NCCA

An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

Project Maths
Tionscadal Mata

Pre-Leaving Certificate Examination

Mathematics (Project Maths)

Paper 2

Higher Level

February 2010 2½ hours

300 marks

Examination number

Centre stamp

Running total	

For examiner	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Grade

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 all six questions

In Section B, answer:

Question 7

Question 8

either Question 9A **or** Question 9B.

Write your answers in the spaces provided in this booklet. There is space for extra work at the back of the booklet. Extra paper may be used if needed. Label any extra work clearly with the question number and part.

The booklet *Formulae and Tables* may be used.

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

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

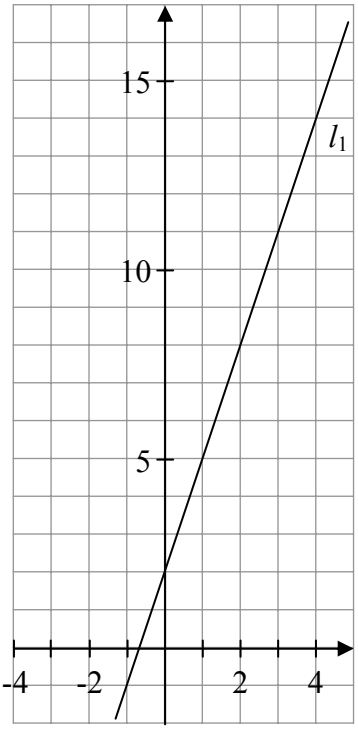
Answers should be given in simplest form, where relevant.

Section A — Concepts and Skills — 150 marks

Answer **all six** questions from this section.

Question 1 (25 marks)

The line l_1 in the diagram has slope 3 and y-intercept 2.



(a) Write down the equation of this line, in the form $y = mx + c$.

(b) On the diagram, draw and label the lines l_2 and l_3, where:
l_2 has slope 3 and y-intercept 7
l_3 has slope 1 and y-intercept 8.

(c) On the diagram, draw and label the line l_4, which is perpendicular to l_1 and passes through the point (0, 4).

(d) Determine whether l_4 passes through the point $(27, -4)$.

Question 2 **(25 marks)**

P is the point (0, 7) and Q is the point (8, 11).

(a) Find the equation of the circle with diameter PQ.

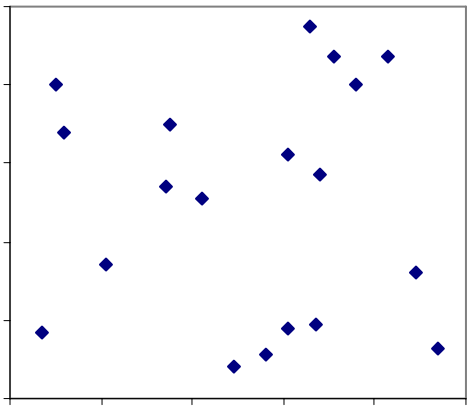
(b) Find the equation of the tangent at Q.

(c) This tangent crosses the x-axis at the point R. Find the co-ordinates of R.

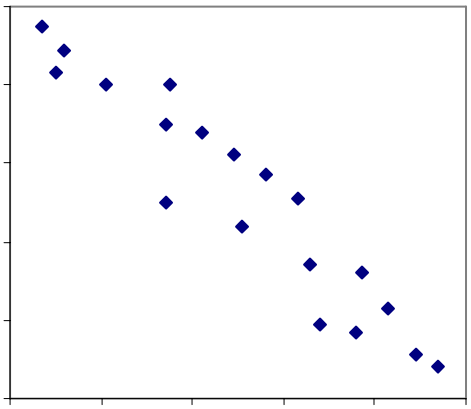
(d) Find $\overrightarrow{PQ}$ and $\overrightarrow{QR}$ in terms of $\vec{i}$ and $\vec{j}$, and verify that $\overrightarrow{PQ} \cdot \overrightarrow{QR} = 0$.

Question 3 **(25 marks)**

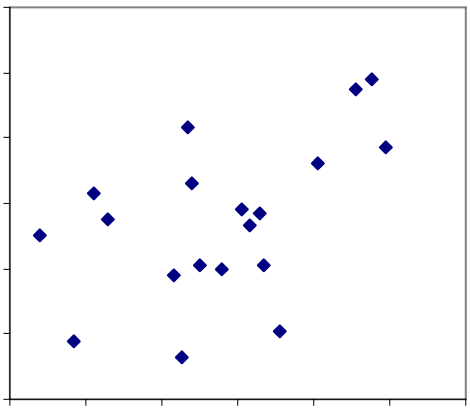
(a) For each of the four scatter plots below, estimate the correlation coefficient.



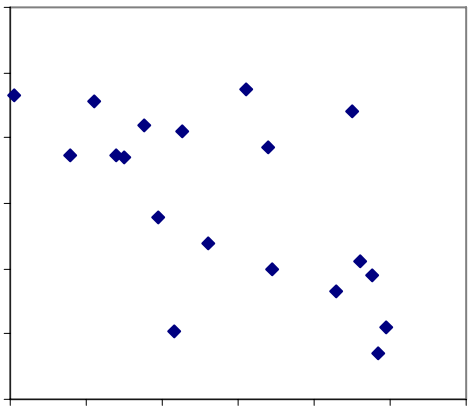
Correlation ≈ _____



Correlation ≈ _____



Correlation ≈ _____



Correlation ≈ _____

(b) Using your calculator, or otherwise, find the correlation coefficient for the data given in the table.

Give your answer correct to two decimal places.

x	y
0.0	0.5
5.0	1.3
5.2	3.3
6.1	6.7
9.3	4.5
9.5	4.6
9.9	6.5

Answer:

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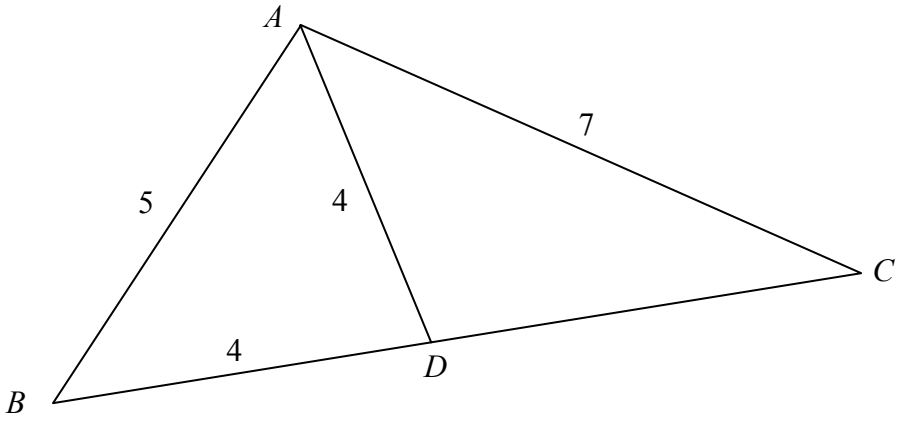
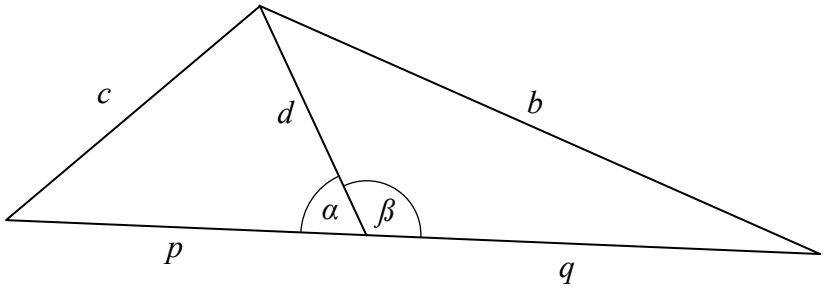
Question 4 **(25 marks)**

(a) ABC is a triangle, and D is a point on $[BC]$.
The lengths $|AB|$, $|AD|$, $|AC|$ and $|BD|$ are as shown in the diagram.



Find $|DC|$, correct to one decimal place.

(b) Consider the diagram below.



(i) Express $\cos\alpha$ and $\cos\beta$ in terms of the labelled lengths.

(ii) Show that $pb^2 + qc^2 = (p+q)(pq+d^2)$

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Question 5 **(25 marks)**

(a) The following formula relates to the *binomial distribution*.

$$P(X = r) = \binom{n}{r} p^r q^{n-r}$$

(i) State what each of the letters p, q, n, and r represents in the formula above.

p is _____

q is _____

n is _____

r is _____

(ii) Describe the type of experiment that results in a random variable that has a binomial distribution.

(b) In a certain type of archery competition, Laura hits the target with an average of two out of every three shots. The shots are independent of each other. During one such competition, she has ten shots at the target.

(i) Find the probability that Laura hits the target exactly nine times.

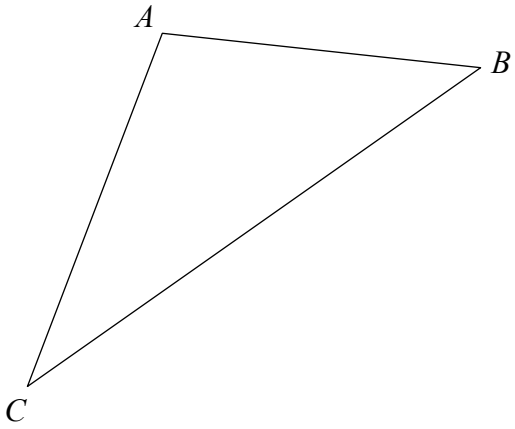
Give your answer correct to three decimal places.

(i) Find the probability that Laura hits the target fewer than nine times.

Give your answer correct to three decimal places.

Question 6 **(25 marks)**

(a) Construct the circumcircle of the triangle ABC below using only a compass and straight edge. Show all construction lines clearly.



(b) State the condition(s) under which the circumcentre of a triangle will lie **inside** the triangle, and justify your answer.

Condition(s):

Justification:

Section B — Contexts and Applications — 150 marks

Answer Question 7, Question 8, and **either** Question 9A **or** Question 9B.

Question 7 — Probability and Statistics — (50 marks)

Some research was carried out into the participation of girls and boys in sport. The researchers selected a simple random sample of fifty male and fifty female teenagers enrolled in GAA clubs in the greater Cork area. They asked the teenagers the question: *How many sports do you play?*

The data collected were as follows:

Boys	Girls
0, 4, 5, 1, 4, 1, 3, 3, 3, 1,	3, 3, 3, 1, 1, 3, 3, 1, 3, 3,
1, 2, 2, 2, 5, 3, 3, 4, 1, 2,	2, 2, 4, 4, 4, 5, 5, 2, 2, 3,
2, 2, 2, 3, 3, 3, 4, 5, 1, 1,	3, 3, 4, 1, 6, 2, 3, 3, 3, 4,
1, 1, 1, 2, 2, 2, 2, 2, 3, 3,	4, 5, 3, 4, 3, 3, 3, 4, 4, 3,
3, 3, 3, 3, 3, 3, 3, 3, 3, 3	1, 1, 3, 2, 1, 3, 1, 3, 1, 3

(a) Display the data in a way that gives a picture of each distribution.

(b) State **one difference** and **one similarity** between the distributions of the two samples.

Difference:

Similarity:

(c) Do you think that there is evidence that there are differences between the two populations? Explain your answer.

Note: you are not required to conduct a formal hypothesis test.

Answer: _____

Justification:

(d) The researchers are planning to repeat this research on a larger scale. List **two** improvements they could make to the design of the research in order to reduce the possibility of *bias* in the samples. Explain why each improvement you suggest will reduce the likelihood of bias.

Improvement 1:

Improvement 2:

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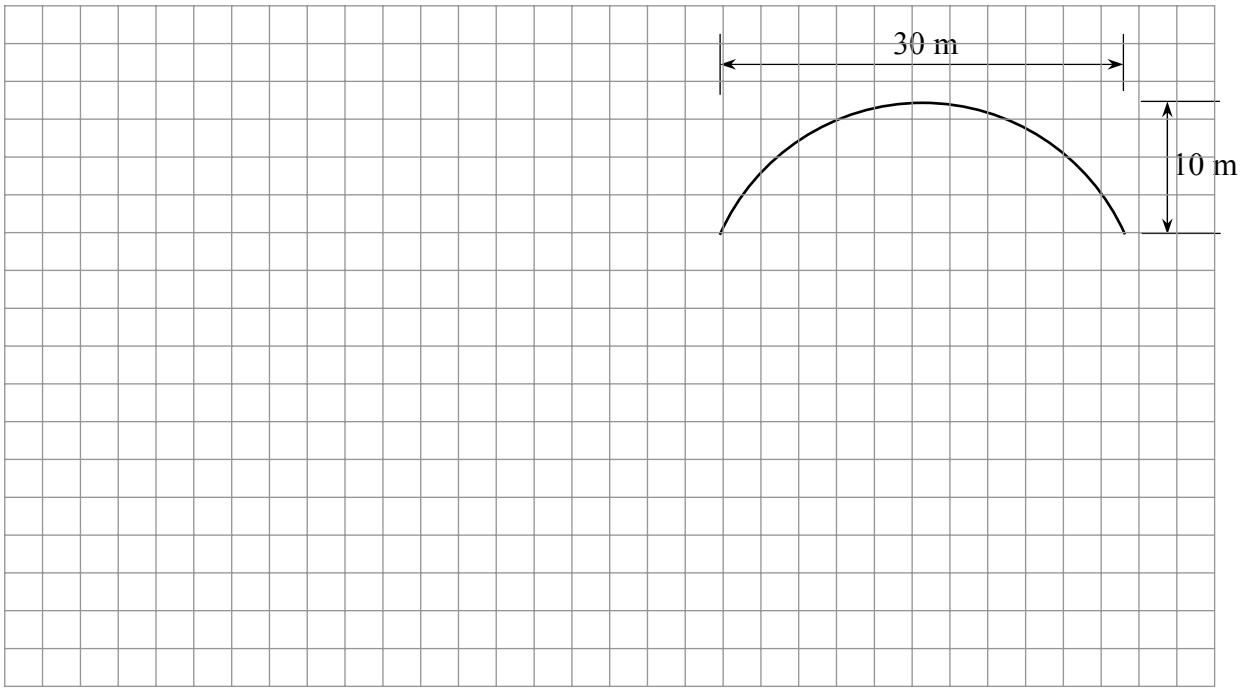
Question 8 **Geometry and Trigonometry** **(50 marks)**

The *Wonder Building* is an arched building that does not need any support inside, due partly to the fact that its shape is an arc of a circle.

The photograph shows a *Wonder Building* being used in Antarctica.

The arc for a *Wonder Building* can be a full semicircle or less than a semicircle. It cannot be more than a semi-circle. The "span" of the building is the total width from one side of the arch to the other.

(a) A particular *Wonder Building* has a span of 30 metres and a height of 10 metres. Find the radius of the arc.



(b) A customer wants a building with a span of 18 metres and a height of 10 metres.

(i) What arc radius would be required to give such a building?

(ii) Explain why the *Wonder Building* that the customer wants is not possible.

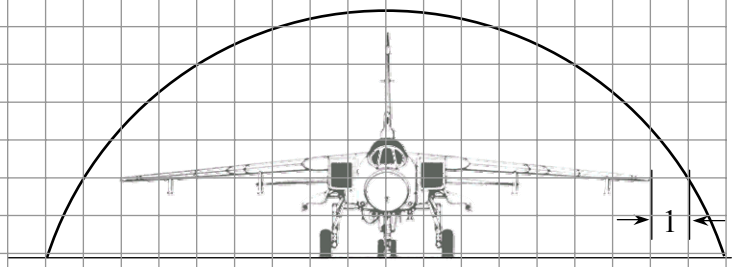
(c) An air force needs a *Wonder Building* to house a *Tornado* military jet.

The dimensions of the aircraft are as follows:

- Wingspan: 14 metres
- Height: 6 metres
- Height of wingtips above ground: 2 metres.

The shelter must be at least 0·5 metres above the top of the tail, and at least 1 metre clear horizontally of the wingtips.

For the shelter to have the exact clearance required, find the radius of the arc.



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Question 9A **Probability and Statistics** **(50 marks)**

A national newspaper reported in January 2010 that the average rent for a 3 bed-roomed house in Ireland was €824 per month. A Dublin estate agent conducted a survey of 40 such properties in the greater Dublin area to see if the same was true there. The estate agent's sample had a mean rent of €1090 and a standard deviation of €480.

(a) Using the estate agent's sample, construct a 95% confidence interval for the mean monthly rent of a 3-bed-roomed house in Dublin.

(b) Explain what your 95% confidence interval means.

(c) The estate agent says that the survey shows that the average rent in Dublin is not the same as the average rent in the country as a whole.

Assuming the information reported by the newspaper is accurate, is there evidence to support the estate agent's statement? Conduct a hypothesis test at the 5% level of significance. Clearly state the null hypothesis, the alternative hypothesis, and the conclusion.

(d) Describe **two** different ways that the estate agent might have collected the data in the sample. In each case, state clearly:

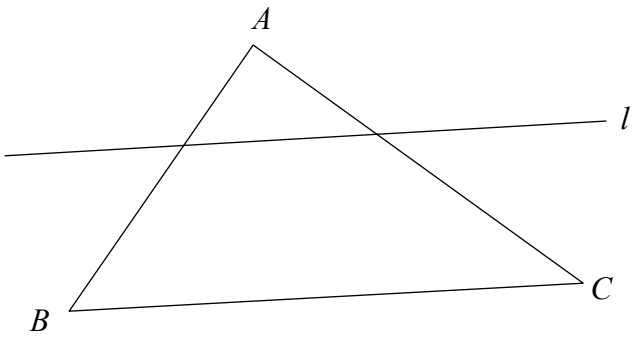
- what list is used to draw the sample from
- how the relevant information about each item is found, and
- what possible sources of bias there are.

Method 1:

Method 2:

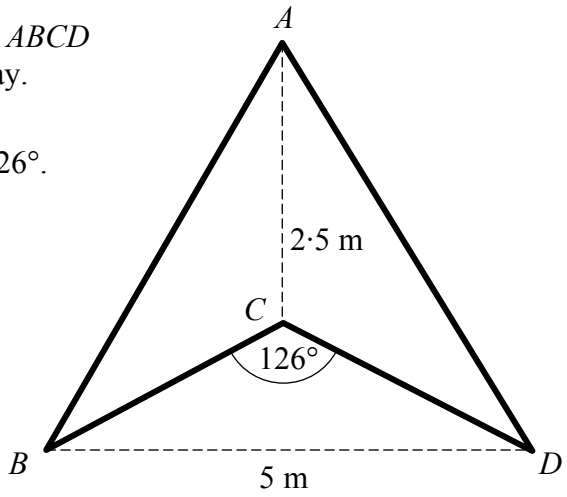
Question 9B **Geometry and Trigonometry** **(50 marks)**

(a) Let ΔABC be a triangle. The line l is parallel to BC and cuts $|AB|$ in the ratio $s : t$, where s and t are natural numbers. Prove that l also cuts AC in the ratio $s : t$.



(b) The diagram represents a large symmetrical arrow *ABCD* that is painted on the ground at one end of a runway.

The distance *BD* is 5 metres and distance *CA* is 2·5 metres, as shown. The angle *ADB* measures 126°.



(i) Find the length of the perimeter of the arrow.
Give your answer correct to one decimal place.

(ii) *Cat's eyes* are reflective devices used in road markings. They are being laid along the perimeter of the arrow. One is placed at each vertex, and others are placed at intervals of no more than half a metre along the perimeter. How many are needed?

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You may use this page for extra work

You may use this page for extra work

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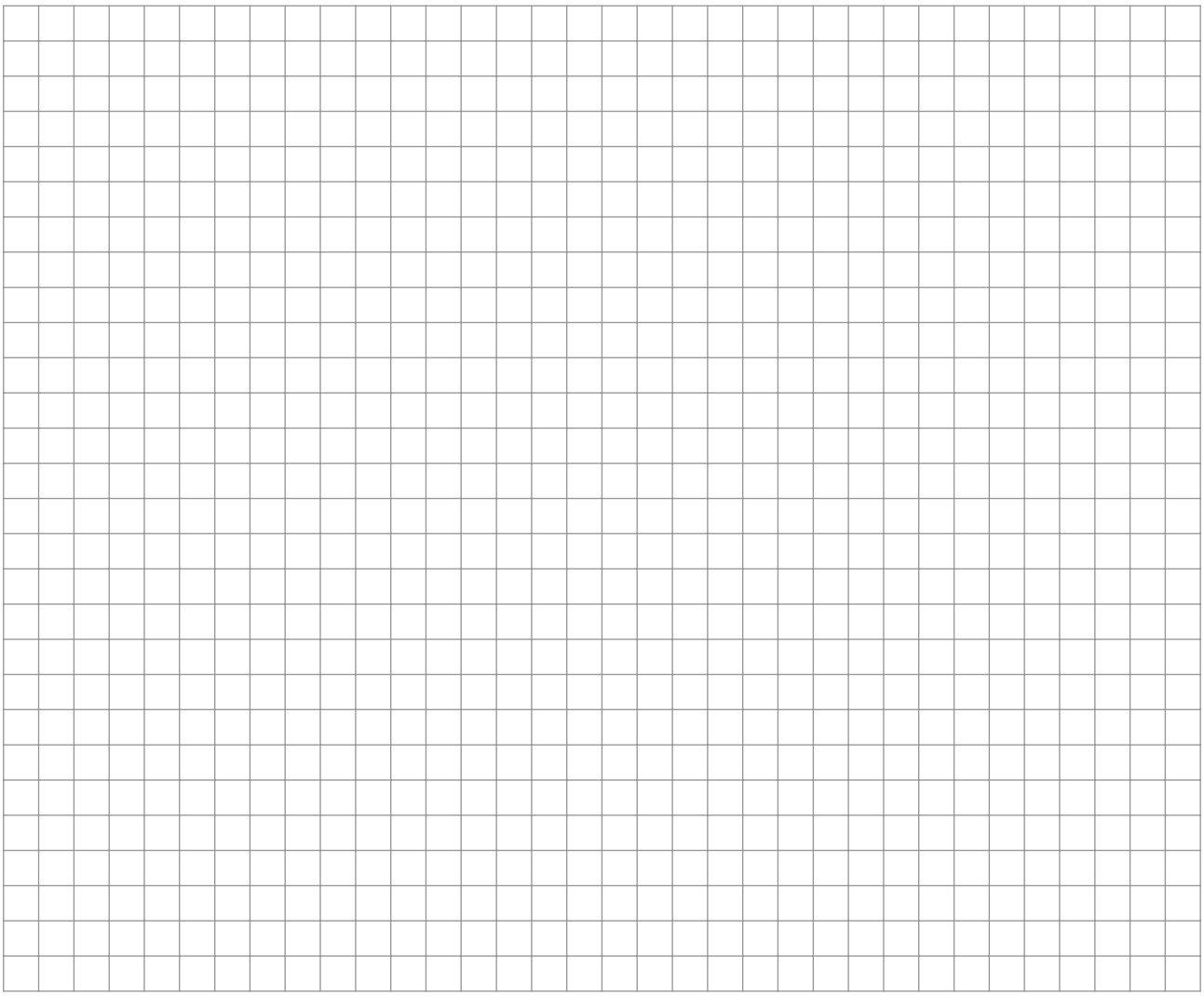

Note to readers of this document:

This pre-Leaving Certificate paper is intended to help teachers and candidates in the 24 *Project Maths* initial schools prepare for the June 2010 examination. The content and structure of the paper do not necessarily reflect the 2011 or subsequent examinations in the initial schools or in all other schools.

Mathematics (Project Maths) – Paper 2

Pre-Leaving Certificate Paper – Higher Level
February 2010