Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination
Sample Paper

Mathematics (Project Maths)

Paper 2

Higher Level

Time: 2 hours, 30 minutes

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. 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 booklet of *Formulae and Tables*. 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.

Section A	Concepts and Skills	150 marks

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

Question 1 **(25 marks)**

The events A and B are such that $P(A) = 0{\cdot}7$, $P(B) = 0{\cdot}5$ and $P(A \cap B) = 0{\cdot}3$.

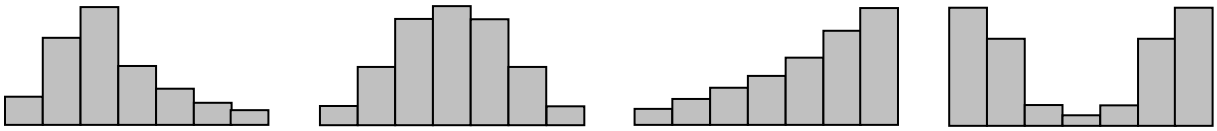
(a) Find $P(A \cup B)$

(b) Find $P(A \mid B)$

(c) State whether A and B are independent events, and justify your answer.

Question 2 **(25 marks)**

The shapes of the histograms of four different sets of data are shown below.



A B C D

(a) Complete the table below, indicating whether the statement is correct (✓) or incorrect (✗) with respect to each data set.

	A	B	C	D
The data are skewed to the left				
The data are skewed to the right				
The mean is equal to the median				
The mean is greater than the median				
There is a single mode				

(b) Assume that the four histograms are drawn on the same scale.
State which of them has the largest standard deviation, and justify your answer.

Answer: _____

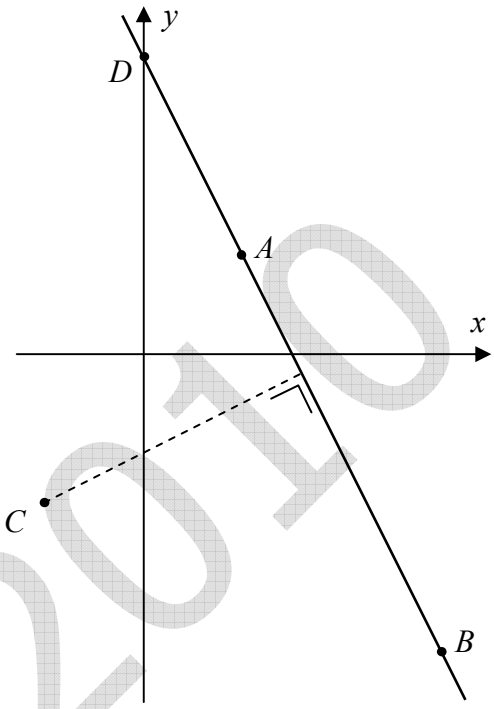
Justification:

Question 3 **(25 marks)**

The co-ordinates of three points A, B, and C are: $A(2, 2)$, $B(6, -6)$, $C(-2, -3)$.
(See diagram on facing page.)

(a) Find the equation of AB.

(b) The line AB intersects the y-axis at D.
Find the coordinates of D.



(iii) Find the perpendicular distance from C to AB.

(iv) Hence, find the area of the triangle ADC.

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Question 4 **(25 marks)**

(a) Write down the equation of the circle with centre (–3, 2) and radius 4.

(b) A circle has equation $x^2 + y^2 - 2x + 4y - 15 = 0$.
Find the values of m for which the line $mx + 2y - 7 = 0$ is a tangent to this circle.

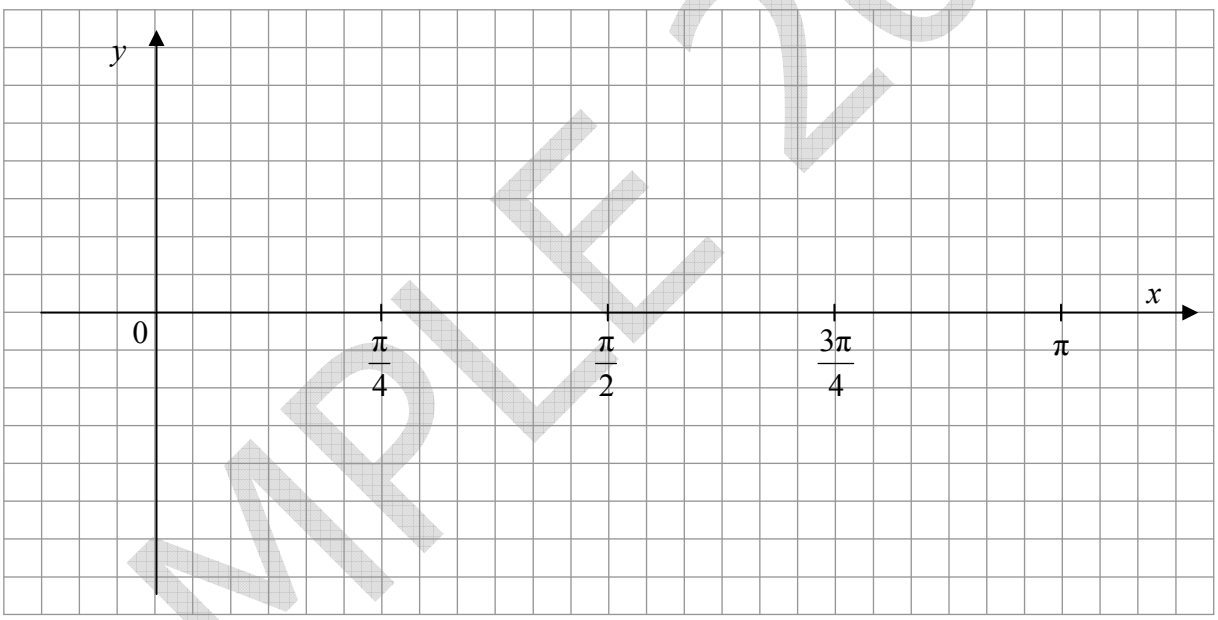
Question 5 **(25 marks)**

The function $f(x) = 3\sin(2x)$ is defined for $x \in \mathbb{R}$.

(i) Complete the table below

x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π
$2x$					
$\sin(2x)$					
$3\sin(2x)$					

(ii) Draw the graph of $y = f(x)$ in the domain $0 \le x \le \pi,\ x \in \mathbb{R}$.



(iii) Write down the range and the period of f.

Range = _____ Period = _____

Question 6 **(25 marks)**

ABCD is a parallelogram in which $[AC]$ is a diagonal.
$\vec{a} = 2\vec{i} - \vec{j}$, $\vec{b} = 5\vec{i} + 3\vec{j}$, and $\vec{c} = -\vec{i} - \vec{j}$.

(i) Express $\vec{d}$ in terms of $\vec{i}$ and $\vec{j}$.

(ii) Find $\overrightarrow{AC}$ and $\overrightarrow{AB}$.

(iii) Hence, find $|\angle CAB|$, correct to the nearest degree.

You may use this page for extra work

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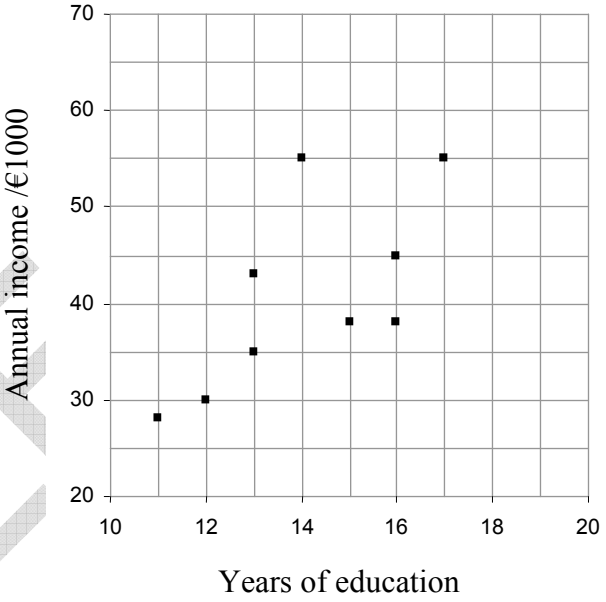
Section B — Contexts and Applications — 150 marks

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

Question 7 — Probability and Statistics — (50 marks)

An economics student is interested in finding out whether the length of time people spend in education affects the income they earn. The student carries out a small study. Twelve adults are asked to state their annual income and the number of years they spent in full-time education. The data are given in the table below, and a partially completed scatter plot is given.

Years of education	Income /€1,000
11	28
12	30
13	35
13	43
14	55
15	38
16	45
16	38
17	55
17	60
17	30
19	58



(i) The last three rows of data have not been included on the scatter plot. Insert them now.

(ii) Calculate the correlation coefficient.

Answer:

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

(iv) Add the line of best fit to the completed scatter plot above.

(v) Use the line of best fit to estimate the annual income of somebody who has spent 14 years in education.

Answer:

(vi) By taking suitable readings from your diagram, or otherwise, calculate the slope of the line of best fit.

(vii) Explain how to interpret this slope in this context?

(viii) The student collected the data using a telephone survey. Numbers were randomly chosen from the Dublin area telephone directory. The calls were made in the evenings, between 7 and 9 pm. If there was no answer, or if the person who answered did not agree to participate, then another number was chosen at random.

List **three** possible problems regarding the sample and how it was collected that might make the results of the investigation unreliable. In each case, state clearly why the issue you mention could cause a problem.

Problem 1:

Problem 2:

Problem 3:

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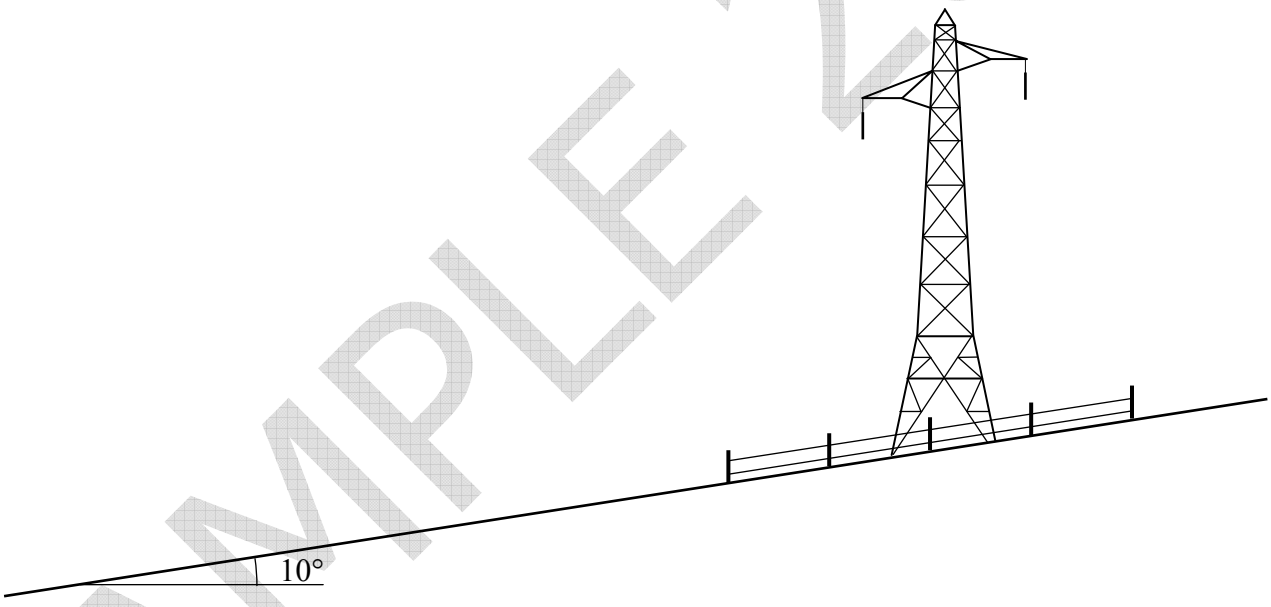
Question 8 **Geometry and Trigonometry** **(50 marks)**

Two surveyors want to find the height of an electricity pylon. There is a fence around the pylon that they cannot cross for safety reasons. The ground is inclined at an angle. They have a clinometer (for measuring angles of elevation) and a 100 metre tape measure. They have already used the clinometer to determine that the ground is inclined at 10° to the horizontal.

(a) Explain how they could find the height of the pylon.

Your answer should be illustrated on the diagram below. Show the points where you think they should take measurements, write down clearly what measurements they should take, and outline briefly how these can be used to find the height of the pylon.

Diagram:



Measurements to be taken:

Procedure used to find the height:

(b) Write down possible values for the measurements taken, and use them to show how to find the height of the pylon. (That is, find the height of the pylon using your measurements, and showing your work.)

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

A car rental company has been using *Evertread* tyres on their fleet of economy cars. All cars in this fleet are identical. The company manages the tyres on each car in such a way that the four tyres all wear out at the same time. The company keeps a record of the lifespan of each set of tyres. The records show that the lifespan of these sets of tyres is normally distributed with mean 45 000 km and standard deviation 8000 km.

(i) A car from the economy fleet is chosen at random. Find the probability that the tyres on this car will last for at least 40 000 km.

(ii) Twenty cars from the economy fleet are chosen at random. Find the probability that the tyres on at least eighteen of these cars will last for more than 40 000 km.

(iii) The company is considering switching brands from *Evertread* tyres to *SafeRun* tyres, because they are cheaper. The distributors of *SafeRun* tyres claim that these tyres have the same mean lifespan as *Evertread* tyres. The car rental company wants to check this claim before they switch brands. They have enough data on *Evertread* tyres to regard these as a known population. They want to test a sample of *SafeRun* tyres against it.

The company selects 25 economy cars at random from the fleet and fits them with the new tyres. For these cars, it is found that the mean life span of the tyres is 43 850 km.

Test, at the 5% level of significance, the hypothesis that the mean lifespan of *SafeRun* tyres is the same as the known mean of *Evertread* tyres. State clearly what the company can conclude about the tyres.

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

(a) Prove that, if two triangles ΔABC and $\Delta A'B'C'$ are similar, then their sides are proportional, in order:

$$\frac{|AB|}{|A'B'|} = \frac{|BC|}{|B'C'|} = \frac{|CA|}{|C'A'|}.$$

Diagram:

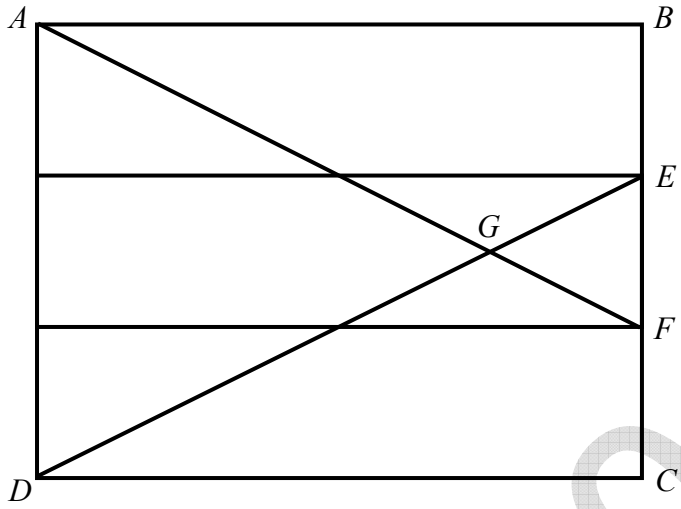
Given:

To prove:

Construction:

Proof:

(b) Anne is having a new front gate made and has decided on the design below.



The gate is 2 metres wide and 1·5 metres high. The horizontal bars are 0·5 metres apart.

(i) Calculate the common length of the bars [AF] and [DE], in metres, correct to three decimal places.

(ii) In order to secure the bar [AF] to [DE], the manufacturer needs to know:

- the measure of the angle EGF, and
- the common distance $|AG| = |DG|$.

Find these measures. Give the angle correct to the nearest degree and the length correct to three decimal places.

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

Leaving Certificate – Higher Level

Mathematics (Project Maths) – Paper 2

Sample Paper
Time: 2 hours 30 minutes