What Is This Module About?

Have you ever gone to the market? I'm sure you have. Have you noticed what vendors do to the goods you buy? Do you know the device they use? When you want to buy, say, $\frac{1}{4}$ kilogram of chicken, you choose the chicken parts you want and the vendor puts the chicken parts on a weighing scale until the scale reads $\frac{1}{4}$ kilogram.

But did you know that when the vendor puts the chicken on the scale, he/she is not only measuring the weight of the chicken but also its mass? Knowing how to measure the mass and weight of objects is very useful for you. For instance, if you know how to measure the weight of the goods you want to buy, you will know exactly how much you should pay. The bigger the mass and weight of your purchase, the bigger the amount that you will have to pay.

This module is made up of two lessons:

Lesson 1—*Differentiating Between Mass and Weight*

Lesson 2—*Units of Mass and Weight*

What Will You Learn From This Module?

After studying this module, you should be able to:

- explain the difference between mass and weight;
- identify the different units of mass and weight;
- convert units of mass and weight to other units;
- read and record measurements of mass and weight using standard measures;
- identify the different type of equipment used in measuring mass and weight;
- use indigenous ways of measuring mass and weight when standard measures are not available; and
- solve problems involving mass and weight.

Let’s See What You Already Know

A. Before you continue studying this module, find out first how much you already know about the topics to be discussed. In your own words, write a description or definition of mass and weight.

1. mass

   ____

2. weight

   ____

B. State whether each of the following units of measurement is a unit of mass, weight or neither. Write **M** on the line if the unit is a unit of mass, **W** if it is a unit of weight and **X** if it is neither.

_____ kilogram	_____ meter	_____ ton
_____ pound	_____ ounce	_____ gram
_____ centimeter	_____ milligram	_____ second

C. Solve the following problems. Write your solutions in the spaces provided.

1. A farmer bought 3 kilograms of fertilizer for his crops. How many grams of fertilizer did he buy?

2. Marie’s poultry farm has 200 chickens. If each chicken consumes 2 kilos of corn every week, how many pounds of corn are consumed every week?

3. An astronaut weighs 67 kilograms on earth. How much would the astronaut weigh on the moon if the gravitational pull of the moon is equal to 1.64 m/s^2?

Well, how was it? Do you think you fared well? Compare your answers with those in the *Answer Key* on page 24 to find out.

If all your answers are correct, very good! You may still study the module to review what you already know. Who knows, you might learn a few more new things as well.

If you got a low score, don't feel bad. This only means that this module is for you. It will help you understand some important concepts that you can apply in your daily life. If you study this module carefully, you will learn the answers to all the items in the test and a lot more! Are you ready?

You may go now to the next page to begin Lesson 1.

LESSON 1

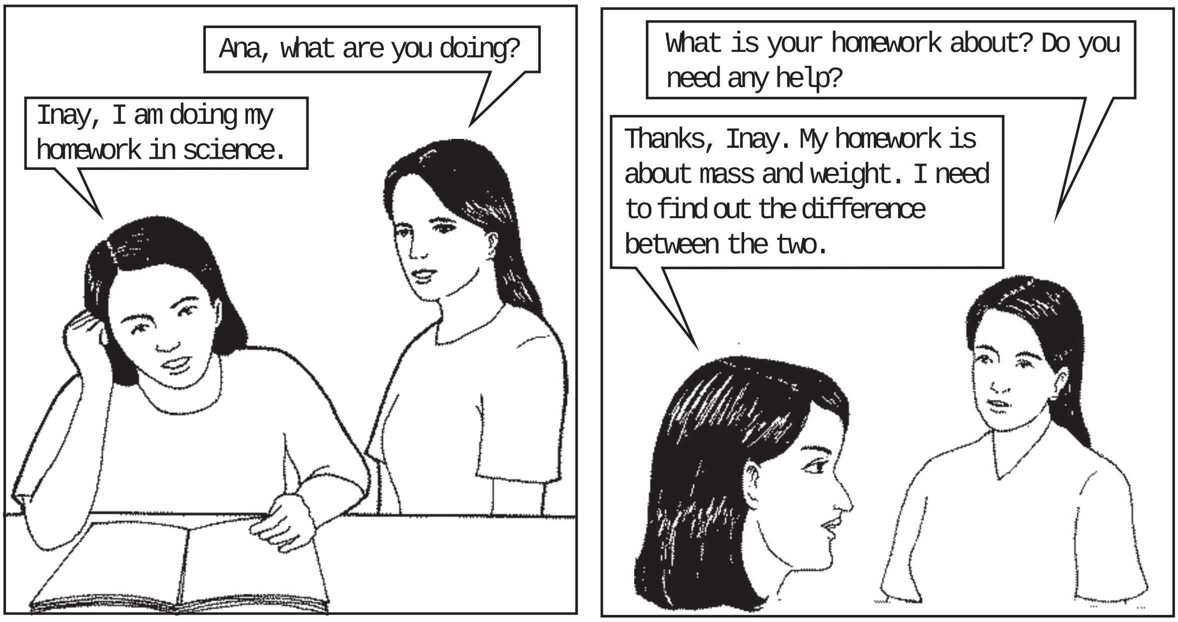
Differentiating Between Mass and Weight

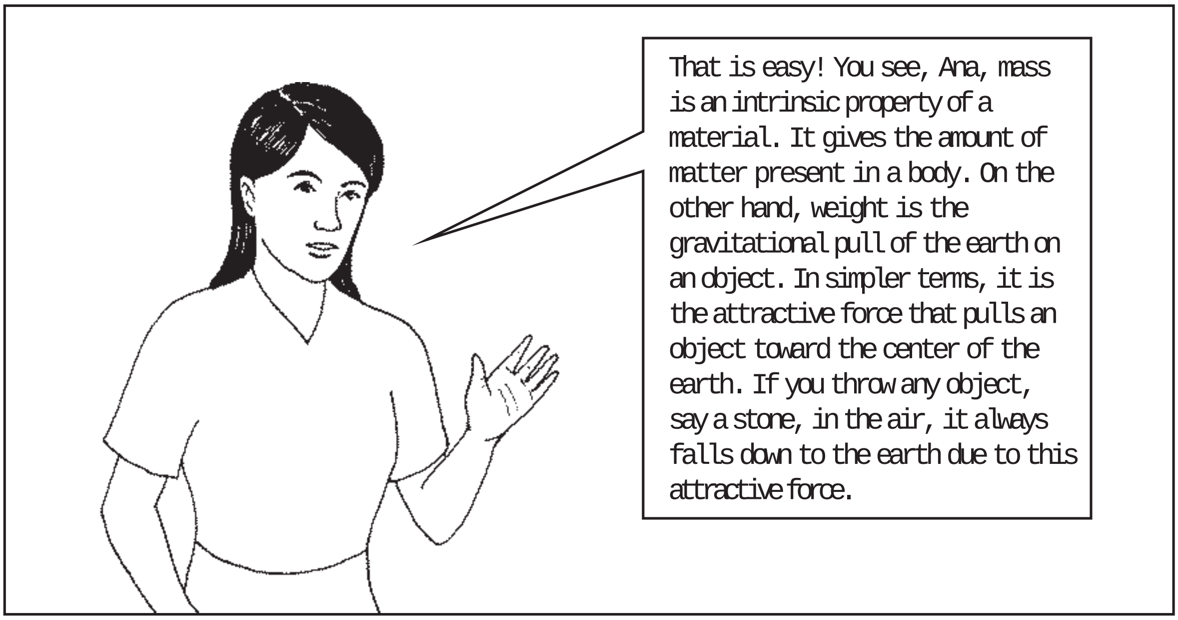
Do you know how heavy you are? If you want to know how heavy you are, you should weigh yourself on a weighing scale. The number that you read from this device is your weight. But did you know that you could be heavier or lighter, depending on where you are? Your weight when you are on top of a mountain is different from your weight at ground or sea level or on the moon. This is because the pull of the earth differs in each of these places. Did you know, however, that your weight may vary but your mass remains the same no matter where you are? This lesson will help you understand better the concepts of mass and weight.

After studying this lesson, you should be able to:

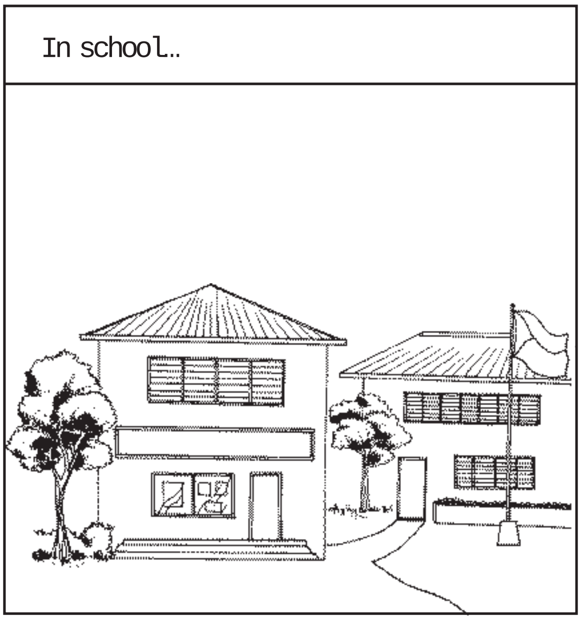
- ♦ explain the concepts of mass and weight;
- ♦ differentiate between mass and weight; and
- ♦ solve problems involving mass and weight.

Let's Read




That is easy! You see, Ana, mass is an intrinsic property of a material. It gives the amount of matter present in a body. On the other hand, weight is the gravitational pull of the earth on an object. In simpler terms, it is the attractive force that pulls an object toward the center of the earth. If you throw any object, say a stone, in the air, it always falls down to the earth due to this attractive force.


Thanks inay! Everything is clearer to me now.
You're welcome, Ana. Anything for you.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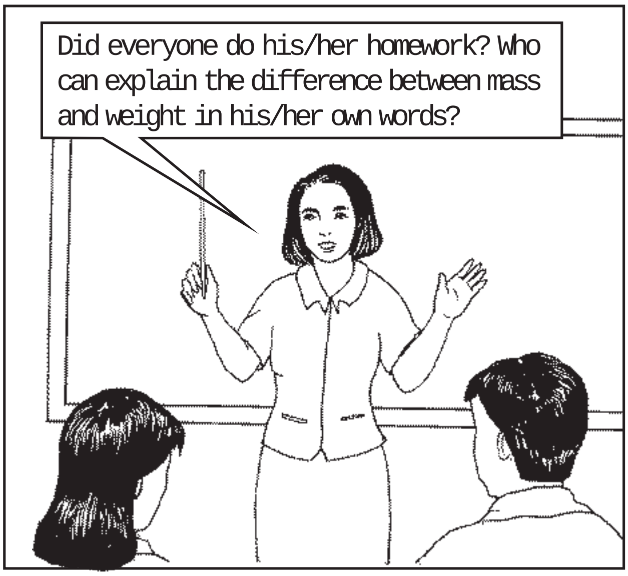

Did everyone do his/her homework? Who can explain the difference between mass and weight in his/her own words?

Let's Try This

In your own words, discuss the difference between mass and weight.

Compare your answer with the one in the *Answer Key* on page 25.

Let's Learn

The concepts of mass and weight are two related ideas. This is why one is often confused for the other most of the time. But in spite of their being very much-related ideas, we must be able to draw the line between the two.

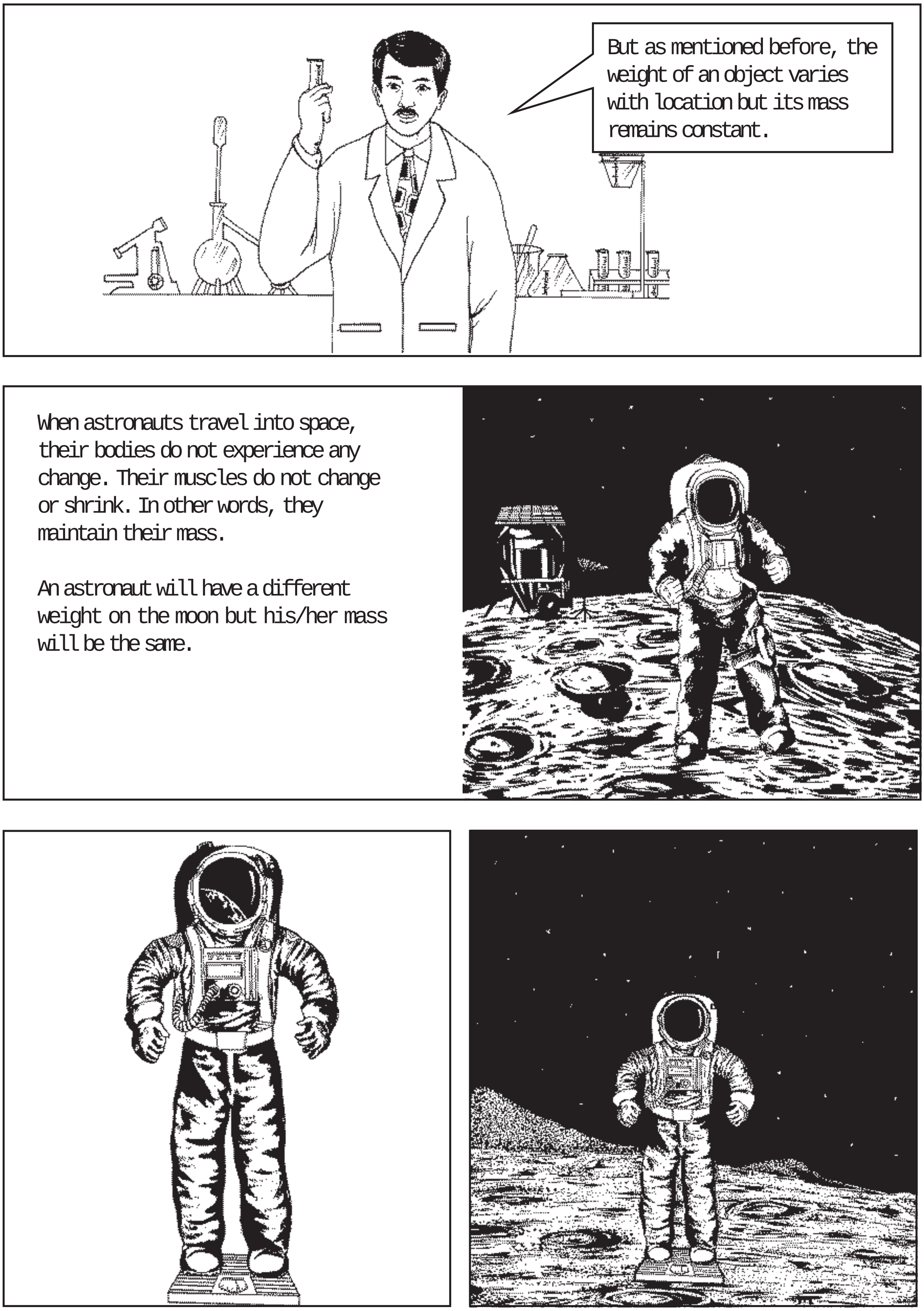
Mass is the amount of material present in a body. And since no two things are made of exactly the same material, we can say that mass is a unique property or an intrinsic property of an object.

Anything that has mass exerts an attractive force on any or other object. This force pulls the other object toward the center of the first object. The strength of the force depends on both the masses of the two objects and their distance from each other. The bigger the mass of an object, the stronger the force it exerts on the other object. The farther an object is from another, the weaker the force it exerts on the other object gets. For example, the earth, having a very big mass, exerts a very strong attractive force on everything on it. When you throw an object in the air, it goes down and hits the ground after some time because of the attractive force of the earth. This force is also responsible for keeping us from falling off the earth. This force that is exerted on an object by the earth is called the **weight of the object on earth. Weight** is defined to be equal to the mass of the object, m, multiplied by the acceleration due to gravity, g, where g = 9.81 meters per second squared (m/s^2) for earth. That is,

weight = mass × acceleration due to gravity

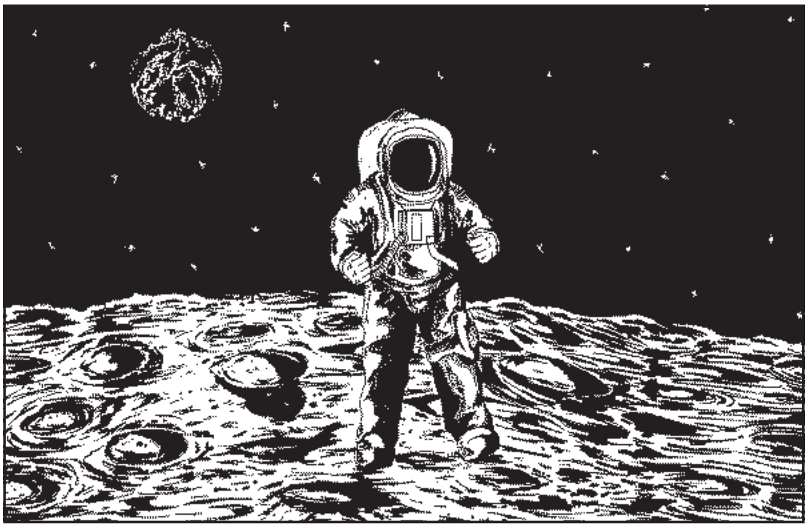
$$w = mg$$

Note that the preceding equation gives us a new unit of measurement. By getting the product of the mass, which is in kilograms, and the acceleration due to gravity which is in meters per second squared, we arrive at an answer in kilogram-meters per second squared (kg·m/s^2).



But why is this so?

If you can recall, anything that has mass exerts an attractive force on another object. The moon, though lighter than the earth, has a very big mass and therefore exerts an attractive force on other objects as well. However, the mass of the moon is much smaller than the mass of the earth so we can expect that the force exerted by the moon to be weaker than that of the earth. Therefore, if an astronaut goes to the moon, he/she will weigh lighter there than he/she does on earth.



Now that the concepts of mass and weight are clearer to you, you can now solve problems involving mass and weight. Study the following problems.

EXAMPLE 1 A poultry farm sells chicken at ₱80 per kilo. If a customer bought ₱4800 worth of chicken, how many kilos did he/she buy?

SOLUTION: We will use a 5-step procedure for solving this problem.

STEP 1 Write down the given facts in the problem.

A kilo of chicken costs ₱80.
The customer bought ₱4800 worth of chicken.

STEP 2 Note what is asked in the problem.

Find out how many kilos of chicken the customer bought.

STEP 3 Write a number sentence that will give you the answer you are looking for.

We are looking for the number of kilos bought, which we will represent with *K*. Multiply *K* by the cost of chicken per kilo and equate it with the amount paid by the customer.

₱80(K) = ₱4800

STEP 4 Now solve for the unknown.

To solve for K, divide both sides of the equation by ₱80.

$$₱80\,(K) = ₱4800$$
$$\frac{\cancel{₱80}\,(K)}{\cancel{₱80}} = \frac{\cancel{₱4800}}{\cancel{₱80}}$$
$$K = 60\text{ kilos}$$

STEP 5 Make a conclusion.

The customer bought 60 kilos of chicken.

EXAMPLE 2 After successfully accomplishing his mission, an astronaut weighed himself on the moon before deciding to go back to earth. He discovered that he weighed 90.2 kg·m/s^2 on the moon. Assuming that the acceleration due to gravity on the moon is equal to 1.64 m/s^2, what is the weight of the astronaut on earth?

SOLUTION:

STEP 1 Write down the given facts.

g on the moon = 1.64 m/s^2

w of the astronaut on the moon = 90.2 kg·m/s^2

STEP 2 Note what is asked in the problem.

Find the weight of the astronaut on earth.

STEP 3 Write a number sentence for the problem.

First we need to find out the mass of the astronaut. We will then multiply this mass with the acceleration due to gravity on earth since the mass of the astronaut is constant whether he is on the moon or on earth.

$$m = \frac{w_{\text{moon}}}{g_{\text{moon}}}$$

Substituting this mass in the equation $w_{\text{earth}} = m \times g_{\text{earth}}$,

$$w_{\text{earth}} = \left(\frac{w_{\text{moon}}}{g_{\text{moon}}}\right) \times g_{\text{earth}}$$

STEP 4 Solving now for w_{earth} ,

$$w_{\text{earth}} = \left(\frac{90.2\text{ kg}\cdot\cancel{\text{m}/\text{s}^2}}{1.64\,\cancel{\text{m}/\text{s}^2}}\right) \times 9.81\,\text{m}/\text{s}^2$$
$$= 539.6\text{ kg}\cdot\text{m}/\text{s}^2$$

STEP 5 Therefore, the astronaut weighs 539.6 kg·m/s^2 on earth.

Let's Try This

Solve the following problems using the step-by-step procedure given in the previous section.

1. If a person spills 0.001 kilogram of rice a day, how many kilograms of rice does one person waste in a year? Assume that a year has 365 days.

2. Marko dreamt that he was on a big weighing scale on Mars. If Marko knew that he weighed 587.4 kg·m/s^2 on earth, what would be the reading on the weighing scale in kg·m/s^2? Assume that the acceleration due to gravity on Mars is 3.7 m/s^2.

Compare your answers with those in the *Answer Key* on pages 25 and 26.

Let's See What You Have Learned

A. Identify what is described by each of the following statements.

__________ 1. It is a force exerted by a massive object on another nearby object pulling the other object toward its center.

__________ 2. An intrinsic property of a body that tells the amount of material present in the body.

__________ 3. A factor of weight that varies from location to location.

__________ 4. A factor of weight that is independent of location.

__________ 5. Mathematical operation used to compute the weight of an object.

B. Solve the following problems. Write your solutions in the spaces provided.

1. A poultry farm consumes 600 kilograms of corn in 30 days. The owner of the farm spends ₱12000.00 for this period. The farm owner has an option to feed the chickens with a mixture of corn, *darak* and vegetables. If the mixture costs ₱15 per kilo, which feed should be used in order to save money?

2. In 1969, Neil Armstrong, Michael Collins and Edwin "Buzz" Aldrin landed on the moon. If each of them weighed 588.6 $kg{\cdot}m/s^2$ here on earth, how light were all three while walking on the moon? Assume that $g_{moon} = 1.64\ m/s^2$.

Compare your answers with those in the *Answer Key* on pages 26 and 27. Did you get a perfect score? If you did, that's very good. If you did not, don't worry. Just review the parts of the lesson you did not understand before moving on to Lesson 2.

Let's Remember

- Mass is an intrinsic property of an object. It is the amount of matter present in an object.
- Weight is the force exerted by a massive body, such as the earth and the moon, on other objects such that this force pulls the other bodies toward the center of the massive body.
- **Weight** changes with location. Mass, however, remains constant.
- The weight of a body in a particular location can be computed using the formula

$$w = m \times g$$

where w = weight of the body
m = mass of the body
g = acceleration due to gravity (on earth g is 9.81 m/s^2)

Lesson 2

Units of Mass and Weight

Now that goods are getting more expensive, it is important that you know how to get the best value for your money. Suppose that you need to buy meat. Meat shops usually sell meat by the pound, while meat stalls in wet markets usually sell meat by the kilogram. So how will you know from which meat seller you could get the best value for your money? You will find out in this lesson.

In this lesson, you will learn new units of measurement. You will find out the different units of mass and weight. You will also learn about the different instruments for measuring mass and weight.

After studying this lesson, you should be able to:

- identify the units of mass and weight;
- convert one unit of mass and weight to another;
- identify the different instruments for measuring mass and weight;
- read and record measures of mass and weight using these instruments; and
- use indigenous ways of measuring mass and weight when standard measures are not available.

Let’s Learn

It is important to know the relationships between units of mass and weight. Knowing these relationships will help you convert one unit of measurement to another.

Mass and weight are quantified using different units of measurement. Mass is measured in kilograms (kg), grams (g) and milligrams (mg). Weight, on the other hand, is measured in tons (T), pounds (lb.), ounces (oz.) and kilogram-meters per second squared ($kg{\cdot}m/s^2$).

Below is a table of units of mass and weight. Read the table aloud several times to help you remember these units easily.

Units of Mass and Weight

1 kilogram (kg) = 1000
1 gram (g) = 1000 millig
1 ton (T) = 2000 pounds
1 pound (lb.) = 16 ounce
1 kilogram (kg) = 2.2 pc
1 ton (T) = 32000 ounce
1 pound (lb.) = 4.45 kilc squared (kg·m/s^2)
1 ton (T) = 907.2 kilogra

Let's Try This

Let's study some problems on converting one unit of mass and weight to another.

EXAMPLE 1 Paul intends to work on his land this coming planting season so he bought a 2.4 T tractor to make his plowing easier. What is the mass of the tractor in kilograms?

SOLUTION In solving this problem, we will use a three-step procedure.

STEP 1 It is always important to remember the conversion factors. You can get the conversion factors from the table above. In this case, the conversion factor that we are going to use is 1 T = 907.2 kg.

STEP 2 Keep in mind that you use a conversion factor to convert the given unit of measurement to the unit asked for in the problem. This implies that one of the units must cancel out in the equation. You can thus express the conversion factor as a ratio with 1 T as the denominator. Thus,

$$\frac{907.2\ \text{kg}}{1\ \text{T}}$$

STEP 3 Next, multiply 2.4 tons by the conversion factor.

$$2.4\,\cancel{T} \times \frac{907.2\text{ kg}}{1\,\cancel{T}} = 2177.3\text{ kg}$$

Remember to always include the appropriate unit in your final answer.

EXAMPLE 2 Nonoy went to the doctor for a checkup. The first thing the doctor did was check Nonoy's weight. He weighed 121 lb. Find Nonoy's weight in kilogram-meters per second squared.

SOLUTION In solving this problem, use the three-step procedure shown in the previous example.

STEP 1 First determine the conversion factor that you need. In this case, the conversion factor is 1 pound = 4.45 kilogram-meters per second squared.

STEP 2 Express the conversion factor as a ratio.

$1\text{ lb.} = 4.45\text{ kg}{\cdot}\text{m/s}^2$

$$\frac{4.45\text{ kg}\cdot\text{m/s}^2}{1\text{ lb.}}$$

STEP 3 Multiply 121 lb. by the conversion factor.

$$121\,\cancel{\text{lb.}} \times \frac{4.45\text{ kg}\cdot\text{m/s}^2}{1\,\cancel{\text{lb.}}} = 538.45\text{ kg}{\cdot}\text{m/s}^2$$

Again, do not forget to include the appropriate unit in your final answer.

Let's Study and Analyze

Consider the following problems.

Anna gave birth to a healthy baby girl weighing 6.5 lb. A month later, she took her baby to the pediatrician for a checkup. The pediatrician weighed the baby and recorded her weight as 4.2 kg. Did Anna's baby gain weight? If she did, how much weight did she gain?

STEP 1 The conversion factor we're going to use is 1 kilogram = 2.2 pounds.

STEP 2 The conversion factor in ratio form is $\dfrac{2.2\text{ pounds}}{1\text{ kilogram}}$.

STEP 3 Let's now multiply 4.2 kg by the conversion factor.

$$4.2\text{ kg} \times \frac{2.2\text{ lb.}}{1\text{ kg}} = 9.24\text{ lb.}$$

Since Anna's baby weighed 6.5 lb. when she was born and now weighs 9.2 lb., we can see that she gained weight.

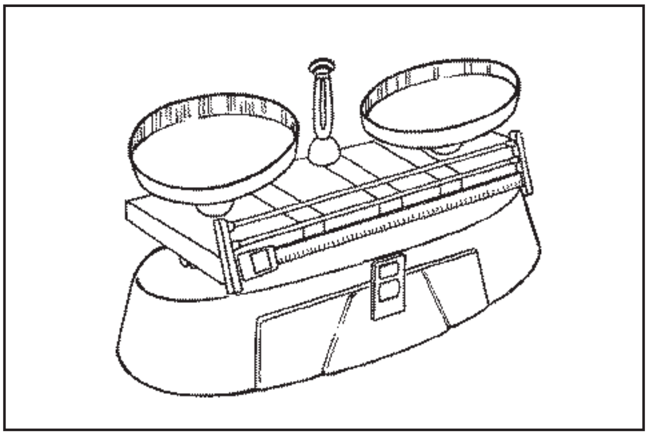
$9.24\text{ lb.} - \cancel{6.5\text{ lb}}. = \cancel{2.7\text{ lb}}.$

Therefore, Anna's baby gained 2.7 lb.

Let's Learn

Mass and weight can be measured using any of a wide variety of instruments. The most commonly used are the weighing scale and platform balance. These instruments help you get a more accurate measure of the mass and weight of different objects. Let's find out more about these measuring devices.

Platform Balance

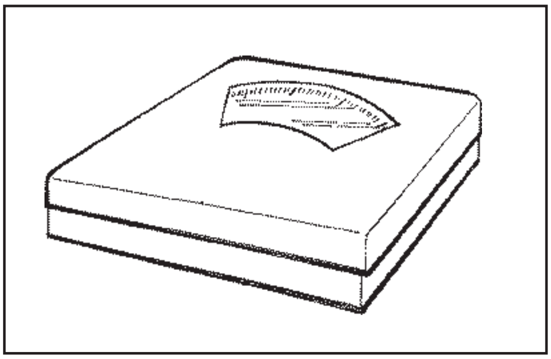


One of the most commonly used measuring devices in laboratories is the platform balance, sometimes called equal arm balance. Using this equipment requires two weights. First is the object that you want to weigh. The second is a set of weights called riders. Riders come in 100 g, 10 g, 1 g and 0.1 g masses. The sensitivity of the balance is 0.1 gram. This means that it can weigh and detect an object that has a mass of at least 0.1 gram. That is why it is usually used in measuring objects that have very small masses.

In using the platform balance, you should first check if the pointer is at zero. Once the pointer is at zero, you may put the object that you want to weigh on one pan. Next, put the riders on the other pan. When the pointer is at zero, the object on the pan is in equilibrium with the combined masses of the riders on the other pan.

You just add up the masses of the riders to know the mass of the object. The only thing you need to remember here is that you have to balance the two objects so you must always fix the pointer at the zero position.

Weighing Scale



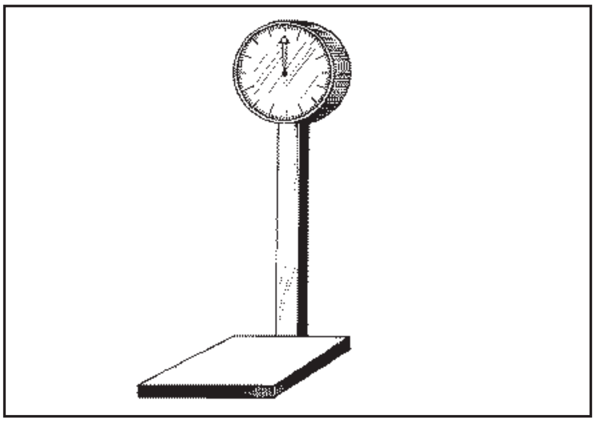
The weighing scale is the most commonly used weighing device. It is also the easiest to use. It is usually used in markets to weigh meat, fish, fruits, vegetables, etc. This instrument is usually used to measure big masses since its sensitivity is 100 grams. It can measure up to 12 kilograms.

The first thing that you should do is to check if the pointer is at zero. You can do this by adjusting the screw below the pan. Unlike the platform balance that requires two kinds of weights, the weighing scale just needs the object to be weighed. All you have to do is put the object on the pan and then read the number at which the pointer stops.

Digital Weighing Scale

Digital weighing scales are now also commonly used. Digital weighing scales are electronic and are very easy to use. All you have to do is put the object to be weighed on the scale and the window on the scale will indicate the weight of the object up to 1/10 or even 1/100 of a kilogram.

Platform Scale

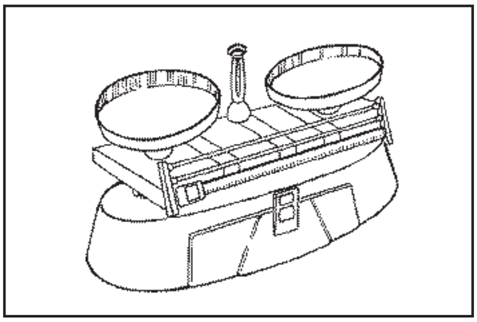


A platform scale is another kind of weighing scale. It is an equipment used to measure objects with very large masses such as cement, sand and gravel. The smallest measurement of the platform scale is 1 lb. It can weigh objects as heavy as 1000 lb.

The platform scale works like a weighing scale. Before you use the platform scale, make sure the pointer is at zero. You can do this by turning the adjustment screw. Then put the object that you wish to weigh. The weight of the object is the number at which the pointer stops.

Let's Try This

Identify the following intruments and provide 2 examples of objects that can be weighed on each device.

1. 

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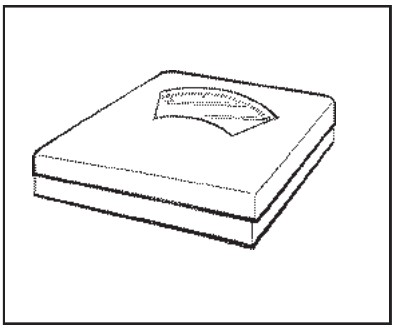
2. 

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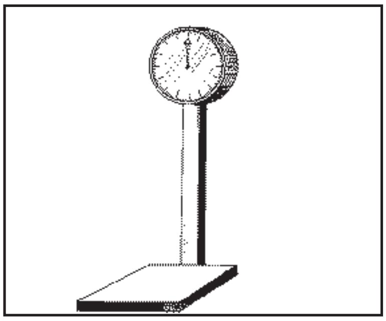
3. 

____

____

4. 

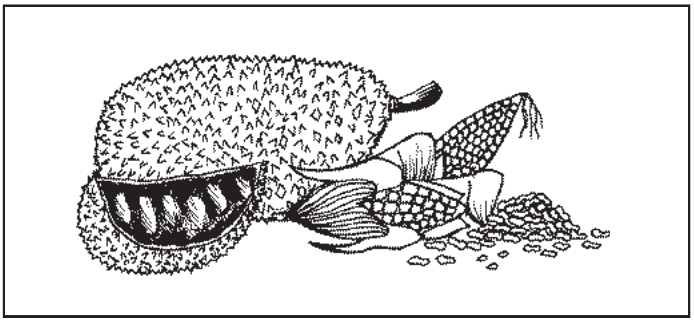
____

____

Compare your answers with those in the *Answer Key* on page 27.

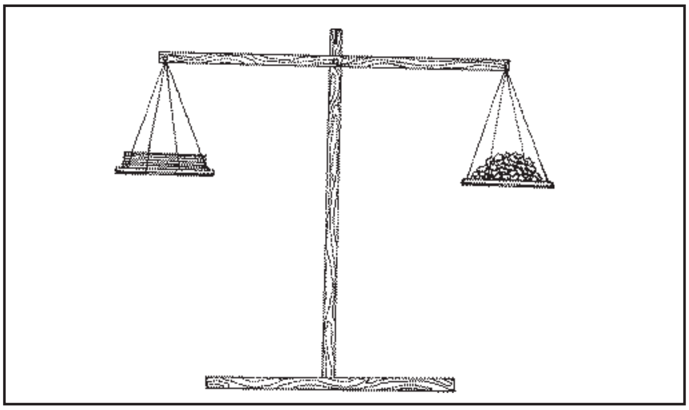
Let's Learn

Have you ever wondered how the mass and weight of an object were determined in the past when there were still no standard units of measure and measuring devices? Can you imagine how people in the old days were able to participate in trade without knowledge of mass and weight? How were rice grains, meat, vegetables and many other goods sold?



Before the standard units of mass and weight were devised, people weighed objects by improvising on what they had.

They made use of corn kernels, peanuts and seeds of different fruits (like jackfruits) to find the mass and weight of a particular object. Do you know how they used these things?



For instance, if they wanted to know how heavy a pad of paper was, they first made an improvised equal arm balance. The paper was placed on one pan of the balance and the corn kernels are placed on the other. Each kernel was assumed to have the same mass as the other kernels. These were added on the pan until the two pans balanced. The kernels were then counted and the mass of the paper was given in terms of the number of corn kernels.

Though this procedure was pretty convenient, using it is not really advisable since measurements obtained are not precise nor accurate.

Let’s See What You Have Learned

A. Convert the following units to the indicated units.

1.	2 kg	=	________	g
2.	2 T	=	________	kg
3.	48 oz.	=	________	lb.
4.	10 lb.	=	________	$kg \cdot m/s^2$
5.	220 lb.	=	________	mg

B. Solve the following problems.

1. A peanut vendor bought 5350 grams of raw peanuts in the market. How much do the peanuts weigh in kilograms?

2. Mark weighs 40 kilograms while Ben weighs 89 pounds. Who weighs more?

Compare your answers with those in the *Answer Key* on pages 27 and 28. Did you get a perfect score? If you did, that’s very good. If you did not, that’s okay. Just review the parts of the lesson you did not understand very well before moving on to the next part of the module.

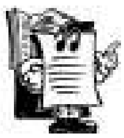
Let's Remember

- Table of Measurements of Mass and Weight

1 kilogram (kg) = 1000
1 gram (g) = 1000 millig
1 ton (T) = 2000 pounds
1 pound (lb.) = 16 ounce
1 kilogram (kg) = 2.2 pc
1 ton (T) = 32000 ounce
1 pound (lb.) = 4.45 kilc squared (kg·m/s^2)
1 ton (T) = 907.2 kilogra

- Mass and weight can be measured using such instruments as the platform scale, weighing scale, platform balance and digital weighing scale.
- Each measuring equipment is designed to measure a particular range of mass.

You have now reached the end of the module. Congratulations! Did you enjoy studying this module? Did you learn a lot from it? Tthe following is a summary of its main points to help you remember them better.



Let's Sum Up

- Mass is an intrinsic property of an object that indicates the amount of matter present in the object.
- Weight is the force exerted by a massive body, such as the earth and the moon, on other objects such that this force pulls the other bodies toward the center of the massive body.
- Weight varies with location. Mass, however, remains constant.
- Weight in a particular location can be computed by using the formula

$$w = m \times g$$

where w = weight of the object

m = mass of the object

g = acceleration due to gravity

♦ Table of Measurements of Mass and Weight

1 kilogram (kg) = 1000
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1 pound (lb.) = 4.45 kilc squared ($kg \cdot m/s^2$)
1 ton (T) = 907.2 kilogra

♦ Mass and weight can be measured using instruments such as the platform scale, weighing scale and platform balance and digital weighing scale.

♦ Each measuring equipment is designed to measure a particular range of mass.

What Have You Learned?

A. Fill in each blank with the appropriate word to complete the sentence. Choose from the words inside the box.

Mass and weight are two closely related concepts. 1.____________ is an intrinsic property of a material that indicates the amount of matter present in the object. On the other hand, the force exerted by a 2.____________object on other objects such that it pulls the other objects toward its center is called 3.____________. Its value can be computed by getting the product of the mass of the object and the 4.____________ in its particular location.

For mass, the units of measurement are 5.____________, 6.___________ and 7.____________ while 8.____________, 9.____________, 10.____________ and 11.____________ are the units of weight.

Unlike before when the mass and weight of objects were measured using 12.___________, measuring mass and weight has now become a lot easier with the help of different measuring instruments such as 13.___________, 14.___________ , 15.___________ and 16. _________.

kilogram	pound	digital weighing scale
gram	mass	acceleration due to gravity
weight	ton	corn kernels and fruit seeds
ounce	milligram	platform scale
platform balance	massive	weighing scale
kilogram-meter per second squared		

B. Solve the following problems. Perform conversions whenever necessary.

1. Kristina went to the market to buy 1.5 kilos of sugar. One vendor is selling sugar at ₱35 per kilo. Another is selling sugar at ₱8.50 per 250 grams. From which vendor should Kristina buy sugar? Indicate how much money she would be able to save.

2. Three astronauts landed on the moon for an exploration. They happened to have brought with them a weighing scale. Out of curiosity, they decided to weigh themselves and got the following results:

   Astronaut 1: 82 $kg{\cdot}m/s^2$

   Astronaut 2: 90.2 $kg{\cdot}m/s^2$

   Astronaut 3: 99.6 $kg{\cdot}m/s^2$

   Suppose that the acceleration due to gravity on the moon and on the earth is equal to 1.64 m/s^2 and 9.81 m/s^2, respectively. What is the weight of each astronaut on earth in pounds?

Compare your answers with those in the *Answer Key* on pages 28 and 29. If you got a score of:

17–18 Very good! You learned a lot from this module. You are now ready to move on to the next module.

10–16 Good! Just review the parts of the parts of the module you did not understand very well before moving on to the next module.

0–9 You should study the whole module agan.

Answer Key

A. Let's See What You Already Know *(pages 2–3)*

A. 1. Mass is an intrinsic property of a material. It is the amount of matter present in a body.

2. Weight is the force exerted by a massive object on other objects such that it pulls these other objects toward its center.

B.

M	kilogram	X	meter	W	ton
W	pound	W	ounce	M	gram
X	centimeter	M	milligram	X	second

C. 1. The conversion factor is: $1\,\text{kg} = 1000\,\text{g}$

In ratio form, the conversion factor is $\dfrac{1000\,\text{g}}{1\,\text{kg}}$

$$3\,\cancel{\text{kg}} \times \frac{1000\,\text{gm}}{1\,\cancel{\text{kg}}} = 3000\,\text{grams}$$

2. a. Kilos of corn consumed every week =

$$200\,\cancel{\text{chickens}} \times \frac{2\ \text{kilos of corn consumed}}{\cancel{1\,\text{chicken}}} = 400\ \text{kilos}$$

b. The conversion factor is $1\,\text{kg} = 2.2\,\text{lb.}$

Conversion factor in ratio form: $\dfrac{2.2\,\text{lb.}}{\text{kg}}$

$$400\,\cancel{\text{kg}} \times \frac{2.2\,\text{lb.}}{1\,\cancel{\text{kg}}} = 880\,\text{lb.}$$

3. weight of astronaut on the moon = mass of astronaut × acceleration due to gravity on the moon

$$\begin{aligned} w_{\text{moon}} &= m \times g_{\text{moon}} \\ &= 67\ \text{kg} \times 1.64\ \text{m/s}^2 \\ &= 109.88\,\text{kg}\cdot\text{m/s}^2 \end{aligned}$$

B. Lesson 1

Let's Try This (page 6)

Answers will vary. The following is a sample answer.

Mass is an intrinsic property of an object that tells the amount of matter present in the object while weight is the force exerted by a massive object on other objects such that the other objects are pulled toward the center of the massive object.

Let's Try This (page 10)

1. **STEP 1** A person spills 0.001 kg rice in a day.

   STEP 2 Find out how many kilograms of rice are spilled by one person in a year given that a year has 365 days.

   STEP 3 number of kilograms of rice spilled by one person each year

   $$= 365\,\cancel{\text{days}} \times \frac{0.001\,\text{kg}}{\cancel{\text{day}}}$$

   STEP 4 number of kilograms of rice spilled by one person in a year

   $$= 365\,\cancel{\text{days}} \times \frac{0.001\,\text{kg}}{\cancel{\text{day}}}$$

   $$= 0.365\text{ kg}$$

   STEP 5 Therefore, a person actually wastes 0.365 kg of rice through spillage each year.

2. **STEP 1** Marko's weight on earth = 45 kg

   g on Mars = 3.7 m/s^2

   STEP 2 Find out what Marko's weight on Mars is.

   STEP 3 To be able to find Marko's weight on Mars, we need to find his mass first. We know that Marko's weight on earth is 45 kg and the acceleration due to gravity on earth is 9.81 m/s^2.

   You can solve for his mass using the equation $w = mg$.

   $$w_{\text{earth}} = m \times g_{\text{earth}}$$

   $$m = \frac{w_{\text{earth}}}{g_{\text{earth}}}$$

You can use the same formula to get Marko's weight on Mars:

$w_{\text{Mars}} = m \times g_{\text{Mars}}$

Substituting the value of *m* in the above equation, you will arrive at this equation:

$$w_{\text{Mars}} = \frac{w_{\text{earth}}}{g_{\text{earth}}} \times g_{\text{Mars}}$$

STEP 4

$$\begin{aligned} w_{\text{Mars}} &= \frac{w_{\text{earth}}}{g_{\text{earth}}} \times g_{\text{Mars}} \\ &= \frac{587.4\ \text{kg} \cdot \text{m/s}^2}{9.81\ \cancel{\text{m/s}^2}} \times 3.7\ \cancel{\text{m/s}^2} \\ &= 221.55\ \text{kg} \cdot \text{m/s}^2 \end{aligned}$$

STEP 5 Therefore, the reading on the weighing scale would be 221.5 kg·m/s^2.

Let's See What You Have Learned (pages 10–11)

A. 1. weight

2. mass

3. acceleration due to gravity

4. mass

5. multiplication

B. 1. $\frac{₱15}{1\ \cancel{\text{kilo}}} \times 600\ \cancel{\text{kilos}} = ₱9000$

It would be better and cheaper to use the mixture since 600 kilos of the mixture only costs ₱9000, unlike the corn feed that costs ₱12000 per 600 kilos.

2. $w_{\text{earth}} = m \times g_{\text{earth}}$

588.6 kg·m/s^2 = m × 9.81 m/s^2

$$m = \frac{588.6\ \text{kg} \cdot \cancel{\text{m/s}^2}}{9.81\ \cancel{\text{m/s}^2}} = 60\ \text{kg}$$

Getting the weight of each on the moon:

w_{moon} = 60 kilograms × 1.64 m/s^2 = 98.4 kg·m/s^2

Since we need the combined weights of the three, we just multiply the weight on the moon by 3.

$98.4\ kg{\cdot}m/s^2 \times 3 = 295.2\ kg{\cdot}m/s^2$

C. Lesson 2

Let's Try This (pages 17–18)

1. platform equal arm balance

   chemicals, small amounts of solid mixtures

2. weighing scale

   meat, fish, rice

3. platform scale

   cement, sand, gravel

4. digital weighing scale

   chemicals, food

Let's See What You Have Learned (page 20)

A. 1. $2\,\cancel{kg} \times \frac{1000\,g}{1\,\cancel{kg}} = 2000\,g$

2. $2\,\cancel{T} \times \frac{907.2\,kg}{1\,\cancel{T}} = 1814.4\ kg$

3. $48\,\cancel{oz.} \times \frac{1\ lb.}{16\,\cancel{oz.}} = 3\,lb.$

4. $10\,\cancel{lb.} \times \frac{4.45\ kg \cdot m/s^2}{1\,\cancel{lb.}} = 44.5\,kg \cdot m/s^2$

5. $220\,\cancel{lb.} \times \frac{1\,kg}{2.2\,\cancel{lb.}} = 100\,kg$

$100\,\cancel{kg} \times \frac{1000\,g}{1\,\cancel{kg}} = 100000\,g$

$100000\,\cancel{g} \times \frac{1000\,mg}{1\,\cancel{g}} = 100000000\,mg$

B. 1. $5350\,\cancel{g} \times \dfrac{1\,kg}{1000\,\cancel{g}} = 5.35\,kg$

2. $4\,\cancel{kg} \times \dfrac{2.2\,lb.}{1\,\cancel{kg}} = 88\,lb.$

Ben weighs 89 lb. Therefore, Ben weighs more than Mark does.

D. What Have You Learned? *(pages 22–23)*

A. 1. Mass

2. massive

3. weight

4. acceleration due to gravity

5. kilogram

6. gram

7. milligram

8. ton

9. ounce

10. pound

11. kilogram-meter per second squared

12. corn kernels and fruit seeds

13. platform scale

14. weighing scale

15. platform balance

B. 1. Vendor 1:

$$1.5\,kg \times \frac{₱35}{1\,kg} = ₱52.50$$

Vendor 2:

$$1.5\,kg \times \frac{1000\,grams}{1\,kg} = 1500\,g$$

$$1500\,g \times \frac{₱8.50}{250\,g} = ₱51.00$$

Therefore, Kristina should buy sugar from the vendor who sells it at ₱8.50 per 250 grams so that she can save ₱1.50.

2. Astronaut 1:

$$\begin{aligned} w_{\text{moon}} &= m \times g_{\text{moon}} \\ m &= \frac{w_{\text{moon}}}{g_{\text{moon}}} \\ &= \frac{82\ \text{kg} \cdot \cancel{\text{m/s}^2}}{1.64\ \cancel{\text{m/s}^2}} \\ &= 50\ \text{kg} \end{aligned}$$

$$w_{\text{earth}} = 50\ \text{kg} \times 9.81\ \text{m/s}^2 = 490.5\ \text{kg} \cdot \text{m/s}^2$$

$$490.5\ \cancel{\text{kg} \cdot \text{m/s}^2} \times \frac{1\ \text{lb.}}{4.45\ \cancel{\text{kg} \cdot \text{m/s}^2}} = 110.22\ \text{lb.}$$

Astronaut 2:

$$\begin{aligned} w_{\text{moon}} &= m \times g_{\text{moon}} \\ m &= \frac{w_{\text{moon}}}{\text{g}_{\text{moon}}} \\ &= \frac{90.2\ \text{kg} \cdot \cancel{\text{m/s}^2}}{1.64\ \cancel{\text{m/s}^2}} \\ &= 55\ \text{kg} \end{aligned}$$

$$w_{\text{earth}} = 55\ \text{kg} \times 9.81\ \text{m/s}^2 = 539.55\ \text{kg} \cdot \text{m/s}^2$$

$$539.55\ \cancel{\text{kg} \cdot \text{m/s}^2} \times \frac{1\ \text{lb.}}{4.45\ \cancel{\text{kg} \cdot \text{m/s}^2}} = 121.25\ \text{lb.}$$

Astronaut 3:

$$\begin{aligned} w_{\text{moon}} &= m \times g_{\text{moon}} \\ m &= \frac{w_{\text{moon}}}{g_{\text{moon}}} \\ &= \frac{101.7\ \text{kg} \cdot \cancel{\text{m/s}^2}}{1.64\ \cancel{\text{m/s}^2}} \\ &= 62\ \text{kg} \end{aligned}$$

$$w_{\text{earth}} = 62\ \text{kg} \times 9.81\ \text{m/s}^2 = 608.22\ \text{kg} \cdot \text{m/s}^2$$

$$608.22\ \cancel{\text{kg} \cdot \text{m/s}^2} \times \frac{1\ \text{lb.}}{4.45\ \cancel{\text{kg} \cdot \text{m/s}^2}} = 136.7\ \text{lb.}$$