Book 2

Geometry

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Introduction

Read and study each section. This section gives important information about the history of geometry and mathematics. Complete the geometry exercise at the end. For the exercise, you will need six sheets of ordinary paper.

Leading Figures in Geometry

Cassiodorus, Thales, Pythagoras of Samos, Euclid of Alexandria, Archimedes, Hooke, and Newton.

Fig. 1

Cassiodorus, a statesman, born in Catanzaro, Italy.

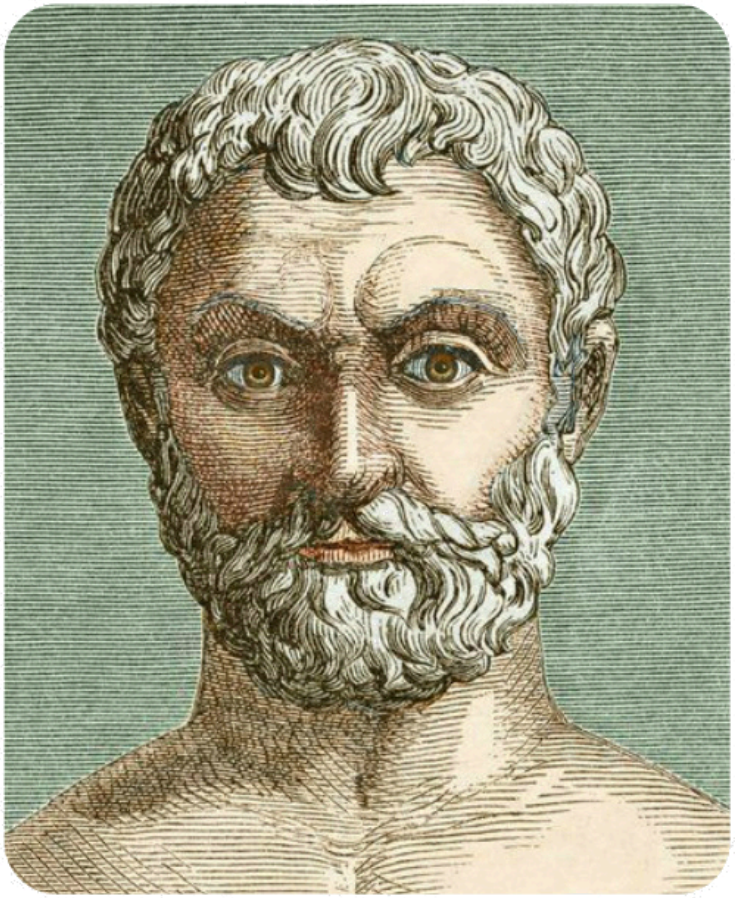


Fig. 2

Thales, born in Miletus, Ionia, 624 years B.C., and died 546 years B.C.

He was a Greek mathematician and philosopher.

Fig. 3

Pythagoras of Samos, who flourished around 520 B. C.

He was a Greek philosopher and mathematician. He made many important mathematician and scientific discoveries, such as the proof of Pythagoras' Theorem.

Fig. 4
Euclid of Alexandria, of 300 B. C., a Greek mathematician. He is the writer of *Elements*, which introduced Euclidean geometry and contains many important proofs in geometry and number theory.

Fig. 5
Archimedes, born in Sicily, Italy, 287 years B. C.

Fig. 6

Robert Hooke, born July 18, 1635, in Freshwater, Isle of Wight, England.

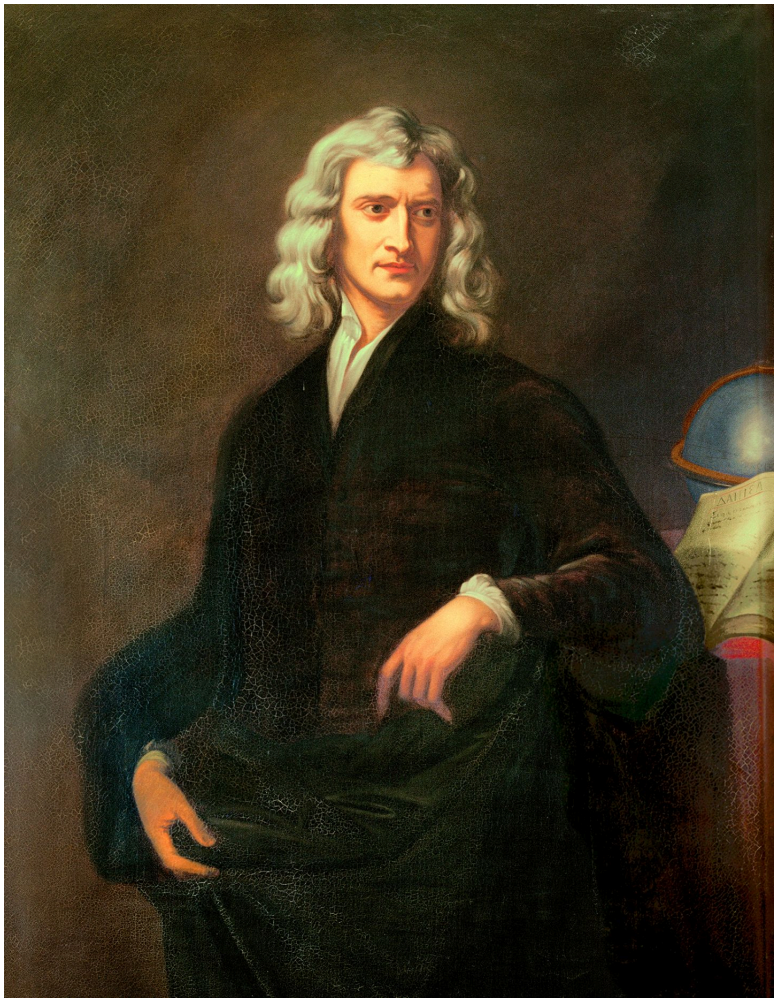


Fig. 7

Isaac Newton, born on January 4, 1643, in Lincolnshire, England.

He was a physicist, mathematician, and astronomer. He wrote *Principia Mathematica*.

Basic Definitions of Geometry

Geometry is the art of measuring land.

A **Point** does not have breadth, length, or thickness.

A **Line** is the distance between two points.

A **Right Line** is a straight line.

A **Curve** is a line that continuously changes direction.

An **Angle** is the opening of two lines meeting in a point.

A **Figure** is a bounded space.

A **Triangle** is a figure with three sides and three angles.

A **Square** has four equal sides, and four right angles.

A **circle** is a plane figure bounded by a curved line running into itself.
Its **diameter** is a straight line drawn from one extremity of its circumference to the other, and its center is equally distant from every part of the circumference.

A **solid** is any body which has length, breadth, and thickness.

A **sphere** is a solid, terminated by a convex surface, every part of which is at an equal distance from a point within, called its center.

Modern squares, with Silas Hawes as the inventor of the modern Carpenter square

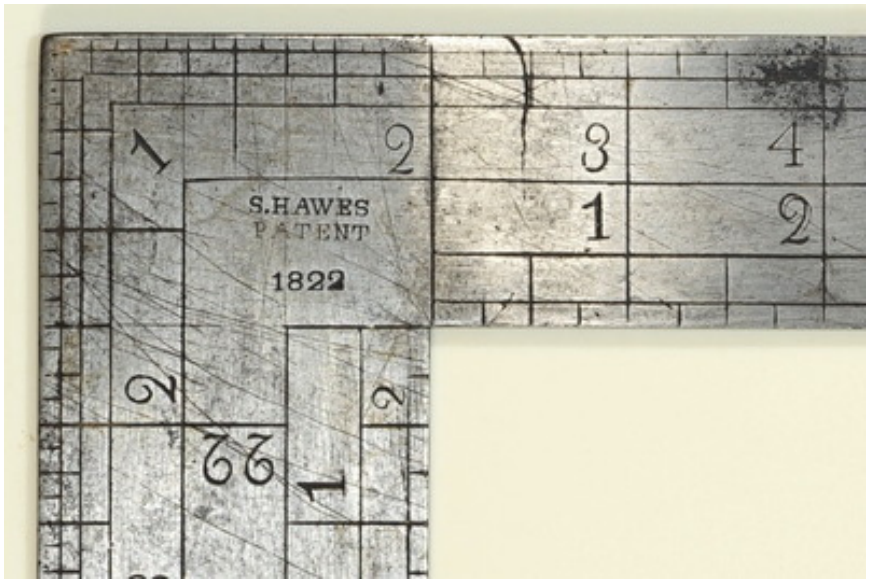
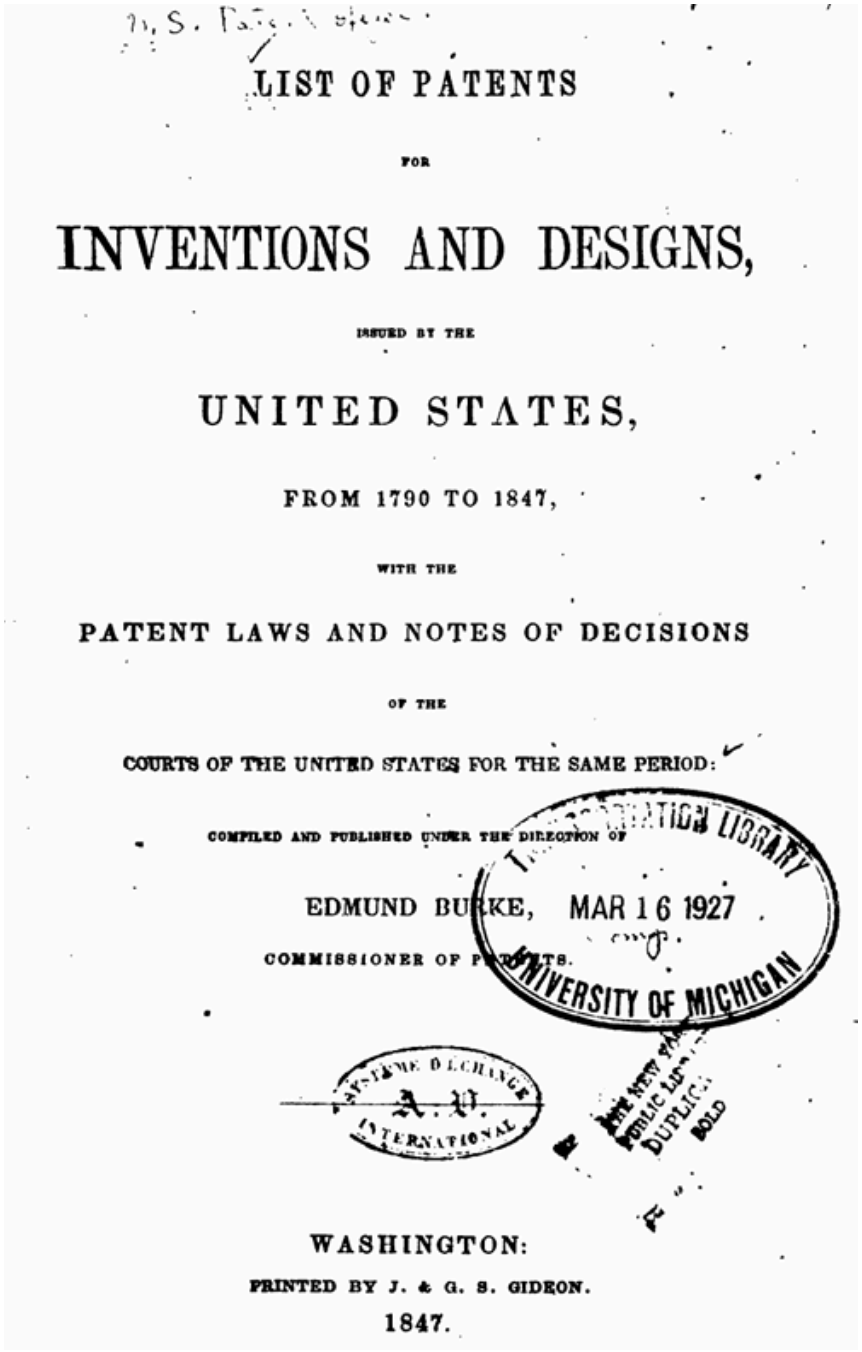


Fig. 8
1822 Silas Hawes Steel Carpenter Square

The patent for the original steel carpenter square is listed in the List of Patents For Inventions and Designs Issued by the United States From 1790 to 1847. The invention is classified under “Lumber, including Machines and Tools for Preparing and Manufacturing such as Sawing, Planing, Mortising, Shingle and Stave, Carpenters’ and Coopers’ Implements”.



LIST OF PATENTS

FOR

INVENTIONS AND DESIGNS,

ISSUED BY THE

UNITED STATES,

FROM 1790 TO 1847,

WITH THE

PATENT LAWS AND NOTES OF DECISIONS

OF THE

COURTS OF THE UNITED STATES FOR THE SAME PERIOD:

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EDMUND BURKE,

COMMISSIONER OF PATENTS.

WASHINGTON:

PRINTED BY J. & G. S. GIDEON.

1847.

Fig. 9
List of Patents For Inventions And Designs, 1847.

INVENTIONS OR DISCOVERIES.	PATENTEES.	RESIDENCE.	WHEN ISSUED.
Shingles and staves, dressing	Daniel Newell	Saratoga, N. Y.	July 26, 1819
Shingles and staves, heading	David Flagg, jr.	New York	Dec. 28, 1832
Shingles and staves, siding laths	Richard Hunt	Carroll, N. Y.	Nov. 19, 1833
Shingles and staves, shaving	Wm. W. Wilkinson	Wayne, Ohio	Sept. 26, 1835
Shingles, veneers, cutting	Robert A. Quatermass	Auburn, Mich	Aug. 17, 1843
Slitting boards	Ez. Olds	Brookfield, Mass.	June 29, 1808
Slitting timber	William Barker	Kingston, Pa.	Mar. 25, 1826
Slitting timber	R. Beale & M. Bucklin	Grafton, N. H.	May 23, 1836
Spade and shovel handles	Harlow Risley	Glastonbury, Ct.	May 1, 1829
Splints, cutting for manufacturing brooms	Lyman Gleason	Le Roy, N. Y.	Oct. 9, 1841
Splints, laths, making and splitting timber	Benjamin Beach	Clarkesville, Ohio	Nov. 10, 1841
Splints, match cutting	John H. Stevens, assignee of Elisha Fitzgerald	New York	July 18, 1840
Splints, match manufacturing	Norman T. Winans & Thaddeus Hyatt	New York	Nov. 26, 1840
Splints, match cutting	John H. Stevens, assignee of Chauncey E. Warner	New York, N. Y.	July 2, 1843
Splitting timber	Daniel Wright	Franklin, N. Y.	Jan. 15, 1818
Spoke shave	Ira L. Beckwith	Quincy, Mass.	April 29, 1837
Square, carpenters'	Cyrus Haws	Bennington Vt.	Dec. 15, 1819
Staves, apparatus for jointing	Horace Baker	McLean, N. Y.	Dec. 9, 1846
Staves, barrel, dressing and jointing	John H. Lester	New London, Conn.	May 9, 1846
Staves for barrels, casks*	Samuel Learned	Ridgway, N. Y.	May 30, 1842
Staves, for barrels, jointing	James Wyman	Boston, Mass.	July 28, 1838
Staves, blind slits, cutting	Hardin Branch	New York, N. Y.	May 3, 1839
Staves, crossing and chiming	Charles F. Beverly	Salem, Ohio	Oct. 16, 1840
Staves, cutting	Jonathan Burt and Erasmus Smith	Sullivan, N. Y.	June 29, 1839
Staves, cutting	Isaac Hosmer and William P. L. Badger	Concord, Mass.	Sept. 2, 1840
Staves, cutting	Cephas Manning	Acton, Mass.	Sept. 10, 1840
Staves, cutting	Oliver Sheldon	NewMarlboro', Mass.	Sept. 10, 1840
Staves, cutting†	Cephas Manning	Acton, Mass.	Sept. 14, 1840
Staves, cutting	Cephas Manning	Acton, Mass.	April 10, 1841
Staves, cutting, for barrels	Thomas Peck	Lenox, N. Y.	Nov. 20, 1837
Staves, cutting, shaving, and jointing	Ebenezer Gregg	Derry, N. H.	Dec. 27, 1833
Staves, cutting, from steamed timber	George Pack	Sullivan, N. Y.	Oct. 10, 1835
Stave machine	John Miner and Silas Merrick	Fallstown, Pa.	Nov. 12, 1845
Staves, cylindrical, for dressing	John R. Averill	Manchester, N. Y.	Dec. 29, 1824
Staves, double, and parallel jointer	Joseph S. Keen	Philadelphia, Pa.	Oct. 1, 1816
Staves, dressing	Levi Benton	Hanover, N. Y.	July 12, 1828
Staves, dressing	Charles B. Goodrich	Rutland, Mass.	Feb. 3, 1829
Staves, dressing	Charles B. Goodrich	Rutland, Mass.	May 10, 1830
Staves, dressing	William Thomas	Pomfret, N. Y.	Oct. 7, 1830
Staves, dressing	John G. Conser	Rebersburg, Pa.	Jan. 31, 1831
Staves, dressing	Lemuel Read and Alfred Willoughby	Rochester, N. Y.	Sept. 16, 1833
Staves, dressing	Ashahel Fairchild	Queensbury, N. Y.	Dec. 17, 1834
Staves, dressing	Joseph Sweet	Boro' of Muncey, Pa.	Oct. 28, 1835
Staves, dressing, for barrels	Solomon Crumber	Puckhorn, Pa.	Mar. 18, 1834
Staves, dressing, heading, and jointing	John G. Tackles	Pomfret, N. Y.	July 20, 1831
Staves, dressing and jointing	Hervey Law	Wilmington, N. C.	July 15, 1840
Staves, dressing, revolving	Charles B. Goodrich	Rutland, Mass.	Feb. 4, 1829
Staves and heads for barrels	Barnabas Langdor and William Mowry	Washington co., N. Y.	June 20, 1811

* Antedated November 30, 1841. † Reissued December 26, 1840.

Fig. 10

Silas Hawes, listed as Cyrus Haws, is the Patentee for the Invention or Discovery of a Carpenters' Square on December 15, 1819.

Fig. 11

4½" Speed Square or Rafter Square.

This speed square, made by Milwaukee, features two cutouts, the right cutout with scribe notches placed at ⅛" increments, and the 3½" ruled straight cutout with 45° corners. All of the white markings are etched on by laser.

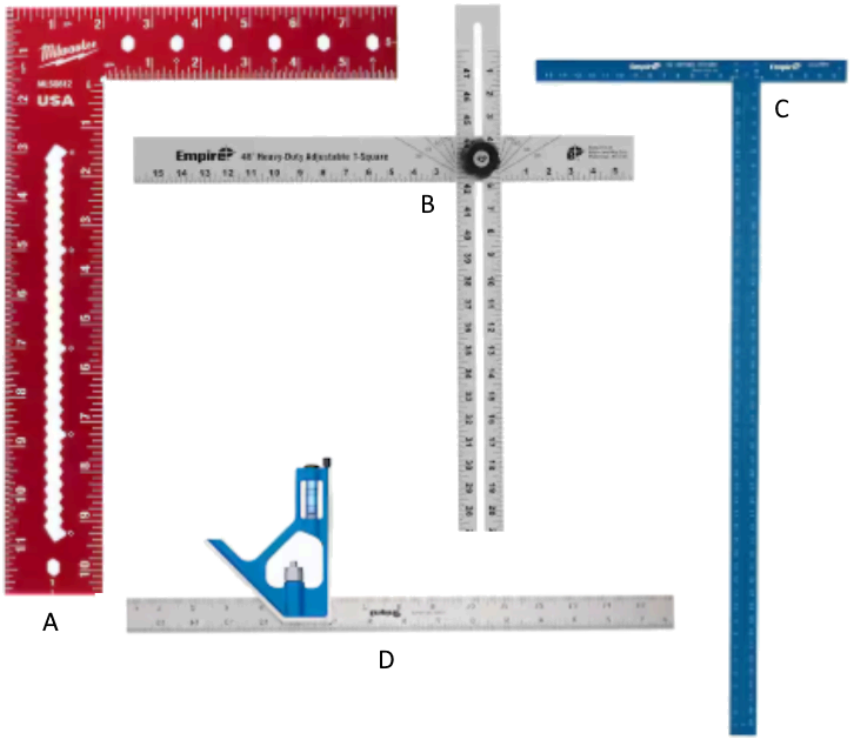


Fig. 12

A. Milwaukee 8x12 inch Framing Square, featuring an ⅛" scribe-guide.

B. Empire 48 in. Adjustable T-Square, featuring an adjustable head that can be set at 30°, 45°, 60°, and 75° angles**.**

C. *Empire 48 in. T-Square*

D. *Empire 16 in. Combination Square, featuring a self-aligning blade lock.*

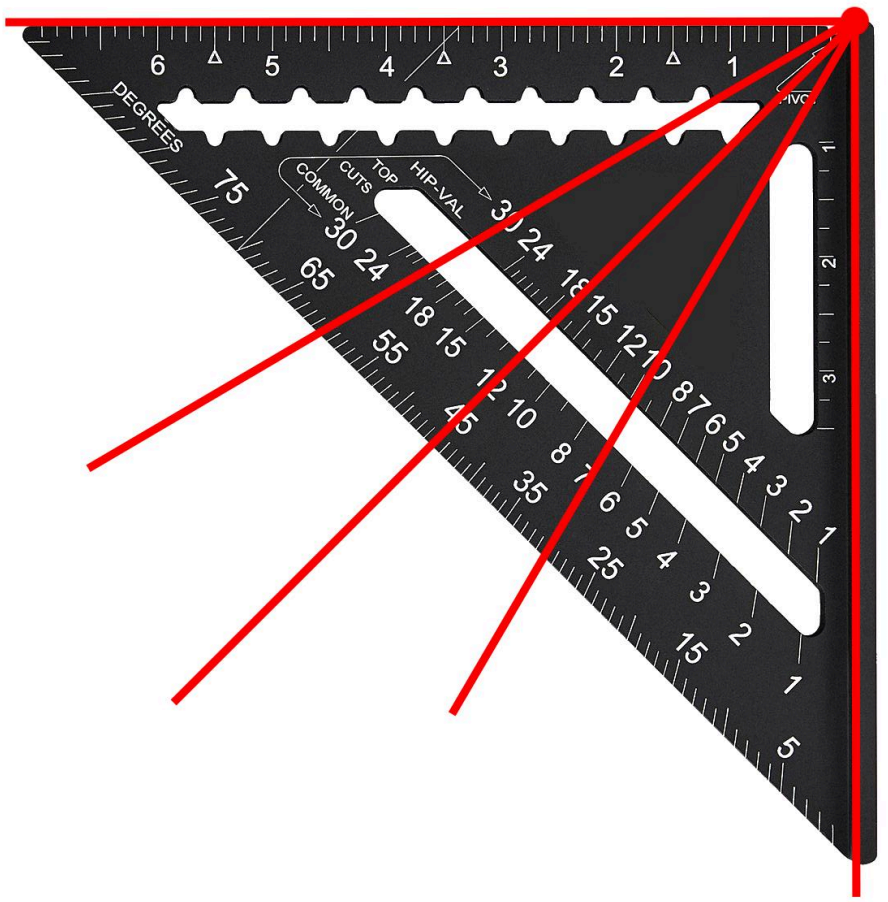


Fig. 13

Measuring 30°, 45°, 60°, and 90° angles on a speed square.

Numbers

1. If two even numbers are added together or subtracted from each other, their sum or difference will be an even number.

Examples:

$$4 + 2 = 6$$

$$8 + 6 = 14$$

$$44 - 28 = 16$$

$$60 + 40 = 76$$

$$108 - 96 = 12$$

$$36 + 40 = 76$$

$$4776 + 8828 = 13604$$

An even number can divide in half with no remainder.

2. If two uneven numbers are added or subtracted, their sum or difference will be an even number.

When an uneven number is divided in half, an extra remains.

Examples:

$$19 + 61 = 80$$

$$15 + 25 = 40$$

$$3 + 11 = 14$$

$$3 + 1 = 4$$

$$15 - 9 = 6$$

$$157 + 83 = 240$$

$$631 - 41 = 590$$

$$301 + 475 = 776$$

3. The sum or difference of an even and an uneven number will be an uneven number.

Examples:

$$68 + 31 = 99$$

$$3 + 6 = 9$$

$$5 + 2 = 7$$

$$3 - 2 = 1$$

$$9 + 16 = 25$$

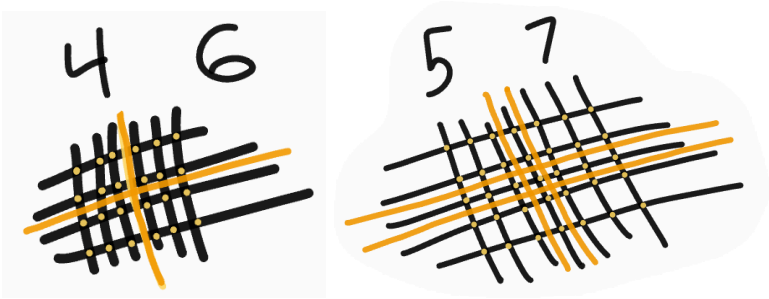
$$223 + 32 = 255$$

$$301 - 76 = 225$$

$$300 - 299 = 1$$

4. The product of two even numbers will be an even number, and the product of two uneven numbers will be an uneven number.

Examples:



$$4 \times 2 = 8$$

$$2 \times 2 = 4$$

$$10 \times 10 = 100$$

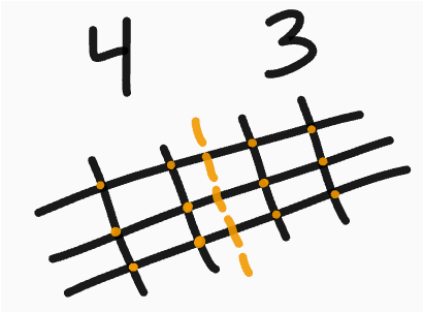
$$9 \times 9 = 81$$

$$11 \times 11 = 121$$

$$50 \times 10 = 500$$

5. The product of an *even* and *uneven* number will be an even number.

Examples:



8 x 9 = 72

10 x 7 = 70

50 x 11 = 550

4 x 3 = 12

8 x 5 = 40

Divisibility

1. If two numbers are divisible by some other number, their sum and difference will also be divisible by the number.

Examples:

9 and 12 are both divisible by 3.

9 + 12 is divisible by 3.

12 - 9 is divisible by 3.

8 and 4 are both divisible by 2.

8 + 4 is divisible by 2.

8 - 4 divisible by 2.

28 and 44 are both divisible by 4.

28 + 44 is divisible by 4.

44 - 28 is divisible by 4.

2. If any number be multiplied by 9, or by any other number divisible by 9, the amount of the figures of the product will be either 9, or a number divisible by 9.

Examples:

5 x 9 = 45

4 + 5 = 9

5 x 81 = 405

4 + 0 + 5 = 9

8 x 27 = 216

2 + 1 + 6 = 9

252 x 81 = 2,268

2 + 2 + 6 + 8 = 18

18 is divisible by 9

9 x 1 = 9

9 x 2 = 18

9 x 3 = 27

9 x 4 = 36

9 x 5 = 45

9 x 6 = 54

9 x 7 = 63

9 x 8 = 72

9 x 9 = 81

9 x 10 = 90

9 x 11 = 99

9 x 12 = 108

9 x 13 = 117

9 x 14 = 126

9 x 15 = 135

Geometric Paper Imprinting

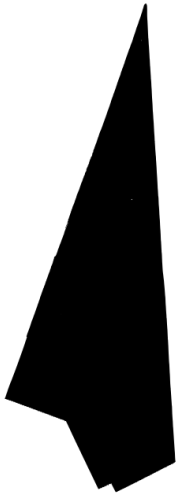
This exercise requires six ordinary sheets of paper and scissors.

The size for a standard sheet of paper is 8.5x11 inches.

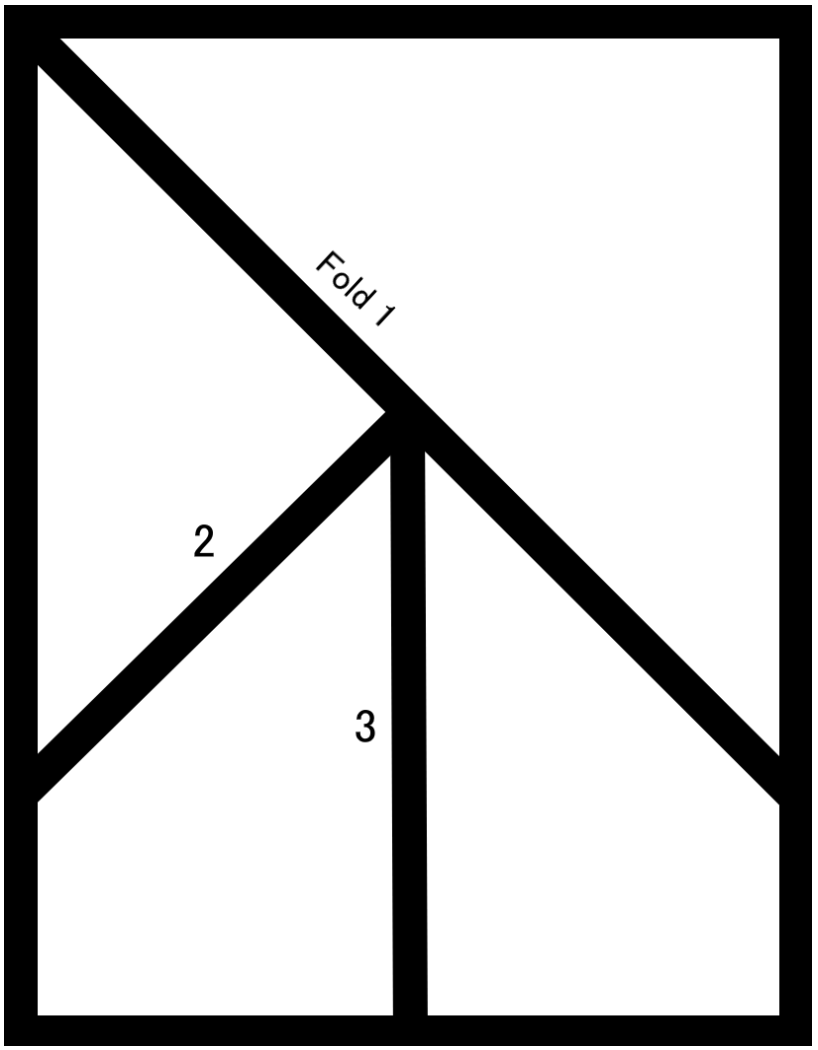
This exercise will show you how to create paper imprints of geometric shapes using single cuts.

To make 2 and 3 folds, follow the Folding Instructions. For a fourth fold, fold the top-right edge to the left side.

Using scissors or by tearing the paper, cut at the positions and angles as shown by the instructions.



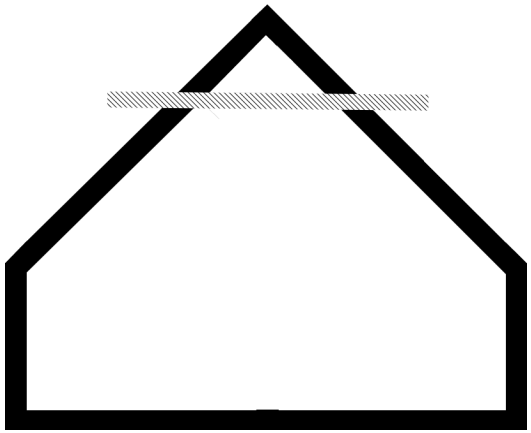
Paper shape when folded four times



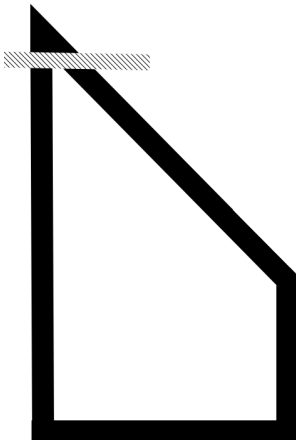
Folding Instructions for up to 3 folds.

To imprint a square,

The cuts at folds 2 and 3 will produce identical shapes. Make a single cut at a straight angle from the top. The distance of the cut from the top will be half the length of the square.



Square Instructions at 2nd fold

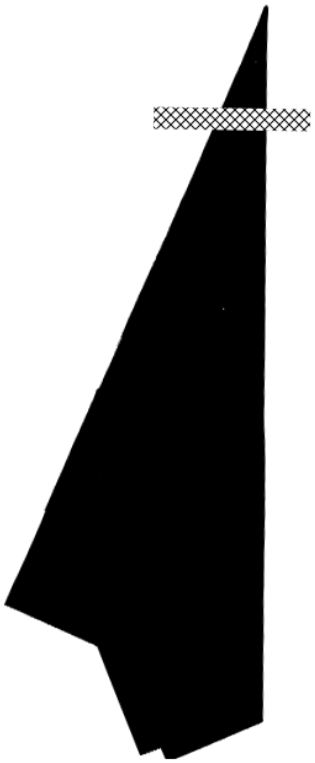


Square Instructions at 3rd fold

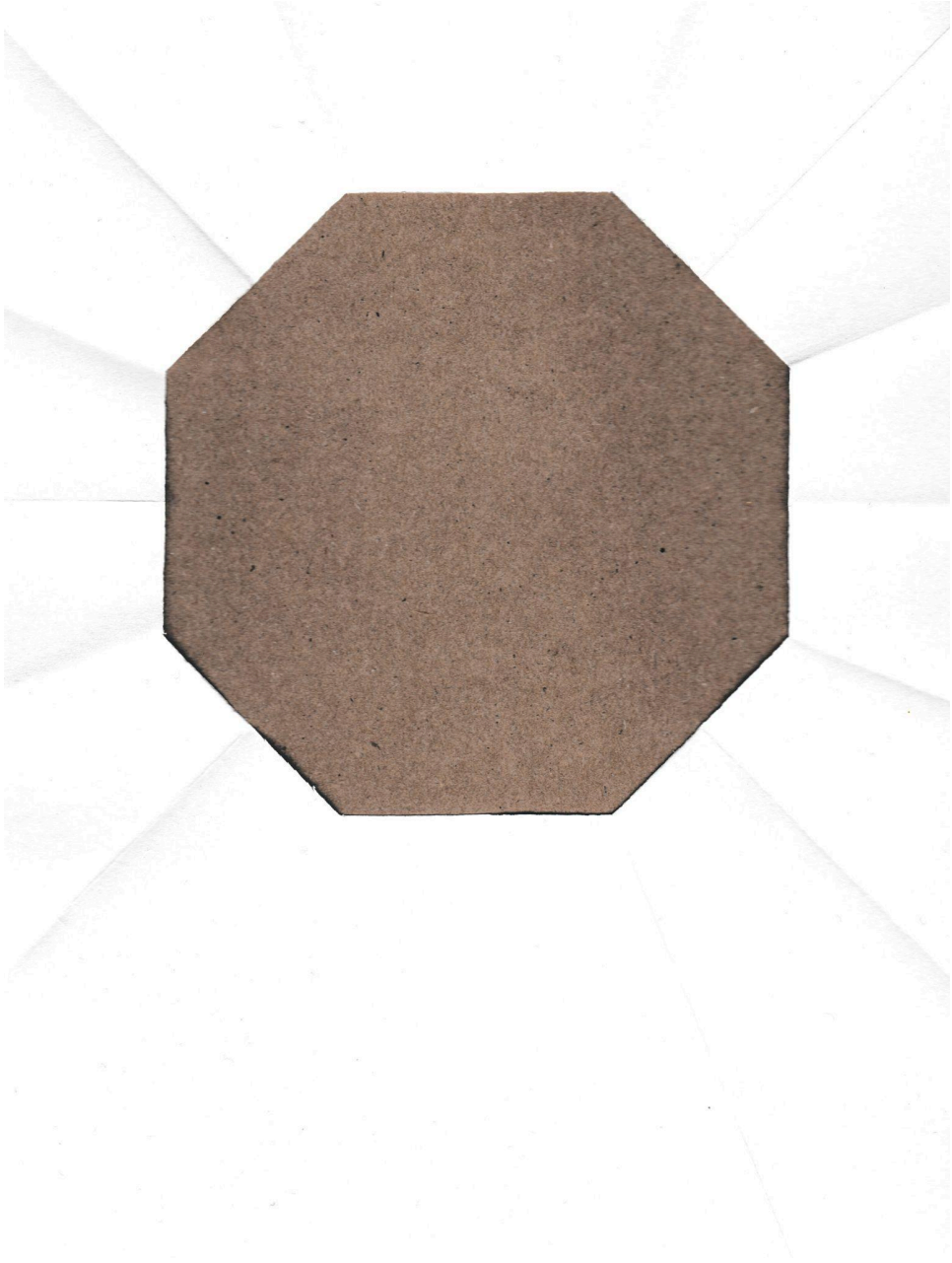
Square

To imprint an octagon,

Make a fourth fold and cut straight from the top, as you would a square. Line up the cut angle with the bottom of the paper.



Octagon Instructions

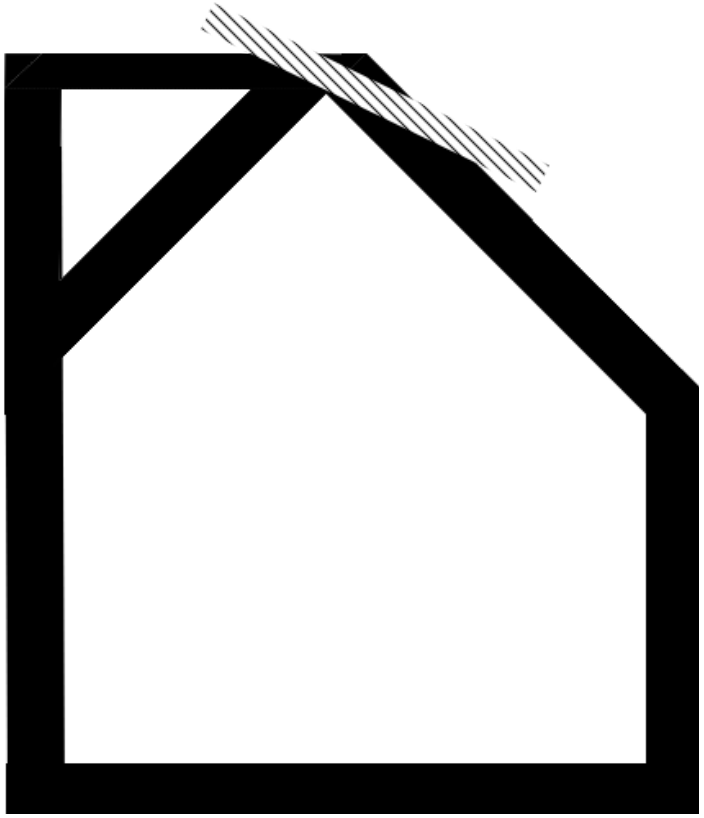


Octagon

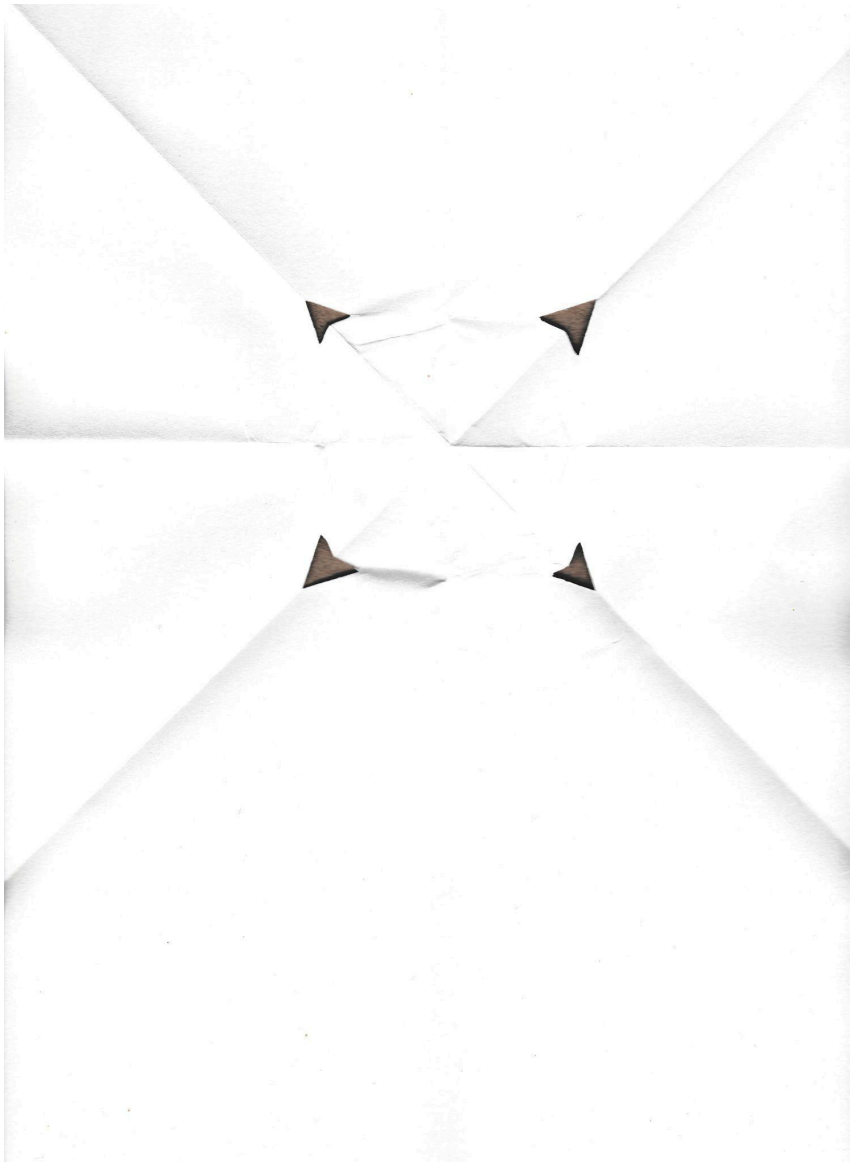
To imprint arrows indicating quadrant diagonals,

Fold back at fold 3, and then cut the side corner.

To cut only one pair of arrows, fold back at fold 2 instead. Then, cutting the right or left corners imprints each pair of arrows.



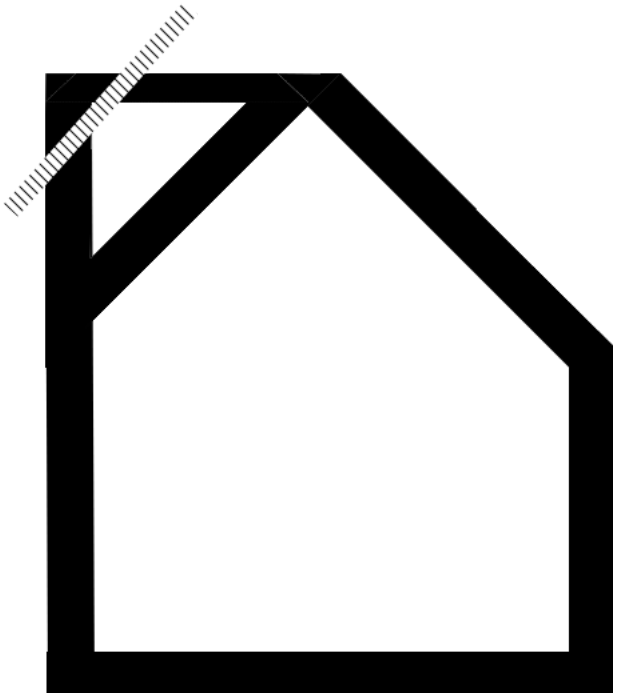
Diagonal Arrows Instructions



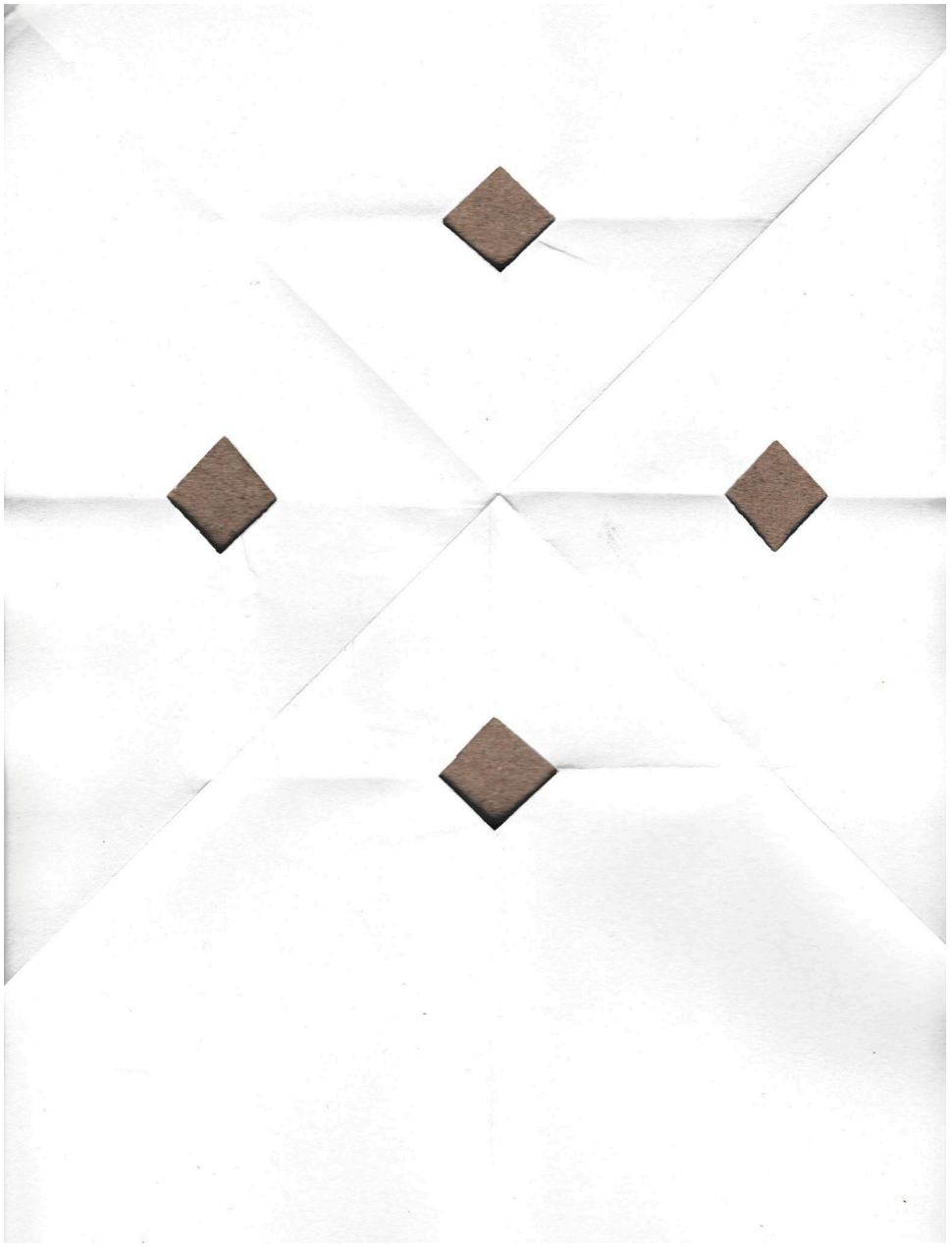
Arrows Indicating Quadrant Diagonals

To imprint quadrant diamond markers,

Fold back at fold 3, and cut the center corner. The length of the fold will determine the distance from the center of the paper to the middle of each diamond.



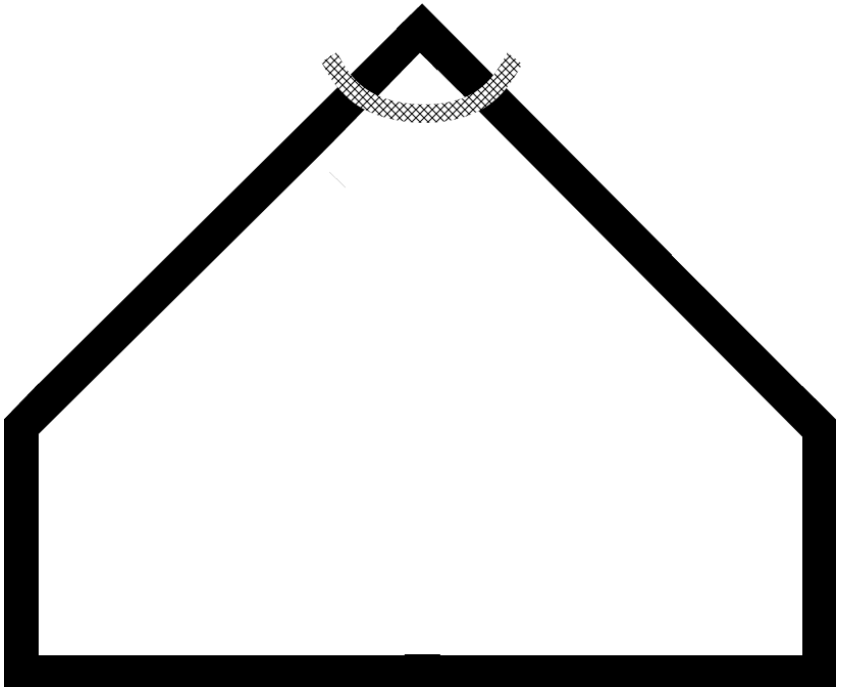
Quadrant Diamonds Instructions



Quadrant Diamond Markers

To imprint a circle,

Do the same as a square, but cut a quarter arc instead of a straight line. Or, use a fourth fold, and cut ⅛ of arc.

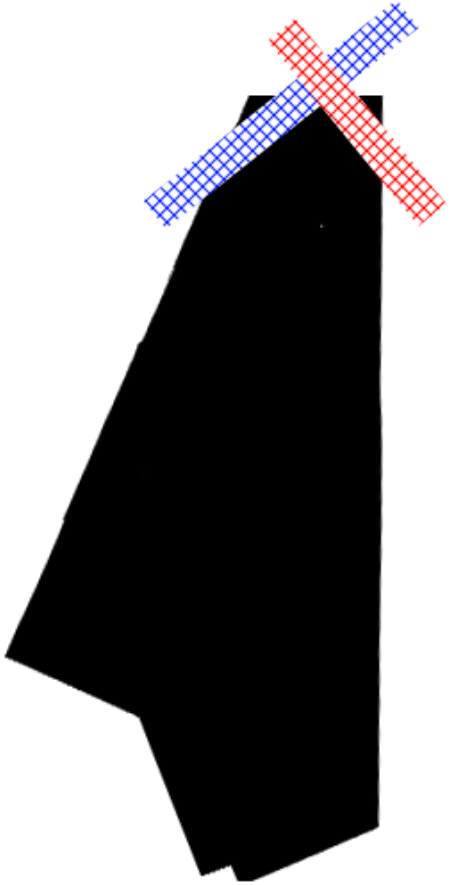


Circle Instructions

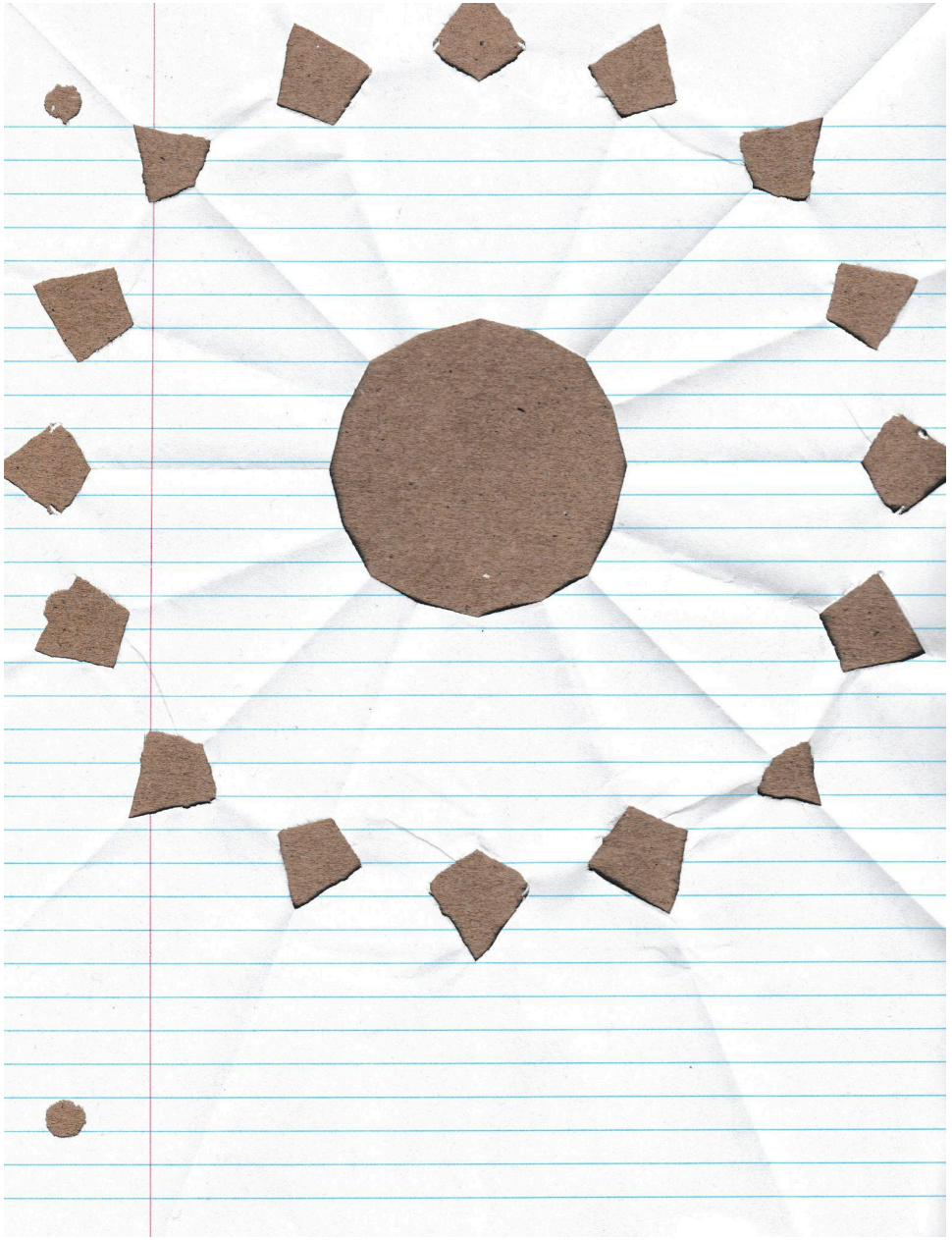
Circle

To imprint a sunflower pattern,

Cut a circle as normal, then cut a 16-arrow ring outline by folding the paper back at the fourth fold, and cutting both corners. Each corner produces 8 impressions forming a ring.



16-Arrow Ring Instructions



Sunflower Pattern