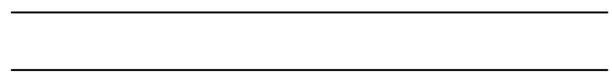
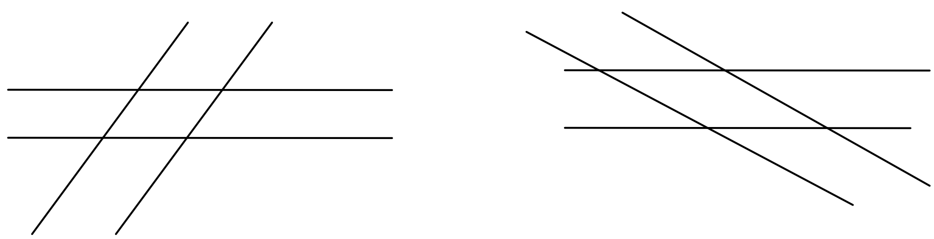
# Rulers

Draw a pair of parallel lines by using the parallel edges of a ruler.



Now place the same ruler at any angle to the parallel lines and draw another pair of parallel lines as shown below.



1. Compare the closed figures that you have created with those of some of the other learners.

2. Write down the **common** properties of the closed figures formed.

***Teacher Notes: Rulers***

*Learners on the van Hiele analysis level should be encouraged to study the properties of the parallelograms, for example, Opposites are equal; opposite angles are equal; diagonals bisect each other, etc. They should also be encouraged to formulate generalisations about parallel lines, for example, when two parallel lines that are the same distant apart intersect, the parallelograms formed have all four sides equal.*

*<u>Class Discussion:</u>*

*The learners can explore by using transparency sheets and should conclude that all the shapes formed have all four sides equal. Since learners will be placing the second pair of parallels at an angle of their choice, the special case of the square can be observed.*

*<u>Additional Challenges:</u>*

- *Will a figure like this always be formed if two parallel lines that are the same distance apart intersect? The variables that affect this conjecture may now be discussed:*
  *(i) the angle at which the lines intersect.*
  *(ii) the distance between the parallel lines.*

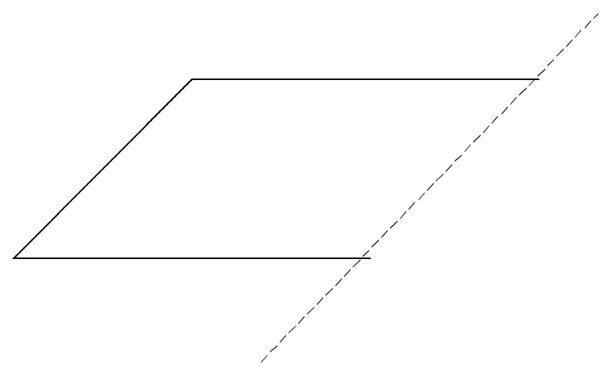
- *Which features of the shape will change if rulers having different widths are used to draw the pairs of parallel lines?*
- *Is it possible to form a kite using two rulers in this way? Explain.*

*Learners on the Analysis level will be able to use their empirical results to conclude that, when two parallel lines that are the same distance apart intersect, all the parallelograms formed have all four sides equal. Learners on the Informal Deduction level should use simple argument to explain this. This activity can be revisited by learners on the Informal Deduction level and ways of verifying the conjecture can be explored, for example, using congruence:*

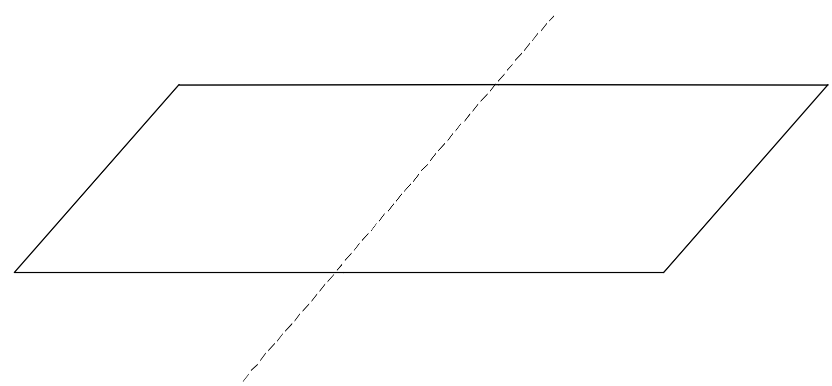
# Symmetry

1. The Grade 7 class were asked the following question in a test:

   *The diagram below shows one half of a symmetrical figure. The dotted line represents the line of symmetry. Draw the whole figure.*

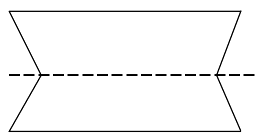


Carl drew this figure as his answer. Is he correct?

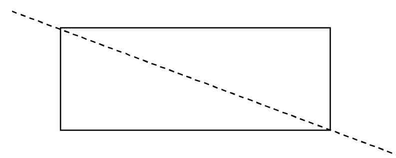


2. Jaco claims that the dotted line in each of the following diagrams is a line of symmetry. Is he correct? Explain!

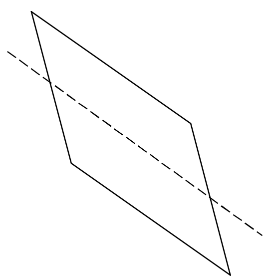
(a)



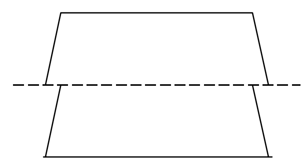
(b)



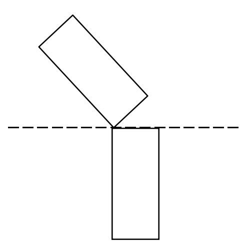
(c)



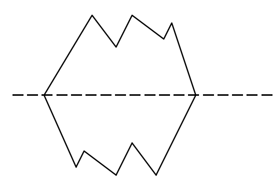
(d)



(e)



(f)



3. The Grade 8 class was asked the following question in a test:

*Explain what it means if we say that an object is 'symmetrical'.*

Mpande gave the following answer:

*A shape is symmetrical if there is a line that can be drawn through it which divides the shape into two identical parts*

Do you agree with Mpande's answer?

***Teacher Notes: Symmetry***
*This can also be used as an assessment activity.*

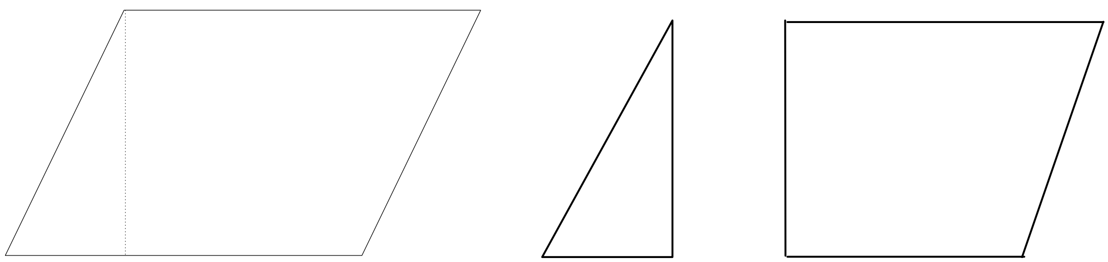
*Question 1:*
*The learners level of understanding will be revealed by the depth at which s/he is able to explore the topic. They should note that this is an incomplete definition of line symmetry as the notion of mirror image has not been included. For example, the diagonal of a rectangle divides the shape into two identical parts but these are not mirror images of one another (if folded the parts will not lie exactly on one another). Learners should come up with such counter examples*

*Questions 2 and 3:*
*These activities deal only with line symmetry. In each case the shapes on either side of the dotted line are identical but in some cases these shapes are not mirror images of one another.*
*Some learners might like to check using mirrors or by folding, while others will recognise the symmetry just by looking at the shapes.*

*Source of Ideas:*
*Zaslasvky, O. (1994). Tracing Students' Misconceptions Back to Their Teacher: A Case of Symmetry.* ***Pythagoras, 33,*** *10-17.*

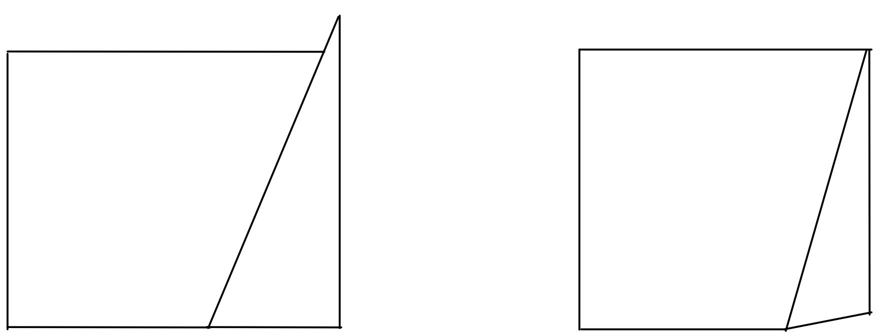
# Agatha's Rectangle

Agatha cuts her parallelogram into two pieces, a triangle and a trapezium, as shown below:



Agatha then slides the triangle to the opposite side of the trapezium to make a rectangle.

Use the properties of the parallelogram to explain why Agatha's pieces will not look like this when put together:



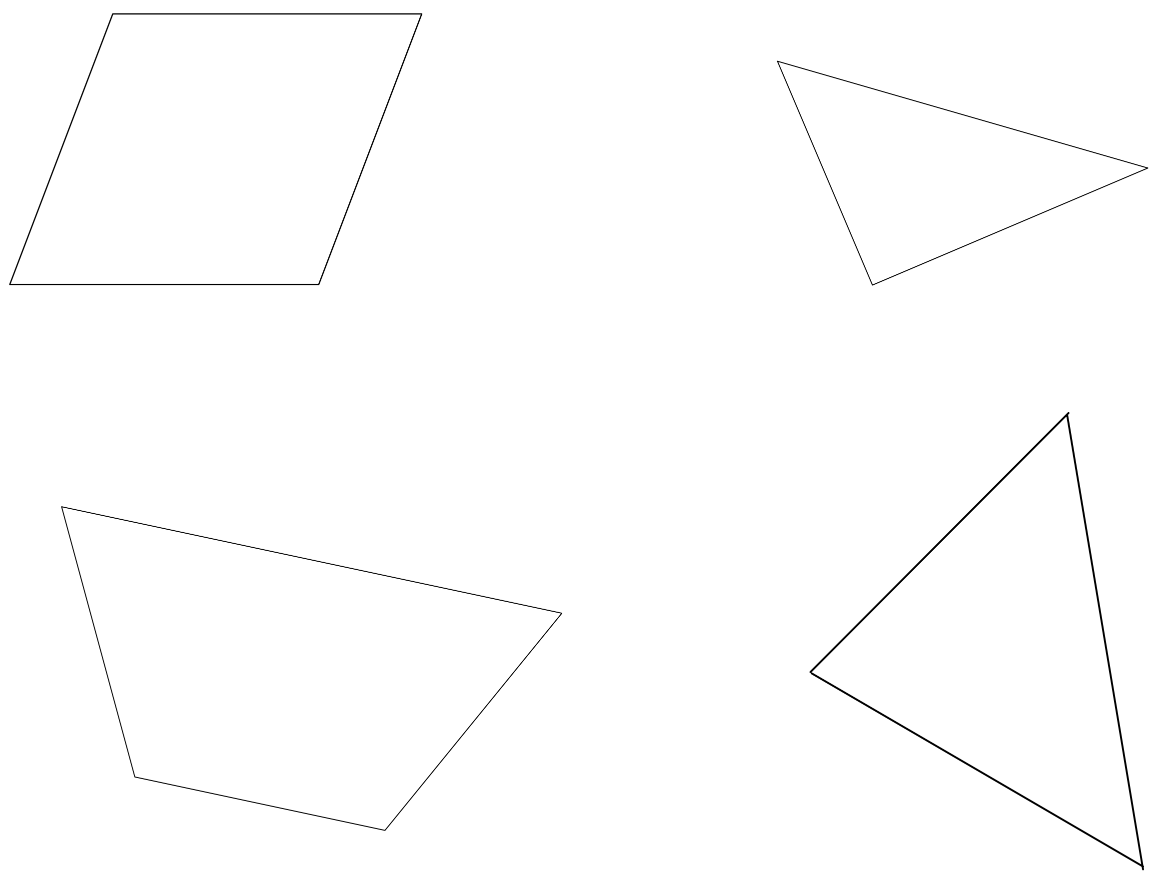
***Teacher Notes: Agatha's Rectangle***

*Learners should be on the van Hiele analysis level so that they can work with the properties of the figures. Van Hiele ordering level is encouraged when the learners have to explain their reasoning.*

# Cut and Rearrange

Make a copy of each of the shapes below.
Cut each of the shapes into pieces so that it can be rearranged into a rectangle.

Write a description of the cuts you made, and how you moved the pieces.



***Teacher Notes: Cut and Rearrange***

*On the van Hiele analysis level learners can use the properties of the figures to determine why a dissection works.*

*On the van Hiele ordering level learners must be able to use the properties to justify why the dissection will work and can use informal deductive arguments.*

*Class Discussion:*

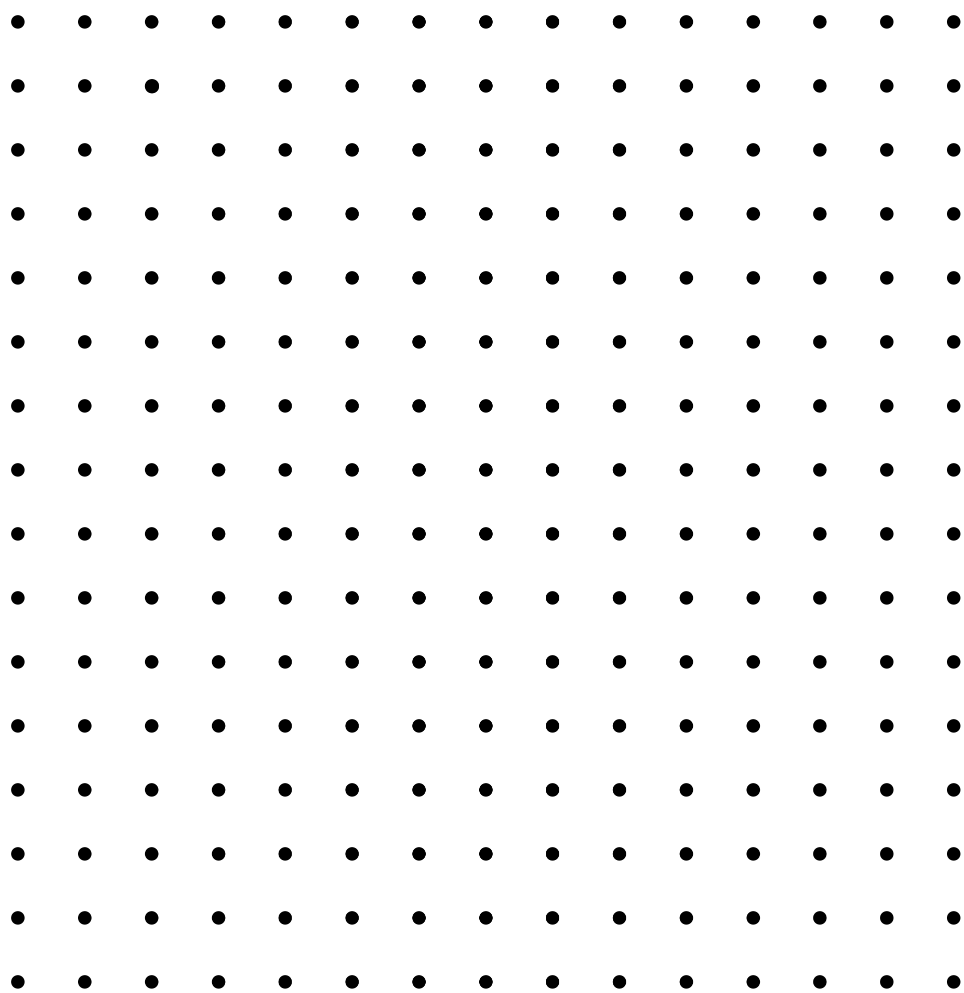
*Learners should be challenged to explain how they know the resulting figure is a rectangle. Sometimes the cut out pieces might* ***look*** *like they fit , but how can one be sure ?*

# Diagonals

1. Draw as many different shaped quadrilaterals that have equal diagonals as you can. Use the dotty paper below.

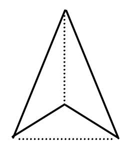
2. Compare the properties of the different quadrilaterals you have drawn.

3. Choose one of the quadrilaterals you have drawn. Now explain in the shortest possible way to a friend how to draw this quadrilateral so that there is no way that it is possible for any of the other quadrilaterals to be drawn.



***Teacher Notes: Diagonals***

*Questions 1 and 2 can be done on the van Hiele analysis level. The learners are encouraged to compare the properties of different figures, thus encouraging movement to the next level. Learners should be encourage to find as many different types of quadrilaterals (not just squares and rectangles). For example they could draw an isosceles trapezium, or a concave figure like this:*

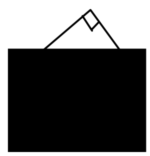


*Question 3 requires that learners make a partition definition and is thus van Hiele ordering level thinking. Definitions at this level are likely to include extraneous information.*

# Guess my Quadrilateral

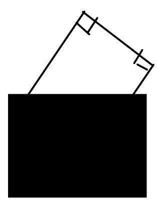
Marlene hides a quadrilateral she has drawn.

She uncovers a part of the quadrilateral as shown below :



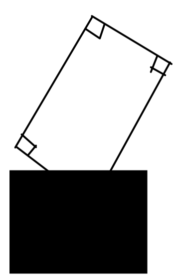
1. What kind of quadrilateral could she be hiding?

She uncovers a little more of her quadrilateral as shown below :



2. Which of the quadrilaterals that you have mentioned in question 1 is Marlene definitely not hiding ?

Before uncovering the quadrilateral completely she reveals the following:



3. What quadrilateral is Marlene hiding?

***Teacher Notes: Guess My Quadrilateral***
*Learners are required to use the given properties of the figure to identify it.*

*<u>Class Discussion:</u>*
*Learners should be encouraged to reflect on how they adapted their thinking as more of the figure was revealed.*

# Clues for Squares

Donald writes down clues on cards that will help his friend to see that he is thinking of a square.

There are 4 angles

There are 4 sides

All angles are right angles

All sides are congruent

Opposite angles are congruent

Opposite sides are parallel

Opposite sides are congruent

1. Donald decides not to show his friend the card with the following clue

All angles are right angles

Is this clue necessary for his friend to know that he was thinking of a square?

2. Donald decides to show all the clues except the following

Opposite sides are parallel

Is his friend able to know that he is thinking of a square?

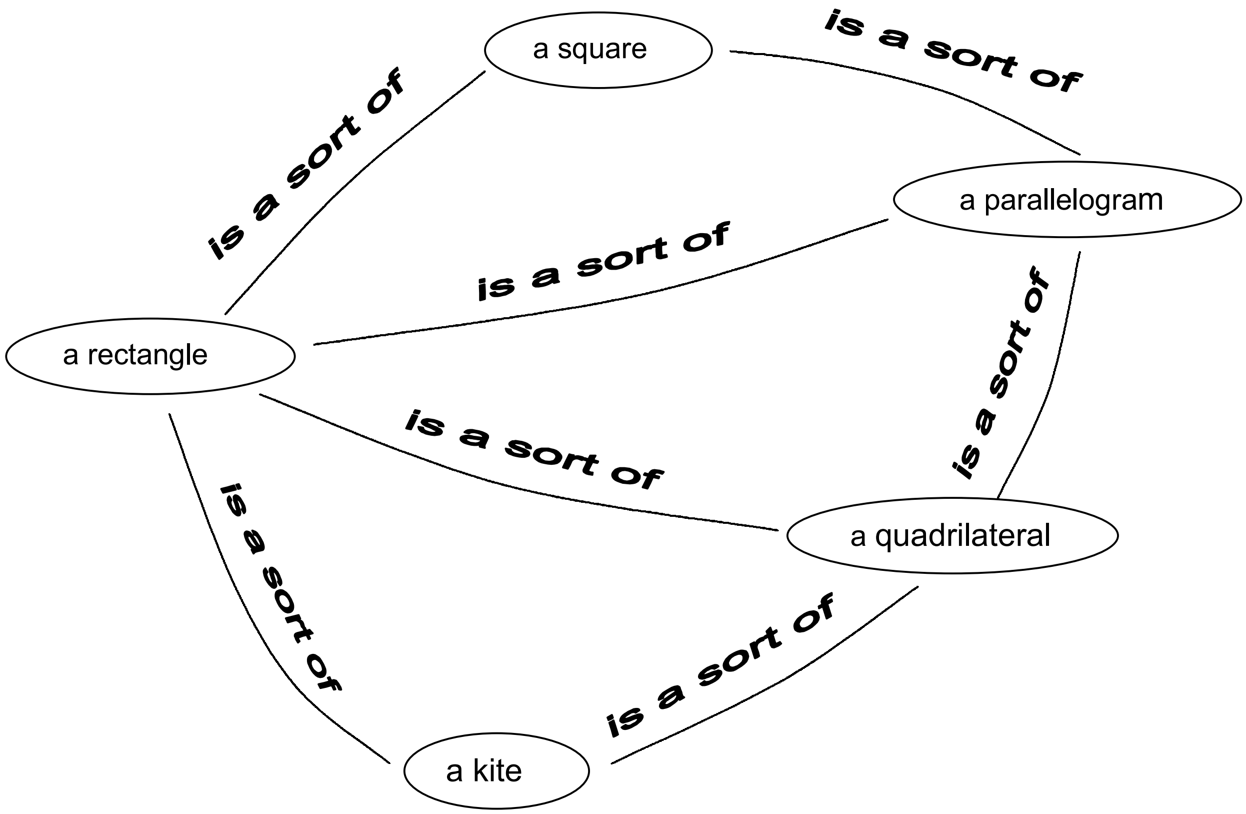
3. What is the smallest number of clues that Donald's friend needs to know that he is thinking of a square?

***Teacher Notes: Clues For Squares***
*This activity can be used to move learners from the van Hiele analysis level to the ordering level. Learners are required to consider the minimum properties required in a definition.*

*Further Activities:*
*Similar activities can be designed using the properties of other classes of figures.*

# Families of Polygons

Here is a family tree of polygons:



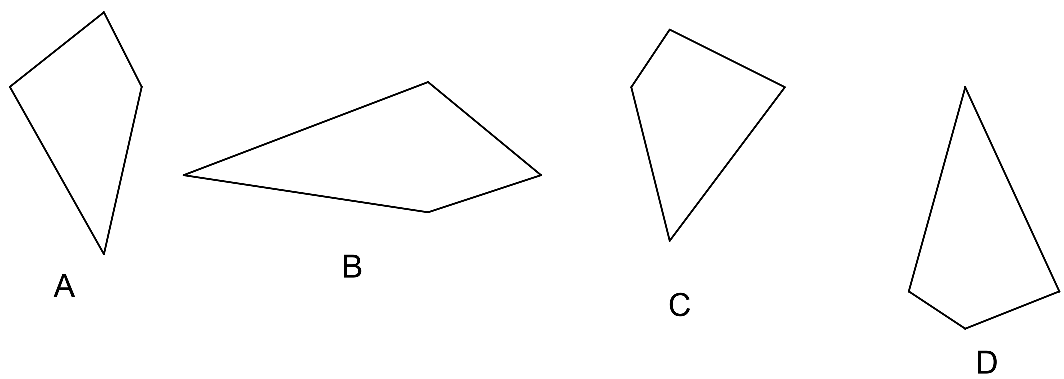

Where would you put a rhombus and a trapezium in this family tree?

***Teacher Notes: Families of Polygons***
*This activity can be done on the van Hiele ordering level as learners are required to consider the **relationships** between the figures*

*<u>Class Discussion:</u> Learners should be permitted to list the properties of the polygons if necessary.*

*<u>Further Activities:</u>*
*This can be adapted so that different quadrilaterals have to be added each time. Learners can also be questioned on the part of the family tree that is given.*

# Investigating Figures




1. What do these shapes have in common?

2. Explain to a friend over the telephone how to draw any shape with the properties of the above shapes.

3. Explain to a friend over the telephone how to draw shape D.

4. The friend claims that the squares and rhombuses also belong to this class of shapes. How can you describe these shapes so that it excludes the squares and the rhombuses ?

***Teacher Notes: Investigating Figures***

*Questions 1, 2 and 3 are appropriate for learners on the van Hiele analysis level as learners are required to study the properties of the figures. Definitions on this level are likely to include extraneous information.*

*Question 4: Understanding of class inclusion requires that learners be on the van Hiele ordering level. The teacher can encourage this thinking by requiring learners to compare the properties of squares and rhombuses.*

*Class Discussion:*

*Learners may use measuring instruments in question 1 to explore the properties of the figures.*

*The learners need to identify the common properties of this class of figures, for example:*

1. *sum of interior angles equals 360°*
2. *four sides*
3. *diagonals intersect at right angles*

*In Question 2, to draw the general figure, the only information needed is two diagonals that intersect at right angles. Learners can be moved towards the Informal Deduction level by considering whether all the information in their definition is necessary.*

*In Question 3, to draw a specific figure more information is needed. In this case the length of the diagonals and the intersection point has to be specified.*

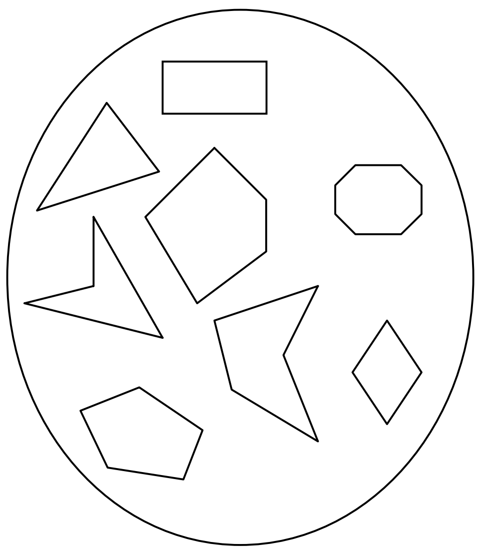
*Learners will have to be on the Informal Deduction level to cope with Question 4. They need to construct a partition definition that excludes all the other figures. The additional information that the two diagonals are not only equal, but also intersect at right angles, has to be added.*

# What is a Polygon?

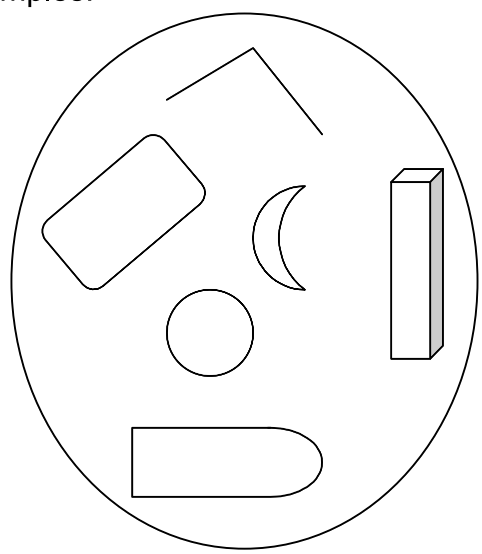
Mr Jafta asked learners in his Grade 7 class to give examples and non-examples of **polygons**.

John gave the following:

Examples:

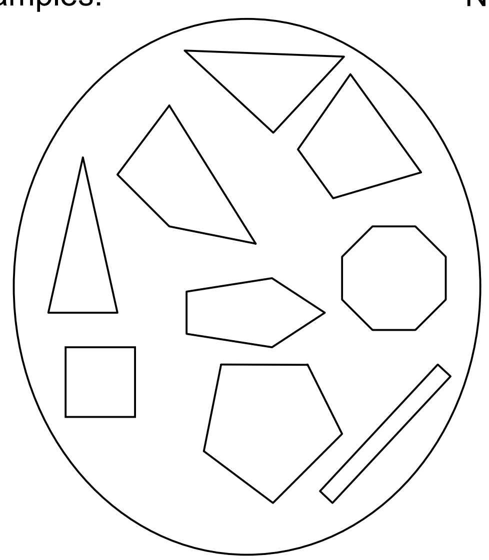


Non-Examples:

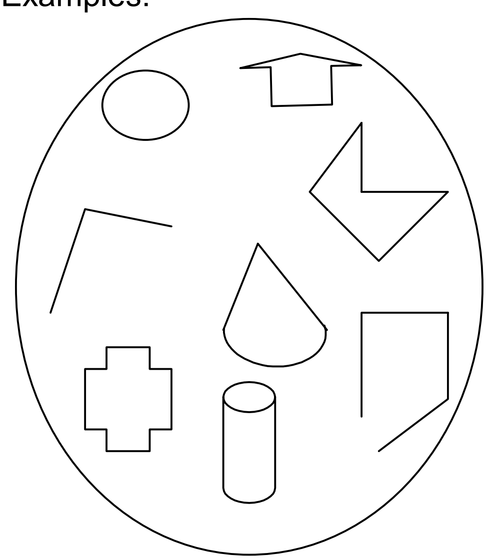


But Zwelakhe gave these examples and non-examples:

Examples:



Non-Examples:



1. What is John's definition of a polygon?
2. What is Zwelakhe's definition of a polygon?
3. Who is correct? Explain.

***Teacher Notes: What is a Polygon?***

*Questions 1 and 2 can be done on the van Hiele analysis level but Question 3 will not make sense on the van Hiele ordering level.*

*Class Discussion:*

*John has included concave and convex polygons in his definition, whereas Zwelakhe only uses convex polygons. The teacher should assist with this vocabulary when required.*

*Learners on the Informal Deduction level should be using minimum conditions in a definition.*

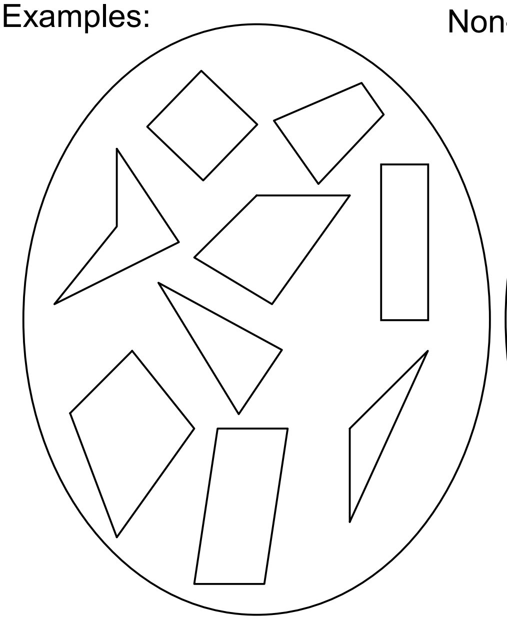
*Learners should note that both are correct definitions, as definitions are a matter of convention.*

*Learners can also be encouraged to write down their own definitions for convex and concave polygons, for example, a convex polygon is a closed four-sided closed figure with no reflexive angle or no diagonals outside the figure; a concave polygon is a closed four-sided figure with reflexive angles or no diagonal outside the figure.*

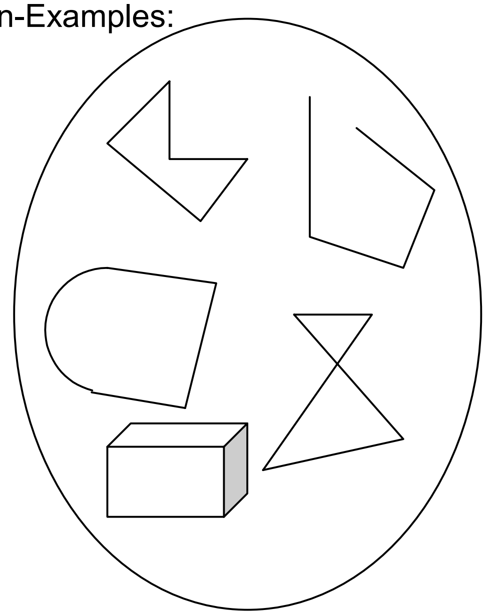
# What is a Quadrilateral?

Mr Jafta asked his Grade 7 learners to give examples and non-examples of quadrilaterals.
Sisanda suggested the following:

Examples:

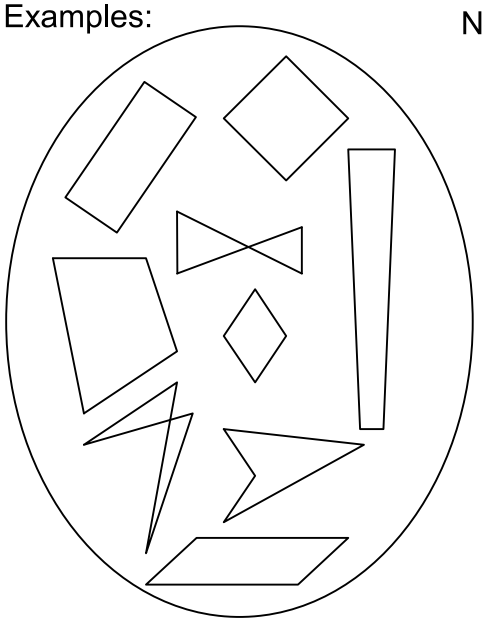


Non-Examples:

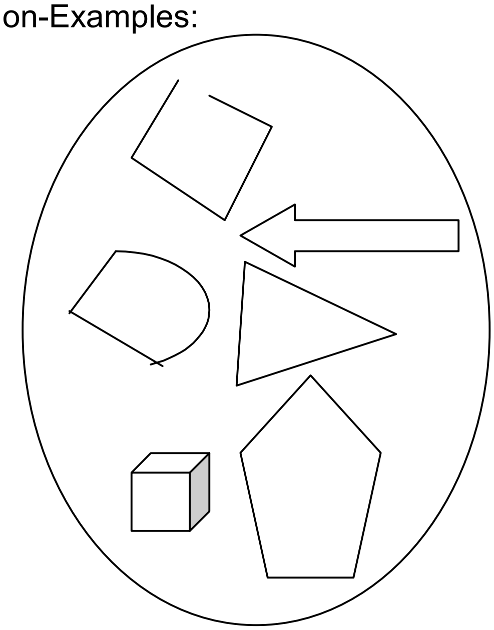


Leroy gave the following examples and non-examples:

Examples:



Non-Examples:



1. What is Sisanda's definition of a quadrilateral?
2. What is Leroy's definition of a quadrilateral?
3. Who do you think is correct?

***Teacher Notes: What is a Quadrilateral?***

*Questions 1 and 2 can be done on the van Hiele analysis level but Question 3 will not make sense on the van Hiele ordering level.*

*Class discussion:*

*Leroy has included "crossed" quadrilateral in his definition whereas Sisanda has excluded this class of figures from the definition.*

*Learners on the Informal Deduction level should be using minimum conditions in a definition.*

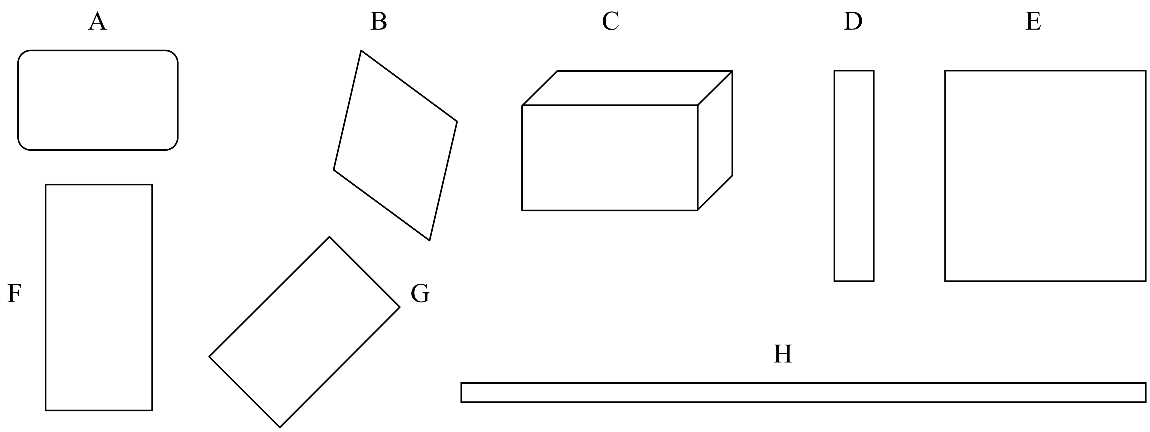
*Learners should note that both are correct definitions, as definitions are a matter of convention.*

*Learners should be encouraged to come up with their own definitions. For the examples provided by Sisanda: A quadrilateral is a closed plane figure consisting of vertices A, B, C, and d, connected by line segments (AB, BC, CD, and DA), and none of the line segments cross each other at any point other than the vertices (a partition definition).*

*For the examples provided by Leroy: A quadrilateral is a closed plane figure consisting of vertices A, B, C, and d, connected by line segments (AB, BC, CD, and DA) (a hierarchical definition).*

# Which are Rectangles?

1. Which of the figures below are rectangles? Explain why or why not for each figure.




2. How would you describe "squareness"?

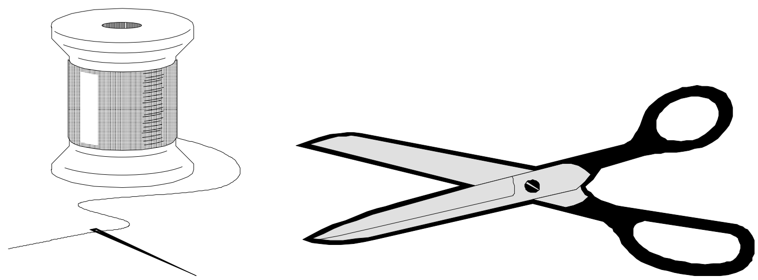
3. Use your description to arrange these rectangles in ascending order (from smallest to biggest) of "squareness".

***Teacher Notes: Which are Rectangles?***

*Question 1 can be done on different levels. On the van Hiele visual level the rectangles will be identified on their appearance as a whole and on the analysis level these will be recognised by their properties. Learners on these two levels are unlikely to identify a square as a special type of rectangle.*

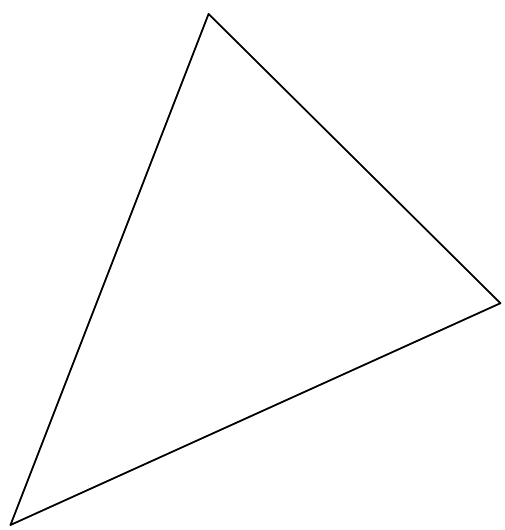
*Question 2 and 3 encourage learners to compare the properties of the figures and to start using hierarchical definitions.*

# Making a Patchwork Quilt



Each class at Eureka High School has to think of a way to raise money at the school fete.

The Grade 8 class has decided to make a quilt which will be raffled at R2 a ticket. The class has decided to make the quilt by sewing triangles of fabric together. There must be no gaps between the fabric triangles.
The triangle shown below is to be used as a template for the quilt:



Each learner has been given a copy of the template and has been asked to cut out ten fabric triangles at home.

1. Why do you think the Grade 8 class has decided to use triangles to make the quilt? Could the class have chosen another figure to use as the template for the quilt?

2. Marie has lost her template and has phoned you to find out what size triangle to cut from the fabric. What is the minimum amount of information you would have to give her on the telephone? Is there more than one way of giving her the information?

3. What if the triangle used as the template was a right-angled triangle?

***Teacher Notes: Making a Patchwork Quilt***

*Learners on the van Hiele analysis level are likely to include extraneous information, but a typical van Hiele ordering level response should take the* ***minimum*** *conditions for congruency into account.*

<u>*Class Discussion:*</u>

*Question 1: Learners should note that the triangles will tessellate*

*Question 2: Learners may use drawing instruments to test their ideas. They should be encouraged to explore the three conditions for congruency appropriate for this acute-angled scalene triangle, namely, SSS, SAS, SSA.*

*The additional criterion, RHS, will have to be added in Question 3.*

<u>*Further Activities:*</u>

*Learners can be required to consider what other shapes could be used to make the quilt, and what information they would give to Marie in each of these cases.*

*Learners can also be required to design quilts as a project – reasons for the choice of shapes and descriptions of the transformations used should be required. Learners should be encouraged to design quilts which make use of more than one type of shape.*

# Family Picnic

The Patel family have arrived at Mandela Park for a picnic lunch. All the family members have arrived: babies, toddlers, teenagers and adults (including the elderly grandmother in the family).

They must find a picnic site which is convenient for all the members of the family:

- The mothers of the babies need to be near to the washing facilities.
- The teenagers want to be near to the kiosk so that they can buy cooldrinks.
- The toddlers want to play on the swings.

The location of these facilities are shown below:

1. Where should the Patels set up their picnic to ensure that all these members of the family are happy with the location?

2. Suppose the facilities formed a different shaped triangle, for example an isosceles, obtuse-angled or right-angled triangle. Where should the Patels have their picnic?

3. The Grandmother has decided that she wants to be near the pond so that she can watch the birds. These four facilities form a rectangle. Where should the picnic be held in this case?

4. What if the four facilities in Question 3 form a parallelogram?

<u>*Source of Ideas:*</u>
*De Villiers, M.D. (1996) Worksheets in **Pythagoras, 40**, 41-52. See also ideas for finding the incentre (Surfing).*

***Teacher Notes: Family Picnic***

*Class Discussion:*

*In Questions 1 and 2, learners are required to find the circumcentre, that is, the intersection of the perpendicular bisectors of the sides of the triangle. This can be done by measuring and constructing. The teacher should only introduce terminology for convenience when required.*

*Note: In using the context of a picnic site we are making certain assumptions, that is, that the terrain is flat, and that the best possible location will be equidistant form all three landmarks (for example, if there were 100 teenagers, one mother and two babies it would make sense to be close the kiosk).*

*In Questions 3 learners can work with the diagonals of a rectangle – this is because the perpendicular bisectors of the sides of a rectangle pass through the point of intersection of the diagonals.*

*In question 4 it is not possible to find four points equidistant from the vertices of a parallelogram. The perpendicular bisectors of the sides of a parallelogram are not concurrent.*

*Note: if the perpendicular bisectors of a polygon are concurrent, then the point of concurrency is a point equidistant from all the vertices, and the polygon is, in fact, cyclic.*

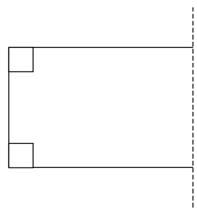
*Source of Ideas:*

*De Villiers, M.D. (1996) Worksheets in **Pythagoras, 40**, 41-52. See also ideas for finding the incentre (Surfing).*

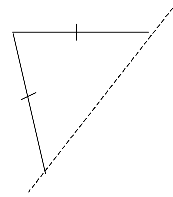
# Creating new Polygons

1. Reflect each of the following shapes in the dotted line. Name the shape and explain how you used the reflection to decide what shape it is.

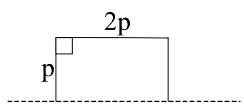
(a)



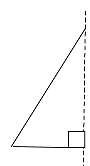
(b)



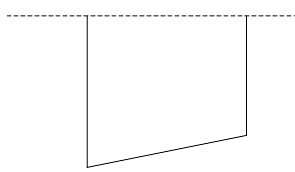
(c)



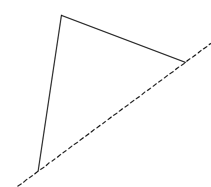

(d)



(e)



(f)



2. Sam says that he can reflect a triangle in one of its sides to create a square. Is this possible?

***Teacher Notes: Creating New Polygons***

*In a van Hiele analysis level response, a learner will list properties in explanation, but is likely to include extraneous information. Van Hiele ordering level explanations will be more precise and might refer to the definition.*

*Class Discussion:*

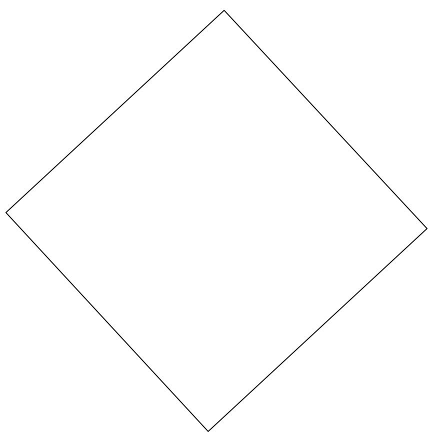
*Question 2 requires that learners work backwards from the properties of the square. This activity could be developed further: What other quadrilaterals can be made by reflecting a triangle over one of its sides? What kind of triangles are required to make the different quadrilaterals?*

# Quadrilaterals

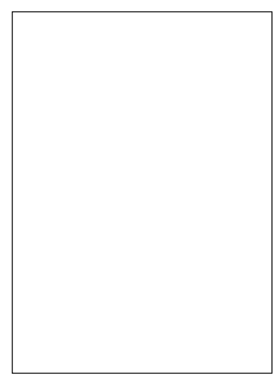
1. Draw in the lines of symmetry in each of the following shapes. Label the lines of symmetry.

2. Now use the line symmetry to write down the properties of the shapes. In each case explain how you used the symmetry to find the properties of the shape.

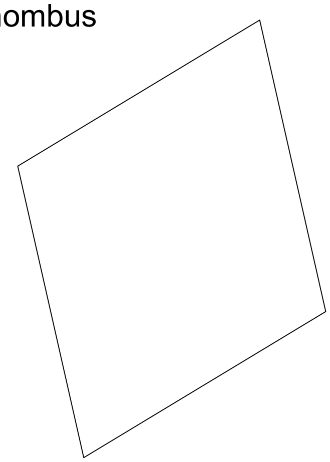
(a) square



(b) rectangle

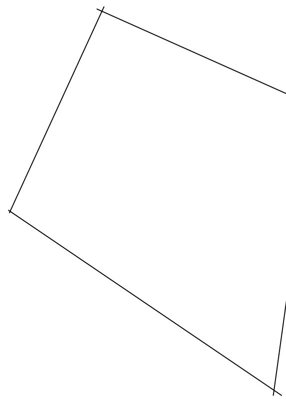


(c ) rhombus

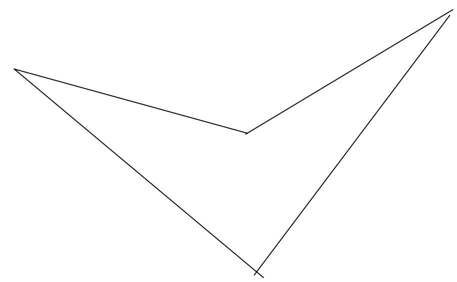


3. Some of the quadrilaterals have not been drawn above. Can you explain?

(d) convex kite



(e) concave kite



***Teacher Note: Quadrilaterals***

*Class Discussion:*

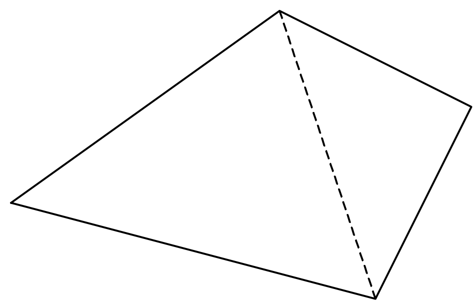
- *Learners should be permitted to cut and fold the shapes if necessary. Some learners will be able to identify properties by visualising the folding.*
- *This method cannot be used for finding the properties of all quadrilaterals, for example, the parallelogram and the trapezium (not isosceles) cannot be studied this way. Learners should note that these quadrilaterals do not have any lines of symmetry. The labelling of the lines of symmetry is important as it will allow the learners to explain how they have used the symmetry to find the properties. Guidance should be given with the labelling if necessary.*

*Further Activities:*

- *Learners could also explore the properties of these shapes using rotational symmetry. How can the point of rotational symmetry be found? Can the same number of properties be found this way?*
- *The properties of other polygons can be studied using rotational and line symmetry.*
- *Another medium should be chosen to explore the properties of the parallelogram (for example, half-turns), and the non-isosceles trapezium. Learners can also use this to confirm their findings for the above quadrilaterals and to decide whether they can use symmetry to find* ***all*** *the properties of each quadrilateral.*

# Exploring using Diagonals

1. One of the diagonals of this quadrilateral has been drawn for you:

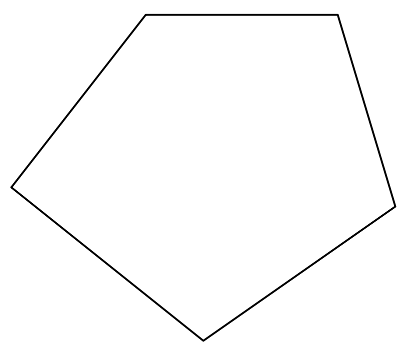


*A line joining two non-adjacent vertices of a polygon is called a **diagonal** of the polygon.*

   (a) What figures can you see in this shape?

   (b) Now draw in the other diagonal and identify the figures formed.

2. Consider the pentagon shown below:



   (a) Draw in **one** diagonal. Identify the figures that are formed.

   (b) Draw in **two** diagonals. Identify the figures that are formed.

   (c) Now do the same for **three** diagonals.

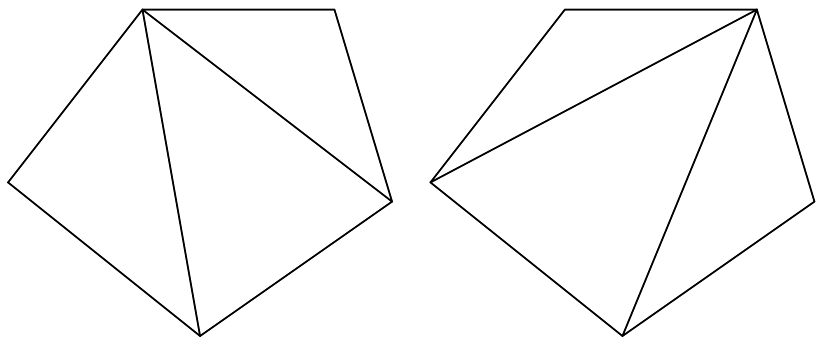
3. Now draw a hexagon and answer (a) to (c) in Question 2 using this new figure.

***Teacher Notes: Exploring using Diagonals***

*<u>Class Discussion:</u>*

*The teacher might need to clarify the use of vocabulary, for example, 'diagonals'. The diagonals chosen can be intersecting or non-intersecting.*

*Questions 2 and 3 are useful opportunities for the discussion of the notion "different". In the example below, three triangles have been formed in each case, but the triangles are not congruent. When will they be congruent?*



*<u>Source of Ideas:</u>*

*Walter, M. (1981) Do We Rob Students of a Chance to Learn?* ***For the Learning of Mathematics, 1,*** *16-18.*

# Notes on Polygons

Owing to an illness, Leon has missed a number of weeks of school. He was not at school when you did the activities on polygons.

Write notes for Leon, indicating what you have learnt about these figures.

***Teacher Notes: Notes on Polygons***

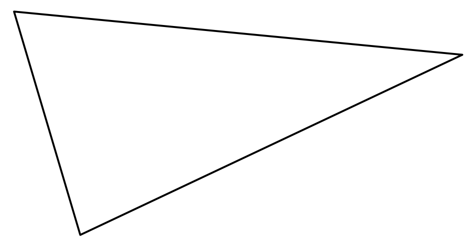
*The teacher should look for understanding of a number of kinds of polygons. The explanation should include diagrams as well as written explanations about properties.*

*This activity can also be adapted to test understanding of, for example, quadrilaterals, triangles or specific classes of these polygons.*

*Learners can also be required to provide examples and non-examples of figures.*

# Reflecting Triangles

Consider the triangle below:



1. **Reflect** the triangle in its sides to make as many different quadrilaterals as possible.
   In each case write down the name of the quadrilateral formed, list its properties and explain how you got the properties.

2 What if Andile's triangle is an isosceles triangle?

3. What if Andile's triangle is a right-angled triangle?

4. What if Andile's triangle is a right-angled isosceles triangle?

5. What if Andile's triangle is an obtuse-angled triangle?

***Teacher Notes: Reflecting Triangles***

*<u>Class Discussion:</u>*

*Learners will have to distinguish what is meant by "different" quadrilaterals. It should be clear that properties must be deduced **from the reflection**, and not by other means.*

*<u>Further Assessment Activities:</u>*

*Learners could be required to use create other polygons from the triangles or to reflect other polygons, for example, parallelograms.*

# Notes on Quadrilaterals

Owing to an illness, Leon has missed a number of weeks of school. He was not at school when you did the activities on quadrilaterals.

Write notes for Leon, indicating what you have learnt about these figures.

***Teacher Notes: Notes on Quadrilaterals***

*The teacher should look for understanding of a number of kinds of quadrilaterals. The explanation should include diagrams as well as written explanations about properties.*

*This activity can also be adapted to test understanding of, for example, triangles or other polygons.*

*Learners can also be required to provide examples and non-examples of figures.*

# Helping Tanya

Tanya has to make polygons out of triangles. She may only use two identical triangles for each polygon.

1. Explain to him how he can make each of the following:
   (a) An isosceles triangle
   (b) An equilateral triangle
   (c) A kite
   (d) A parallelogram
   (e) A rectangle
   (f) A square
   (g) A rhombus

   Remember to explain what triangles he must use for each polygon **and** how she must construct the figure.

2. Is it possible to make a trapezium in this way?

***Teacher Notes: Helping Tanya***

*Learners will have to work with the properties of the polygons to decide what kind of triangle to begin with.*

*Class Discussion:*

*Learners should use vocabulary of transformations to describe the construction of the figures.*

*The area of each polygon in terms of the area of the original triangle can be explored.*

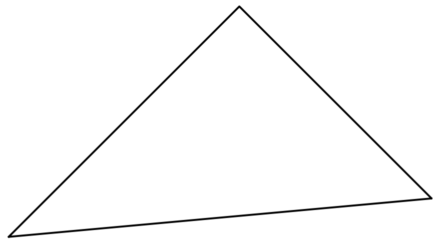
*Further Activities:*

*Learners could be required to use triangles to construct polygons with more than four sides.*

*The use of triangles to construct the figures can be used to explore the sum of the interior angles of polygons.*

# Helping Tema

Tema has **one** triangle as shown below:



He has to use **transformations** to make as many different polygons as possible with this triangle.

He can use *rotations* or *reflections.*

1. Can you help him? In each case explain how you know what kind of polygon you have made **and** what transformation you have used.

2. What if Tema's triangle is an isosceles triangle?

3. What if Tema's triangle is a right-angled triangle?

4. What if Tema's triangle is an obtuse-angled triangle?

***Teacher Notes: Helping Tema***

*<u>Class Discussion:</u>*

*Learners will have to distinguish what is meant by "different" polygons. They should be encourage to be systematic when creating polygons with different number of sides (this can be specified if necessary).*

*<u>Further Activities:</u>*

*Learners could be required to use other polygons, for example quadrilaterals as the template.*

# Drawing our own Triangles

1. Draw **four** different triangles in the space below. In each case label the triangles and explain why they are different.

2. Now compare your triangles to those of a classmate. In what ways are the triangles different? In what ways are they the same?

***Teacher Notes: Drawing our own Triangles***

*In the van Hiele visual level learners will distinguish between triangles on the basis of their appearance as a whole. Orientation might be a problem in this case. On the van Hiele analysis level learners will use properties to compare the triangles. In Question 2 learners are required to compare the properties of different triangles, and the discussion can be used to move learners towards the Informal Deduction Level in which relationships between classes of figures are noted. Learners should be encouraged to compare properties of, for example, isosceles and equilateral triangles.*

*Class Discussion:*

*It should be stressed that drawings need not be accurate, but should be labeled correctly.*

*Learners might need assistance naming the triangles. The teacher should introduce the conventions as a way of making it easier to discuss and compare figures.*

*This is a useful opportunity to discuss what we mean by "different" (similarity and congruence can be discussed here).*

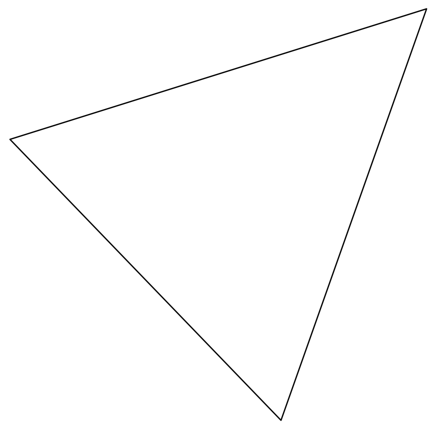
*Question 2 can be omitted in an assessment activity.*

*Further Activities:*

*The activity can be varied using different polygons. This is particularly useful for learners who are still on the Recognition level and are moving towards the Analysis level.*

# How many Lines of Symmetry 1?

1. How many lines of symmetry does an equilateral triangle have?



2. Now explore the number of lines in a symmetry in a square and a regular hexagon. Write down what you notice.
3. Now choose one other polygon that you think is appropriate and check whether your observation also works for this case.
4. Try to explain why this is so.

Now explore the rotational symmetry in this class of shapes. Write down what you notice and try to explain this.

***Teacher Notes: How many Lines of Symmetry 1?***

*Questions 1 to 3 are appropriate for the van Hiele analysis level with learners recognising properties and working empirically. Question 4 requires that learner give an informal proof (van Hiele ordering level).*

*Class Discussion:*

- *Learners should note that this activity deals with regular polygons and that the number of sides/vertices will determine the number of lines of symmetry.*
- *Learners will have learnt in the previous activity that a line of symmetry in a triangle must pass through a vertex and bisect the opposite side. One line of symmetry yields two congruent sides of the triangle. A second line of symmetry through another vertex will also yield two congruent sides, one of which is not the same as those created previously. The triangle therefore must be equilateral.*
- *Rotational Symmetry: Learners should note that the type of rotational symmetry corresponds to the number of sides/vertices in a regular polygon, for example, if a regular shape has n sides it will have rotational symmetry of order n. When explaining learners should refer to the sum of the internal angles.*
- *This activity might lead to the question: what about irregular polygons?(see Shilgalis)*

*Source of Ideas:*

*Shilgalis, T.W. (1992) Symmetries of Irregular Polygons. In **Mathematics Teacher, 85,** 342-344.*

# How many Lines of Symmetry 2?

Mr Gadebe asked the Grade 8 class to explore a number of different polygons and asked the learners to find out the number of lines of symmetry in each polygon.

1. Melusi said that one of the triangles had two lines of symmetry. Is he correct?

2. Portia said she could draw three lines of symmetry in one of the quadrilaterals. Is she correct?

3. Write down what you notice about the lines of symmetry in triangles. What do you notice about those in quadrilaterals? And in pentagons? And in hexagons? Try to explain.

***Teacher Notes: How many Lines of Symmetry 2?***

*This activity explores the conditions under which a line will be a line of symmetry of a particular shape.*

*Learners on different van Hiele levels will respond differently. Learners on the visual level will need to try out specific examples by drawing and folding. Those on the analysis level should use correct vocabulary. They will refer to specific examples and try to generalise from this, whereas those on the ordering level will try to explain why this is so in all cases.*

*Class Discussion:*

*Learners should be led to conclude the following: If the number of sides is odd, then the line of symmetry must pass through a vertex and bisect the opposite side at right angles. If the number of sides of the polygon is even, then the line must be of two types: it must either pass through two vertices or it must bisect two sides at right angles.*

**BACK TO TOP OF SECTION**

**BACK TO PREVIOUS SECTION SEC03A**

**FORWARD TO NEXT SECTION SEC03C**