



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination 2018

Mathematics

Paper 2
Higher Level

Monday 11 June
Morning 9:30 to 12:00

300 marks

Examination Number

Centre Stamp

Running Total	
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For Examiner					
Q.	Ex.	Adv. Ex.	Q.	Ex.	Adv. Ex.
1			11		
2			12		
3			13		
4			14		
5					
6					
7					
8					
9					
10			Total		

Grade

Instructions

There are 14 questions on this examination paper. Answer **all** questions.

Questions do not necessarily carry equal marks. To help you manage your time during this examination, a maximum time for each question is suggested. If you remain within these times you should have about 10 minutes left to review your work.

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.

You may lose marks if your solutions do not include supporting work.

You may lose marks if you do not include the appropriate units of measurement, where relevant.

You may lose marks if you do not give your answers in simplest form, where relevant.

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

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Question 1 (Suggested maximum time: 5 minutes)

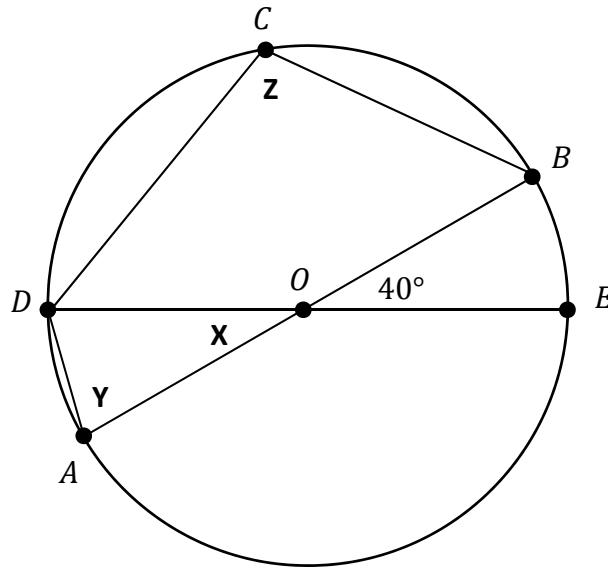
Question 1 (Suggested maximum time: 5 minutes)

The diagram below shows a circle with centre O .

The five points A, B, C, D , and E are on the circle.

$[AB]$ and $[DE]$ are diameters of the circle, and $|\angle BOE| = 40^\circ$.

The angles **X**, **Y**, and **Z** are labelled.



- (a)** Write down the size of the angle **X**.

- (b)** Work out the size of the angle Y.

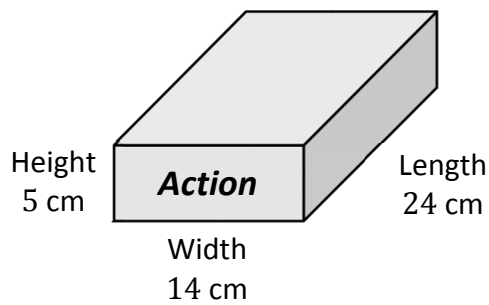
- (c)** Work out the size of the angle **Z**.

[illegible]

Question 2 (Suggested maximum time: 10 minutes)

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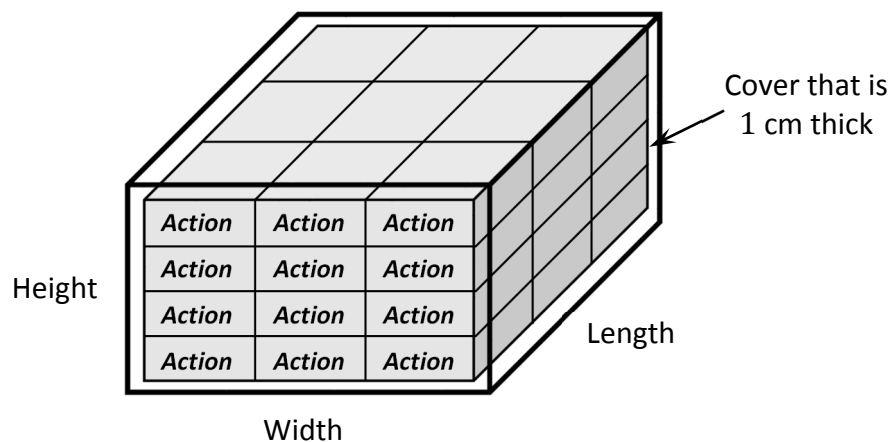
A new *Action* camera is sold in a box that is 5 cm high, 14 cm wide, and 24 cm long.



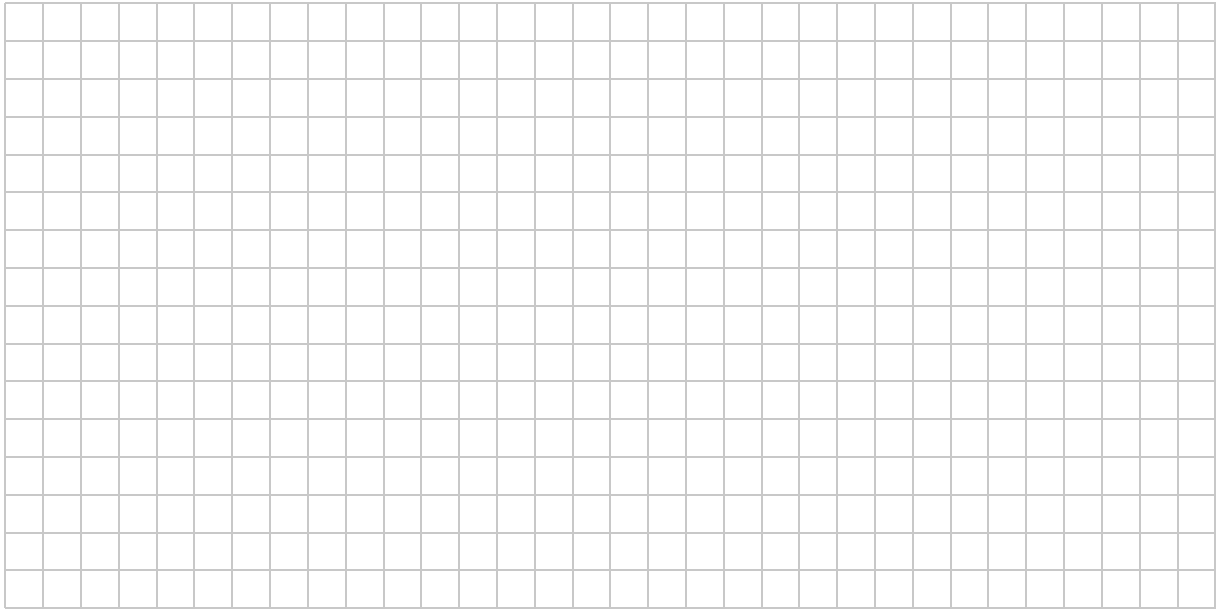
- (a)** Work out the **volume** of this box, in cm^3 .

36 of these boxes are packed together and a cover that is **1 cm thick** is put all around the outside of the 36 boxes, as shown below.

- (b)** Work out the outside dimensions of this **cover**, in cm.

[illegible]

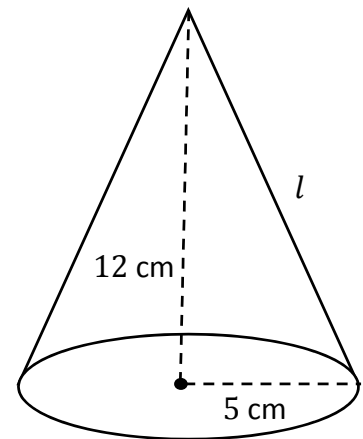
- (c) The cover that is put around the 36 boxes is made of plastic.
Work out the **volume** of plastic in the cover.



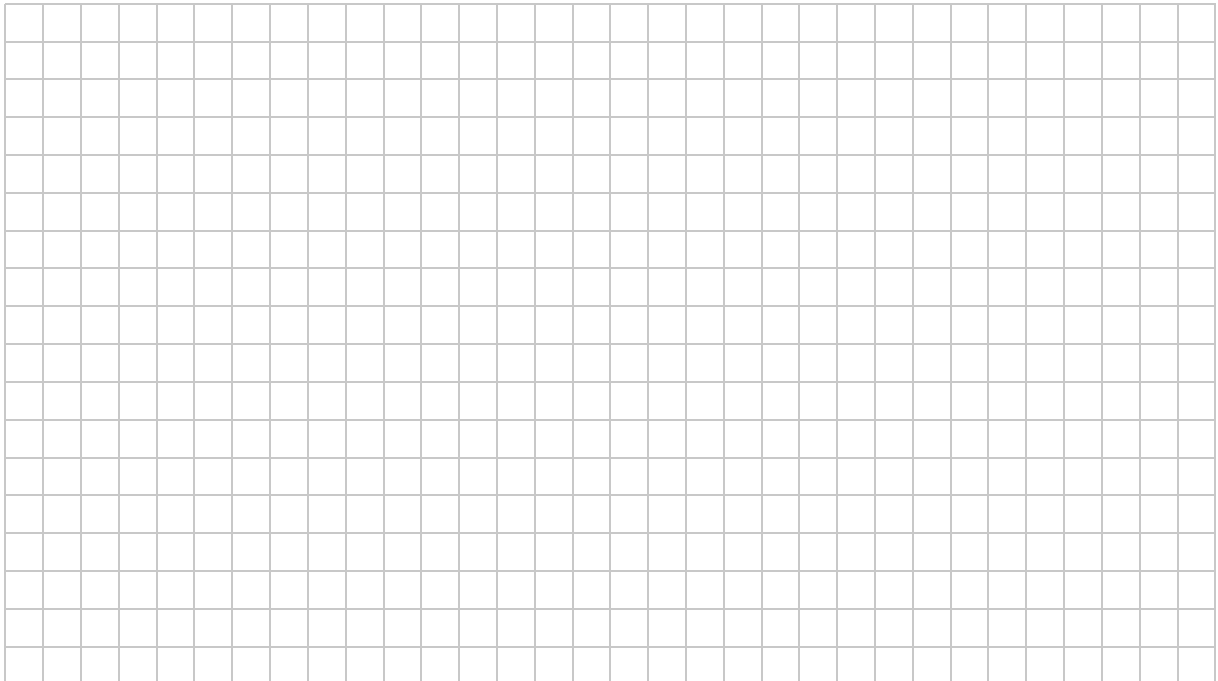
Question 3**(Suggested maximum time: 10 minutes)**

A solid cone has a radius of 5 cm and a vertical height of 12 cm, as shown.

- (a) Use the theorem of Pythagoras to work out the value of l , the slant height of the cone.



- (b) Work out the **total surface area** of the cone.
Give your answer in cm^2 , correct to one decimal place.



Question 4 (Suggested maximum time: 10 minutes)

Question 4 (Suggested maximum time: 10 minutes)

Hager takes part in a chess competition. In each game, she can win (**W**), draw (**D**), or lose (**L**). In each game she plays, each of these three outcomes is equally likely.

- (a)** Write down the probability that Hager wins her first game.

- (b)** Fill in the table below to show the 9 possible outcomes for Hager's first two games. One is already done. L W means that she loses Game 1 and wins Game 2.

		Game 2		
		W	D	L
Game 1	W			
	D			
	L	L W		

- (c) Find the probability that Hager:

- (i) wins Game 1 and loses Game 2

- (ii) wins **at least one** of her first two games.

[illegible]

- (d)** Hager plays 3 games in the competition.

- (i) Work out the total number of different possible outcomes for her 3 games.

[illegible]

- (ii) Work out the probability that she **doesn't win any** of her 3 games.

[illegible]

Question 5 (Suggested maximum time: 10 minutes)

Question 5 (Suggested maximum time: 10 minutes)

The list below shows the time (in minutes) taken by 12 students to solve a maths problem.

3, 5, 6, 7, 9, 9, 10, 12, 13, 14, 14, 15

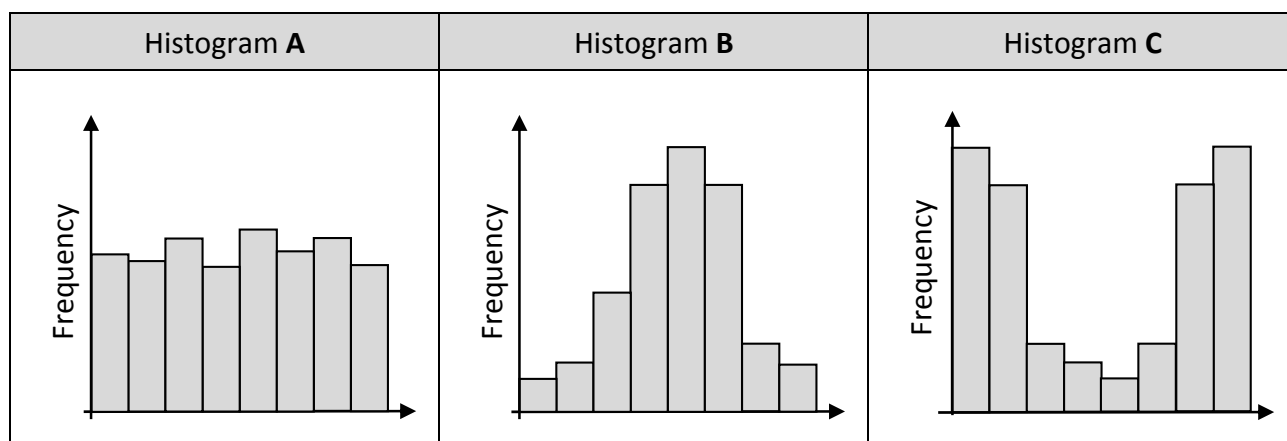
- (a) (i) Work out the **range** of the data.

[illegible]

- (ii) Work out the **inter-quartile range** of the data.

[illegible]

(b) The table below shows three histograms.



Each of the histograms above matches one of the statements in the table below.

Write **A**, **B**, and **C** in the correct places in the table to show which histogram matches each statement.

Statement	Histogram (A, B, or C)
Inter-quartile Range = $\frac{1}{4}$ of Range	
Inter-quartile Range = $\frac{1}{2}$ of Range	
Inter-quartile Range = $\frac{3}{4}$ of Range	

(c) Justify your answer for Histogram B.

Question 6 (Suggested maximum time: 20 minutes)

Question 6 (Suggested maximum time: 20 minutes)

16 girls and 14 boys went on a school tour to Barcelona.

The weight of each student's bag (in kg) is shown in the tables below.

Girls			
5·8	6·3	6·9	7·6
7·8	8·0	8·1	8·7
9·1	9·4	9·5	9·6
9·8	9·8	9·8	11·3

Boys			
5·9	6·8	7·4	8·5
8·6	8·7	8·8	9·2
9·4	9·5	9·5	9·7
9·7	10·5		

- (a) The mean weight of the girls' bags was 8.6 kg, correct to one decimal place. Work out the **mean weight** of the **boys'** bags, correct to one decimal place.

[illegible]

- (b)** Use the data in the tables above to complete the following frequency table.

Weight (kg)	5 – 6	6 – 7	7 – 8	8 – 9	9 – 10	10 – 11	11 – 12
Number of Girls' bags		2					
Number of Boys' bags		1					

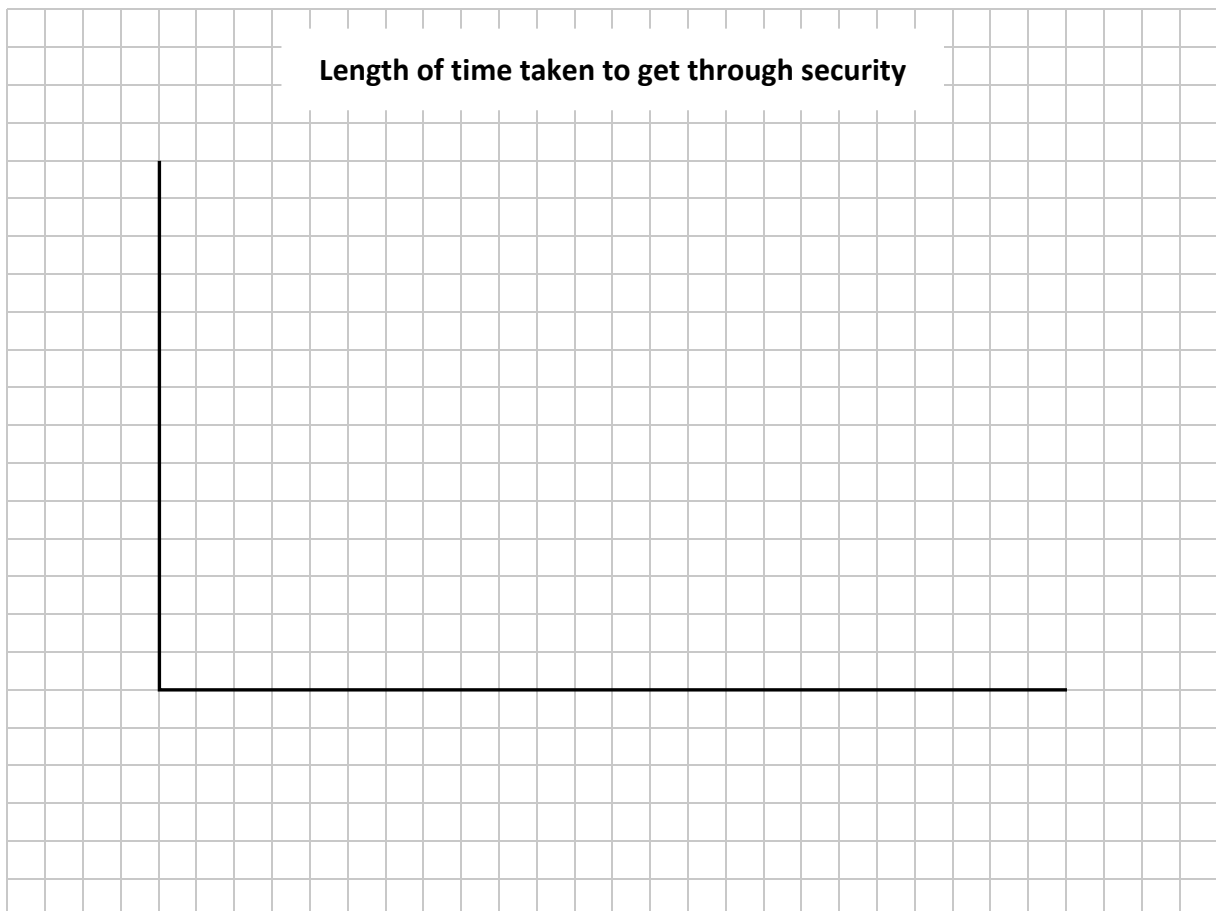
[Note: 5 – 6 means 5 kg or more but less than 6 kg, etc.]

[illegible]

- [illegible]

Time (minutes)	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25	25 – 30
Number of students	4	8	11	6	0	1

(d) Draw a **histogram** to represent this data. Label each axis clearly.



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The table below shows the amount of money that the 30 students spent at the airport.

Amount of money (€)	0 – 5	5 – 10	10 – 20	20 – 30	30 – 50	50 – 100	100 – 150
Number of students	5	4	7	8	3	1	2

[Note: 5 – 10 means €5 or more but less than €10, etc.]

- (e) Use **mid-interval values** to estimate the **mean** amount of money spent. Give your answer in euro, correct to the nearest cent.

A full-page view of a blank sheet of graph paper. The grid consists of thin, light gray horizontal and vertical lines forming small squares across the entire page. There are no margins, text, or other markings on the paper.

- (f) Use the values in the table to estimate the **median** amount of money spent, as accurately as you can. **Justify** your answer.

Remember that there were 30 students in total.

A full-page view of a blank sheet of graph paper. The grid consists of thin, light gray horizontal and vertical lines forming small squares across the entire page. There are no margins, text, or other markings on the paper.

Question 7 (Suggested maximum time: 15 minutes)

Question 7 (Suggested maximum time: 15 minutes)

- (a) The line j has a slope of $\frac{2}{5}$. The line n is **perpendicular** to j .

- (i)** Write down the size of the angle between the lines j and n .

- (ii) The line n goes through the point $(6, -1)$.
Write down the **equation** of the line n . You do not need to simplify your answer.

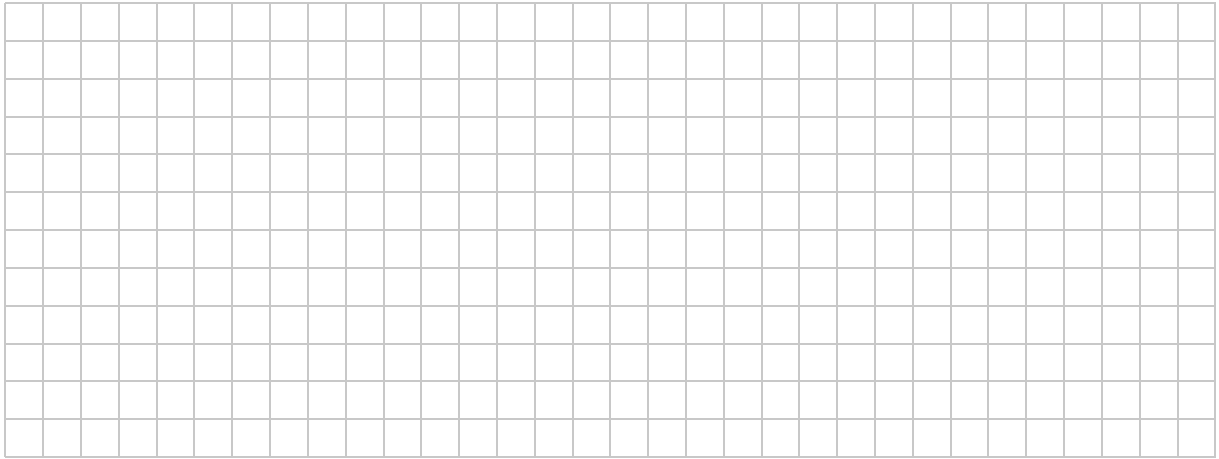
[illegible]

- (b)** The equations of two other lines, k and l , are given in the table below.

- (i) Complete the table by filling in the **slope** of each line and the **point** where each line crosses the y -axis. There is space for more work on the next page.

	Equation	Slope	Point where the line crosses the y -axis
Line k	$y = x - 1$		
Line l	$2x - 3y = 6$		

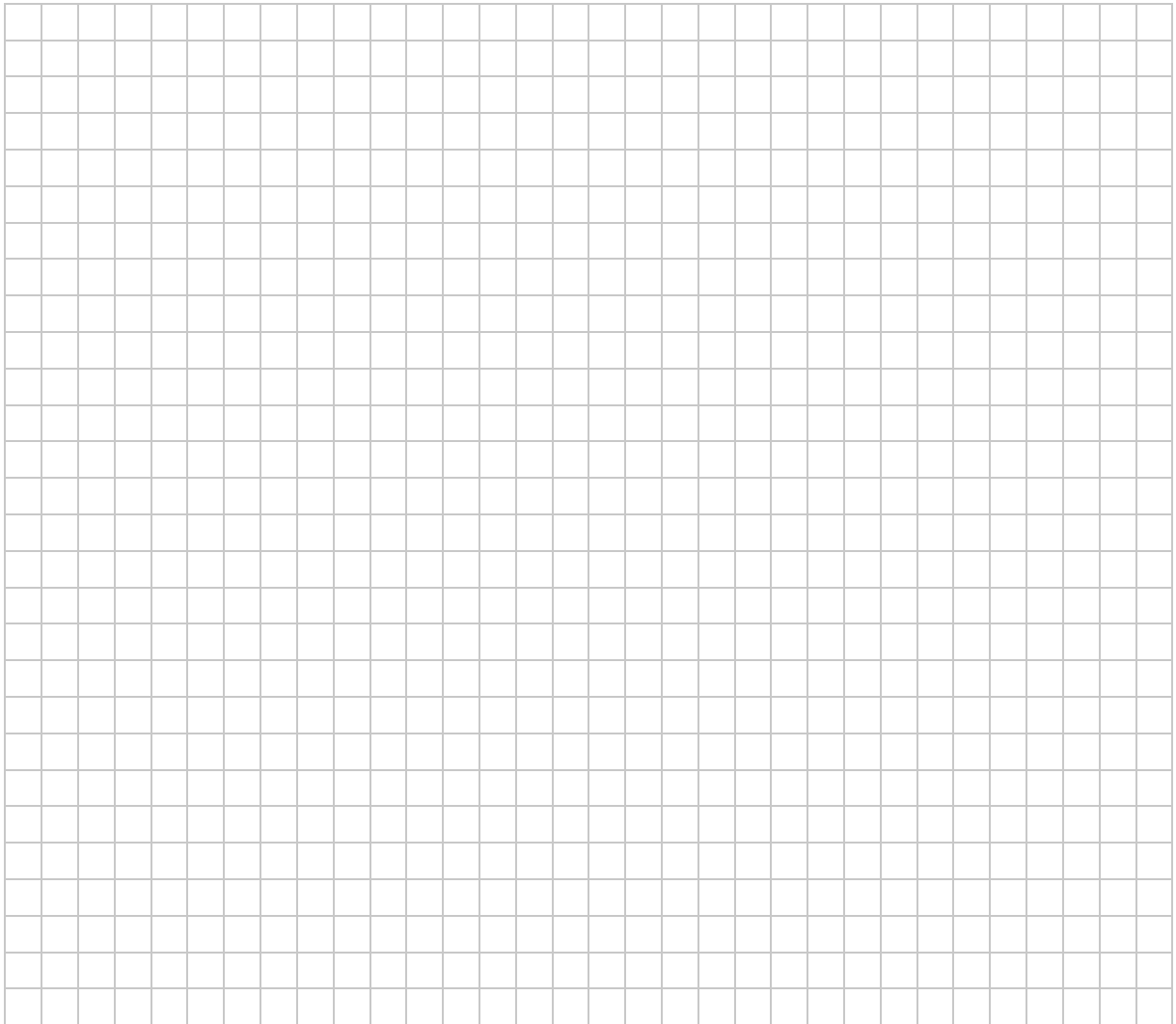
A full page of blank graph paper with a uniform grid of small squares. The grid consists of 20 columns and 15 rows, providing a total of 300 square units for drawing or calculation.



(ii) Use **algebra** to find the point of intersection of the lines k and l .

Line k : $y = x - 1$

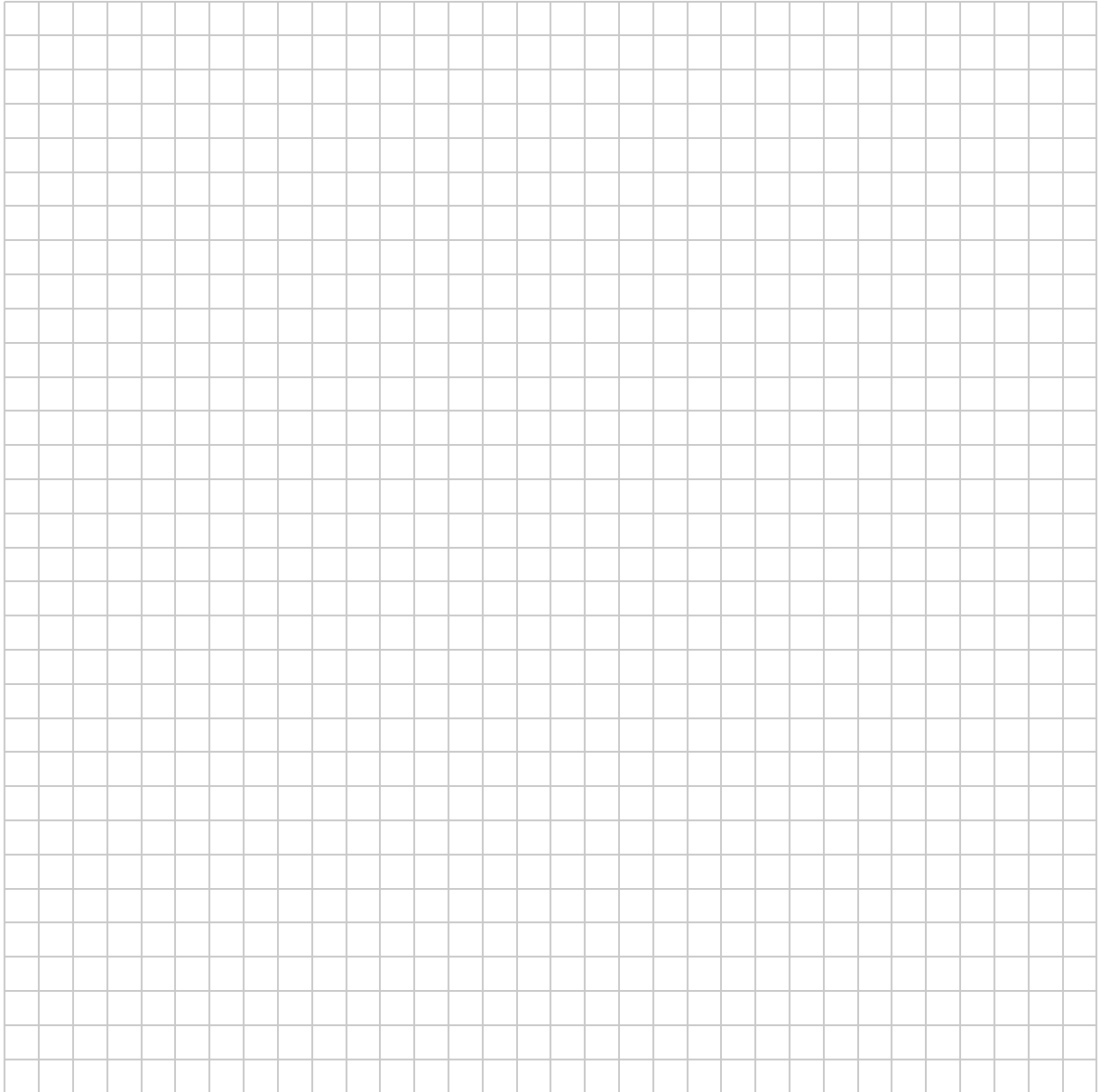
Line l : $2x - 3y = 6$



Question 8**(Suggested maximum time: 5 minutes)**

The line h has a slope of -2 . It passes through the point $(1, 101)$.

Find how many points on this line have co-ordinates that are both **positive whole numbers**, including the point $(1, 101)$. **Justify** your answer fully.



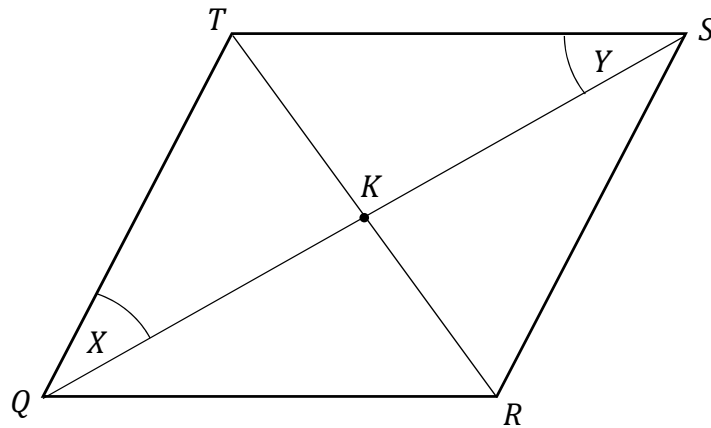
Answer =

Question 9**(Suggested maximum time: 5 minutes)**

The diagram shows the rhombus $QRST$.

It is a parallelogram in which all four sides are equal in length.

The diagonals cross at the point K . Two of the angles are marked X and Y .



Sanjay is trying to prove that the triangles QKT and SKT are congruent.

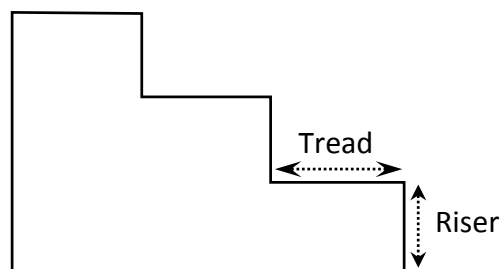
Fill in the missing statements and reasons in the table below to complete Sanjay's proof correctly.

	Statement	Reason
1.	$ QT = TS $	$QRST$ is a rhombus
2.	QST is an isosceles triangle	
3.	$ \angle X = \angle Y $	
4.		The diagonals of a parallelogram bisect each other
5.	QKT is congruent to SKT	

Question 10

(Suggested maximum time: 15 minutes)

Grace is putting some stairs into a new house. The diagram on the right shows three of the steps in the stairs. Each step consists of a riser and a tread. All of the risers in the stairs are the same size as each other, as are the treads.

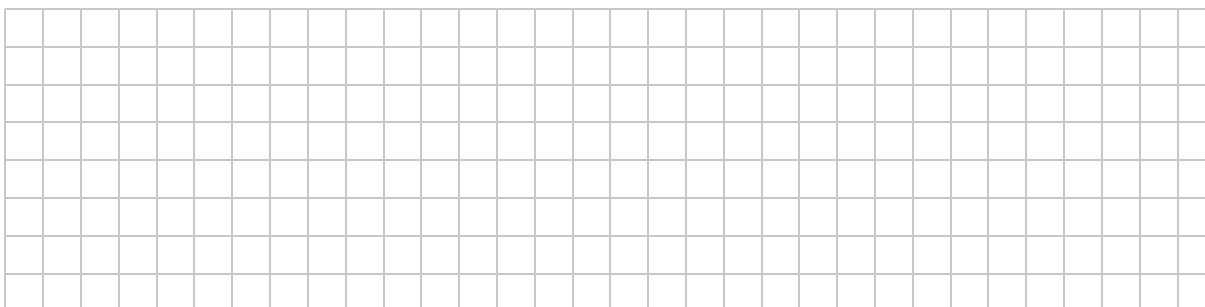


The table below shows measurements for stairs in private and public buildings. The optimum length is the best possible length.

	Tread (mm)		Riser (mm)	
	Minimum	Optimum	Optimum	Maximum
Private	220	250	175	220
Public	280	300	150	180

Grace's stairs will have the **optimum** size step for a **private** building.

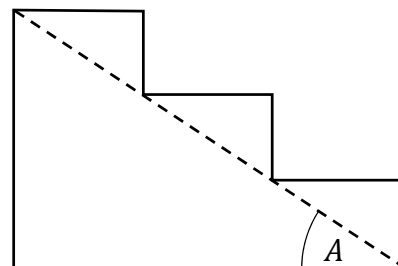
- (a) Grace's stairs will climb a total vertical height of 2.1 m (i.e. the sum of the risers is 2.1 m). Work out the horizontal length of Grace's stairs (i.e. the sum of the treads).



- (b) The angle of elevation of Grace's stairs is marked A in the diagram on the right.

Using trigonometry, and **without** measuring, work out the size of the angle A .

Give your answer correct to the nearest degree.



- (c) Write down the length of the tread and the riser that would give the **maximum angle** of elevation for a **public** building. Give each answer in mm.

[illegible]

Question 11

(Suggested maximum time: 5 minutes)

F is an angle in a right-angled triangle, and $\cos F = \frac{6}{11}$.

By drawing a diagram of a right-angled triangle, find the value of $\sin F$.
Give your answer in surd form.

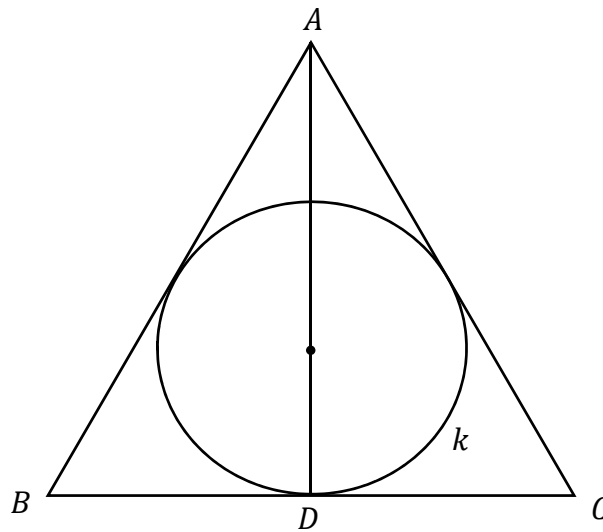
[illegible]

Question 12**(Suggested maximum time: 15 minutes)**

The diagram below shows a Horcrux.

ABC is an equilateral triangle. D is the midpoint of $[BC]$. AD is perpendicular to BC .

The circle k touches the three sides of ABC .

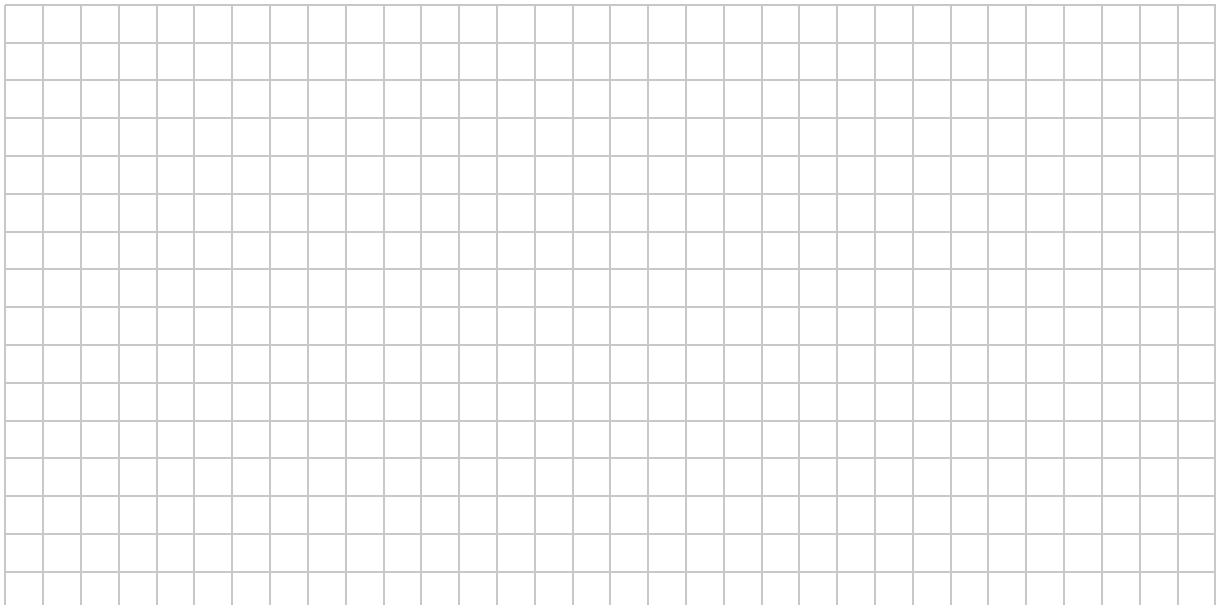


- (a) Write the correct transformation into the box below. Be as specific as you can.

" ABD is the image of ACD under

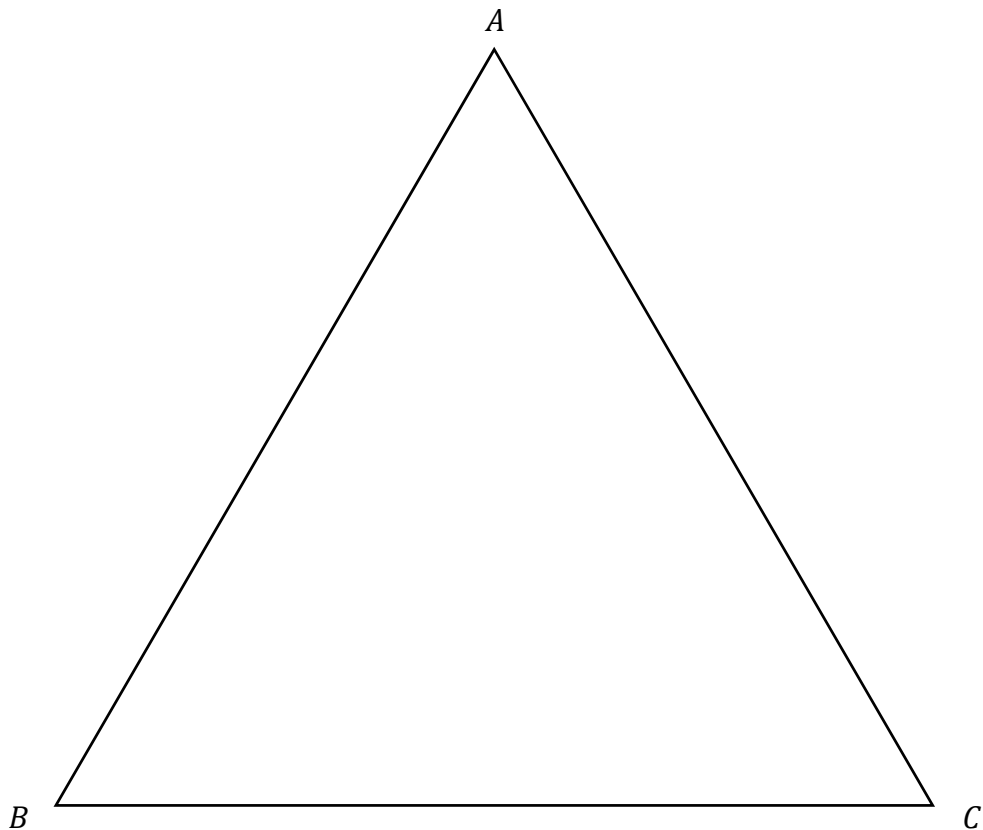
."

- (b) $|AD| = 10$ cm. Work out the length $|AB|$.
Give your answer in cm, in surd form.



- (c) The diagram below shows the triangle ABC .
Construct the rest of the Horcrux, using the following facts:
- (i) The line AD is the **perpendicular bisector** of $[BC]$.
 - (ii) The centre of the circle k is the point of intersection of AD and the **bisector** of the angle at B .

You may only use a compass and straight edge. Show all of your construction lines clearly.



Question 13

(Suggested maximum time: 10 minutes)

When she is on holidays, Barbara sees the building shown on the right. She wants to estimate the surface area of one of the spheres in the building.

She estimates that the **radius** of this sphere is 9 m.

- (a) Using Barbara's estimate for the radius, work out her estimate of the **surface area** of this sphere. Give your answer in m^2 , in terms of π .



A black and white photograph of the Seattle Center's 'Space Needle' structure. The image shows the lower portion of the tower, including the observation deck and the lattice structure. The tower is surrounded by trees and a parking lot with a 'P' sign. The image is positioned on the right side of a large grid of squares.

The **actual radius** of this sphere is between 8 m and 10 m, inclusive.

- (b)** Work out the **maximum** value of the **percentage error** in Barbara's estimate of the surface area of this sphere (i.e. the error as a percentage of the actual surface area).
Give your answer correct to the nearest percent.

Source of the image: <https://commons.wikipedia.org>. Altered.

Question 14

(Suggested maximum time: 5 minutes)

A pizzeria has the following poster:



A 9 inch pizza is in the shape of a circle with a **diameter** of 9 inches.

Each Big Pizza is in the shape of a bigger circle, and is divided into **6 slices of equal area**.

Use the information in the poster to work out the **radius** of a Big Pizza.

Give your answer in inches in the form $\frac{3^p}{2}$, where $p \in \mathbb{Q}$.

A full-page sheet of white graph paper featuring a uniform grid of thin, light gray horizontal and vertical lines. The grid consists of small squares covering the entire area of the page.

Page for extra work.

Label any extra work clearly with the question number and part.

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This image shows a full page of blank graph paper. The grid consists of thin, light gray horizontal and vertical lines that intersect to form small squares across the entire surface. There are no margins, text, or other markings on the paper.

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