

SMILE WORKCARDS

Angle Pack Two

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Radar

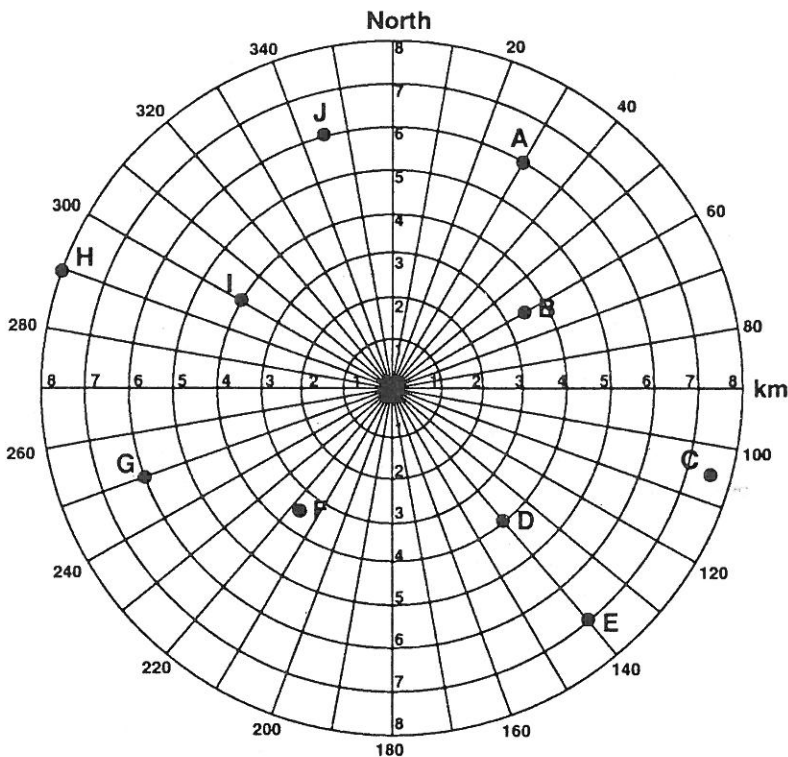
Radar uses high-powered radio pulses for locating objects from a central point.

A radar screen is made up of radii at 10° intervals and concentric circles.

Objects on a radar screen can be located by **polar co-ordinates**.

The first number of a polar co-ordinate represents the distance from the centre, the second number represents a 3 figure bearing.

1. The objects **A** to **J** are located on this radar screen.
Complete the table of polar co-ordinates for each object.



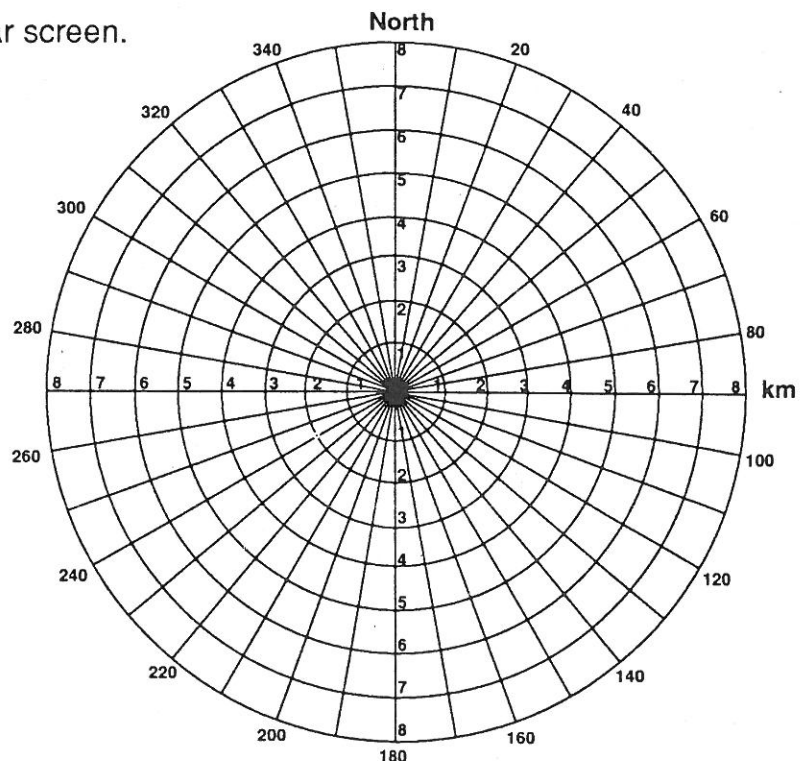
Object **A** is 6 kilometres away from the centre, on a bearing of 030° .

The **polar co-ordinates** of object **A** are (6, 030).

Object	Polar co-ordinates
A	(6, 030)
B	
C	
D	
E	
F	
G	
H	
I	
J	

2. Plot these nine objects on this radar screen.

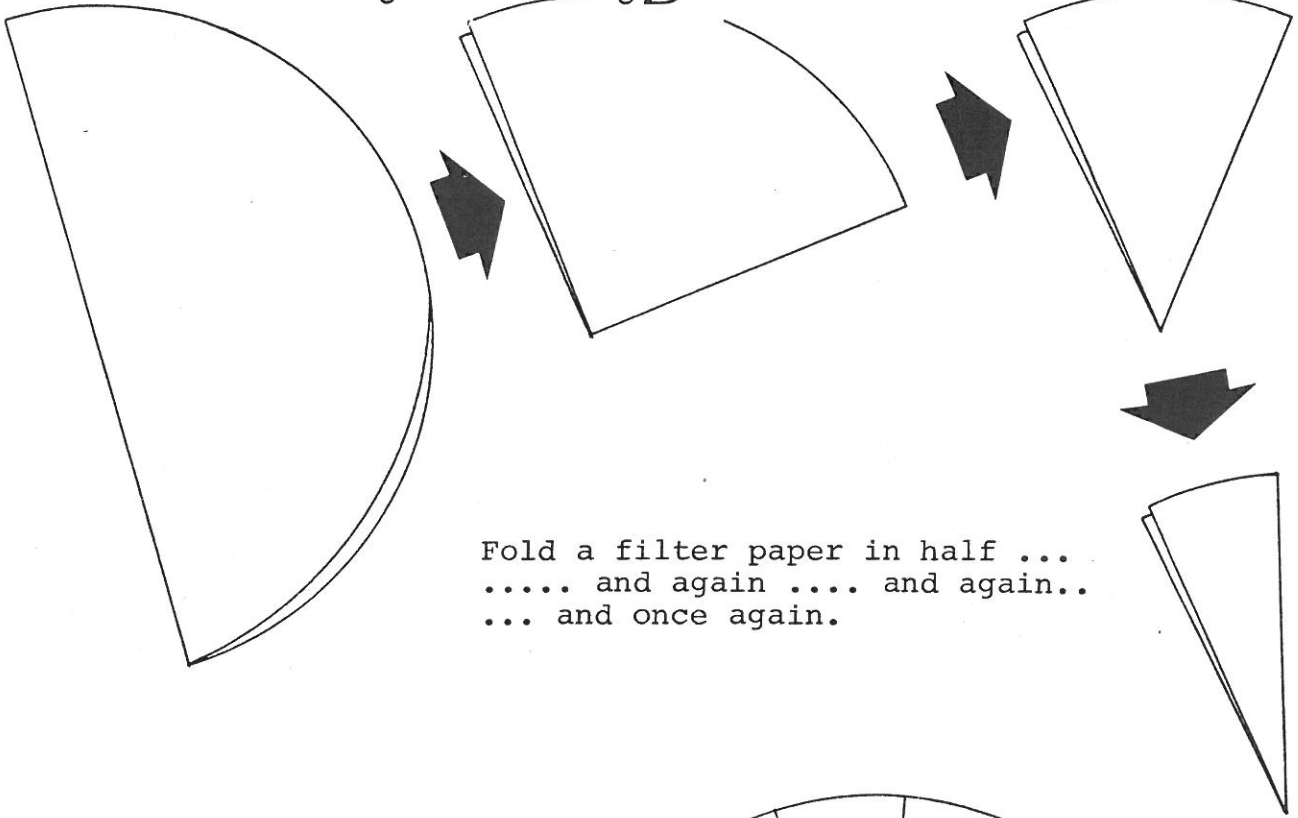
Object	Polar co-ordinates
a	(4, 025)
b	(6.5, 070)
c	(2, 105)
d	(8, 150)
e	(8, 215)
f	(5, 260)
g	(7.5, 260)
h	(1, 300)
i	(3, 345)



0788

Materials: paper circle, angle indicator.

Free Hand Angles

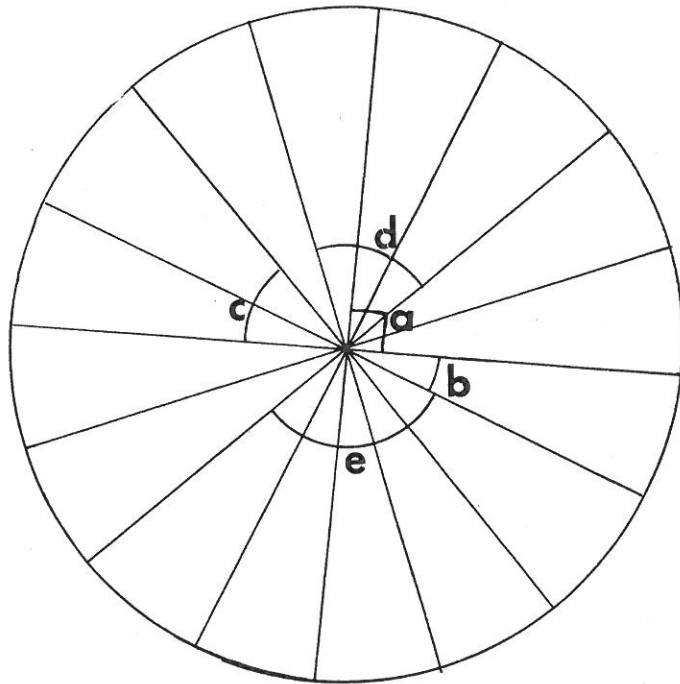


Fold a filter paper in half ...
..... and again and again..
... and once again.

Open out the paper, and draw the lines.

If you have folded carefully, angle **a** should be 90° (right-angle).

- (1) So angle **b** = \blacksquare°
 angle **c** = \blacksquare°
 angle **d** = \blacksquare°
 angle **e** = \blacksquare°



- (2) Angle **b** = $22\frac{1}{2}^\circ$ so an angle of 20° is slightly smaller.

Do a free-hand drawing (ruler, pencil only) for each of the following angles.

20° , 30° , 40° 350°

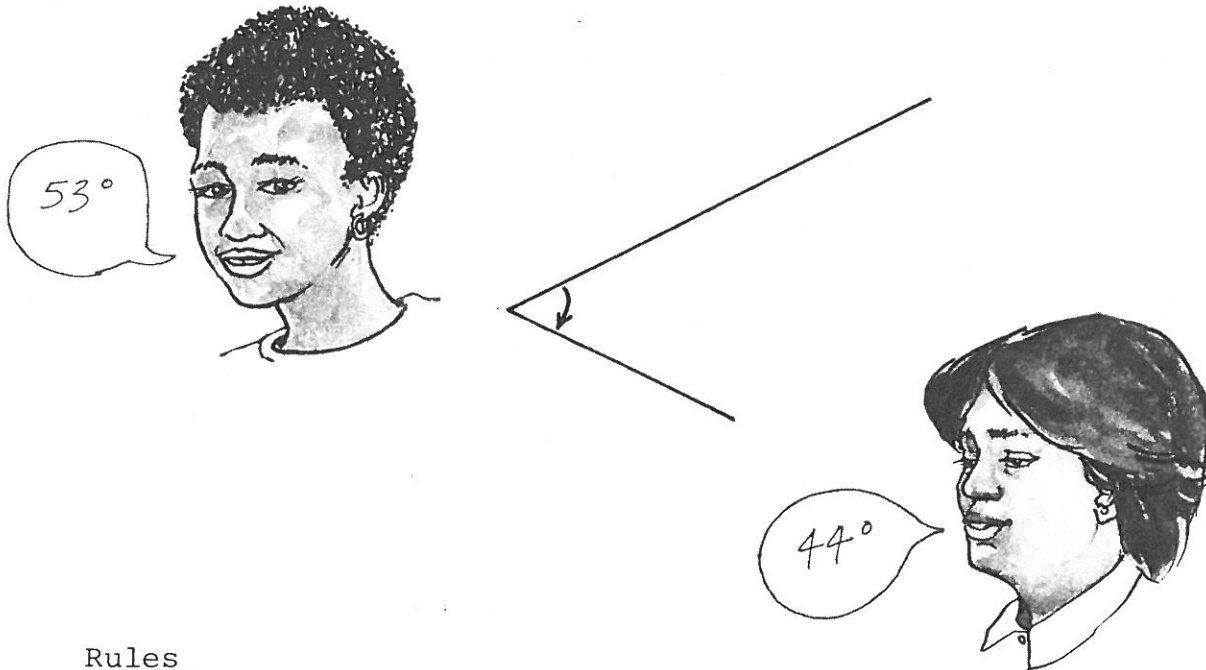
- (3) Check all your angles with an angle indicator.

You will need: angle indicator.

ANGLE

This is a competition for 2 or more.

ESTIMATION



Rules

- (1) One player draws an angle (take turns).
- (2) All players record an estimate (guess) for the size of the angle.
- (3) One player measures the angle (take turns).
- (4) The player with the best guess scores 1 point.
- (5) The winner is the first player to score 10 points.

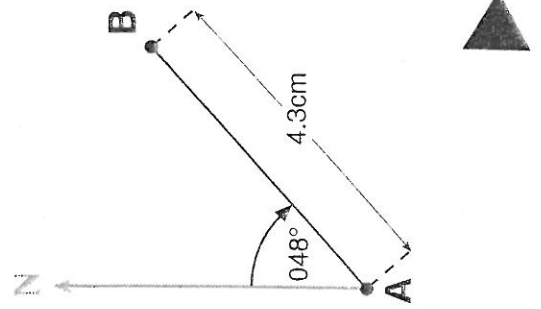
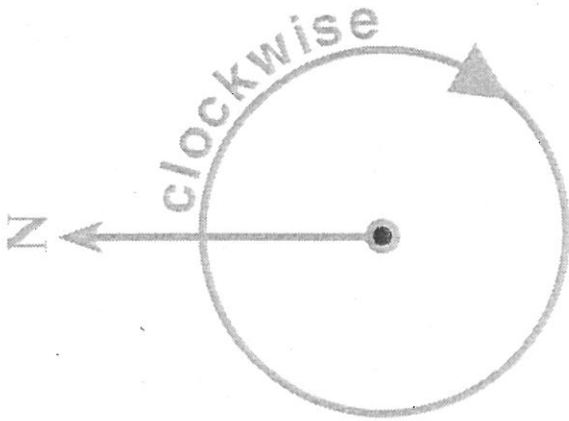
More Advanced Version

- (1) - (3) As above
- (4) Each player starts with 50 points.
Subtract 1 point for each degree you are out.
- (5) When a player reaches 0 he loses.

You will need: an angle indicator, a ruler.

Bearings

Bearings are measured in a **clockwise direction** from **North** and are written as **3-digit numbers**.



The bearing of **B** from **A** is **048°**.

A to **B** measures **4.3cm**.

The scale used is **1cm : 100m**
or **1cm** represents **100m**.

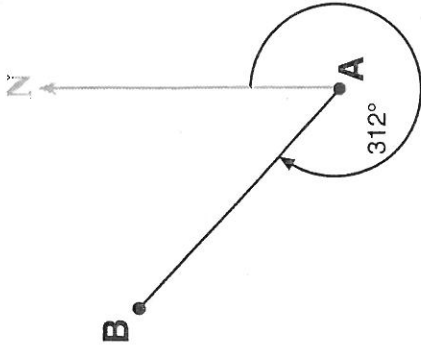
A to **B** represents the distance **430m**.

1) The bearing of **B** from **A** is **312°**.

A to **B** measures **3.9cm**.

The scale used is **1cm : 100m**.

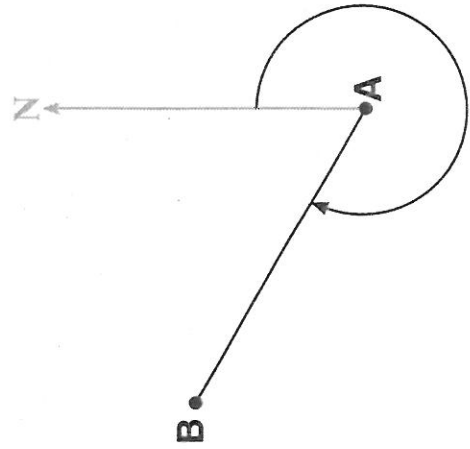
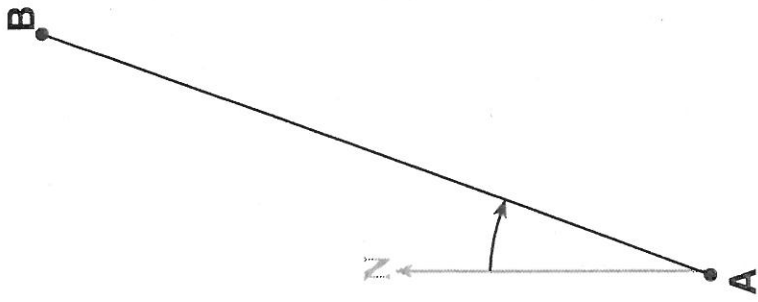
What distance in metres does this represent ?



2) In each of the following diagrams

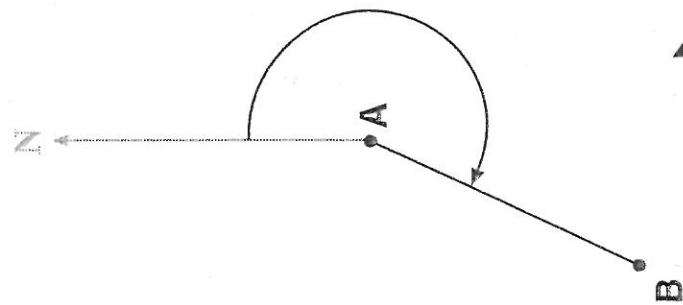
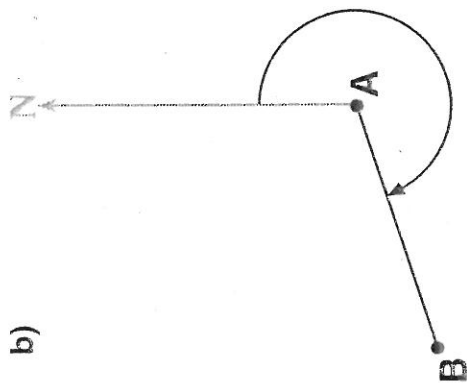
- measure the bearing as accurately as possible.
 - measure the distance **AB** and find the distance in metres it represents.
- The scale used is **1cm : 100m**.
- Record your results in a table.

	Bearing of B from A	A to B	
		Distance on diagram	Distance represented
1.	312°	3.9cm	



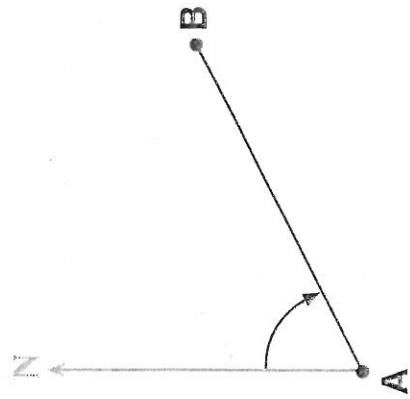
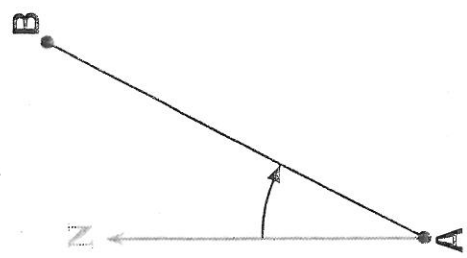
e)

f)



b)

d)



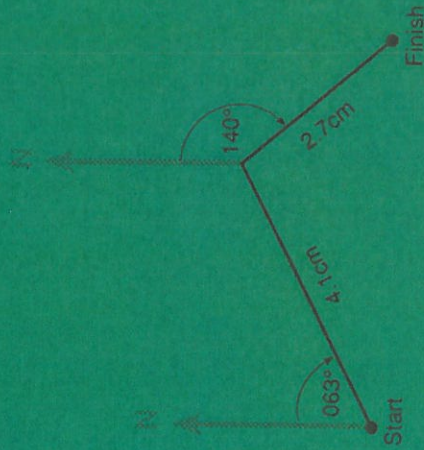
a)

c)

Bearings and Scale Drawing

You will need an angle indicator.

1. a) This drawing represents a **two-stage journey**. It is drawn on a scale of 1cm:100km.

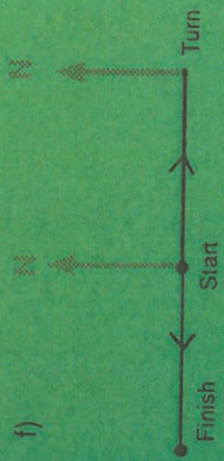
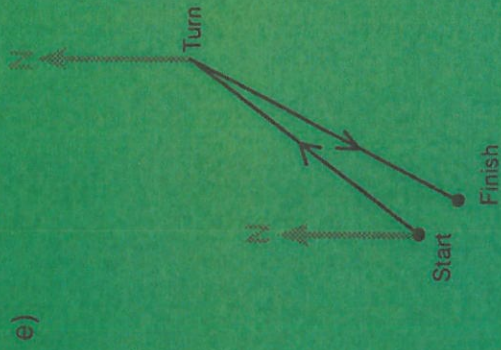
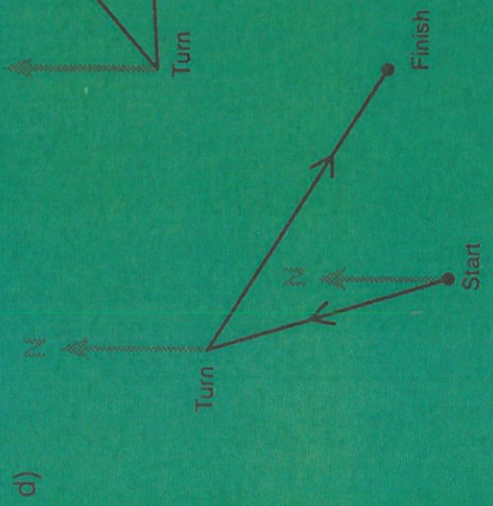
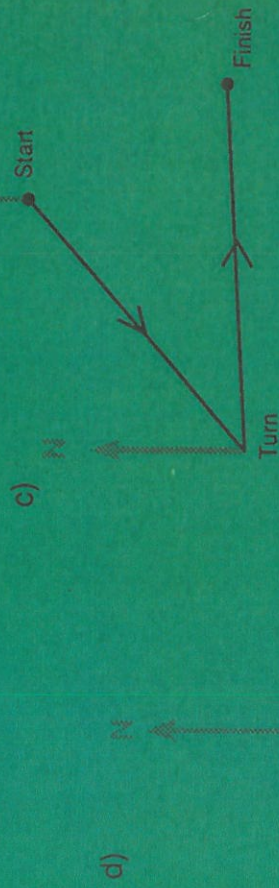
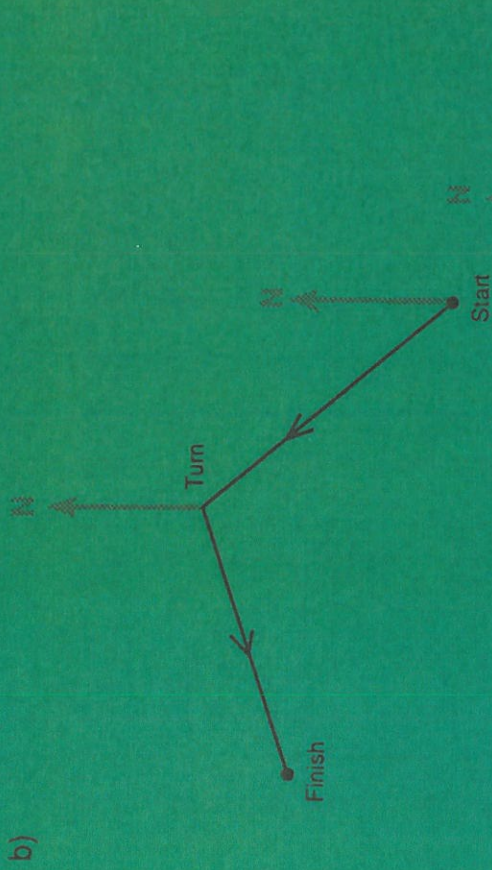


The first stage of the journey is:

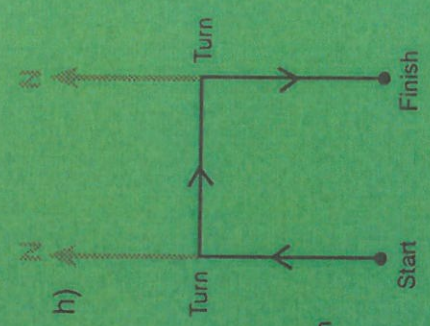
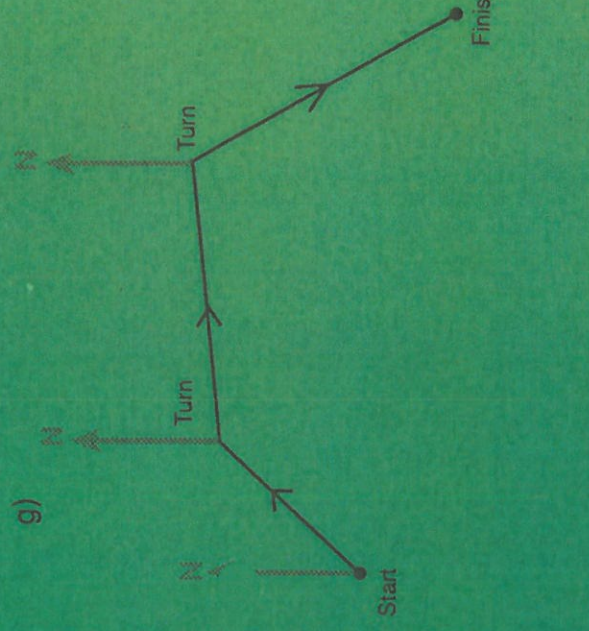
410km on a bearing of 063° .

- What is the **second** stage of this journey?

Describe each of these two-stage journeys.
The scale is 1cm:100km throughout.



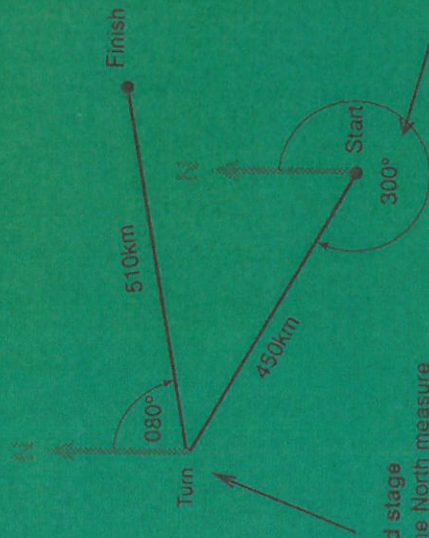
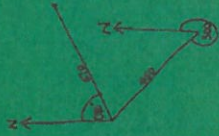
Describe these three-stage journeys.



Drawing two-stage journeys.

2. A two-stage journey is 450km on a bearing of 300° followed by 510km on a bearing of 080° .

A rough sketch is useful to help you decide where to start a scale drawing.



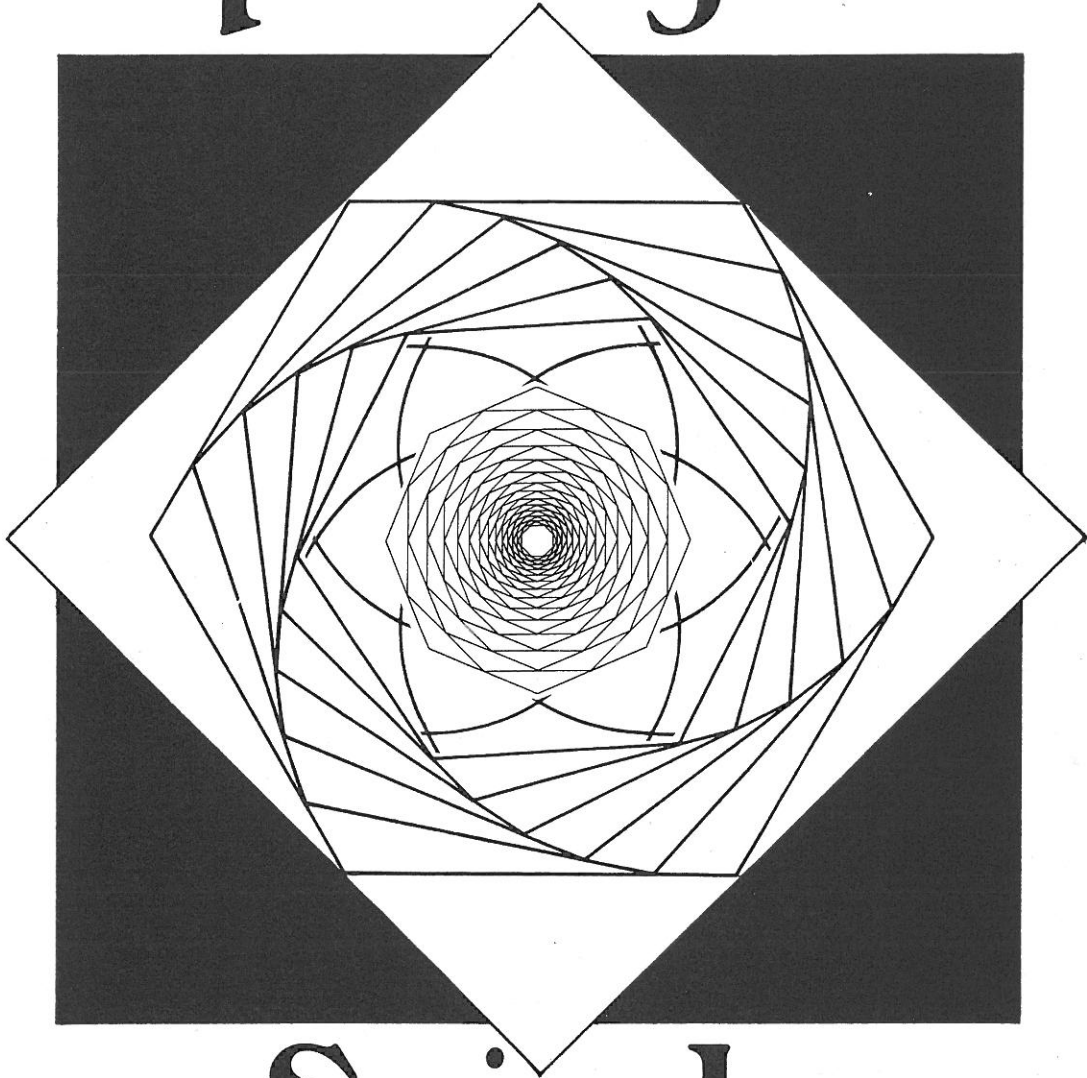
Second stage
From the North measure 080° in a clockwise direction.
Draw a line 5.1cm to represent the second stage of the journey.

First stage
From the North measure 300° in a clockwise direction.
Draw a line 4.5cm to represent the first stage of the journey.

Draw scale drawings of these two-stage journeys.

- 600km on a bearing of 75° , followed by 350km on a bearing of 210° .
- 500km on a bearing of 260° followed by 290km on a bearing of 030° .

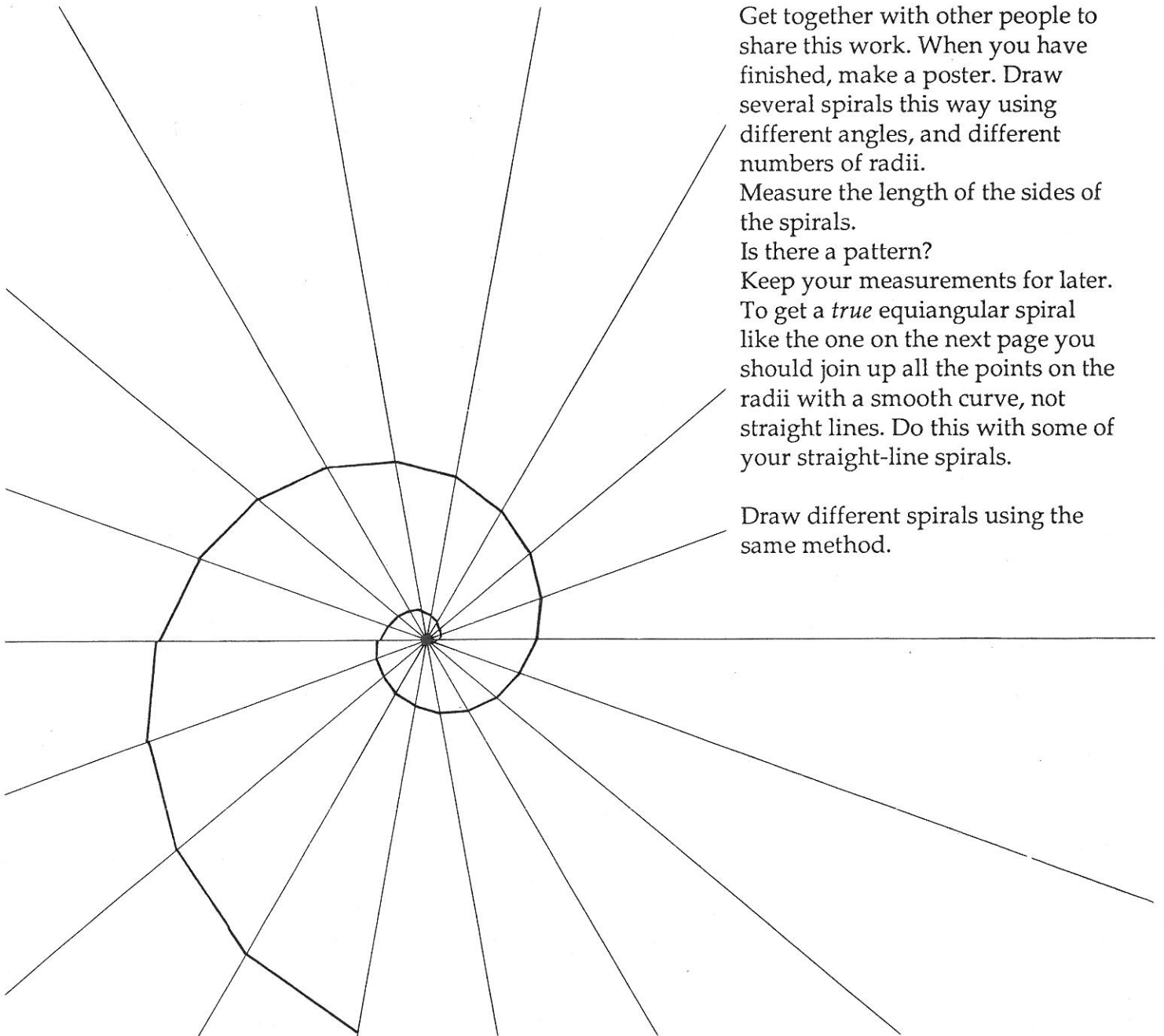
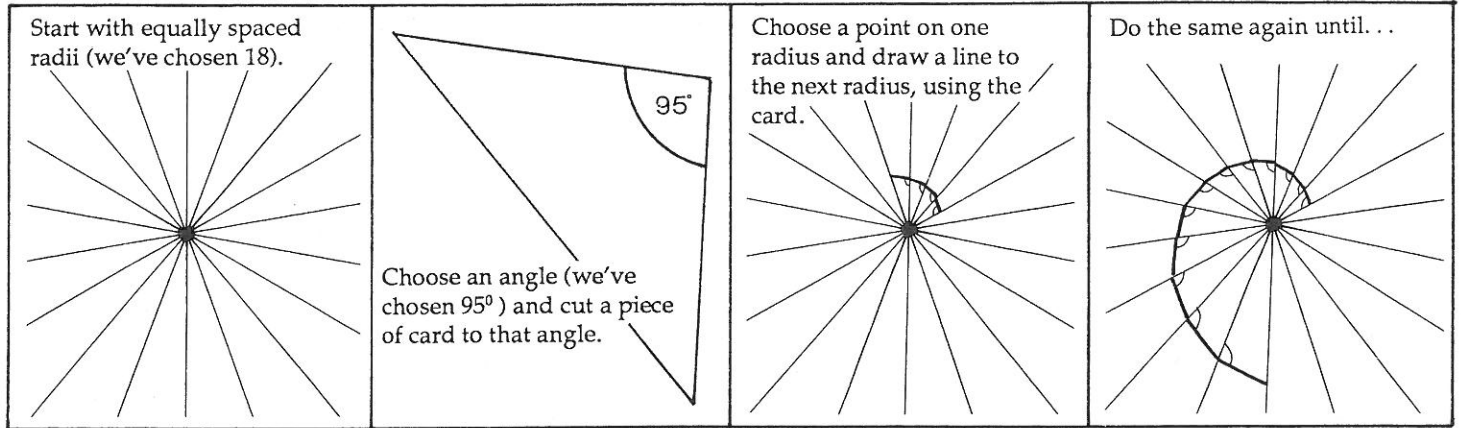
Equiangular



Spirals

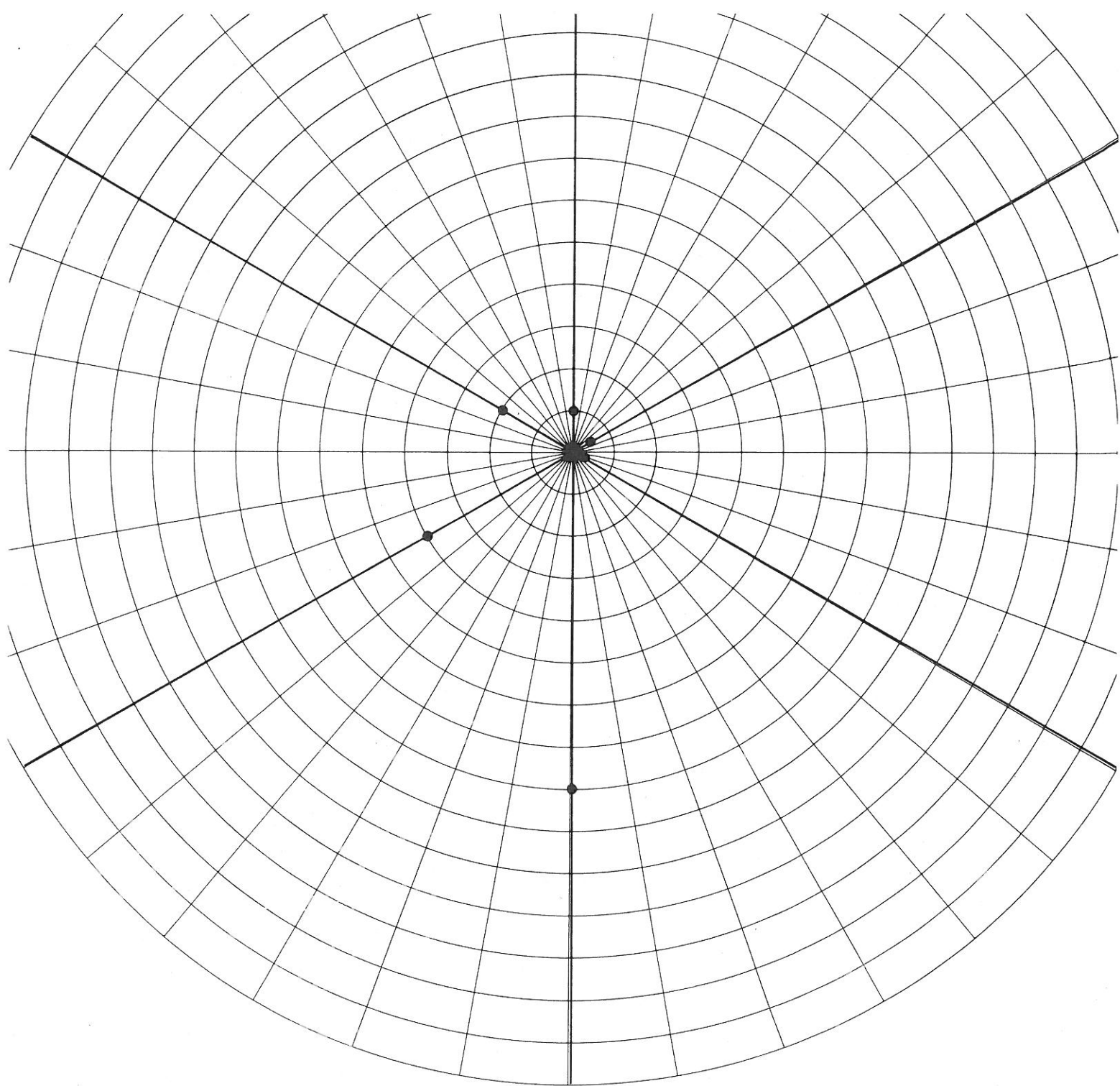
how to draw

Equiangular Spirals Angle method



Get together with other people to share this work. When you have finished, make a poster. Draw several spirals this way using different angles, and different numbers of radii. Measure the length of the sides of the spirals. Is there a pattern? Keep your measurements for later. To get a *true* equiangular spiral like the one on the next page you should join up all the points on the radii with a smooth curve, not straight lines. Do this with some of your straight-line spirals.

Draw different spirals using the same method.



Sequence method

This spiral was drawn using the sequence... $\frac{1}{4}, \frac{1}{2}, 1, 2, 4, 8, 16 \dots$

It has an angle of 125° . Can you see what this means?

The sequence above was made by multiplying.

Explain how.

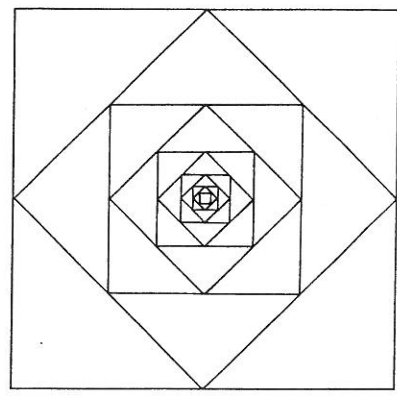
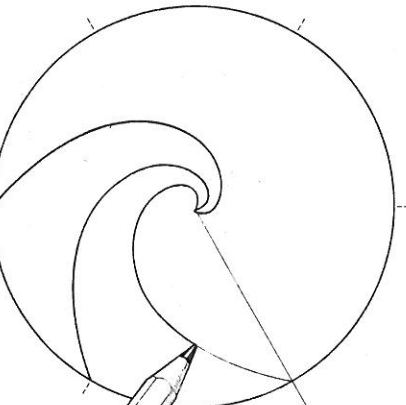
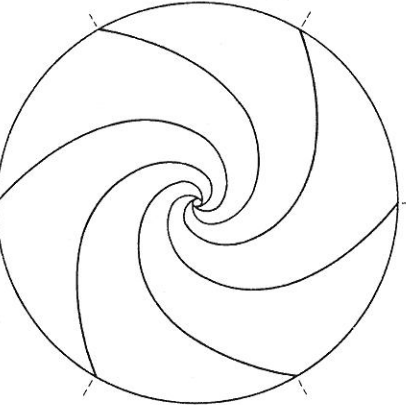
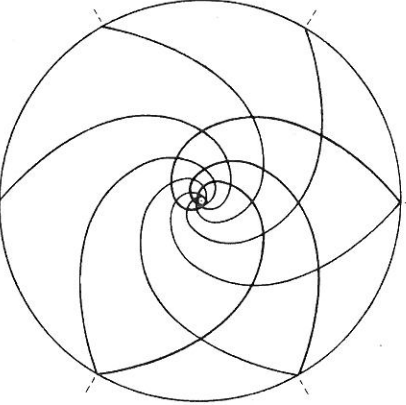
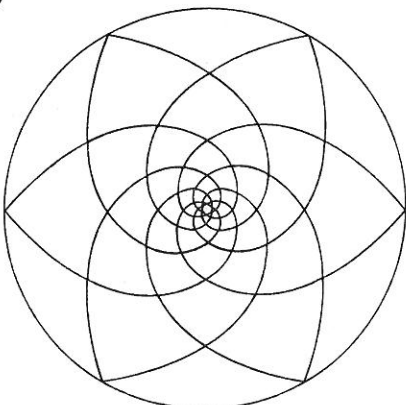
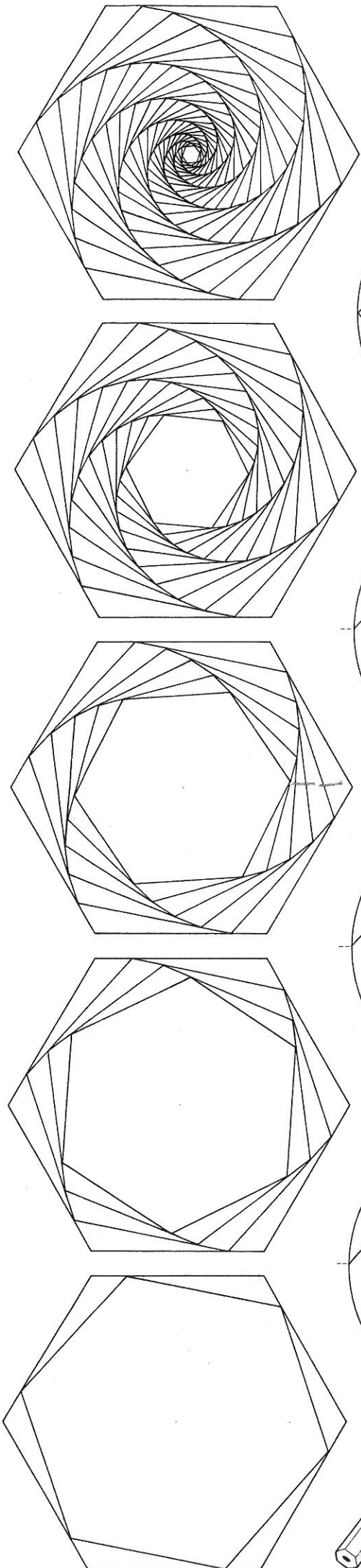
Get together with some other people to draw some equiangular spirals from other sequences like this.

Try... $\frac{1}{3}, 1, 3, 9 \dots$ (multiplying by 3)

... $0.90, 1, 1.1, 1.21, 1.33, 1.46 \dots$ (multiplying by 1.1).

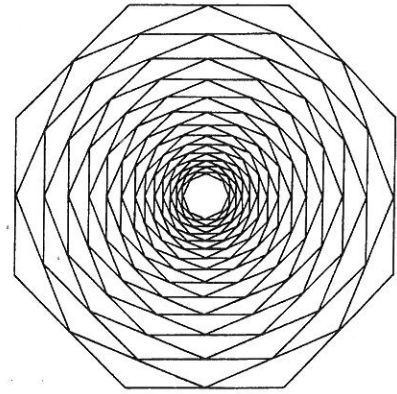
If you have a calculator, use it.

Using polar graph paper will help.



Patterns from Spirals

Draw some patterns of your own.
 Start with squares, triangles, pentagons, octagons or any other shape.
 Colour them and make a poster.
 Share the work among several people.
 Make your own patterns like these.



Measuring up

Measure up some of your spirals.

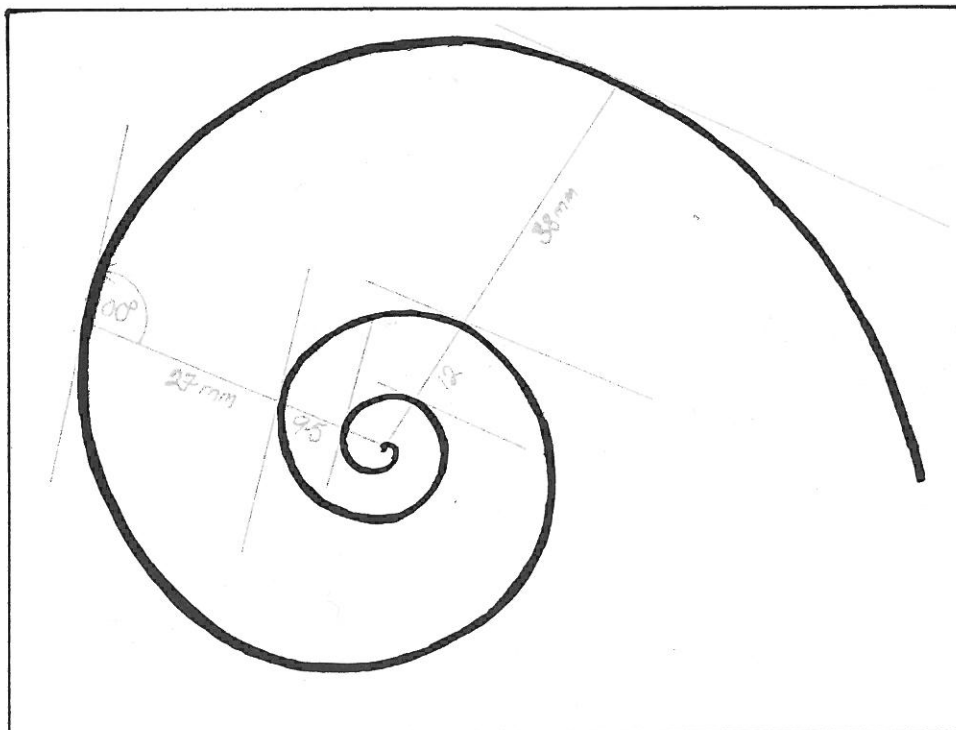
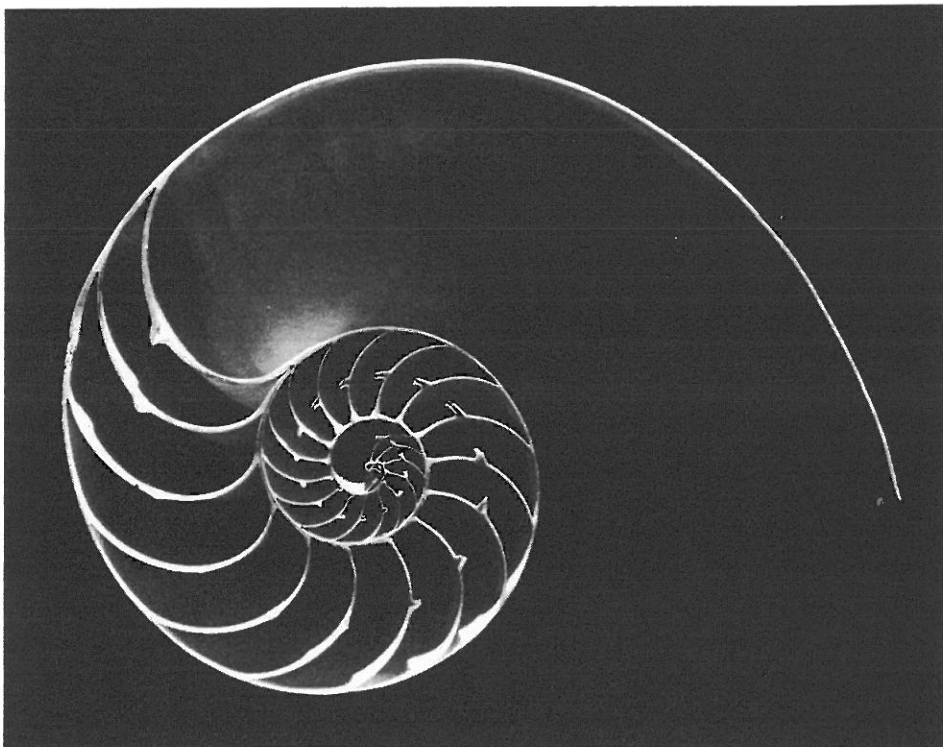
- measure the radii
- measure how far apart the turns of the spiral are
- draw tangents (straight lines that just touch the spiral) and measure angles
- measure the length of each turn (use string to help)

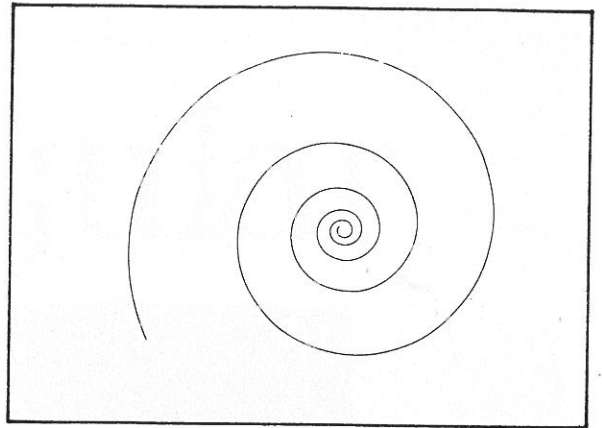
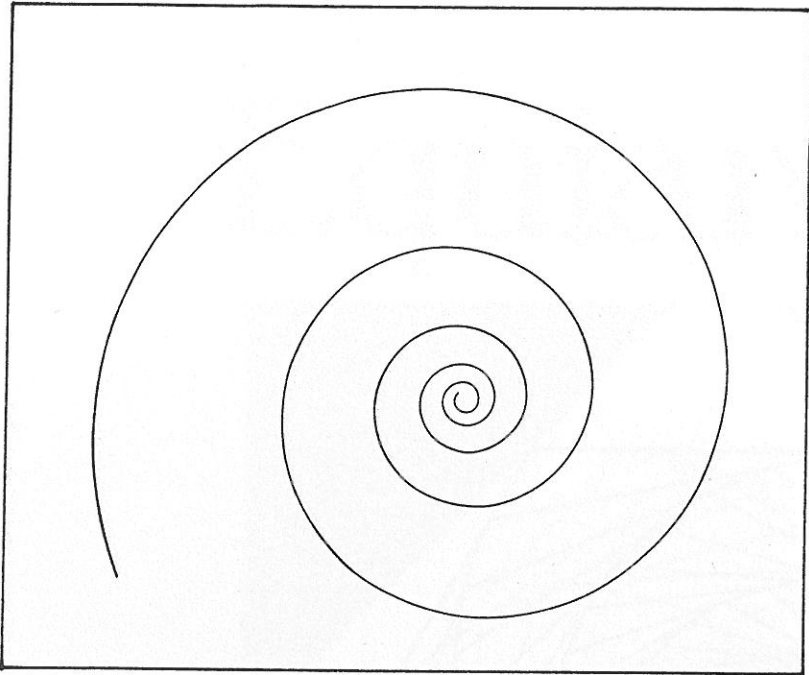
What things are special about equiangular spirals?

Take one spiral you drew using the sequence method. Check it has equal angles.

Take one spiral you drew using the angle method. Check the radii increase in a multiplication sequence. (It may help to use a calculator).

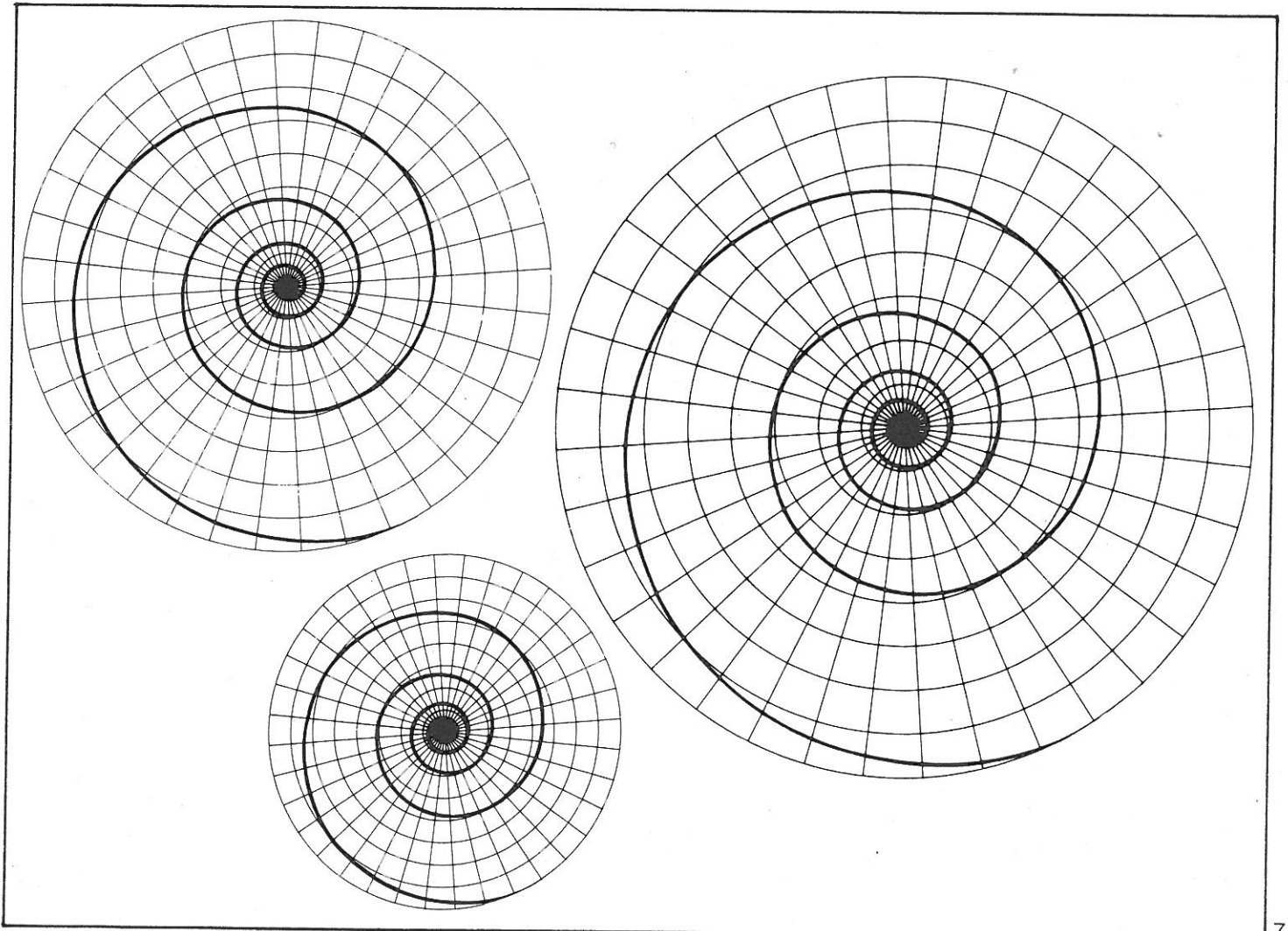
Some natural things are spirals. Is the inside of this shell an equiangular spiral?

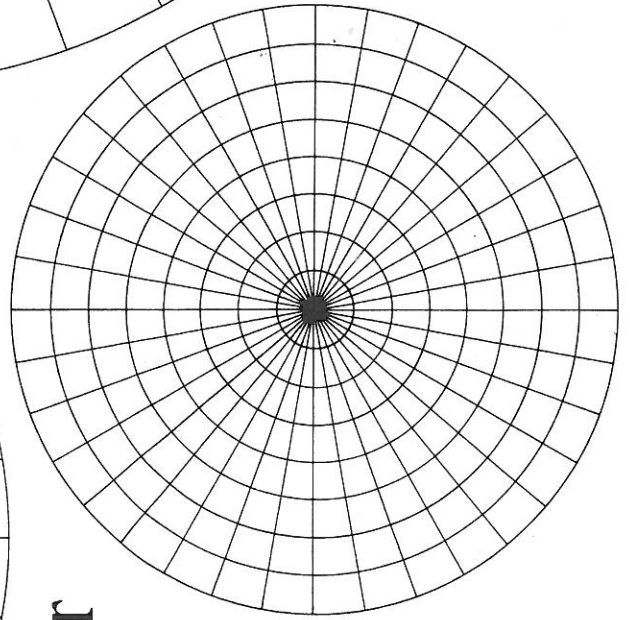
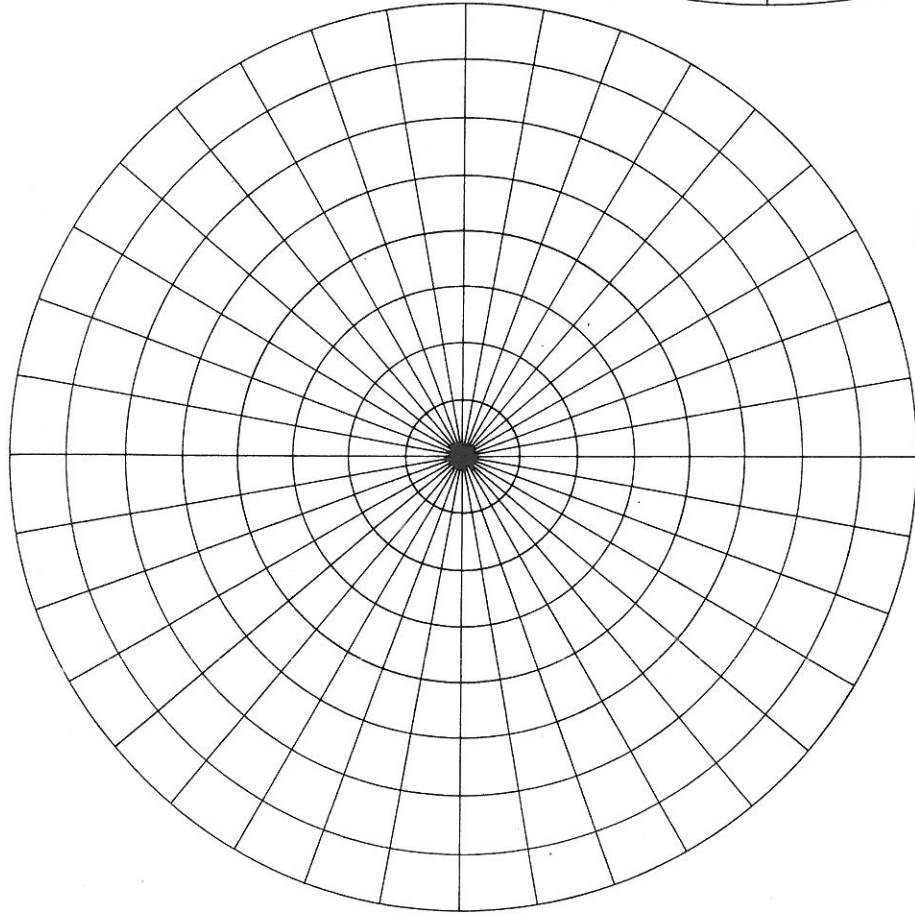
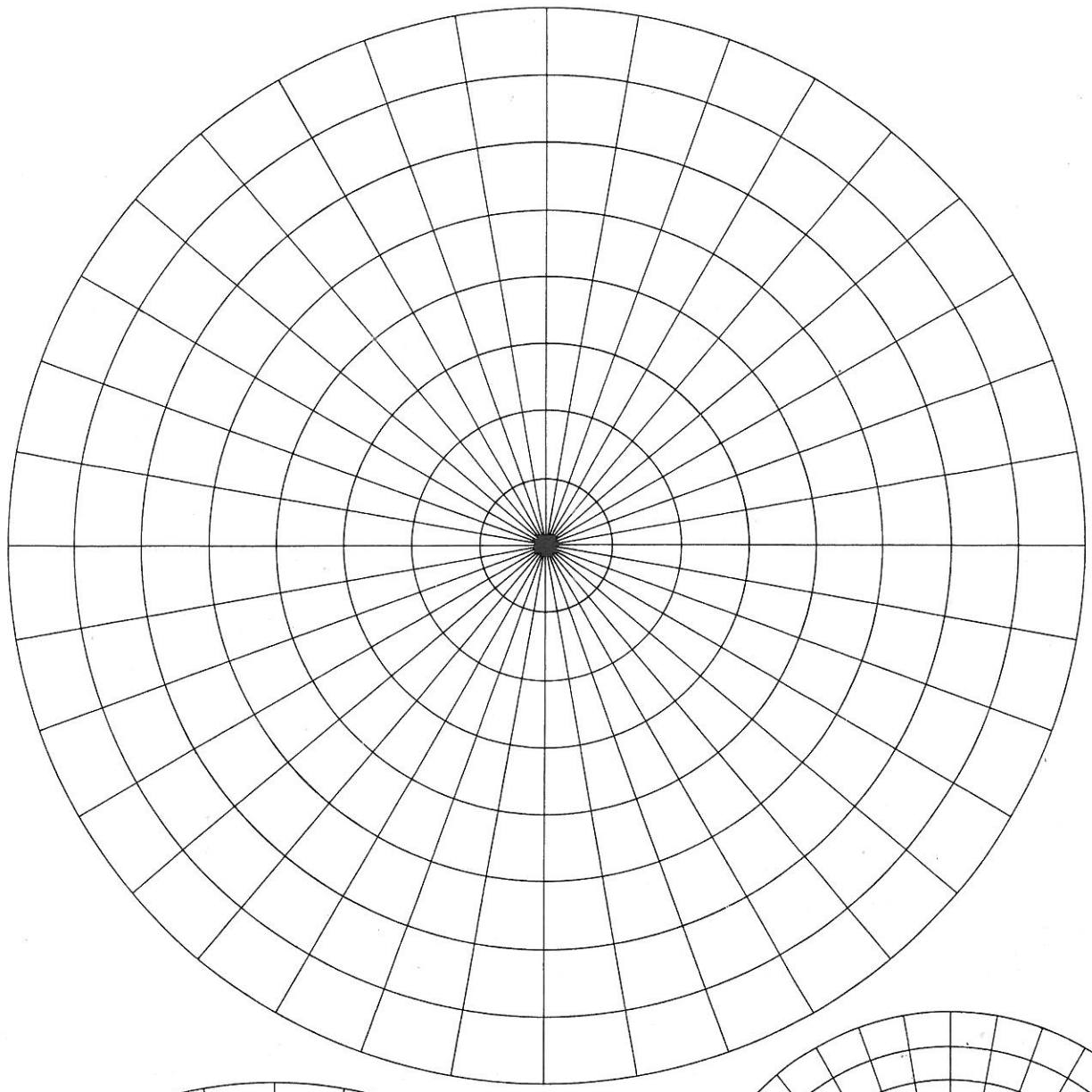




Here are copies of the same equiangular spiral.
Trace the small one and try to fit it on the two larger ones.
Does it fit?
Does this happen with all equiangular spirals?
What about other spirals?

Use copies of *Equiangular Spirals* (Smile Worksheet 1999A) to draw the same spirals to different scales.



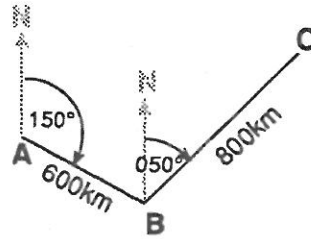


**Equiangular
Spirals**

Journeys

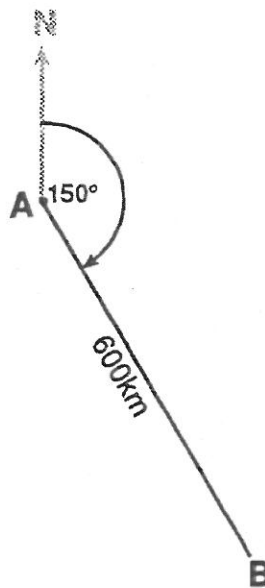
The journey from **A** to **B** is 600km on a bearing of 150° .
The journey from **B** to **C** is 800km on a bearing of 050° .

This is a rough sketch of the journey from **A** to **B** to **C**.



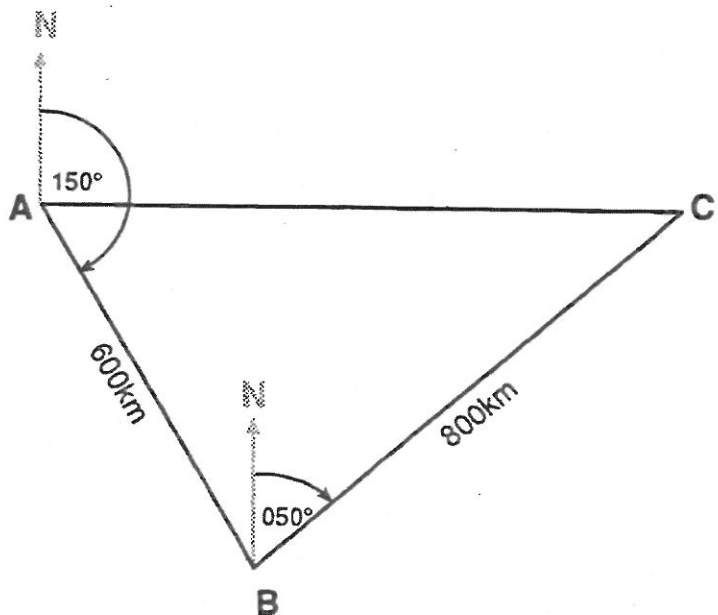
This is a **scale drawing** of the journey from **A** to **B**.

Scale 1cm = 100km



This is a scale drawing of the journey from **A** to **B** to **C**. The direct journey from **A** to **C** has been added.

Scale 1cm = 100km



1. Use an angle indicator and ruler to measure the bearing and distance of the direct journey from **A** to **C**.

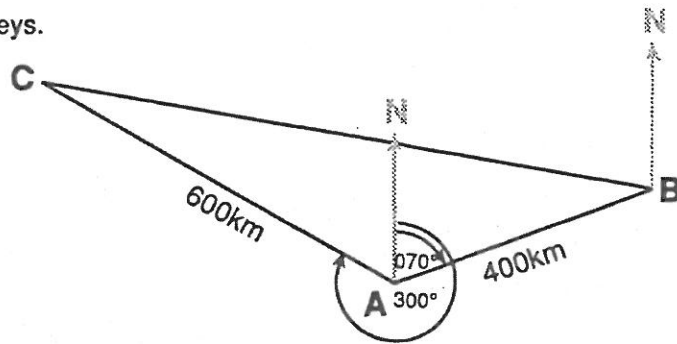
Remember bearings are always measured from North and are given by 3 figures.



The journey of **A** to **B** is 400km on a bearing of 070°.
 The journey of **A** to **C** is 600km on a bearing of 300°.

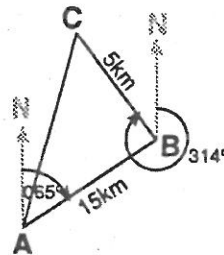
This scale drawing represents both journeys.

Scale 1cm = 100km



2. What is the distance and bearing of the journey from **B** to **C**?

3. This shows a rough sketch of a journey, from **A** to **B** followed by **B** to **C**.



- a) Draw the journey accurately using a scale of 1cm = 2km.
- b) Measure the distance and bearing from **A** to **C**.

Draw accurate scale drawings to complete the missing details for each of these journeys.
 Always remember to state your scale. You may find it helpful to draw a rough sketch of each journey before making an accurate drawing.

	A to B		B to C		A to C	
	Distance	Bearing	Distance	Bearing	Distance	Bearing
4.	700km	175°			1200km	082°
5.	500km	090°	375km	250°		
6.	185km	110°	260km	270°		235°
7.	1000km	220°	1640km	020°	780km	

8. Draw an accurate scale drawing for this 3-stage journey.

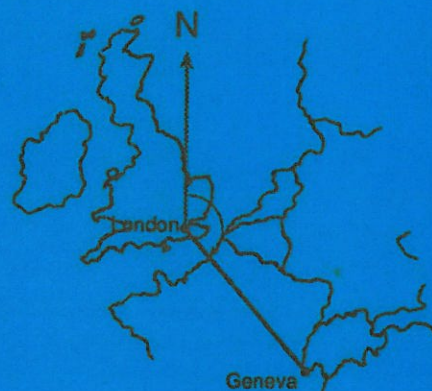
	A to B		B to C		C to D	
	Distance	Bearing	Distance	Bearing	Distance	Bearing
	60km	050°	40km	320°	45km	260°

What is the bearing and distance of the journey from **A** to **D**?

Back Bearings

The bearing of Geneva from London is 140° .

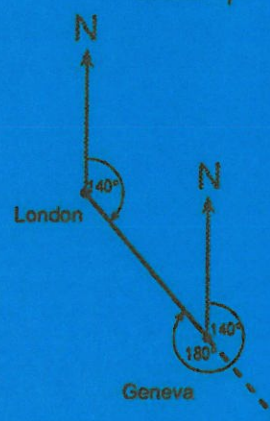
- What is the bearing of London from Geneva?



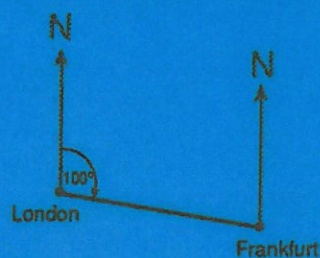
The North lines are parallel so corresponding angles are equal.

The bearing of London from Geneva is

$$140^\circ + 180^\circ = 320^\circ$$



- The bearing of Frankfurt from London is 100° .
 - What is the bearing of London from Frankfurt?



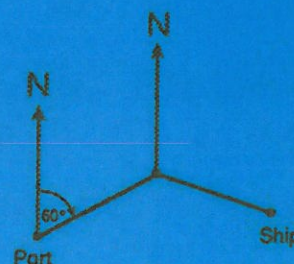
- The bearing of Sunderland from Glasgow is 120° .
 - What is the bearing of Glasgow from Sunderland?

- A ship sails from a port on a bearing of 060° for 40km. It then alters course to a bearing of 110° for 50km.

Using the scale 1cm = 10km draw the course of the ship.

- From your scale drawing find the bearing and distance of the ship from the port.

This shows a rough sketch of the ship's journey.



- Two planes leave an airport at the same time.

Plane A flies on a bearing of 330° at 800 km/h.

Plane B flies due east at 1200 km/h.

- Draw a scale diagram to show the position of the two planes and their distance apart after:

a) $\frac{1}{4}$ hour

b) $\frac{1}{2}$ hour

c) $\frac{3}{4}$ hour

d) 1 hour