

Wheels Diameter / Distance Traveled

Note to the teacher

On these pages, students will learn about the relationships between wheel radius, diameter, circumference, revolutions and distance. Students will use formulas relating these measurements to compute the distance a wheel of given diameter travels for a given number of wheel revolutions. Students will have to use both fractions and decimals to make these calculations. While the worksheet is designed to help students learn the geometry of the circle and the relationship between wheel size, revolutions and distance, and may be completed by students with little background in these areas, the existing ability to multiply fractions and decimals will be necessary to successfully complete the worksheet. Teachers may wish to review any or all of these skills depending on their students' background.

Note that there are no instructions regarding rounding. The answers assume rounding to 2 digits beyond the decimal place, except for known fractions. Teachers may wish to supply additional instructions. If they do not, students' answers will vary slightly according to what rounding conventions they use.

The illustration below explains and reinforces the relationships between radius, diameter and circumference.



Radius is the measurement of a straight line from the center of a circle to the edge. Radius will always equal one half diameter.



Diameter is the measurement of a straight line across the center of an object (in this case a wheel).



The **circumference** of a circle is the total distance around its outside. Circumference equals the diameter of the circle times π (pi), which is about 3.14. One revolution of a wheel will make it move a distance equal to its circumference.

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Instructions

Based on the information provided about the wheels shown on these pages, calculate how far they will travel.

If the wheel below completes 2.3 revolutions, how far will it go? Use the tables below to find the answer.

Diameter		π (pi)		Circumference
1.75"	×	3.14	=	5.5"

Circumference		Revolutions		Distance
5.5"	×	2.3	=	12.65"

After reviewing the concepts, students are expected to use the following procedure:

- Identify the diameter indicated below the pictured wheel (1.)
- Enter it in the box labeled "Diameter"
- Multiply this diameter by π (pi), simplified to 3.14, to find the circumference
- Find the number of revolutions specified in the instructions (2.)
- Enter it in the box labeled "Revolutions"
- Multiply this number by the number calculated for circumference to find the distance the wheel will travel

Approximate classroom time: 10-20 minutes depending on students' background

Students successfully completing the worksheet will be able to:

1. Identify diameter from a labeled drawing
2. Describe the geometry of a circle
3. Describe the relationship between radius, diameter, circumference, revolutions and distance for a wheel
4. Calculate circumference from diameter
5. Calculate distance from wheel circumference and revolutions
6. Multiply decimals and fractions

Standards addressed:

Math Standards

Numbers and Operations
Algebra / Geometry
Measurement
Problem Solving

Technology Standards

The Nature of Technology Standards 1; Design 8, 9

Note: Workbook answers begin on the next page.

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Instructions

Based on the information provided about the wheels shown on these pages, calculate how far they will travel. An example is shown below. Complete the information on the following pages.

Example

If the wheel below makes one revolution, how far will it go? Use the tables below to find the answer.



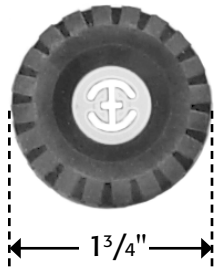
	Diameter		π (pi)		Circumference
①	1.125"	×	3.14	=	3.53"
	Circumference		Revolutions		Distance
②	3.53"	×	1	=	3.53"

Wheels Diameter / Distance Traveled

Instructions

Based on the information provided about the wheels, calculate how far they will travel.

If the wheel below completes 2.3 revolutions, how far will it go? Use the tables below to find the answer.

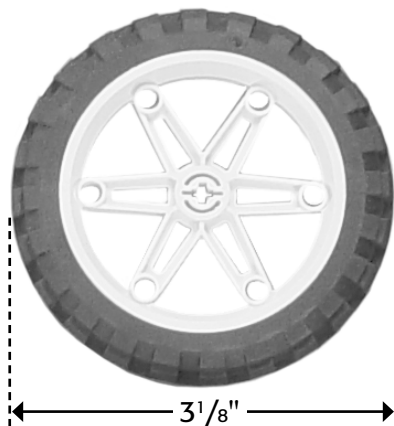


①	Diameter	×	π (pi)	=	Circumference
	1.75"		3.14		5.5"
②	Circumference	×	Revolutions	=	Distance
	5.5"		2.3		12.65"

Since the circumference is equal to $\pi \times D$, it is equal to: **$3.14 \times 1.75" = 5.50"$** .

With the wheel turning 5.50" in one revolution, it would travel: **$5.50" \times 2.3$ revolutions or 12.65" total.**

If the wheel below completes $3\frac{5}{8}$ revolutions, how far will it go? Use the tables below to find the answer.



①	Diameter	×	π (pi)	=	Circumference
	3.125"		3.14		9.81"
②	Circumference	×	Revolutions	=	Distance
	9.81"		3.625		35.56"

Since the circumference is equal to $\pi \times D$, it is equal to: **$3.14 \times 3.125" = 9.81"$** .

With the wheel turning 9.81" in one revolution, it would travel: **$9.81" \times 3.625$ revolutions or 35.56" total.**

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If the wheel below completes $4 \frac{5}{16}$ revolutions, how far will it go? Use the tables below to find the answer.



①	Diameter 1.9375"	×	π (pi) 3.14	=	Circumference 6.08"
②	Circumference 6.08"	×	Revolutions 4.3125	=	Distance 26.22"

As in the previous problems, the first thing to do is to convert the fractional portions of the problem to decimals. The diameter converts from $1 \frac{15}{16}$ " to 1.9375" and the number of rotations converts from $4 \frac{5}{16}$ " to 4.3125".

*The circumference is equal to $\pi \times D$ or: **$3.14 \times 1.9375 = 6.08$ "**.*

*After turning 4.3125 revolutions, the total distance traveled would be: **$6.08" \times 4.3125 = 26.22$ "**.*

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Questions

1. If you want your robot to go 15.748 centimeters and your robot has wheels with diameters of 2.5", how many revolutions must your wheel make?

*The first thing to do is find the circumference of our wheels; that will tell us how far our robot will go in one wheel revolution. Circumference is equal to $\pi \times D$ or: **$3.14 \times 2.5" = 7.85"$** .*

*We obviously can't work with inches and centimeters in the same equation, so the easiest thing to do is convert the circumference from inches to centimeters. The conversion factor is 2.54 cm/inch. If we multiply **7.85 inches x 2.54 cm/inch, we'll get 19.94 cm**, because the inch units in both the numerator and denominator cancel out. The number of revolutions your wheels need to make to go this distance is: **$15.748 / 19.4$ or 0.81 revolutions.***

2. If there were a wheel that had a circumference of 12.36375 cm, what would the diameter be?

*Since we already know the C (circumference) = $\pi \times D$ (diameter), all we have to do is solve the equation for diameter by dividing both sides by π . Once we do that we find out that $D = C/\pi$. In our case the diameter, D , is equal to: **$12.36375 / 3.14$ or 3.94 cm.***

3. If I wanted my robot to win a 2 meter race, what wheels would I use and how many revolutions would it have to make? (Hint: To win the race, you should try to go the fewest number of revolutions. You may have to go over 2 meters.)

Assuming that all the robots are driven by motors with the same speed, it will be the robot with the largest wheels that will win because those wheels will make the least number of revolutions. The largest wheels we have available to us are the ones with a $3 \frac{1}{8}"$ diameter.

We already calculated that this wheel has a circumference of 9.81 inches, but we need to convert the circumference to centimeters. Remember that the conversion factor is 2.54 cm/inch. Just as we did previously, if we multiply the 9.81 inch circumference x 2.54 cm/inch, we get 24.92 centimeters (remember how the inches cancelled out in both the numerator and denominator). The great thing about the metric system is that all measurements are easily convertible (we don't have to remember that there are 12 inches in a foot or that there are 5280 feet in a mile); in the metric system, there are 100 centimeters in a meter and 1000 meters in a kilometer. Our 2 meter race course can also be measured as 200 centimeters long.

*So, if we want to know how many revolutions our wheels have to turn, we divide 200 centimeters by 24.92 centimeters/revolution (remember the circumference is how far the wheel goes in one revolution). The number of revolutions is equal to: **$200 \text{ cm}/24.92 \text{ (cm/revolution)} = 8.03$ revolutions.***