What do you know about constructions?

Using only a pencil, ruler and compass, construct a triangle with side lengths 6 cm, 8 cm and 10 cm.

Compare it with your partner's triangle .

Are they exactly the same?

Using only a pencil, ruler and compass, construct an isosceles triangle with one side length 5 cm and another 7 cm.

Compare it with your partner's triangle .

Are they exactly the same?

Using only a pencil, ruler and compass, construct a triangle with one side length 5 cm, another 7 cm with the angle between equal to 60^{o}.

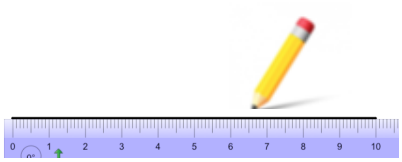
Compare it with your partner's triangle .

Are they exactly the same?

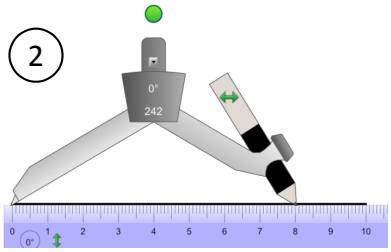
1

Using only a pencil, ruler and compass, construct a triangle with side lengths 6 cm, 8 cm and 10 cm.

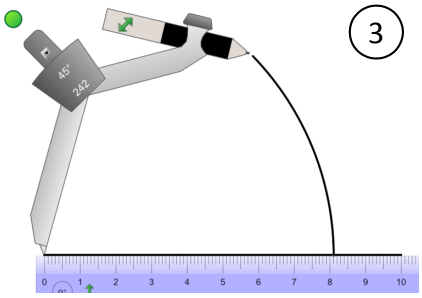
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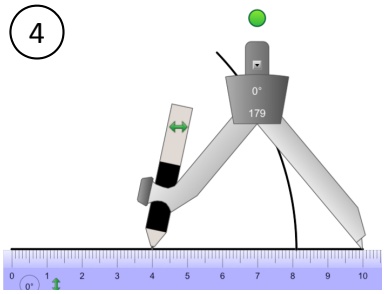
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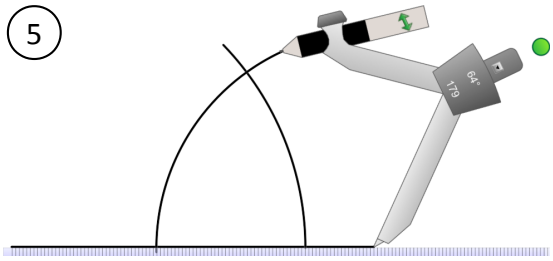
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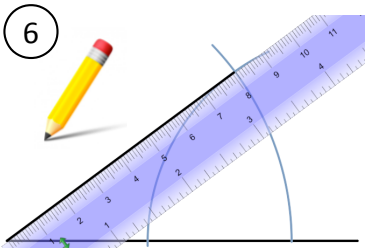
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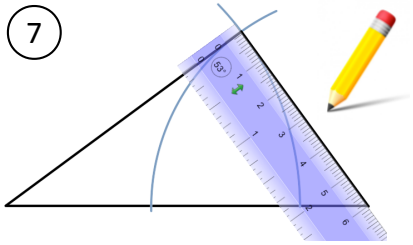
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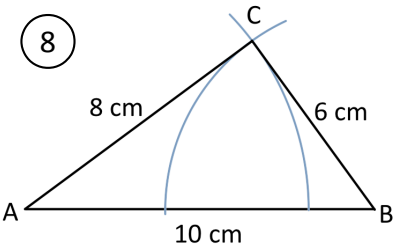
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7



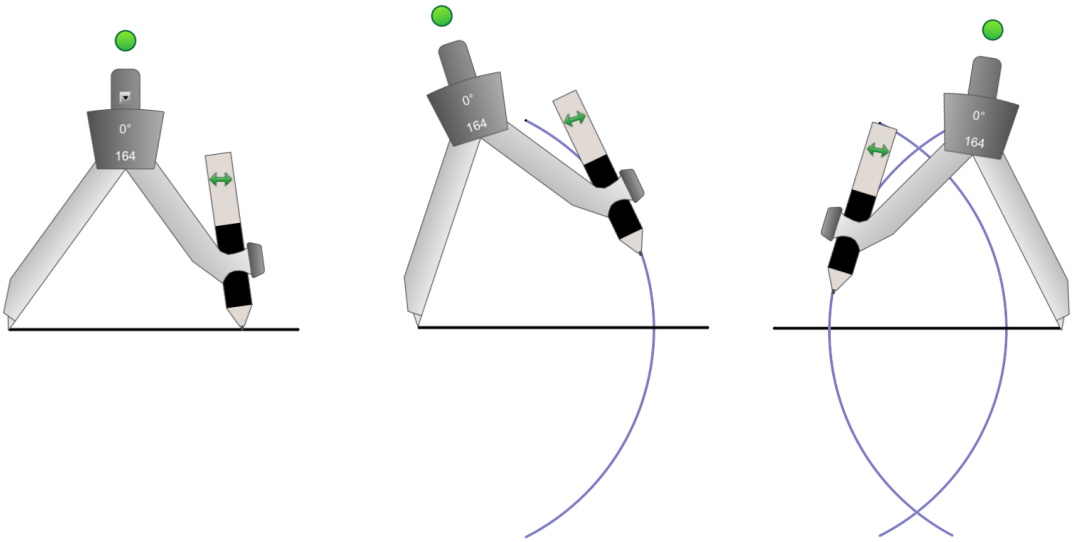
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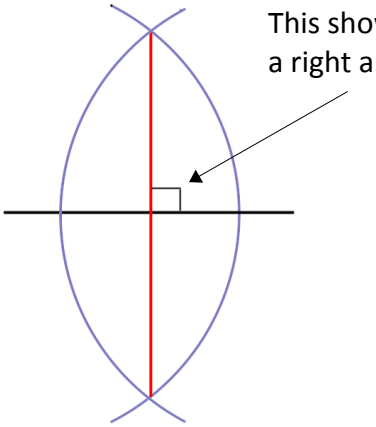


2

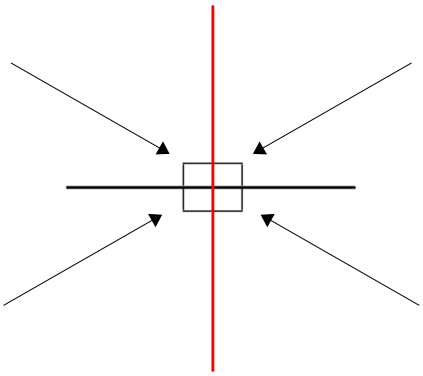
Look carefully at your final diagram. How would you classify this triangle?

Constructing a right angle



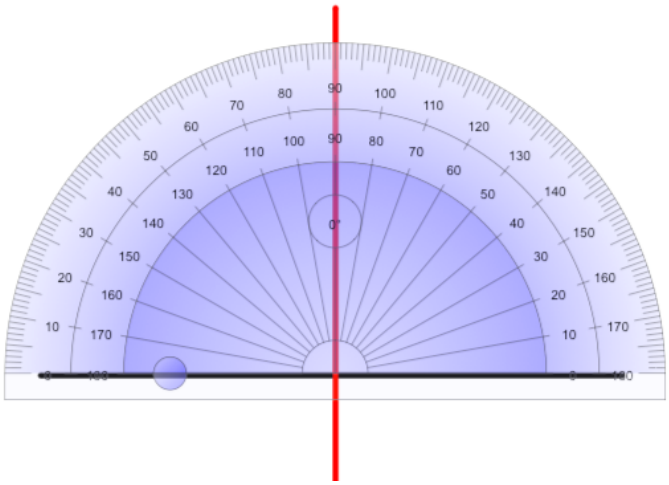


This shows it is a right angle.



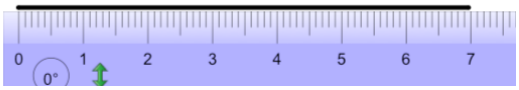
But by symmetry this actually creates 4 right angles.

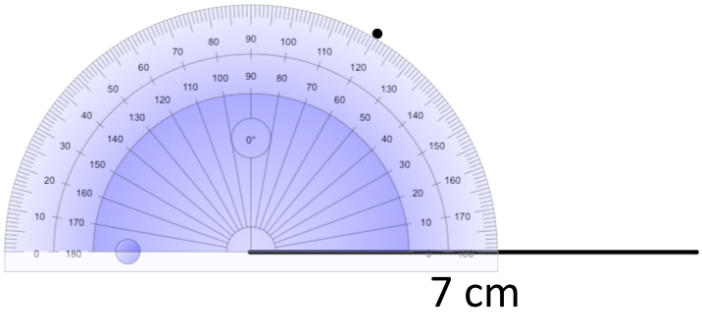
Measuring angles

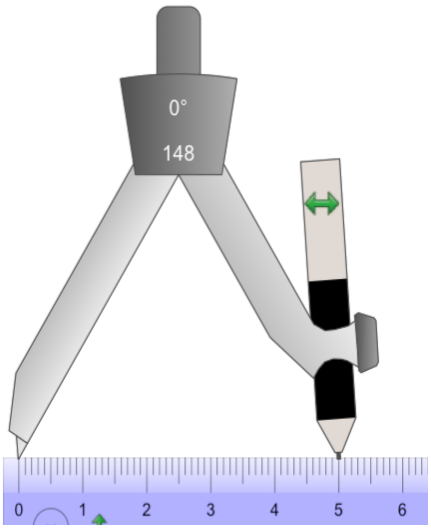


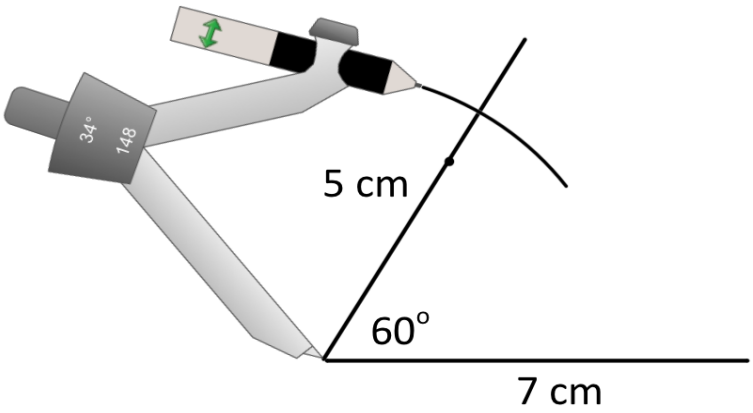
We measure angles using a protractor. It is often semicircular and is divided into 180 equal divisions known as degrees (°).
A right-angle measures 90°.
A straight angle measures 180°.

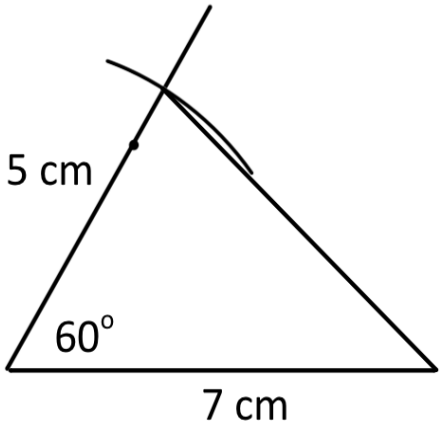
3 Using only a pencil, ruler and compass, construct a triangle with one side length 5 cm, another 7 cm with the angle between equal to 60°.











Fitness check

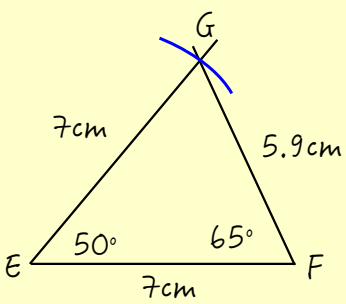
Construct these triangles using a pencil, ruler and compass.
In each case, measure the unknown side lengths and angles.

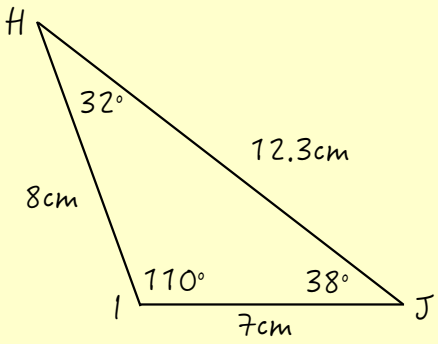
1. Construct triangle EFG given that EF = 7 cm, EG = 7 cm and ∠FEG = 50°.
2. Construct a triangle HIJ given HI = 8 cm, IJ = 7 cm and ∠HIJ = 110°.
3. Construct a triangle KLM given that KL = 6cm, ∠KLM = 42° and ∠KML = 63°.
4. Construct a triangle NOP given that NP = 5cm, NO = 12 cm and OP = 13 cm.
5. Construct a triangle TUV given ∠TUV = 40°, ∠TVU = 60° and ∠UTV = 80°.
   Can you explain why, in this case, you may not all draw identical triangles?



Alice

Alice's solutions for Q1 and Q2

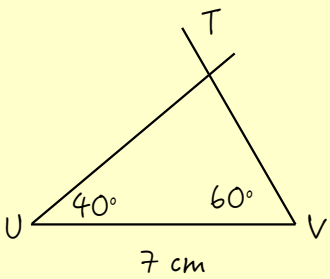


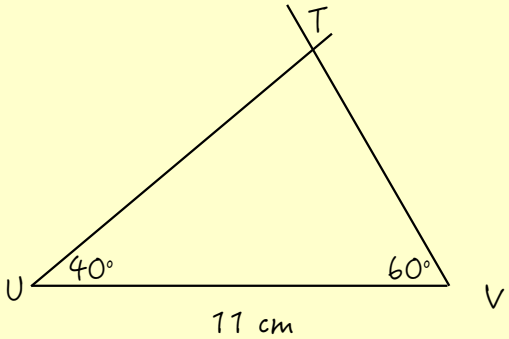




Matthew

Matthew's explanation for Q5.



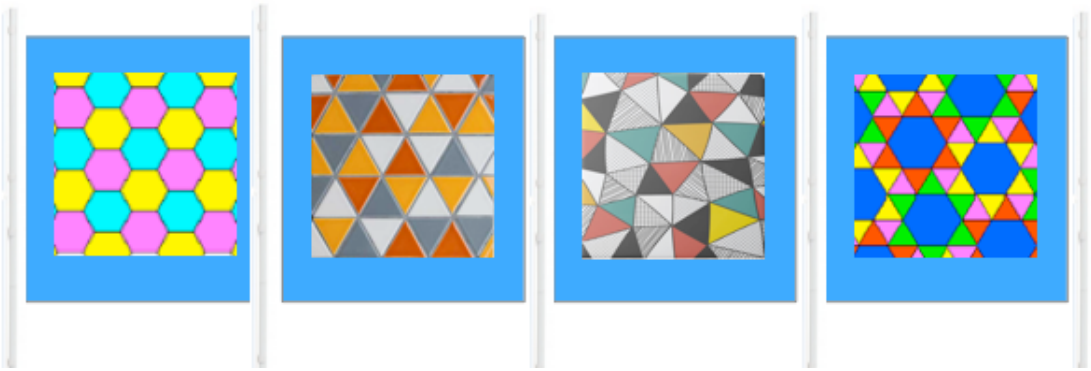


As you have only been given the angles, the first side you draw can be any length.

Two triangles that have matching angles but are not the same size are called **similar triangles**.

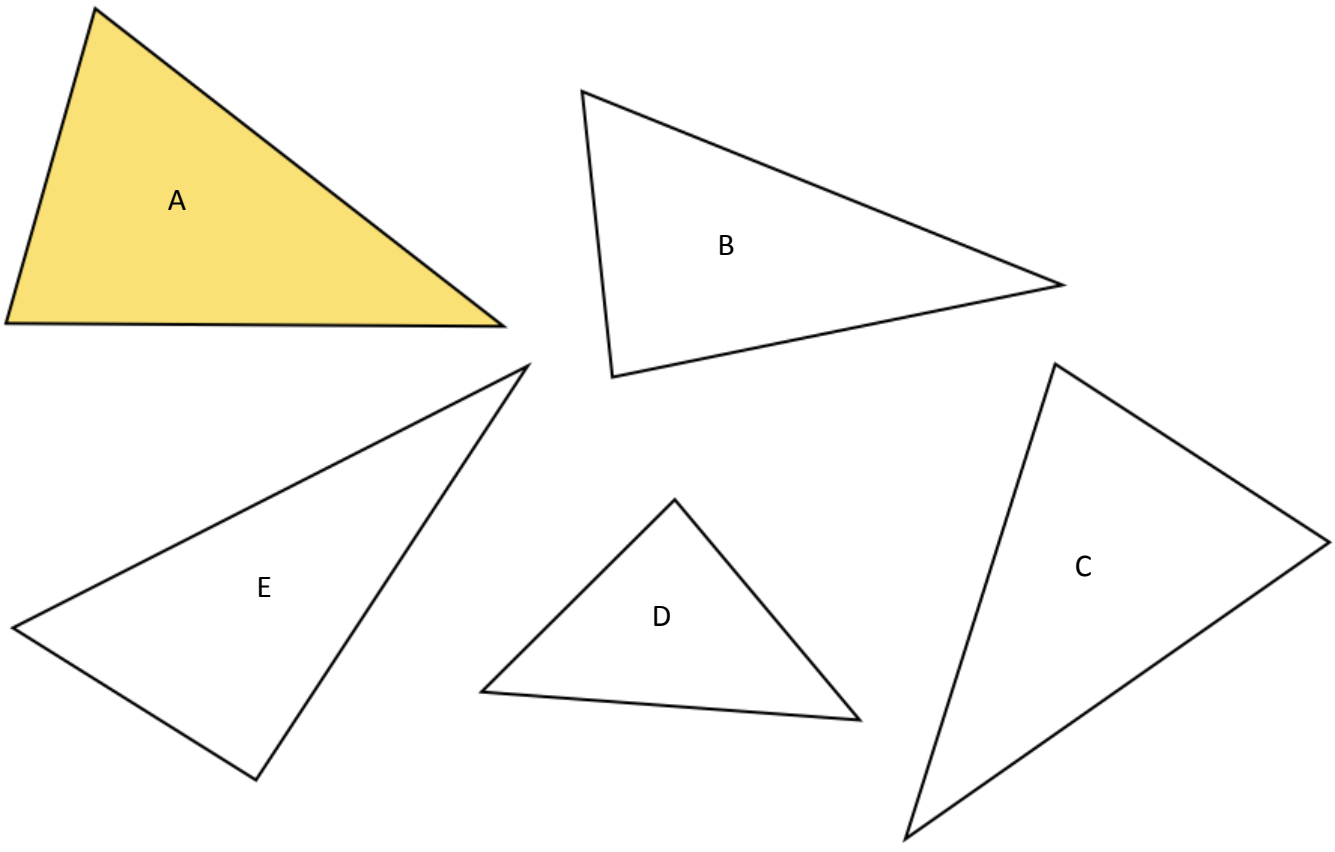
The art of tiling

Interior designers just love regular mathematical designs, whether for the wall or the floor. Just look at the selection of tiles on show at a recent exhibition.

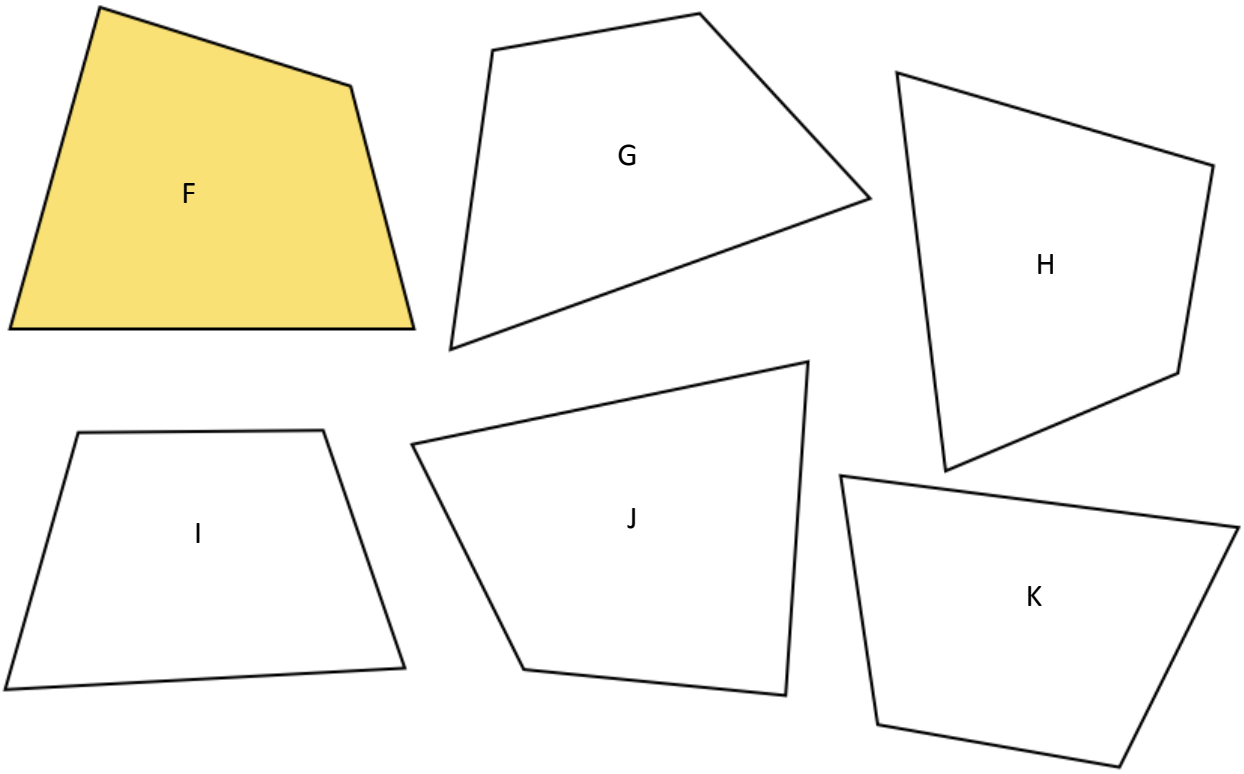


When you fit individual tiles together, with no gaps or overlaps, to fill a flat space you have a **tiling**. This is often used on wals and floors. As you can see, you can use a variety of shapes to do this.
Another word for a tiling is a **tessellation.**
In a tessellation, a basic pattern is repeated over and over again with varying degrees of complexity. As there are no gaps, the shapes must fit together perfectly. So it is important that you can recognise pieces that are the same and pieces that fit together.

To test your tiling ability, decide which of the shapes below is the same as shape A.



Which of the following figures are the same shape?



4 Find which of the figures B to E are the same shape and size. Then, find the figures that are the same size and shape from F to K.

1. Make a prediction about which one you think will match.
2. Cut out the shapes from the resource sheet Geometry2a_R1 to help you.
3. Experiment with the shapes to find which ones are the same shape and size.

When two figures can fit on top of each other perfectly, we say that they are **congruent**.



Jon

In that case, I think A and E are congruent.



Sarah

Well, I think F, H and J are congruent.

I think B and C are congruent too.



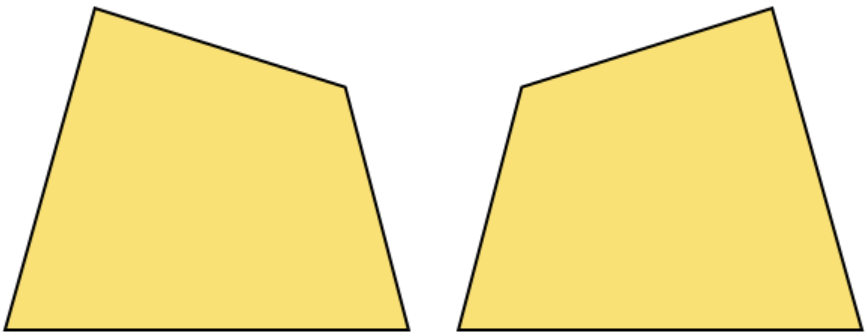
Alice

What about I and K?



Matthew

5 Are these two shapes congruent?





Amber

They are the same shape, but you have to flip one of them over to make them fit. Is that allowed?

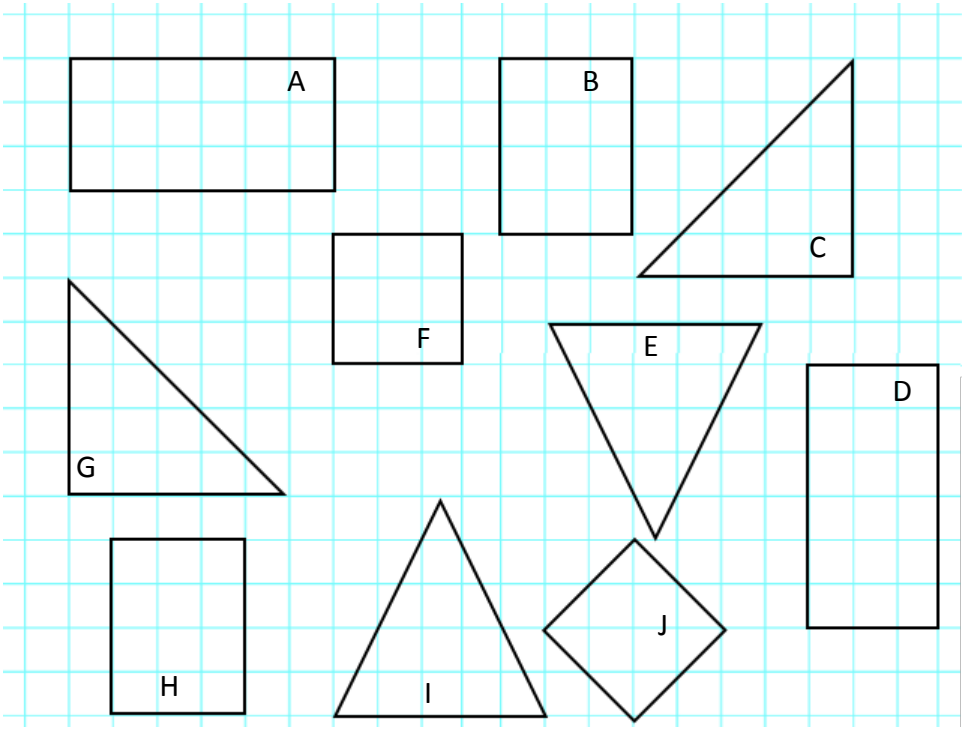


Evie

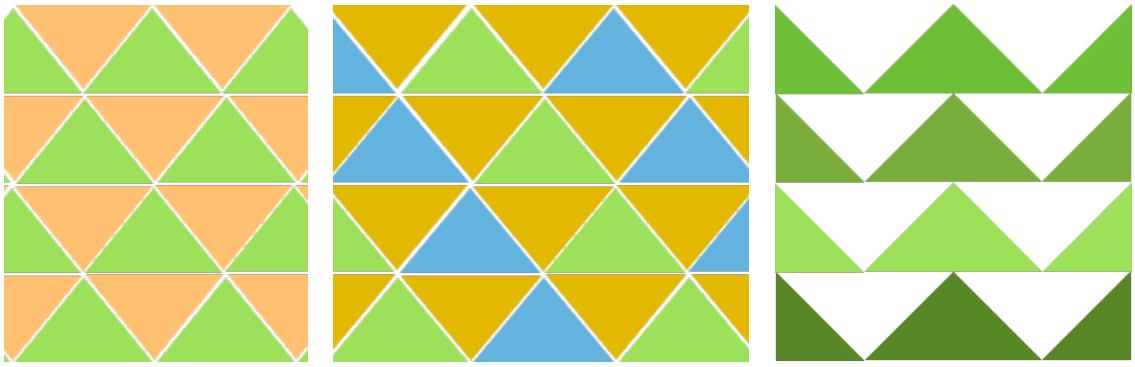
Congruent figures just have to be the same shape and size. Flipping them over is fine.

Fitness check

Find the congruent shapes.

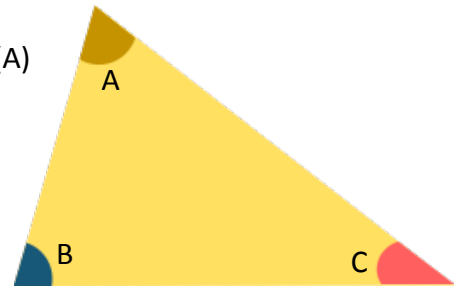


Can we make a tiling pattern with triangles?

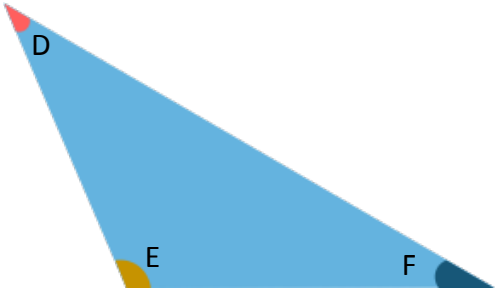


6 Look at the triangles below. Can you make a tiling pattern with triangle A? What about triangle B?

(A)



(B)

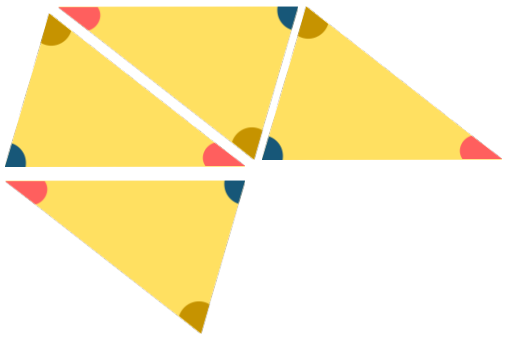


Use Resource sheet Geometry2a_R2, cut out the triangles and see if you make a tiling pattern with each set.



Alice

What if I try this...





Sarah

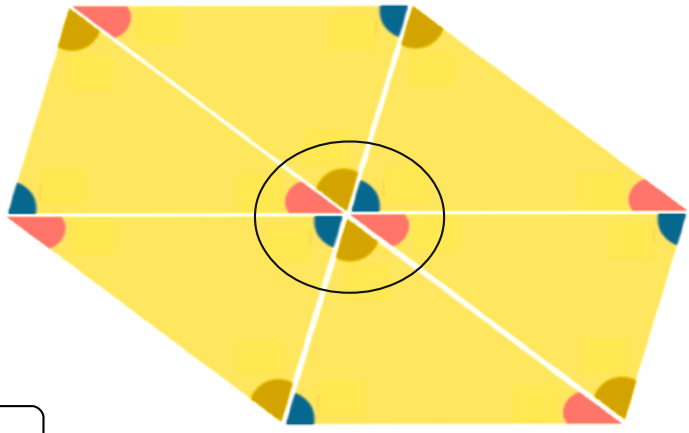
I think we can use triangle (B) to make one...





Jon

I've noticed something really interesting about my tessellation.



7 What do you think Jon had noticed?



Alice

The sides that are the same length are touching each other.

Opposite angles are the same.



Sarah



Matthew

The six triangles come together at a corner form a 360° angle.

And the three triangles come together to form a straight line.



Evie

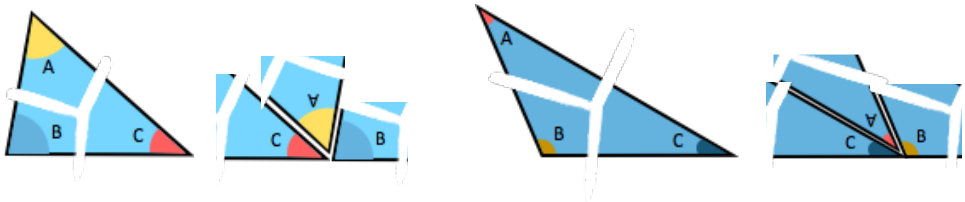
8 Does this work for any triangle? Design your own triangle and see if it tessellates.



Jon

In fact, if you start with any triangle and cut off the corners, they fit together to make a straight angle.

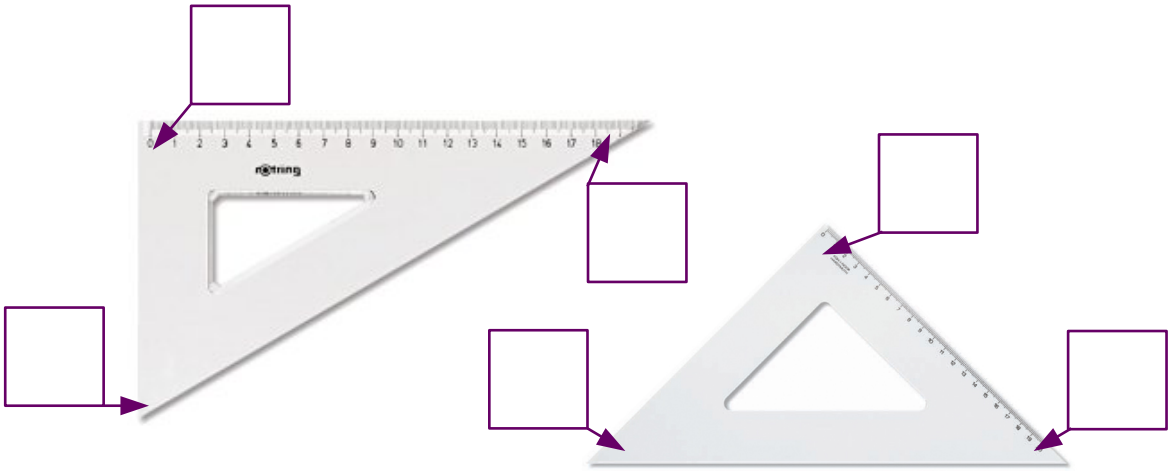
Look ...



And so the sum of the three angles of a triangle is always 180°.

9 Check out Jon's claim by measuring the angles in your set squares.

Find the measurements of the angles in these set square:.

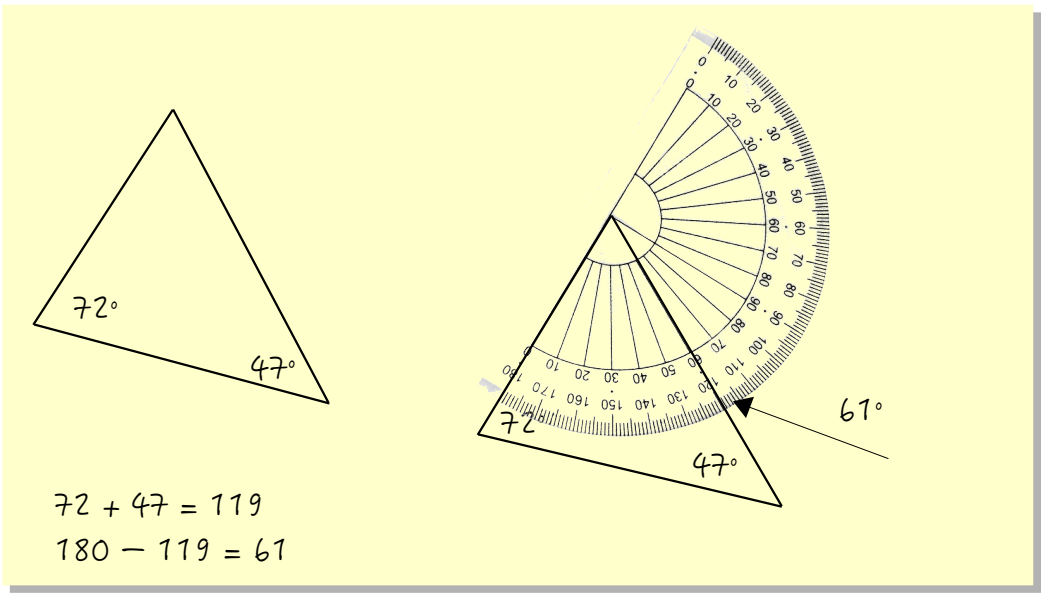


10 Now draw any triangle in your exercise book, then measure two of the angles and calculate the third angle. Measure it to see if you were right.

Amber's work

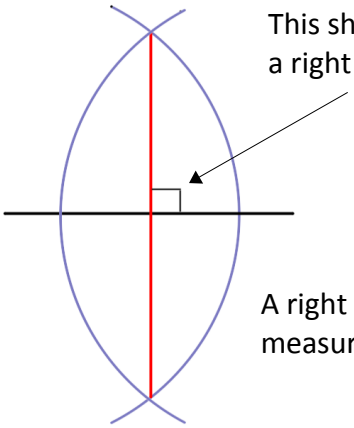


Amber



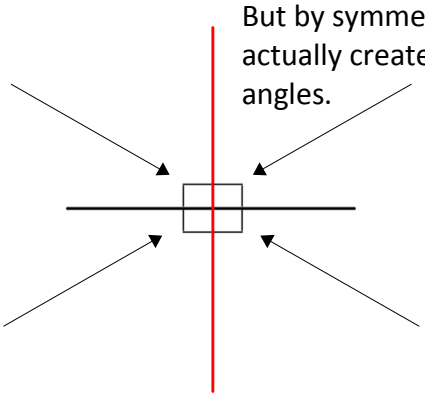
Angle facts

Some important angle facts



This shows it is a right angle.

A right angle measures 90°.

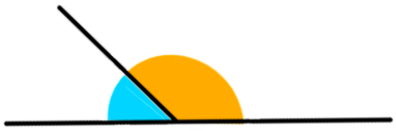


But by symmetry, this actually creates 4 right angles.

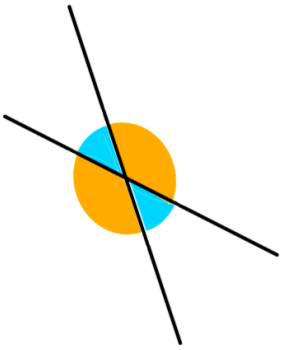
4 right angles measure 360°.



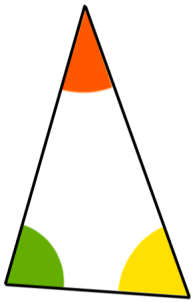
Angles at a point add up to 360°.



Angles on a straight line add up to 180°.



Vertically opposite angles are equal

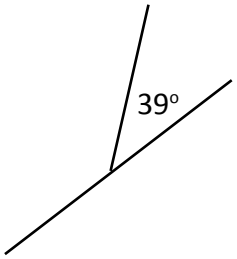


Angles in a triangle add up 180°

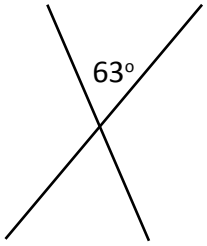
Fitness check

Calculate the unknown angles:

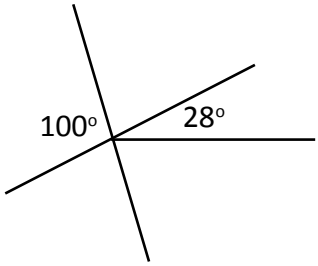
A



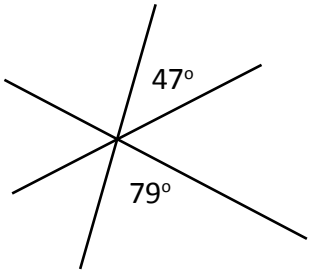
B



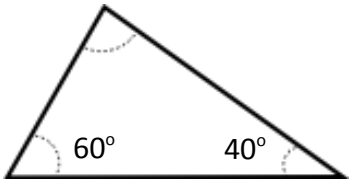
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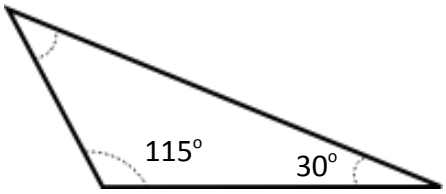
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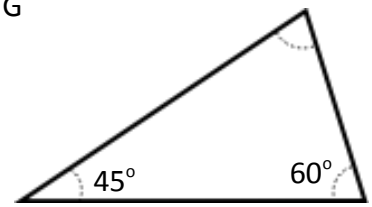
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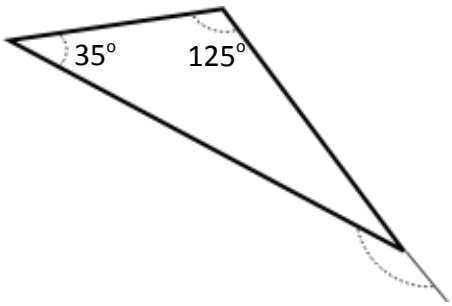
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G



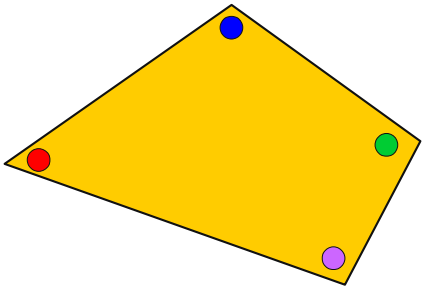
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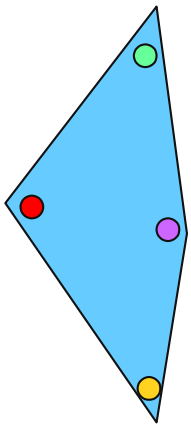
Can we make a tiling pattern with quadrilaterals?

11 Look at the quadrilaterals below. Can you make a tiling pattern with quadrilateral A? What about quadrilateral B?

(A)



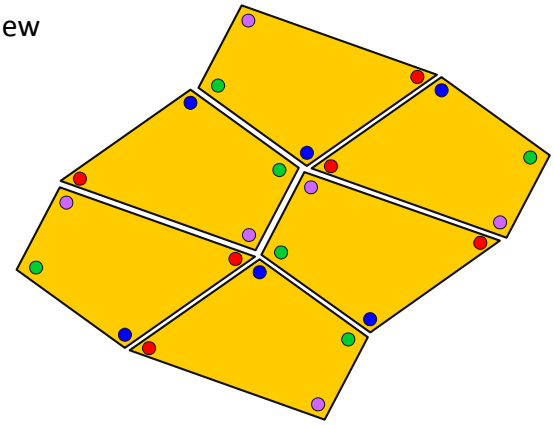
(B)



Use Resource sheet Geometry2a_R3, cut out the quadrilaterals and see if you make a tiling pattern with each set.

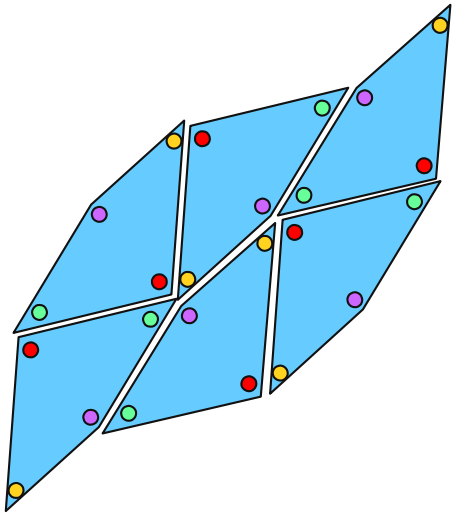


Matthew: Shape (A) seems to work ...



... and so does shape (B) ... Amber



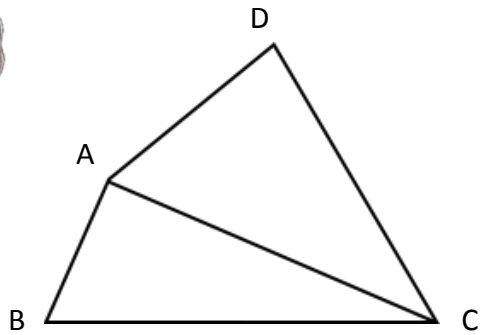


12 What does this tell you about the sum for the four angles of a quadrilateral?

1. Can you think of any other ways you could find the sum for the four angles of a quadrilateral?



Alice

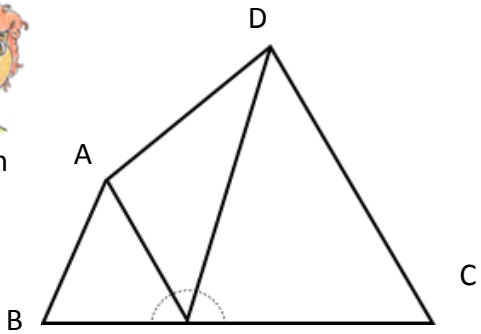


180 x 2 = 360

Answer = 360°



Sarah



(180 x 3) - 180 = 540 - 180

Answer = 360°

2. Look at Alice's work and explain her thinking...



Jon

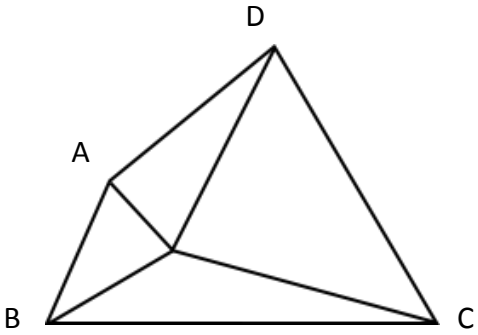
First, split quadrilateral ABCD into two triangles with diagonal AC. Since the sum of the three angles of a triangle is 180°...

3. Look at Sarah's work and explain her thinking..



Amber

I've found another way.
This is my diagram.

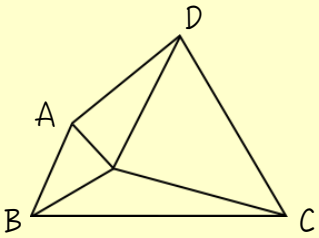


13 What calculation did Amber write down?



Amber

Amber's working



(4 x 180) = 720

720 – 360 = 360

Answer = 360°.

14 What is common about these three friends' ideas?



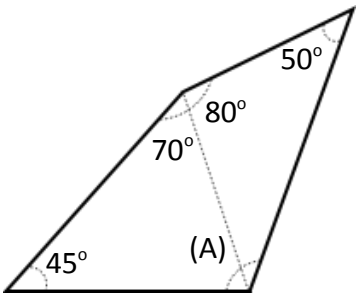
Jon

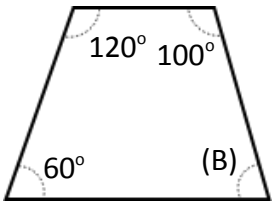
The sum of the angles of a quadrilateral can be found by splitting the quadrilateral into triangles. The sum of the angles of a quadrilateral is 360°.

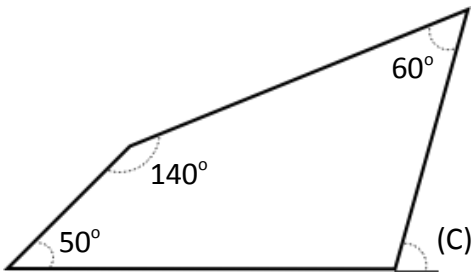
We can explain this because we know that the sum of the angles of a triangle is 180°

Fitness check

In each of these quadrilaterals, find the unknown angle.





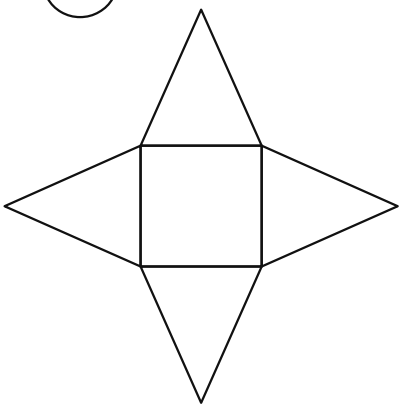


Let's think about nets

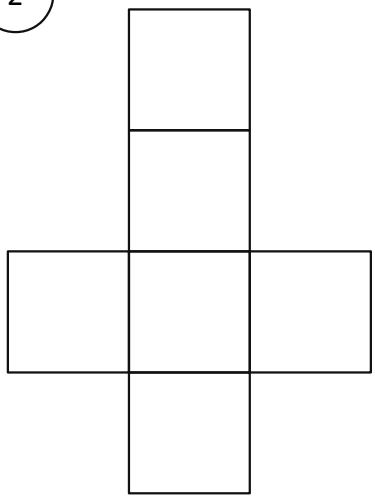
3D shapes have faces (sides), edges and vertices (corners). A net is what a 3D shape would look like if it were opened out flat.

Look at these six nets. Can you describe the 3D shape that could be made from each net?

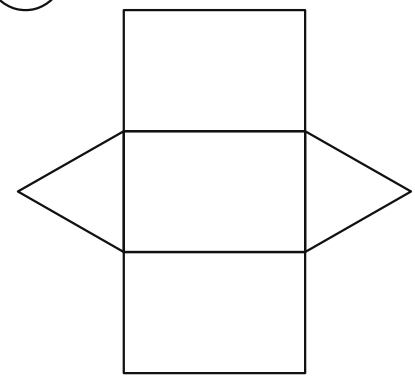
1



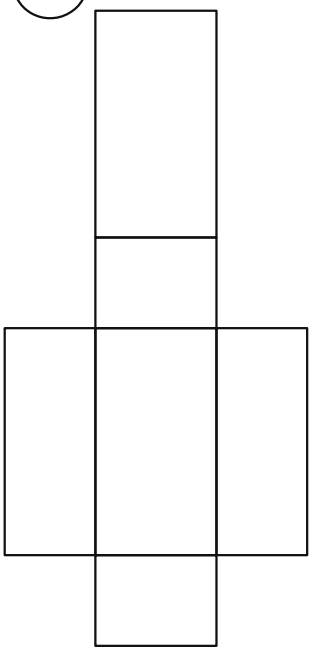
2



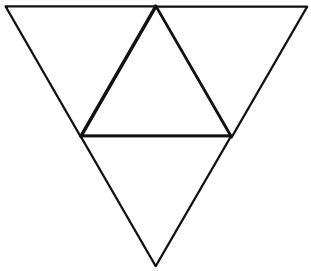
3



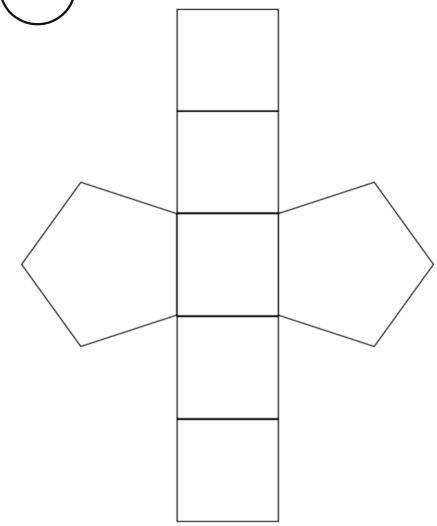
4



5



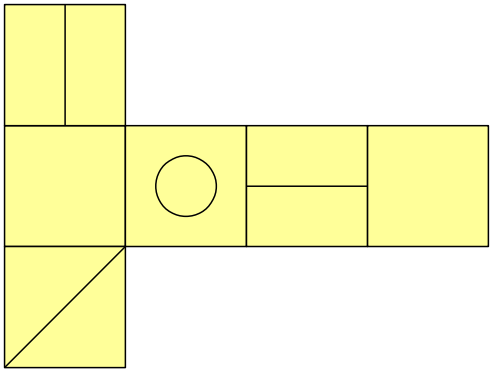
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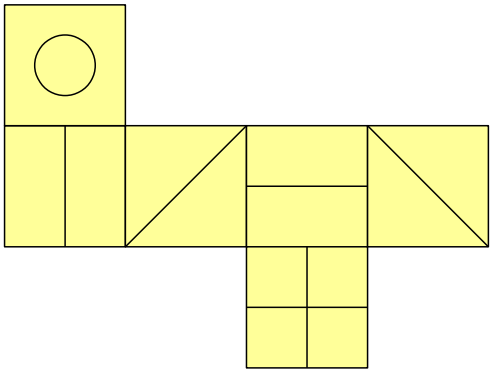


Let's think about nets

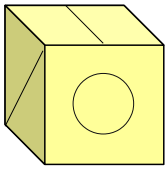
Puzzle Corner

When folded, the figures on the left become one of the figures on the right – but which one? Make models to check if you were right.

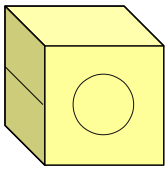




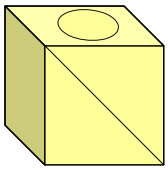
(i)



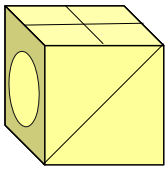
(ii)



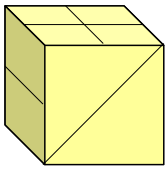
(iii)



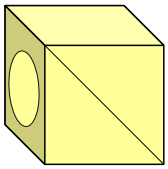
(iv)



(v)



(vi)



Let's think about nets

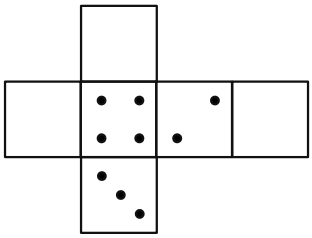
Puzzle Corner

The diagram shows a cube where three of the faces have a pattern of dots, as shown below. The other faces are white and have no dots.

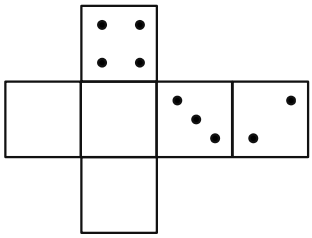


Which of these could be the net of this cube?

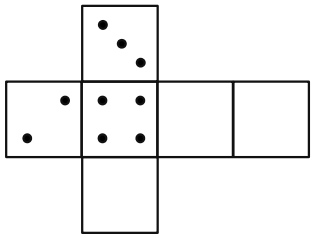
A



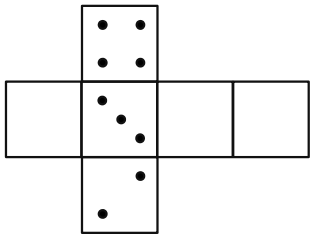
B



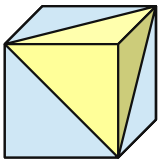
C



D

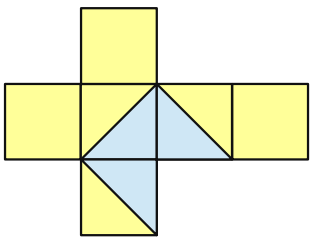


This diagram shows a yellow cube where three of the faces have a blue triangular pattern.

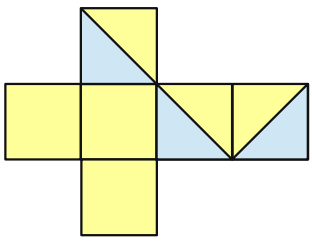


Which of these could be the net of this cube?

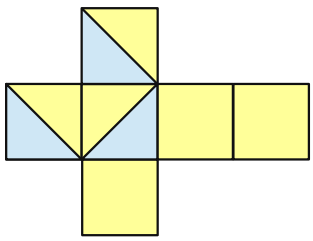
A



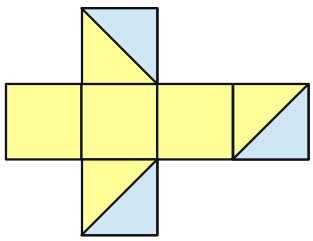
B



C

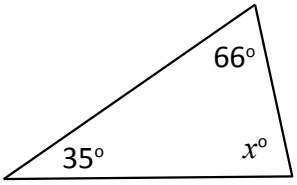


D



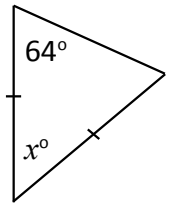
Geometry 2a: Mastery questions

1. What is the size of the missing angle?



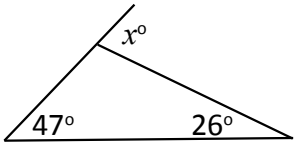
A	101°	B	79°	C	89°	D	91°

2. What is the size of the missing angle?



A	64°	B	180°	C	116°	D	52°

3. What is the size of the missing angle?



A	47°	B	107°	C	73°	D	26°

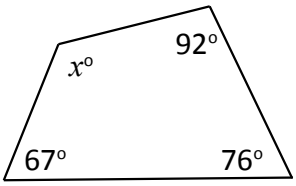
4. What is the greatest number of obtuse angles you can have in a triangle?

A	0	B	1	C	2	D	3

5. What is the greatest number of obtuse angles you can have in a quadrilateral?

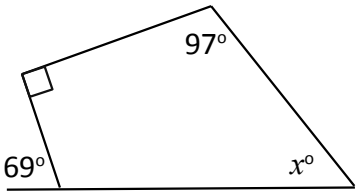
A	1	B	2	C	3	D	4

6. What is the size of the missing angle?



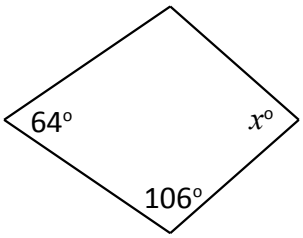
A	110°	B	125°	C	76°	D	67°

7. What is the size of the missing angle?



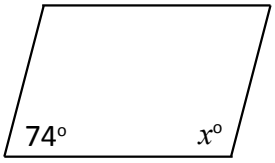
A	101°	B	69°	C	89°	D	62°

8. What is the size of the missing angle in this kite?



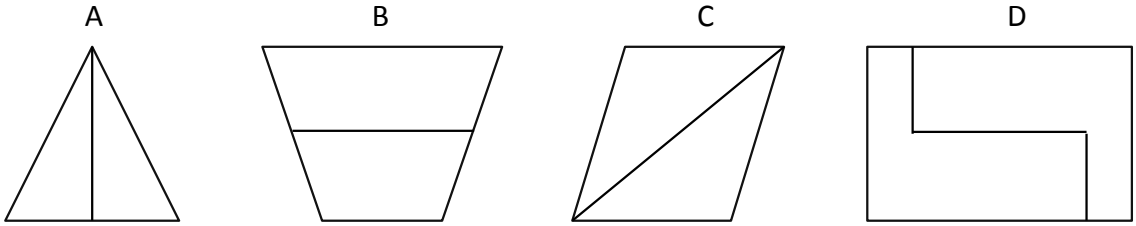
A	116°	B	64°	C	36°	D	84°

9. What is the size of the missing angle in this parallelogram?

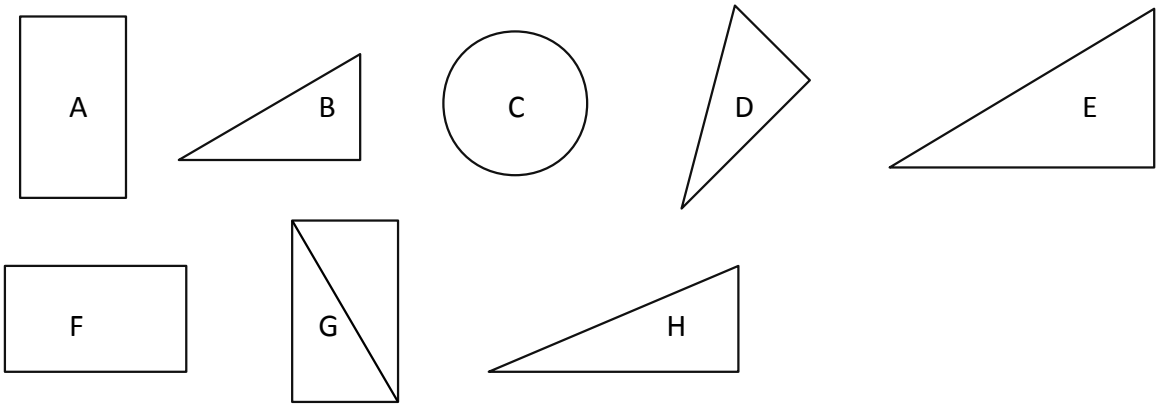


A	106°	B	74°	C	116°	D	286°

10. Which of the following shapes has not been split into two congruent halves?

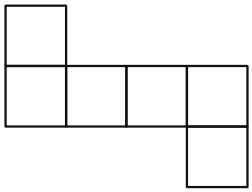


11. Which of these shapes is congruent to B?

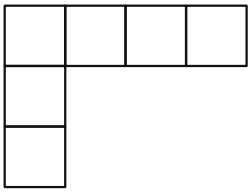


112. Which of these is the net of a cube?

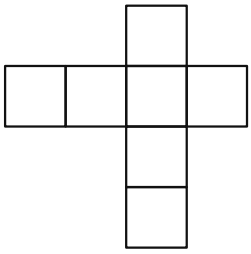
A



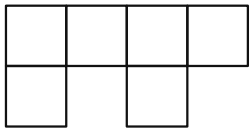
B



C



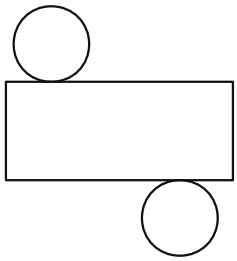
D



13. What shapes do you need to make the net of a square based pyramid?

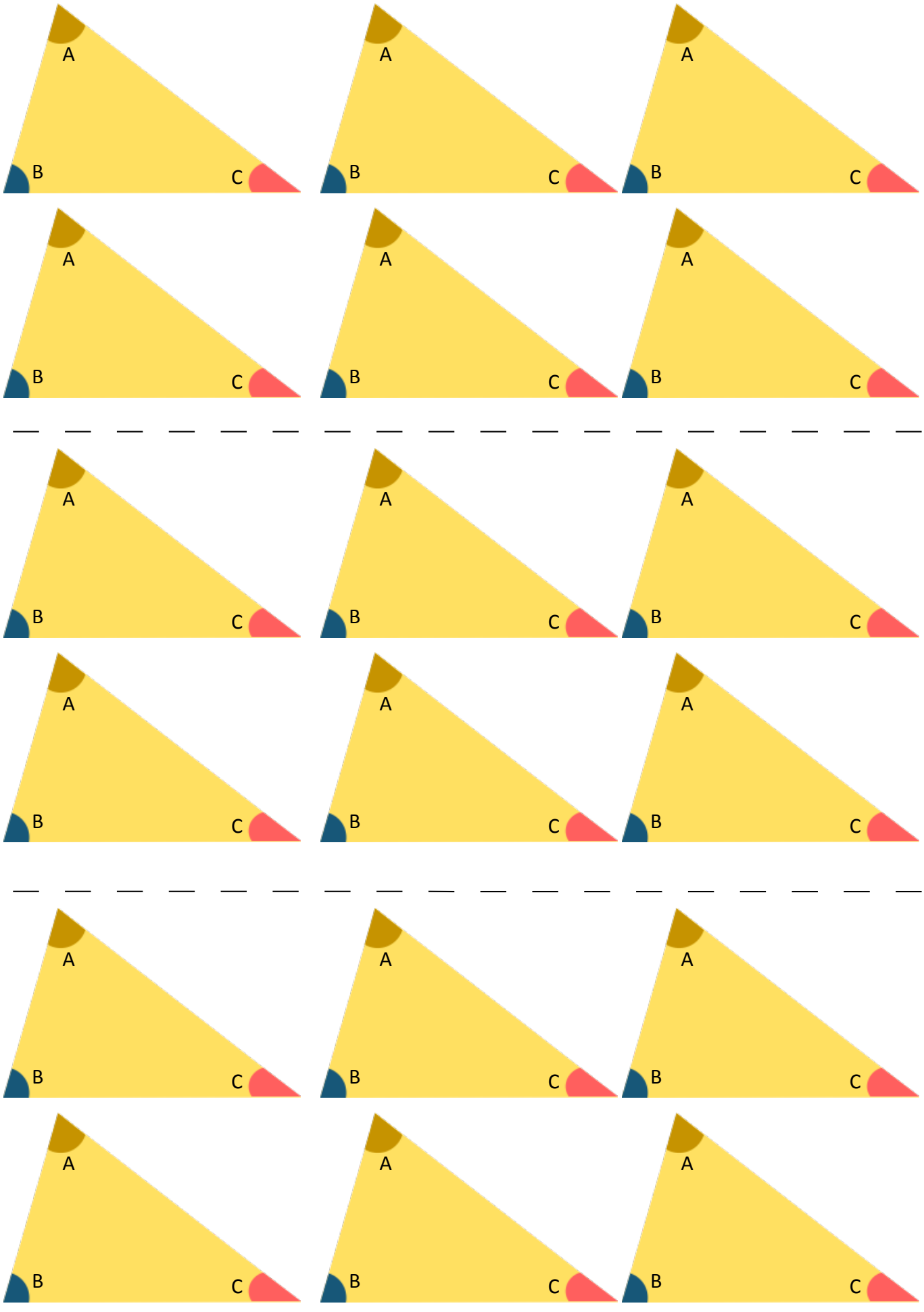
A Three squares, two triangles
B Two squares, four triangles
C Six squares
D One square, 4 triangles

14. Which 3D shape matches this net?

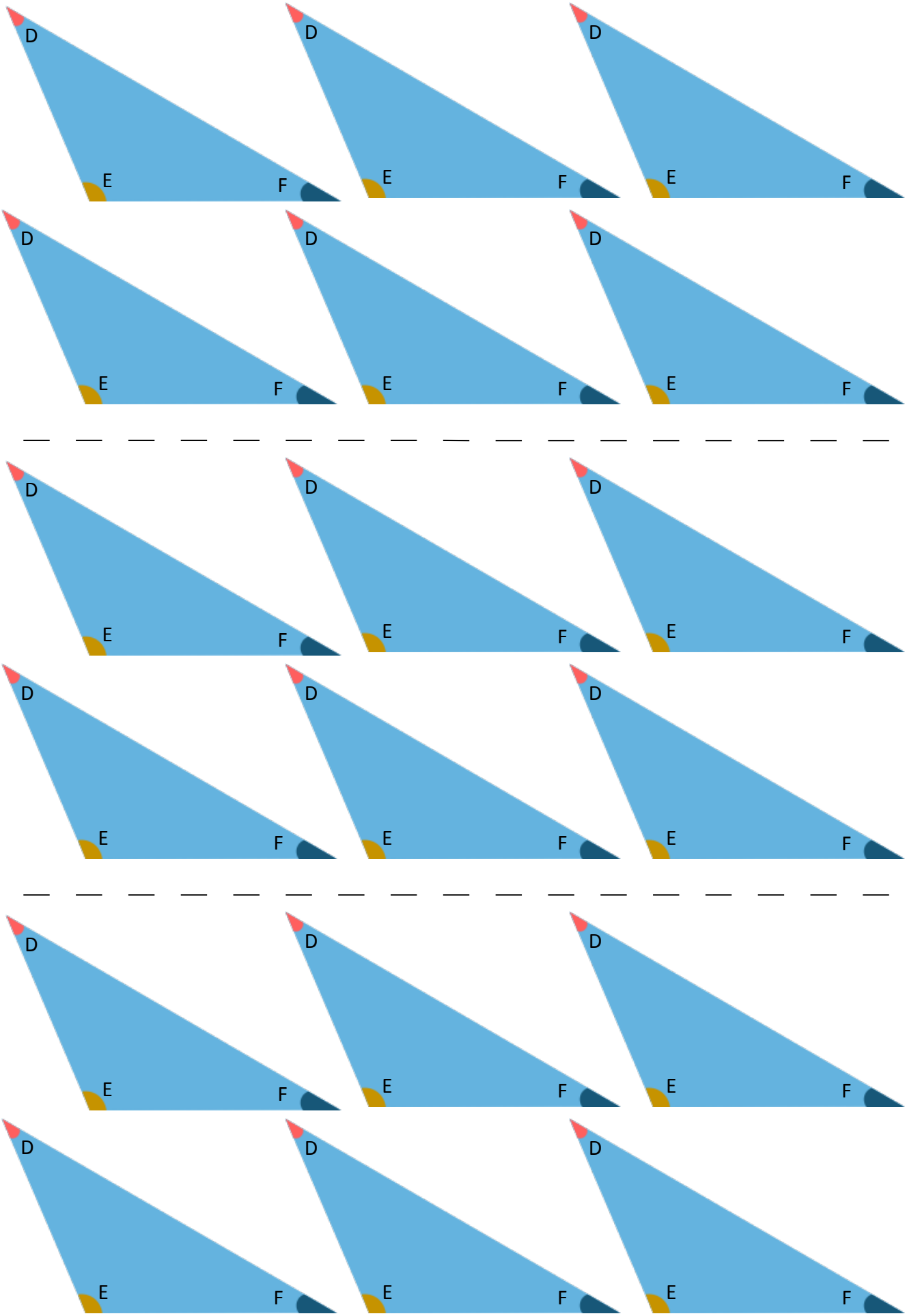


A Cone
B Cylinder
C Sphere
D Hemisphere

Resource sheet Geometry2a_R1



Resource sheet Geometry2a_R2



Resource sheet Geometry2a_R3

