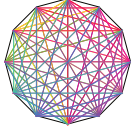
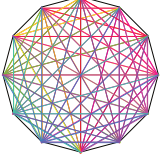


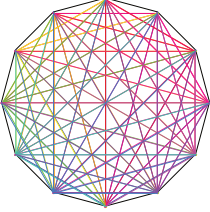

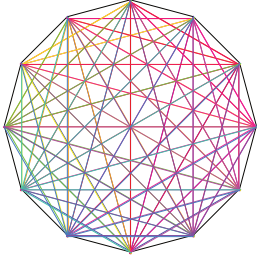
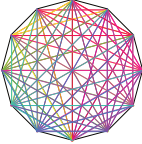
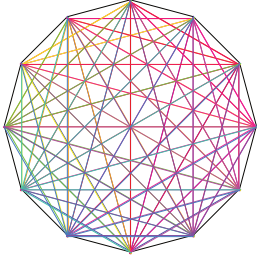

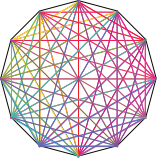


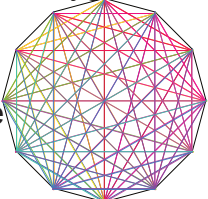
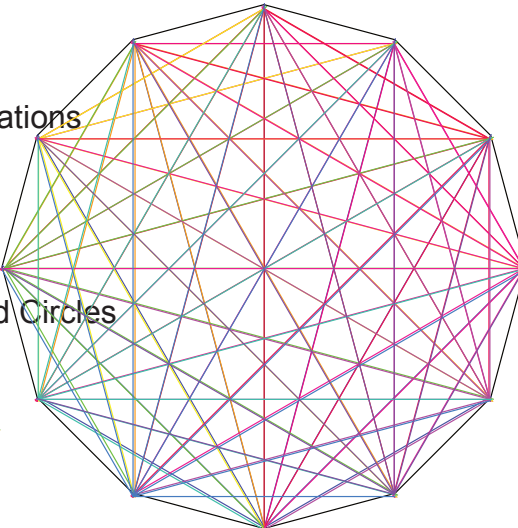


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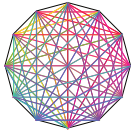
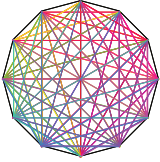


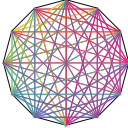

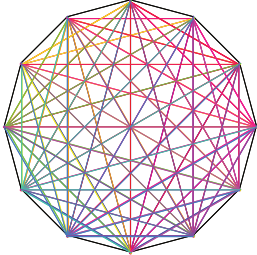
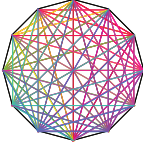
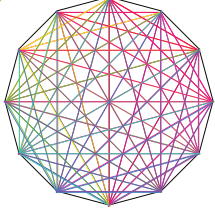
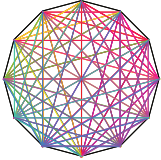



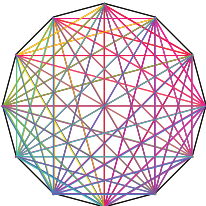
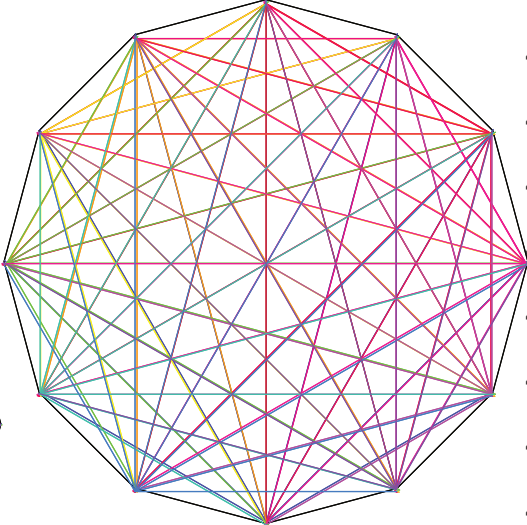
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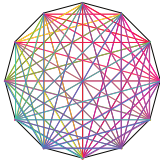


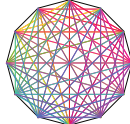

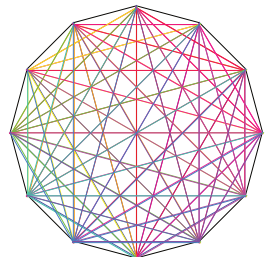
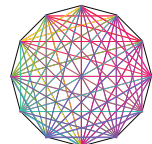
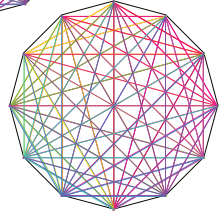

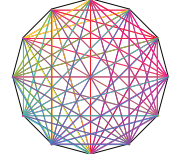


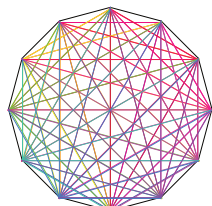
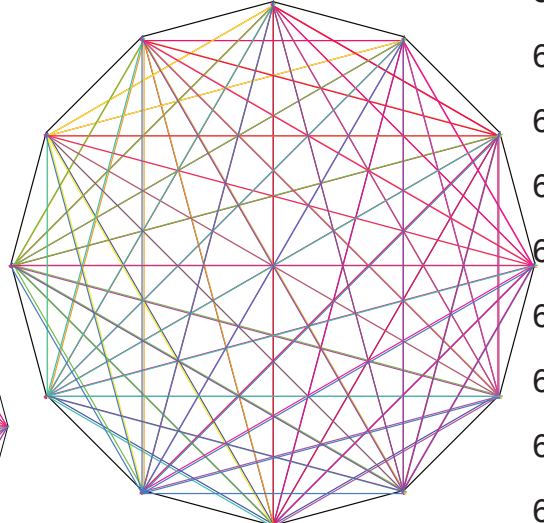
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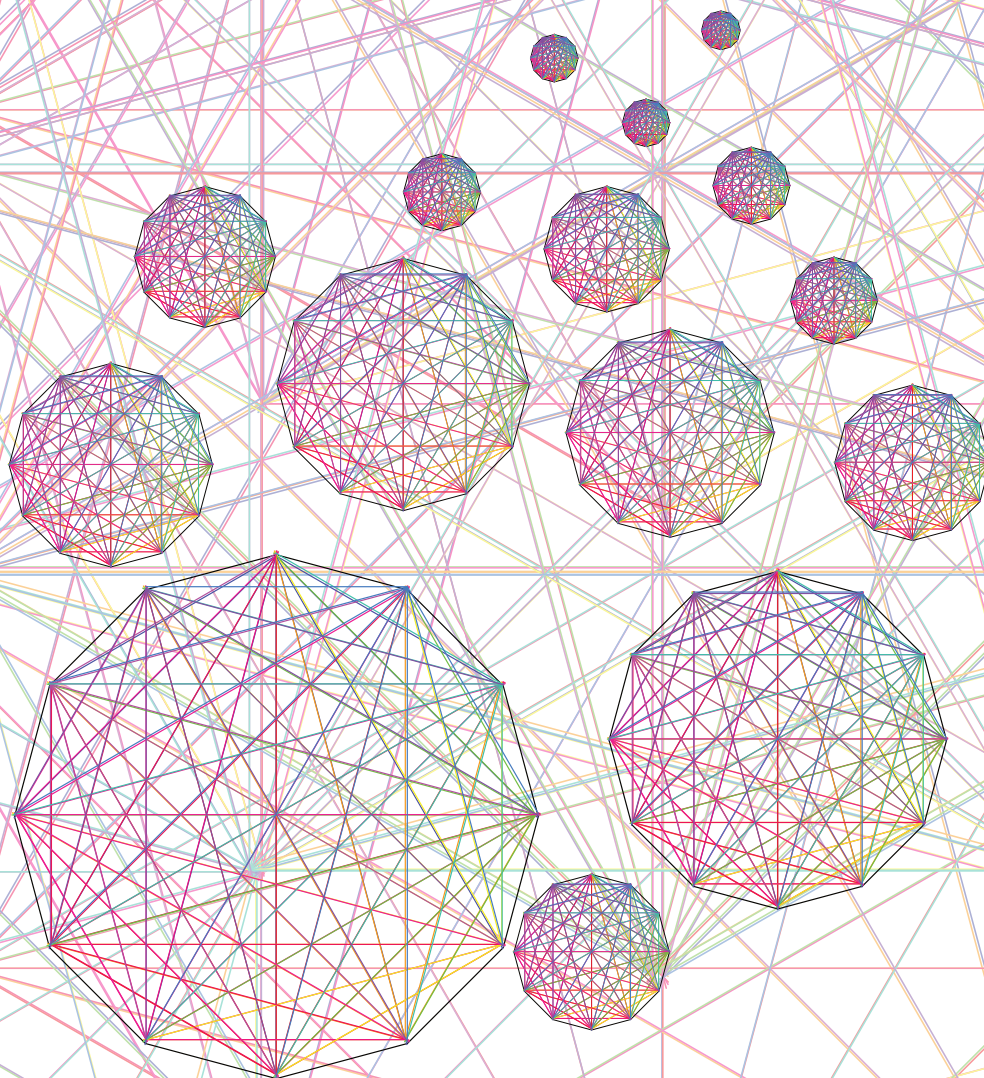
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Symbols and Icons

The hand icon: indicates manipulation with the template that should be observed by the teacher. Also make sure that the student manipulate the template and not the paper.

The ear icon indicates an auditory activity or that an activity will be instruction - based. Make sure that the student follow your step-by-step instructions.

The speech bubbles icon indicates a discussion. This suggests that the student's reasoning and viewpoint should be noted before the activity commences.

The eye icon indicates visual perception. The student should observe how the shapes are used - resulting in a certain perspective.

The scissor icon indicates that shapes should be cut out or block shapes from the shape set should be used.

The games icon indicates that there will be a games-based activity in the MATHOMAT Games & Activities manual that relates to the example of work that is shown in this document.

Handy hints and tips will be shown with a red check-mark. Ideas might often include topics / terminology / fields that may not have been done yet. These are merely suggestions that the teacher may use at his/her own discretion.

The lightbulb icon indicates that there is an idea to incorporate the work being discussed to bridge into a different field or topic or to revise a certain concept from another field with the current topic.

This document sets out to showcase the uses and diversity of the template. These lessons are by no means the full extend of what can be taught using MATHOMAT. Neither were they designed to be used as stand-alone lesson plans. In certain instances the diagrams and sketches in this document are not all drawn to scale, this does not influence the concepts dealt with in this document.

Our manual - and workbook range are designed to give in-depth coverage of the topics on geometry as well as some algebra. Our extensive lesson plans start from the very basics and progress gradually to the more advanced levels.

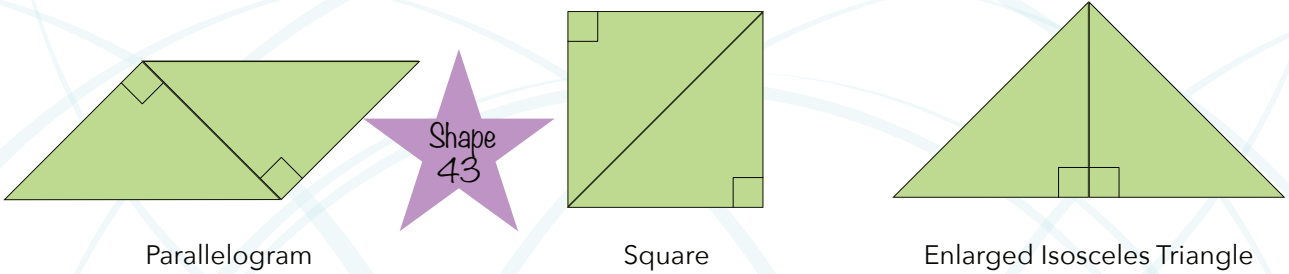
This document is complemented by the Unwrap for MATHOMAT PRIMARY.

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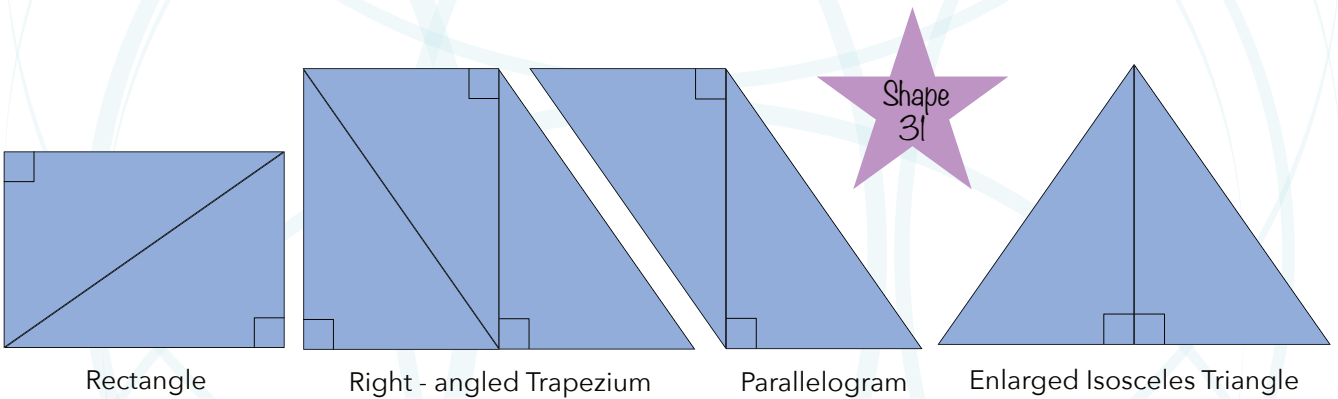
Triangles Examples

Exploring Quadrilateral Properties using Triangles

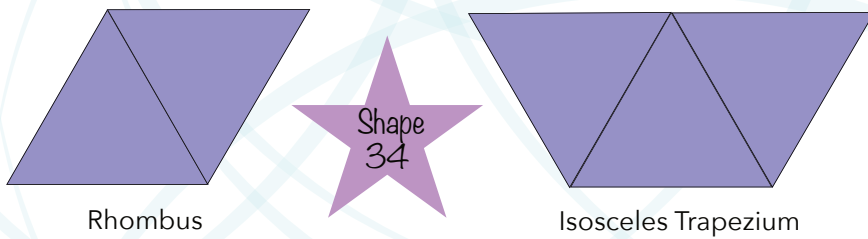
The Isosceles right-angled Triangle.



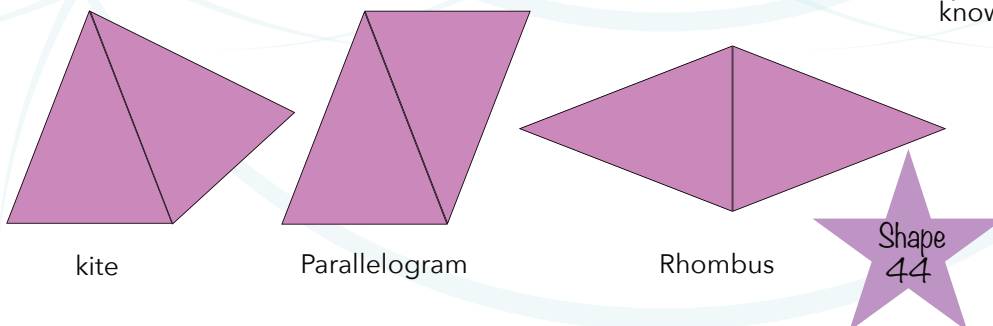
The Scalene right-angled Triangle.



The Equilateral triangle



The Isosceles Triangle



A wealth of composite shapes can be drawn by using just the different triangles found on the template. This is a unique way to approach quadrilateral properties, making use of knowledge about triangles

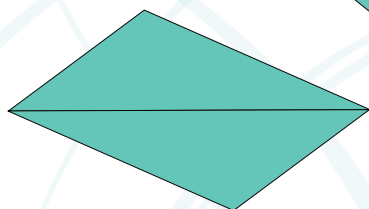


Triangles Examples

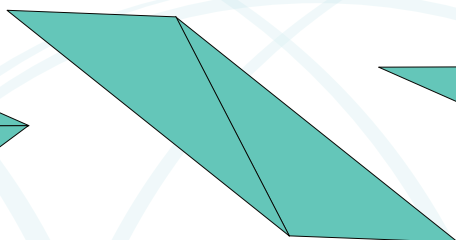
Exploring Transformation using Triangles

The Scalene Triangle

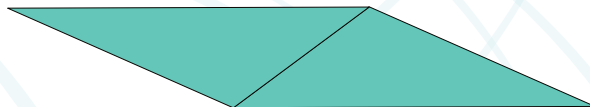
These quadrilaterals were made using rotation.



Parallelogram



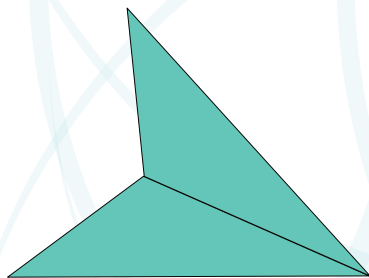
Parallelogram



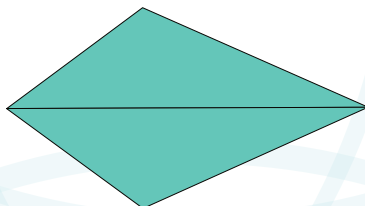
Parallelogram



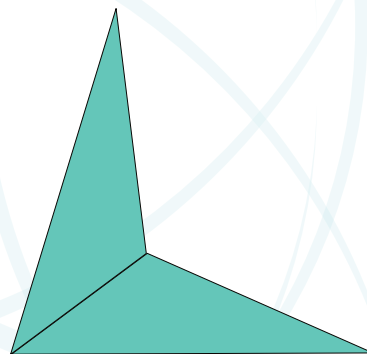
These quadrilaterals were made using reflection.



Concave Kite



Convex Kite



Concave Kite

Shape property might be better understood when presented as a hands-on activity. Have the students use their cut-out shapes or block shapes to complete the activity below. After they have built the composite shape, they must draw it with their MATHOMAT

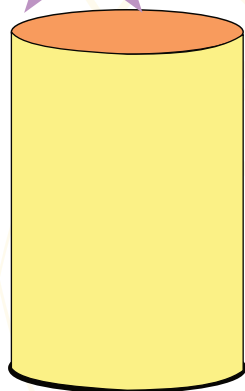
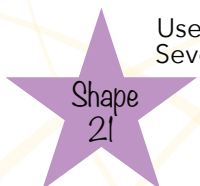
Have students discuss how the properties of the triangle influences the properties of the quadrilateral. Only some of the combinations are shown here, refer to the Teacher's Manual for more.



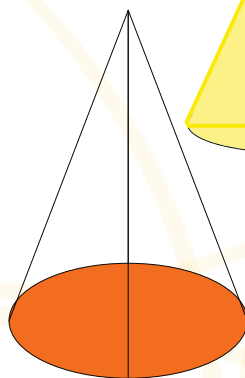
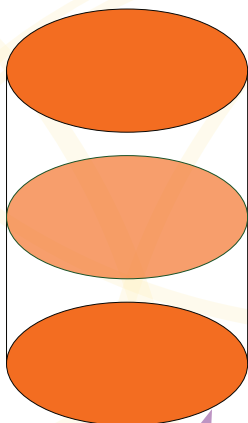
Ellipses Examples

Putting 3D Objects in Perspective and Euclidean Geometry

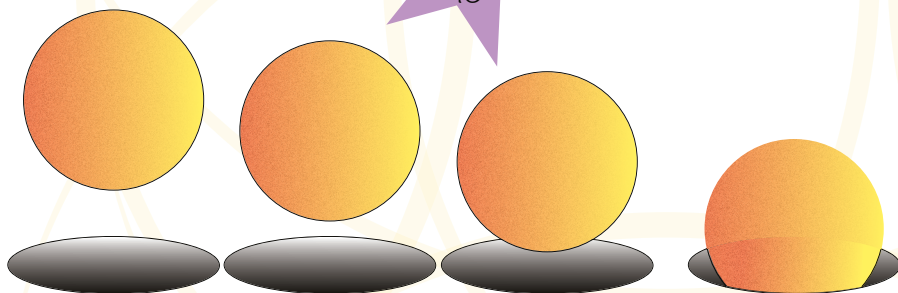
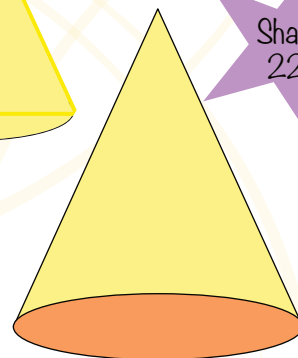
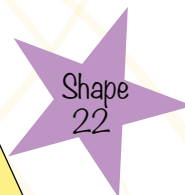
Use ellipses to draw a cylinder - the perspective is different than when circles are used. Several different 3D objects can be drawn with the ellipse combined with other shapes on the template.



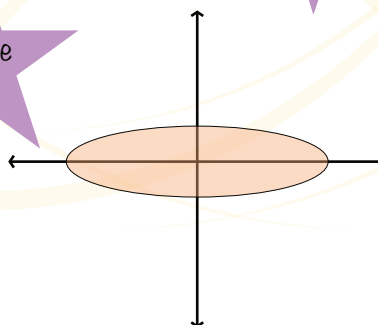
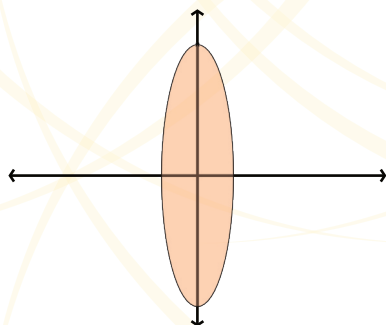
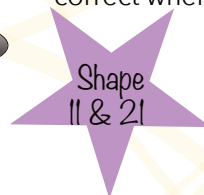
Cylinders



Cones



This sketch would not have worked if a circle was used to show the hole in the ground. The perspective is more correct when using an ellipse.



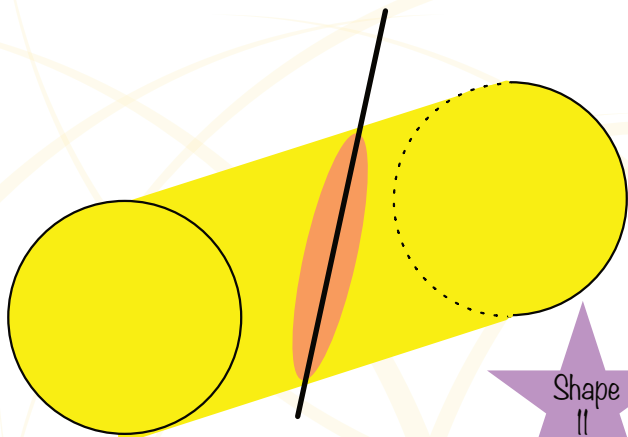
The ellipses may be used in conjunction with the Cartesian Plane. The major and minor axes are clearly marked on the template.



Ellipses Examples

3D Objects, Cross-sections and Drawings

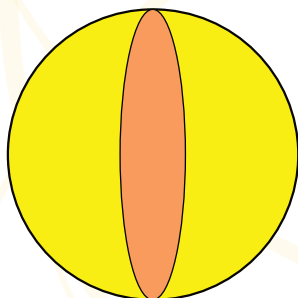
Cylinders and Cones look better when drawn with an ellipse than it does with a circle. Take care to explain that the base is still a circle shape - but how we see it is more like an ellipse.



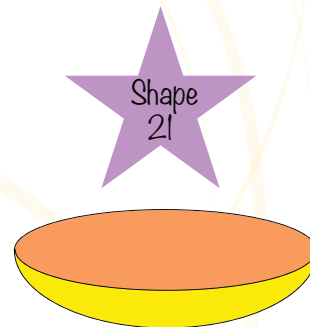
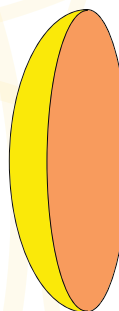
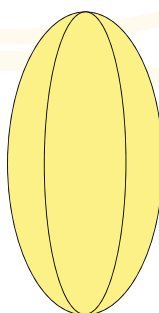
An ellipse is used to show the cross-section through a cylinder. The cross section is not perpendicular, hence the base and the face will differ. If this cross-section was perpendicular we would have had a circle-shaped face.



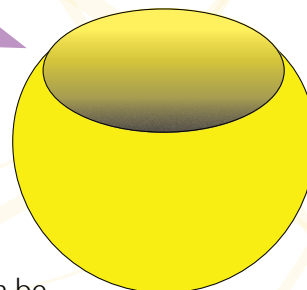
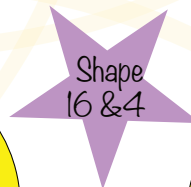
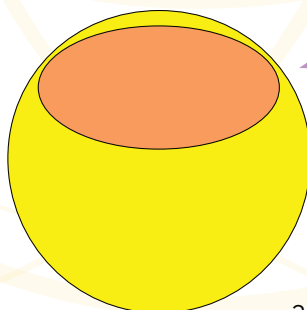
Cross-sections through various 3D objects can result in having an ellipse as a face.



The cross section through a sphere



A 3D oval is called an ellipsoid



3D objects can be drawn using the shapes on the template as a guide.

Studying the perpendicular cross-sections of 3D objects enables students to identify the base more readily. Other types of cross-sections deliver interesting results which introduces some of the functions used in Algebra. ✓



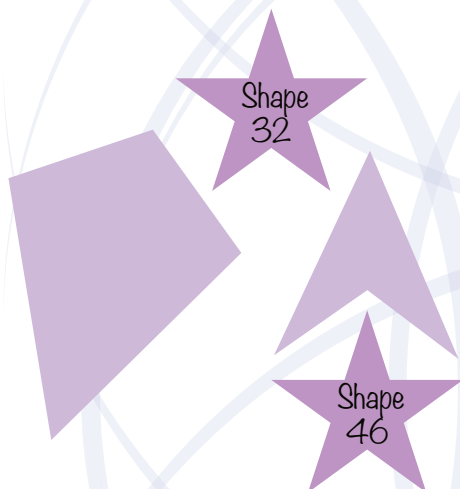
Quadrilaterals Examples

Exploring Irregular Quadrilaterals, Properties and Rotation

Ask your students to group the quadrilaterals.
Use the protractor to draw a full circle for each group.

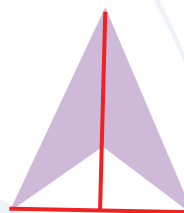
However they choose to group them, they must be able to state why they grouped those specific shapes together.

This is a fun exercise for students and provides the teacher with much needed insight into their reasoning and observation skills.



Being able to label these two shapes as kites draws on the student's knowledge on quadrilateral properties.

In this instance the concave kite presents a problem because the short diagonal is not inside the shape - it falls on the outside. That, however does not matter because properties of a kite can still be used to define it as a diagonal.

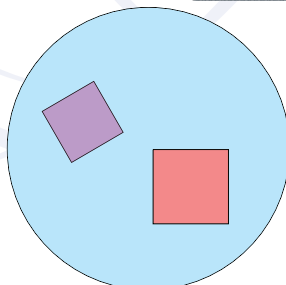
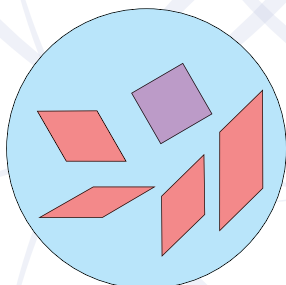
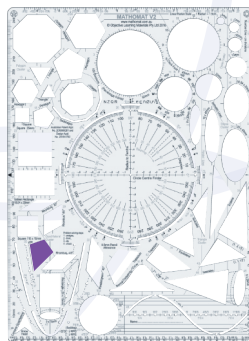


In order to explore the effect that rotation has on a shape we can draw any shape on the template while the template is perpendicular to the edge of the paper.

Rotate the template and draw the same shape again.

Did the properties of the shape change?

Rotation does not influence the size or properties of a shape.



Most of the time it is perception that causes groupings like the circle on the left, where the square, after rotation, is mistaken for a rhombus.

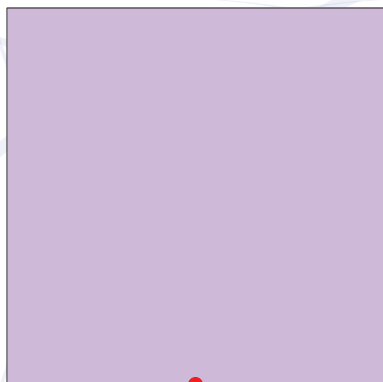
The square has been rotated, but the properties of the shape did not change because of the rotation. Often a student will say that the purple shape in the left circle is a "diamond" or rhombus.



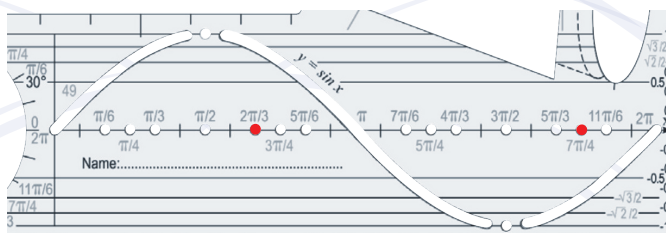
Quadrilaterals Examples

The Golden Ratio

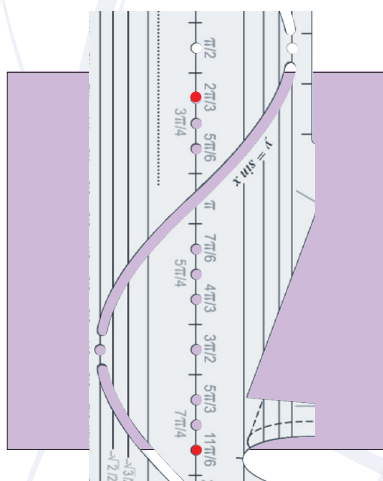
Drawing a golden rectangle



Draw an enlarged square, use a factor of two. Mark the bottom side in the middle.



Locate the following two holes on the template by the Sin Graph.



Place the $\frac{11\pi}{6}$ hole at the centre of the bottom side. Place a pencil in the hole so that the template can swivel.

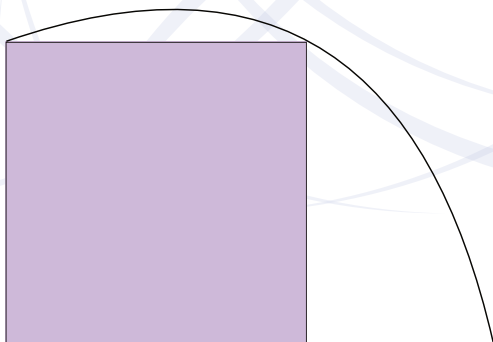


Use a second pencil in the hole at the top, it will line up exactly with the vertex of the square.

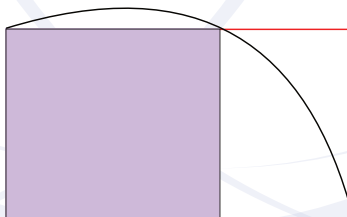
While holding the bottom pencil in place, draw with the top one.

An arc will form as you draw.

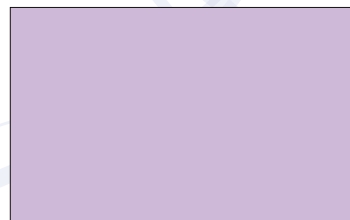
The pencil in the hole at the bottom side of the square will only anchor the template. You do not draw with it.



Start your arc from the top right vertex of the square and draw as shown. Stop the arc at the bottom of the side of the square.



Draw a line from the bottom side of the square to where the arc stops. Continue to draw the sides and top as shown in red.



Your new rectangle is a golden rectangle.

Read about and explore the Golden Ratio in the series of Teacher's Manuals. ✓

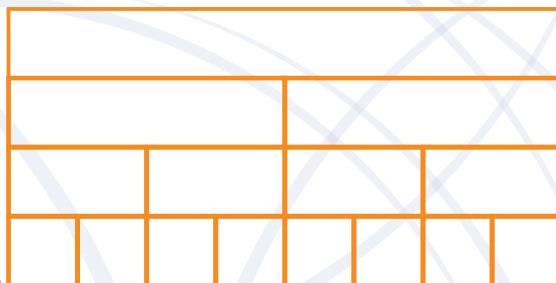


Quadrilaterals Examples

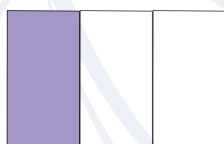
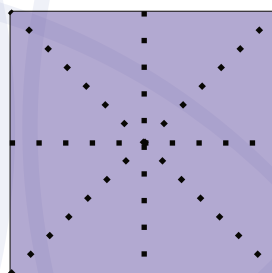
Fractions and Symmetry

Students can build their own fraction walls, using either the rectangle, square and even the equilateral triangle.

They should not work from ready made fractions charts. To show how equivalent fractions work, drawing it is best as it develops their understanding.



Enlarging the regular shapes will make them easier to explore. The lines of symmetry of the square can be marked out, the shape can be cut out and the symmetry can be proven by folding along the dotted lines. The important conclusion is that opposite sides must fit on each other as well as opposite angles. Adjacent sides as well as adjacent angles will also fit.

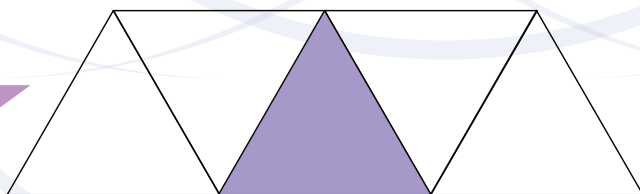


Using the rectangle and square to illustrate continuous fractions, helps students to work with fractions divided in equal-sized portions from the very start.



Both of the diagrams on the left shows $\frac{1}{3}$. When the two pieces are compared to each other they are not the same size.

This is a good topic for discussion and investigating fractions.



$$\frac{1}{5}$$

Representing continuous fractions with odd-numbered denominators can be easily done using a strip of equilateral triangles.



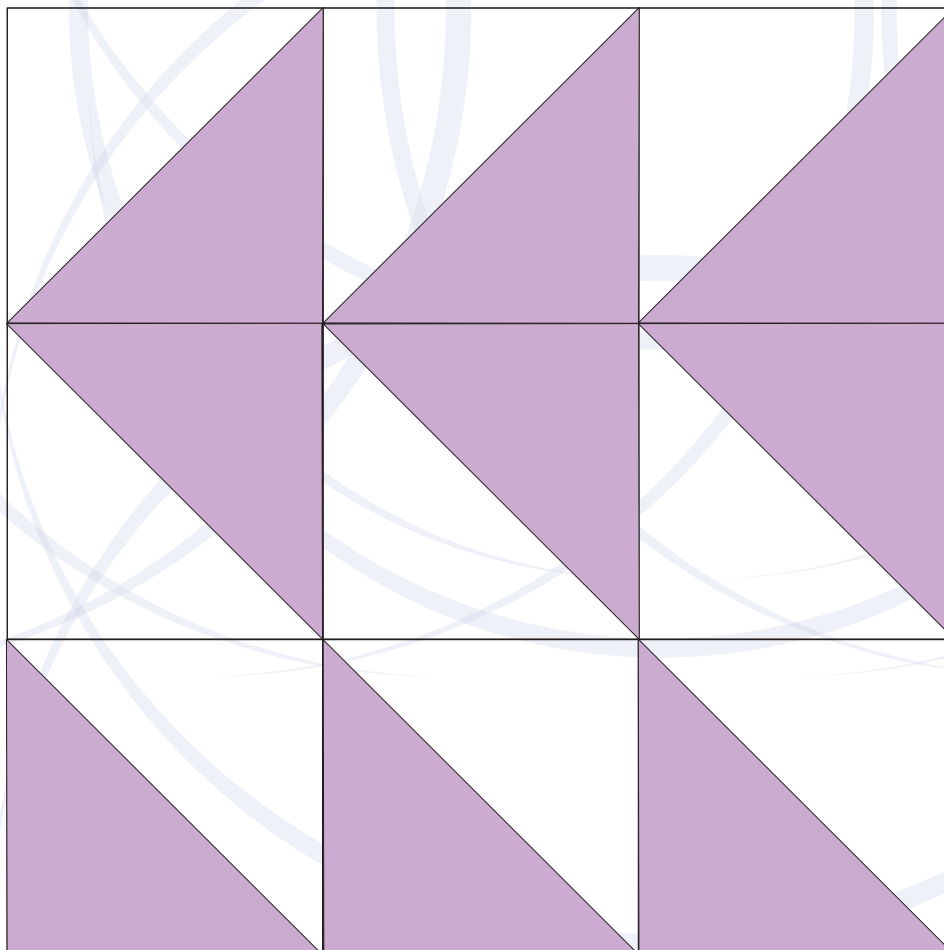
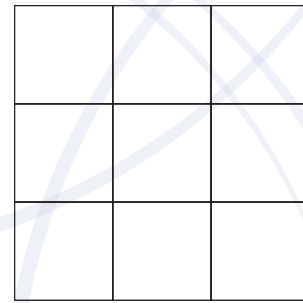
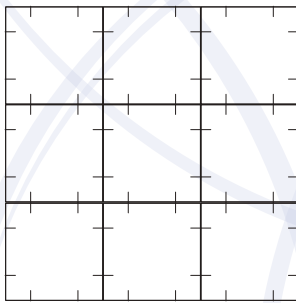
Create a Tessellation-based Puzzle with Squares with marked intervals.

Sebastian Truchet paved the way to encoding visual patterns. Cyril Stanley Smith worked from Truchet's ideas and introduced alternatives to the basic Truchet Tile.

The Square on the template works for Smith's ideas as the intervals can be marked from the template as shown below.

These alternatives are discussed in the series of Teacher's Manuals.

The concept that Truchet had can be easily reproduced using the Square on the template. No intervals need to be marked off for this type of tiling.



Each square should have a diagonal running through it.

Let the students experiment with curved lines to connect opposite vertices.

Cut the squares loose and pack different patterns.

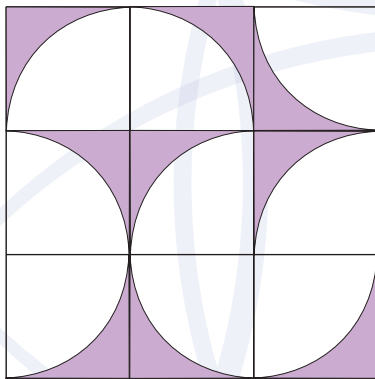
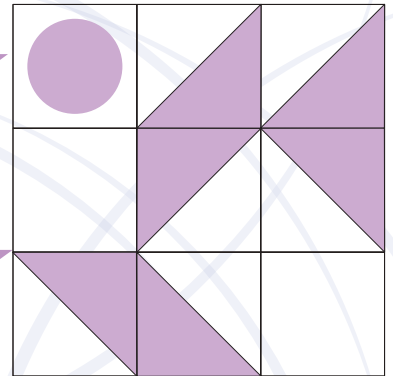
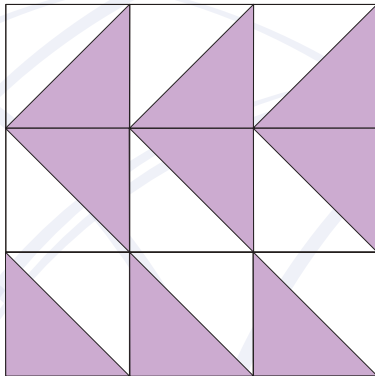
There will be many various ways to tile a pattern.

See the series of Teacher's Manuals for more ideas on developing spatial skills with our other examples on these tiles.

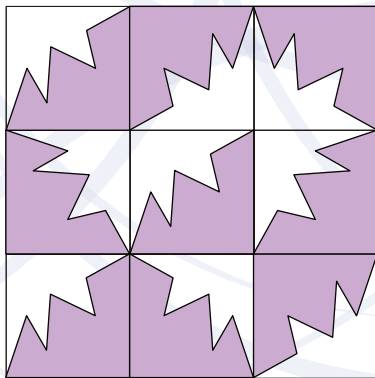
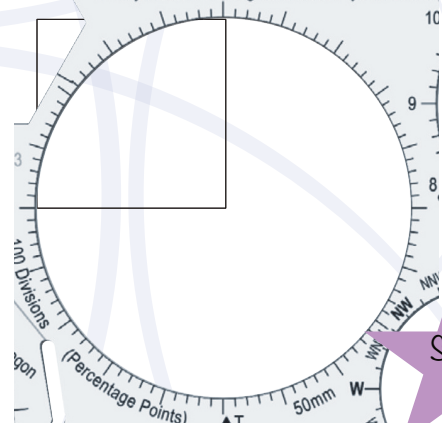


Create a Tessellation-based Puzzle with Squares

Add Circles, curves and blank Squares to the tile for a variety of puzzles.



Use the Circle and position it as shown to create the arcs inside the square.



This game serves as an early introduction to rigid transformations. It will be a good idea to incorporate this into all of the transformation - lessons as well. A complete lesson plan was developed for these tiles to be used with transformations in the series of Teacher's Manuals.

Add some circles and curved diagonals to the squares for more challenging puzzles.

Let each student draw their tile on paper with their template. Keep these as cards and hand them out around the class.

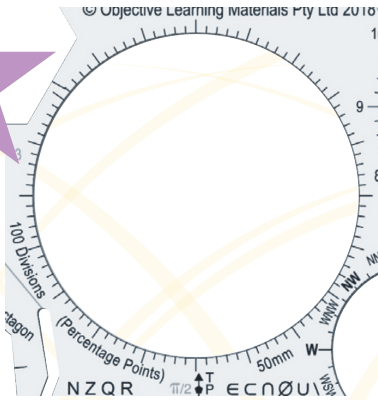
They can now build each other's drawings.

Increase the difficulty by having them study a card pattern, put it face down and see how far they can build from memory. This is a very good visual memory recall exercise.

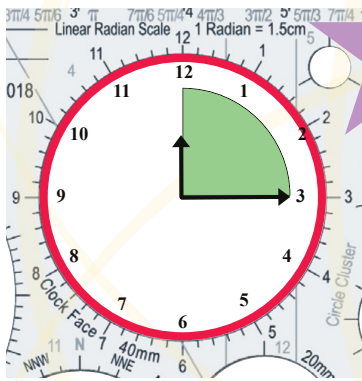
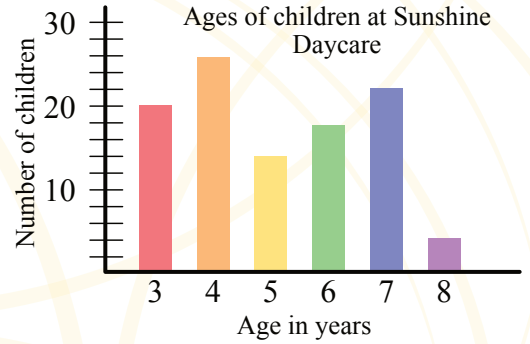
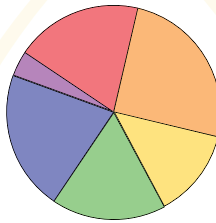


Circles Examples

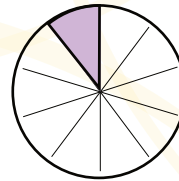
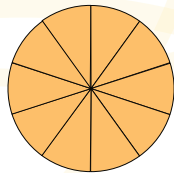
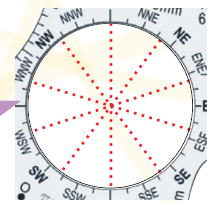
Representing Data, Time, Fractions and Problem solving



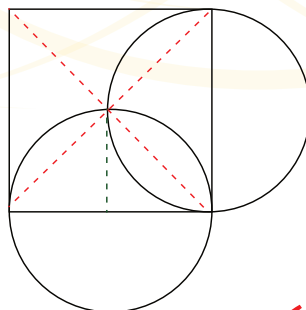
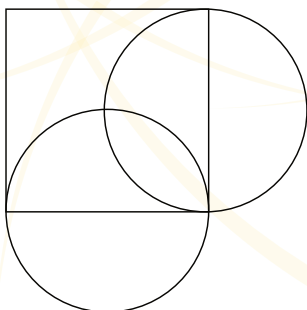
This circle is the biggest on the template, save for the protractor. The main use is for pie-charts as the divisions are marked off in hundreds. Working from a bar graph to a pie-chart is easy when using this circle for the pie chart and any of the rectangles for the bar graph.



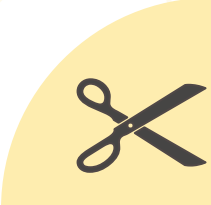
Turn the circle into fractions and use it alongside the clock-face - this way halves and quarters can be visualized.



Steps to create fractions: Select a circle, mark off the points, divide into sectors.

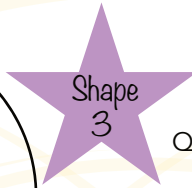
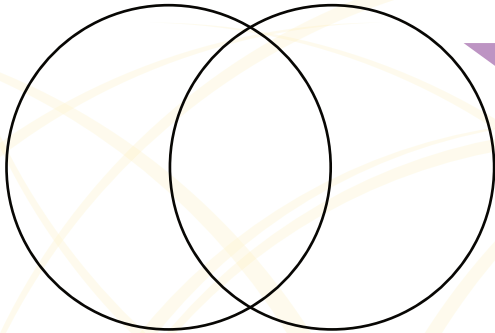


Being able to model problems is critical to understanding the process of solving them. ✓

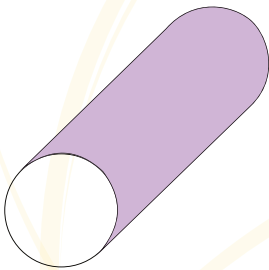


Circles Examples

Patterns, Venn-diagrams, 3D objects and Decomposing Shapes

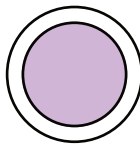
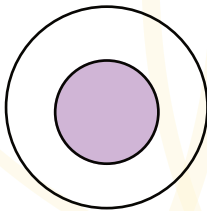
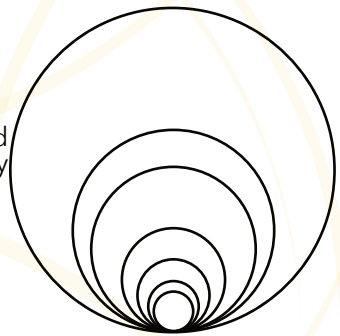


Quick and easy Venn diagrams - the circle from the protractor can be used for this as well.



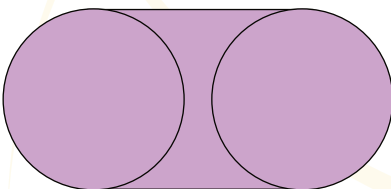
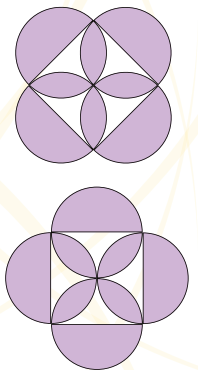
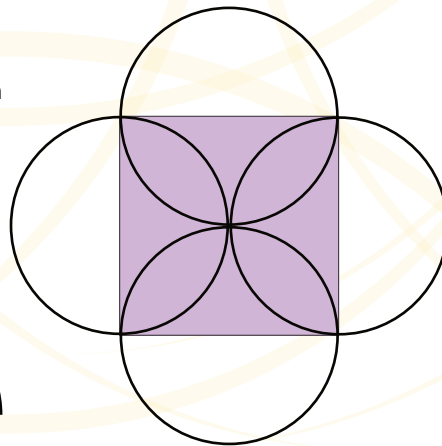
Creating 3D objects by using the 2D shapes.

Exploring patterns and properties of circles by using them in art projects or patterns.



Some optical illusion experiments will have students understand the power of perspective in geometry. Both of the coloured - in circles are same size.

This diagram shows the intersections of the circles with the square. Some very intricate questions on area has been developed by using only certain parts of these types of diagrams. It is very useful for students to see how figures can be decomposed into their respective units.

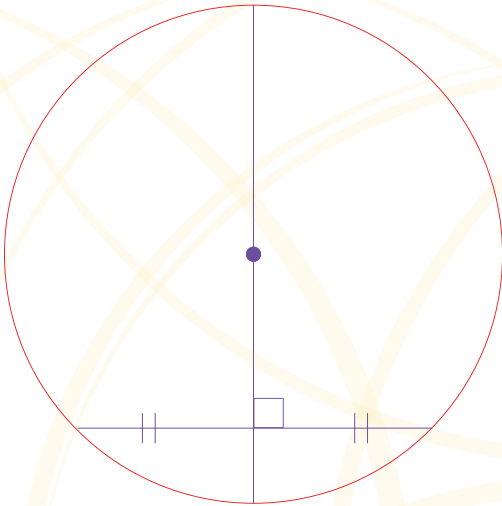


Drawing composite shapes

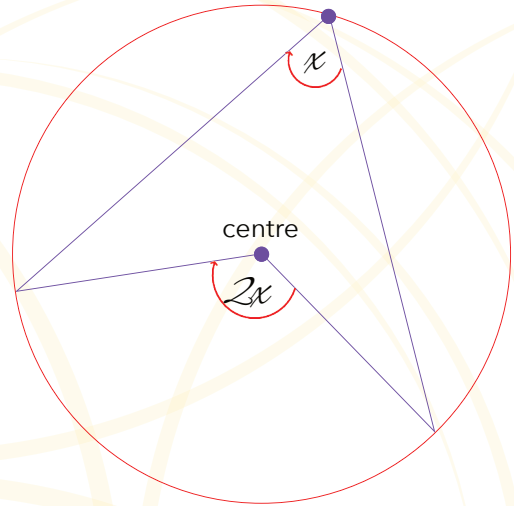


Circles Examples

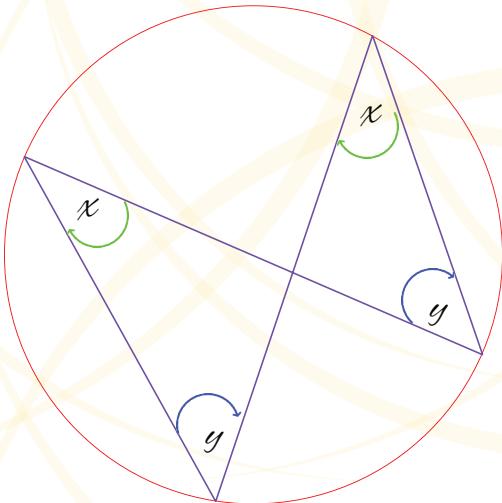
Euclidean Geometry and Modelling some Circle Theorems



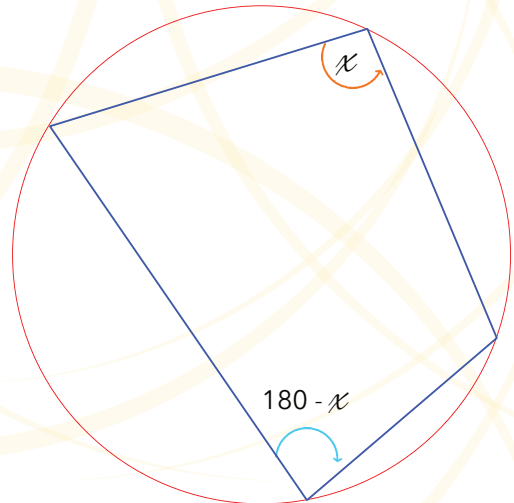
A line drawn from the centre of a circle to the midpoint of a chord is perpendicular to the chord.



The angle subtended by an arc at the centre of a circle is double the size of the angle subtended by the same arc on the circle's circumference.



Angles subtended by the same arc of the circle in the same segment are equal.



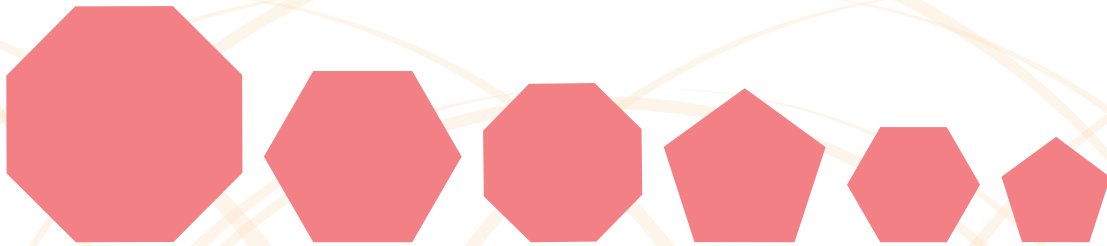
The opposite angles of a cyclic quadrilateral are supplementary.

Have the students first draw the diagrams and measure angles. See if they can come to the conclusion of the Theorem by themselves.

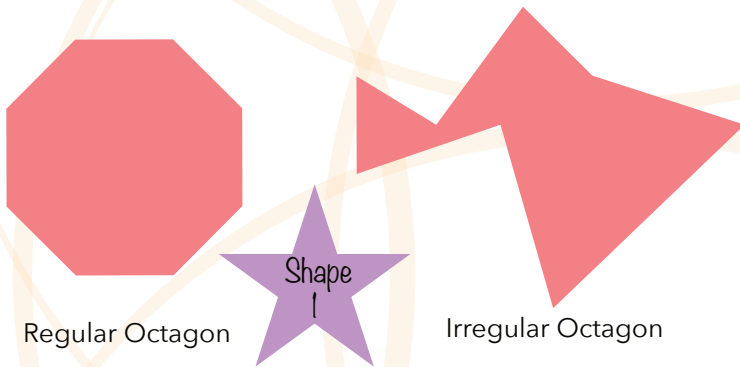


Regular Polygon Cluster Examples

Exploring Regular Shape Properties and Algebraic Equations

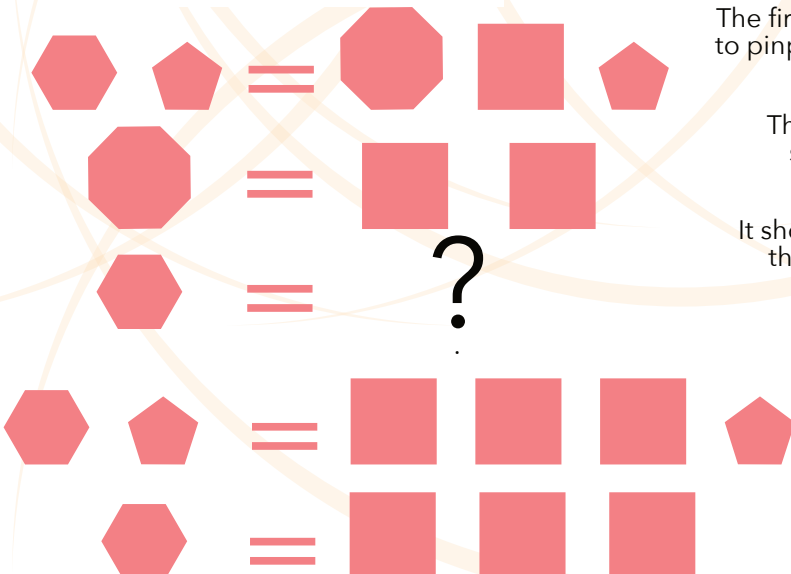


Regular polygons are a great start for exploring symmetry. Enlarge these shapes and have students measure the angles and sides. Have students write down the properties for each one as they go along.



Have students each pick a regular polygon. Allow for them to make a certain number of changes to convert it into an irregular polygon of the same number of sides as the original one. How many properties changed? How many properties stayed the same?

This critical thinking exercise shows an equation



The first line presents a fact, the second line helps us to pinpoint that two squares will be the equivalent of one octagon.

The student should re-write the first line and substitute the octagon with two squares.

It should now be easier for the student to deduct that one Hexagon is equal to three Squares.

Introduce values for each shape and progress to a point where only numbers are used.

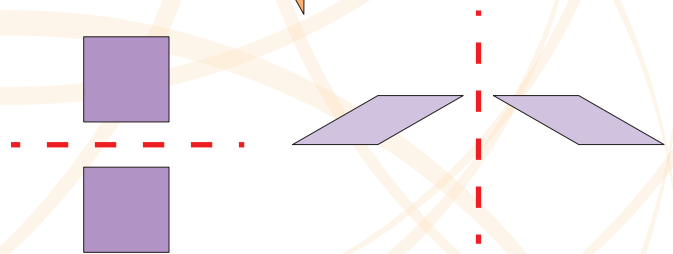
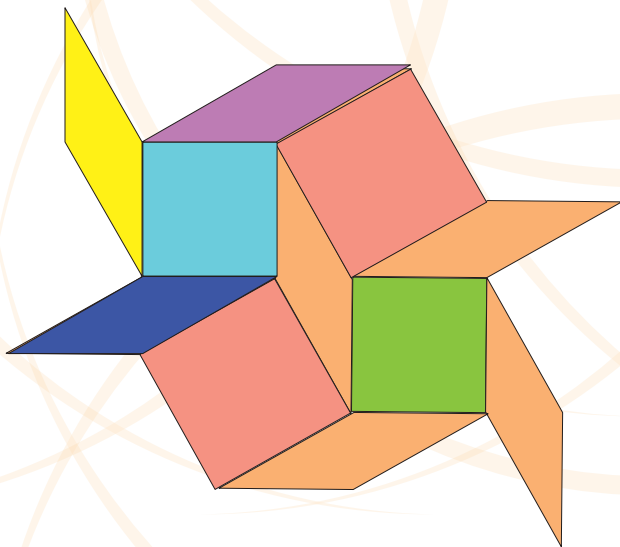
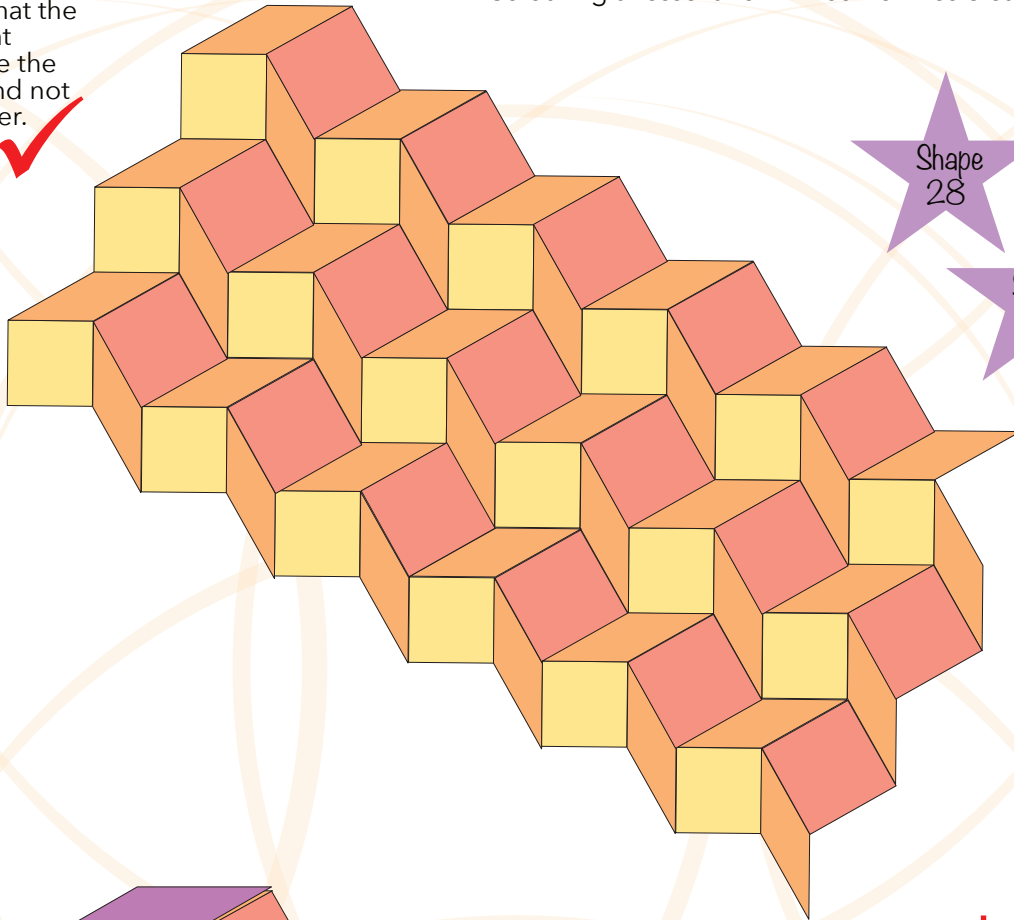


Polygon Clusters

Tessellations

Make sure that the student manipulate the template and not the paper. ✓

Colouring a tessellation will sometimes create a 3D-effect.



Discuss the transformations of the shapes:

Purple Rhombus to Yellow Rhombus - Translation and Rotation: anti - clockwise.

Blue Square to Green Square - Translation: Up and Left.

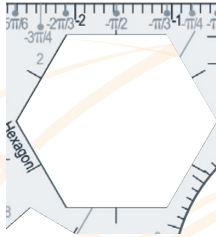
Look at the two reflections of the two shapes from the tessellation.

Experiment with the rotation of these shapes as well. Some transformations seem to have no 'effect' unless we add some features. ✓



Tessellation puzzle

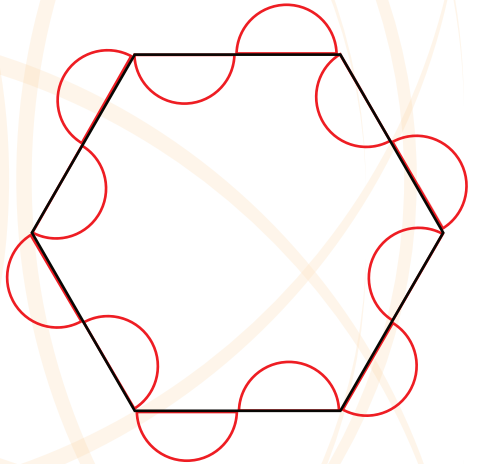
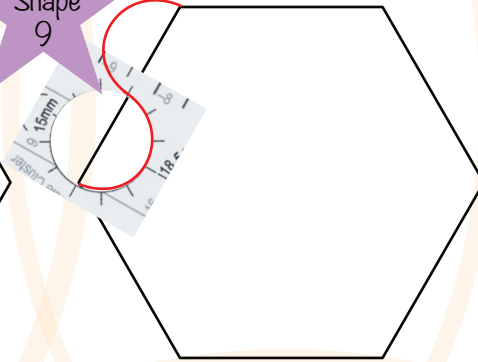
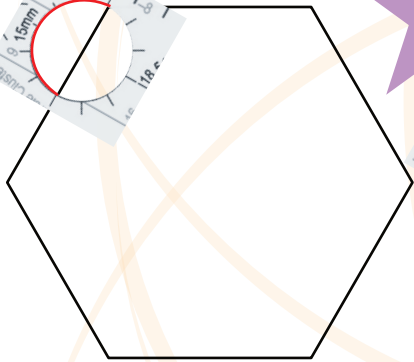
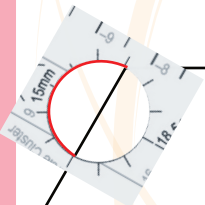
Create a Tessellation Puzzle with Regular Polygons and Circles



Use the template to measure the midpoint of the sides if formal measurement has not yet been done.



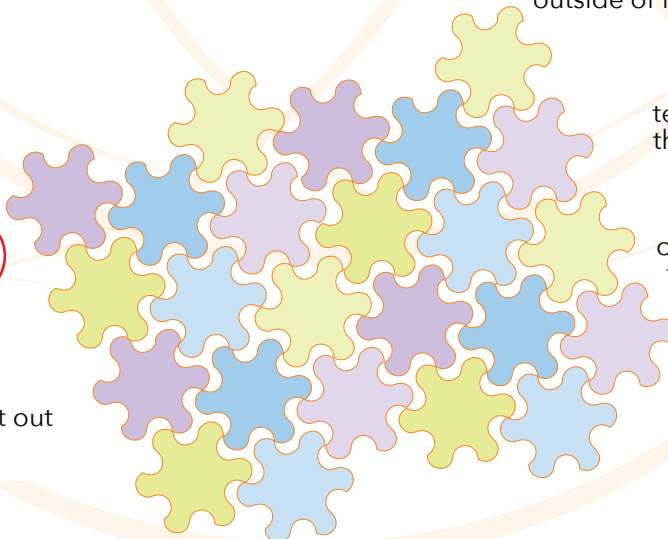
Enlarge the Hexagon by a factor of two. Measure the side and mark a point halfway on each of the sides. Draw the hexagon lightly in pencil.



Use Circle no 9 as shown to create two semi-circles on each side of the **enlarged** Hexagon no 2. One semi-circle should be inside the Hexagon and the other on the outside of it.



Erase the pencil marks and cut out the semi-circle pattern.



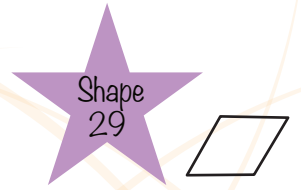
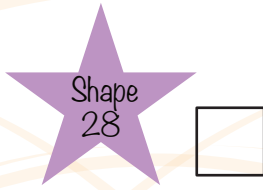
Compare this tessellation to the one in the MATHOMAT Primary Unwrap.

Let the students see if they can find a correlation between the tessellations. Can they explain what it is and why it formed?

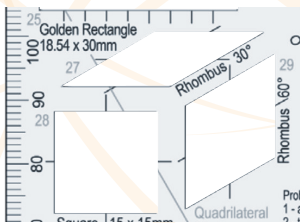
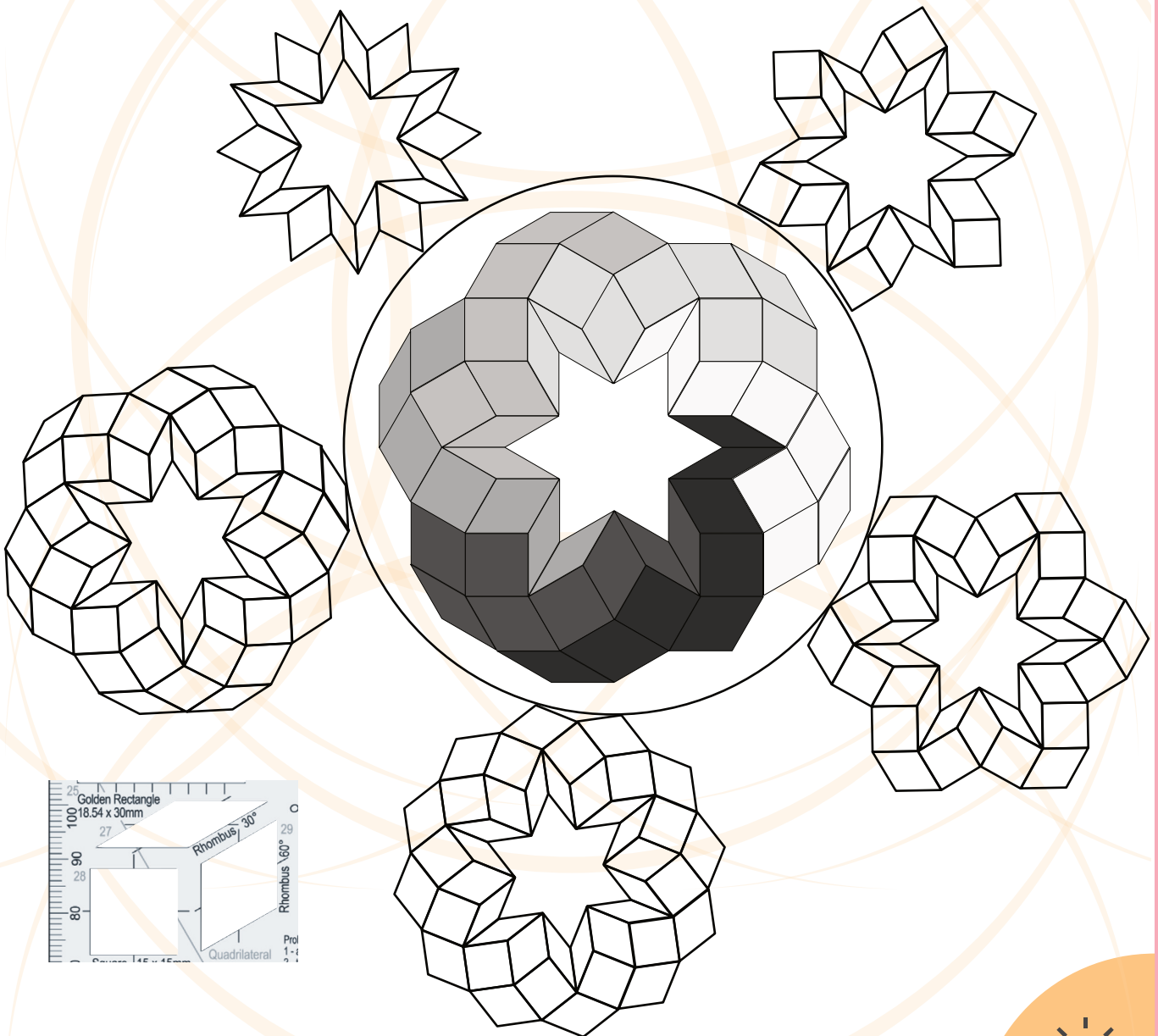


3D Objects - Cube cluster

More Complex 3D Objects with the Cube



The cluster for the cube can also be used. The cube can then be transformed by means of rotation creating a more complex object.

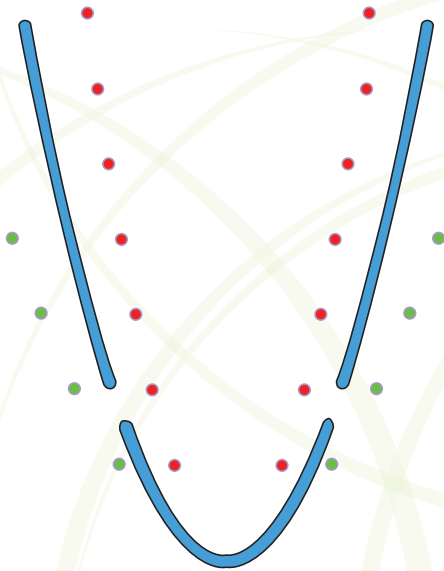


Play around with colouring the finished object. Different shades lighter and darker will result in a different - looking object.

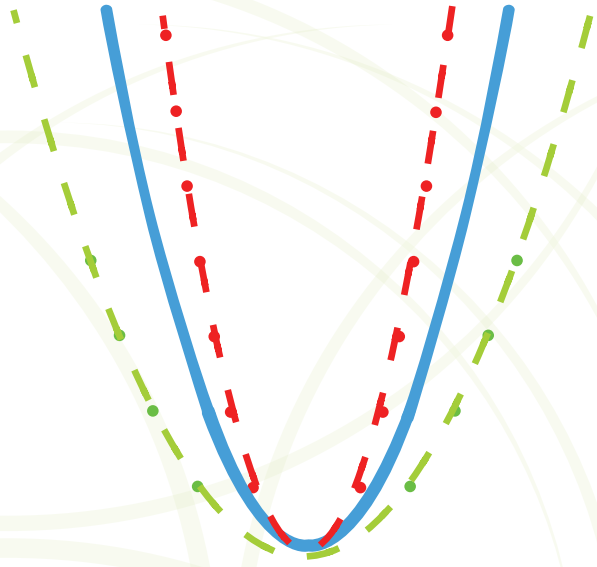


Parabolas examples

Standard Form Solid lines and Variations Dotted lines



Visualizing how changing values in the formula leads to a change in how the parabola looks.



Join the dots to form lines.

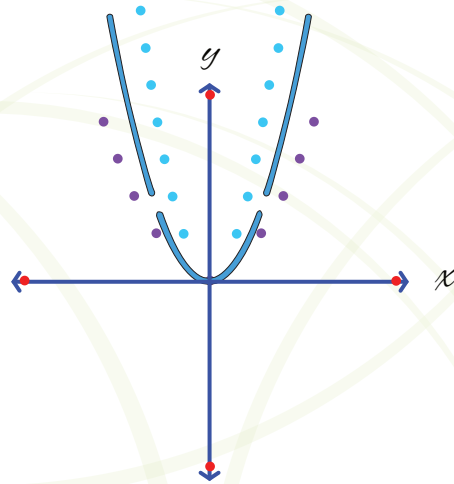
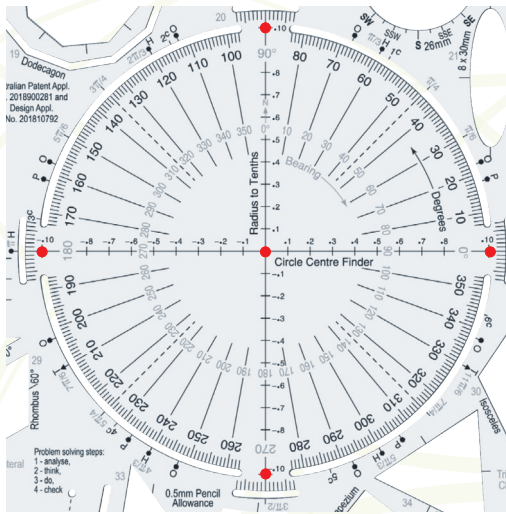
Use the parabola in conjunction with the Cartesian Plane. Explore how the shape changes as variables in the formula are altered. Explore how rotation affects a Parabola, by applying the straight line test for functions, to both of the sketches.



Cartesian Plane examples

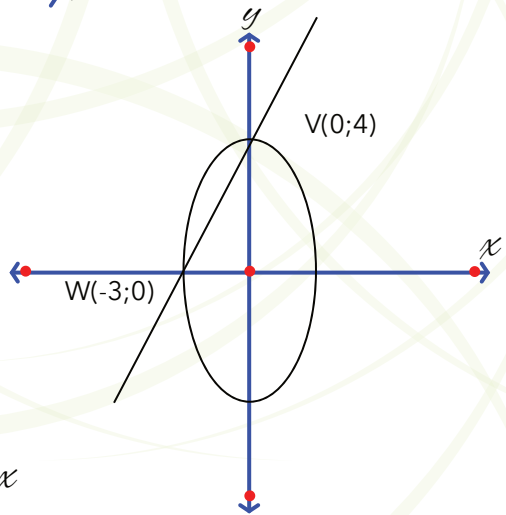
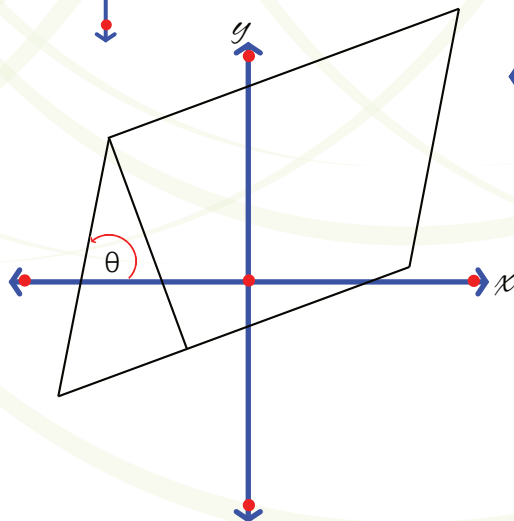
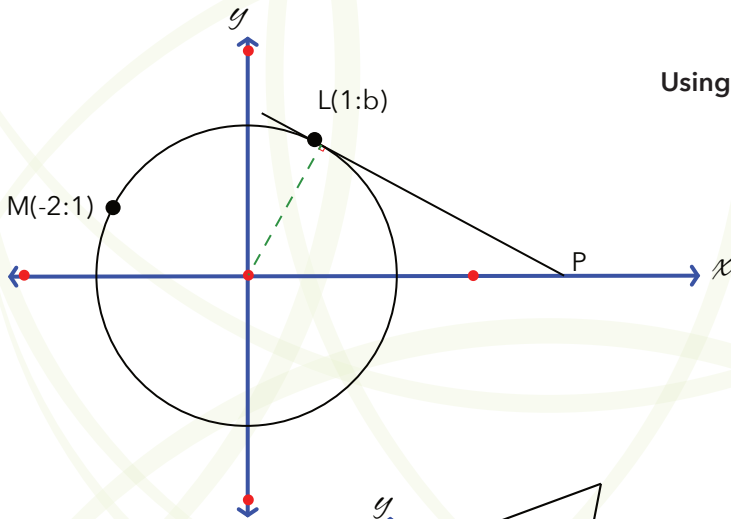
Sketch the Cartesian Plane

Join the dots to form a system of axes.



Use the Cartesian Plane to explore the parabola.

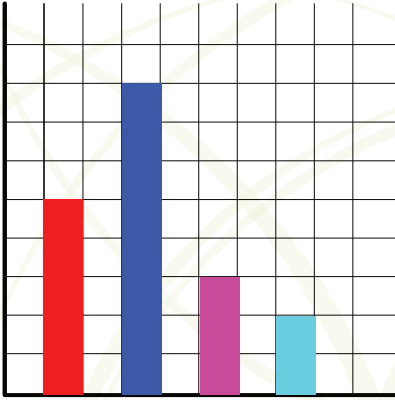
Using the Cartesian Plane to explore Analytic Geometry problems.



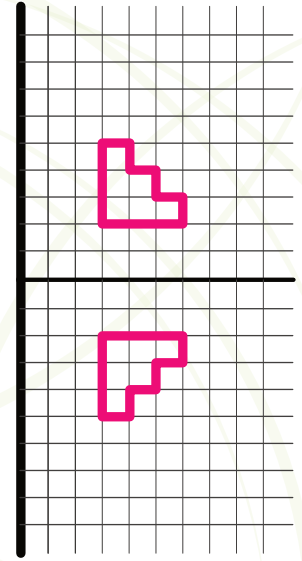
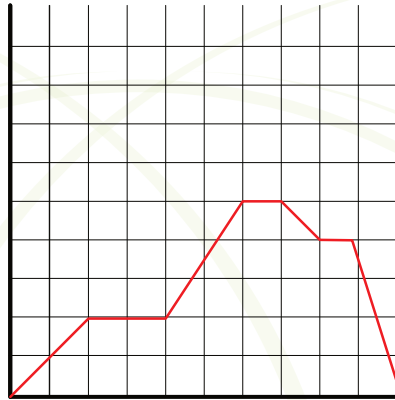
Some Uses for Grids

The Square Grid

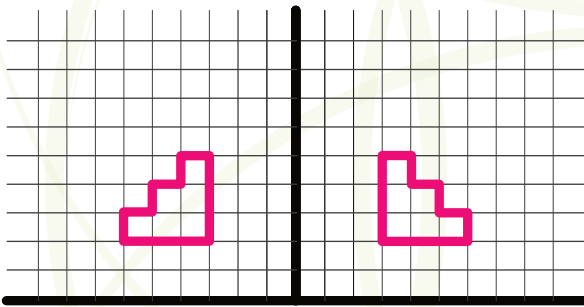
Bar graph.



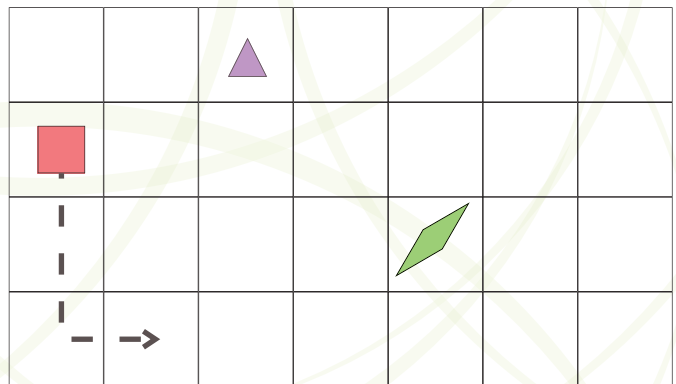
Line graph



Reflection over the x-axis, not to be confused with a rotation.

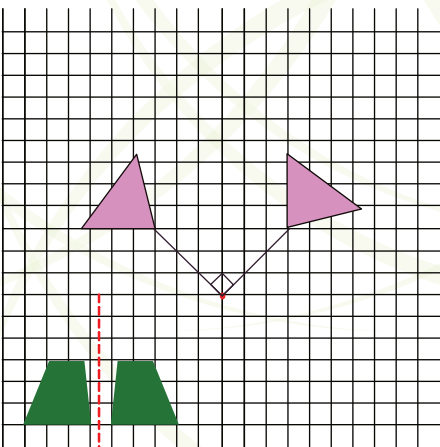


Reflection over the y-axis, not to be confused with a rotation.



Use the square (the bigger the better) to draw a grid. Have the students move cut-out shapes to perform the transformation that is being dictated.

For example: Red square: Translate two down and one to the right.

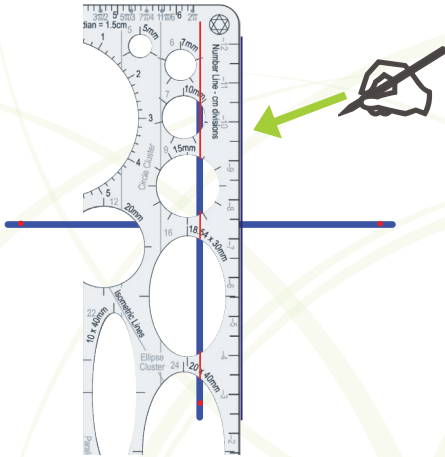


A grid for transformations

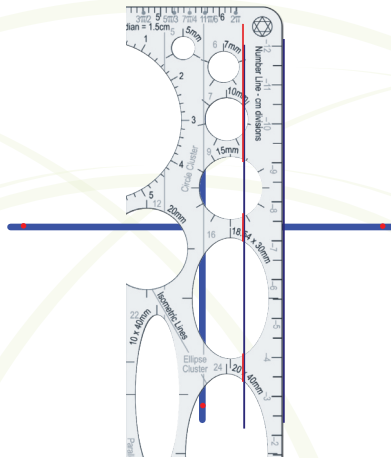


Drawing a grid

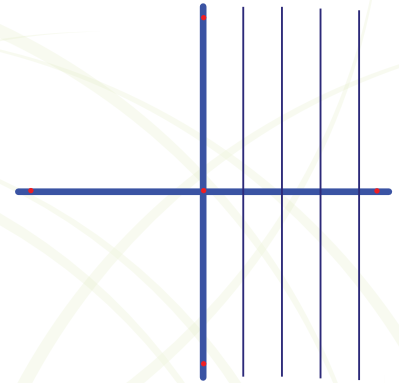
Using Parallel lines for a Square Grid



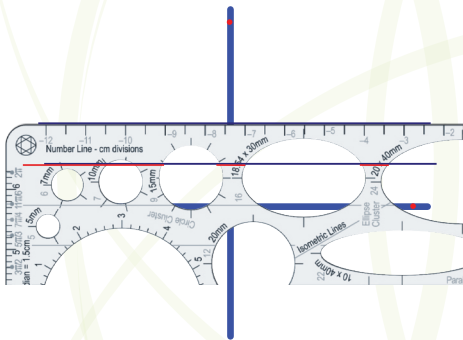
Fit the first parallel line on the template on the y-axis and draw a line.



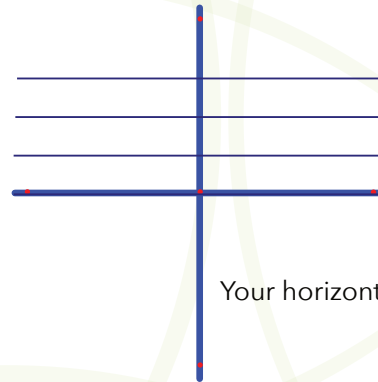
Fit the first parallel line on the template on each new line you draw.



Your vertical lines should look like this.

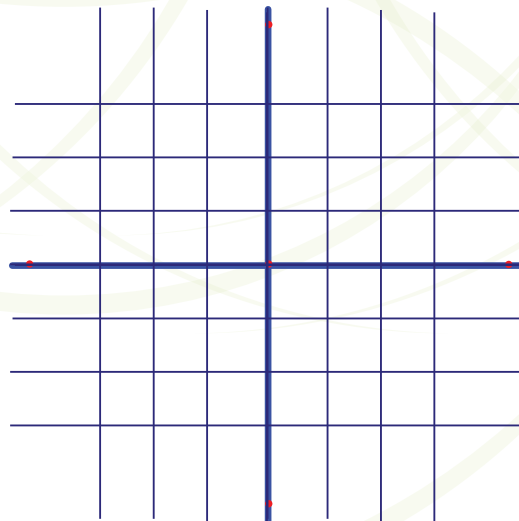


Turn your template and fit the first parallel line on the x-axis. Repeat the process as you have done for the vertical lines.



Your horizontal lines should look like this.

Repeat the process on the left side of the y-axis as well as the bottom of the x-axis.



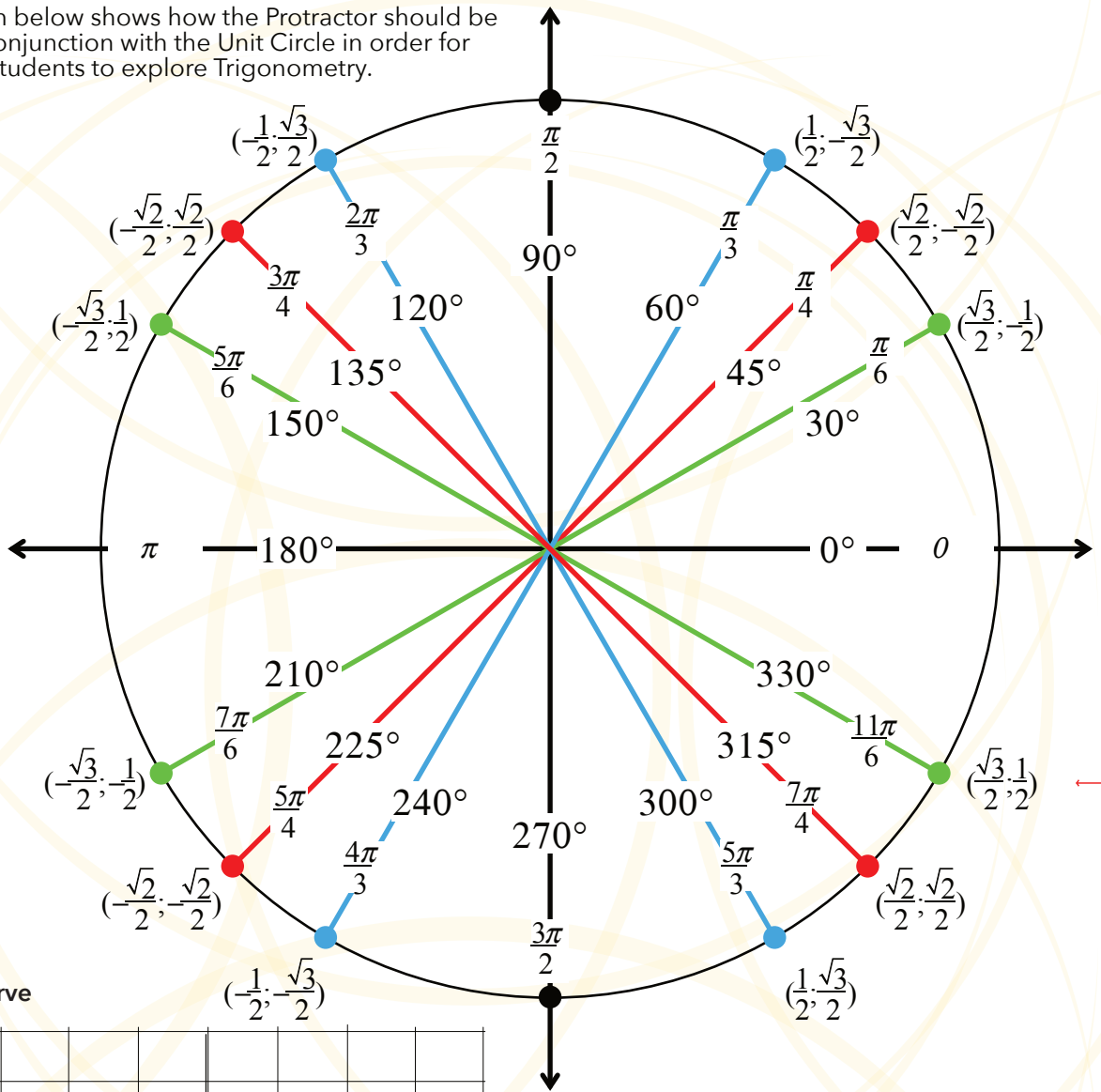
A completed grid.



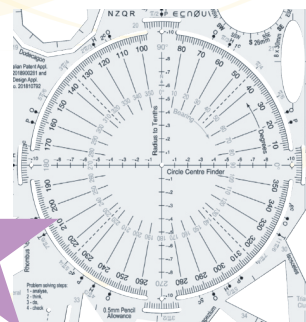
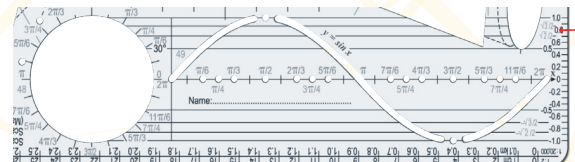
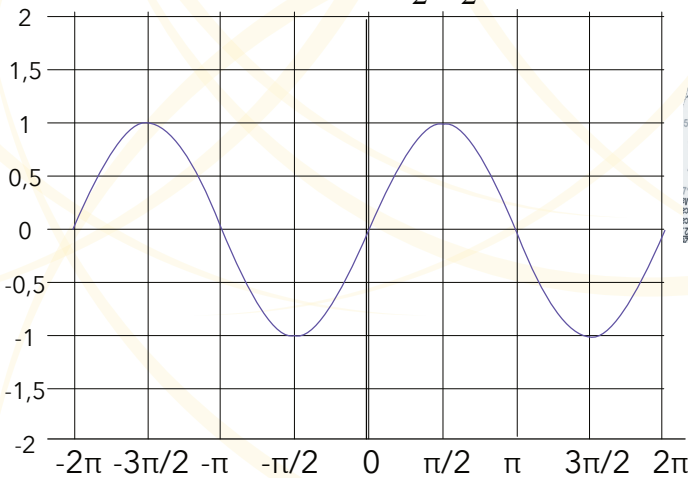
Trigonometry Graph cluster and Normal frequency curve.

Using Different Components Together

The diagram below shows how the Protractor should be used in conjunction with the Unit Circle in order for students to explore Trigonometry.



A Sin Curve



Ratio's are also on the Triangles, Shapes 31 & 43

Shape 20



Polygons on the Protractor

The Octagon

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Linear Radian Scale 12 1 Radian = 1.5cm

Number Line - cm divisions

Circle Cluster

8 Clock Face

40mm NE ESE

50mm W

26mm S

10 x 40mm

8 x 30mm SE

10 x 40mm

20 x 40mm

Isometric Lines

Ellipse Cluster

24

27

26

31

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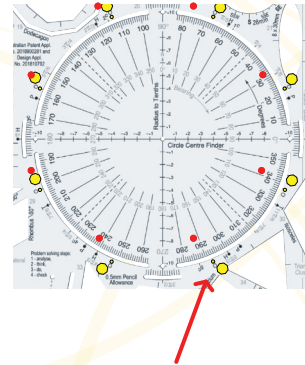
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Polygons on the Protractor

Exploring similarity with the Large Octagon.

Connect the points for a quick Large Regular Octagon.



Make sure you mark off on the inside of the arcs, the space that is the circumference of the circle.

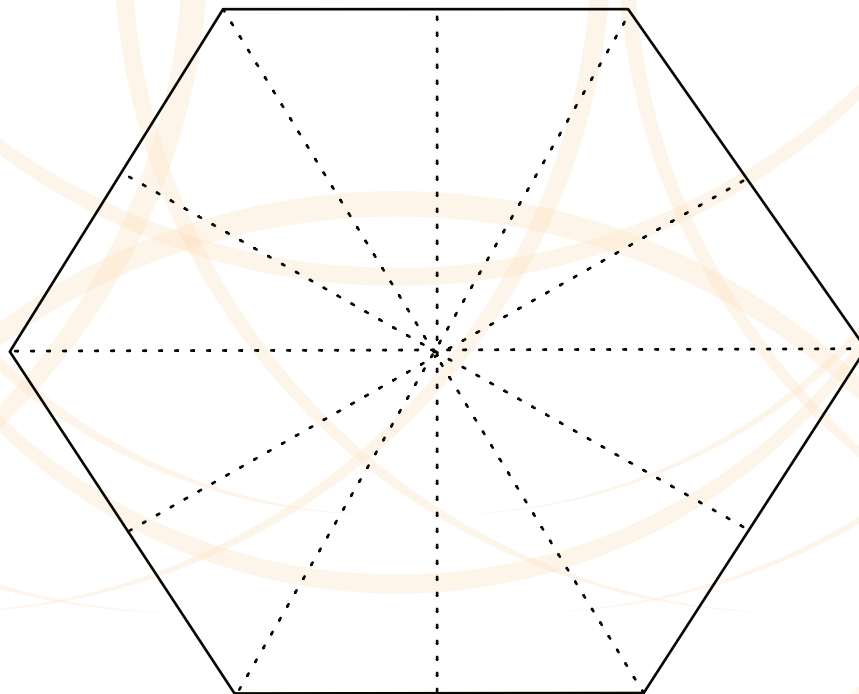
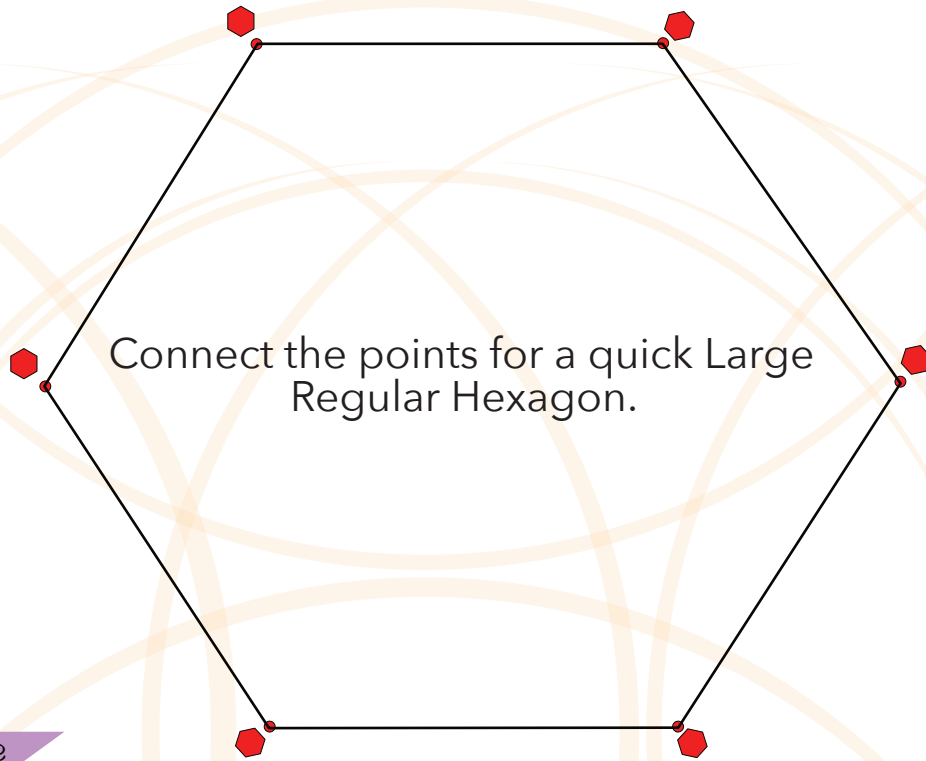


Physically explore enlargements and prove similarity in a concrete way. No need for formal angle measurement - so younger students can gain an in-depth knowledge on similarity and enlargement.



Polygons on the Protractor

Exploring symmetry with the Large Hexagon.



Physically explore symmetry in a concrete way.
The shape can be cut out and folded for a concrete experience.



Polygons on the Protractor

The Pentagon

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Linear Radian Scale 12 1 Radian = 1.5cm

Number Line - cm divisions

Circle Cluster: 5mm, 7mm, 10mm, 15mm, 20mm, 26mm, 30mm, 40mm, 45mm, 50mm, 60mm, 8 x 30mm, 10 x 40mm, 18.54 x 30mm, 20 x 40mm

Isometric Lines, Ellipse Cluster, Scalene, Triangle Cluster, Equilateral, Isosceles, Trapezium, Normal Frequency Curve, Parallelogram, Rhombus, Square, Golden Rectangle, Rhombus 30°, Rhombus 45°, Rhombus 60°, Kite, Convex Quadrilateral, Arrow Head, Concave Quadrilateral, Rectangle 25 x 15mm, Rectangle 5 x 15mm, 5 x 15mm, 10mm, 15mm, 20mm, 25mm, 30mm, 35mm, 40mm, 45mm, 50mm, 55mm, 60mm, 65mm, 70mm, 75mm, 80mm, 85mm, 90mm, 95mm, 100mm, 105mm, 110mm, 115mm, 120mm, 125mm, 130mm, 135mm, 140mm, 145mm, 150mm, 155mm, 160mm, 165mm, 170mm, 175mm, 180mm, 185mm, 190mm, 195mm, 200mm, 205mm, 210mm, 215mm, 220mm, 225mm, 230mm, 235mm, 240mm, 245mm, 250mm, 255mm, 260mm, 265mm, 270mm, 275mm, 280mm, 285mm, 290mm, 295mm, 300mm, 305mm, 310mm, 315mm, 320mm, 325mm, 330mm, 335mm, 340mm, 345mm, 350mm

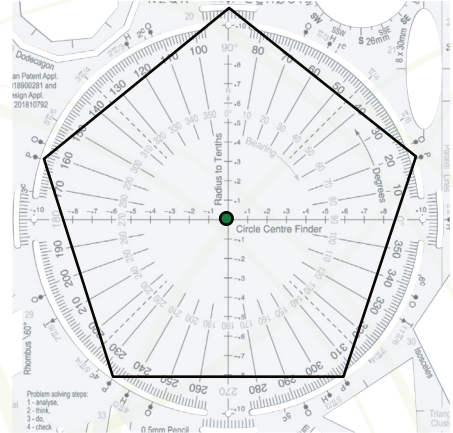
Problem solving steps:
1 - analyse,
2 - think,
3 - do,
4 - check

Scale 1:20,000
Scale 1:2,000

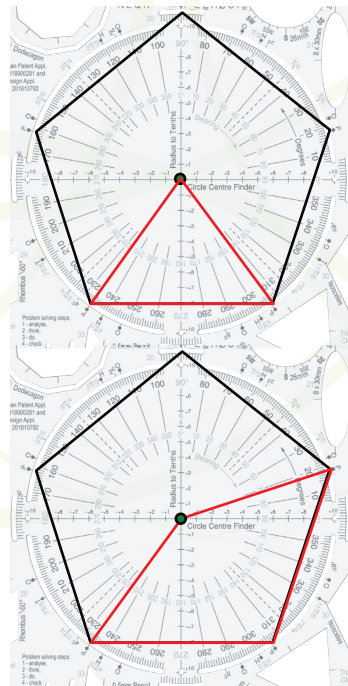
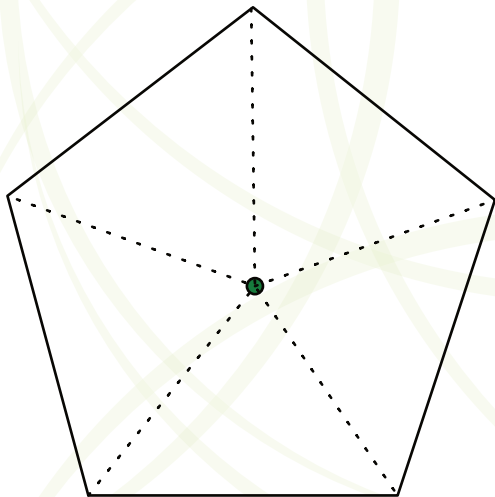
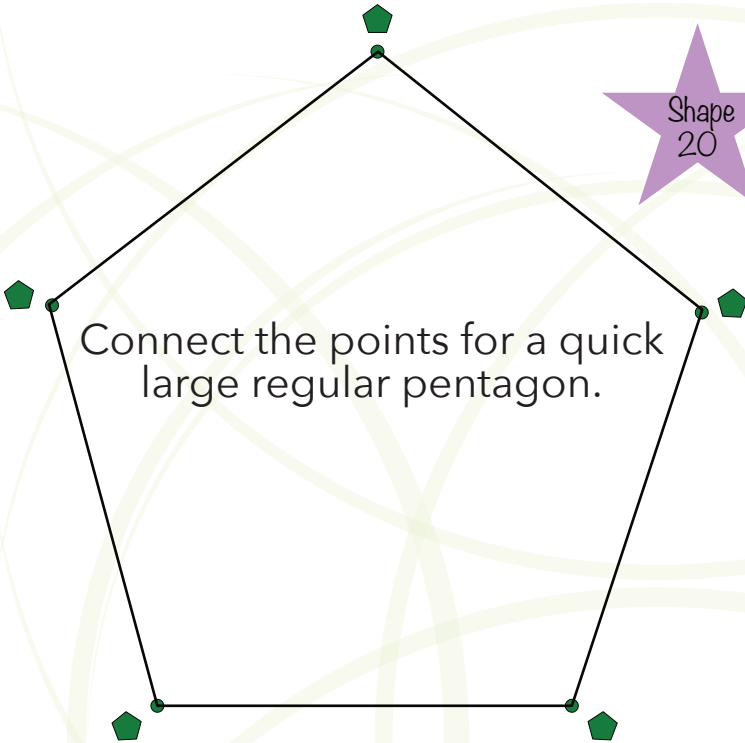
Name: _____

Polygons on the Protractor

Exploring Decomposing with the Large Pentagon.



Mark the centre of the pentagon with the circle centre finder.



By cutting out these triangles we prove congruency for the triangles.

It may also help students understand how the polygon formulas work.

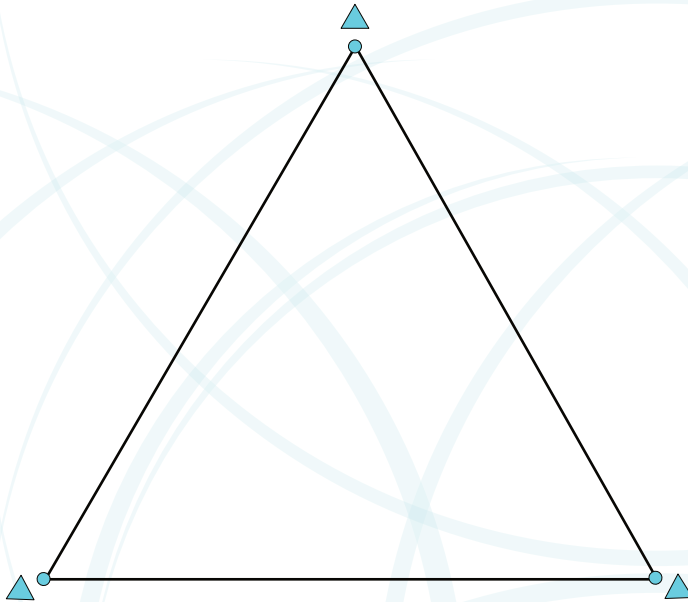
Finding the degrees for the inside angles of this pentagon is now easy.

The midpoint has five angles fitted, all of them with same magnitude, so 360° divided by 5 to get those, then apply equilateral triangle properties to get the rest of the angles.

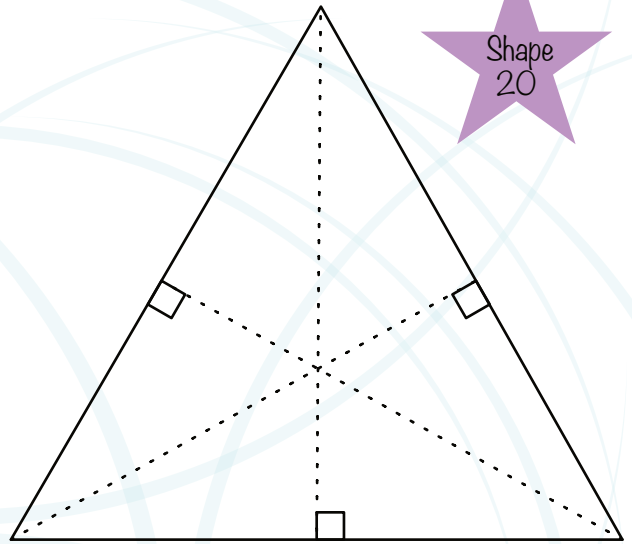


Polygons on the Protractor

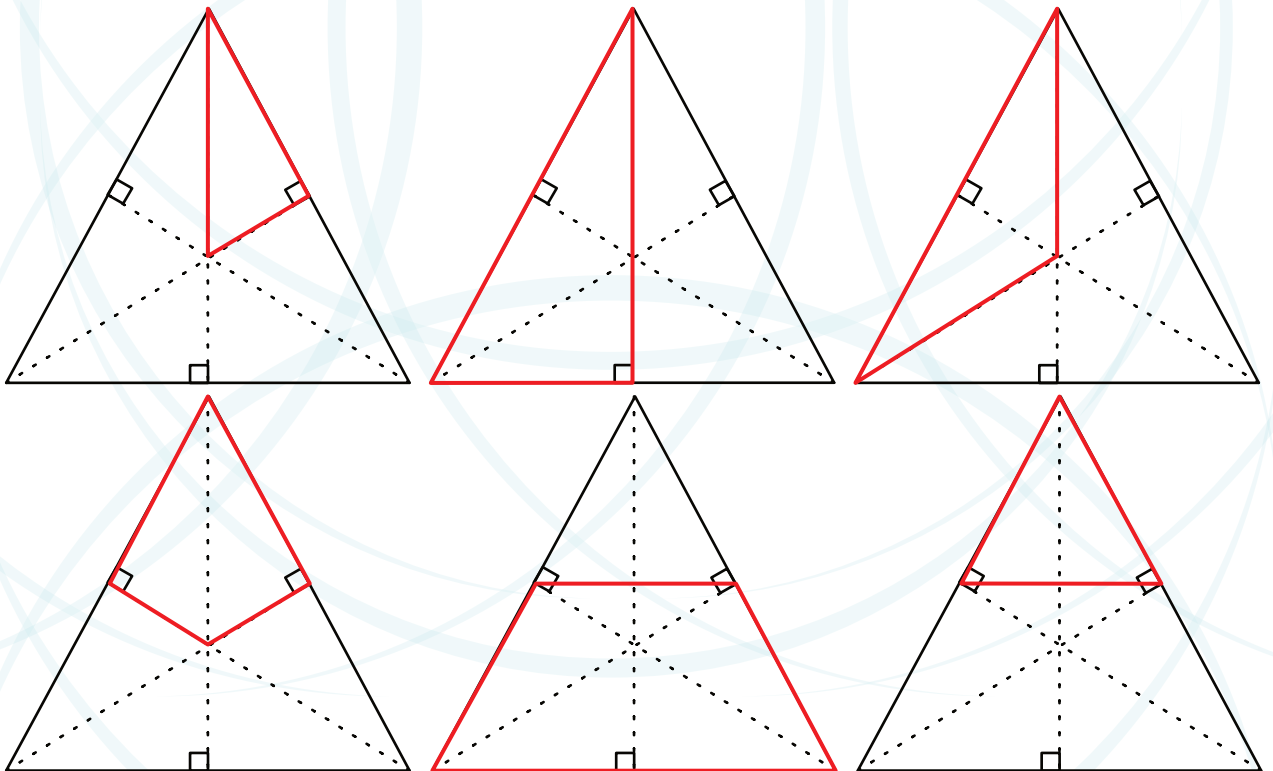
Exploring Perpendicular Line Intersections with the Equilateral Triangle



Connect the points for a quick large regular triangle.



Explore symmetry and congruency with the perpendicular bisectors.



Being able to identify shapes within polygons is an important skill, especially when studying Analytical Geometry.

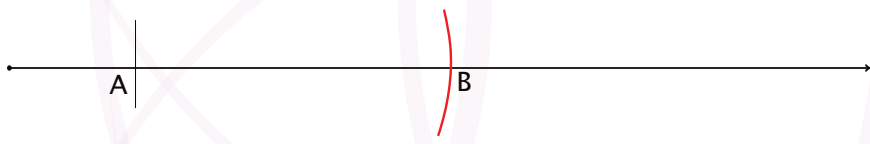
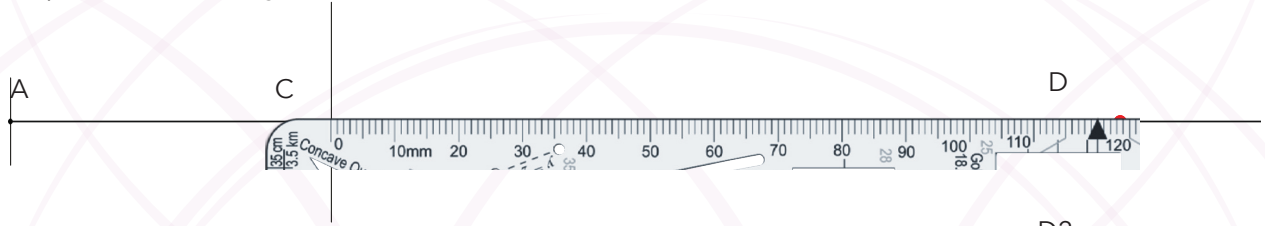


The Three - Point - Measure: TPM

Constructions using the TPM

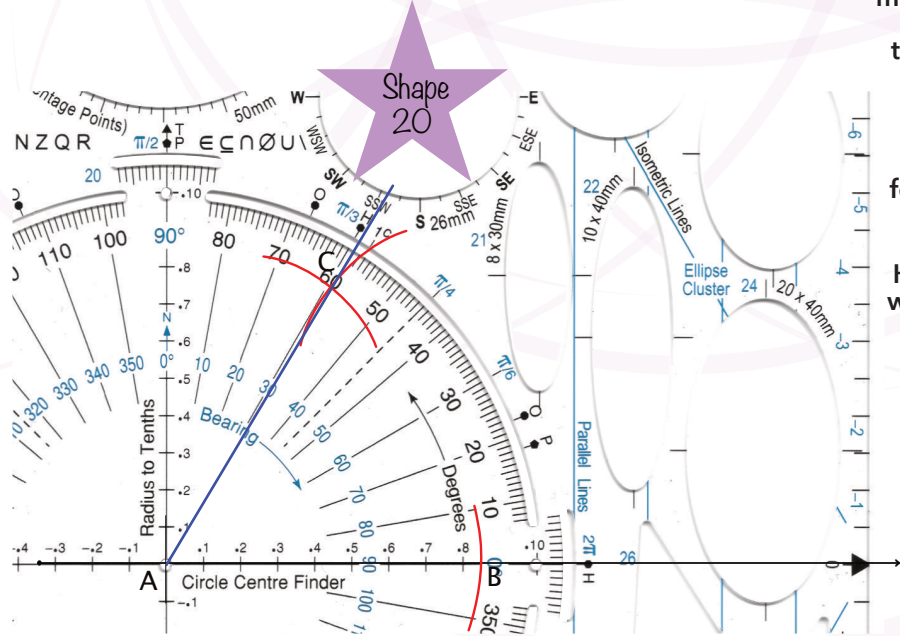
The construction process using a TPM

The process of creating an arc



Arcs created for a specific construction

Accurate construction



Our Constructions manual shows how to do these constructions using three different methods.

This enables our young students who have not yet mastered formal measurement to explore the drawing of angles.

Our intermediate students are taught the unique TPM method to do constructions by using more features of the template.

Lastly our proficient students can manipulate the template and combine their knowledge on rotation and template - manipulation to do quick constructions.

All three these methods explores different parts of how angles are formed and bisected as well as their close relationship with circles.

Having a student master all of them will ensure a deeper knowledge and understanding of geometry.

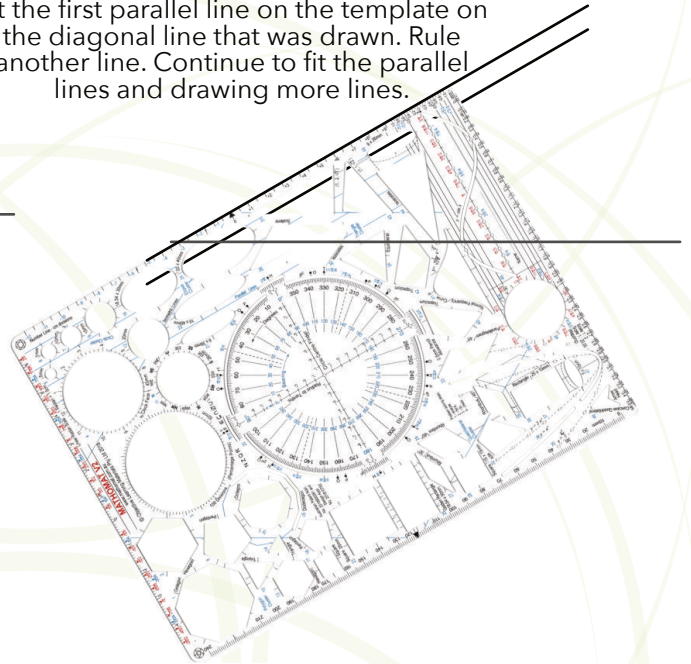
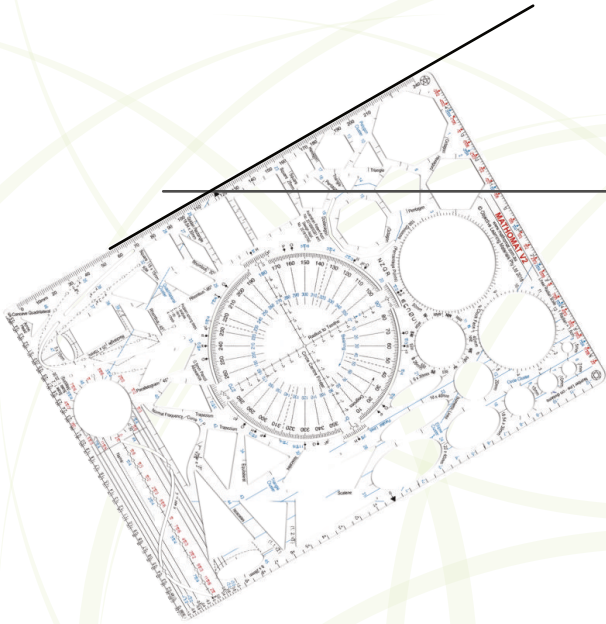
None of our construction-methods involves a compass.



The Isometric Grid: Drawing it

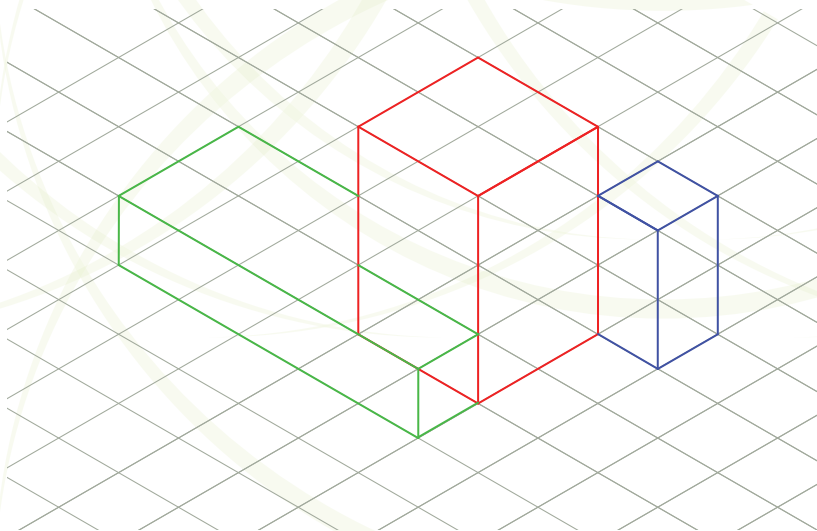
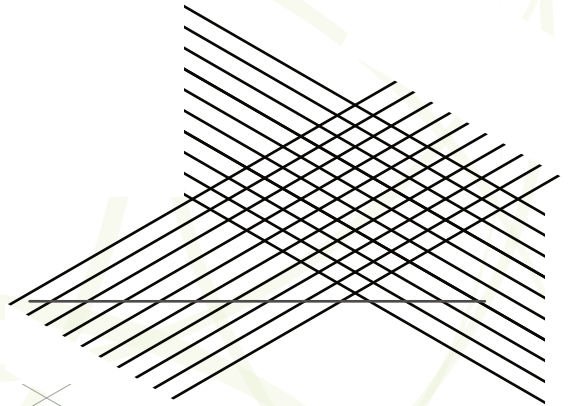
Sketching the Grid and 3D Objects

Fit the first parallel line on the template on the diagonal line that was drawn. Rule another line. Continue to fit the parallel lines and drawing more lines.



Start with a horizontally ruled line. Rotate the template so that any of the isometric lines fits onto the horizontal line. Rule a line.

Turn the template so that you can draw more diagonals on the other side of the completed ones. These diagonals should intersect each other.



One of the uses of an isometric grid is to be able to draw scaled diagrams in 3D.

This is a good way to explain volume and have students draw different views of stacked blocks.



The Half-Dodecagon

Constructing the Dodecagon

MATHOMAT V2
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Linear Radian Scale 12 1 Radian = 1.5cm

Number Line - cm divisions

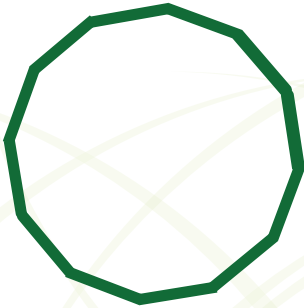
Circle Cluster

5mm 7mm 10mm 15mm 20mm 26mm 30mm 40mm 45mm 50mm 55mm 60mm 65mm 70mm 75mm 80mm 85mm 90mm 95mm 100mm 105mm 110mm 115mm 120mm

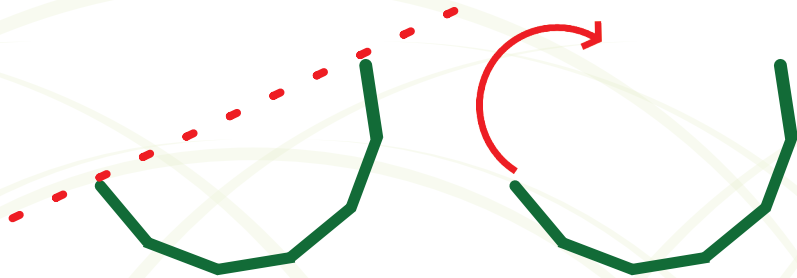
1 Octagon 2 Hexagon 3 Pentagon 4 Triangle 5 Square 6 Rhombus 7 Kite 8 Trapezium 9 Parallelogram 10 Polygon Cluster 11 Clock Face 12 Isosceles 13 Triangle 14 Pentagon 15 Hexagon 16 Octagon 17 Square 18 Rhombus 19 Dodecagon 20 Circle Centre Finder 21 Bearing 22 D. Degrees 23 Perpendicular Lines 24 Ellipse Cluster 25 Golden Rectangle 26 Rhombus 30° 27 Rhombus 45° 28 Rhombus 60° 29 Square 15 x 15mm 30 Kite 31 Quadrilateral Cluster 32 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 33 Normal Frequency Curve 34 Trapezium 35 Equilateral 36 Triangle Cluster 37 Isosceles 38 Scalene 39 (1, 2, √3) 40 (1, 1, √2) 41 8 x 20mm 42 8 x 25mm 43 10 x 40mm 44 8 x 30mm 45 10 x 30mm 46 Arrow Head 47 Concave Quadrilateral 48 Rectangle 25 x 15mm 49 Parallelogram 45° 50 Rhombus 45° 51 Rhombus 60° 52 Rhombus 30° 53 Square 15 x 15mm 54 Kite 55 Quadrilateral Cluster 56 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 57 Normal Frequency Curve 58 Trapezium 59 Equilateral 60 Triangle Cluster 61 Isosceles 62 Scalene 63 (1, 2, √3) 64 (1, 1, √2) 65 8 x 20mm 66 8 x 25mm 67 10 x 40mm 68 8 x 30mm 69 10 x 30mm 70 Arrow Head 71 Concave Quadrilateral 72 Rectangle 25 x 15mm 73 Parallelogram 45° 74 Rhombus 45° 75 Rhombus 60° 76 Rhombus 30° 77 Square 15 x 15mm 78 Kite 79 Quadrilateral Cluster 80 Problem solving steps: 1 - 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analyse, 2 - think, 3 - do, 4 - check 153 Normal Frequency Curve 154 Trapezium 155 Equilateral 156 Triangle Cluster 157 Isosceles 158 Scalene 159 (1, 2, √3) 160 (1, 1, √2) 161 8 x 20mm 162 8 x 25mm 163 10 x 40mm 164 8 x 30mm 165 10 x 30mm 166 Arrow Head 167 Concave Quadrilateral 168 Rectangle 25 x 15mm 169 Parallelogram 45° 170 Rhombus 45° 171 Rhombus 60° 172 Rhombus 30° 173 Square 15 x 15mm 174 Kite 175 Quadrilateral Cluster 176 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 177 Normal Frequency Curve 178 Trapezium 179 Equilateral 180 Triangle Cluster 181 Isosceles 182 Scalene 183 (1, 2, √3) 184 (1, 1, √2) 185 8 x 20mm 186 8 x 25mm 187 10 x 40mm 188 8 x 30mm 189 10 x 30mm 190 Arrow Head 191 Concave Quadrilateral 192 Rectangle 25 x 15mm 193 Parallelogram 45° 194 Rhombus 45° 195 Rhombus 60° 196 Rhombus 30° 197 Square 15 x 15mm 198 Kite 199 Quadrilateral Cluster 200 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 201 Normal Frequency Curve 202 Trapezium 203 Equilateral 204 Triangle Cluster 205 Isosceles 206 Scalene 207 (1, 2, √3) 208 (1, 1, √2) 209 8 x 20mm 210 8 x 25mm 211 10 x 40mm 212 8 x 30mm 213 10 x 30mm 214 Arrow Head 215 Concave Quadrilateral 216 Rectangle 25 x 15mm 217 Parallelogram 45° 218 Rhombus 45° 219 Rhombus 60° 220 Rhombus 30° 221 Square 15 x 15mm 222 Kite 223 Quadrilateral Cluster 224 Problem solving steps: 1 - 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analyse, 2 - think, 3 - do, 4 - check 585 Normal Frequency Curve 586 Trapezium 587 Equilateral 588 Triangle Cluster 589 Isosceles 590 Scalene 591 (1, 2, √3) 592 (1, 1, √2) 593 8 x 20mm 594 8 x 25mm 595 10 x 40mm 596 8 x 30mm 597 10 x 30mm 598 Arrow Head 599 Concave Quadrilateral 600 Rectangle 25 x 15mm 601 Parallelogram 45° 602 Rhombus 45° 603 Rhombus 60° 604 Rhombus 30° 605 Square 15 x 15mm 606 Kite 607 Quadrilateral Cluster 608 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 609 Normal Frequency Curve 610 Trapezium 611 Equilateral 612 Triangle Cluster 613 Isosceles 614 Scalene 615 (1, 2, √3) 616 (1, 1, √2) 617 8 x 20mm 618 8 x 25mm 619 10 x 40mm 620 8 x 30mm 621 10 x 30mm 622 Arrow Head 623 Concave Quadrilateral 624 Rectangle 25 x 15mm 625 Parallelogram 45° 626 Rhombus 45° 627 Rhombus 60° 628 Rhombus 30° 629 Square 15 x 15mm 630 Kite 631 Quadrilateral Cluster 632 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 633 Normal Frequency Curve 634 Trapezium 635 Equilateral 636 Triangle Cluster 637 Isosceles 638 Scalene 639 (1, 2, √3) 640 (1, 1, √2) 641 8 x 20mm 642 8 x 25mm 643 10 x 40mm 644 8 x 30mm 645 10 x 30mm 646 Arrow Head 647 Concave Quadrilateral 648 Rectangle 25 x 15mm 649 Parallelogram 45° 650 Rhombus 45° 651 Rhombus 60° 652 Rhombus 30° 653 Square 15 x 15mm 654 Kite 655 Quadrilateral Cluster 656 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 657 Normal Frequency Curve 658 Trapezium 659 Equilateral 660 Triangle Cluster 661 Isosceles 662 Scalene 663 (1, 2, √3) 664 (1, 1, √2) 665 8 x 20mm 666 8 x 25mm 667 10 x 40mm 668 8 x 30mm 669 10 x 30mm 670 Arrow Head 671 Concave Quadrilateral 672 Rectangle 25 x 15mm 673 Parallelogram 45° 674 Rhombus 45° 675 Rhombus 60° 676 Rhombus 30° 677 Square 15 x 15mm 678 Kite 679 Quadrilateral Cluster 680 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 681 Normal Frequency Curve 682 Trapezium 683 Equilateral 684 Triangle Cluster 685 Isosceles 686 Scalene 687 (1, 2, √3) 688 (1, 1, √2) 689 8 x 20mm 690 8 x 25mm 691 10 x 40mm 692 8 x 30mm 693 10 x 30mm 694 Arrow Head 695 Concave Quadrilateral 696 Rectangle 25 x 15mm 697 Parallelogram 45° 698 Rhombus 45° 699 Rhombus 60° 700 Rhombus 30° 701 Square 15 x 15mm 702 Kite 703 Quadrilateral Cluster 704 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 705 Normal Frequency Curve 706 Trapezium 707 Equilateral 708 Triangle Cluster 709 Isosceles 710 Scalene 711 (1, 2, √3) 712 (1, 1, √2) 713 8 x 20mm 714 8 x 25mm 715 10 x 40mm 716 8 x 30mm 717 10 x 30mm 718 Arrow Head 719 Concave Quadrilateral 720 Rectangle 25 x 15mm 721 Parallelogram 45° 722 Rhombus 45° 723 Rhombus 60° 724 Rhombus 30° 725 Square 15 x 15mm 726 Kite 727 Quadrilateral Cluster 728 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 729 Normal Frequency Curve 730 Trapezium 731 Equilateral 732 Triangle Cluster 733 Isosceles 734 Scalene 735 (1, 2, √3) 736 (1, 1, √2) 737 8 x 20mm 738 8 x 25mm 739 10 x 40mm 740 8 x 30mm 741 10 x 30mm 742 Arrow Head 743 Concave Quadrilateral 744 Rectangle 25 x 15mm 745 Parallelogram 45° 746 Rhombus 45° 747 Rhombus 60° 748 Rhombus 30° 749 Square 15 x 15mm 750 Kite 751 Quadrilateral Cluster 752 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 753 Normal Frequency Curve 754 Trapezium 755 Equilateral 756 Triangle Cluster 757 Isosceles 758 Scalene 759 (1, 2, √3) 760 (1, 1, √2) 761 8 x 20mm 762 8 x 25mm 763 10 x 40mm 764 8 x 30mm 765 10 x 30mm 766 Arrow Head 767 Concave Quadrilateral 768 Rectangle 25 x 15mm 769 Parallelogram 45° 770 Rhombus 45° 771 Rhombus 60° 772 Rhombus 30° 773 Square 15 x 15mm 774 Kite 775 Quadrilateral Cluster 776 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 777 Normal Frequency Curve 778 Trapezium 779 Equilateral 780 Triangle Cluster 781 Isosceles 782 Scalene 783 (1, 2, √3) 784 (1, 1, √2) 785 8 x 20mm 786 8 x 25mm 787 10 x 40mm 788 8 x 30mm 789 10 x 30mm 790 Arrow Head 791 Concave Quadrilateral 792 Rectangle 25 x 15mm 793 Parallelogram 45° 794 Rhombus 45° 795 Rhombus 60° 796 Rhombus 30° 797 Square 15 x 15mm 798 Kite 799 Quadrilateral Cluster 800 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 801 Normal Frequency Curve 802 Trapezium 803 Equilateral 804 Triangle Cluster 805 Isosceles 806 Scalene 807 (1, 2, √3) 808 (1, 1, √2) 809 8 x 20mm 810 8 x 25mm 811 10 x 40mm 812 8 x 30mm 813 10 x 30mm 814 Arrow Head 815 Concave Quadrilateral 816 Rectangle 25 x 15mm 817 Parallelogram 45° 818 Rhombus 45° 819 Rhombus 60° 820 Rhombus 30° 821 Square 15 x 15mm 822 Kite 823 Quadrilateral Cluster 824 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 825 Normal Frequency Curve 826 Trapezium 827 Equilateral 828 Triangle Cluster 829 Isosceles 830 Scalene 831 (1, 2, √3) 832 (1, 1, √2) 833 8 x 20mm 834 8 x 25mm 835 10 x 40mm 836 8 x 30mm 837 10 x 30mm 838 Arrow Head 839 Concave Quadrilateral 840 Rectangle 25 x 15mm 841 Parallelogram 45° 842 Rhombus 45° 843 Rhombus 60° 844 Rhombus 30° 845 Square 15 x 15mm 846 Kite 847 Quadrilateral Cluster 848 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 849 Normal Frequency Curve 850 Trapezium 851 Equilateral 852 Triangle Cluster 853 Isosceles 854 Scalene 855 (1, 2, √3) 856 (1, 1, √2) 857 8 x 20mm 858 8 x 25mm 859 10 x 40mm 860 8 x 30mm 861 10 x 30mm 862 Arrow Head 863 Concave Quadrilateral 864 Rectangle 25 x 15mm 865 Parallelogram 45° 866 Rhombus 45° 867 Rhombus 60° 868 Rhombus 30° 869 Square 15 x 15mm 870 Kite 871 Quadrilateral Cluster 872 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 873 Normal Frequency Curve 874 Trapezium 875 Equilateral 876 Triangle Cluster 877 Isosceles 878 Scalene 879 (1, 2, √3) 880 (1, 1, √2) 881 8 x 20mm 882 8 x 25mm 883 10 x 40mm 884 8 x 30mm 885 10 x 30mm 886 Arrow Head 887 Concave Quadrilateral 888 Rectangle 25 x 15mm 889 Parallelogram 45° 890 Rhombus 45° 891 Rhombus 60° 892 Rhombus 30° 893 Square 15 x 15mm 894 Kite 895 Quadrilateral Cluster 896 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 897 Normal Frequency Curve 898 Trapezium 899 Equilateral 900 Triangle Cluster 901 Isosceles 902 Scalene 903 (1, 2, √3) 904 (1, 1, √2) 905 8 x 20mm 906 8 x 25mm 907 10 x 40mm 908 8 x 30mm 909 10 x 30mm 910 Arrow Head 911 Concave Quadrilateral 912 Rectangle 25 x 15mm 913 Parallelogram 45° 914 Rhombus 45° 915 Rhombus 60° 916 Rhombus 30° 917 Square 15 x 15mm 918 Kite 919 Quadrilateral Cluster 920 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 921 Normal Frequency Curve 922 Trapezium 923 Equilateral 924 Triangle Cluster 925 Isosceles 926 Scalene 927 (1, 2, √3) 928 (1, 1, √2) 929 8 x 20mm 930 8 x 25mm 931 10 x 40mm 932 8 x 30mm 933 10 x 30mm 934 Arrow Head 935 Concave Quadrilateral 936 Rectangle 25 x 15mm 937 Parallelogram 45° 938 Rhombus 45° 939 Rhombus 60° 940 Rhombus 30° 941 Square 15 x 15mm 942 Kite 943 Quadrilateral Cluster 944 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 945 Normal Frequency Curve 946 Trapezium 947 Equilateral 948 Triangle Cluster 949 Isosceles 950 Scalene 951 (1, 2, √3) 952 (1, 1, √2) 953 8 x 20mm 954 8 x 25mm 955 10 x 40mm 956 8 x 30mm 957 10 x 30mm 958 Arrow Head 959 Concave Quadrilateral 960 Rectangle 25 x 15mm 961 Parallelogram 45° 962 Rhombus 45° 963 Rhombus 60° 964 Rhombus 30° 965 Square 15 x 15mm 966 Kite 967 Quadrilateral Cluster 968 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 969 Normal Frequency Curve 970 Trapezium 971 Equilateral 972 Triangle Cluster 973 Isosceles 974 Scalene 975 (1, 2, √3) 976 (1, 1, √2) 977 8 x 20mm 978 8 x 25mm 979 10 x 40mm 980 8 x 30mm 981 10 x 30mm 982 Arrow Head 983 Concave Quadrilateral 984 Rectangle 25 x 15mm 985 Parallelogram 45° 986 Rhombus 45° 987 Rhombus 60° 988 Rhombus 30° 989 Square 15 x 15mm 990 Kite 991 Quadrilateral Cluster 992 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 993 Normal Frequency Curve 994 Trapezium 995 Equilateral 996 Triangle Cluster 997 Isosceles 998 Scalene 999 (1, 2, √3) 1000 (1, 1, √2) 1001 8 x 20mm 1002 8 x 25mm 1003 10 x 40mm 1004 8 x 30mm 1005 10 x 30mm 1006 Arrow Head 1007 Concave Quadrilateral 1008 Rectangle 25 x 15mm 1009 Parallelogram 45° 1010 Rhombus 45° 1011 Rhombus 60° 1012 Rhombus 30° 1013 Square 15 x 15mm 1014 Kite 1015 Quadrilateral Cluster 1016 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1017 Normal Frequency Curve 1018 Trapezium 1019 Equilateral 1020 Triangle Cluster 1021 Isosceles 1022 Scalene 1023 (1, 2, √3) 1024 (1, 1, √2) 1025 8 x 20mm 1026 8 x 25mm 1027 10 x 40mm 1028 8 x 30mm 1029 10 x 30mm 1030 Arrow Head 1031 Concave Quadrilateral 1032 Rectangle 25 x 15mm 1033 Parallelogram 45° 1034 Rhombus 45° 1035 Rhombus 60° 1036 Rhombus 30° 1037 Square 15 x 15mm 1038 Kite 1039 Quadrilateral Cluster 1040 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1041 Normal Frequency Curve 1042 Trapezium 1043 Equilateral 1044 Triangle Cluster 1045 Isosceles 1046 Scalene 1047 (1, 2, √3) 1048 (1, 1, √2) 1049 8 x 20mm 1050 8 x 25mm 1051 10 x 40mm 1052 8 x 30mm 1053 10 x 30mm 1054 Arrow Head 1055 Concave Quadrilateral 1056 Rectangle 25 x 15mm 1057 Parallelogram 45° 1058 Rhombus 45° 1059 Rhombus 60° 1060 Rhombus 30° 1061 Square 15 x 15mm 1062 Kite 1063 Quadrilateral Cluster 1064 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1065 Normal Frequency Curve 1066 Trapezium 1067 Equilateral 1068 Triangle Cluster 1069 Isosceles 1070 Scalene 1071 (1, 2, √3) 1072 (1, 1, √2) 1073 8 x 20mm 1074 8 x 25mm 1075 10 x 40mm 1076 8 x 30mm 1077 10 x 30mm 1078 Arrow Head 1079 Concave Quadrilateral 1080 Rectangle 25 x 15mm 1081 Parallelogram 45° 1082 Rhombus 45° 1083 Rhombus 60° 1084 Rhombus 30° 1085 Square 15 x 15mm 1086 Kite 1087 Quadrilateral Cluster 1088 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1089 Normal Frequency Curve 1090 Trapezium 1091 Equilateral 1092 Triangle Cluster 1093 Isosceles 1094 Scalene 1095 (1, 2, √3) 1096 (1, 1, √2) 1097 8 x 20mm 1098 8 x 25mm 1099 10 x 40mm 1100 8 x 30mm 1101 10 x 30mm 1102 Arrow Head 1103 Concave Quadrilateral 1104 Rectangle 25 x 15mm 1105 Parallelogram 45° 1106 Rhombus 45° 1107 Rhombus 60° 1108 Rhombus 30° 1109 Square 15 x 15mm 1110 Kite 1111 Quadrilateral Cluster 1112 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1113 Normal Frequency Curve 1114 Trapezium 1115 Equilateral 1116 Triangle Cluster 1117 Isosceles 1118 Scalene 1119 (1, 2, √3) 1120 (1, 1, √2) 1121 8 x 20mm 1122 8 x 25mm 1123 10 x 40mm 1124 8 x 30mm 1125 10 x 30mm 1126 Arrow Head 1127 Concave Quadrilateral 1128 Rectangle 25 x 15mm 1129 Parallelogram 45° 1130 Rhombus 45° 1131 Rhombus 60° 1132 Rhombus 30° 1133 Square 15 x 15mm 1134 Kite 1135 Quadrilateral Cluster 1136 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1137 Normal Frequency Curve 1138 Trapezium 1139 Equilateral 1140 Triangle Cluster 1141 Isosceles 1142 Scalene 1143 (1, 2, √3) 1144 (1, 1, √2) 1145 8 x 20mm 1146 8 x 25mm 1147 10 x 40mm 1148 8 x 30mm 1149 10 x 30mm 1150 Arrow Head 1151 Concave Quadrilateral 1152 Rectangle 25 x 15mm 1153 Parallelogram 45° 1154 Rhombus 45° 1155 Rhombus 60° 1156 Rhombus 30° 1157 Square 15 x 15mm 1158 Kite 1159 Quadrilateral Cluster 1160 Problem solving steps: 1 - analyse, 2 - think, 3 - do, 4 - check 1161 Normal Frequency Curve 1162 Trapezium 1163 Equilateral 1164 Triangle Cluster 1165 Isosceles

The Dodecagon Examples

Drawing the Dodecagon and Diagonals

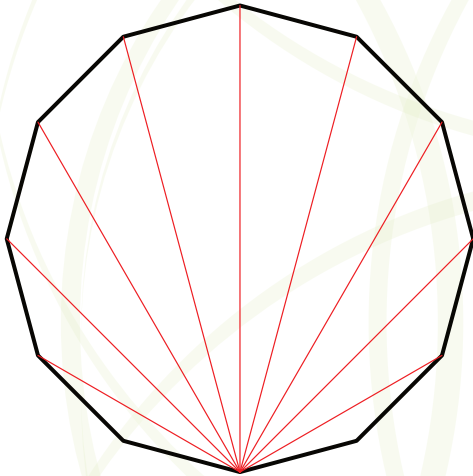


The dodecagon

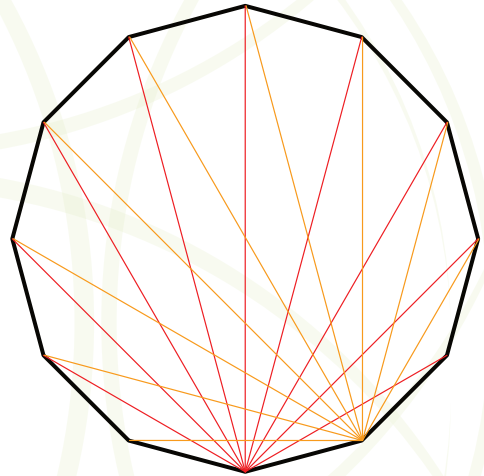


An introduction into reflecting over a diagonal or the line $y=x$

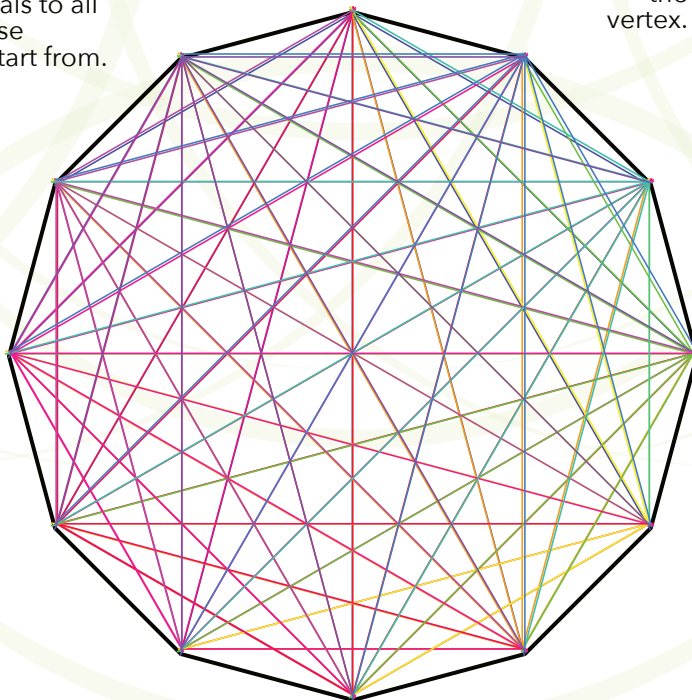
Completion by rotating the template enhances spatial skills.



Draw an enlarged dodecagon. Pick a vertex and draw diagonals to all the vertices except to those adjacent to the one you start from.

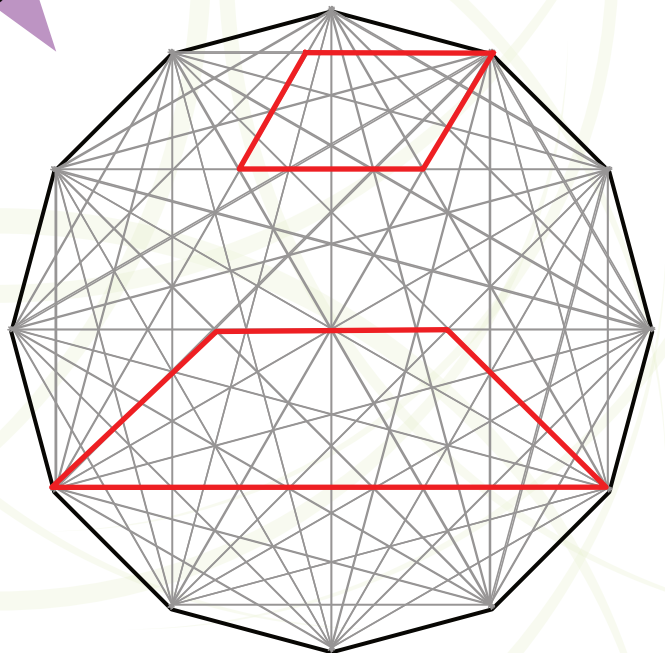
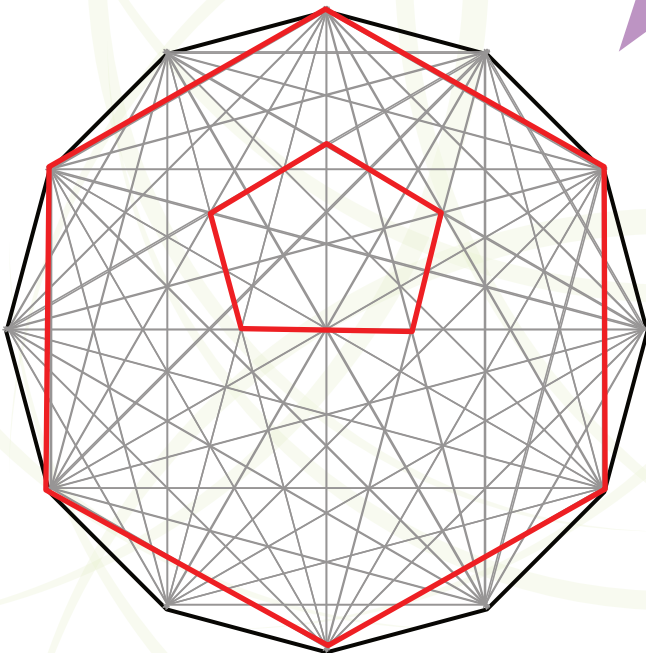
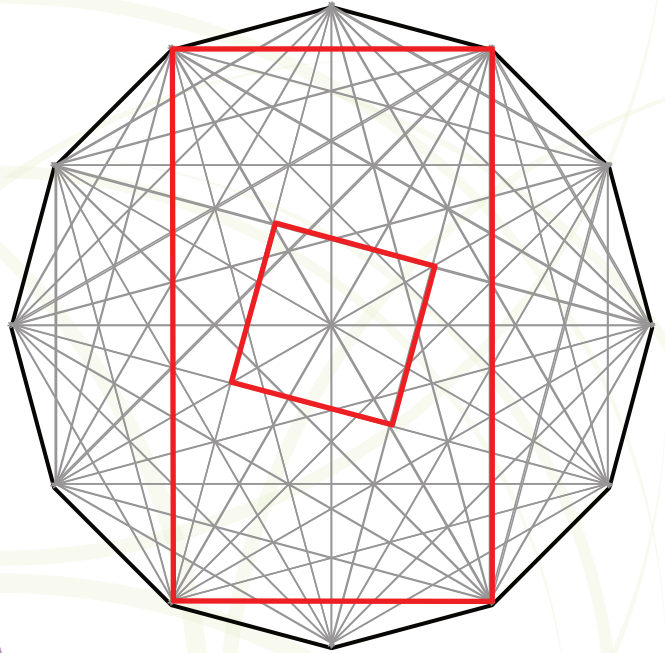
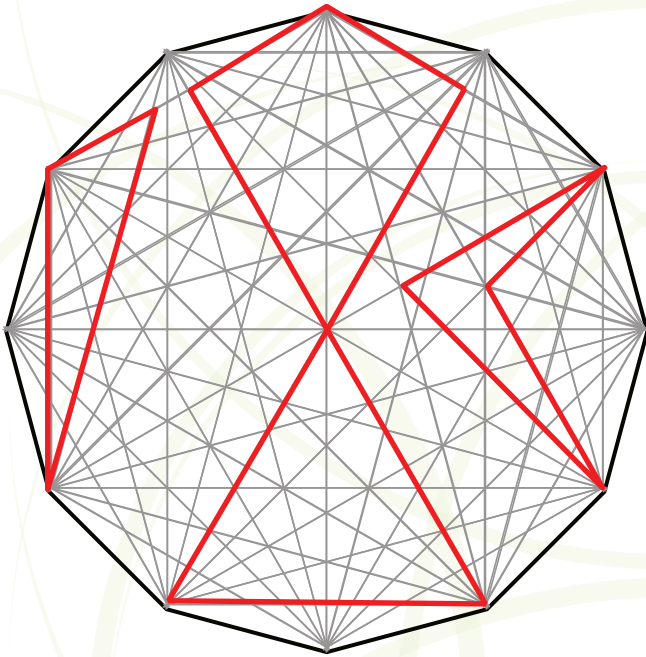


Pick a different colour and repeat the process from the adjacent vertex. Keep on doing this for the remaining vertices.



Polygons on the Protractor

Exploring Visio-Spatial Ability

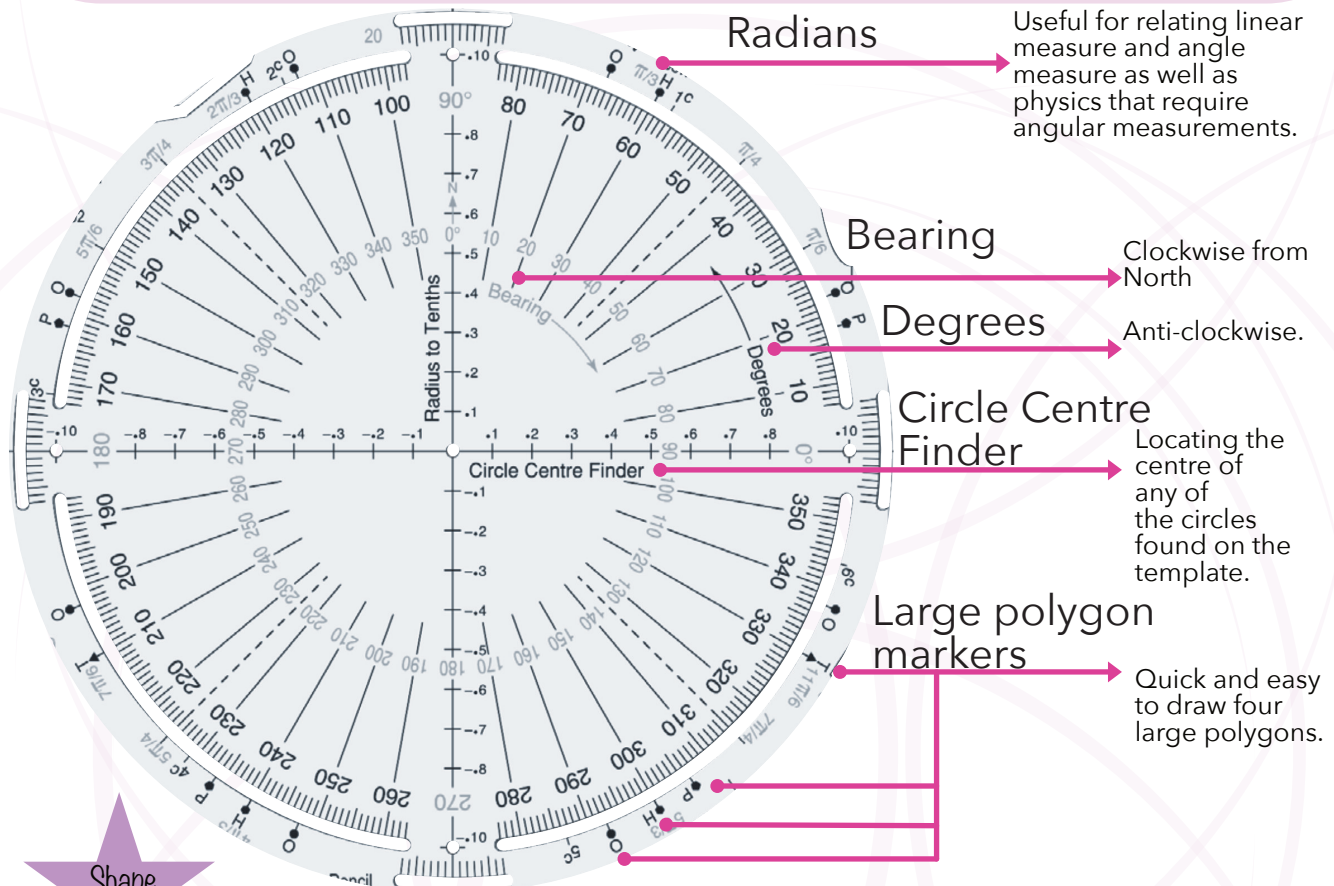


Have the students draw up some grey dodecagons with diagonals from each vertex. Let them search and draw all the different shapes they can find. When they identify a shape, let them name the shape-properties.



The Protractor and Circle Centre Finder

Using the features on the Protractor



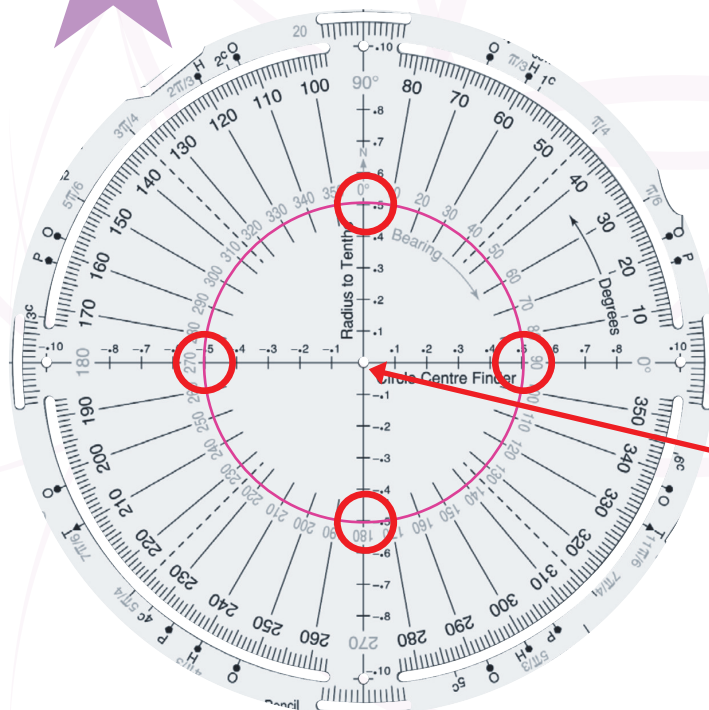
Radians
Useful for relating linear measure and angle measure as well as physics that require angular measurements.

Bearing
Clockwise from North

Degrees
Anti-clockwise.

Circle Centre Finder
Locating the centre of any of the circles found on the template.

Large polygon markers
Quick and easy to draw four large polygons.



Using the Circle centre finder

- #1 Draw a circle
- #2 Position the template over the circle so that the numbers on the x and y axis line up on the circumference of the circle. The same number should be on the circumference.
(There will be negative numbers but distance is not measured in negatives.)
- #3 Once the numbers are lined up on the circumference, mark the centre with a pen or pencil in the hole right in the middle of the protractor. This is also the origin of the Cartesian plane.
Knowing the centre or midpoint of a circle enables us to work with circle theorems as well as use circles for pie-charts and fractions, to name but a few.



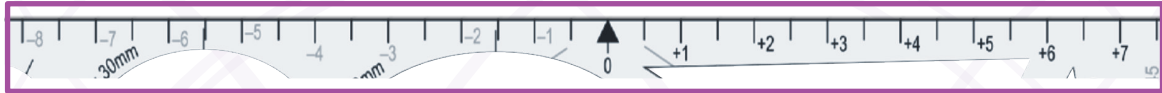
The Rulers Examples

Using the Four Rulers



The linear radian scale.

This scale (1,5 cm) units is for use with the unit circle and the trigonometry graph cluster.

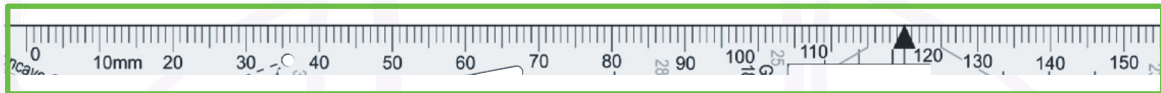


The integer scale.

Use this scale when working with directed numbers. The Cartesian plane can also be scaled using this ruler.

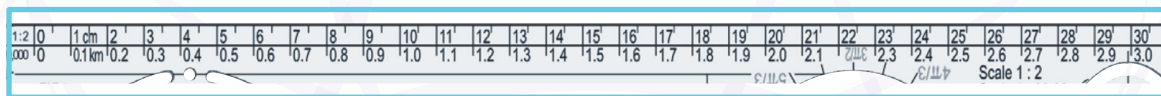
When horizontal: To the left is in a negative direction and to the right is in a positive direction.

When Vertical: The direction up is positive and the direction down is negative.



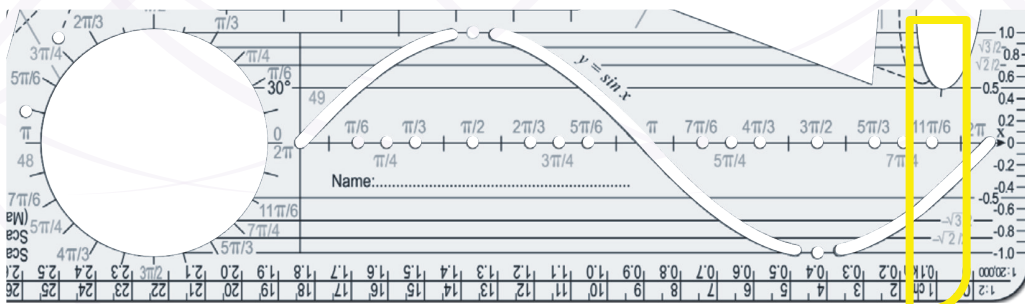
The millimetre scale.

This scale is used for general measurement as well as when doing the compass-less constructions.



The scale ruler.

This ruler has graduations for engineering drawing in a 1:2 ratio as well as 1:20000 for mapping.



The Sine scale.

This scale is used to measure output from the trigonometry graph cluster as height of the curve above and below the x-axis.



3D Clusters

Quick Draw 3D Objects

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Linear Radian Scale 1 Radian = 1.5cm

Number Line - cm divisions

Circle Cluster: 5mm, 6mm, 7mm, 10mm, 15mm, 20mm, 22mm, 18.54 x 30mm, 10 x 40mm, 20 x 40mm

Triangle Cluster: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Circle Centre Finder

Problem solving steps:
1- analyse,
2- think,
3- do,
4- check

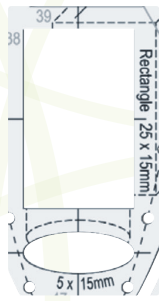
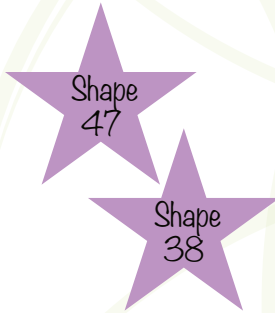
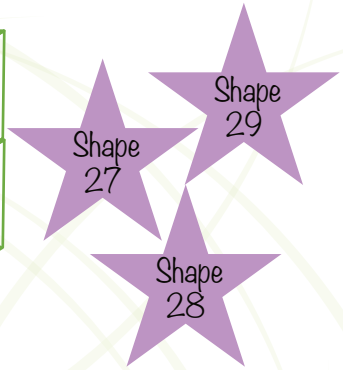
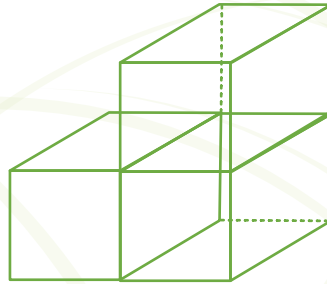
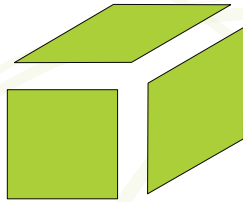
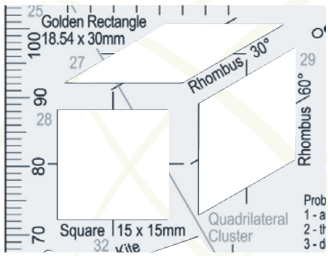
Scale 1:2000
Scale 1:2

Name:

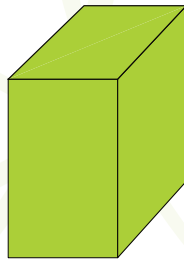
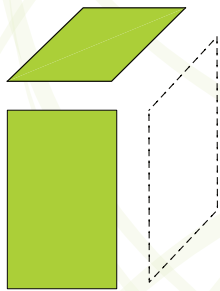
3D Clusters Examples

Creating 3D Objects with the Clusters

Cubes



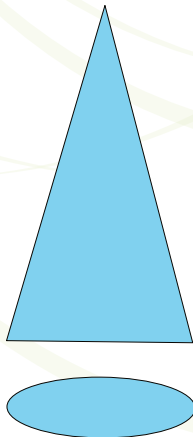
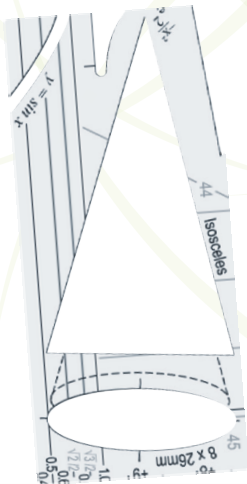
Cylinders



Rectangular Prism

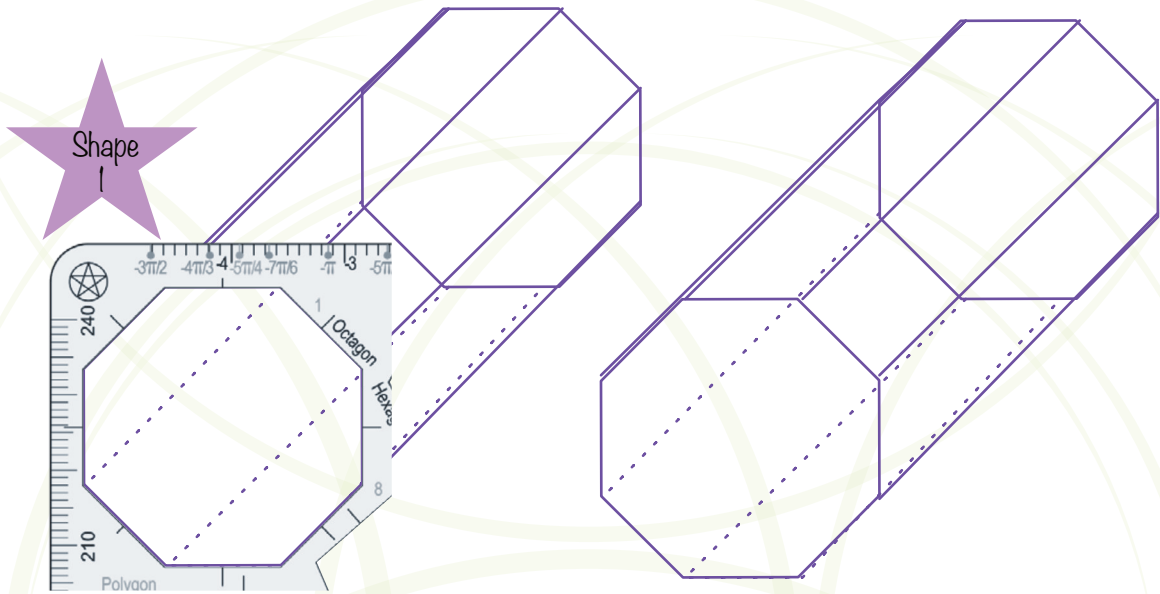


Cones

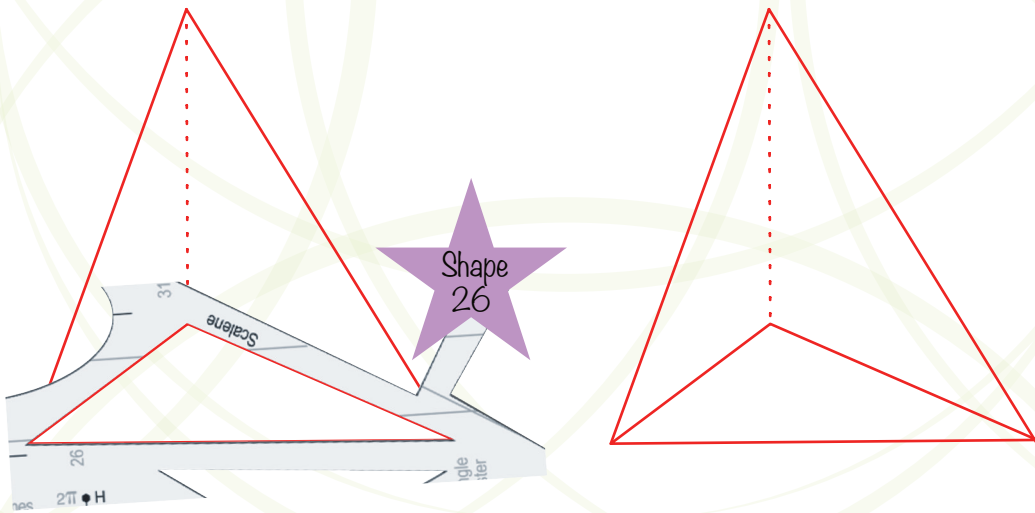


3D Objects Without Clusters

Composing 3D Objects



Many students may still think that the face of the object that it is resting on is the base. Drawing the 3D object will help them, together with studying the geometry facts for 3D objects to understand why this is not always the case.



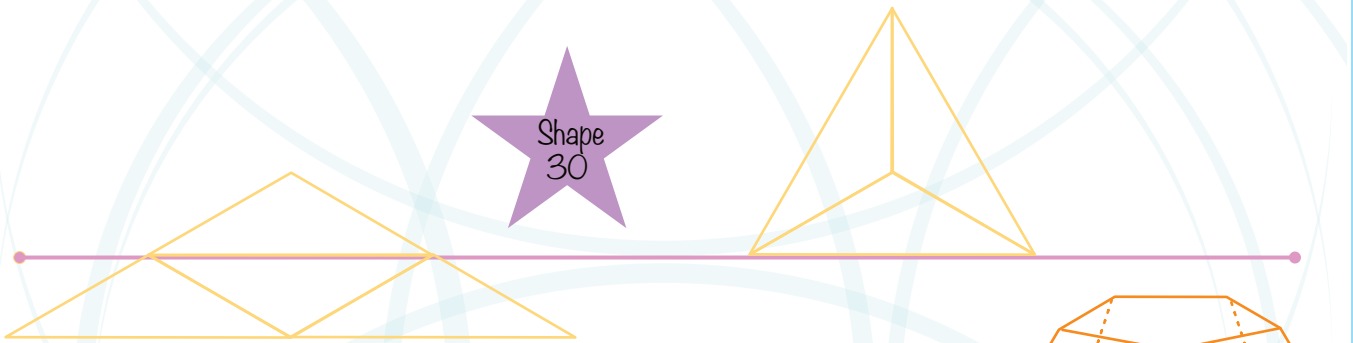
The Triangular-based Pyramid is easier to draw in perspective, when the Scalene Triangle is used.



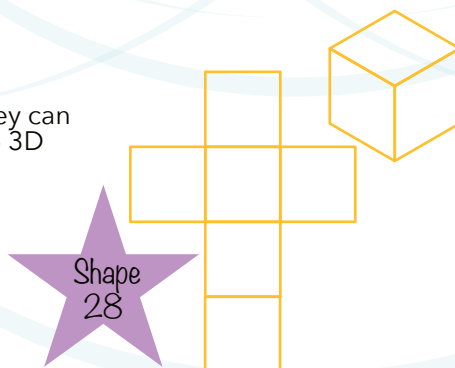
Nets Examples

Some nets that can be made with the template

Have the students draw a guideline to start sketching for the nets to make sure they draw them accurately.



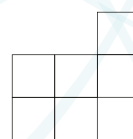
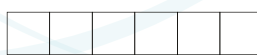
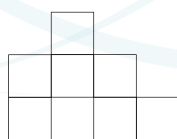
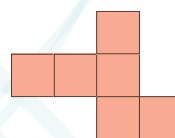
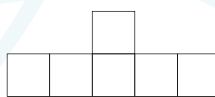
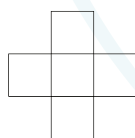
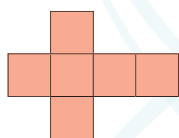
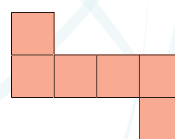
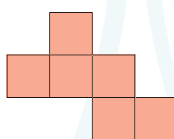
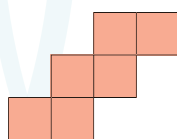
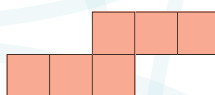
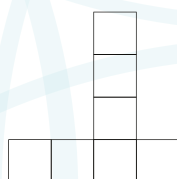
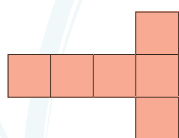
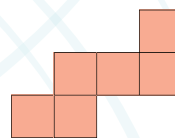
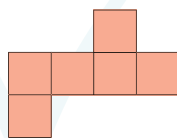
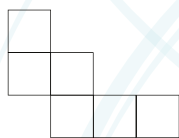
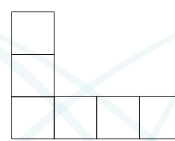
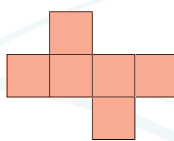
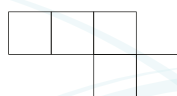
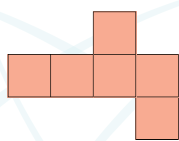
Once the nets are drawn, they can be cut out and folded into 3D objects.



Nets Examples

Eleven nets for the Cube

There are eleven nets for a cube. Those that will fold into Cubes have been coloured in.



Let students discuss why some nets cannot fold into a cube.



Irregular Polygon Enlargement

Enlargement by Translation

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Linear Radian Scale 1 Radian = 1.5cm

Number Line - cm divisions

Circle Cluster
5mm, 6mm, 7mm, 10mm, 15mm, 20mm, 26mm, 30mm, 35mm, 40mm, 45mm, 50mm, 55mm, 60mm, 65mm, 70mm, 75mm, 80mm, 85mm, 90mm, 95mm, 100mm

Clock Face 1
N, NE, E, SE, S, SW, W, NW, NNW, NNE, ESE, ENE, SSE, SSW, WSW, WNW, NNW, NNE, ESE, ENE, SSE, SSW, WSW, WNW

Circle Centre Finder

Radius to Tenths

Bearing

Circle to Centres

Parallel Lines

Isosceles

Triangle Cluster

Scalene

Equilateral

Isosceles

Normal Frequency Curve

$y = \sqrt{2\pi} e^{-x^2/2}$

$y = \sin x$

Problem solving steps:
1- analyse,
2- think,
3- do,
4- check

Scale 1:2000
Scale 1:200
Scale 1:20

Arrow Head

Concave Quadrilateral

10mm

20

30

40

50

60

70

80

90

100

110

120

130

140

150

160

170

180

190

200

210

240

1 Octagon

2 Hexagon

3 Pentagon

4 Triangle

5 Polygon Cluster

6 Square 25mm

7 Square 15x15mm

8 Kite

9 Rhombus 30°

10 Rhombus 45°

11 Parallelogram 45°

12 Rectangle 25 x 15mm

13 Golden Rectangle 18.54 x 30mm

14 Rhombus 60°

15 Rhombus 90°

16 Square 115 x 15mm

17 Quadrilateral Cluster

18 Triangle

19 Pentagon

20 Hexagon

21 Octagon

22 Dodecagon

23 Polygon Cluster

24 Ellipse Cluster

25 Schematic Lines

26 Parallel Lines

27 Golden Rectangle 18.54 x 30mm

28 Rhombus 60°

29 Rhombus 90°

30 Square 115 x 15mm

31 Quadrilateral Cluster

32 Triangle

33 Pentagon

34 Hexagon

35 Octagon

36 Dodecagon

37 Polygon Cluster

38 Ellipse Cluster

39 Schematic Lines

40 Parallel Lines

41 Isosceles

42 Triangle Cluster

43 Scalene

44 Equilateral

45 Isosceles

46 Normal Frequency Curve

47 $y = \sqrt{2\pi} e^{-x^2/2}$

48 $y = \sin x$

49 Arrow Head

50 Concave Quadrilateral

51 10mm

52 20

53 30

54 40

55 50

56 60

57 70

58 80

59 90

60 100

61 110

62 120

63 130

64 140

65 150

66 160

67 170

68 180

69 190

70 200

71 210

72 240

73 Octagon

74 Hexagon

75 Pentagon

76 Triangle

77 Polygon Cluster

78 Square 25mm

79 Square 15x15mm

80 Kite

81 Rhombus 30°

82 Rhombus 45°

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84 Rectangle 25 x 15mm

85 Golden Rectangle 18.54 x 30mm

86 Rhombus 60°

87 Rhombus 90°

88 Square 115 x 15mm

89 Quadrilateral Cluster

90 Triangle

91 Pentagon

92 Hexagon

93 Octagon

94 Dodecagon

95 Polygon Cluster

96 Ellipse Cluster

97 Schematic Lines

98 Parallel Lines

99 Isosceles

100 Triangle Cluster

101 Scalene

102 Equilateral

103 Isosceles

104 Normal Frequency Curve

105 $y = \sqrt{2\pi} e^{-x^2/2}$

106 $y = \sin x$

107 Arrow Head

108 Concave Quadrilateral

109 10mm

110 20

111 30

112 40

113 50

114 60

115 70

116 80

117 90

118 100

119 110

120 120

121 130

122 140

123 150

124 160

125 170

126 180

127 190

128 200

129 210

130 240

131 Octagon

132 Hexagon

133 Pentagon

134 Triangle

135 Polygon Cluster

136 Square 25mm

137 Square 15x15mm

138 Kite

139 Rhombus 30°

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142 Rectangle 25 x 15mm

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144 Rhombus 60°

145 Rhombus 90°

146 Square 115 x 15mm

147 Quadrilateral Cluster

148 Triangle

149 Pentagon

150 Hexagon

151 Octagon

152 Dodecagon

153 Polygon Cluster

154 Ellipse Cluster

155 Schematic Lines

156 Parallel Lines

157 Isosceles

158 Triangle Cluster

159 Scalene

160 Equilateral

161 Isosceles

162 Normal Frequency Curve

163 $y = \sqrt{2\pi} e^{-x^2/2}$

164 $y = \sin x$

165 Arrow Head

166 Concave Quadrilateral

167 10mm

168 20

169 30

170 40

171 50

172 60

173 70

174 80

175 90

176 100

177 110

178 120

179 130

180 140

181 150

182 160

183 170

184 180

185 190

186 200

187 210

188 240

189 Octagon

190 Hexagon

191 Pentagon

192 Triangle

193 Polygon Cluster

194 Square 25mm

195 Square 15x15mm

196 Kite

197 Rhombus 30°

198 Rhombus 45°

199 Parallelogram 45°

200 Rectangle 25 x 15mm

201 Golden Rectangle 18.54 x 30mm

202 Rhombus 60°

203 Rhombus 90°

204 Square 115 x 15mm

205 Quadrilateral Cluster

206 Triangle

207 Pentagon

208 Hexagon

209 Octagon

210 Dodecagon

211 Polygon Cluster

212 Ellipse Cluster

213 Schematic Lines

214 Parallel Lines

215 Isosceles

216 Triangle Cluster

217 Scalene

218 Equilateral

219 Isosceles

220 Normal Frequency Curve

221 $y = \sqrt{2\pi} e^{-x^2/2}$

222 $y = \sin x$

223 Arrow Head

224 Concave Quadrilateral

225 10mm

226 20

227 30

228 40

229 50

230 60

231 70

232 80

233 90

234 100

235 110

236 120

237 130

238 140

239 150

240 160

241 170

242 180

243 190

244 200

245 210

246 240

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248 Hexagon

249 Pentagon

250 Triangle

251 Polygon Cluster

252 Square 25mm

253 Square 15x15mm

254 Kite

255 Rhombus 30°

256 Rhombus 45°

257 Parallelogram 45°

258 Rectangle 25 x 15mm

259 Golden Rectangle 18.54 x 30mm

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269 Polygon Cluster

270 Ellipse Cluster

271 Schematic Lines

272 Parallel Lines

273 Isosceles

274 Triangle Cluster

275 Scalene

276 Equilateral

277 Isosceles

278 Normal Frequency Curve

279 $y = \sqrt{2\pi} e^{-x^2/2}$

280 $y = \sin x$

281 Arrow Head

282 Concave Quadrilateral

283 10mm

284 20

285 30

286 40

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289 70

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292 100

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950 Kite

951 Rhombus 30°

952 Rhombus 45°

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954 Rectangle 25 x 15mm

955 Golden Rectangle 18.54 x 30mm

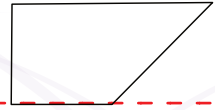
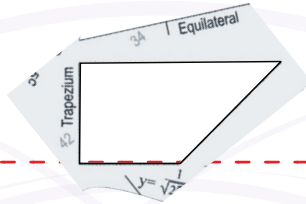
956 Rhombus 60°

9

Irregular Polygon Enlargement Example

One of Three Ways to Enlarge - Translation.

Shape
42

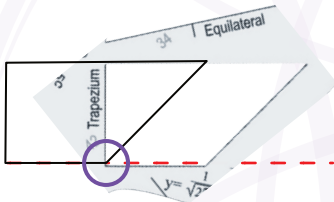


Start by drawing a guide line.
As we progress with the enlargement we will need these.

Draw the irregular shape, the Right-Angled Trapezium, lightly in pencil.

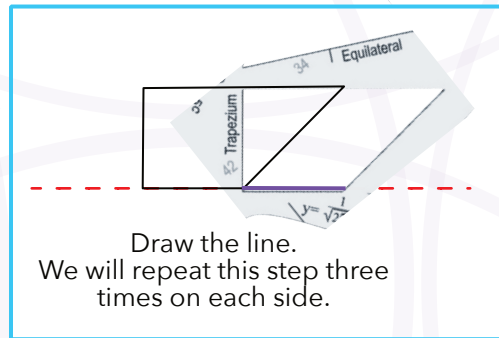
This is what the start should look like. There is already one side on the guideline. The bottom side.

The bottom side has been drawn once.



Place the template so that the side that will be produced is lined up with the vertex.

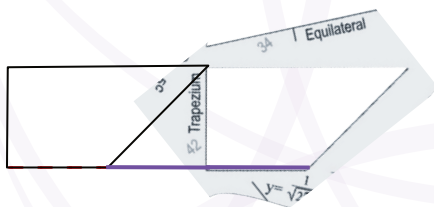
Remember we already drew the bottom side once!



Draw the line.
We will repeat this step three times on each side.

This step should be repeated for as many times as you want to enlarge the shape for. If you do this three times, you enlarge by a factor of three. If you do it twice, you enlarge by a factor of two.

It is important that you whatever factor you choose to enlarge by, you use the same factor for each side.

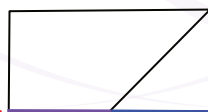


Move the template to line up the vertex with the end of the line that was last drawn.

This was the second time the bottom-side was drawn.

Move the template again to line up the vertex with the end of the line that was last drawn.

This is the third line, so we draw the vertex and adjacent side as well.



.....Continued on the next page.

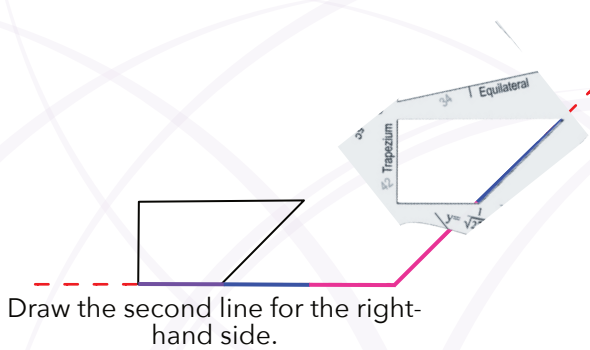
Use the ruler on the side and draw a guideline again. We will place the shape on this line to start the right-hand side. We will continue the steps as we did for the bottom side. Move template three times and draw the vertex on the third translation.

We used the irregular Trapezium, but you can use any regular or irregular shape. See the Primary Unwrap for the regular shape enlargement. ✓



Irregular Polygon Enlargement

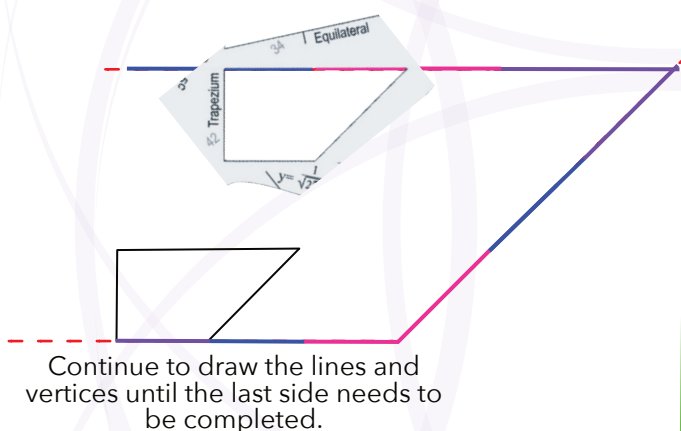
Enlarging an Irregular Polygon continued



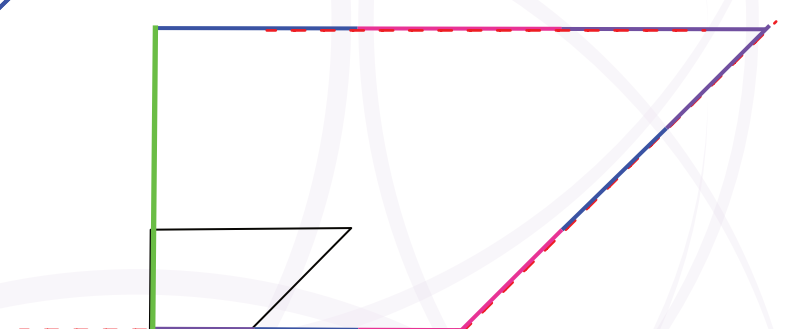
Draw the second line for the right-hand side.



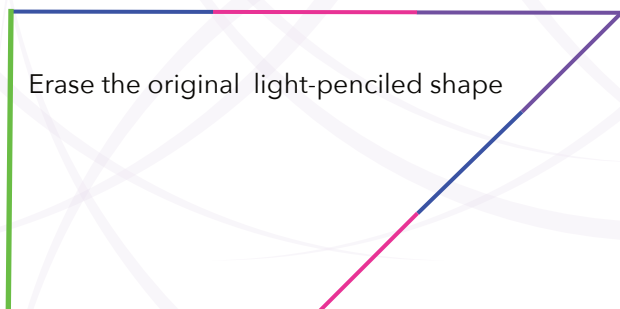
Draw the third and last line for the right-hand side. Remember to draw the vertex and adjacent side, as well as a guideline.
You will do this after each time the third line was drawn. (Because the factor of enlargement that we chose was three.)



Continue to draw the lines and vertices until the last side needs to be completed.




Your last side should also be three times longer than the template's shape corresponding side.



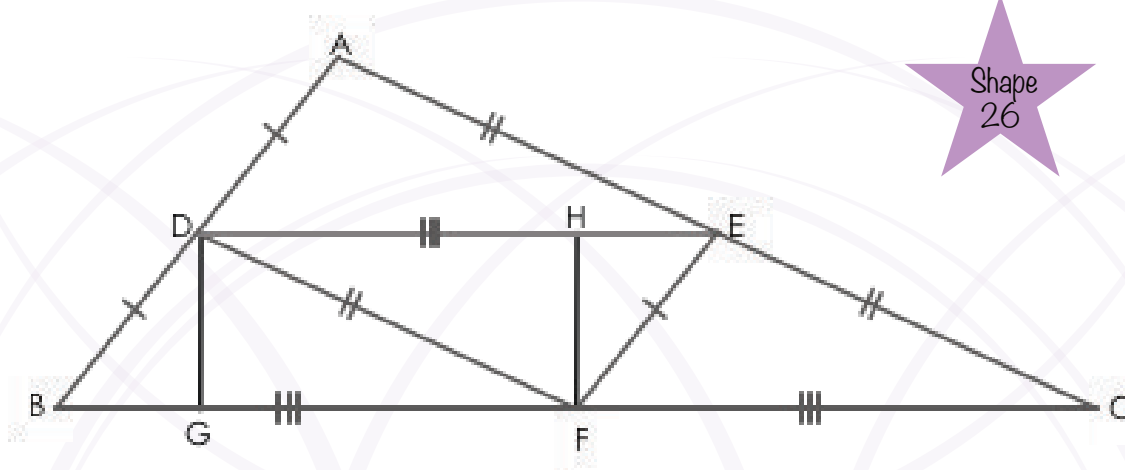
Erase the original light-penciled shape

Can we prove this enlargement?
 Measure the sides of the original shape.
 Measure the sides of the enlargement.
 Take the lengths of the original shape's sides and multiply by three. (The factor we used) Does this result give us the side lengths of the enlargement?

Knowing the side lengths and multiplying them by the factor of enlargement is a quicker way to enlarge. 
 You will still need to use the vertices to measure the angles even if you have the new side lengths.



The Midpoint Theorem



By tessellating with the scalene triangle, we can prove the **Midpoint Theorem** by using the parallelogram DEFB on the inside.

Examine $\triangle ABC$:

(Note that a unit triangle is one of the four tessellated triangles.)

- Measure AB, BC and AC
- Measure the vertices of the unit triangle with the protractor on the V2.
- Measure angles B, C and A with the protractor on the V2.

Conclusions:

1. The large triangle's sides are exactly DOUBLE those of a unit-triangle.
2. The unit-triangle's angles measures exactly the same magnitude as triangle ABC (large triangle.)
3. DE is exactly half of BC.

Their similarity enables proportionality or ratios to come into effect. This is clearly seen by the ratio of the sides:

$$\begin{array}{l} \triangle \quad DA = \frac{1}{2} \text{ of } AB \\ \triangle \quad DE = \frac{1}{2} \text{ of } BC \\ \triangle \quad AE = \frac{1}{2} \text{ of } AC \end{array}$$

This concludes that if a line is drawn from the midpoint of one side of a triangle (DE) to the midpoint of a second side of the triangle and it is parallel to the third side, then the line will be HALF of the THIRD side.

This theorem is usually done with an exterior-drawn parallelogram and congruent triangles to complete the proof.

This is a simplified version.

See our series of Teacher's Manuals for other ways to prove this theorem.

Have the students enlarge the unit triangle. Draw a non-parallel line DE and repeat the exercise.

They can now see that the theorem will not work. Let them discuss the reasons why.



Visualizing Problems

Changes to Area and Perimeter

Draw these diagrams and use units to measure area and perimeter, let the students record their measurements in a grid.

One Square

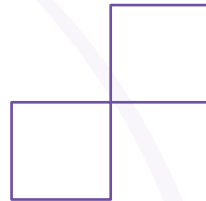


Perimeter 4 units

Two Squares



Perimeter 6 units

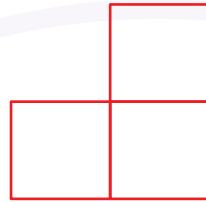


Perimeter 8 units

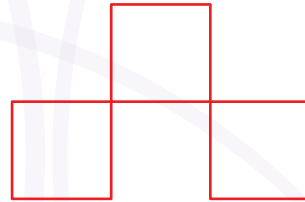
Three Squares



Perimeter 8 units



Perimeter 8 units

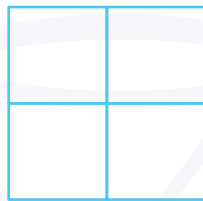


Perimeter 12 units

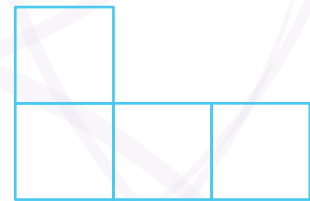
Four Squares



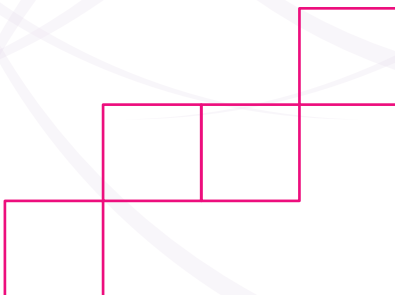
Perimeter 10 units



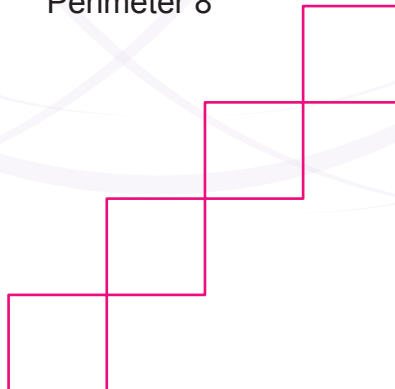
Perimeter 8



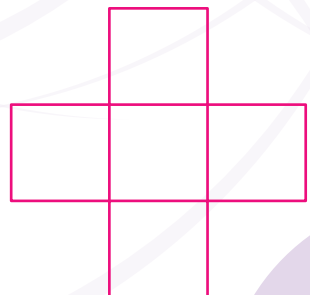
Perimeter 10



Perimeter 14 units



Perimeter 16 units



Perimeter 12



Changes to Area & Perimeter and Changes to Point of Rotation

	<p>Area can change without affecting perimeter:</p>	
	<p>Area changes from $2u^2$ to $3u^2$ Perimeter unchanged 8 units.</p>	
	<p>Area can change along with perimeter:</p>	
	<p>Area changes from $2u^2$ to $3u^2$ Perimeter changes from 6 units to 8 units.</p>	
	<p>Perimeter can change without having an effect on area. Area stays $3u^2$ Perimeter changes from 12 units to 8 units.</p>	

How changing the point of rotation along with angle magnitude influence the end result.



Rotation Clockwise.

No intersecting sides.

Sides line up as you rotate.

Rotation Clockwise

Intersecting sides.

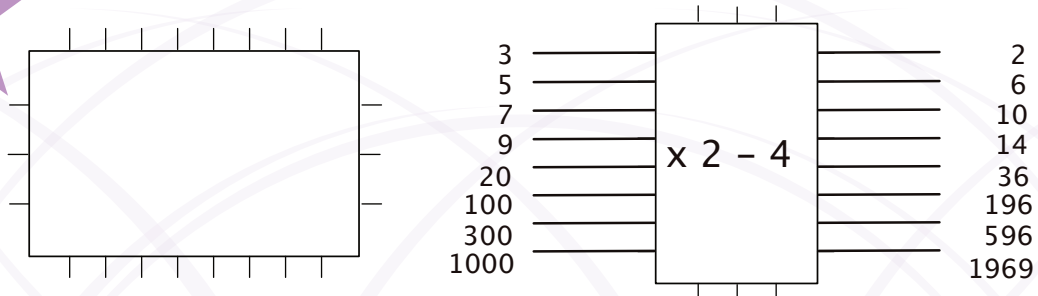
Longest side rotate so that it halves the top left vertex with each rotation.



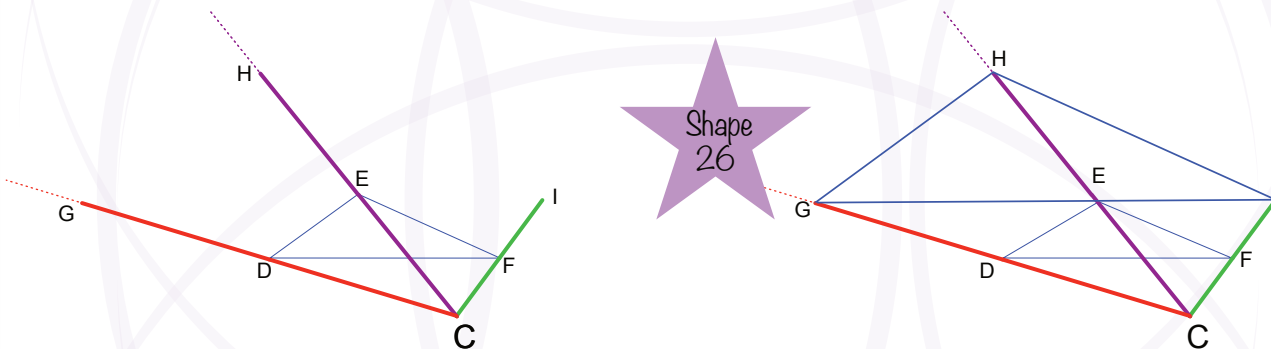
Other Useful Features

Some Handy Ideas

Quick and easy flow-chart using the golden rectangle.



Enlarging non-regular (irregular) 2D shapes



Rotations, from inside a shape as well as on the Cartesian plane.

Teacher Manual Excerpts

Chapter 1

Fractions

Fractions are often hard to draw - hence pupils are left to draw them as best they can even if portions are not the same size. This is really not ideal as fractions are based on the fact that when we divide, we have equal-sized portions.

Visually representing $\frac{1}{7}$ or any odd numbered denominator is also not an easy task, especially if a continuous fraction is needed.

This chapter shows how we use the MATHOMAT Primary template to accomplish all the different types of representations.

We cover the basics of fractions and gradually work up to more intricate fraction properties.

A fractions game is explained - the cards are in the back of this manual under the resources section.

The aim of this chapter is to not only teach what fractions are and how they work but also how to represent them visually and how to make use of those representations when dealing with word problems.

In Chapter 1

- What is a fraction?
- Teaching fractions with MATHOMAT
- The traditional fraction-wall
- Visualizing and drawing fractions
- Different representations
- Bridging from fractions into area and perimeter
- Bridging from fractions into composite shapes
- Bridging from fractions into tessellations
- Visually explaining fraction rules
- Choosing which representation is best for different kinds of problems
- Geometry fractions with MATHOMAT
- Word Problems
- Fractions exercises

Vocabulary

- Numerator
- Denominator
- Unit shape
- Attribute shapes
- Discrete representations
- Continuous representations
- Area models
- Transitivity
- Symmetry
- Reflexivity

What you will need:

- MATHOMAT PRIMARY template

Cut outs of the following shapes:

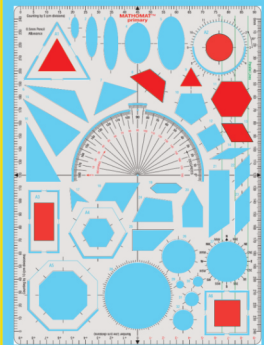
- Shape 8 Trapezium x 2
- Shape 11 Hexagon x 1
- Shape 13 Rhombus x 3
- Shape 9 Triangle x 6

The Mathomat Fractions - game

This is under the resources section at the back of the book.

On the template:

The shapes used in this chapter



AVAILABLE MATERIAL FOR MATHOMAT

Teacher's manual

- Lesson plans
- Activities
- Guidance
- Hints and Ideas
- Topic specific information

Student Workbook

- Activities
- Worksheets
- Investigations
- Theorems

Constructions Manual

- Constructions without a compass
- Three different ways for each construction
- Base level
- Mid level
- Advanced level


Games and Activity Guide

- Authentic games and activities to encourage student involvement.
- Critical Thinking skills development
- Spatial Ability development
- Encouraging mathematical exploration

Teacher Manual Excerpts


Fractions

Two triangles makes one rhombus




1 triangle is $\frac{1}{2}$ of a rhombus

Three triangles makes one trapezium



1 triangle is $\frac{1}{3}$ of a trapezium


Six triangles makes one hexagon



1 triangle is $\frac{1}{6}$ of a hexagon.

The important thing for them to notice is that all the triangles are the same size. Let them prove it by placing the template on the shapes and see if the triangle fits on all the triangles they drew.

Next they can prove it by cutting the triangles out and comparing the size.



The regular shapes are great to use when teaching halves.

Draw the following shapes:

- Shape 11 - Hexagon
- Shape 8 - Trapezium
- Shape 13 - Rhombus

Use the triangle, shape 9, to see how many triangles can be drawn inside the other shapes.


The triangle is used as the unit shape - this means the smallest part that the other shapes consist of or can be divided into.

By drawing fraction walls, students discover that these wall work with a unit shape.

Use the following:


- Shape A 3 - Rectangle
- Shape A 1 - Triangle
- Shape A 6 - Square

The way in which we will manipulate the template when drawing fractions walls is almost the same as when we tessellate.



This representation comes in handy when a student must indicate odd denominator fractions.


It is often difficult for students to divide a rectangle, square or circle into odd numbers. This is a good way to have an odd denominator fraction represented in a continuous way.



One fifth

Two sevenths

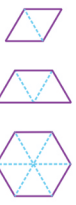
A discrete representation of two fifths.



If your students have not yet learned about all the shape names yet, have them colour the shapes in specific colours and then ask them to use a certain amount of a specific colour to build another coloured shape.


You may use numbers as well.

Have the students draw the shapes again, this time let them fold along the blue lines. The smallest shape that all of them can fold into is the triangle.



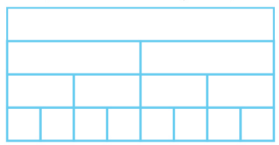
Let the students tessellate this triangle.

Let them find shapes they have used on page 3 and have them colour it in.



This fraction wall was done with squares.

Let them compare $\frac{1}{2}$ of the square fraction wall with $\frac{1}{2}$ of the rectangle fraction wall. They must see that the sizes differ because the unit shapes differ.



A rectangular fraction wall.

This fraction wall is best done when the paper is in landscape orientation. They can start with however many rectangles are necessary and expand as needed.

Fractions Game

The idea of this game is to get students to pay attention to the denominator of the fraction.

They should understand that the denominator and numerator conveys information about the fraction.

This game aims to help them remember that for addition and subtraction the denominator must be the same.

How to play: For an even number of players

Two players will present a card in one turn.

Take turns to throw the dice.

If the denominators on the card should change depending on the operator on the dice then player One gets the two cards.

If the denominators on the card should stay the same depending on the operator on the dice, then player Two gets the two cards.

You can adapt the game to fit the content you are teaching on fractions.

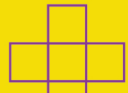

Winner is the one with the most cards.

Use the largest square on the template and draw a net for a cube.


There are 11 nets for a cube, we only provide one for this exercise.

Draw the following net:

- Shape A 6 - Square

Mark the cube with operational signs the students are familiar with.

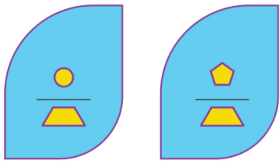


Fractions Game Examples

You will find the full set of cards for the game at the back of this book in the resources section.

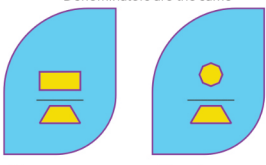
Before the game starts the players must decide who will keep the cards for a "denominators change" and who keeps it for a "denominators stay".

Denominators are the same



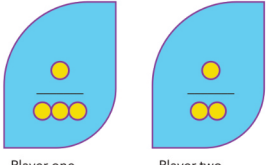
Player one Player two

Denominators are the same



Player one Player two

Denominators are the same



Player one Player two

Rule states that for dividing fractions, the denominators do not need to be the same.

OUTCOME: Cards show same denominator so it stays. (If cards showed different denominators they will stay as well.)

Player Two gets the cards

Rule states that for equating fractions, the denominators need to be the same.

OUTCOME: Cards show same denominator so it stays.

Player Two gets the cards.

Rule states that for adding fractions, the denominators need to be the same.

OUTCOME: Cards show different denominators so they must change

Player One gets the cards.

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