Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7141363470

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/63**

Paper 6 (Extended) **May/June 2017**

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Graphics Calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.
You may use an HB pencil for any diagrams or graphs.
DO **NOT** WRITE IN ANY BARCODES.

Answer both parts **A** and **B**.
You must show all the relevant working to gain full marks for correct methods, including sketches.
In this paper you will also be assessed on your ability to provide full reasons and communicate your mathematics clearly and precisely.
At the end of the examination, fasten all your work securely together.
The total number of marks for this paper is 40.

This document consists of **16** printed pages.

DC (NH/AR) 134782/2

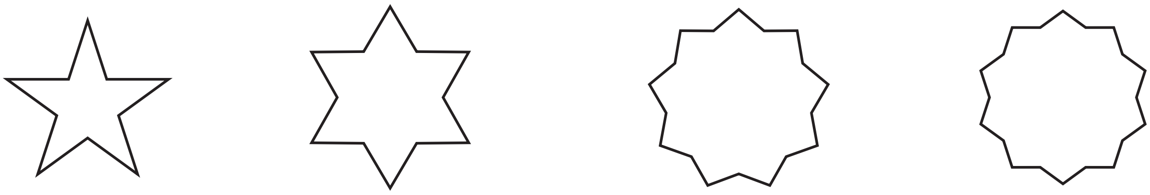
CAMBRIDGE International Examinations

Answer **both** parts **A** and **B**.

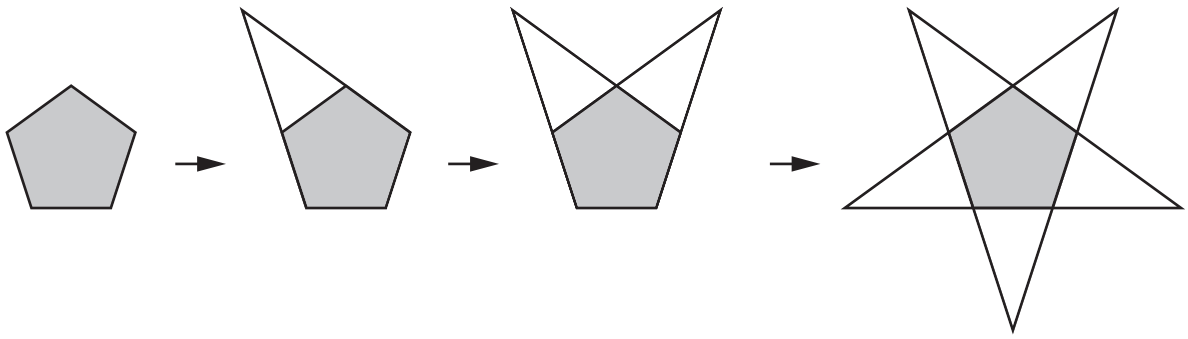
A INVESTIGATION REGULAR STARS (20 marks)

You are advised to spend no more than 45 minutes on this part.

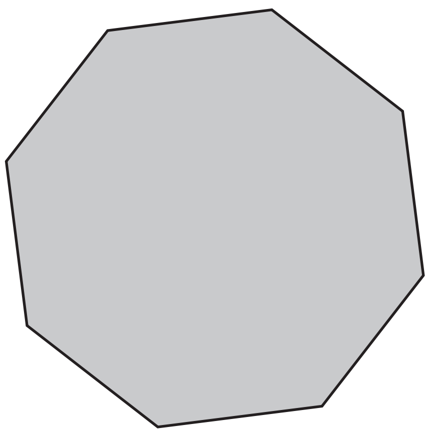
This investigation is about the construction of regular stars and their properties.
Here are some regular stars.

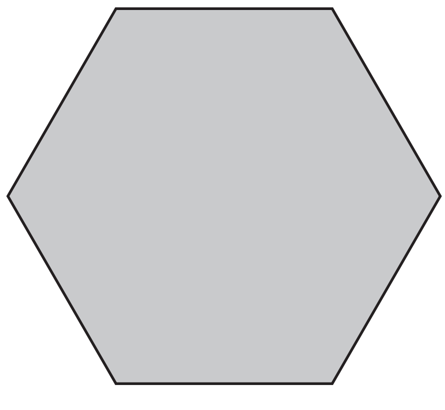


1 You can make regular stars by extending the sides of regular polygons.
For example, this regular polygon makes a regular star with 10 sides and 5 points.



(a) Use a straight edge to draw the regular stars made from these regular polygons.





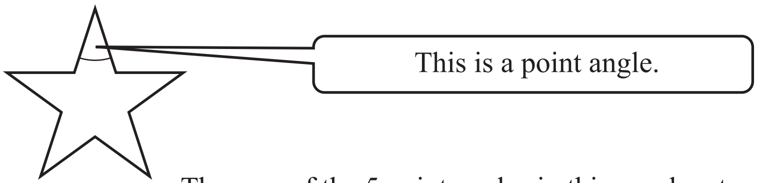
(b) **(i)** Complete this table.

Number of sides (P) of the starting polygon	Number of sides (S) of the star
5	10
6	
7	
8	
9	

(ii) Write down a formula for S in terms of P.

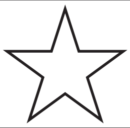
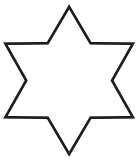
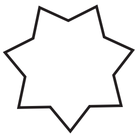
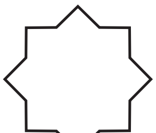
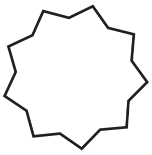
....

(c)



The sum of the 5 point angles in this regular star is 180°.

(i) Complete the table.

Regular star	Number of points	Sum of star's point angles
	5	180°
	6	360°
	7	540°
	8	720°
	9	

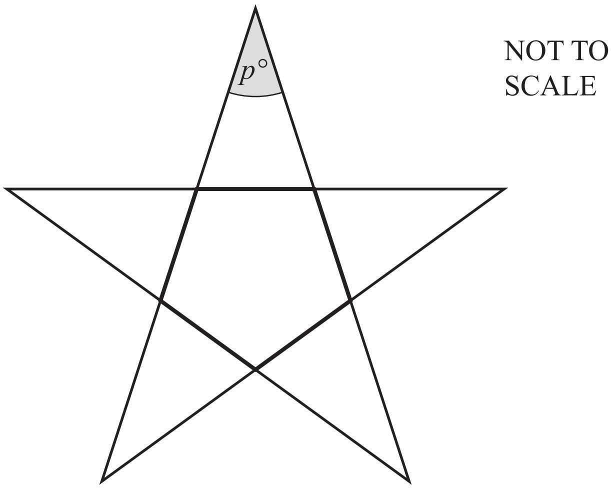
(ii) Is it possible for a regular star, made from a regular polygon, to have the sum of its point angles equal to 1450°?
Explain how you decide.

....

....

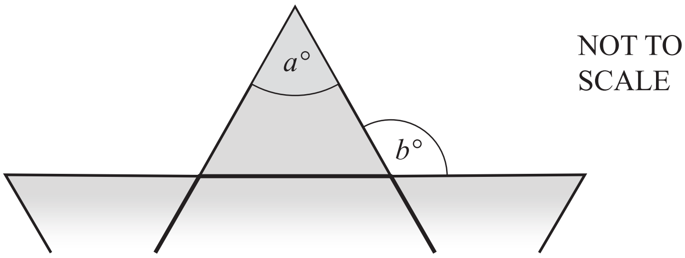
(d) **(i)** The regular pentagon making a regular star is shown in bold.

The sum of the interior angles of a pentagon is 540°.
Use this information to calculate the value of p.



....

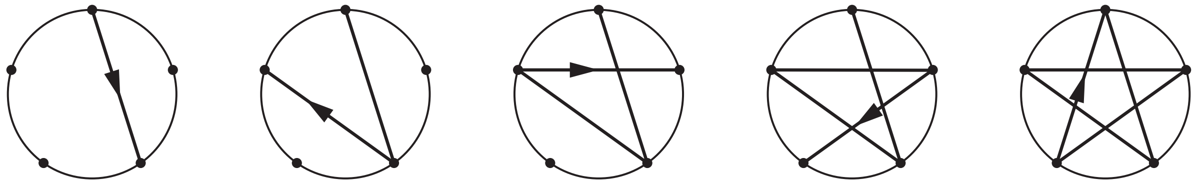
(ii) This diagram shows part of a different regular star.
It also shows, in bold, part of the regular polygon that makes it.



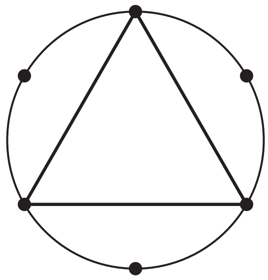
Find an equation connecting a and b.
Write your answer in its simplest form.

....

2 You can also make regular stars by joining dots that are equally spaced round a circle.
Here is a star made by joining every second dot round a circle with 5 equally spaced dots.



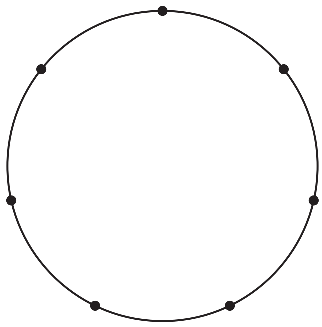
The 3-point star below is made by connecting every second dot round a circle with 6 equally spaced dots.



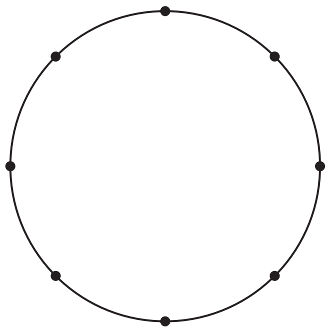
Regular polygons are also regular stars and their vertices are the points of the star.

(a) Draw the stars made by connecting every second dot round these circles.

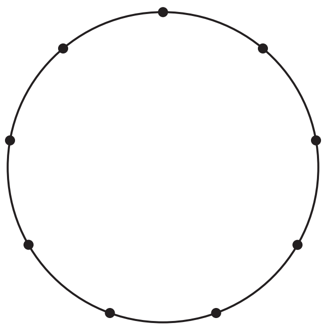
7 dots



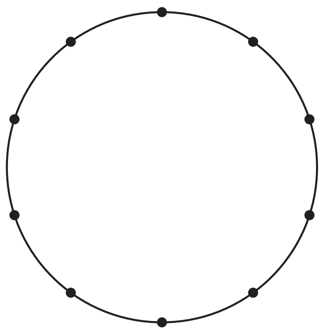
8 dots



9 dots



10 dots



Complete this table.

Number of equally spaced dots	Number of points on the star
5	5
6	3
7	
8	
9	
10	
11	

(b) Write down two conclusions you can make from the results in your table.

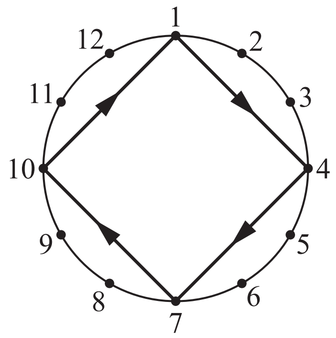
1 ....

....

2 ....

....

3 In **question 2** you made stars by joining every second dot round a circle.
You can also make stars by joining every third dot.



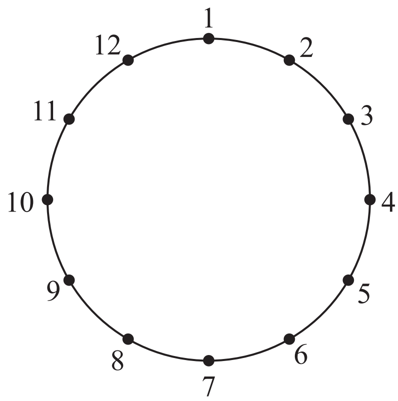
Starting from 1, dots are numbered clockwise.

This gives a code for this star.

1 ➞ 4 ➞ 7 ➞ 10 ➞ 1

(a) On the circle below draw the star with this code.

1 ➞ 3 ➞ 5 ➞ 7 ➞ 9 ➞ 11 ➞ 1

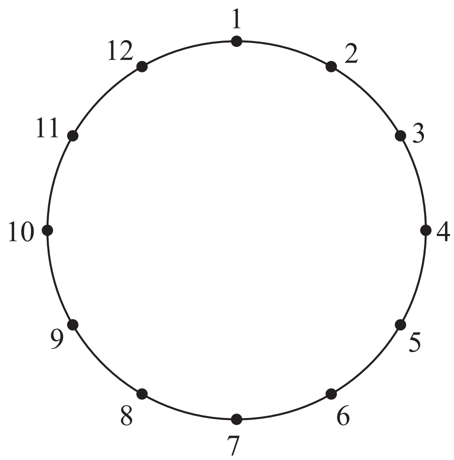


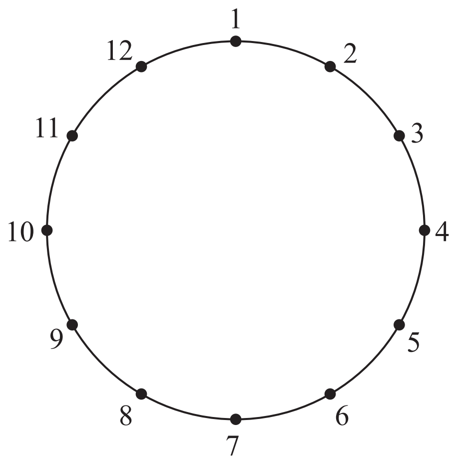
(b) To make stars you join every *n*th dot round a circle with 12 dots.
When $n = 2$ not all the dots are used.
When $n = 3$ not all the dots are used.

When $n \leqslant 6$, find two other values of n and the codes for stars that do **not** use all the dots.
There are some 12-dot circles below if you need them.

n = ... with code 1 ➞ ....

n = ... with code 1 ➞ ....





(c) **(i)** To make stars you join every nth dot round a circle with 20 dots.
For $n \leqslant 10$, not all the dots are used when $n = 2$ or 4 or 5 or 10.

When d is the number of dots round a circle and $n \leqslant \frac{d}{2}$, what is true about n when not all the dots are used?

....

....

....

....

(ii) When d is a prime number greater than 2, find an expression, in terms of d, for the number of different stars that can be drawn.

....

....

(d) Here are the last four numbers in the code for a star.

$$\ldots \rightarrow 98 \rightarrow 106 \rightarrow 114 \rightarrow 1$$

(i) Find the number of dots round the circle.

....

(ii) Find the number of points on the star.

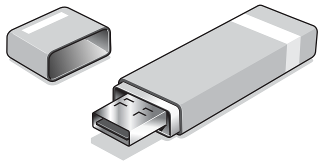
....

The modelling task starts on page 12.

B MODELLING RELIABILITY (20 marks)

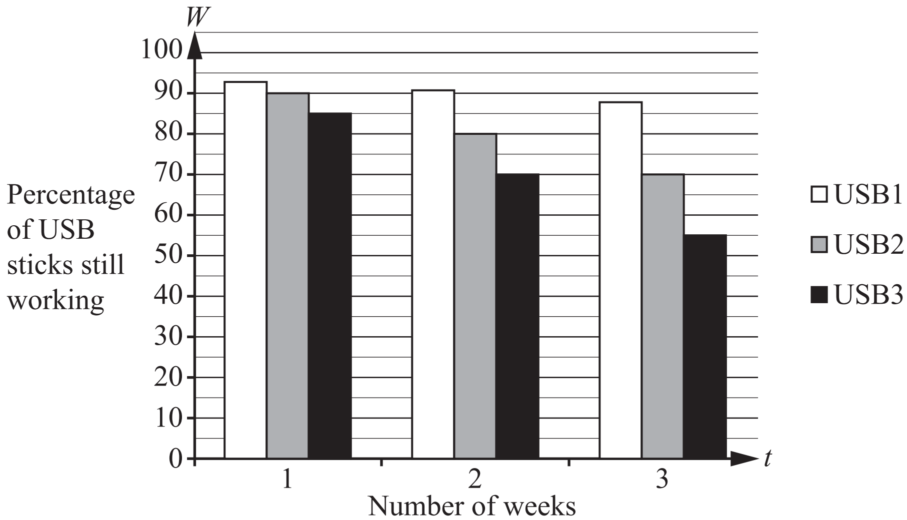
You are advised to spend no more than 45 minutes on this part.

This task is about modelling the reliability of USB memory sticks.



A factory makes three types of USB memory stick, USB1, USB2 and USB3.
The factory tests the reliability of a sample by saving and deleting data 10 000 times a day.
The percentage of sticks that still work at the end of each week is recorded.
This gives a measure of reliability.

1 This bar chart shows the percentage, W, of three types of USB stick that were still working at the end of each week, t.



(a) What percentage of the USB2 sticks were still working after two weeks?

....

(b) Which type of USB stick had the greatest percentage failure from the end of week 1 to the end of week 2?
Write down this percentage.

....

(c) The results for the USB3 sticks are modelled by this equation.

$$W = 100 - 15t$$

Explain why this is not a good model for USB3 sticks that have been tested for 7 or more weeks.

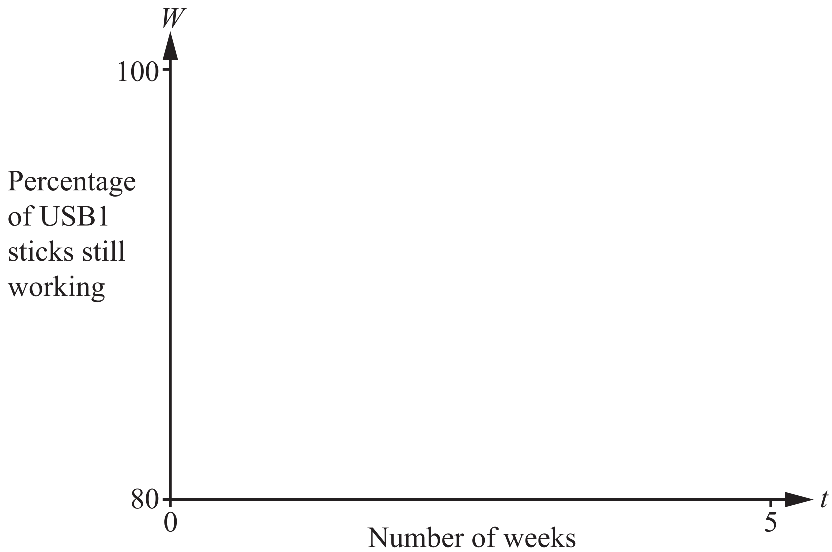
....

....

(d) The results for the USB1 sticks fit this model.

$$W = t^2 - 7t + 100$$

(i) Sketch the graph for this model on the axes below for $t \leqslant 5$.



(ii) Explain why this model is not suitable for USB1 sticks that have been tested for more than three weeks.

....

....

(e) A model for the USB2 sticks is $W = kt + 100$, where k is a constant.

Find the value of k.

....

2 The factory's engineers want to estimate the percentage of USB1 memory sticks that still work after a year of testing.

They use the mean time between failures (MTBF) to measure the reliability.

$$\text{MTBF} = \frac{\text{Total testing time}}{\text{Total number of failures}}$$

Example

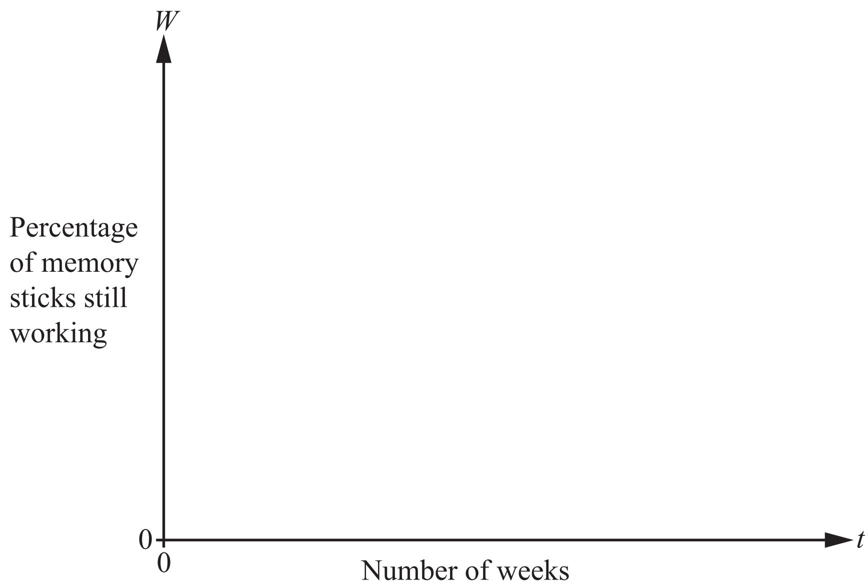
15 400 memory sticks are each tested for 10 weeks.
During this time 1100 failed.
$\text{MTBF} = \dfrac{15400 \times 10}{1100} = 140$ weeks

A model for the percentage, W, of memory sticks still working after time t weeks is

$$W = 100 \times 3^{-\left(\frac{t}{m}\right)}, \text{ where } m \text{ is the MTBF in weeks.}$$

(a) A sample of memory sticks has MTBF = 10 weeks.

(i) Sketch a graph of W against t for $t \leqslant 30$.



(ii) After how many weeks are only half the sticks still working?

....

(b) A sample of ten USB1 sticks is tested for 8 weeks.
During this time 4 failed.

Use the model for W to calculate the percentage of USB1 sticks still working after one year (52 weeks).

....

(c) Use the model to estimate the **probability** of a memory stick still working for as long as its MTBF.

....

(d) Another factory says that 99% of their memory sticks still work after 52 weeks.

Find the MTBF.

....

Question 3 is printed on the next page.

3 One engineer suggests a simpler model.
She says

Test 100 memory sticks for 1 week.
The probability that x fail is $\frac{x}{100}$.

(a) Explain why her model for the percentage of memory sticks still working after t weeks is

$$W = 100 \times \left(1 - \frac{x}{100}\right)^t$$

....

....

....

(b) One memory stick out of the 100 failed in the first week.

(i) Use her model to find the percentage of memory sticks still working after 5 weeks.

....

(ii) Compare her model with the model in **question 2**.