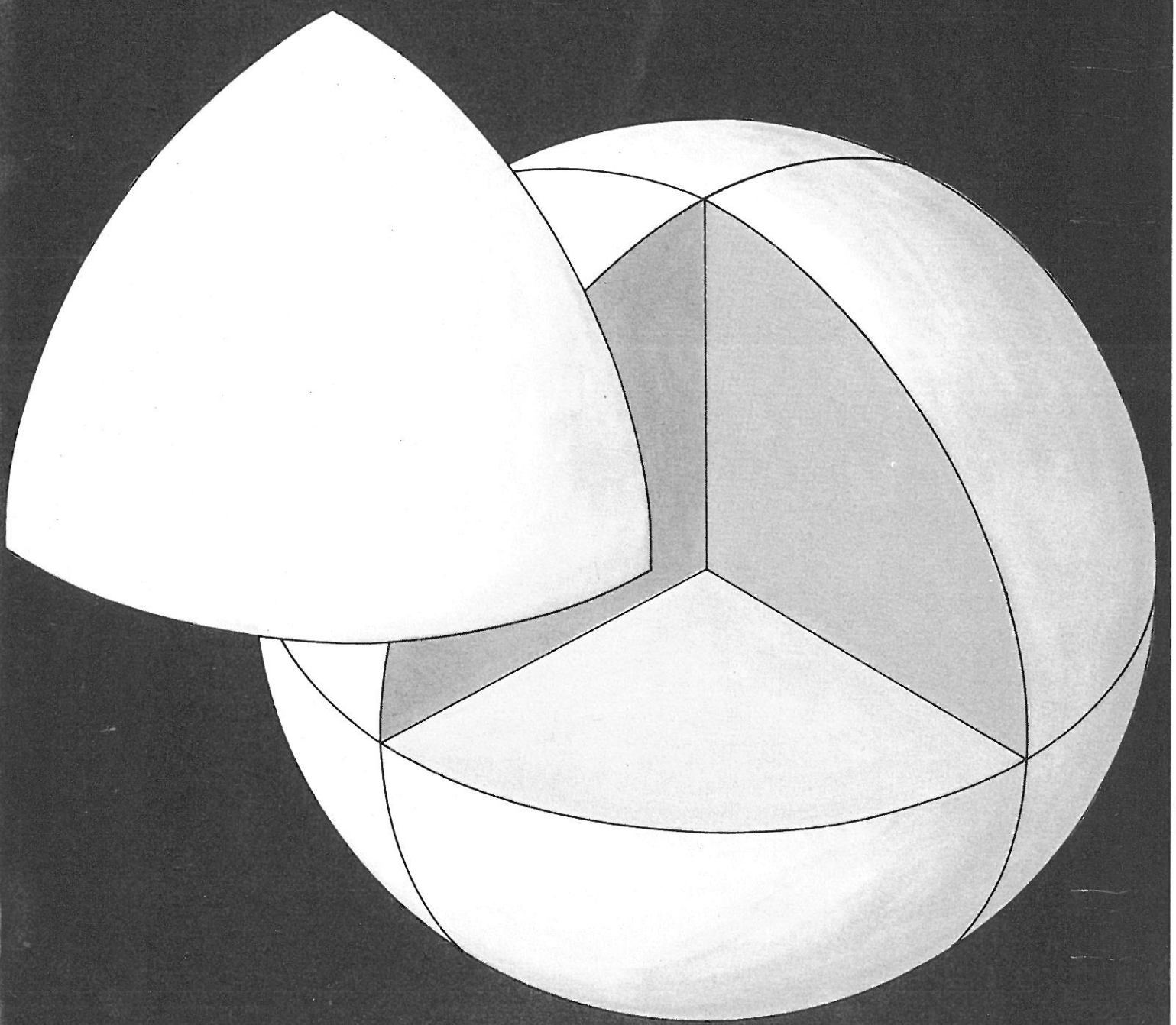
Triangles

Smile 1679B



How to use this booklet

This booklet is about triangles: triangles drawn on paper and triangles on the sphere.

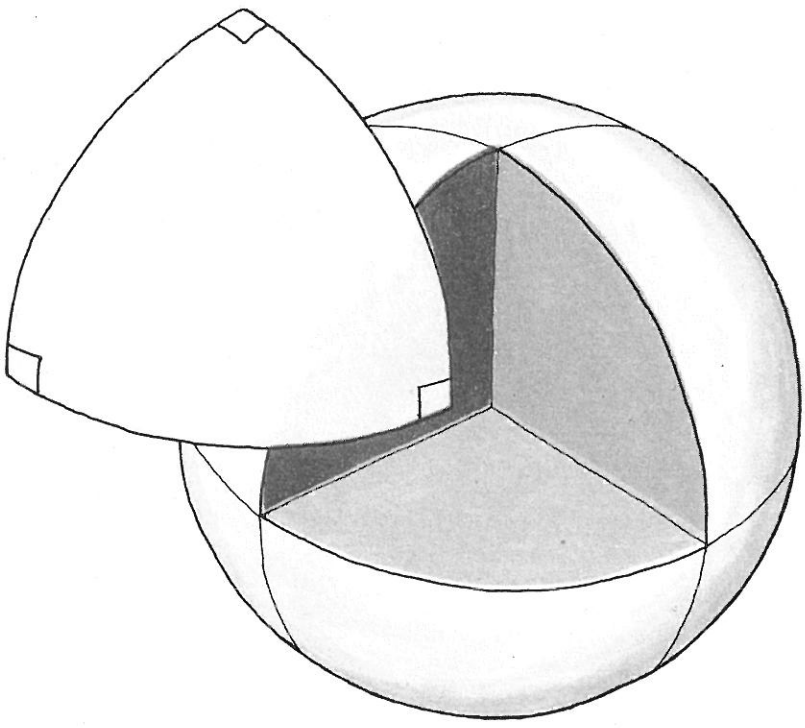
Pages 3 and 5 tell you how to measure your triangles.
Pages 6 and 7 suggest how you can investigate the differences between the two kinds of triangles.

There is a lot of work to do so, if you are working in a group, share it out.
But remember to talk over your results with everyone and to check any results that seem odd.

When you've finished, write up a group report.
Talk about what you've found out and then decide which member of the group is going to write each section of the report.

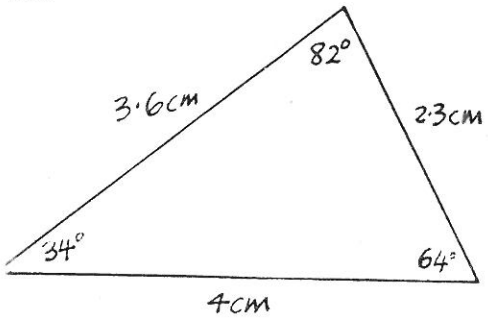
What is unexpected about the sum of the angles of this curved triangle?

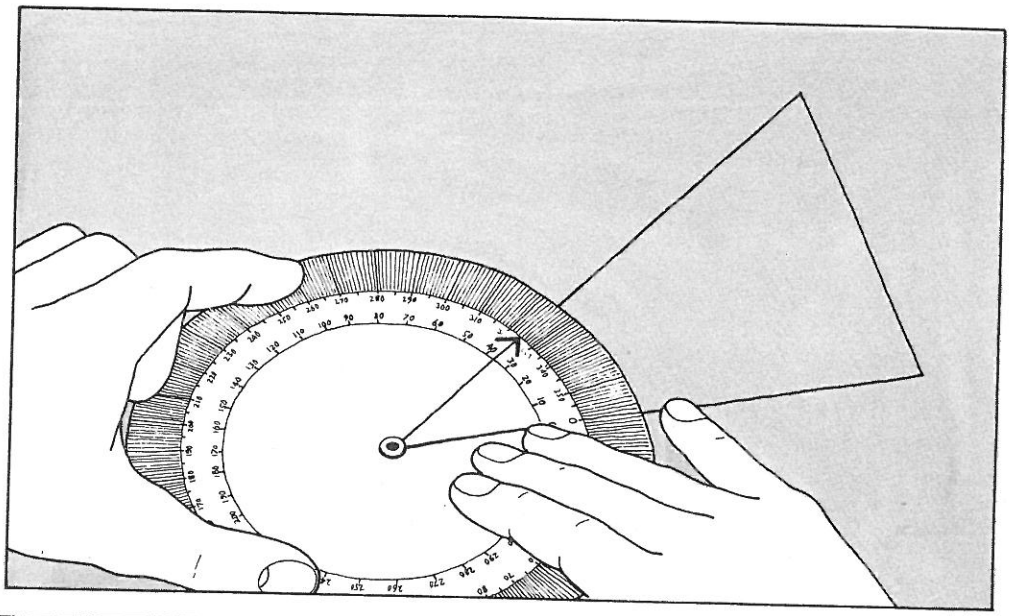
It is difficult to use an angle indicator to measure the angles (why?)
Instead look at the sphere to determine the size of each angle.



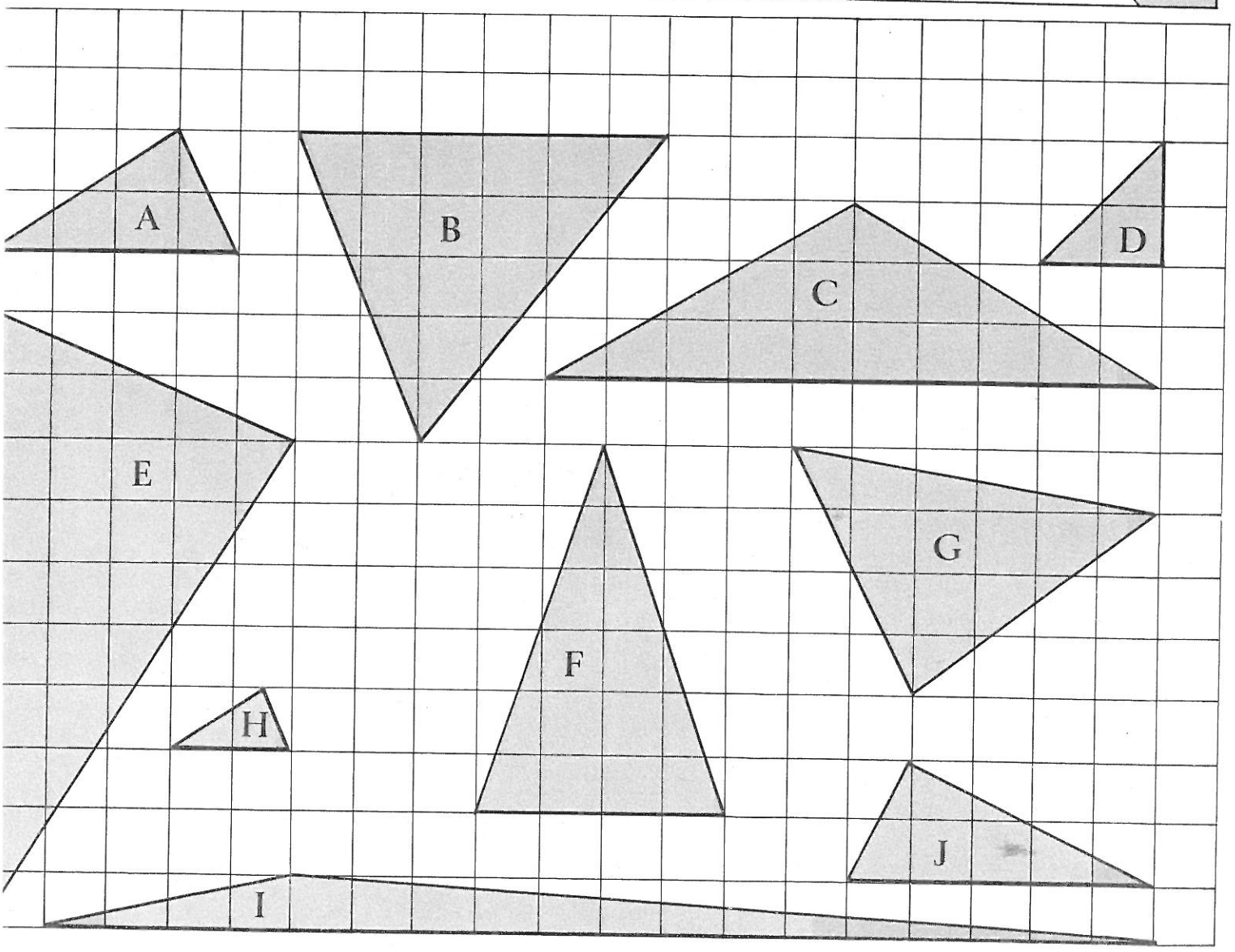
Measuring triangles on a flat surface

You are probably used to measuring triangles drawn on paper. Measure the triangles below and record your measurements on worksheet 1679D like this:

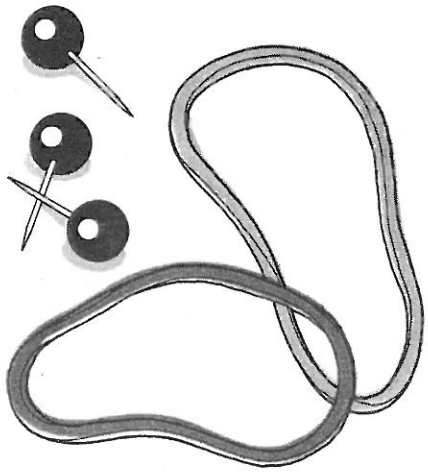




Then draw two triangles of your own and record their measurements.



Making triangles on a sphere



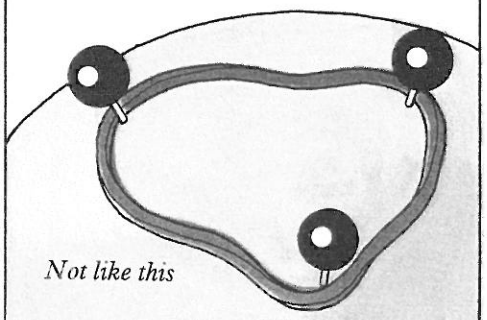
You need:

Rubber ball
3 map pins
Thin rubber bands.

Stick the 3 pins into the ball. Put a rubber band round them to make a triangle.

Check the three things below.

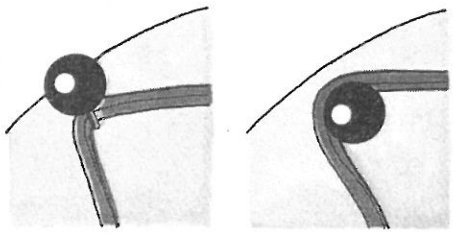
1 The band is not too loose.



Not like this

If it is, use a smaller rubber band or move the pins further apart.

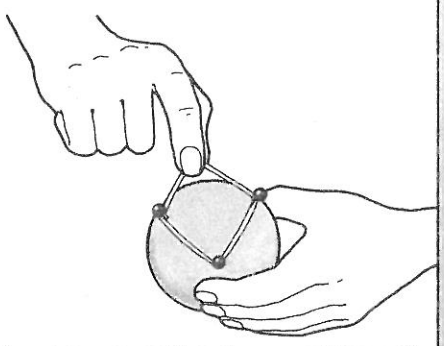
2 The band is round the shaft of the pin.



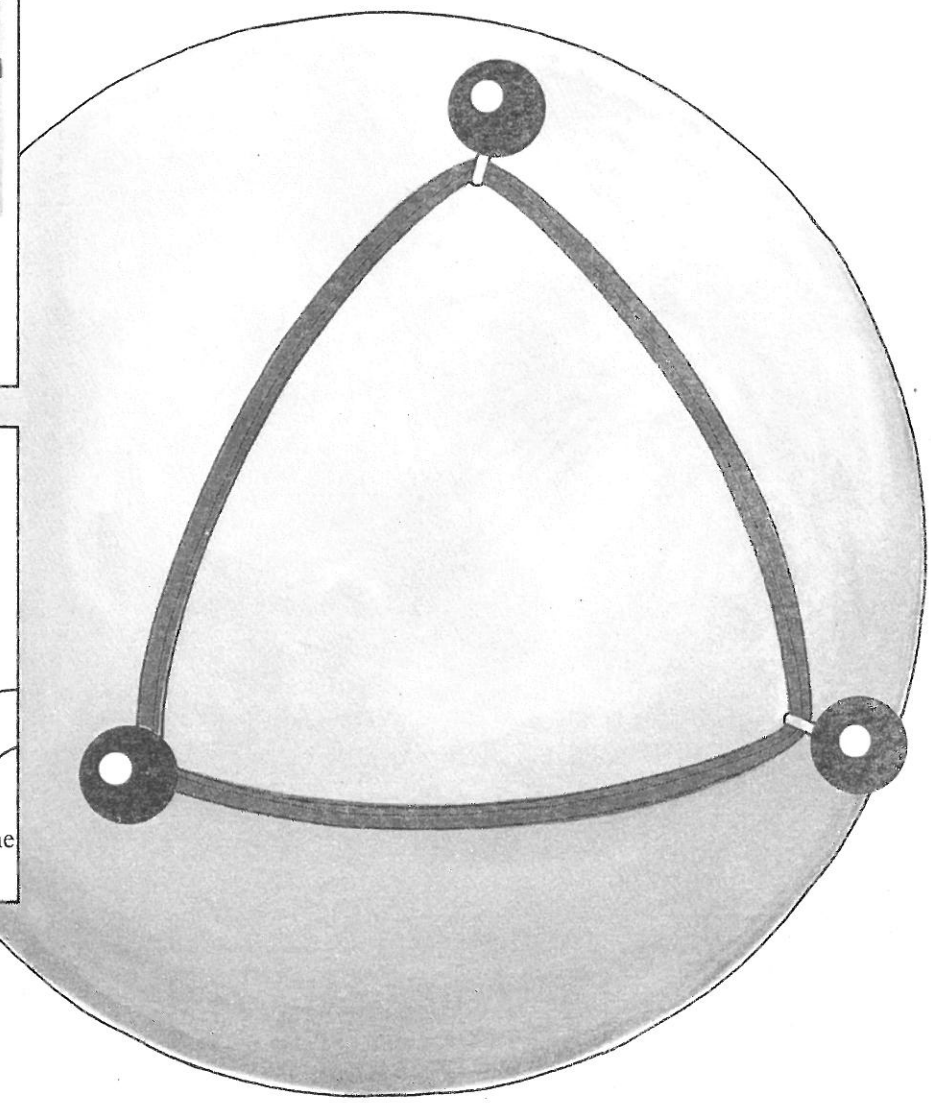
Like this *not like this*

If it is not, use a thinner rubber band or pull the pin out a little.

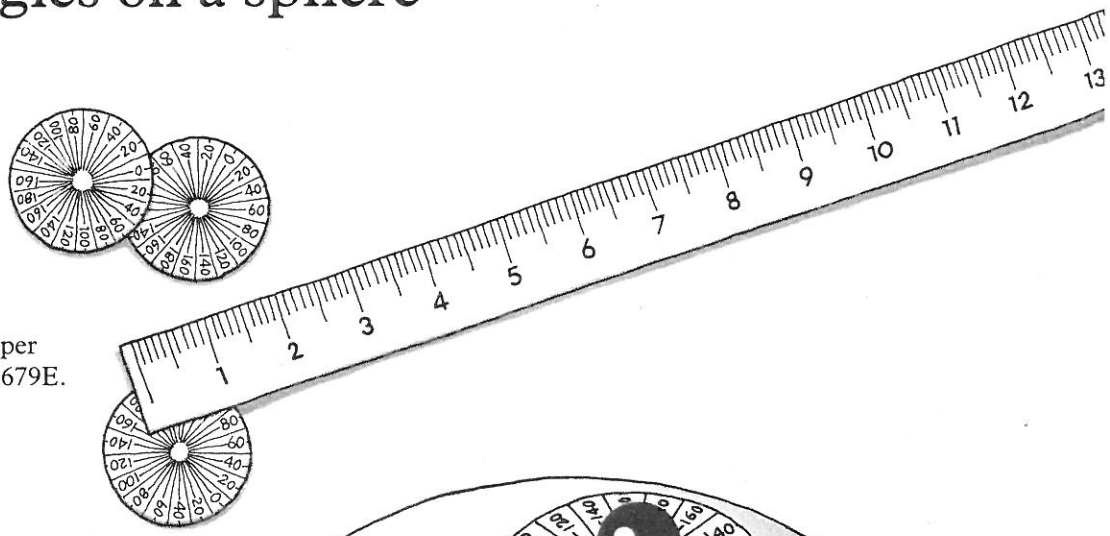
3 All the lines are straight.



If they are not, pull each one out from the ball and let it snap back.



Measuring triangles on a sphere



You need:

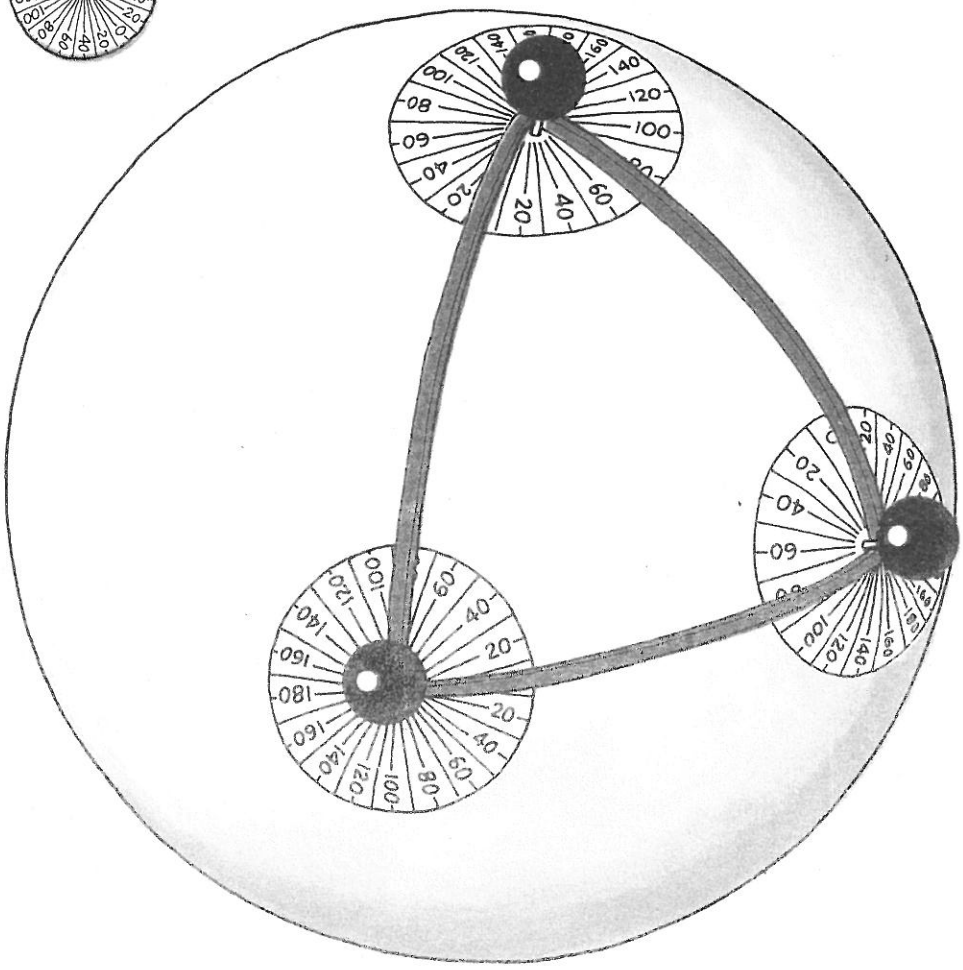
3 angle measurers and a paper ruler cut from worksheet 1679E.

Now you are going to measure triangles on the sphere.

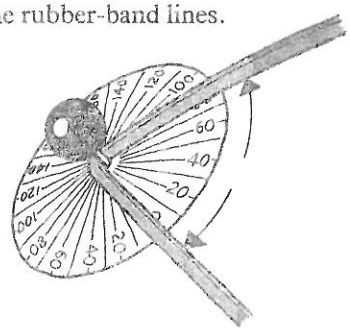
Put an angle measurer onto each pin.

Stick the pins in the ball and put on a rubber band.

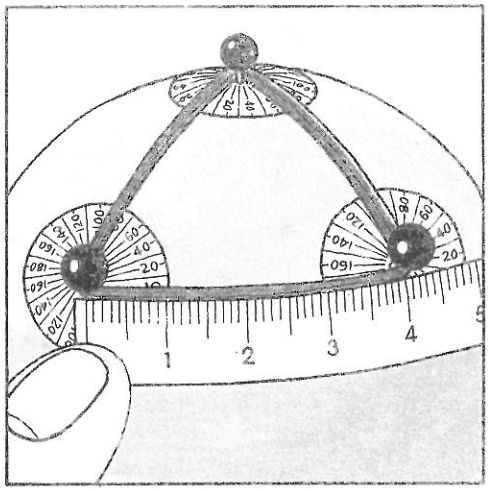
Check that the band is not loose, the band is tight round the pins and all the lines are straight.



Choose one of the pins. Turn the angle measurer until the 0° line is under one of the rubber-band lines.



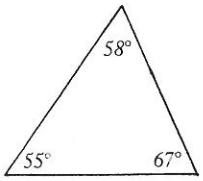
Now use the paper ruler to measure the sides.



Check that the sides are still straight.
Measure the angle.
Record it on worksheet 1679D.
Measure the other two angles in the same way.

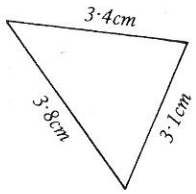
Nine statements about triangles

1 The sum of the angles of a triangle is always 180°.



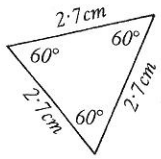
$58°+67°+55°=180°$

2 The sum of the lengths of the sides of a triangle is always less than 50cm.

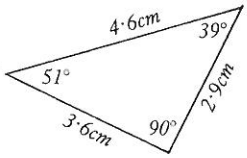


$3·4+3·1+3·8=10·3$

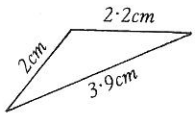
3 If three sides of a triangle are equal then all its angles are the same.



4 The largest angle in a triangle is opposite its longest side.



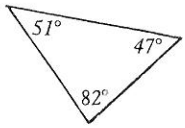
5 The sum of the two shorter sides of a triangle is always more than the length of the longest side.



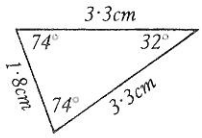
$2+2·2=4·2$

$4·2>3·9$

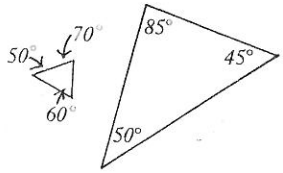
6 The sum of the two smallest angles of a triangle is always bigger than the largest angle.



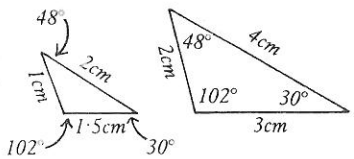
7 If two angles of a triangle are equal, so are two of its sides.



8 The sum of the angles of a triangle is bigger in bigger triangles.



9 The angles of a triangle don't change if you double the length of its sides.



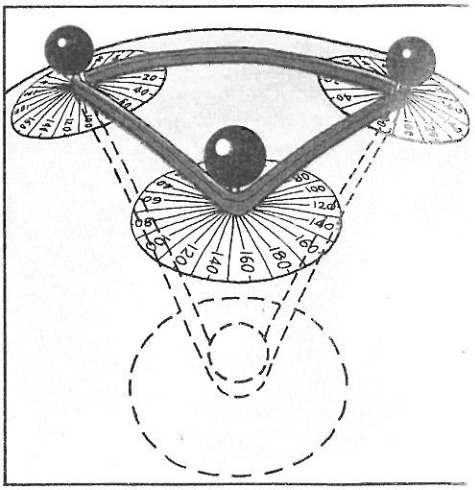
Checking statement 8

It isn't easy to measure area on the sphere. So, when you are checking statement 8 on the ball, start with a small triangle. Measure its angles. Then move just one pin so that you make a slightly larger triangle. Measure its angles. Then move another pin to make a slightly larger triangle still.

Your triangles will be getting bigger and bigger.

What is happening to the sum of their angles?

Compare your results for triangles on paper and for triangles on the ball. Write up a report. If you're working in a group, share out the work.



True or false?

On the opposite page are nine statements about triangles. Some are true for triangles on a flat surface; some are true for triangles on a sphere; some are true for both.

Use the measurements you recorded on worksheet 1679D to help you check each statement.

Copy and complete the table. Try to put a reason each time.

But be careful. Even if you check a statement on all your triangles and find that it's true, there could be others for which it is false.

Always try to think of triangles which don't work, and if you think there aren't any write down the reasons why.

What are the differences?

	Triangles on paper		Triangles on a sphere	
	True or false	Reasons	True or false	Reasons
1				
2				
3				
4				
5				
6				

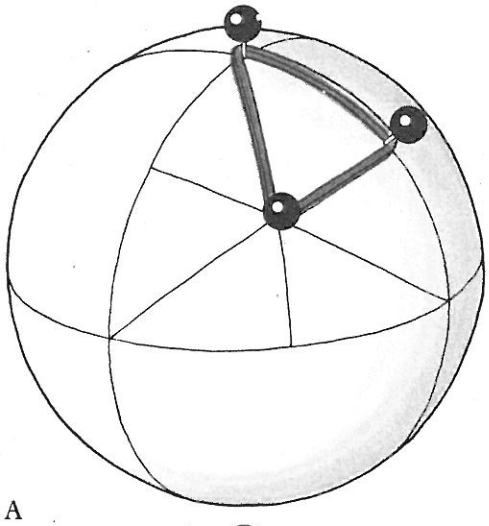
Areas and angles of curved triangles

You can leave the work on this page until you have done the other booklets if you wish.

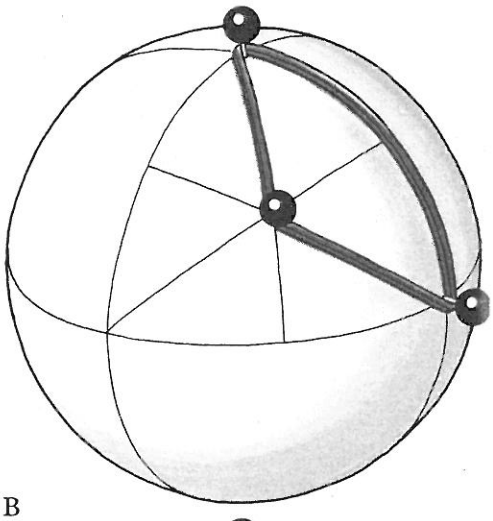
Here are pictures of 5 spherical triangles.

For each triangle work out:

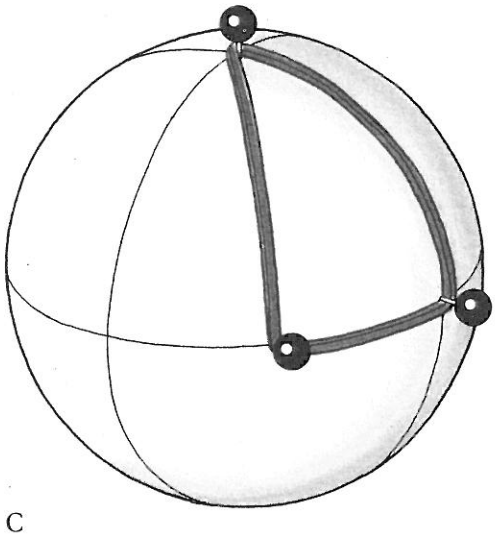
- the sum of the angles
- the difference between that and 180°
- the number of each triangle you would need to completely cover the sphere's surface



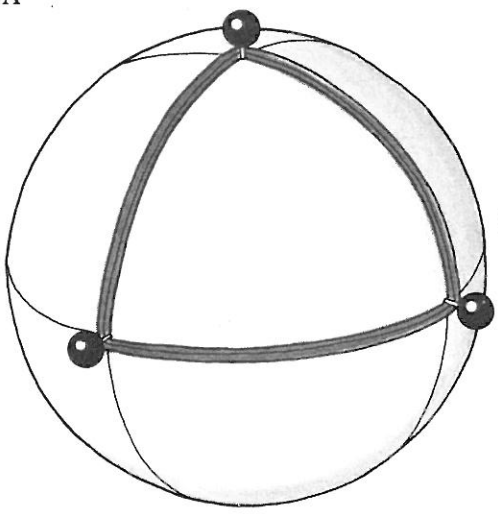
A



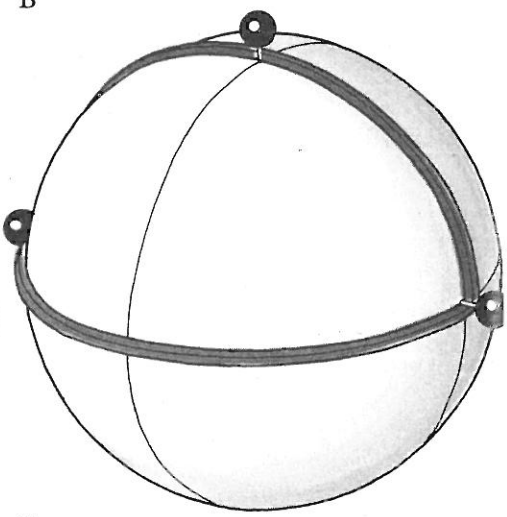
B



C



D



E

Copy and complete this table.	A	B	C	D	E
Sum of angles	195°				
Difference between sum of angles and 180°	15°				
Number of triangles needed to cover sphere's surface	48				

Is there a connection between the sum of the angles of a spherical triangle and its area?