

## Coimisiún na Scrúduithe Stáit

State Examinations Commission

Leaving Certificate Examination, 2011

# Mathematics <br> (Project Maths - Phase 2) 

Paper 2

## Ordinary Level

Monday 13 June Morning 9:30-12:00

300 marks


| For examiner |  |
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| Question | Mark |
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## 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 | 2 questions |

Answer all eight questions, as follows:
In Section A, answer:
Questions 1 to 5 and
either Question 6A or Question 6B.
In Section B, answer Question 7 and Question 8.

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.

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

Answer all six questions from this section.

## Question 1

The points $A(6,1)$ and $B(2,-1)$ are shown on the diagram.
(a) Find the equation of the line $A B$.


(b) The line $A B$ crosses the $y$-axis at $C$. Find the co-ordinates of $C$.

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(c) Find the ratio $\frac{|A B|}{|A C|}$, giving your answer in the form $\frac{p}{q}$, where $p$ and $q$ are whole numbers.


## Question 2

A circle $c_{1}$ has centre $(0,0)$ and diameter 8 units.
(a) Show $c_{1}$ on a co-ordinate diagram.

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(b) Find the equation of $c_{1}$.

(c) Prove that the point $(3,2)$ is inside $c_{1}$ and that the point $(3,3)$ is outside it.

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(d) Another circle, $c_{2}$, has centre $(0,1)$ and just touches the circle $c_{1}$. Show $c_{2}$ on your diagram in part (a) above and find the equation of $c_{2}$.

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## Question 3

A plastic toy is in the shape of a hemisphere. When it falls on the ground, there are two possible outcomes: it can land with the flat side facing down or with the flat side facing up. Two groups of students are trying to find the probability that it will land with the flat side down.
(a) Explain why, even though there are two outcomes, the answer is not necessarily equal to $\frac{1}{2}$.

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(b) The students estimate the probability by experiment. Group A drops the toy 100 times. From this, they estimate that it lands flat side down with probability $0 \cdot 76$. Group B drops the toy 500 times. From this, they estimate that it lands flat side down with probability $0 \cdot 812$.
(i) Which group's estimate is likely to be better, and why?

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(ii) How many times did the toy land flat side down for Group B?

(iii) Using the data from the two groups, what is the best estimate of the probability that the toy lands flat side down?


Below is a stem-and-leaf plot showing the number of sweets in each of nineteen packets of sweets.

| 2 | 5 |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 2 | 6 | 6 | 7 |  |  |  |  |  |
| 2 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 |
| 3 | 0 | 0 | 0 | 0 | 1 | 1 |  |  |
| 3 | 2 |  |  |  |  |  |  |  |

Key: $2 \mid 5$ means 25 sweets.
(a) What is the median number of sweets?

Answer: $\qquad$
(b) What is the range of the data?

(c) Find the interquartile range of the data.

(d) The sentences below describe the type of data shown in the stem-and-leaf plot above. Delete the incorrect word in each pair of brackets.
"This is a set of [univariate / bivariate] data. The data are [discrete / continuous]."

## Question 5

(a) Find the volume of a cylinder of radius 6 mm and height 20 mm . Give your answer in two forms, as follows:
(i) in terms of $\pi$, and
(ii) correct to two decimal places.

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(b) A solid rectangular block measures $60 \mathrm{~mm} \times 35 \mathrm{~mm} \times 20 \mathrm{~mm}$.

Cylindrical holes of radius 6 mm are drilled, one at a time, through the block, in the direction shown.

After how many holes will more than half of the original block have been removed?


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Answer either 6A or 6B.

## Question 6A

(a) Show clearly how to construct the centroid of the triangle below.
(Note: all instruments are permitted. If you are using measurements, show your measurements and calculations.)

(b) State what is meant by the word axiom, and explain why axioms are needed in order to prove theorems.


## OR

## Question 6B

In the diagram, $A B C D$ is a cyclic quadrilateral and $A B C F$ is a parallelogram.

Show that $D E F G$ is a cyclic quadrilateral.



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Answer Question 7 and Question 8.

## Question 7

(75 marks)
One of the items of information gathered in a census is the size of every household. The size of the household is the number of people living in it. The following table shows the number of "Permanent Private Households" of each size in Ireland, according to the census held in various years from 1926 to 2006. For the purposes of this question, you should ignore the fact that there are also other types of household in Ireland.

|  | $\begin{gathered} 1 \\ \text { person } \end{gathered}$ | $\begin{gathered} 2 \\ \text { people } \end{gathered}$ | $\begin{gathered} 3 \\ \text { people } \end{gathered}$ | $\begin{gathered} 4 \\ \text { people } \end{gathered}$ | $\begin{gathered} 5 \\ \text { people } \end{gathered}$ | $\begin{gathered} 6 \\ \text { people } \end{gathered}$ | $\begin{gathered} 7 \\ \text { people } \end{gathered}$ | $\begin{gathered} 8 \\ \text { people } \end{gathered}$ | $\begin{gathered} 9 \\ \text { people } \end{gathered}$ | $\begin{gathered} \geq 10 \\ \text { people } \end{gathered}$ | All sizes |
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| 1926 | 51,537 | 98,437 | 102,664 | 96,241 | 82,324 | 65,310 | 48,418 | 33,297 | 21,089 | 23,361 | 622,678 |
| 1946 | 68,881 | 118,738 | 116,401 | 103,423 | 84,437 | 62,955 | 44,028 | 28,503 | 17,970 | 17,318 | 662,654 |
| 1966 | 88,989 | 139,541 | 114,436 | 97,058 | 79,320 | 61,068 | 42,512 | 27,098 | 16,550 | 20,732 | 687,304 |
| 1986 | 176,017 | 195,647 | 143,142 | 155,534 | 127,336 | 83,657 | 44,139 | 23,088 | 8,438 | 7,884 | 964,882 |
| 2006 | 326,134 | 413,786 | 264,438 | 243,303 | 136,979 | 54,618 | 15,141 | 5,050 | 1,719 | 1,128 | 1,462,296 |

(Source: Central Statistics Office, http://www.cso.ie/statistics/HousingandHouseholds.htm)
(a) Use the information in the table to answer the following:
(i) In 1966, how many households had exactly 8 people living in them?

Answer: $\qquad$
(ii) In 1986, how many people lived in households of exactly 7 people?

(iii) Calculate, correct to one decimal place, an estimate of the mean number of people per household in 2006.

(b) Conor, Fiona, and Ray were each asked, separately, to make a presentation about the patterns they could see in the data. They each spoke for one minute and showed one slide. The slides they made are shown below. By considering the slides, state the main point or points that each of them was trying to make.

| Conor was trying to show... |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Conor's slide


Fiona's slide


Ray's slide



(c) A household is randomly selected from among all the households in 2006. What is the probability that it has seven or eight people?

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(d) 1000 households are to be randomly selected from among all the households in 2006. Let $X$ represent the number of 4-person households selected.
Find $E(X)$, the expected value of $X$.

(e) Mary wonders whether there are differences in size between the households in South Dublin and those in Dublin City. She gets the relevant data for 2006 and makes the following charts.

(i) Describe what differences there are, if any, between the two distributions above.

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(ii) There are approximately 81,000 households in South Dublin. Approximately how many people live in 4-person households in South Dublin?

(iii) What is the median size for a household in Dublin City?

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(iv) A person is selected at random from among all those living in Dublin City. Which is more likely: that the person lives alone, or that the person lives in a three-person household? Explain your answer.

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## Question 8

The tables in a primary school classroom are like the one in the photograph. The top of the table is in the shape of a trapezium, as shown in the diagram below the photograph.

The measurements are as follows:

$$
\begin{aligned}
& |A D|=140 \mathrm{~cm} \\
& |B C|=70 \mathrm{~cm} \\
& |A B|=|D C| \\
& |\angle A D C|=|\angle D A B|=60^{\circ} .
\end{aligned}
$$

(a) Show that $|A B|=70 \mathrm{~cm}$.

(b) Find the distance between the parallel sides $[A D]$ and $[B C]$. Give your answer in centimetres, correct to one decimal place.

(c) Some of the tables are painted with a yellow and blue pattern as shown. What fraction of the surface is yellow? Show your work.


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(d) Two of the tables, painted as in part (c) above, are arranged to form a hexagon. Prove that the yellow area is a rectangle.


(e) Twelve of the tables are arranged as six hexagons in a classroom, as shown in the diagram. The clearance between neighbouring tables is 2 metres and the clearance to the side walls is 1.5 metres, as shown.

Find the total width of the classroom, in metres, correct to two decimal places.


(f) The tops of the trapezium tables are made of wood. The wood is 1.6 cm thick. Each cubic centimetre of the wood weighs 0.75 grams. Each table also has a metal frame weighing 6 kilograms. How much does each table weigh?
Give your answer in kilograms, correct to one decimal place.


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You may use this page for extra work.


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Leaving Certificate 2011 - Ordinary Level Mathematics (Project Maths - Phase 2) - Paper 2
Monday 13 June
Morning 9:30-12:00

