizzes. Go through them carefully looking for any question or problem you do not know how to answer. Then get the help you need to be able to address those items successfully.

2. Go through all of your flash cards several times.

3. Go through each of the 14 chapter Objectives Lists, and look up any item you are unsure about.

4. Look up practice computations from old quizzes or Review Guides and work them for practice. Be sure to practice computations involving each of the equations you have studied, including volume.

5. If you feel you need more practice, read through the end of chapter exercises and try addressing some of those questions.

6. Reading the text is always a good idea. Select chapters that you have read only once and read them again.

First and Last Name______________________________

Physical Science Quiz 14

Point values for each item are shown in parentheses. Questions on this quiz may be answered with a few sentences. Write all responses in complete sentences using correct spelling and grammar.

1. Describe the Cycle of Scientific Enterprise. (20)

2. What is science? (20)

3. Distinguish between truth and scientific facts. (20)

4. Why would it be inappropriate to say, “Oh, you don’t have to believe that—it’s only a theory.”? (20)

5. For each of the formulas listed in the table below, write in the names of the elements in the compound and the atomic ratio. The first row is filled in as an example. Use the Periodic Table of the Elements on the back as a resource for the element names. (20)

Formula	Atomic Ratio in Compound
H_2O	2:1, hydrogen : oxygen
$CaCO_3$	
Al_2O_3	
$NaOH$	
H_2SO_4	
NH_3	

liquid at room temperature

radioactive

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 **H** Hydrogen 1.0079																	2 **He** Helium 4.0026
2	3 **Li** Lithium 6.941	4 **Be** Beryllium 9.0122											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.0067	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984	10 **Ne** Neon 20.1797
3	11 **Na** Sodium 22.9898	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.9815	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.9738	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
4	19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.9559	22 **Ti** Titanium 47.88	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.9380	26 **Fe** Iron 55.847	27 **Co** Cobalt 58.9332	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.9216	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
5	37 **Rb** Rubidium 85.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.9059	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.9064	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium 98.9072	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.9055	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.82	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.76	52 **Te** Tellurium 127.60	53 **I** Iodine 126.9045	54 **Xe** Xenon 131.29
6	55 **Cs** Cesium 132.905	56 **Ba** Barium 137.327	71 **Lu** Lutetium 174.967	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.85	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.2	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.9665	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.9804	84 **Po** Polonium 208.9824	85 **At** Astatine 209.9871	86 **Rn** Radon 222.0176
7	87 **Fr** Francium 223.0197	88 **Ra** Radium 226.0254	103 **Lr** Lawrencium 262.11	104 **Rf** Rutherfordium 261.11	105 **Db** Dubnium 262.114	106 **Sg** Seaborgium 263.118	107 **Bh** Bohrium 262.12	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 **Ds** Darmstadtium (281)	111 **Rg** Roentgenium (281)	112 **Cn** Copernicium (285)	113 **Nh** Nihonium (284)	114 **Fl** Flerovium (289)	115 **Mc** Moscovium (288)	116 **Lv** Livermorium (293)	117 **Ts** Tennessine (294)	118 **Og** Oganesson (294)

57 **La** Lanthanum 138.9055	58 **Ce** Cerium 140.115	59 **Pr** Praseodymium 140.9077	60 **Nd** Neodymium 144.24	61 **Pm** Promethium 144.9127	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.965	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.9253	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.9303	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.9342	70 **Yb** Ytterbium 173.04
89 **Ac** Actinium 227.0278	90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.0359	92 **U** Uranium 238.0289	93 **Np** Neptunium 237.0482	94 **Pu** Plutonium 244.0642	95 **Am** Americium 243.0614	96 **Cm** Curium 247.0703	97 **Bk** Berkelium 247.0703	98 **Cf** Californium 251.0796	99 **Es** Einsteinium 252.083	100 **Fm** Fermium 257.0951	101 **Md** Mendelevium 258.10	102 **No** Nobelium 259.1009

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Physical Science Quiz 16

Point values for each item are shown in parentheses. Questions on this quiz may be answered with a few sentences. Write all responses in complete sentences using correct spelling and grammar.

1. Convert 1,150 milligrams into kilograms. (20)

2. Convert 14.5 gpm into L/s. (See the helpful conversion factors on the other side.) (20)

3. Convert 1.875 ft into cm. (20)

4. Describe some of the reasons the SI System of units is universally used for scientific work. (10)

5. Explain what is meant by the "dual nature of light." (10)

6. Explain what "potential energy" is, and give two examples. (10)

7. Distinguish between heterogeneous mixtures and homogeneous mixtures. (10)

Helpful Conversion Factors

0.3048 m = 1 ft

1.609 km = 1 mi

1,609 m = 1 mi

3.785 L = 1 gal

First and Last Name____________________________

Physical Science Quiz 18

Point values for each item are shown in parentheses. Questions on this quiz may be answered with a few sentences. Write all responses in complete sentences using correct spelling and grammar.

1. Describe two physical properties of copper, and two physical properties of glass. (20)

2. Describe the relationship between the volume and pressure of a gas. If you wish, you may use a simple sketch of a graph in your explanation. (20)

3. The moon is 238,900 mi from earth. Convert this value to meters. (20)

4. Distinguish between truth and scientific theories. (10)

5. Briefly describe some of the evidence in nature for an intelligent creator. (10)

6. List three drawbacks of using nuclear energy. (10)

7. Distinguish between mixtures and compounds. (10)

Helpful Conversion Factors

0.3048 m = 1 ft

1.609 km = 1 mi

1,609 m = 1 mi

3.785 L = 1 gal