PROPERTIES OF SHAPES

Key Concepts

Lines of symmetry

The number of lines that cut an image in half such that each half of the figure is the mirror image of the other half.

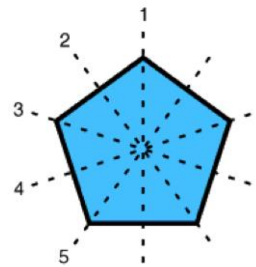
Order of rotation

The number of times a figure fits into itself in one complete rotation of 360 degrees.

Congruent shapes

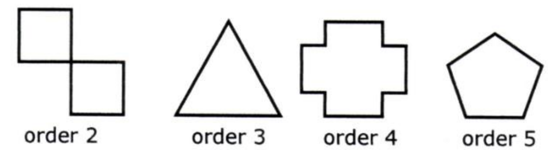
Images that are identical to one another. They can be flipped or rotated, not enlarged.

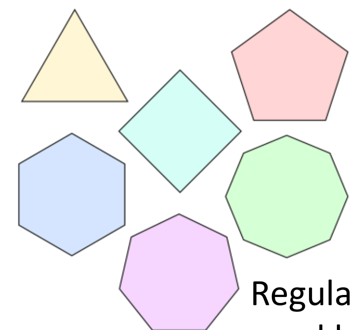
Examples



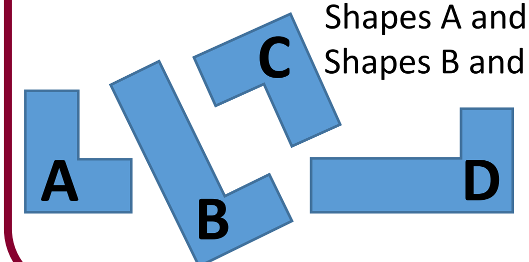
This regular polygon has 5 lines of symmetry

Order of rotation





Regular shapes have equal lengths of sides and equal angles.



Shapes A and C are congruent.
Shapes B and D are congruent.

sparx

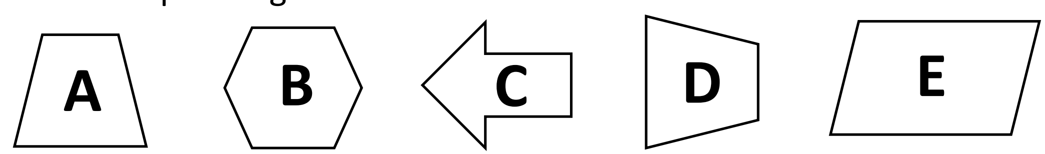
M276, M618, M276, M523

Key Words

Rotation
Symmetry
Congruent
Regular
Irregular

Questions

1) How many lines of symmetry does shape B have?
2) What is the order of rotation of shape E?
3) Which shape is congruent to shape A?
4) Which shape is regular?



ANSWERS: 1) 6 2) 2 3) D 4) B, regular hexagon

TYPES OF ANGLE AND ANGLES IN POLYGONS

Key Concepts

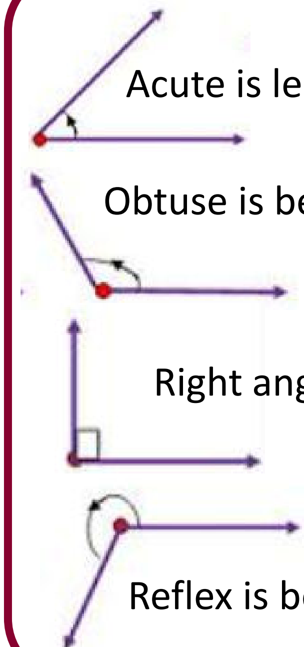
Regular polygons have equal lengths of sides and equal angles.

Angles in polygons
Sum of interior angles
$= (number\ of\ sides - 2) \times 180$

Exterior angles of **regular** polygons $= \frac{360}{number\ of\ sides}$

Types of angle
There are four types which need to be identified – acute, obtuse, reflex and right angled.

Examples



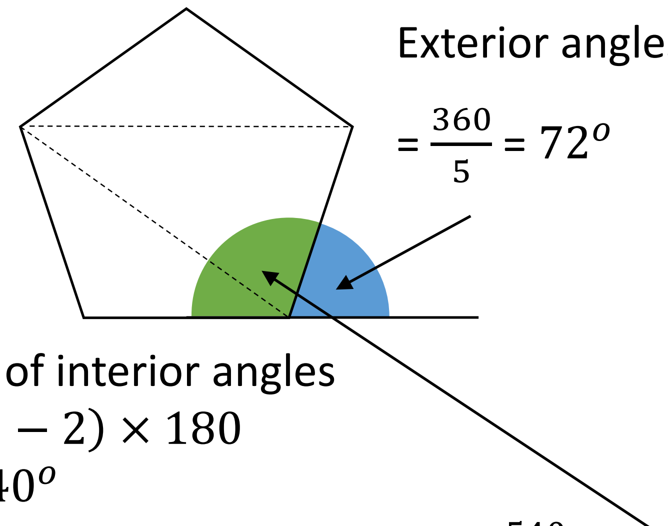
Acute is less than 90°

Obtuse is between 90° and 180°

Right angled is 90°

Reflex is between 180° and 360°

Regular Pentagon



Exterior angles

$= \frac{360}{5} = 72^o$

Sum of interior angles
$= (5 - 2) \times 180$
$= 540^o$

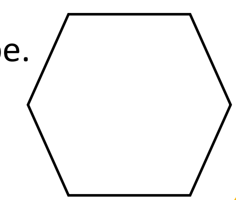
Interior angle $= \frac{540}{5} = 108^o$

sparx

M502
M679
M653

Key Words
Polygon
Interior angle
Exterior angle
Acute
Obtuse
Right angle
Reflex

Questions
1) Calculate the sum of the interior angles for this regular shape.
2) Calculate the exterior angle for this regular shape.
3) Calculate the size of one interior angle in this regular shape.



ANSWERS: 1) 720° 2) 60° 3) 120°

ANGLE FACTS INCLUDING ON PARALLEL LINES

Key Concepts

Angles in a **triangle equal 180º**.

Angles in a **quadrilateral equal 360º**.

Vertically opposite angles are equal in size.

Angles on a **straight line equal 180º**.

Base angles in an isosceles triangle are equal.

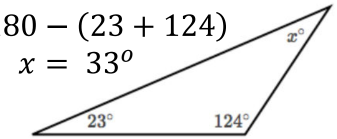
Alternate angles are equal in size.

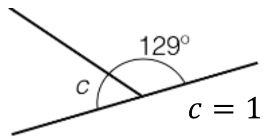
Corresponding angles are equal in size.

Allied/co-interior angles are equal 180º.

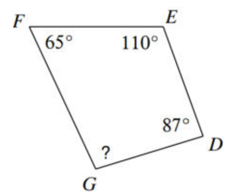
Examples

$x = 180 - (23 + 124)$
$x = 33^o$

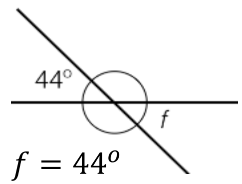




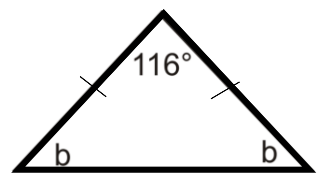
$c = 180 - 129$
$x = 51^o$



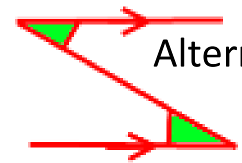
$? = 360 - (65 + 110 + 87)$
$? = 98^o$



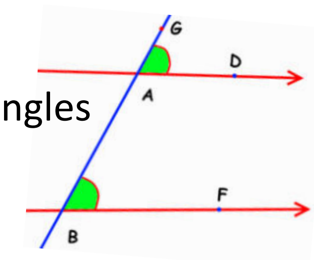
$f = 44^o$



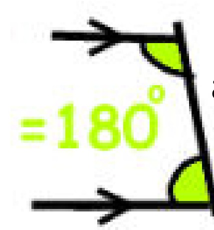
$b = (180 - 116) \div 2$
$b = 32^o$



Alternate angles are equal



Corresponding angles are equal



Allied/co-interior angles equal 180º

sparx

M331

M606

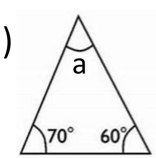
Key Words

Angle
Vertically opposite
Straight line
Alternate
Corresponding
Allied
Co-interior

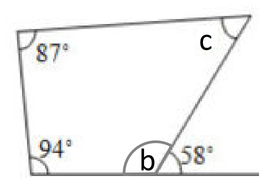
Questions

Calculate the missing angle:

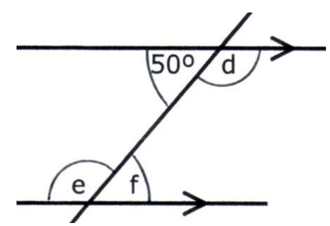
a)



b)



c)

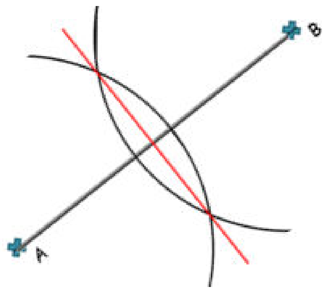


ANSWERS: 1) a=50º 2) b=122º c=57º 3) d=130º e=130º f=50º

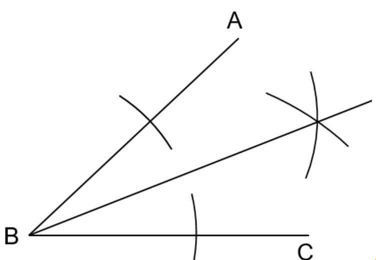
CONSTRUCTIONS

Key Concept

Line Bisector



Angle Bisector



Key Words

Construction: To draw a shape, line or angle accurately using a compass and ruler.
Loci: Set of points with the same rule.
Parallel: Two lines which never intersect.
Perpendicular: Two lines that intersect at 90°.
Bisect: Divide into two parts.
Equidistant: Equal distance.

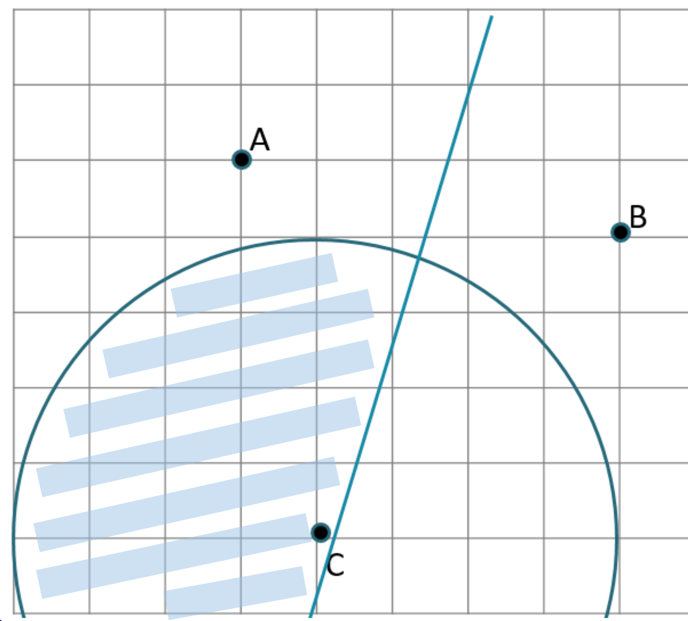
Examples

Shade the region that is:

- closer to A than B
- less than 4 cm from C

Line bisector of A and B

Circle with radius 4cm



M253,U820

Tip

Watch for scales.

For a scale of:
1 cm = 4 km.

20 km = 5 cm
6 cm = 24 km

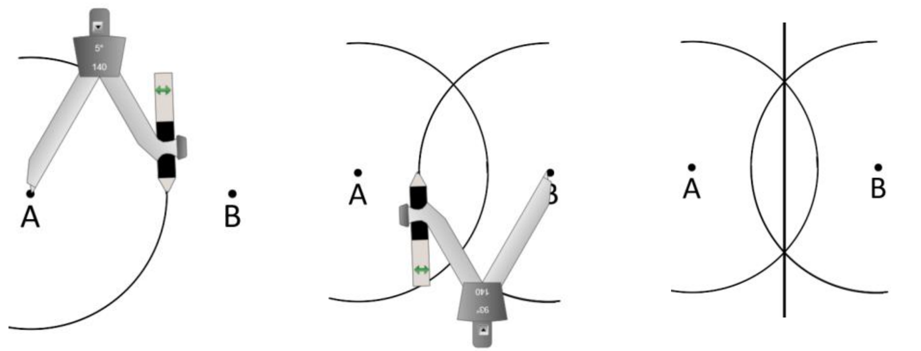
Questions

1) Draw these angles then bisect them using constructions:
a) 46° b) 18° c) 124°
2) Draw these lines and bisect them: a) 6cm b) 12cm

CONSTRUCTIONS

Examples

Bisect the distance between two points.

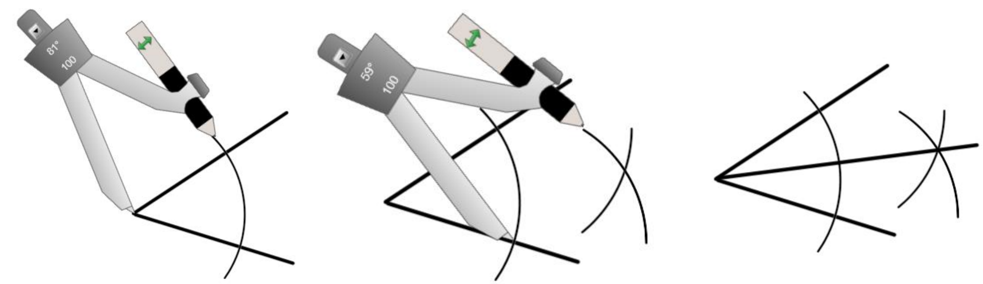


1) Open your compasses past halfway between the two points and draw an arc.

2) Keep your compasses at the same width and repeat from the other point.

3) Draw a line joining the two points where the arcs cross

Bisect an angle.



1) Open your compasses and draw an arc over both lines from the angle

2) Keep your compasses at the same width and draw two further arcs with the point of your compasses at the intersections.

3) Draw a line joining the two points where the arcs cross and the angle point

sparx

M239
M232

Key Words

Compass
Bisect
Angle
Arc

Try and recreate the above two constructions on paper using a pair of compasses and a pencil and ruler.

ANSWERS

AREA AND PERIMETER OF BASIC SHAPES

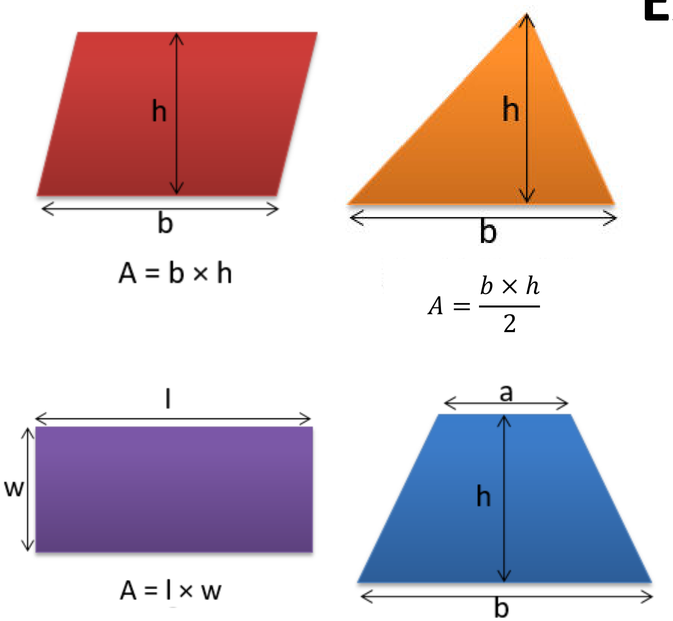
Key Concepts

The **area** of a 2D shape is the space inside it. It is measured in units squared e.g. cm^2

The **perimeter** of a shape is the distance around the edge of the shape. Units of length are used to measure perimeter e.g. mm, cm, m

A **compound shape** is a shape made up of others joined together.

Examples



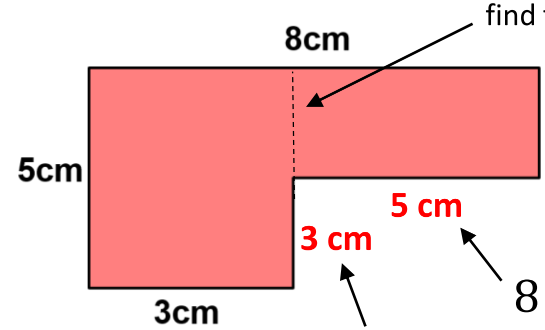
Parallelogram: A = b × h

Triangle: $A = \frac{b \times h}{2}$

Rectangle: A = l × w

Trapezium: $A = \frac{(a + b) \times h}{2}$

Split the shape into shapes that you can find the area of



$8 - 3 = 5cm$

$5 - 2 = 3cm$

$$Area = (5 \times 3) + (2 \times 5) = 25cm^2$$

$$Perimeter = 3 + 5 + 8 + 2 + 5 + 3 = 26cm$$

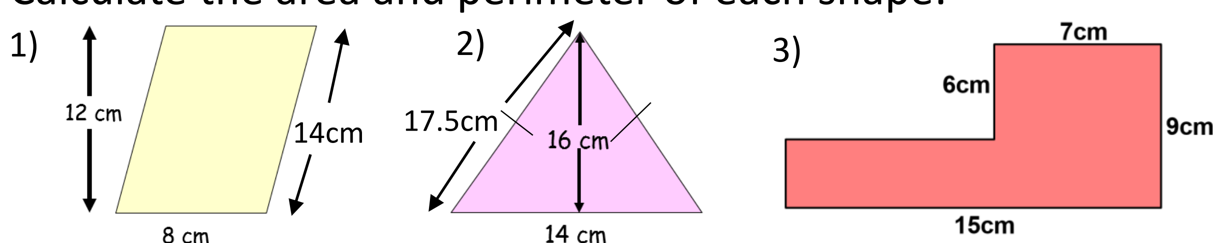
Key words

Area
Perimeter
Base
Height
Width
Length

sparx

M635, M690, M900, M269, M390, M635, M610, M996

Calculate the area and perimeter of each shape:

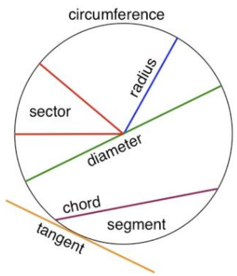


ANSWERS: 1) A = 96 cm^2 P = 44cm 2) A = 112 cm^2 P = 49cm 3) A = 87 cm^2 P = 48cm

PERIMETER AND CIRCUMFERENCE

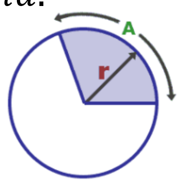
Key Concepts

Parts of a circle



Circumference of a circle is calculated by πd and is the distance around the circle.

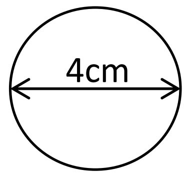
Arc length of a sector is calculated by $\frac{\theta}{360}\pi d$.



Examples

Calculate:

a) **Circumference**



C = $\pi \times 4$

$= 4\pi$

or $= 12.57$cm

b) **Diameter** when the circumference is 20cm

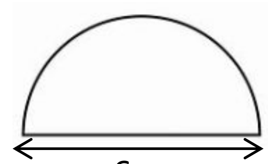
C = $\pi \times d$

20 = $\pi \times d$

$\frac{20}{\pi} = d$

Or $6.37cm$

c) **Perimeter**



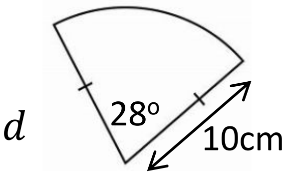
$$P = \frac{\pi \times d}{2} + d$$

$$P = \frac{\pi \times 6}{2} + 6$$

$$P = 3\pi + 6$$

Or = 15.42cm

d) **Arc length**



$$\text{Arc} = \frac{\theta}{360} \times \pi \times d$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 2 \times 10$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 20$$

$$\text{Arc} = \frac{14}{9}\pi$$

Or = 4.89cm

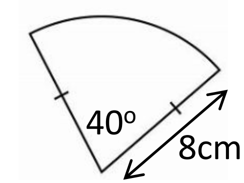
U604 U950 U221

Key Words

Circle
Perimeter
Circumference
Radius
Diameter
Pi
Arc

Calculate:

1) The circumference of a circle with a diameter of 12cm
2) The diameter of a circle with a circumference of 30cm
3) The perimeter of a semicircle with diameter 15cm
4) The arc length of the diagram



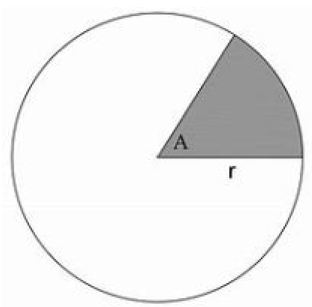
ANSWERS: 1) 12π or 37.7cm 2) $\frac{30}{\pi}$ or 9.54cm 3) 38.56cm 4) $\frac{16}{9}\pi$ or 5.59cm

AREA OF CIRCLES AND PART CIRCLES

Key Concepts

The **area** of a circle is calculated by πr^2

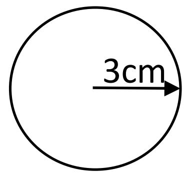
The **area of a sector** is calculated by $\frac{\theta}{360}\pi r^2$



Examples

Calculate:

a) **Area**



A = $\pi \times 3^2$

= 9π

or = 28.3cm^2

b) **Radius** when the area is 20cm^2

A = $\pi \times r^2$

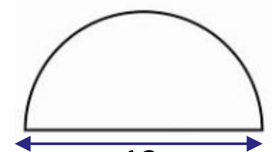
20 = $\pi \times r^2$

$\frac{20}{\pi} = r^2$

$\sqrt{\frac{20}{\pi}} = r$

Or $2.52cm$

c) **Area**



$P = \frac{\pi \times r^2}{2}$

$P = \frac{\pi \times 6^2}{2}$

$P = 18\pi$

Or = 56.55cm^2

d) **Area of a sector**

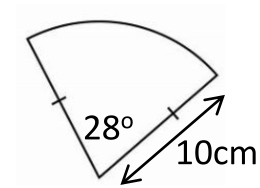
Arc $= \frac{\theta}{360} \times \pi \times r^2$

Arc $= \frac{28}{360} \times \pi \times 10^2$

Arc $= \frac{28}{360} \times \pi \times 100$

Arc $= \frac{70}{9}\pi$

Or = 24.43cm



sparx

U604 U950

U221 U373

Key Words

Circle

Area

Radius

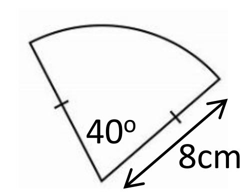
Diameter

Pi

Sector

Calculate:

1) The area of a circle with a radius of 9cm
2) The radius of a circle with an area of 45cm^2
3) The area of a semicircle with diameter of 16cm
4) The area of the sector in the diagram



ANSWERS: 1) 81π or 254.47cm^2 2) $\sqrt{\frac{45}{\pi}}$ or 3.78cm^2 3) 32π or 100.53cm 4) $\frac{64}{9}\pi$ or 22.34cm

REFLECTION, ROTATION AND TRANSLATION

Key Concepts

A **reflection** creates a mirror image of a shape on a coordinate graph. The mirror line is given by an equation eg. $y = 2, x = 2, y = x$. The shape does not change in size.

A **rotation** turns a shape on a coordinate grid from a given point. The shape does not change size but does change orientation.

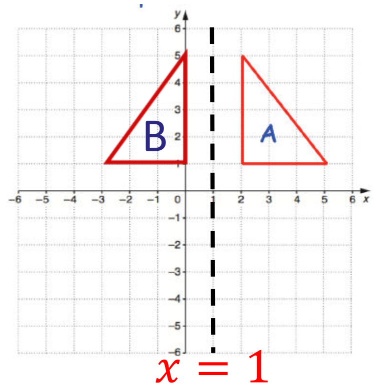
A **translation** moves a shape on a coordinate grid. Vectors are used to instruct the movement:

$\begin{pmatrix} x \\ y \end{pmatrix}$

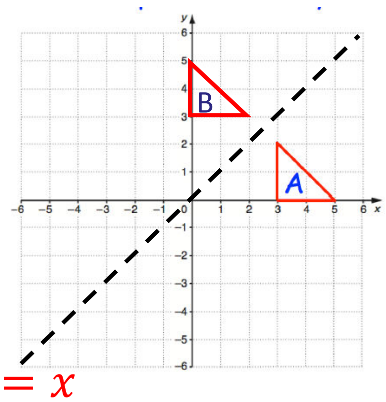
- x: Positive-Right, Negative - Left
- y: Positive-Up, Negative - Down

Examples

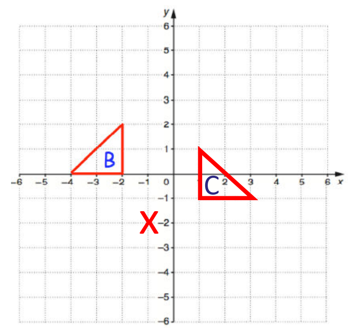
Reflect shape A in the line $x = 1$. Label it B.



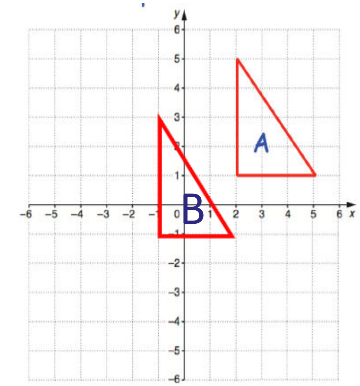
Reflect shape A in the line $y = x$. Label it B.



Rotate shape B from the point (-1, -2)



Translate shape A by $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$. Label it B



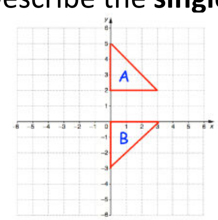
A reflection creates a mirror image of a shape on a coordinate graph. The mirror line is given by an equation eg. $y = 2, x = 2, y = x$. The shape does not change in size.

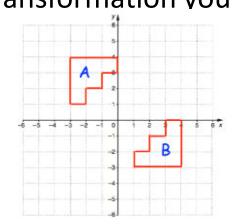
U134, U196, U696, U799

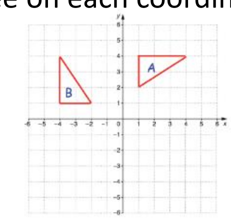
Key Words

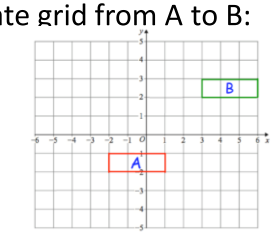
Rotate
Clockwise
Anticlockwise
Centre
Degrees
Reflect
Mirror image
Translate
Vector

Describe the **single** transformation you see on each coordinate grid from A to B:









ANSWERS: a) reflection, $y = 1$ b) reflection $y = x$ c) rotation, centre (0,0), 90° anticlockwise d) translation $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$