Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination 2017

Mathematics

Paper 2
Higher Level

Monday 12 June
Morning 9:30 – 12:00

300 marks

Examination Number

Centre Stamp

Running Total	

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

Grade

Instructions

There are 12 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. You may 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 will lose marks if you do not show all necessary work.

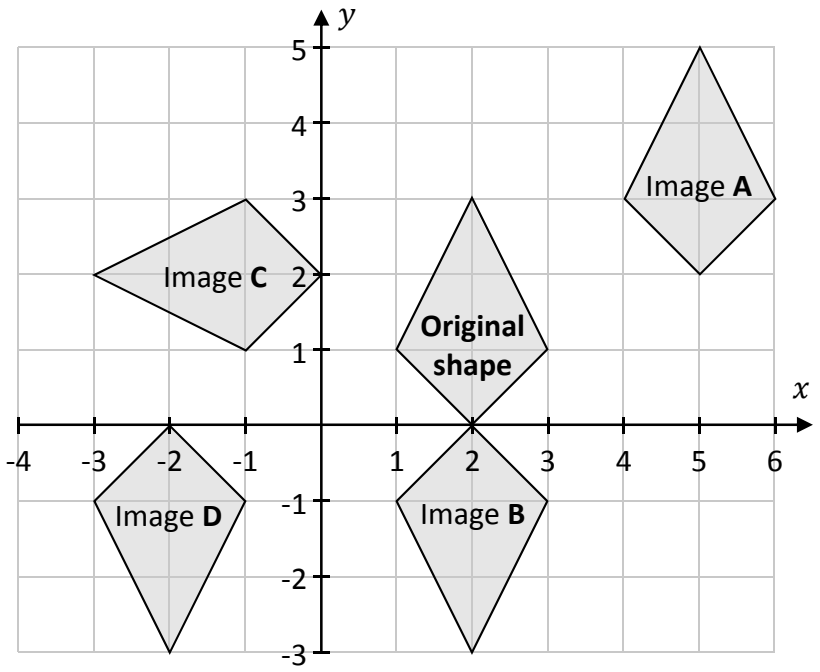
You may lose marks if you do not include the appropriate units of measurement, where relevant.

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:

Question 1 **(Suggested maximum time: 5 minutes)**

The co-ordinate diagram below shows an original shape, and its image under four transformations.

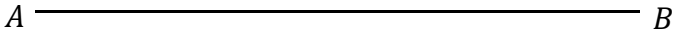


Write **A**, **B**, **C**, and **D** into the appropriate places in the table below, to show which image comes from each transformation. You may use each letter only **once**.

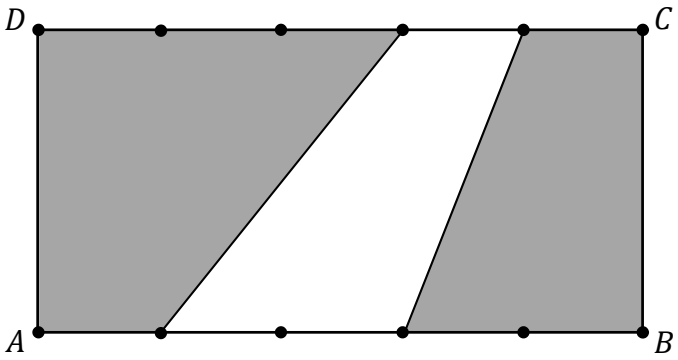
Transformation	**Image** (**A**, **B**, **C**, or **D**)
Axial Symmetry	
Central Symmetry in $(0, 0)$	
Rotation about $(0, 0)$	
Translation	

Question 2 **(Suggested maximum time: 10 minutes)**

(a) The diagram shows the line segment $[AB]$.
Divide the line segment into **three** equal parts, without measuring it.
Show all of your construction lines clearly.



(b) The diagram below shows the rectangle $ABCD$.
$[AB]$ and $[CD]$ are each divided into five equal parts.
Some of the endpoints of these parts are joined by line segments, as shown.



Find the **percentage** of the area of $ABCD$ that is **shaded**. Show all of your working out.

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

Keri has some ball bearings. Each one is in the shape of a sphere with a radius of 6 mm.

(a) Find the **volume** of one ball bearing. Give your answer in mm^3 in terms of π.

Keri is going to melt down some of her ball bearings.
She will use this material to make a sphere of radius 25 mm.

(b) Find the least number of ball bearings Keri must melt down so that she has enough material to make a sphere of radius 25 mm.

Keri has 350 ball bearings in total.

(c) Find the radius of the biggest sphere Keri could make, if she melted down all 350 ball bearings. Give your answer correct to the nearest millimetre.

Question 4 **(Suggested maximum time: 15 minutes)**

The stem and leaf diagram below shows the number of copies of the *Newry News* sold each week over 17 weeks in a particular shop.

The value in the diagram for one of the weeks is p, where $p \in \mathbb{N}$, $1 \leq p < 10$.

0	8					
1	6	6	7	9	9	9
2	0	1	5	6	8	
3	2	4				
4	1	3	p			

Key: $3|2 = 32$ copies of the *Newry News*

(a) The **range** of the data is 39. Find the value of p.

$p =$

(b) Find the value of each of the following statistics for this data:

(i) the **mode**

(ii) the **median**.

(c) The **sum** of the data in the stem and leaf diagram is 431.
Use this fact to find the **mean** of the data, correct to one decimal place.

(d) In the 18th week there was a special issue of the *Newry News*, and there were a lot more copies of it sold than in any of the other weeks.

(i) Find the **modal** number of copies sold per week over the whole 18 weeks (i.e. the mode).

(ii) Find the **median** number of copies sold per week over the whole 18 weeks.

(iii) The **mean** number of copies sold per week over the whole 18 weeks was 28·5. Work out the number of copies that were sold in the 18th week.

Question 5 **(Suggested maximum time: 10 minutes)**

A box contains red pens and blue pens.

The probability that a pen picked at random from the box is **red** is $\frac{2}{7}$.

(a) Write down **three** possible values for the number of **red** pens in the box.

(b) Find the **probability** that a pen picked at random from the box will be **blue**.

(c) Explain why there **cannot** be exactly 20 pens in **total** in the box.

(d) Some green pens are put into the box, so that 25% of the pens in the box are now green.
One pen is then picked at random from the box.
Find the **probability** that this pen is **blue**.
Give your answer as a fraction, in its simplest form. Show all of your working out.

Question 6 **(Suggested maximum time: 15 minutes)**

Clara asked all of the students in her school some questions about their eating and exercise.
One of Clara's questions was:

How healthy is your diet? Tick one box.			
Very healthy	Fairly healthy	Not very healthy	Very unhealthy
❑	❑	❑	❑

She drew a pie chart to show her results.
Her results, and the size of each angle in the pie chart, are shown in the table below.

Category	Very healthy	Fairly healthy	Not very healthy	Very unhealthy
Number of students		150	170	
Size of angle (degrees)	96°	90°		

(a) Find the **probability** that a student chosen at random from those surveyed ticked "Very healthy" **or** "Fairly healthy".

(b) Complete the table above.
Note: 90° in the pie chart represents 150 students.

This question continues on the next page.

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(c) Complete the table below to show one question in each case that Clara could ask that would generate each type of data. Each question should be about eating or exercise. One is already filled in.

Type of Data	Question
Numerical continuous	
Numerical discrete	
Categorical ordinal	How healthy is your diet? Tick one box. Very healthy ❑ Fairly healthy ❑ Not very healthy ❑ Very unhealthy ❑
Categorical nominal	

(d) Clara is worried that the students in her school are not a representative sample of all of the students in Ireland.

Explain why it is important to have a **representative** sample when doing statistical research.

Question 7 **(Suggested maximum time: 5 minutes)**

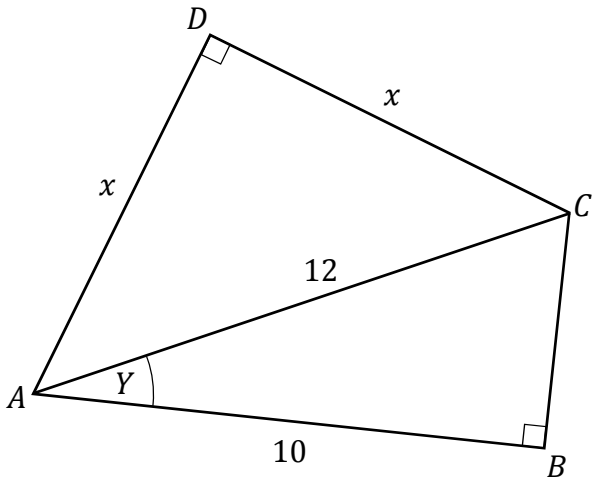
Rosie and Gary are out for a walk and decide to estimate the height of a local tower.
They have no measuring tape, so they use one of Gary's shoes.

They measure the tower's shadow and find that it is 30 shoe lengths long.
They measure Rosie's shadow and find that it is 4 shoe lengths long.
Rosie knows that she is 140 cm tall.

Use this information to estimate the height of the tower. Give your answer in metres.
It might be helpful to draw a diagram.

Question 8 **(Suggested maximum time: 15 minutes)**

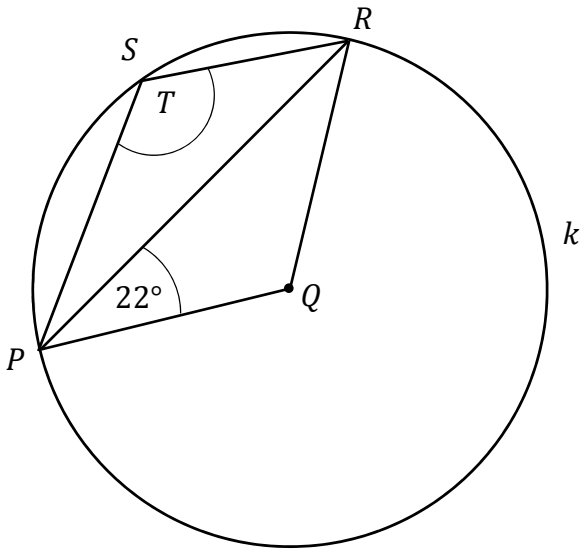
(a) The diagram below shows two right-angled triangles, ABC and ACD.
They have right angles at B and D, respectively.
$|AB| = 10$, $|AC| = 12$, and $|AD| = |DC| = x$, as shown.
The angle BAC is marked Y.



(i) Use trigonometry to find the size of the angle Y.
Give your answer correct to one decimal place.

(ii) Find the value of x. Give your answer correct to two decimal places.

(b) The diagram below shows two different triangles, PQR and RSP.
The points R, S, and P are on the circle k, and Q is the centre of the circle k.
$|\angle QPR| = 22°$, as shown. The angle PSR is marked T.



Find the size of the angle T. Show all of your working out.

Question 9 **(Suggested maximum time: 15 minutes)**

(a) The following three terms are used in geometry:

Corollary **Proof** **Axiom**

Write each of these terms in the table below to match each term to its description.

Description	Term
A statement that is accepted without proof.	
A statement that follows easily from a previous statement.	
An argument showing that a statement must be true.	

(b) Salem writes the following statement:

"If a shape is a square, then it must have four right angles."

(i) Complete the **converse** of Salem's statement:

"If a shape has four right angles, then ____ ."

(ii) Is the **converse** of Salem's statement **true** or **false**? Justify your answer.

Answer:

Justification:

(c) Prove that, in a parallelogram, opposite sides are equal in length.

Diagram:

Given:

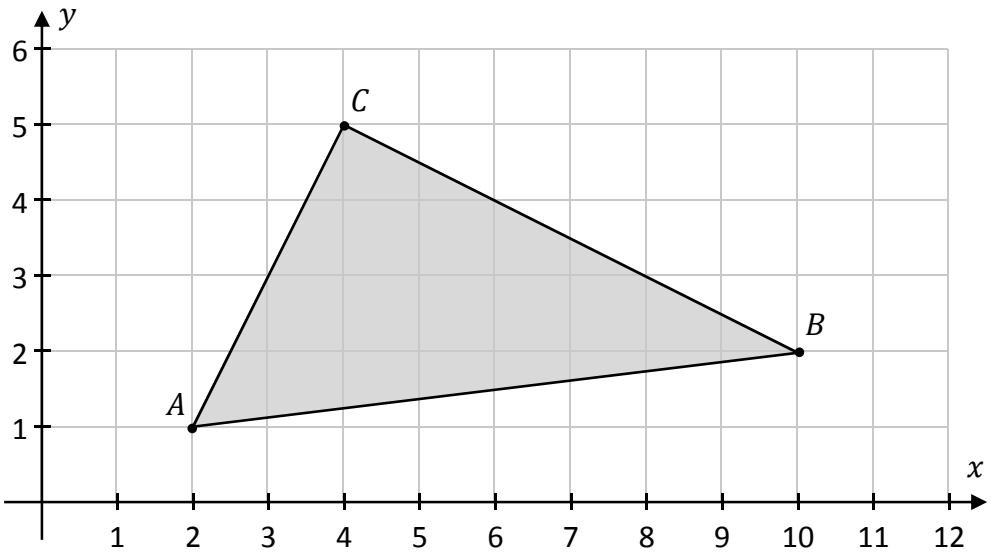
To Prove:

Construction:

Proof:

Question 10 **(Suggested maximum time: 20 minutes)**

The co-ordinate diagram below shows the triangle ABC.



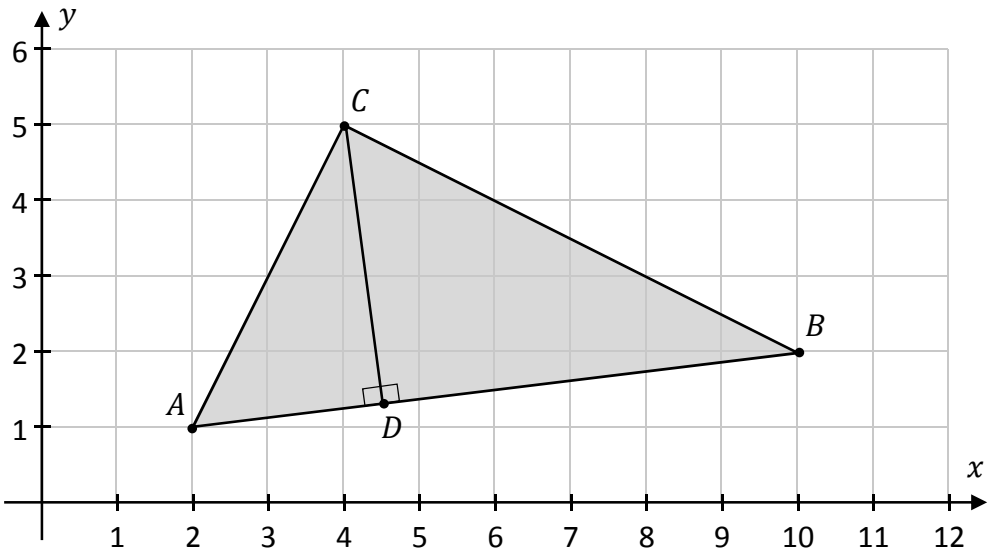
(a) Write down the co-ordinates of the points A, B, and C.

A (,)	B (,)	C (,)

(b) Show that ABC is a **right-angled** triangle, without measuring.

(c) Hence, or otherwise, show that the **area** of the triangle ABC is 15 square units.

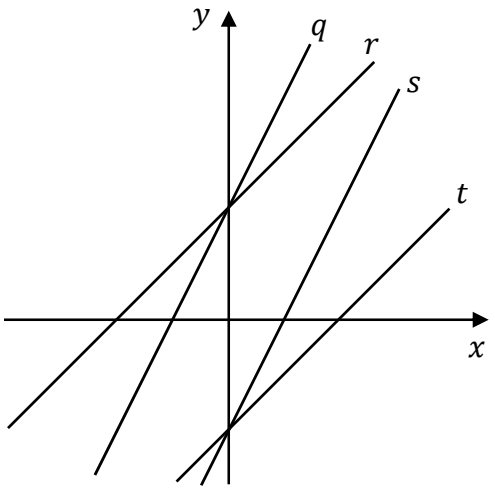
The point D lies on AB so that CD is perpendicular to AB, as shown.



(d) Find $|CD|$. Give your answer in surd form.
Remember that the area of ABC is 15 square units.

Question 11 **(Suggested maximum time: 10 minutes)**

The co-ordinate diagram below shows the lines q, r, s, and t.
q is parallel to s, and r is parallel to t.



Line ($\boldsymbol{q}$, $\boldsymbol{r}$, $\boldsymbol{s}$, or $\boldsymbol{t}$)	**Equation**
	$y = x + 3$
	$y = x - 3$
	$y = 2x + 3$
s	

(a) Complete the table above to show the equation of each line in the diagram.
Three equations and one line are already filled in.

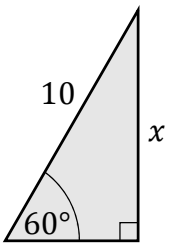
(b) Use **algebra** to find the point of intersection of the lines $y = x - 3$ and $y = 2x + 3$.

(c) The line l is a vertical line.
It cuts the line $y = x - 3$ at the point A.
It cuts the line $y = x + 3$ at the point B.

Find the **distance** $|AB|$.

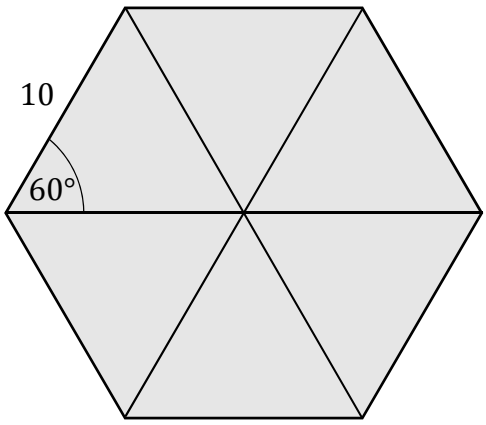
Question 12 **(Suggested maximum time: 10 minutes)**

The diagram on the right shows a right-angled triangle with a hypotenuse of length 10 units.



(a) Use trigonometry to find the length of the side marked x.
Give your answer in surd form.

The diagram below shows a regular hexagon with sides of length 10 units.
The hexagon is divided into 6 equilateral triangles.



(b) Work out the **area** of this hexagon. Give your answer in the form $a\sqrt{3}$, where $a \in \mathbb{N}$.

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