Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination, 2013
Sample Paper

Mathematics
(Project Maths – Phase 3)

Paper 2

Higher Level

Time: 2 hours, 30 minutes

300 marks

Examination number

Centre stamp

Running total	

For examiner			
Question	Mark	Question	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8			
9			
10		Total	

Grade

Instructions

There are 17 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. 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.

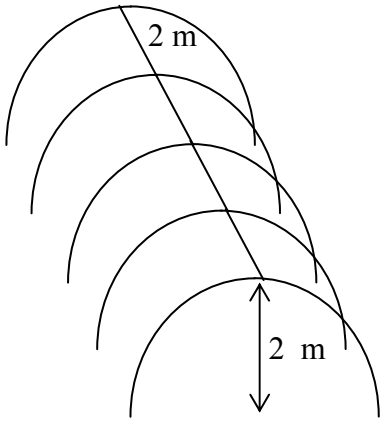
Write the make and model of your calculator(s) here:

Question 1 **(Suggested maximum time: 20 minutes)**

Deirdre constructs a "polytunnel" on a level part of her back garden. Five vertical, semicircular metal hoops, each of radius 2 m are attached to brackets at ground level and covered with a polythene sheet. The hoops are 2 m apart.

(a) Find the area of ground covered by the tunnel.

(b) The hoops are also held in place by a straight piece of metal attached at the top of each hoop. Find the total length of metal needed to construct the tunnel.



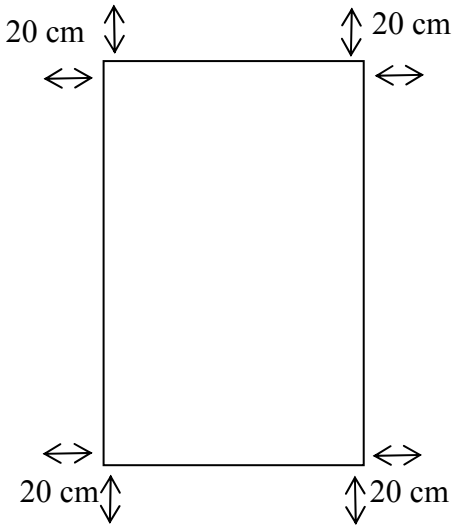
(c) The polythene is buried in the ground to a depth of 25 cm all around the tunnel (including both ends). Find the dimensions and area of the smallest rectangular sheet of polythene that can be used.

Length: Width:

Area:

(d) Find the volume of air in the tunnel.

(e) To finish, Deirdre constructs a rectangular raised bed of height 25 cm inside the tunnel. There is a space of 20 cm between the bed and each side of the tunnel. The bed is then filled with topsoil. Soil costs €80 per tonne and 1 m^3 of soil weighs 0·75 tonnes. Find the cost of filling the bed with soil.



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

In an experiment, a standard die is tossed 600 times.
The results are partially recorded in the table below.

Number on die	1	2	3	4	5	6
Frequency	92	101	115	98		105

(a) Calculate the number of times that a 5 appeared. Write your answer in the table above.

(b) After looking at the results, Anne claims that the die is unbiased (fair).
Do you agree with her? Give a reason for your answer.

(c) If this die is tossed 300 times, how many times would you expect to get an even number, based on the data in the table? Give a reason for your answer.
Answer: _____

Reason:

Question 3 **(Suggested maximum time: 5 minutes)**

John is going to a festival for the weekend. Each outfit he will wear consists of a pair of jeans, a shirt, a jumper and a pair of shoes. He has packed:

3 pairs of jeans (black, navy and blue)
4 shirts (white, green, yellow and red)
2 jumpers (black and brown)
3 pairs of shoes (boots, sandals and flip-flops).

(a) Write down two examples of different outfits John could select to wear.

Example 1:

Example 2:

(b) How many different possible outfits can John wear over the weekend?

Question 4 **(Suggested maximum time: 10 minutes)**

35 people coming back from America were asked if they had visited New York, Boston or San Francisco. The results were as follows:

20 had visited New York.
13 had visited Boston.
16 had visited San Francisco.

7 had been to all three cities.

3 had been to both New York and San Francisco, but not Boston.
1 had been to both New York and Boston, but not San Francisco.
8 had been to Boston and San Francisco.

(a) Display this information in a Venn diagram.

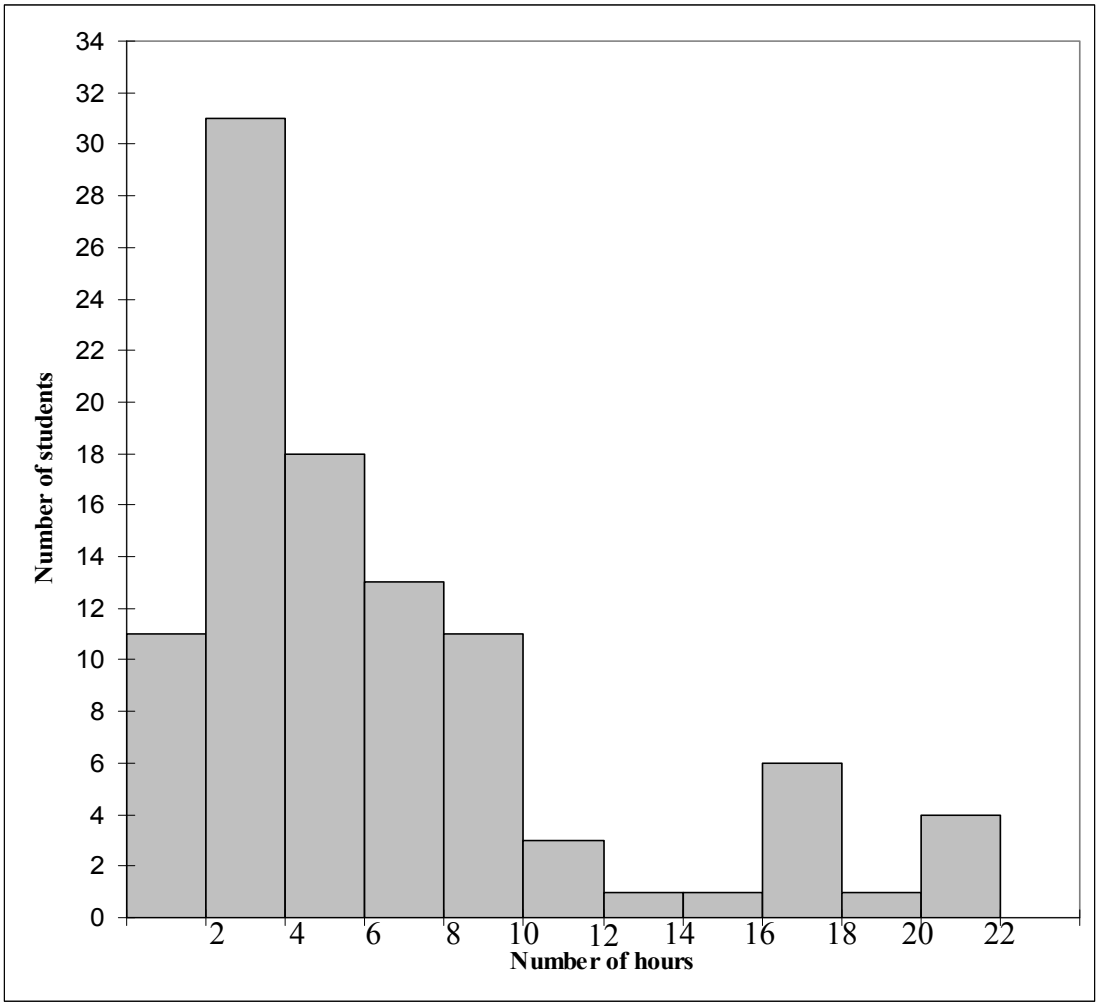
(b) If one person is chosen at random from the group, what is the probability that the person had not visited any of the three cities?

(c) If one person is chosen at random, what is the probability that the person had visited New York only?

(d) If one person is chosen at random, what is the probability that the person had visited Boston or New York?

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

The phase 9 *CensusAtSchool* questionnaire contained the question "Approximately how long do you spend on social networking sites each week?" The histogram below illustrates the answers given by 100 students, randomly selected from those who completed the survey.



(a) Use the data from the histogram to complete the frequency table below.

No. of Hours	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22
No. of Students											

[Note: 2-4 means 2 hours or more but less than 4 hours, etc.]

(b) What is the modal interval? _____

(c) Taking mid-interval values, find the mean amount of time spent on social networking sites.

(d) John is conducting a survey on computer usage by students at his school. His questionnaire asks the same question. He plans to carry out his survey by asking the question to twenty first year boys on the Monday after the mid-term break. Give two reasons why the results from John's question might not be as representative as those in the histogram.

Question 6 **(Suggested maximum time: 10 minutes)**

Three groups of 10 students in a third year class were investigating how the number of jelly beans in a bag varies for three different brands of jelly beans.

Each student counted the number of jelly beans in a bag of brand A or B or C. Their results are recorded in the tables below.

Group 1 (Brand A)

23	25	25	26	26
32	32	33	34	35

Group 2 (Brand B)

17	22	22	24	24
29	29	29	29	29

Group 3 (Brand C)

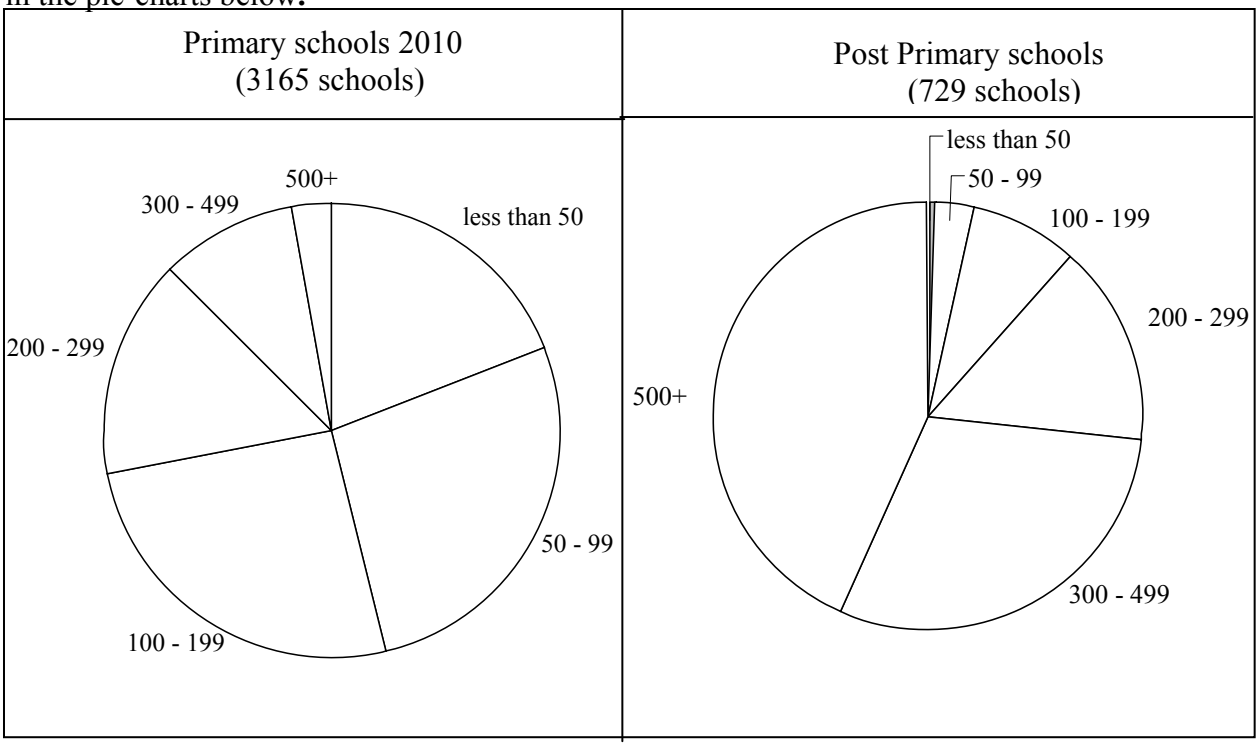
25	25	25	26	26
29	29	30	30	31

(a) Display the data in a way that allows you to describe and compare the data for each brand.

(b) If you were to buy a bag of jelly beans which brand would you buy? Give a reason for your answer based on the data provided in the tables. In your explanation you should refer to the **mean** number of jelly beans per bag, and the **range** or **spread** of the number of jelly beans per bag for each brand.

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

The number of students attending primary and second level schools in Ireland in 2010 is illustrated in the pie-charts below.

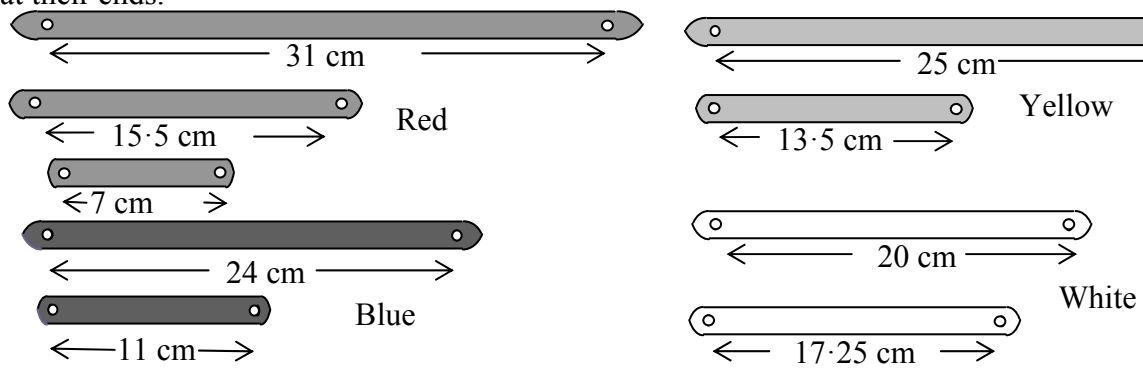


(a) The angle in the slice for Primary schools with between 100 and 199 pupils is 93·725°. Calculate the number of schools in this category.

(b) Mary claims that the charts show that there is roughly the same number of post primary schools as primary schools in the 200-299 range. Do you agree with Mary? Give a reason for your answer based on the data in the charts.

Question 8 **(Suggested maximum time: 10 minutes)**

Monica has a set of nine coloured plastic strips (long red, middle red, short red, etc.) as shown below. The strips can be joined together, to form geometrical objects, by pins through small holes at their ends.



(a) Is it possible to make an object in the shape of an isosceles triangle using any three of the nine strips? Give a reason for your answer.

Answer:
Reason:

(b) Monica would like to join four strips together to form an object in the shape of a parallelogram. Explain why it is not possible to do this.

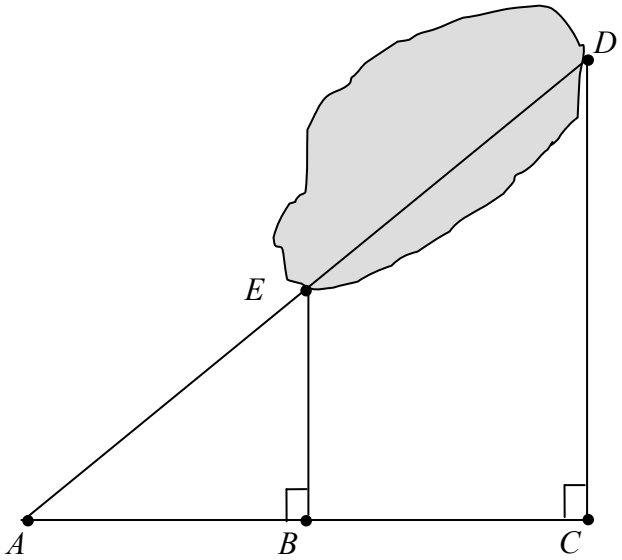
(c) The long yellow, long blue and short red strips are used to form an object in the shape of a triangle. Monica thinks that this might be a right angled triangle. Investigate if she is correct.

(d) Monica uses the long blue and the long white strips to form the arms of a right angle. Find the length of a strip that would be needed to complete this triangular shape. Give your answer correct to two decimals places.

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

Three paths, [*AE*], [*BE*] and [*CD*], have been constructed to provide access to a lake from a road *AC* as shown in the diagram.

The lengths of the paths from the road to the lake are as follows:
$|AE| = 120$ m
$|BE| = 80$ m
$|CD| = 200$ m.

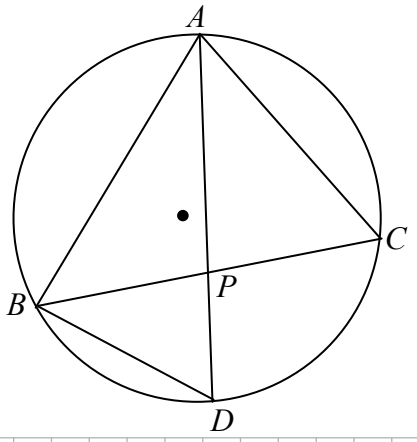


(a) Explain how these measurements can be used to find $|ED|$.

(b) Find $|ED|$.

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

A, B, C and *D* are four points on a circle as shown.
[*AD*] bisects $\angle BAC$.
P is the point of intersection of *AD* and *BC*.

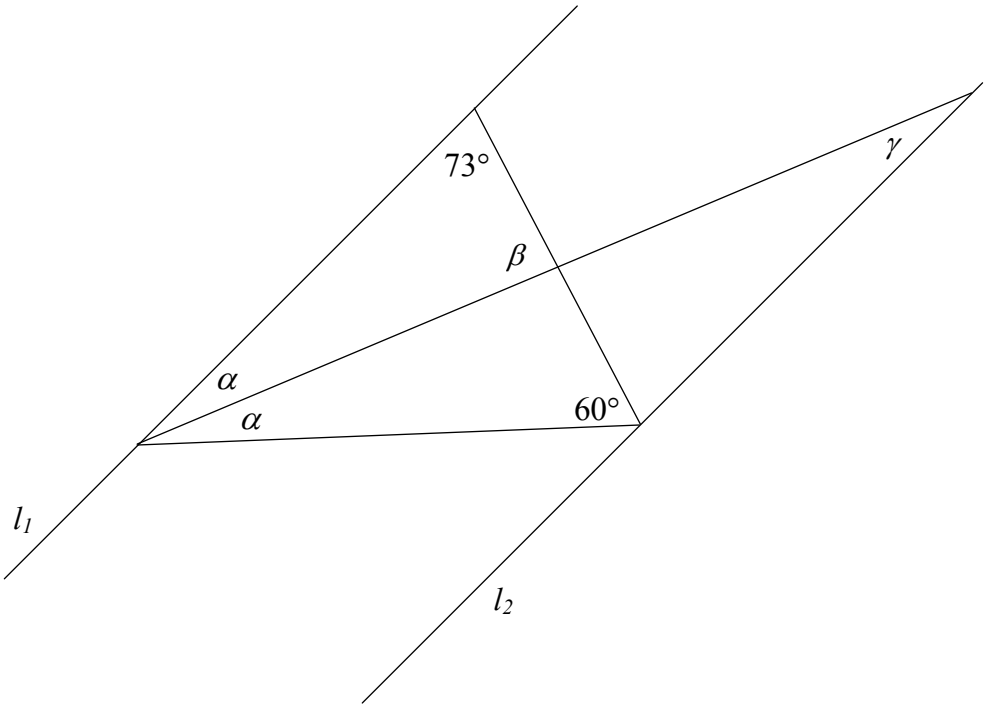


(a) Show that ΔADB and ΔAPC are similar.

(b) Show that $|AC| \cdot |BD| = |AD| \cdot |PC|$

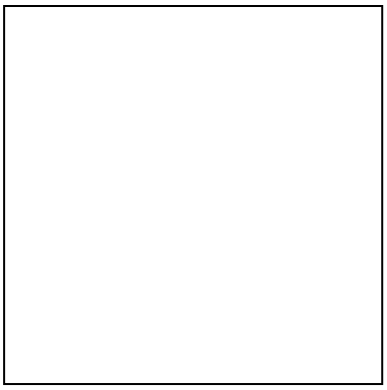
Question 11 **(Suggested maximum time: 5 minutes)**

If $l_1 \parallel l_2$, find the sizes of the angles α, β and γ in the following diagram.



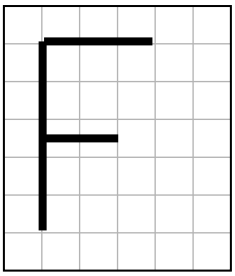
Question 12 **(Suggested maximum time: 5 minutes)**

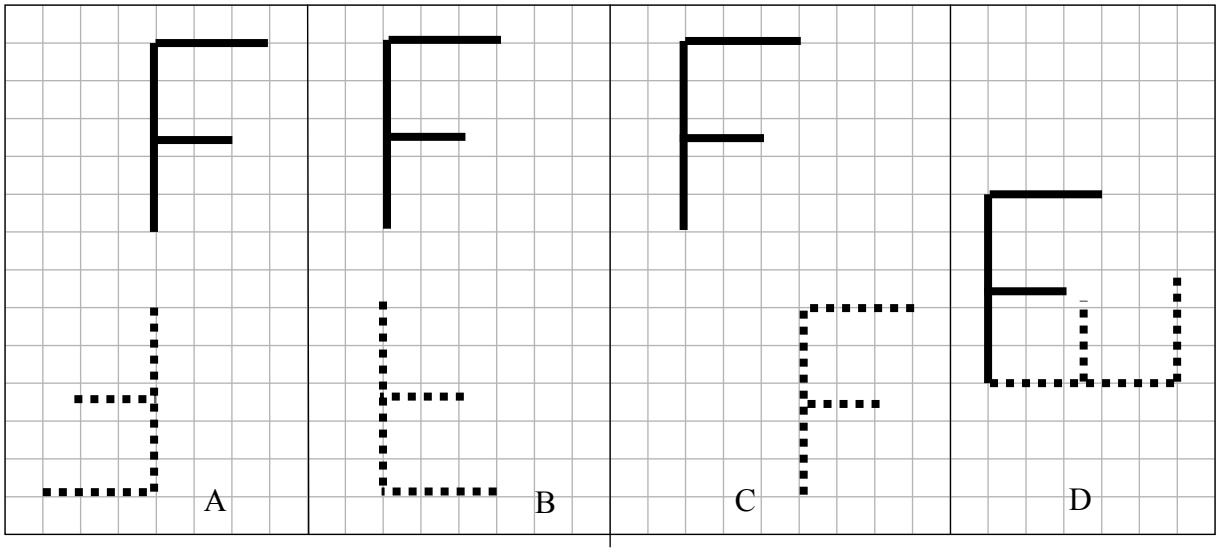
(a) The diagram shows a square.
Draw in all its axes of symmetry.



(b) Each of the four diagrams A, B, C and D shows the object in **Figure 1** and its image under a transformation. For each of A, B, C and D, state one transformation (translation, axial symmetry or central symmetry) that will map the object onto that image.

Figure. 1





A

B

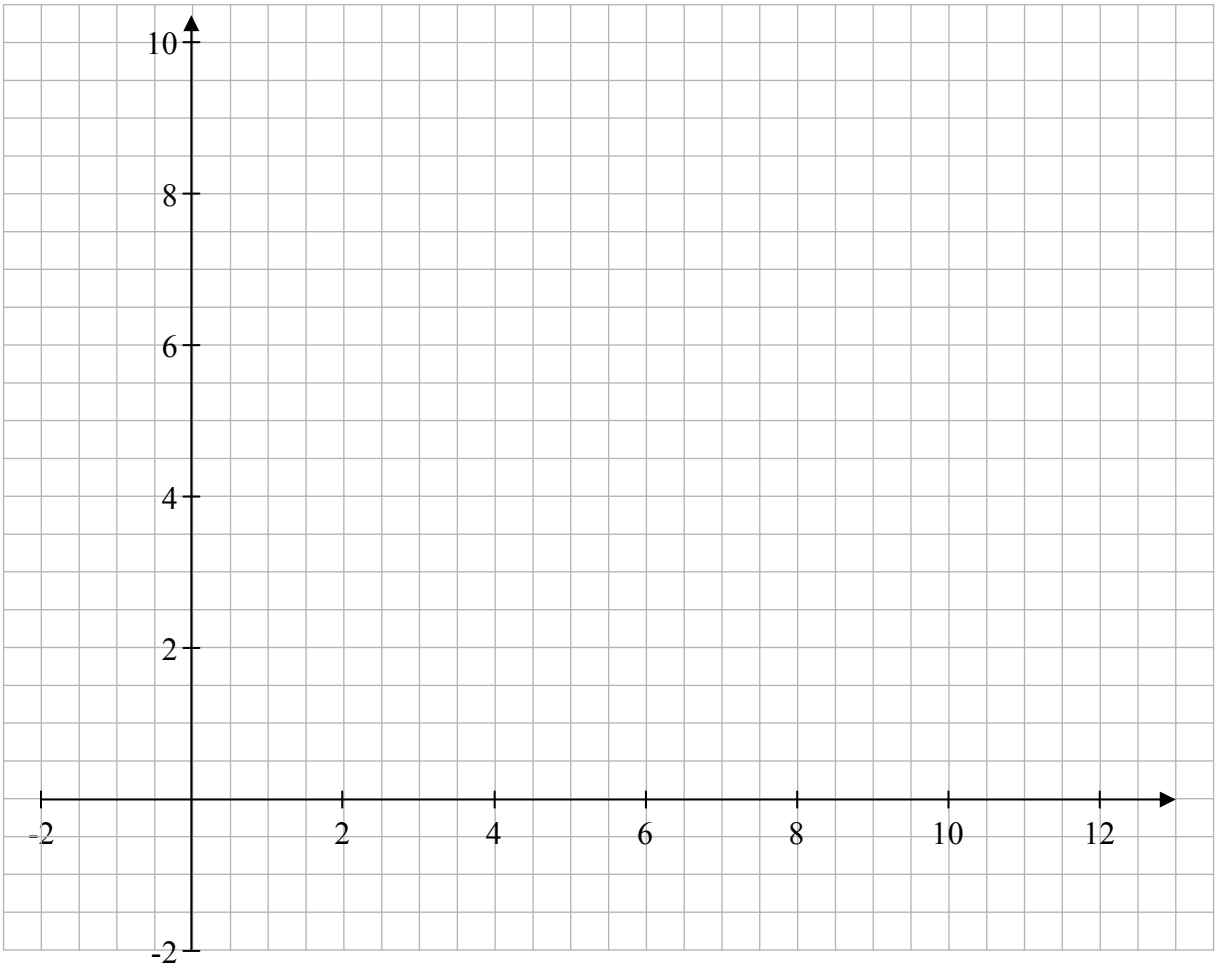
C

D

Question 13 **(Suggested maximum time: 10 minutes)**

$A(2, 3)$, $B(10, 4)$, $C(12, 9)$, and $D(4, 8)$ are four points.

(a) Plot the points on the coordinate plane below and join A to B, B to C, C to D and D to A to form the quadrilateral $ABCD$.



(b) Verify that **one pair** of opposite sides of $ABCD$ are equal in length.

(c) By finding E and F, the midpoints of $[AC]$ and $[BD]$ respectively, verify that the diagonals of $ABCD$ bisect each other.

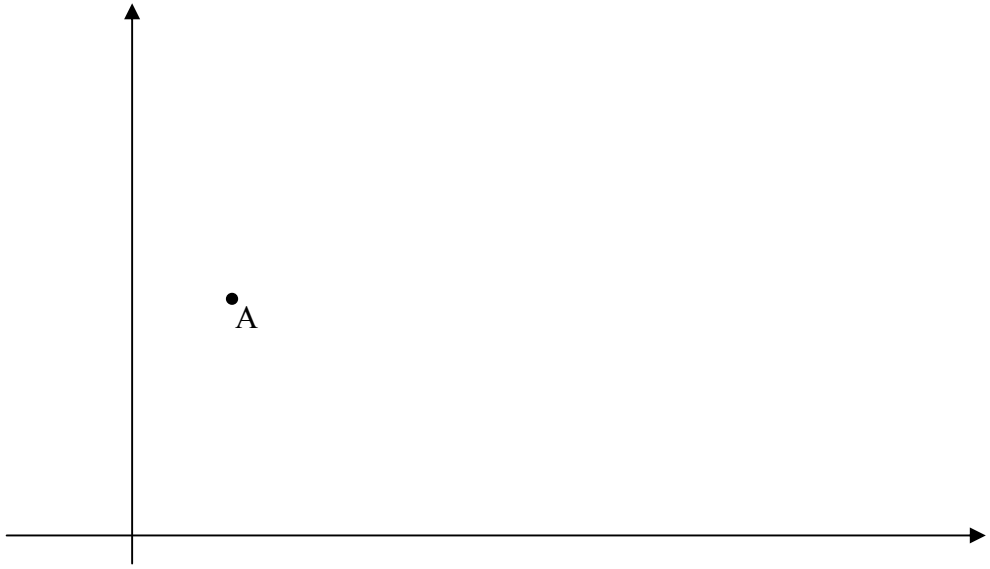
(d) Can you now conclude that $ABCD$ is a parallelogram? Give a reason for your answer.

Question 14 **(Suggested maximum time: 5 minutes)**

The point A is shown on the coordinate plane.
The same scale is used on both axes.

(a) Draw and label a line l_1 through A which has a slope of $\frac{1}{2}$.

(b) Draw and label a line l_2 through A which has a slope of -2.



Question 15 **(Suggested maximum time: 10 minutes)**

During a trigonometry lesson a group of students wrote down some statements about what they expected to happen when they looked at the values of trigonometric functions of some angles. Here are some of the things they wrote down.

(i) The value from any of these trigonometric functions will **always** be less than 1.

(ii) If the size of the angle is doubled then the value from the trigonometric functions will not double.

(iii) The value from all of the trigonometric functions will increase if the size of the angle is increased.

(iv) I do not need to use a calculator to find Sin 60°. I can do it by drawing an equilateral triangle. The answer will be in surd form.

They then found the sin, cos and tan of some angles, correct to three decimal places, to test their ideas.

(a) Do you think that (i) is correct? Give an example to justify your answer.

Answer: _____

Example:

(b) Do you think that (ii) is correct? Give an example to justify your answer.

Answer: _____

Example:

(c) Do you think that (iii) is correct? Give an example to justify your answer.

Answer: _____

Example:

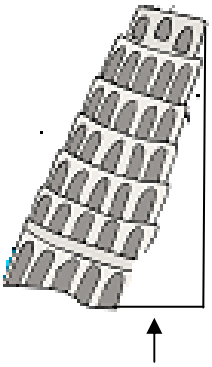
(d) Show how an equilateral triangle of side 2 cm can be used to find Sin 60° in surd form.

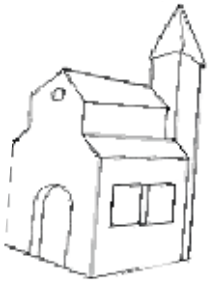
Sin 60° =

Question 16 **(Suggested maximum time: 10 minutes)**

The Leaning Tower of Pisa is 55·863 m tall and leans 3·9 m from the perpendicular, as shown below. The tower of the Suurhusen Church in north-western Germany is 27·37 m tall and leans 2·47 m from the perpendicular.

Pisa





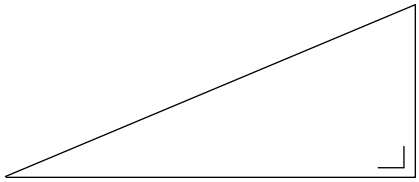
Suurhusen

By providing diagrams and suitable calculations and explanations, decide which tower should enter the *Guinness Book of Records* as the **Most Tilted Tower in the World**.

Question 17 **(Suggested maximum time: 5 minutes)**

In the right-angled triangle shown in the diagram, one of the acute angles is four times as large as the other acute angle.

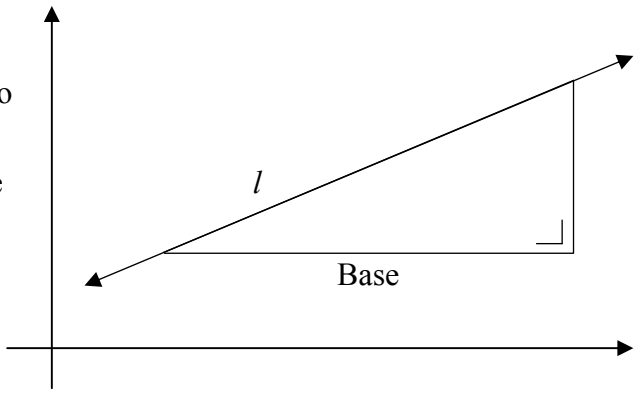
(a) Find the measures of the two acute angles in the triangle.



(b) The triangle in part **(a)** is placed on a co-ordinate diagram. The base is parallel to the x-axis.

Find the slope of the line l that contains the hypotenuse of the triangle.

Give your answer correct to three decimal places.



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Note to readers of this document:

This sample paper is intended to help teachers and candidates prepare for the June 2013 examination in the *Project Maths* initial schools. The content and structure do not necessarily reflect the 2014 or subsequent examinations in the initial schools or in all other schools.

The number of questions on the examination paper may vary somewhat from year to year.

Junior Certificate – Higher Level

Mathematics (Project Maths – Phase 3) – Paper 2

Sample Paper, 2013
Time: 2 hours 30 minutes