Skill and Practice Sheet Answers

3A Science Vocabulary

Prefix is in bold and suffix is underlined:

thermometer	**electro**lyte	**mono**atomic
volumetric	**endo**thermic	**spectro**scope
prototype	**con**vex	**super**saturated

Student definitions:

Answers may vary. Correct answers include:

1. The study of water
2. Many units
3. The same kind
4. Different kinds
5. Existing light
6. An instrument for measuring the full range of something

Dictionary definitions:

1. The science dealing with the properties, distribution, and circulation of water
2. A chemical compound formed by the union of small molecules, usually consisting of repeating units
3. Of the same kind, having uniform structure
4. Consisting of dissimilar ingredients
5. The emission of light (as by a chemical or physiological process)
6. An instrument for measuring spectra

Definitions based on prefixes and suffixes:

1. thermometer
2. sonogram (or sonograph)
3. monoatomic
4. telescope

Word	Dictionary Definition
thermometer	An instrument for measuring temperature
sonogram	A graph that shows the loudness of sound at different frequencies
monoatomic	Containing only one type of atom
telescope	A cylindrical instrument for viewing distant objects

3B Ratios and Proportions

1. 6 tablespoons; 2 eggs
2. $^{3}/_{4}$ cup; $^{1}/_{3}$ teaspoon
3. $^{1}/_{4}$ teaspoon; $^{3}/_{4}$ cup
4. Table answers:

Sugar	$^{3}/_{8}$ cup
Butter	3 tablespoons
Milk	1 tablespoon
Chocolate chips	1 cup
Eggs	1 egg
Vanilla extract	$^{1}/_{2}$ teaspoon
Baking soda	$^{1}/_{6}$ teaspoon
Salt	$^{1}/_{8}$ teaspoon
Confectioner's sugar	1 tablespoon

5. To make 16 brownies, you need two eggs and 2 tablespoons of sugar. Therefore, to make 8 brownies, you only need 1 of each unit for each ingredient: 1 egg and 1 tablespoon of sugar.
6. Since 8 brownies requires 1 cup of chocolate chips, 3 cups of chocolate chips will make 24 brownies.
7. 1.5 teaspoons vanilla are needed to make 24 brownies.

3C Mass vs. Weight

1. 15 pounds
2. 2.6 pounds
3. 7.0 kilograms
4. Yes, a balance would function correctly on the moon. The unknown mass would tip the balance one-sixth as far as it would on Earth, but the masses of known quantity would tip the balance one-sixth as far in the opposite direction as they did on Earth. The net result is that it would take the same amount of mass to equalize the balance on the moon as it did on Earth. (In the free fall environment of the space shuttle, however, the masses wouldn't stay on the balance, so the balance would *not* work).
5. Answers are:
   a. As the elevator begins to accelerate upward, the scale reading is greater than the normal weight. As the elevator accelerates downward, the scale reads less than the normal weight.
   b. When the elevator is at rest, the scale reads the normal weight.
   c. The weight appears to change because the spring is being squeezed between the top and the bottom of the scale. When the elevator accelerates upward, it is as if the bottom of the scale is being pushed up while the top is being pushed down. The upward force is what causes the spring to be compressed more than it is normally. When the elevator accelerates downward, the bottom of the scale provides less of a supporting force for the feet to push against. Therefore, the spring is not compressed as much and the scale reads less than the normal weight.

3D Net Force and Newton's First Law

1. When at rest, the cart experiences a normal force of 105 N and its weight of -105 N.
2. The net force on the cart is +20 N. While the cart is on the slippery margarine, it is not moving at constant velocity since it is experiencing a net force (acceleration).
3. The normal force on the cart after it is loaded with groceries is +180 N.
4. Gravity accelerates the cart down the ramp.
5. The friction force is greater on the rough blacktop than on the smooth tile.
6. The line of twenty empty carts has twenty times as much inertia, so it takes a much greater force to get it moving.

3E Isaac Newton

1. The isolation due to the Plague allowed Newton to focus on his scientific work, free from the distractions of university life. However, most scientists learn a great deal from discussing their ideas with peers. Collaboration also enables experimental scientists to test a greater number of hypotheses.
2. Newton was an active member of the scientific community at Cambridge for just under 30 years. In that time, he made great strides in understanding light and optics, planetary motion, universal gravitation, and calculus. He made extraordinary contributions to many scientific fields during those years.
3. Example answer: Newton's first law says that unless you apply an unbalanced force to an object, the object will keep on doing what is was doing in the first place. So a rolling ball will keep on rolling until an unbalanced force changes its motion, while a ball that is not moving will stay still unless acted on by an unbalanced force.
4. Example answer: The law of universal gravitation says that the force of attraction between two objects is directly related to the masses of the objects and inversely related to the distance between them.
5. Newton's law of universal gravitation.
6. Newton claimed that 20 years earlier, he had invented the material that Leibnitz published. Newton accused Leibnitz of plagiarism. Most historians today agree that the two developed the material independently, and therefore they are known as co-discoverers.

Extra information: The famous legend of Newton's apple tells of Newton sitting in his garden in Linconshire in 1666, watching an apple fall from a tree. He later noted that "In the same year, I began to think of gravity extending to the orb of the moon." However, he did not make public his musings about gravity until the 1680's, when he formulated his law of universal gravitation.

3F Newton's Second Law

1. 2.100 m/s^2
2. 83 m/s^2
3. 82 N
4. 6 kg
5. 9800 N
6. 900 kg
7. 1.9 m/s^2

3G Mass, Weight, and Gravity

1. Answers are:
   a. 22 newtons
   b. 8.1 newtons
   c. 8.9 N/kg
2. Answers are:
   a. 65 kilograms
   b. 640 newtons
   c. 240 newtons
3. Answers are:
   a. 23.10 N/kg
   b. 0.6 N/kg
   c. 4.9 newtons
4. Answers are:
   a. 195,700 newtons
   b. 19,970 kilograms
   c. 146,800 newtons
   d. weight of toy-filled boxes = 48,900 newtons.
   mass of toy-filled boxes = 4,990. kg

3H Gravity Problems

Table 1 answers:

Planet	Force of gravity in Newtons (N)	Value compared to Earth's gravity
Mercury	3.7	0.38
Venus	8.9	0.91
Earth	9.8	1
Mars	3.7	0.38
Jupiter	23.1	2.36
Saturn	9.0	0.92
Uranus	8.7	0.89
Neptune	11.0	1.12
Pluto	0.6	0.06

1. 9.5 pounds on Neptune
2. 1,030 newtons on Saturn
3. The baby weighs 45 newtons on Earth which is equal to 10.04 pounds.
4. Venus, Jupiter, Neptune, Pluto, then Saturn
5. Answer:

$$\text{Gravity} = \left(\frac{6.67\times10^{-11}\,\text{N}\cdot\text{m}^2}{\text{kg}^2}\right)\frac{(6.4\times10^{24})(5.7\times10^{26})}{(6.52\times10^{11})^2}$$

$$= 5.72\times10^{17}\,\text{N}$$

3I Acceleration Due to Gravity

1. velocity = –14.7 m/s
2. velocity = 11.3 m/s
3. velocity = –76.4 m/s
4. velocity = –16 m/s
5. depth = 86 meters
6. height = 11 meters; yes
7. time = 5.6 seconds
8. time = 7.0 seconds