

PART 3 MODULE 6

GEOMETRY: UNITS OF GEOMETRIC MEASURE

LINEAR MEASURE

In geometry, linear measure is the measure of **distance**. For instance, **lengths, heights,** and **widths** of geometric figures are distances, as are the **radius, diameter** and **circumference** of a circle. The **perimeter** of a figure is another example of distance.

Distance is measured in *linear units*, such as inches, feet, yards, miles, meters, centimeters, millimeters and kilometers. There are many other units of linear measure, but those listed above are commonly used.

CONVERTING LINEAR UNITS

In the United States, any educated person should be aware of the following relationships among basic units of linear measure in the English system (inches, feet, yards, miles), and among the basic units of linear measure in the metric system (meters, centimeters, millimeters, kilometers).

1 foot = 12 inches

1 yard = 3 feet

1 yard = 36 inches

1 mile = 5280 feet

1 meter = 1000 millimeters

1 meter = 100 centimeters

1 kilometer = 1000 meters

EXAMPLE 3.6.1

1. How many feet are in 13 yards?
2. How many inches are in 4 yards?
3. How many meters are in 3 kilometers?
4. How many feet are in 120 inches?
5. How many meters are in 820 centimeters?
6. How many miles are in 2000 feet?

EXAMPLE 3.6.1 SOLUTIONS

Notice that in the list of conversions given above, the units of measure in the left-hand column are larger than the corresponding units in the right-hand column. We convert from larger units to smaller units by multiplying (for instance, to convert from yards to inches we multiply by 36); we convert from smaller units to larger units by dividing (for instance, to convert from centimeters to meters we divide by 100).

1. To convert 13 yards to feet we multiply by 3.
 $(13 \text{ yards})(3 \text{ feet per yard}) = 39 \text{ feet}$
2. To convert 4 yards to inches we multiply by 36.
 $(4 \text{ yards})(36 \text{ inches per yard}) = 144 \text{ inches}$
3. To convert 3 kilometers to meters we multiply by 1000.
 $(3 \text{ km})(1000 \text{ m per km}) = 3000 \text{ meters}$
4. To convert 120 inches to feet we divide by 12.
 $120/12 = 10 \text{ feet}$
5. To convert 820 centimeters to meters we divide by 100.
 $820/100 = 8.2 \text{ meters}$
6. To convert 20000 feet to miles we divide by 5280.
 $20000/5280 = 3.88 \text{ miles (we have rounded to two decimal places)}$

SQUARE MEASURE and CUBIC MEASURE

Square units (such as square inches or square centimeters) are used to describe the **area** of a two-dimensional figure. Area is the amount of 2-dimensional space covered by an object, for instance.

To understand the difference between linear measure and square measure, you must realize (for example) that **one square inch** is the area of a **square** that is 1 inch wide and 1 inch high.

Cubic units (such as cubic meters or cubic yards) are used to describe the **volume** of a three-dimensional figure. Volume is the amount of 3-dimensional space occupied by a solid object, for instance, or the amount of fluid that can be contained in a hollow vessel.

To understand the difference between linear measure and cubic measure, you must realize (for example) that **cubic inch** is the volume of a **cube** that is 1 inch long, 1 inch wide and 1 inch high.

CONVERSIONS INVOLVING SQUARE MEASURE OR CUBIC MEASURE

EXAMPLE 3.6.2

How many square inches are in 2 square yards?

EXAMPLE 3.6.2 SOLUTION

We might expect that to convert square yards to square inches we multiply by 36. This is not correct, however. We must understand that the meaning of "square" is both geometric and algebraic: "1 square yard" means "1 yard \times 1 yard"

$$1 \text{ square yard} = 1 \text{ yard} \times 1 \text{ yard}$$

$$1 \text{ square yard} = (36 \text{ inches})(36 \text{ inches}) = 1296 \text{ square inches}$$

$$2 \text{ square yards} = 2(1296) = 2592 \text{ square inches}$$

$$= 2592 \text{ square inches}$$

EXAMPLE 3.6.3

How many cubic feet are in 10 cubic yards?

EXAMPLE 3.6.2 SOLUTION

We might expect that to convert cubic yards to cubic feet we multiply by 3. This is not correct, however. We must understand the meaning of "cubic," which is both geometric and algebraic:

"1 cubic yard" means " 1 yard \times 1 yard \times 1 yard"

$$1 \text{ cubic yard} = (1 \text{ yard})(1 \text{ yard})(1 \text{ yard})$$

$$1 \text{ cubic yard} = (3 \text{ feet})(3 \text{ feet})(3 \text{ feet}) = 27 \text{ cubic feet}$$

$$10 \text{ cubic yards} = 10(27) = 270 \text{ cubic feet}$$

WORLD WIDE WEB NOTE

For additional practice on problems like these visit the companion website and try THE BIG UNIT-IZER.

PRACTICE EXERCISES

1. How many square feet are in 5 square yards? A. 135 B. 15 C. 45 D. 9
2. How many cubic inches are in 6 cubic yards?
A. 216 B. 10368 C. 279936 D.46656
3. There are 100 centimeters in one meter. How many cubic centimeters are in one cubic meter?
A. 100 B. 1,000 C. 10,000 D. 1,000,000
4. How many square yards are in 5184 square feet?
A. 15552 B. 1728 C. 576 D. 46656
5. How many square feet are in 9 square yards? A. 27 B. 1 C. 3 D. 81
6. How many cubic yards are in 90 cubic feet? A. 30 B. 3.333 C. 10 D. 270
7. How many square feet are in 120 square inches?
A. 17280 B. 1440 C. 10 D. 0.833
8. How many square feet are in 8 square yards? A. 72 B. 216 C. 24 D. 64
9. How many cubic yards are in 108 cubic feet?
A. 12 B. 2916 C. 36 D. 4
10. How many square inches are in 2 square feet?
A. 6 B. 24 C. 2592 D. 288
11. How many square inches are in 42 square feet?
A. 6048 B. 0.292 C. 3.5 D. 504
12. How many square feet are in 2160 square inches?
A. 240 B. 180 C. 15 D. 25920

ANSWERS TO PRACTICE EXERCISES

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|------|------|------|-------|-------|-------|
| 1. C | 2. C | 3. D | 4. C | 5. D | 6. B |
| 7. D | 8. A | 9. D | 10. D | 11. A | 12. C |