



Coimisiún na Scrúduithe Stáit  
State Examinations Commission

Leaving Certificate Examination 2013

Mathematics  
(Project Maths – Phase 3)

Paper 2

Higher Level

Monday 10 June      Morning 9:30 – 12:00

300 marks

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| Examination number |
|--------------------|

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| Centre stamp |
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| Running total |  |
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| For examiner |      |
|--------------|------|
| Question     | Mark |
| 1            |      |
| 2            |      |
| 3            |      |
| 4            |      |
| 5            |      |
| 6            |      |
| 7            |      |
| 8            |      |
| 9            |      |
|              |      |
|              |      |
| Total        |      |

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| Grade |
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## Instructions

There are **two** sections in this examination paper.

|           |                           |           |             |
|-----------|---------------------------|-----------|-------------|
| Section A | Concepts and Skills       | 150 marks | 6 questions |
| Section B | Contexts and Applications | 150 marks | 3 questions |

Answer **all nine** questions, as follows:

In Section A, answer

Questions 1 to 5 and

**either** Question 6A **or** Question 6B.

In Section B, answer Questions 7 to 9.

Write your answers in the spaces provided in this booklet. You may lose marks if you do not do so. There is space for extra work at the back of the booklet. You may also ask the superintendent for more paper. Label any extra work clearly with the question number and part.

The superintendent will give you a copy of the *Formulae and Tables* booklet. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

Marks will be lost if all necessary work is not clearly shown.

Answers should include the appropriate units of measurement, where relevant.

Answers should be given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

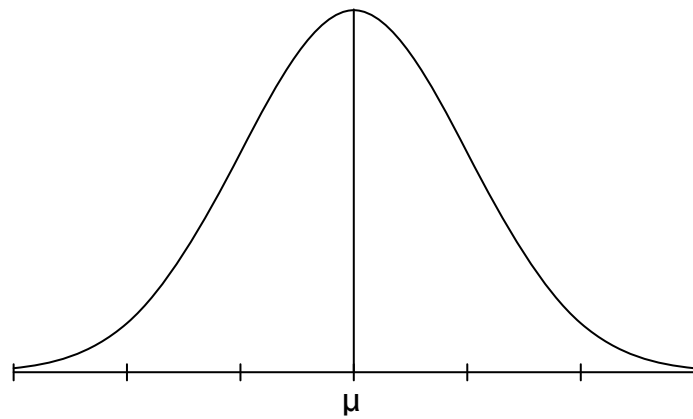




### Hormone A

The effect of hormone A was to increase the height of all of the plants.

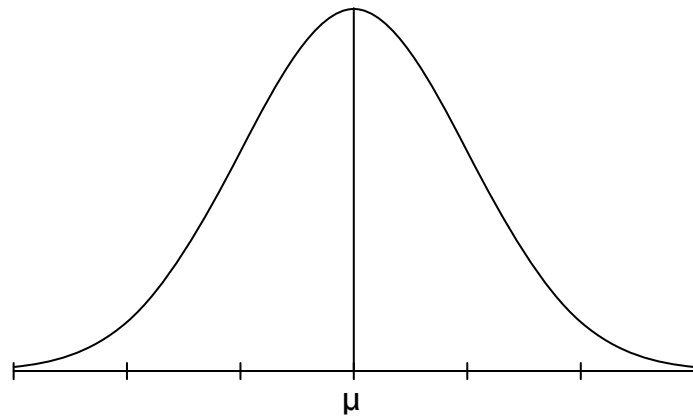
Diagram A



### Hormone B

The effect of hormone B was to reduce the number of really small plants and the number of really tall plants. The mean was unchanged.

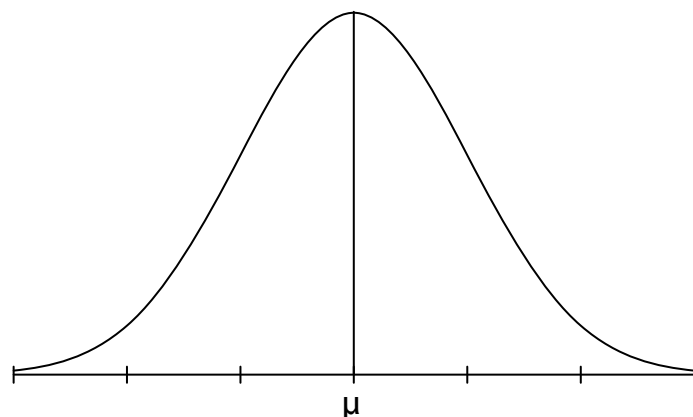
Diagram B



### Hormone C

The effect of hormone C was to increase the number of small plants and the number of tall plants. The mean was unchanged.

Diagram C

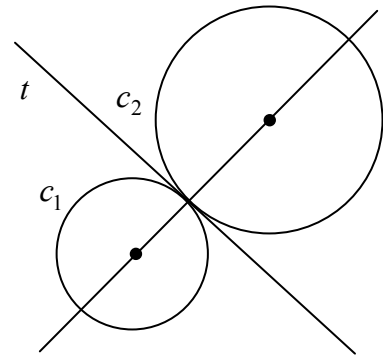
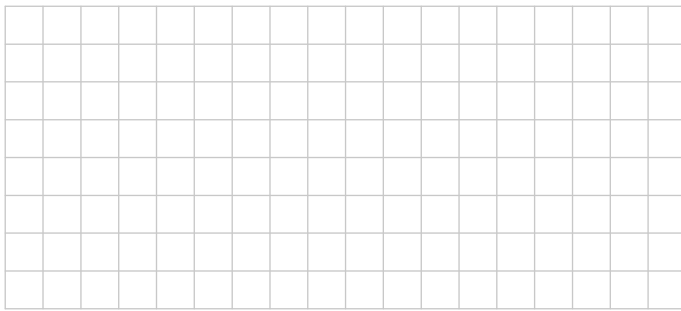




**Question 4**

**(25 marks)**

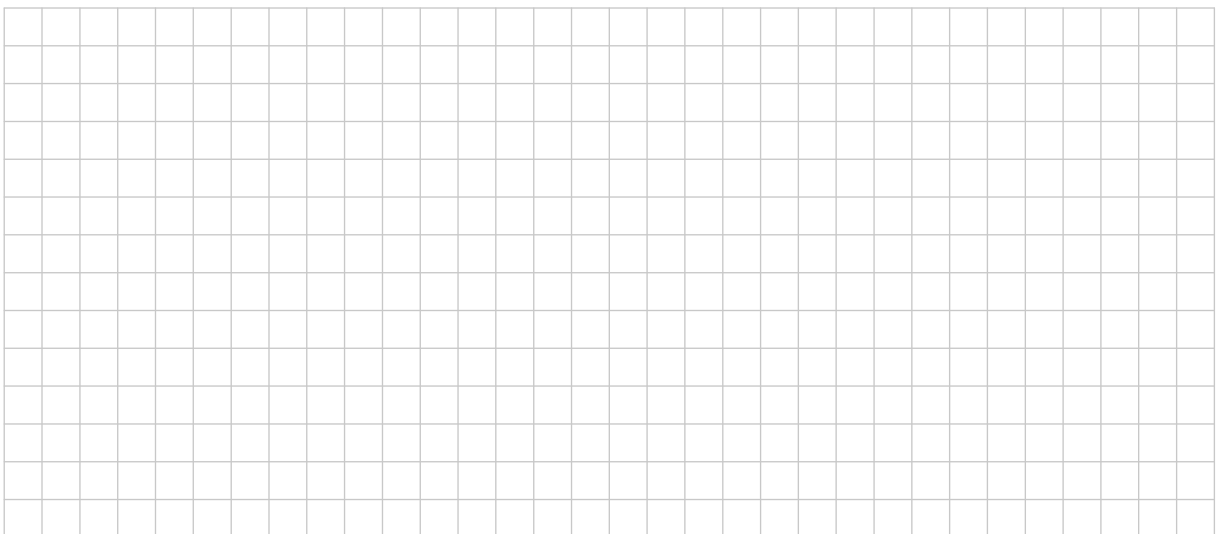
The circles  $c_1$  and  $c_2$  touch externally as shown.



(a) Complete the following table:

| Circle | Centre     | Radius | Equation                      |
|--------|------------|--------|-------------------------------|
| $c_1$  | $(-3, -2)$ | 2      |                               |
| $c_2$  |            |        | $x^2 + y^2 - 2x - 2y - 7 = 0$ |

(b) (i) Find the co-ordinates of the point of contact of  $c_1$  and  $c_2$ .



(ii) Hence, or otherwise, find the equation of the tangent,  $t$ , common to  $c_1$  and  $c_2$ .

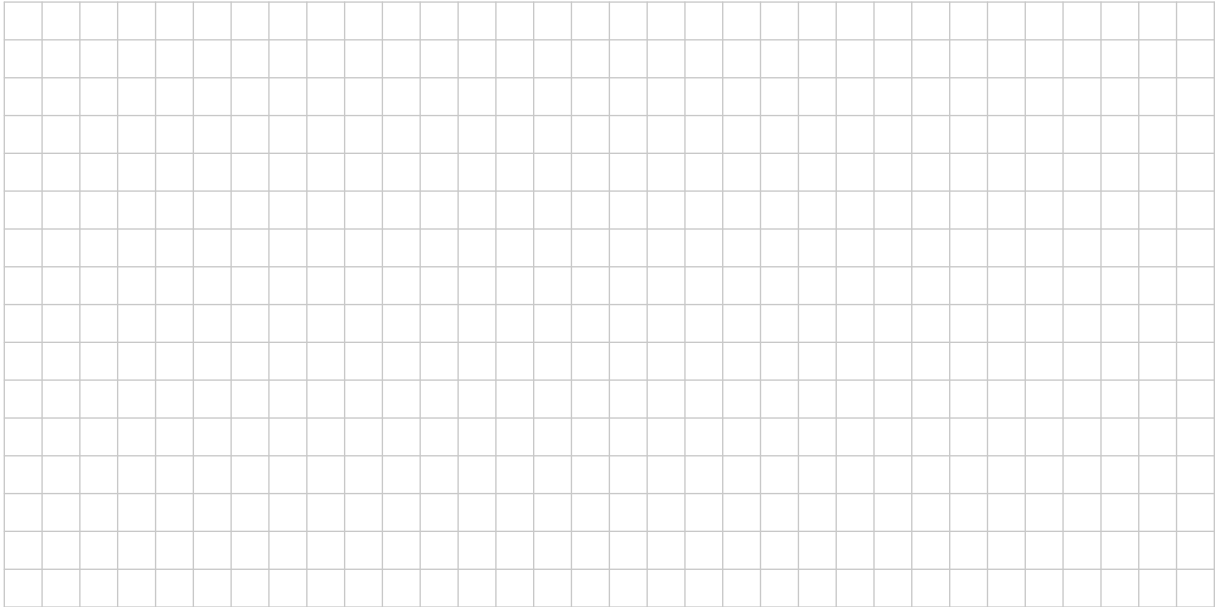


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**Question 5****(25 marks)**

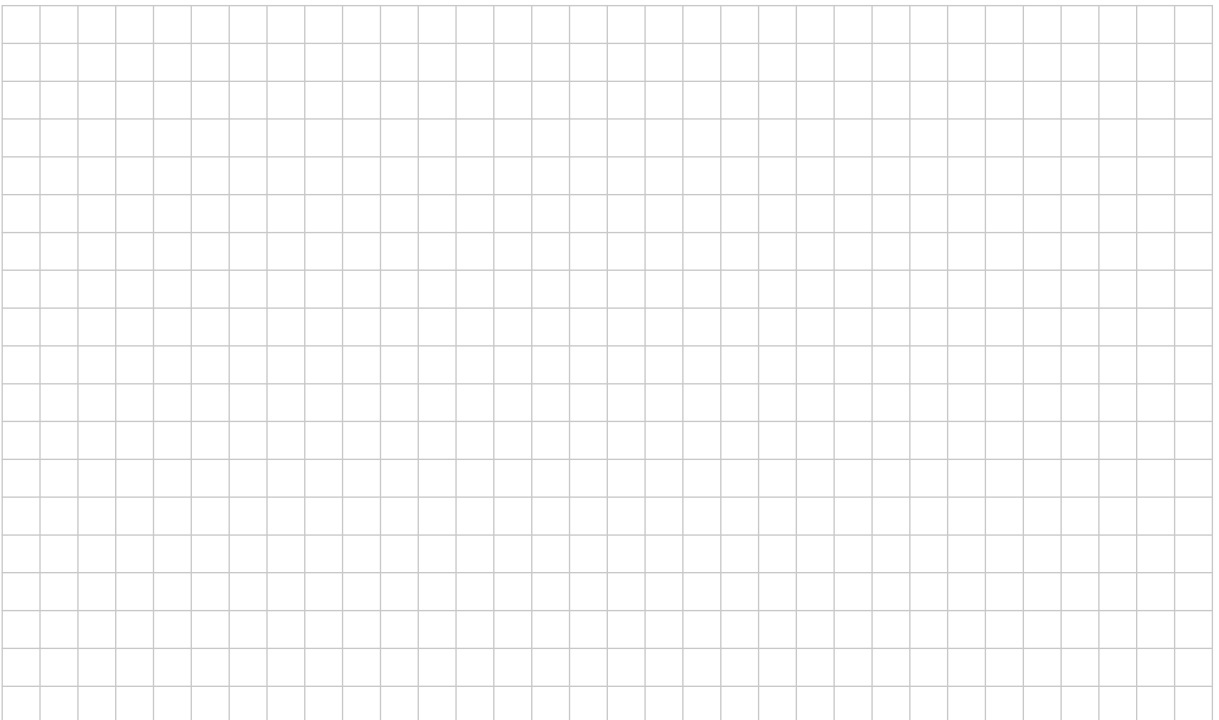
- (a) In a triangle  $ABC$ , the lengths of the sides are  $a$ ,  $b$  and  $c$ . Using a formula for the area of a triangle, or otherwise, prove that

$$\frac{a}{\sin \angle A} = \frac{b}{\sin \angle B} = \frac{c}{\sin \angle C}.$$

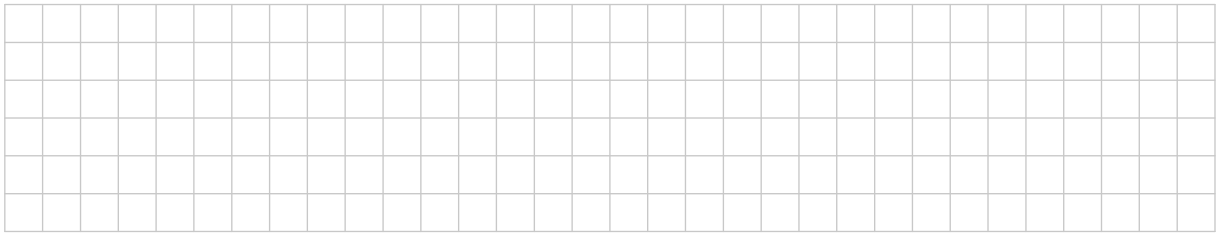


- (b) In a triangle  $XYZ$ ,  $|XY| = 5$  cm,  $|XZ| = 3$  cm and  $|\angle XYZ| = 27^\circ$ .

- (i) Find the two possible values of  $|\angle XZY|$ . Give your answers correct to the nearest degree.







(ii) Draw a sketch of the triangle  $XYZ$ , showing the two possible positions of the point  $Z$ .



(c) In the case that  $|\angle XZY| < 90^\circ$ , write down  $|\angle ZXY|$ , and hence find the area of the triangle  $XYZ$ , correct to the nearest integer.

$|\angle ZXY| =$  \_\_\_\_\_

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**Question 6**

**(25 marks)**

Answer **either** 6A **or** 6B.

**Question 6A**

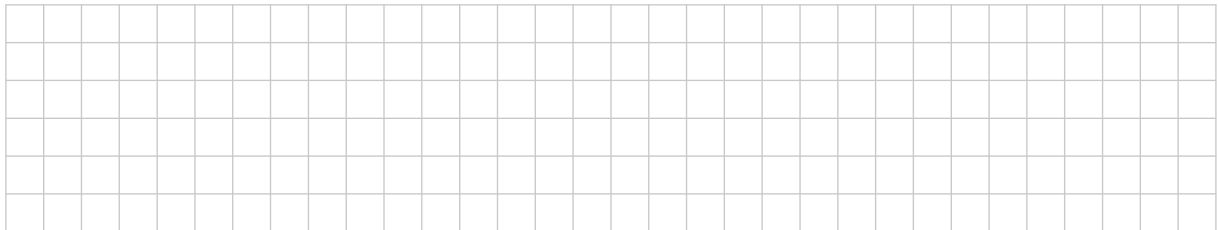
(a) Complete each of the following statements.

(i) The circumcentre of a triangle is the point of intersection of \_\_\_\_\_  
\_\_\_\_\_

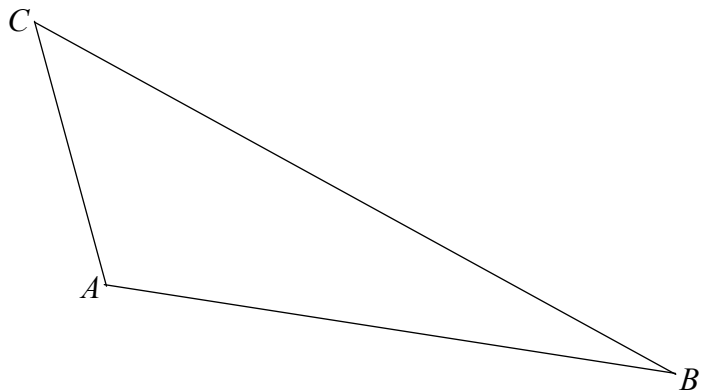
(ii) The incentre of a triangle is the point of intersection of \_\_\_\_\_  
\_\_\_\_\_

(iii) The centroid of a triangle is the point of intersection of \_\_\_\_\_  
\_\_\_\_\_

(b) In an equilateral triangle, the circumcentre, the incentre and the centroid are all in the same place. Explain why this is the case.



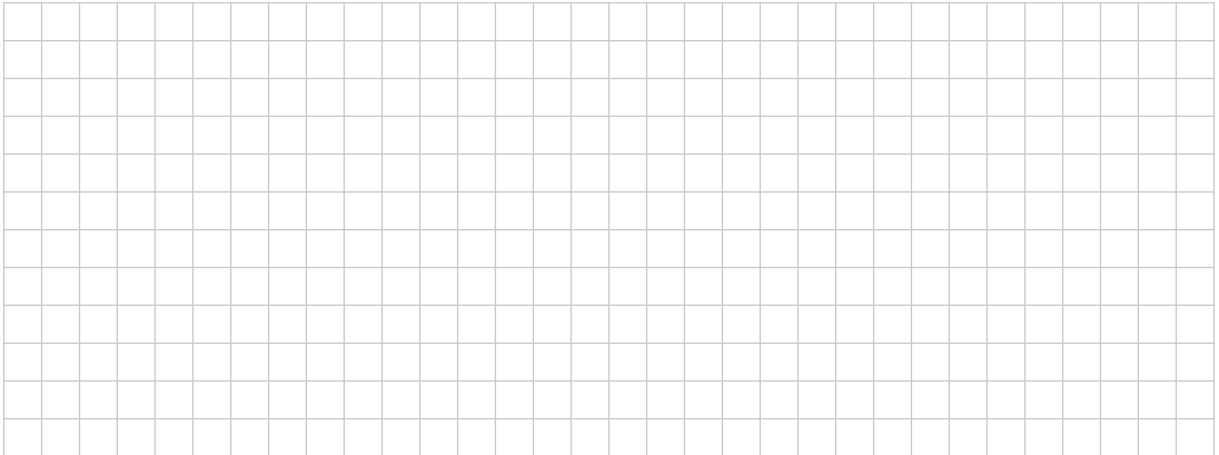
(c) Construct the orthocentre of the triangle  $ABC$  below. Show all construction lines clearly.



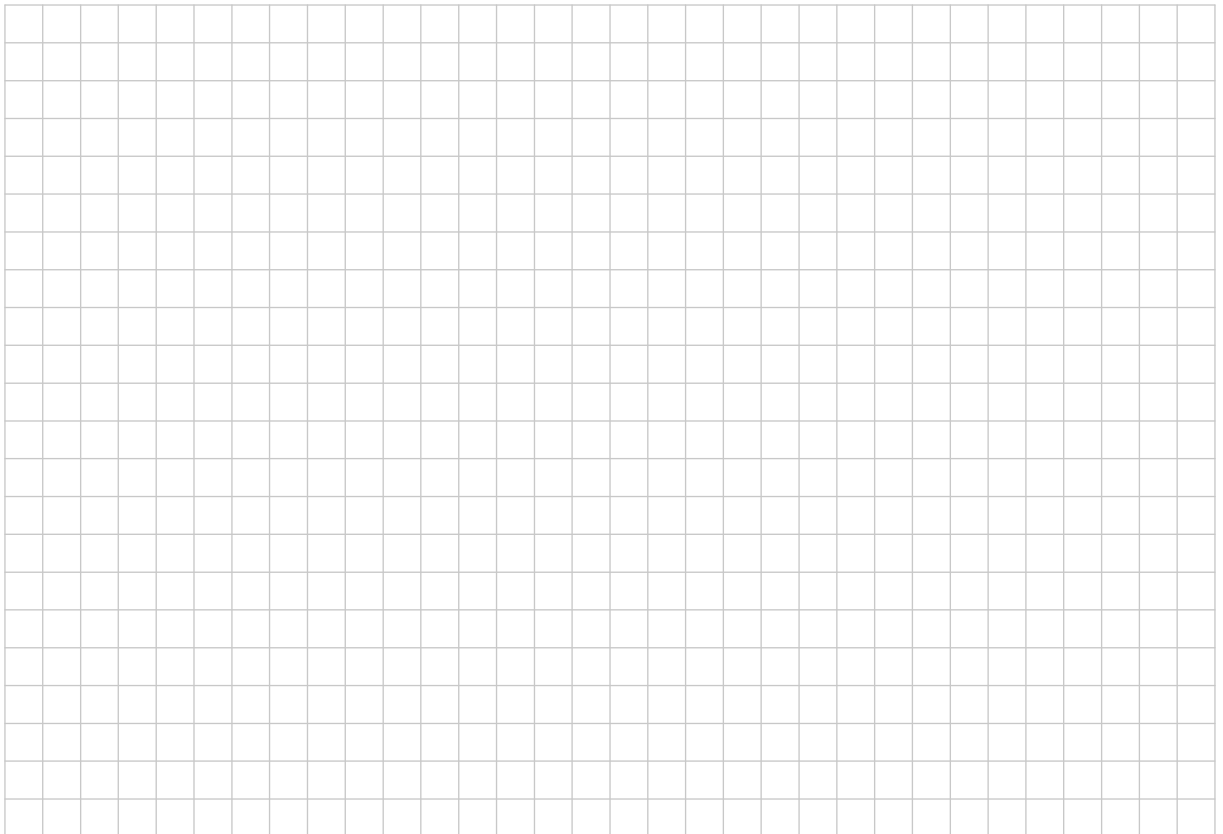
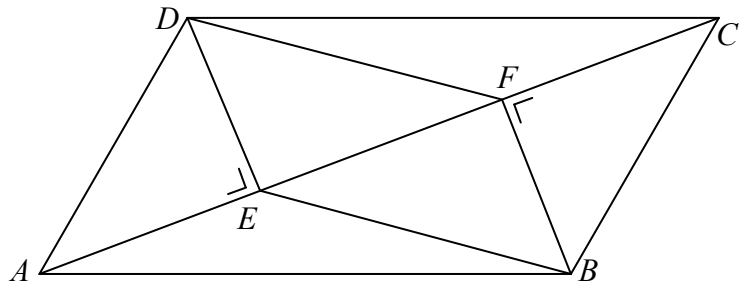
OR

**Question 6B**

- (a) A quadrilateral (four sided figure) has two sides which are parallel and equal in length.  
Prove that the quadrilateral is a parallelogram.



- (b) In the parallelogram  $ABCD$ ,  
 $DE$  is perpendicular to  $AC$ .  
 $BF$  is perpendicular to  $AC$ .  
Prove that  $EBFD$  is a parallelogram.



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- (f) The responses of ten individual passengers to the questions on age and in-flight spend are given below.

|                        |    |    |    |    |    |    |    |    |    |    |
|------------------------|----|----|----|----|----|----|----|----|----|----|
| Age (years)            | 46 | 29 | 37 | 18 | 25 | 75 | 52 | 35 | 40 | 31 |
| In-flight spend (euro) | 30 | 15 | 20 | 0  | 10 | 45 | 25 | 20 | 20 | 30 |

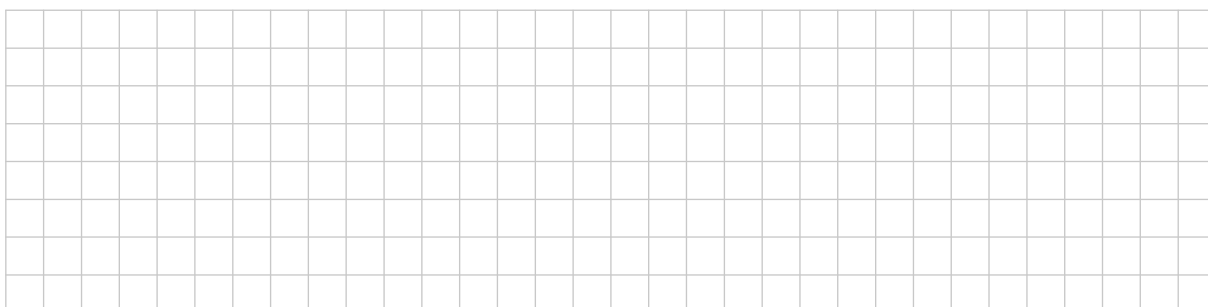
- (i) Draw a scatter plot of the data.



- (ii) Calculate the correlation coefficient between passenger age and in-flight spend.

Answer: \_\_\_\_\_

- (iii) What can you conclude from the completed scatter plot and the correlation coefficient?



- (iv) Sketch the line of best fit in the completed scatter plot above.

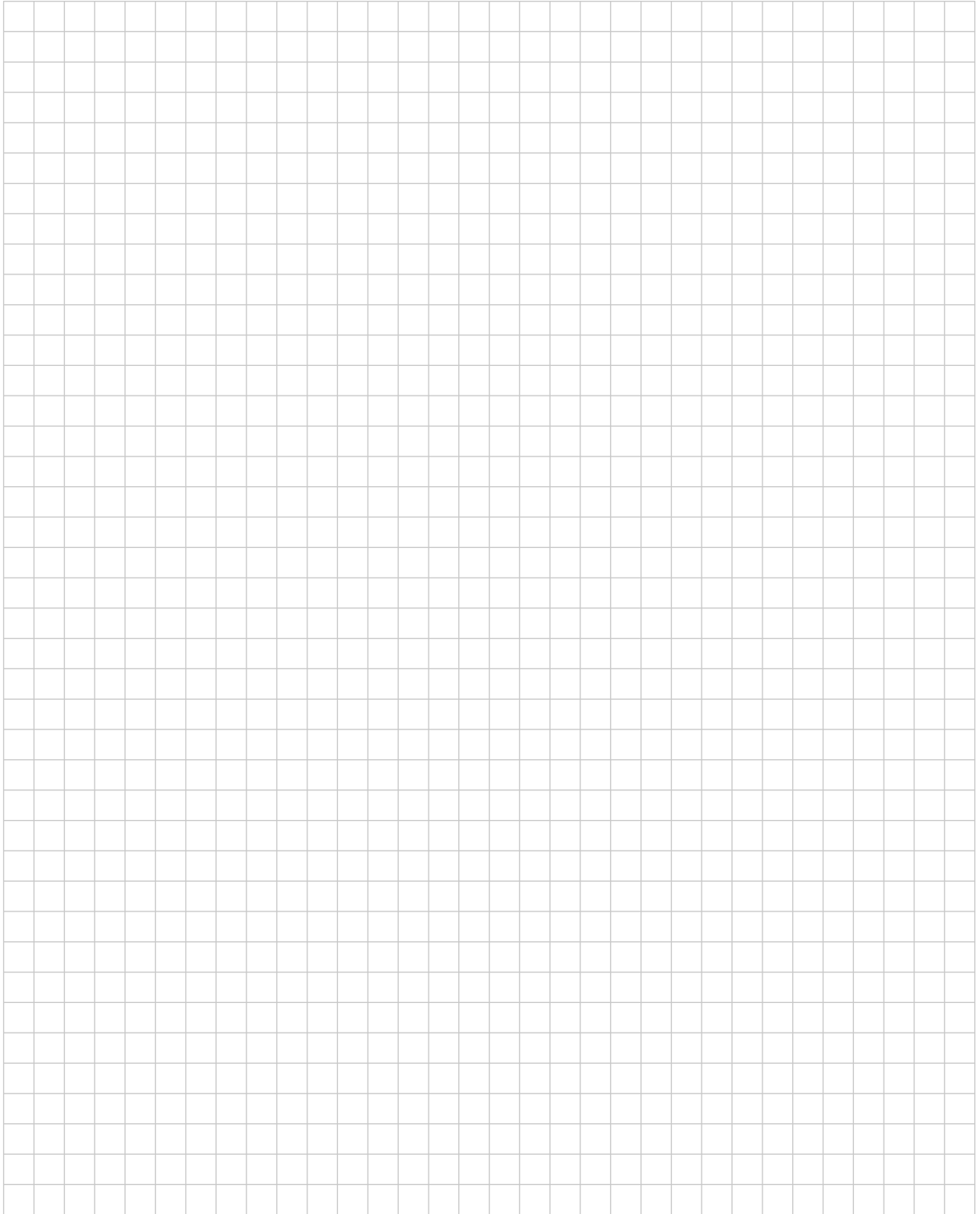
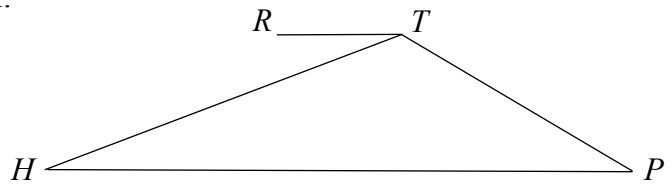
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- (b) The point  $T$  is directly east of the point  $R$ .  
 $|HT| = 110$  km and  $|TP| = 80$  km.

Find  $|RT|$ .

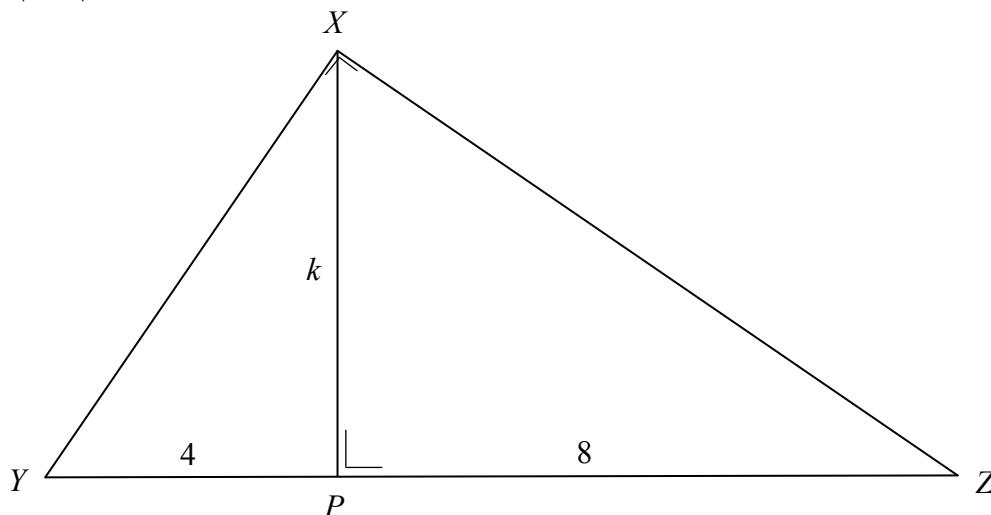


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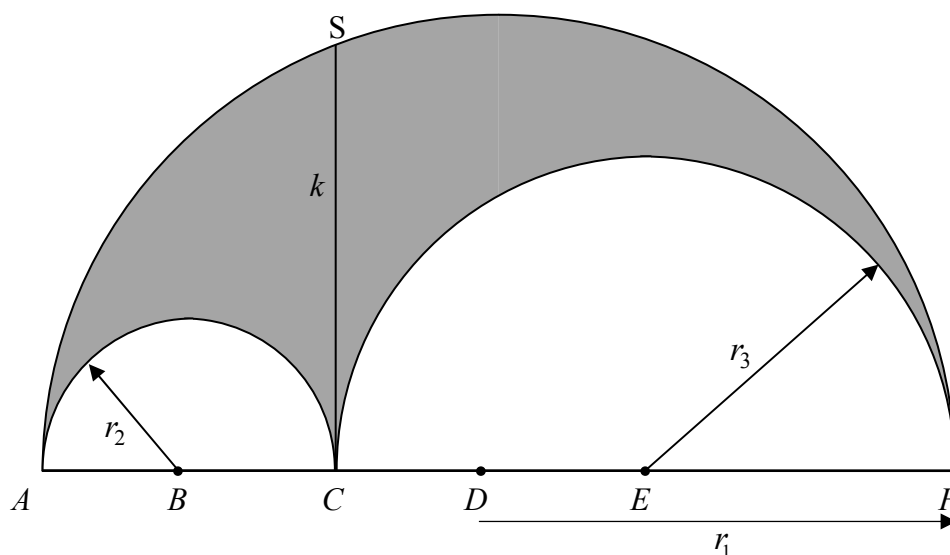
**Question 9**

**(45 marks)**

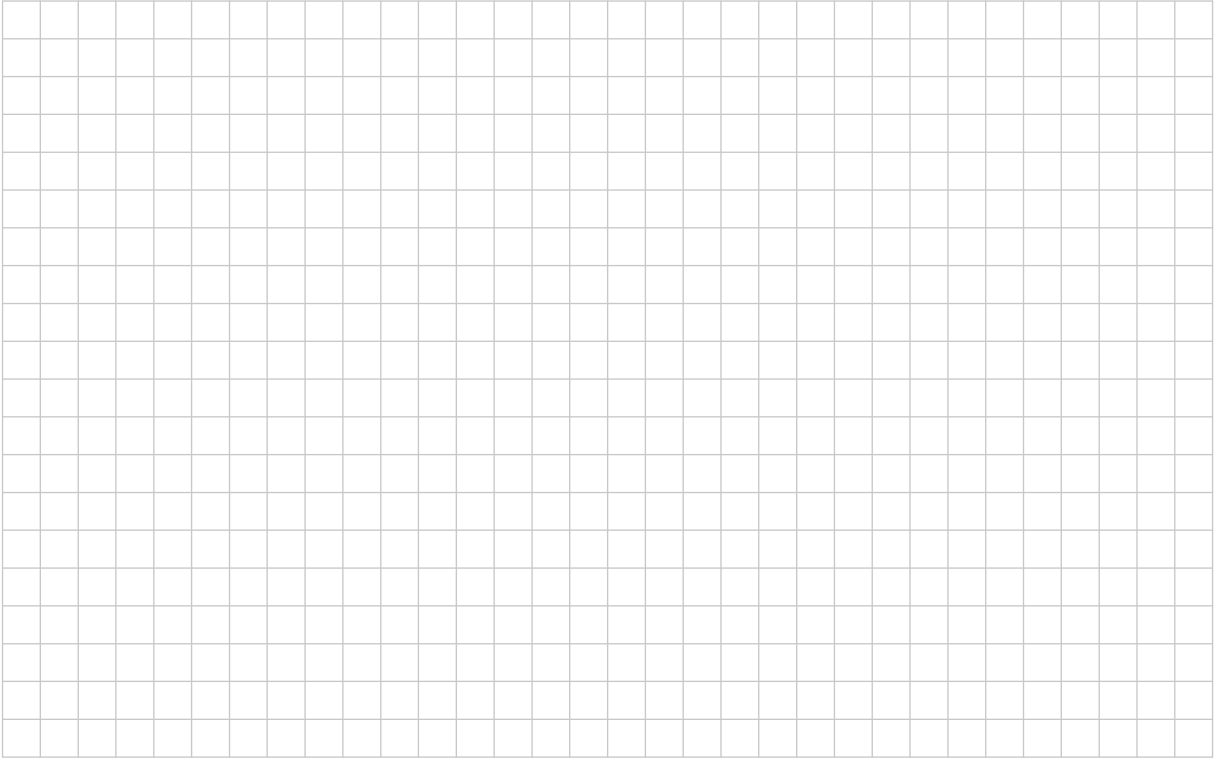
- (a) The triangle  $XYZ$  is right-angled at  $X$  and  $XP$  is perpendicular to  $YZ$ .  
 $|YP| = 4$ ,  $|PZ| = 8$  and  $|PX| = k$ . Find the value of  $k$ .



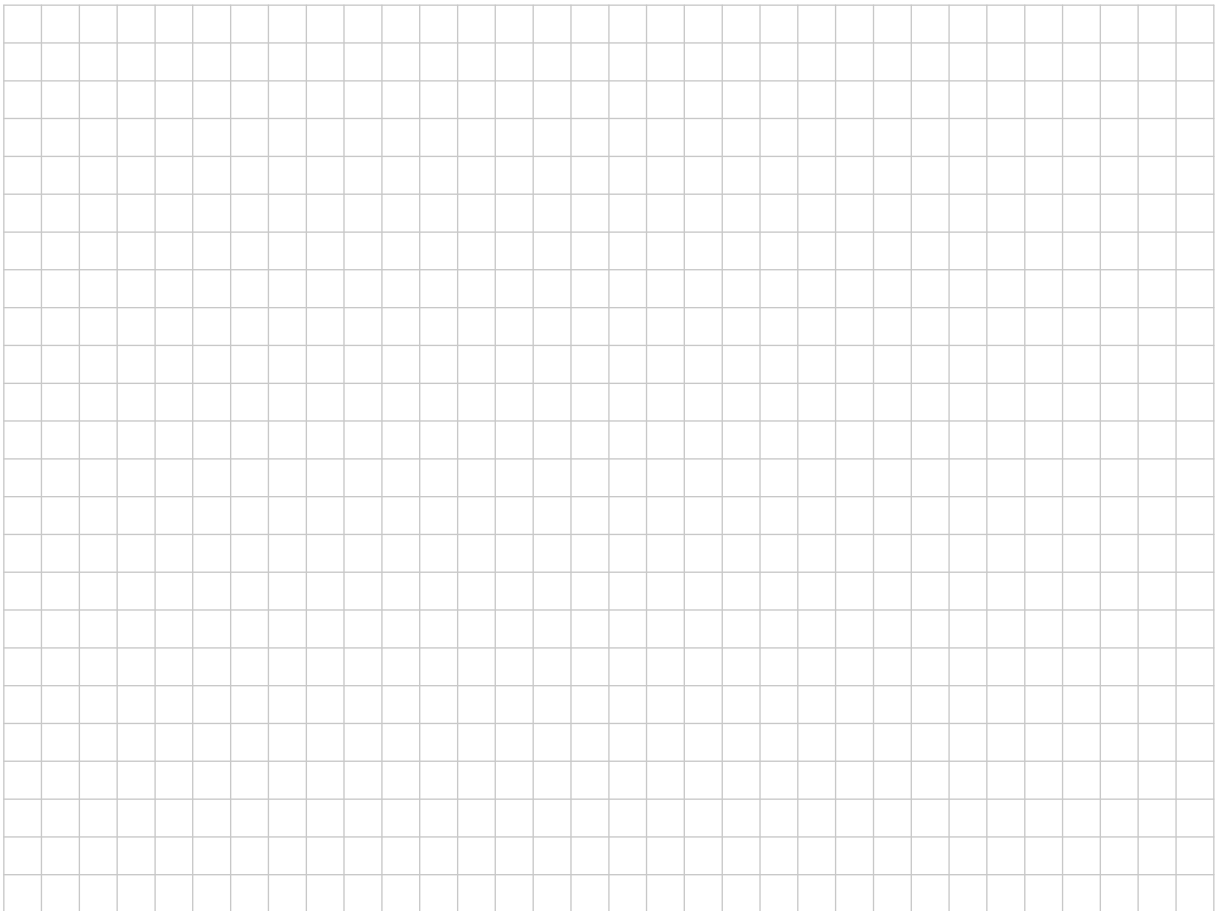
- (b) The shaded region in the diagram below is called an **arbelos**. It is a plane semicircular region of radius  $r_1$  from which semicircles of radius  $r_2$  and  $r_3$  are removed, as shown. In the diagram  $SC \perp AF$  and  $|SC| = k$ .



- (i) Show that, for fixed  $r_1$ , the perimeter of the arbelos is independent of the values of  $r_2$  and  $r_3$ .



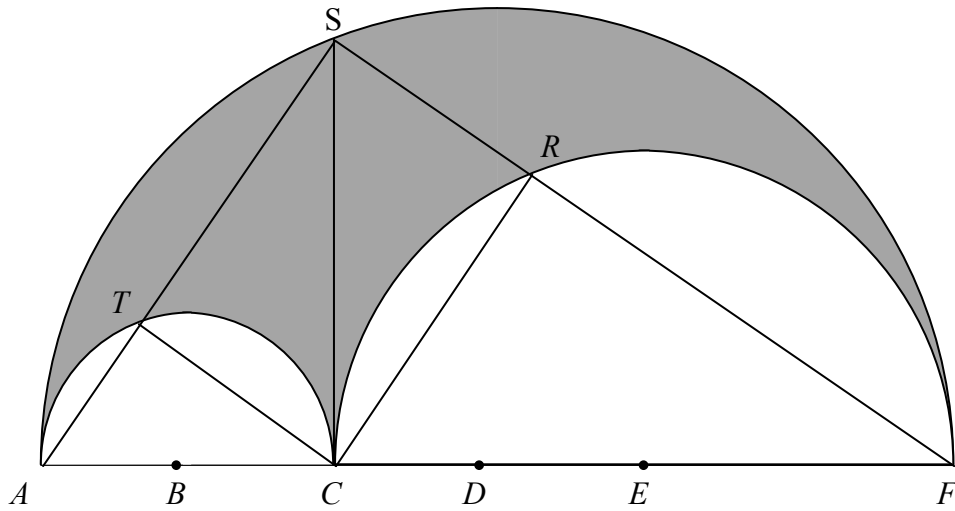
- (ii) If  $r_2 = 2$  and  $r_3 = 4$ , show that the area of the arbelos is the same as the area of the circle of diameter  $k$ .



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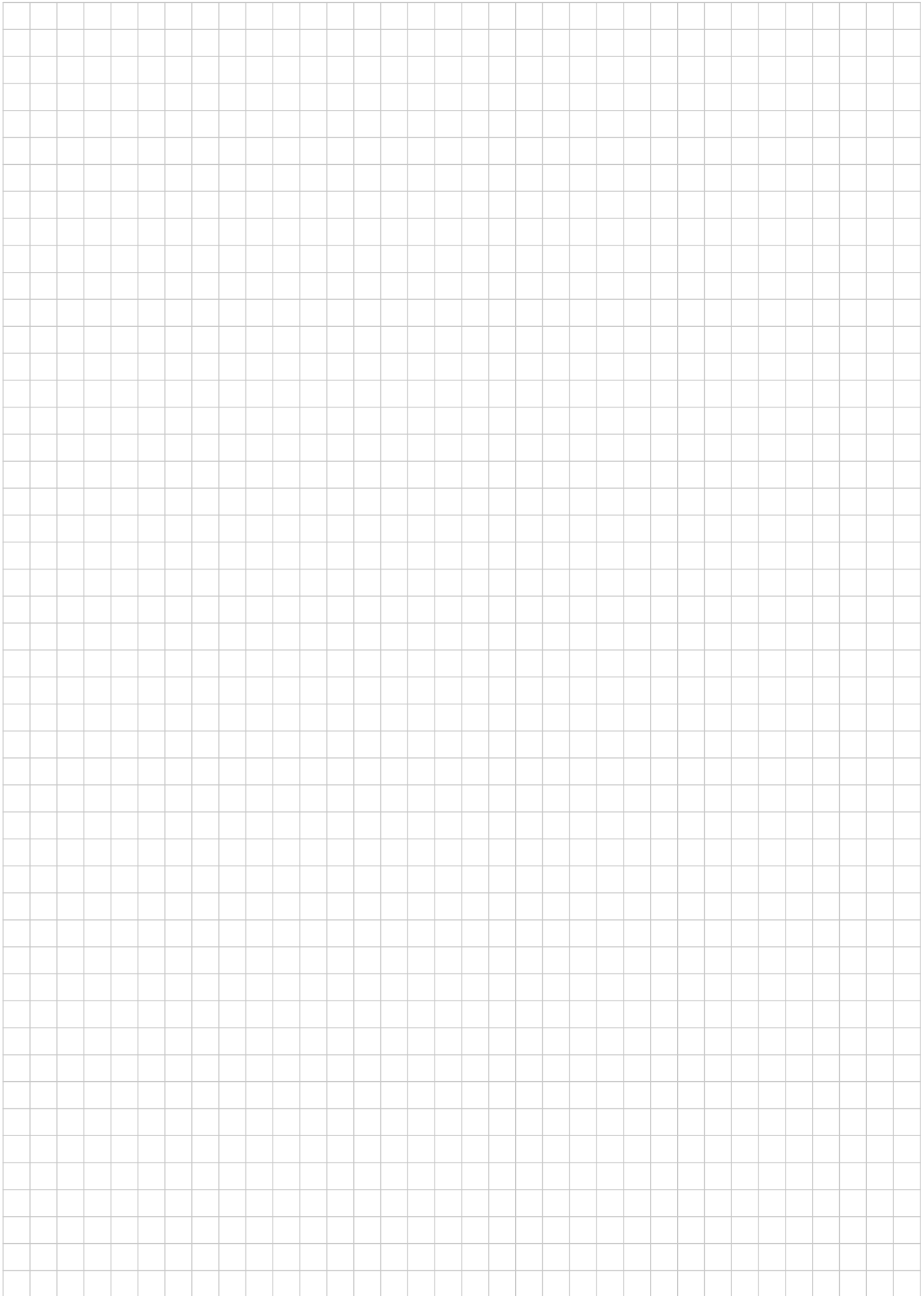


- (d)  $AS$  and  $FS$  cut the two smaller semicircles at  $T$  and  $R$  respectively.  
 Prove that  $RSTC$  is a rectangle.

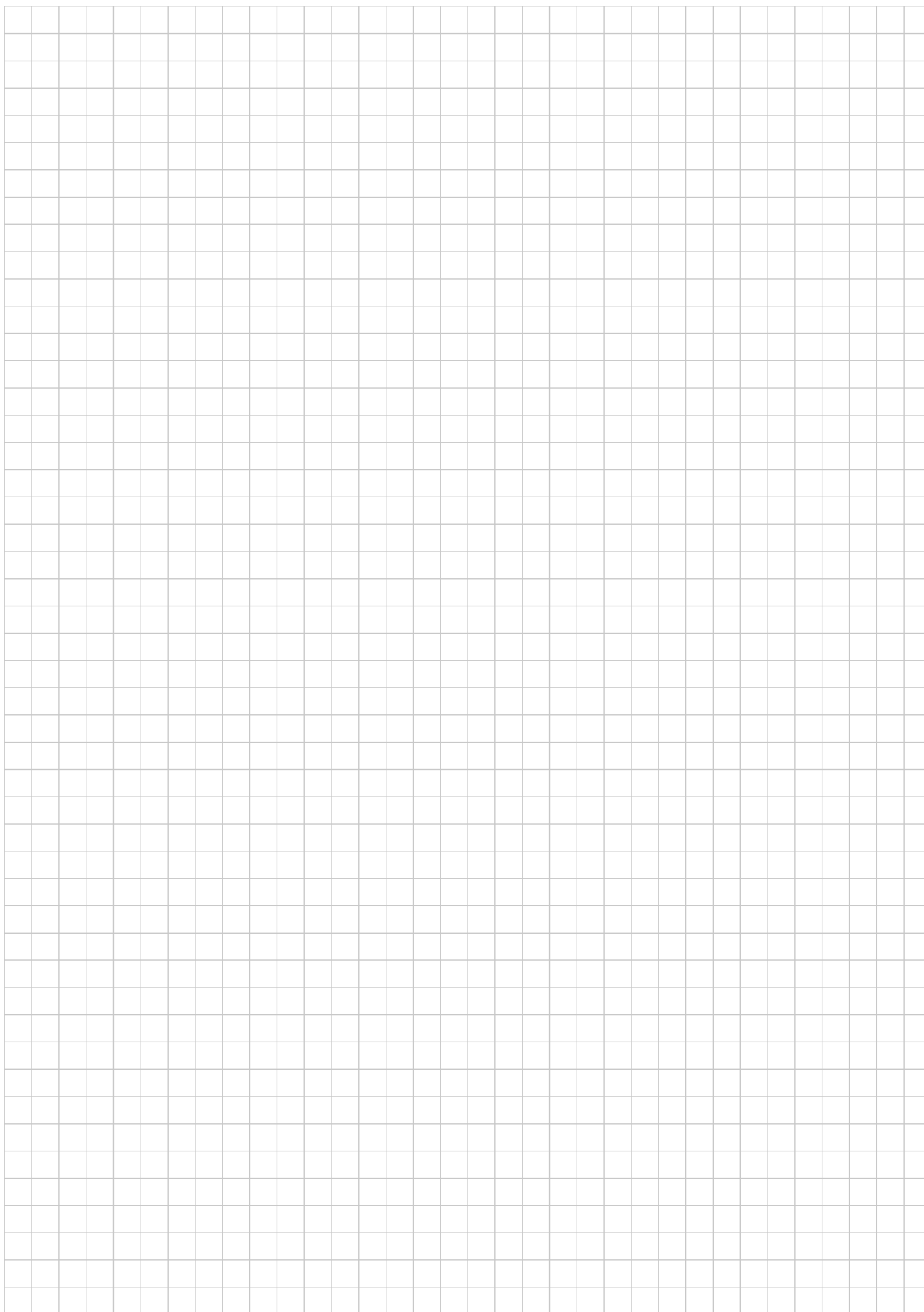


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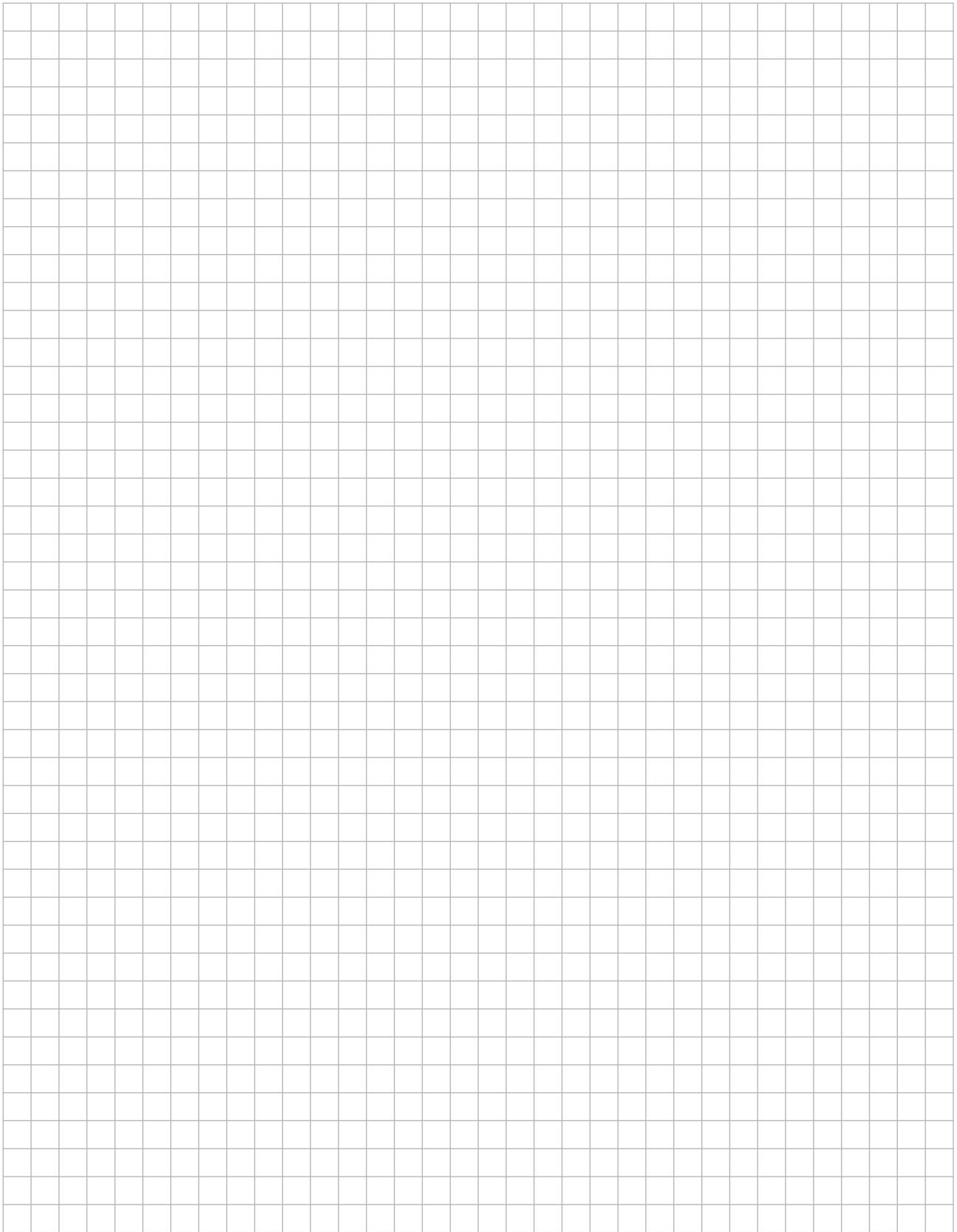
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Leaving Certificate 2013 – Higher Level

## Mathematics (Project Maths – Phase 3) – Paper 2

Monday 10 June

Morning 9:30 – 12:00