Leaving Certificate Sample and Examination Papers Phase 1

For the 2012 Examination

ORDINARY LEVEL

Includes:

2011 Leaving Certificate Examination Paper 2
2011 Sample Examination Paper 2
2010 Leaving Certificate Examination Paper 2
2010 Sample Examination Paper 2

Leaving Certificate 2012 Examination Guidelines

ORDINARY LEVEL

Some Points to Note:

- **Paper one** will be unchanged from previous years; same structure, same choice.

- **Paper two** will continue to have a question (50 marks) based on the 'applied arithmetic and measure' (area and volume) topic from the unchanged syllabus material. Section A (5 questions worth a total of 125 marks) will focus on concepts and skills, while Section B (3 questions worth a total of 125 marks) will focus on contexts and applications.

- Paper two will examine ***Area and Volume*** *(unchanged syllabus material)*, **Statistics and Probability** *(Strand 1)* and **Geometry and Trigonometry** *(Strand 2)*.

- Learning outcomes from more than one strand can be examined in a single question.

- All questions must be answered, there is **no*** choice.

  **Section 2.1 of the syllabus indicates that candidates will have the option of answering a question on the synthetic geometry set out in the syllabus, or answering a problem-solving question based on the geometrical results from the corresponding syllabus level at Junior Certificate. This option will apply for a three year period only that is for candidates sitting the Leaving Certificate examination in 2012, 2013 and 2014. There will be no choice after that stage.*

- The old option questions are no longer on the syllabus (i.e. Further Geometry, Plane Vectors, Further Sequences and Series or Linear Programming).

- There is a new type of marking scheme in place for examining the new syllabus; more information and these marking schemes can be found on: *http://www.examinations.ie*

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2011

Mathematics
(Project Maths – Phase 2)

Paper 2

Ordinary Level

Monday 13 June Morning 9:30 – 12:00

300 marks

Examination number

Centre stamp

Running total	

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

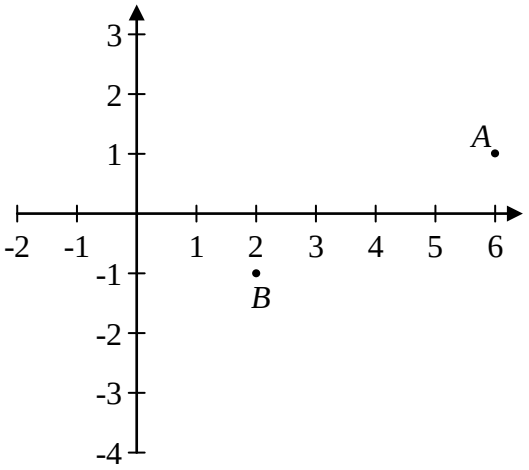
Write the make and model of your calculator(s) here:

Section A — Concepts and Skills — 150 marks

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

Question 1 **(25 marks)**

The points $A(6, 1)$ and $B(2, -1)$ are shown on the diagram.



(a) Find the equation of the line AB.

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

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

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Question 2 **(25 marks)**

A circle c_1 has centre (0, 0) and diameter 8 units.

(a) Show c_1 on a co-ordinate diagram.

(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.

(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.

Question 3 **(25 marks)**

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 $\frac{1}{2}$.

(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 0·76. Group B drops the toy 500 times. From this, they estimate that it lands flat side down with probability 0·812.

(i) Which group's estimate is likely to be better, and why?

(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?

Question 4 **(25 marks)**

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 | 5 means 25 sweets.

(a) What is the *median* number of sweets?

Answer: _____

(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 **(25 marks)**

(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 π, and

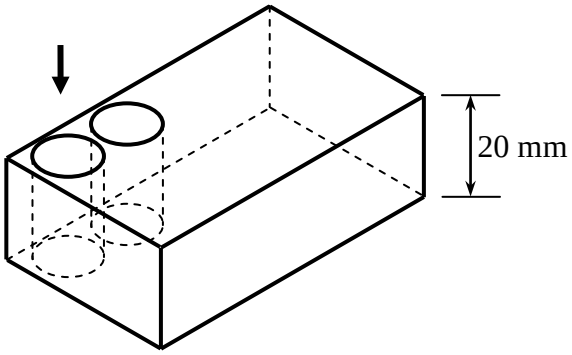
(ii) correct to two decimal places.

Area and Volume will be examined from the old syllabus in 2012.

(b) A solid rectangular block measures 60 mm × 35 mm × 20 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?



Area and Volume will be examined from the old syllabus in 2012.

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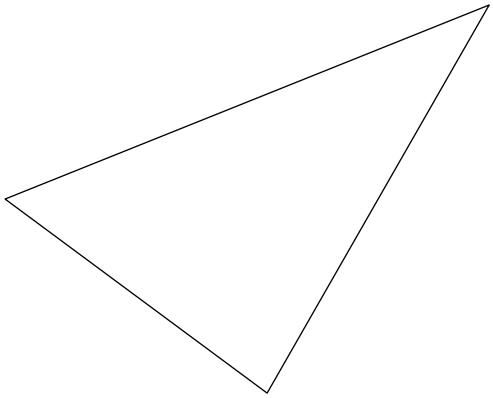
Question 6 **(25 marks)**

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.)



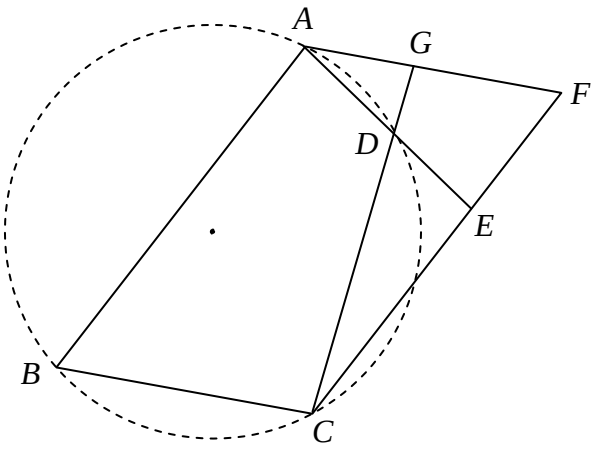
(b) State what is meant by the word *axiom*, and explain why axioms are needed in order to prove theorems.

OR

Question 6B

In the diagram, *ABCD* is a cyclic quadrilateral and *ABCF* is a parallelogram.

Show that *DEFG* is a cyclic quadrilateral.



Section B — Contexts and Applications — 150 marks

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.

	1 person	2 people	3 people	4 people	5 people	6 people	7 people	8 people	9 people	≥10 people	All sizes
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: _____

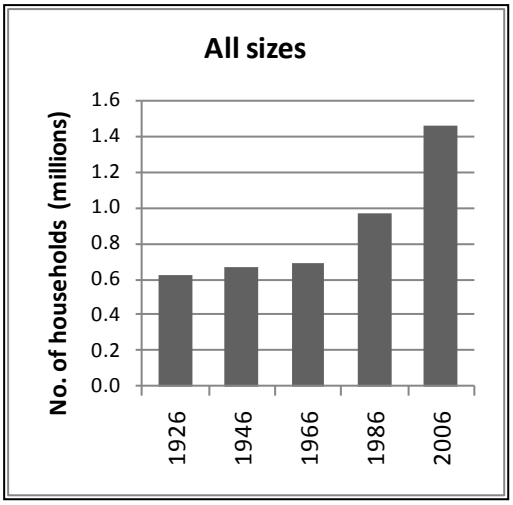
(ii) In 1986, how many **people** lived in households of exactly 7 people?

(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.

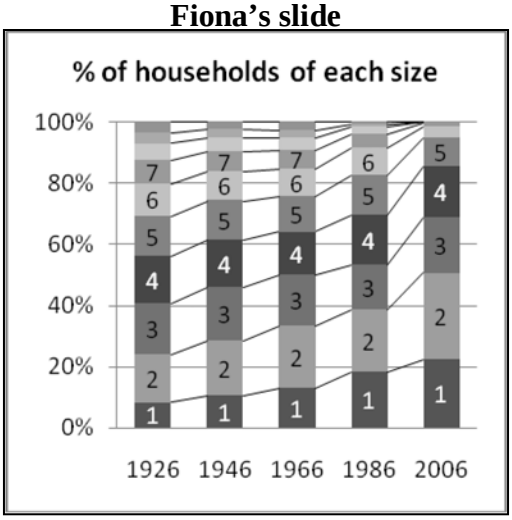
Conor was trying to show…

Conor's slide



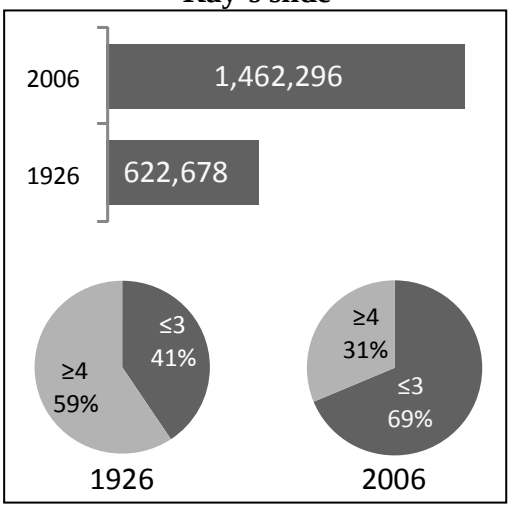
Fiona was trying to show…

Fiona's slide



Ray was trying to show…

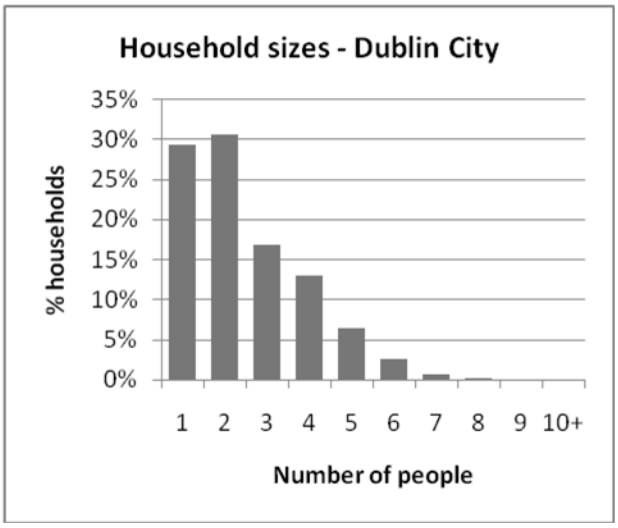
Ray's slide

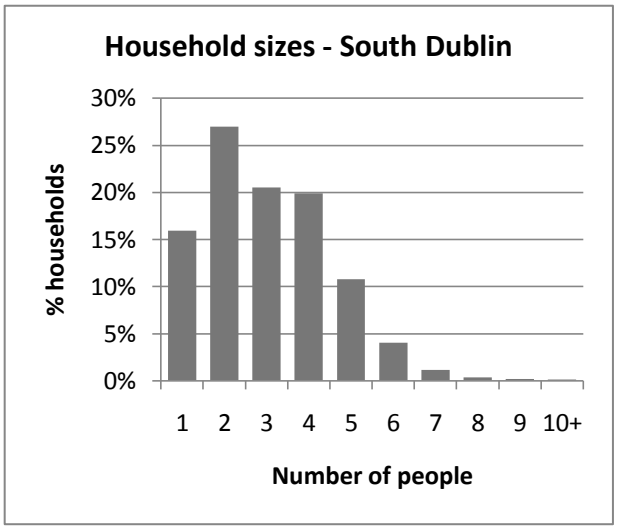


(c) A household is randomly selected from among all the households in 2006. What is the probability that it has seven or eight people?

(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.

(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?

(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.

Question 8 **(75 marks)**

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.

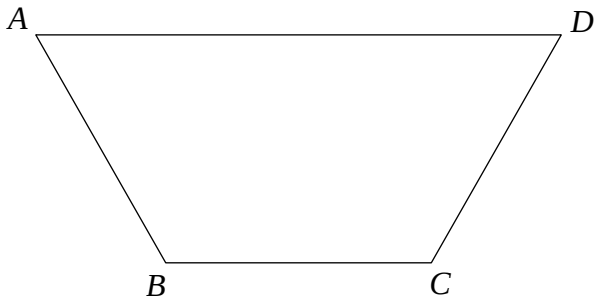
The measurements are as follows:

$|AD| = 140$ cm

$|BC| = 70$ cm

$|AB| = |DC|$

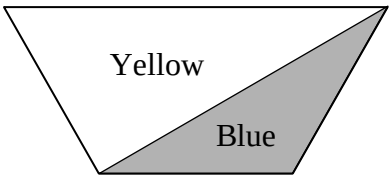
$|\angle ADC| = |\angle DAB| = 60°$.



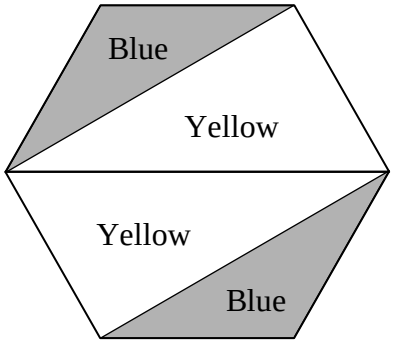
(a) Show that $|AB| = 70$ cm.

(b) Find the distance between the parallel sides [*AD*] and [*BC*]. 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.



(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.



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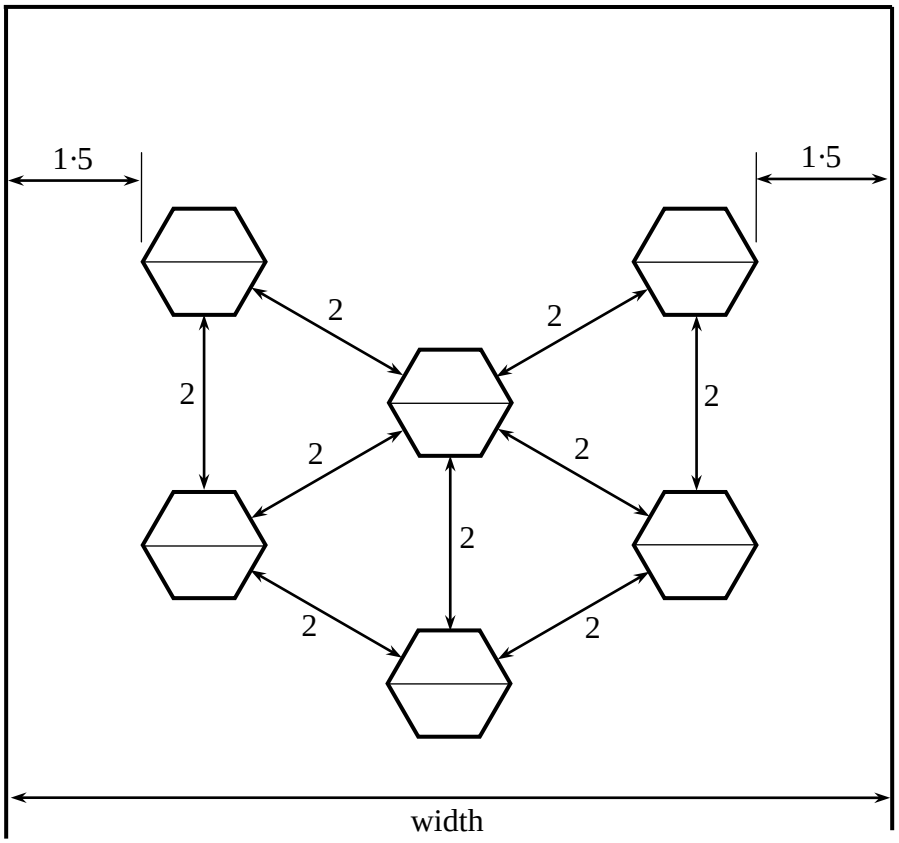
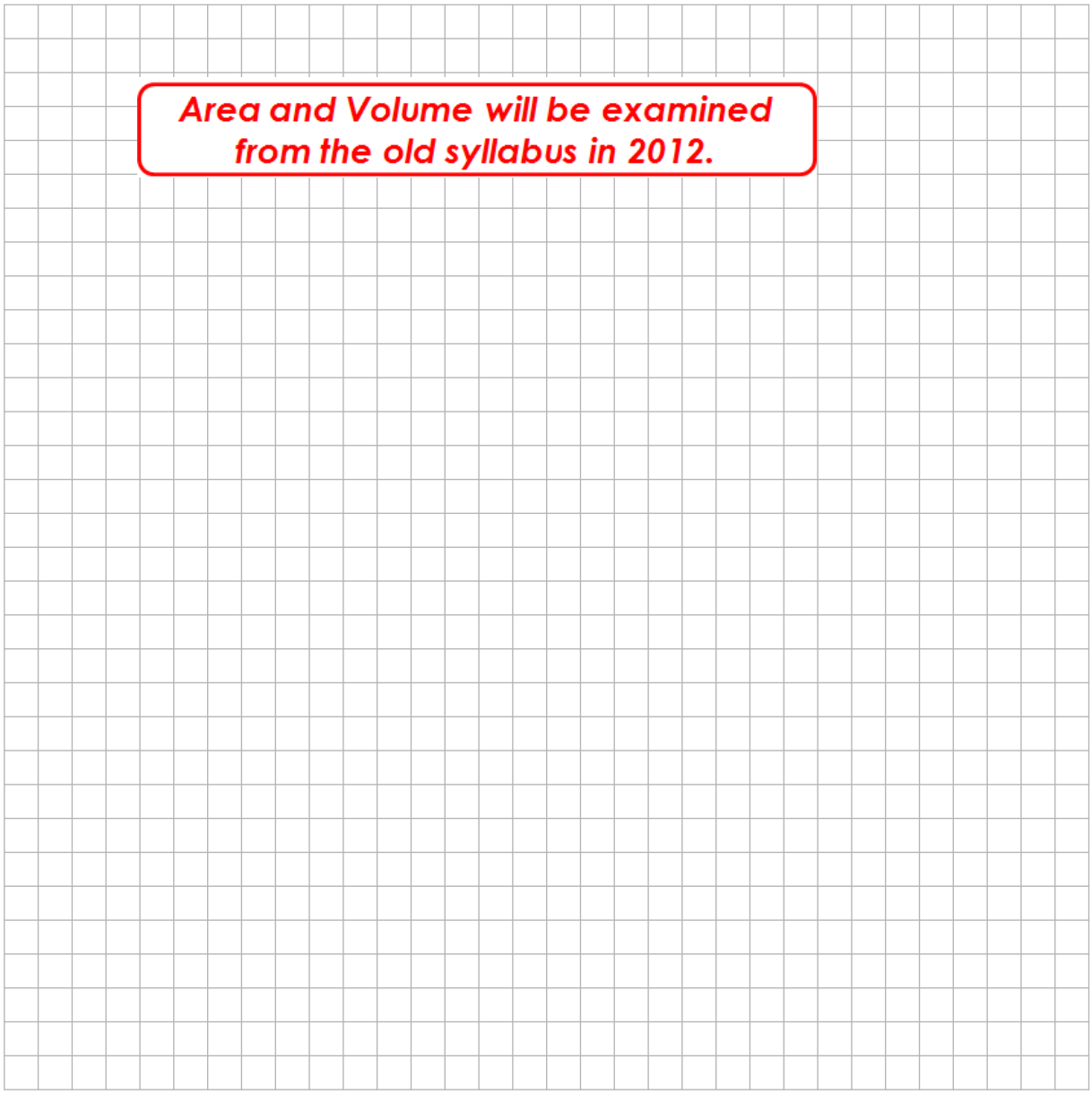
(e) Twelve of the tables are arranged as six hexagons in a classroom, as shown in the diagram. The clearance between neighbouring tables is 2 metres and the clearance to the side walls is 1·5 metres, as shown.

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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Leaving Certificate 2011 – Ordinary Level

Mathematics (Project Maths – Phase 2) – Paper 2

Monday 13 June
Morning 9:30 – 12:00

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2011
Sample Paper

Mathematics
(Project Maths – Phase 2)

Paper 2

Ordinary 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	
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	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.

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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)**

(a) State the *fundamental principle of counting*.

(b) How many different ways are there to arrange five distinct objects in a row?

(c) Peter is arranging books on a shelf. He has five novels and three poetry books. He wants to keep the five novels together and the three poetry books together. In how many different ways can he arrange the books?

Question 2 **(25 marks)**

A biased die is used in a game. The probabilities of getting the six different numbers on the die are shown in the table below.

Number	1	2	3	4	5	6
Probability	0·25	0·25	0·15	0·15	0·1	0·1

(a) Find the expected value of the random variable X, where X is the number thrown.

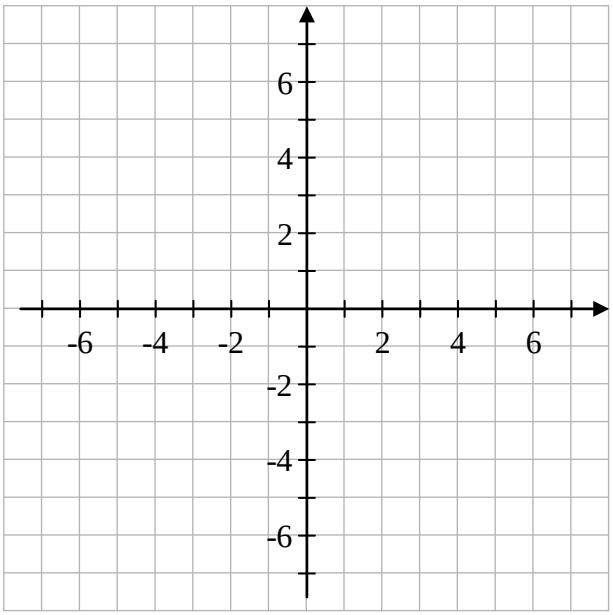
(b) There is a game at a funfair. It costs €3 to play the game. The player rolls a die once and wins back the number of euro shown on the die. The sentence below describes the difference between using the above biased die and using a fair (unbiased) die when playing this game. By doing the calculations required, complete the sentence.

"If you play the game many times with a fair die, you will win an average of _____ per game, but if you play with the biased die you will lose an average of _____ per game."

Question 3 **(25 marks)**

The points *A*, *B*, and *C* have co-ordinates as follows:

A (3, 5)
B (–6, 2)
C (4, –4)



(a) Plot *A*, *B*, and *C* on the diagram.

(b) Find the equation of the line *AB*.

(c) Find the area of the triangle *ABC*.

Question 4 **(25 marks)**

The circle c has centre $P(-2, -1)$ and passes through the point $Q(3, 1)$.

(a) Show c, P, and Q on a co-ordinate diagram.

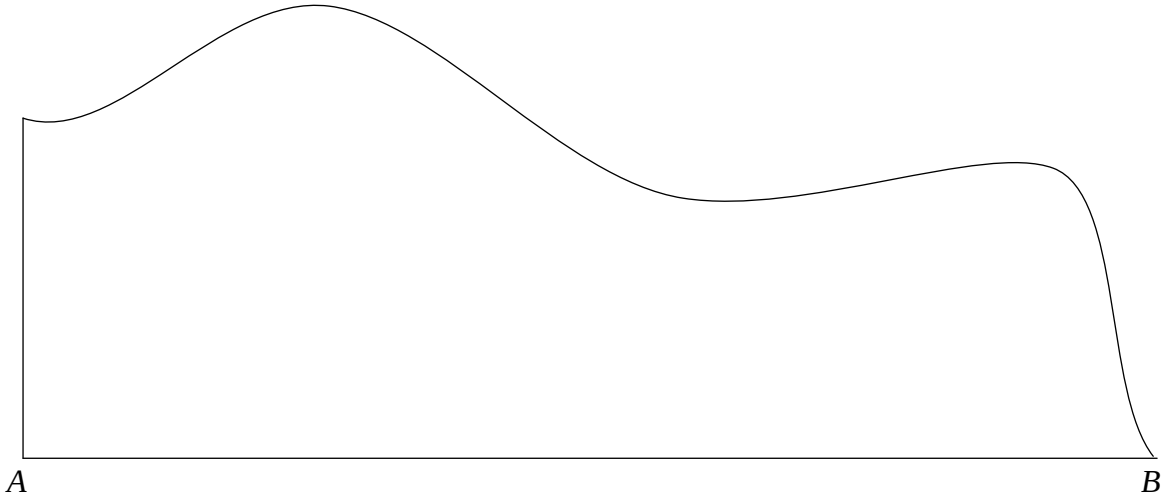
(b) Find the radius of c and hence write down its equation.

(c) R is the point $(1, 6)$. By finding the slopes of PQ and QR, show that QR is a tangent to c.

Question 5 **(25 marks)**

The diagram below shows a shape with two straight edges and one irregular edge. By dividing the edge [*AB*] into five equal intervals, use the trapezoidal rule to estimate the area of the shape.

Record your constructions and measurements on the diagram. Give your answer correct to the nearest cm^2.



Area and Volume will be examined from the old syllabus in 2012.

Question 6 **(25 marks)**

Answer **either** 6A **or** 6B.

Question 6A

(a) Explain what is meant by the *converse* of a theorem.

Explanation:

(b) There are some geometric statements that are true, but have converses that are false. Give one such geometric statement, and state also the (false) converse.

Statement:

Converse (false):

OR

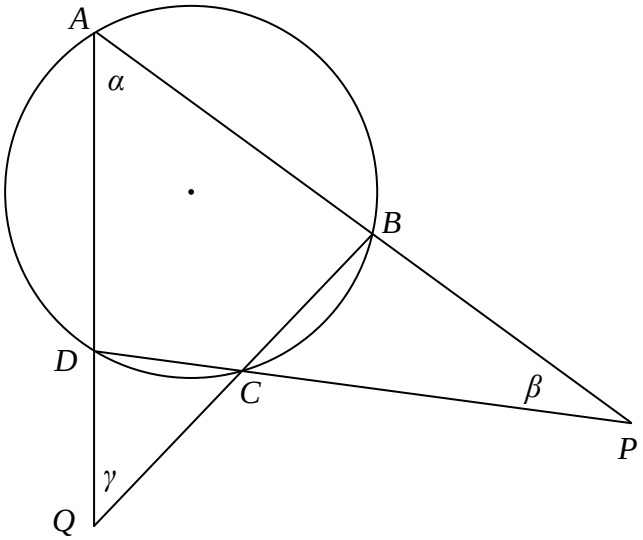
Question 6B

ABCD is a cyclic quadrilateral.

The opposite sides, when extended, meet at *P* and *Q*, as shown.

The angles α, β, and γ are as shown.

Prove that $\beta + \gamma = 180° - 2\alpha$.



Section B	Contexts and Applications	150 marks

Answer Question 7 and Question 8.

Question 7 **(75 marks)**

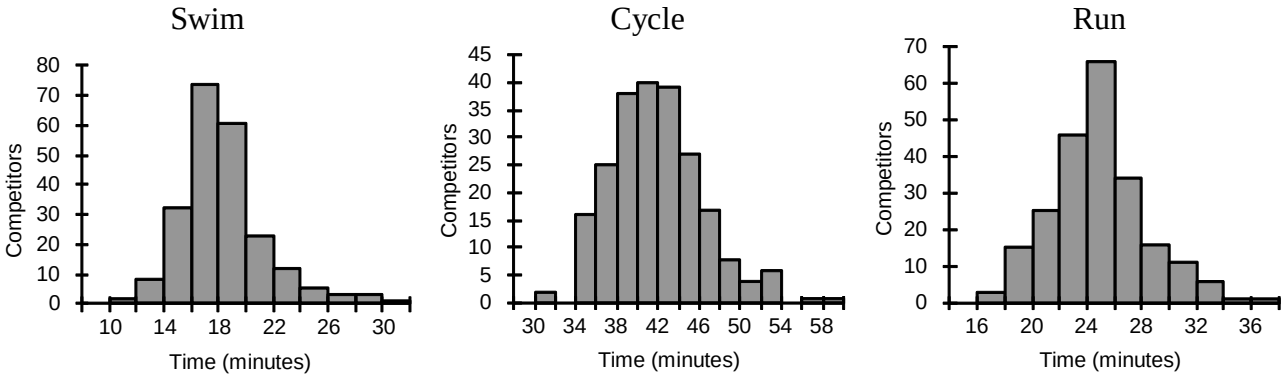
The *King of the Hill* triathlon race in Kinsale consists of a 750 metre swim, followed by a 20 kilometre cycle, followed by a 5 kilometre run.

The questions below are based on data from 224 athletes who completed this triathlon in 2010.

Máire is analysing data from the race, using statistical software. She has a data file with each competitor's time for each part of the race, along with various other details of the competitors.

Lizzie Lee, winner of the women's event

Máire produces histograms of the times for the three events. Here are the three histograms.



(a) Use the histograms to complete the following sentences:

(i) The event that, on average, takes longest to complete is the _____.

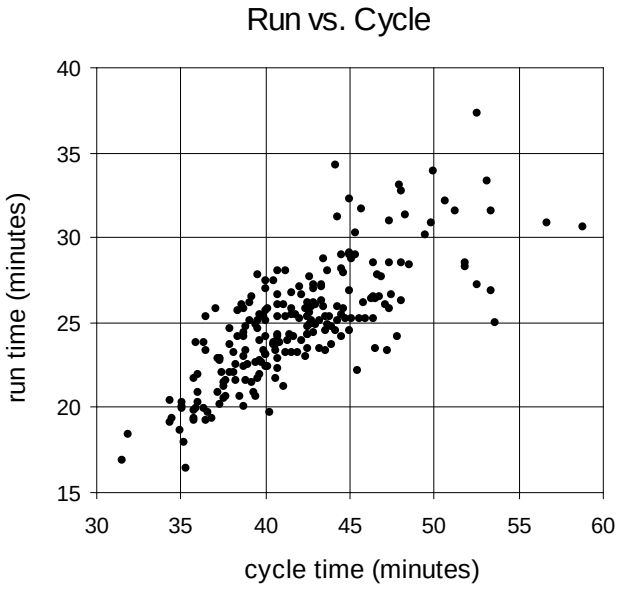
(ii) In all three histograms, the times are grouped into intervals of _____ minutes.

(iii) The time of the fastest person in the swim was between _____ and _____ minutes.

(iv) The median time for the run is approximately _____ minutes.

(v) The event in which the times are most spread out is the _____.

(b) Máire is interested in the relationship between the athletes' performance in the run and in the cycle. She produces the following scatter diagram.



(i) The correlation coefficient between the times for these two events is one of the numbers below. Write the letter corresponding to the correct answer in the box.

A. 0·95
B. 0·77
C. 0·13
D. –0·13
E. –0·77
F. –0·95

(ii) Frank was the slowest person in the run. How many people took longer to complete the cycle than Frank did?

Answer: _____

(iii) Brian did not enter this race. Suppose that he had, and suppose that he completed the cycle in 52 minutes and the run in 18 minutes. Explain why this performance would have been very unusual.

page | running

(c) Máire knows already that the male athletes tend to be slightly faster than the female athletes. She also knows that athletes can get slower as they get older. She thinks that male athletes in their forties might be about the same as female athletes in their thirties. She decides to draw a back-to-back stem-and-leaf diagram of the times of these two groups for the swim. There were 28 females in their thirties, and 32 males in their forties. Here is the diagram:

Female, 30 – 39 years		**Male, 40 – 49 years**
4	13	
	14	9
1 0	15	1 3 4 5 6
9 8 8 7 3 2 2	16	3 4 6 7 7 8
6 4 3 2	17	6 7 7
1	18	0 1 3 8 9
9 6 3 1 0 0	19	0 0 1 2 3 4
	20	3 9 9
3 3 2	21	2 2
4	22	
	23	0
8	24	
	25	
5	26	
	27	
	28	
7	29	

Key: | 14 | 9 means 14·9 minutes.

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

(ii) Máire drew the diagram because she thought that these two groups would be about the same. Do you think that the diagram would cause Máire to confirm her belief or change it? Give reasons for your answer.

Question 8 **(75 marks)**

(a) A stand is being used to prop up a portable solar panel. It consists of a support that is hinged to the panel near the top, and an adjustable strap joining the panel to the support near the bottom.

By adjusting the length of the strap, the angle between the panel and the ground can be changed.

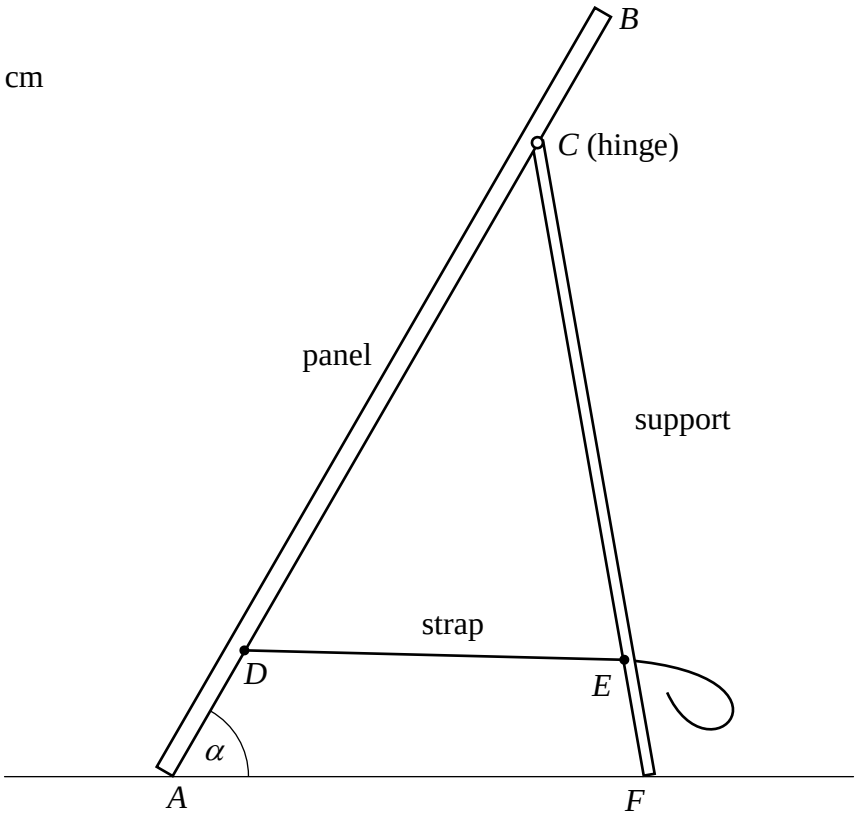
The dimensions are as follows:

$|AB| = 30$ cm

$|AD| = |CB| = 5$ cm

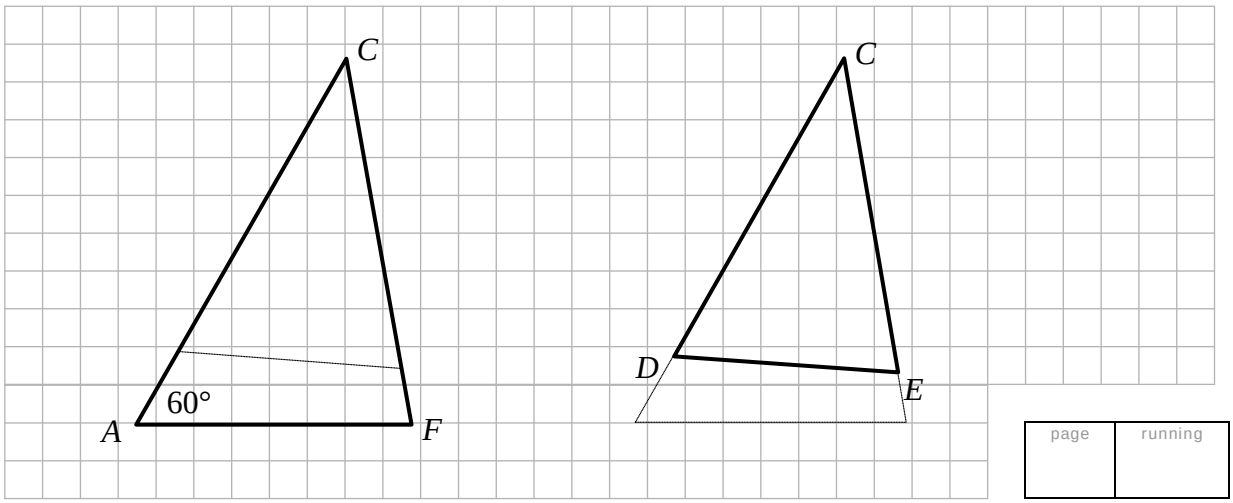
$|CF| = 22$ cm

$|EF| = 4$ cm.



We want to find out how long the strap has to be in order to make the angle α between the panel and the ground equal to 60°

(i) Two diagrams are given below – one showing triangle *CAF* and the other showing triangle *CDE*. Use the measurements given above to record on the two diagrams below the lengths of **two** of the sides in **each** triangle.

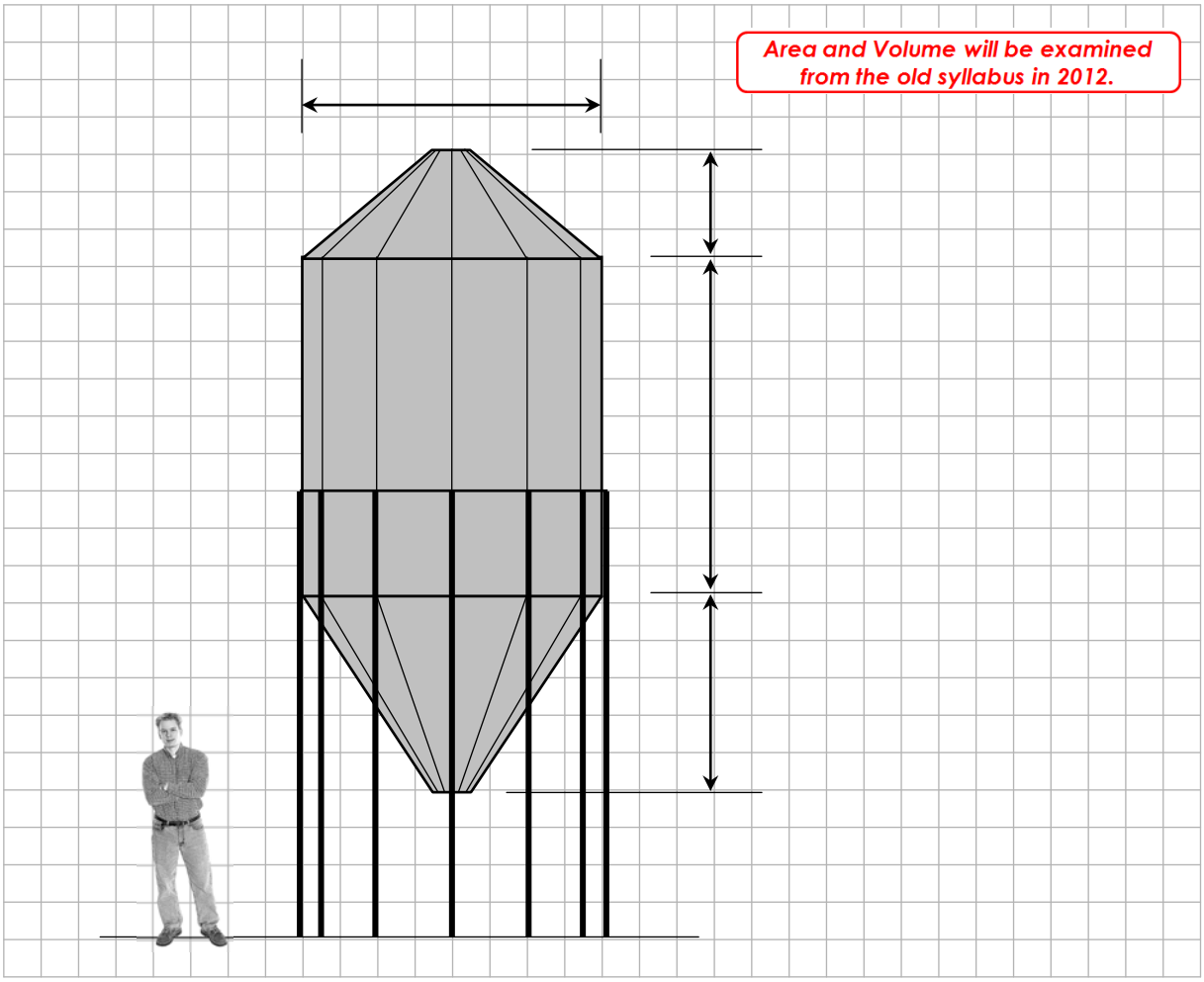


(ii) Taking $\alpha = 60°$, as shown, use the triangle CAF to find $|\angle CFA|$, correct to one decimal place.

(iii) Hence find $|\angle ACF|$, correct to one decimal place.

(iv) Use triangle CDE to find $|DE|$, the length of the strap, correct to one decimal place.

(b) The diagram below is a scale drawing of a hopper tank used to store grain. An estimate is needed of the capacity (volume) of the tank. The figure of the man standing beside the tank allows the scale of the drawing to be estimated.



(i) Give an estimate, in metres, of the height of an average adult man.

Answer: Area and Volume will be examined from the old syllabus in 2012.

(ii) Using your answer to part **(i)**, estimate the dimensions of the hopper tank. Write your answers in the spaces provided on the diagram.

(iii) Taking the tank to be a cylinder with a cone above and below, find an estimate for the capacity of the tank, in cubic metres.

Area and Volume will be examined from the old syllabus in 2012.

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Note to readers of this document:

This sample paper is intended to help teachers and candidates prepare for the June 2011 examination in the *Project Maths* initial schools. The content and structure do not necessarily reflect the 2012 or subsequent examinations in the initial schools or in all other schools.

Leaving Certificate 2011 – Ordinary Level

Mathematics (Project Maths – Phase 2) – Paper 2

Sample Paper
Time: 2 hours 30 minutes

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination

Mathematics (Project Maths)

Paper 2

Ordinary Level

Monday 14 June Morning 9:30 – 12:00

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 **three** sections in this examination paper:

Section 0	Area and Volume (old syllabus)	50 marks	1 question
Section A	Concepts and Skills	125 marks	5 questions
Section B	Contexts and Applications	125 marks	3 questions

Answer **all nine** questions, as follows:

In Section 0, answer Question 1.

In Section A, answer Questions 2, 3, 4, 5 and 6.

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.

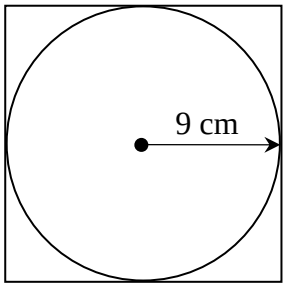
Answers should be given in simplest form, where relevant.

Section 0 Area and Volume (old syllabus) 50 marks

Answer **Question 1** from this section.

Question 1 **(50 marks)**

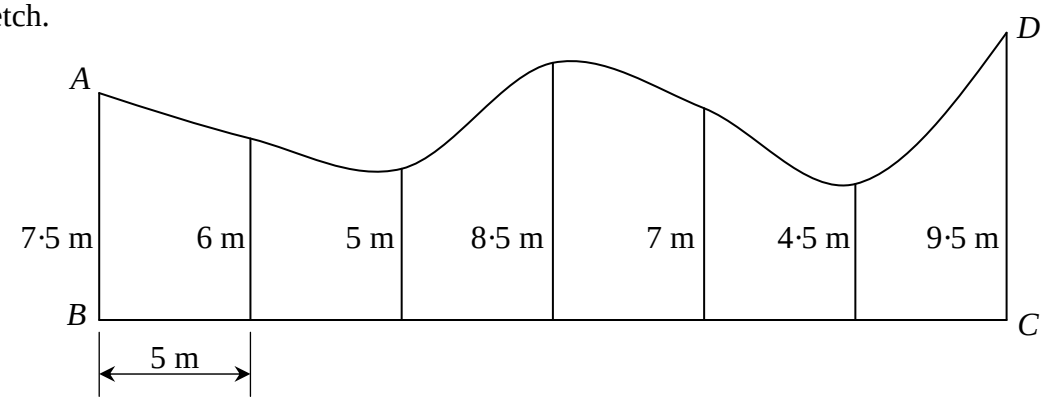
(a) A circle is inscribed in a square as shown.
The radius of the circle is 9 cm.



(i) Find the perimeter of the square.

(ii) Calculate the area of the square.

(b) The diagram shows a sketch of a field *ABCD* that has one uneven edge. At equal intervals of 5 m along [*BC*], perpendicular measurements are made to the uneven edge, as shown on the sketch.



(i) Use Simpson's rule to estimate the area of the field.

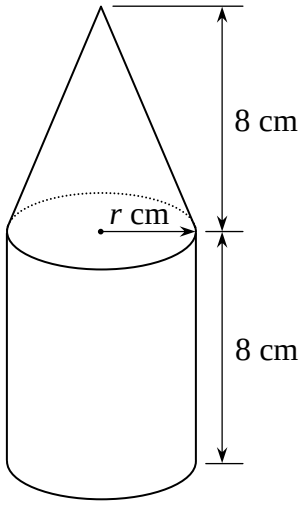
(ii) The actual area of the field is 200 m^2.
Find the percentage error in the estimate.

(c) **(i)** The diameter of a solid metal sphere is 9 cm.
Find the volume of the sphere in terms of π.

(ii) The sphere is melted down. All of the metal is used to make a solid shape which consists of a cone on top of a cylinder, as shown in the diagram.

The cone and the cylinder both have height 8 cm.
The cylinder and the base of the cone both have radius *r* cm.

Calculate *r*, correct to one decimal place.



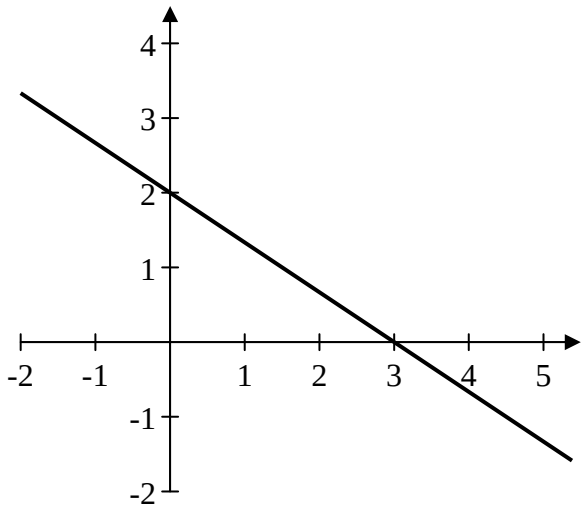
Section A — Concepts and Skills — 125 marks

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

Question 2 **(25 marks)**

(a) A line crosses the x-axis at $x = 3$ and the y-axis at $y = 2$.

Find the equation of the line.



(b) The equations of two lines l_1 and l_2 are:

$$l_1: \quad x + 3y = 8$$

$$l_2: \quad 6x - 2y = 15.$$

Determine whether these lines are perpendicular. Justify your answer clearly.

page | running

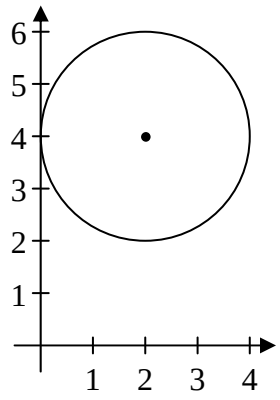
Question 3 **(25 marks)**

(a) A circle has centre (0, 0) and passes through the point (3, 4).

(i) Find the equation of the circle.

(ii) Find the co-ordinates of the two points at which the circle crosses the *y*-axis.

(b) A circle has centre (2, 4) and touches the *y*-axis.
Find the equation of the circle.



Question 4 **(25 marks)**

(a) Using a calculator, or otherwise, find the mean and standard deviation of the data in the following frequency table.

x	20	30	40	50
f	16	38	26	20

Mean = _____ Standard deviation = _____

(b) Below is a stem-and-leaf plot of the heights of a group of students, in centimetres.

13	3					
13	5	6				
14	0	0	1			
14	6	6	7	8		
15	0	1	2	2	3	3
15	5	5	6	7		

Key: 13 | 3 means 133 cm.

(i) How many students are in the group?

Answer: _____

(ii) What is the *range* of heights in the group?

(iii) What percentage of the students are between 145 cm and 154 cm in height?

Question 5 **(25 marks)**

(a) Helen has enough credit to download three songs from the internet. There are seven songs that she wants.

(i) How many different possible selections of three songs can she make?

(ii) If there is one particular song that she definitely wants, how many different selections can she now make?

(b) **(i)** Two fair coins are tossed. What is the probability of getting two heads?

(ii) Two fair coins are tossed 1000 times. How often would you expect to get two heads?

(c) Síle hands Pádraig a fair coin and tells him to toss it ten times. She says that if he gets ten heads then she will give him a prize. The first nine tosses are all heads. How likely is it that the last toss will also be a head? Tick the correct answer, and give a reason.

Extremely unlikely ☐

Fairly unlikely ☐

50-50 chance ☐

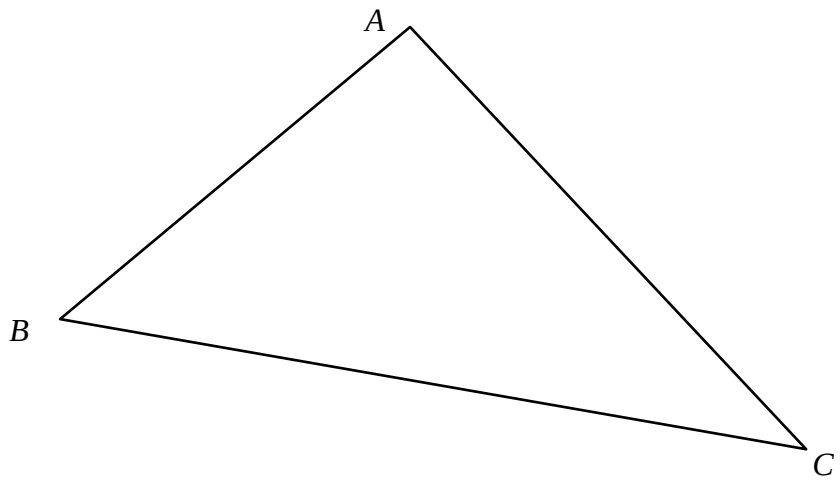
Fairly likely ☐

Almost certain ☐

Reason:

Question 6 **(25 marks)**

The diagram shows a triangle ABC in which $|AB| = 6$ cm, $|CB| = 10$ cm, and $|\angle ABC| = 50°$.



(a) Calculate the area of triangle ABC, correct to the nearest cm^2.

(b) Calculate the length of $[AC]$, correct to one decimal place.

(c) The triangle $A'BC'$ is the image of triangle ABC under the enlargement with centre B and scale factor 3. Find the area of $A'BC'$, correct to the nearest cm^2.

page	running

Section B — Contexts and Applications — 125 marks

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

Question 7 — Probability and Statistics — (40 marks)

The table below gives motor insurance information for fully licensed, 17 to 20-year-old drivers in Ireland in 2007. All drivers who had their own insurance policy are included.

	Number of drivers	Number of claims	Average cost per claim
Male	9634	977	€6108
Female	6743	581	€6051

(Source: adapted from: Financial Regulator. *Private Motor Insurance Statistics 2007*.)

Questions **(a)** to **(e)** below refer to drivers in the table above only.

(a) What is the probability that a randomly selected **male** driver made a claim during the year? Give your answer correct to three decimal places.

(b) What is the probability that a randomly selected **female** driver made a claim during the year? Give your answer correct to three decimal places.

(c) What is the *expected value* of the cost of claims on a male driver's policy?

(d) What is the *expected value* of the cost of claims on a female driver's policy?

(e) The male drivers were paying an average of €1688 for insurance in 2007 and the female drivers were paying an average of €1024. Calculate the average surplus for each group, and comment on your answer.

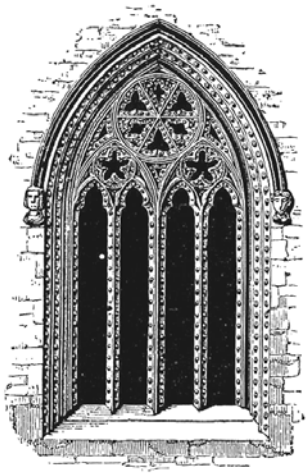
(Note: the *surplus* is the amount paid for the policy minus the expected cost of claims.)

Male	Female
Comment:	

(f) A 40-year-old female driver with a full license has a probability of 0·07 of making a claim during the year. The average cost of such claims is €3900. How much should a company charge such drivers for insurance in order to show a surplus of €175 per policy?

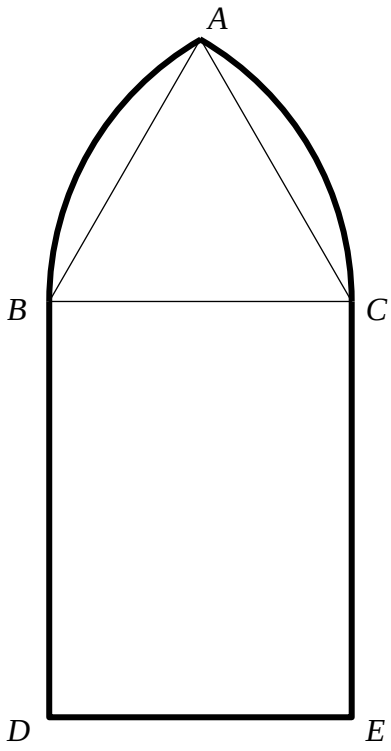
Question 8 **Geometry and Trigonometry** **(40 marks)**

Windows are sometimes in the shape of a pointed arch, like the one shown in the picture.



A person is designing such an arched window. The outline is shown in the diagram below the picture.

The centre for the arc AB is C and the centre for the arc AC is B. $|BD| = 2{\cdot}4$ metres and $|DE| = 1{\cdot}8$ metres.



(a) Show that $|\angle ABC| = 60°$.

(b) Find the length of the arc AB.
Give your answer in metres, correct to three decimal places.

(c) Find the length of the perimeter of the window.
Give your answer in metres, correct to two decimal places.

(d) Find the height of the window.
Give your answer in metres, correct to two decimal places.

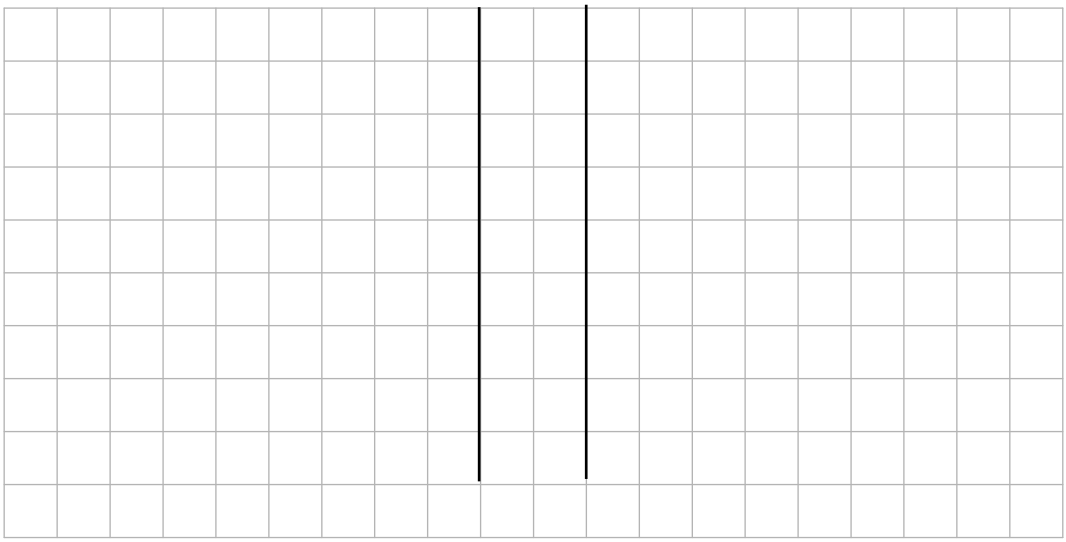
(e) Make an accurate scaled drawing below of the outline of the window, using the scale 1:30.
That is, 1 cm on your diagram should represent 30 cm in reality.

Question 9A **Probability and Statistics** **(45 marks)**

Students in two schools – one in County Kerry and the other in County Offaly – were arguing about which county had the nicest weather in the summer. They agreed to record the highest temperature at each school on ten randomly selected days during the summer of 2009. The results were as follows:

Temperature at Kerry school (/°C)			Temperature at Offaly school (/°C)		
18·5	17·2	17·8	22·1	18·0	19·1
17·6	17·5	17·2	17·2	18·4	18·6
17·1	16·9	16·9	19·8	19·0	17·6
17·1			17·0		

(a) Construct a back-to-back stem-and-leaf plot of the above data.



(b) State **two differences** between the two distributions.

Difference 1:

Difference 2:

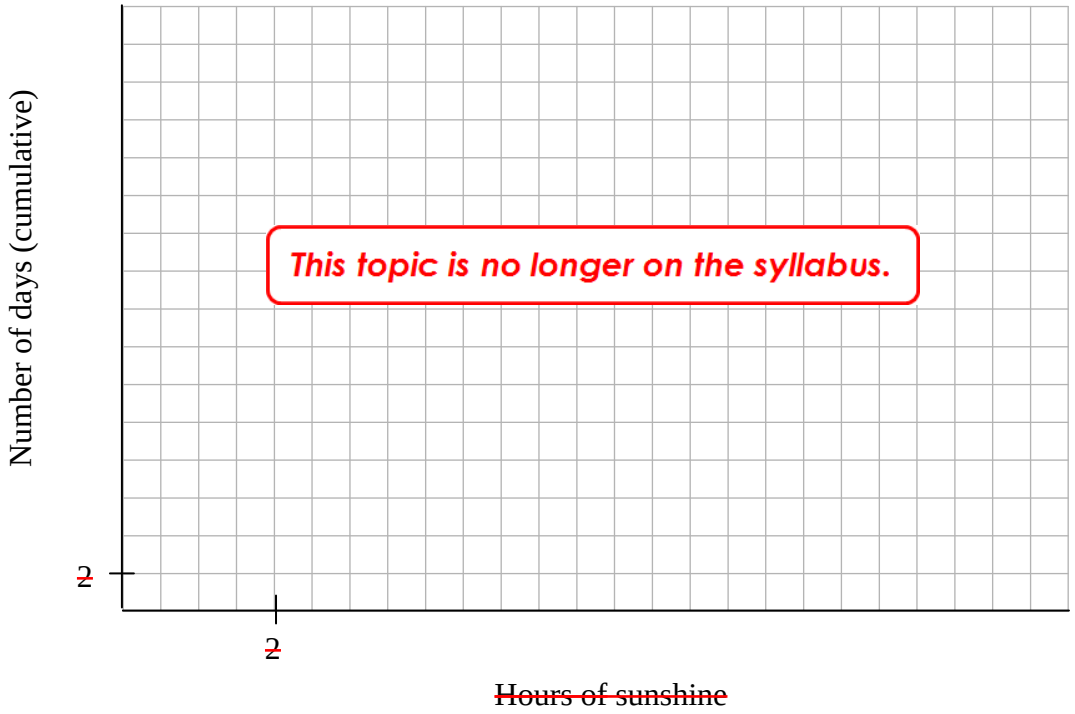
(c) ~~Perform a *Tukey Quick Test* on the data, stating clearly what can be concluded.~~

~~This topic is no longer on the syllabus.~~

(d) The students in Offaly looked also at the amount of sunshine. They recorded the number of hours of sunshine each day in July 2009. The data are summarised in the table below.

Hours of sunshine	≤ 2	≤ 4	≤ 6	≤ 8	≤ 10	≤ 12
Number of days	11	12	20	29	30	31

Draw a cumulative frequency curve to represent this data, using the scale indicated.



(e) Use your cumulative frequency curve to estimate:

(i) the median number of hours of sunshine

(ii) the number of days with **more than** 7 hours of sunshine.

(f) The mean amount of sunshine per day in Offaly in July generally is 4·24 hours. A day is chosen at random from the days in July 2009, as described in part **(d)** above. What is the probability that the amount of sunshine on that day was less than the mean?

(Data in this question adapted from *Monthly Weather Bulletin, July 2009*, at www.met.ie.)

Question 9B **Geometry and Trigonometry** **(45 marks)**

(a) The photograph shows the *Dockland* building in Hamburg, Germany.

The diagram below is a side view of the building. It is a parallelogram.

The parallelogram is 29 metres high.
The top and bottom edges are 88 metres long.

Photo by *NatiSythen*. Wikipedia Commons. License: CC-SA

(i) Find the area of this side of the building.

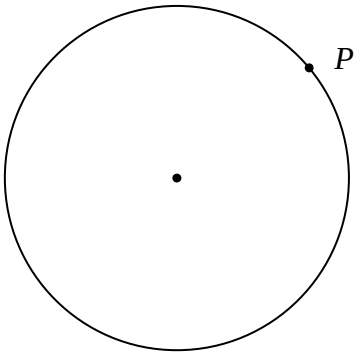
.

(ii) If $|BD| = |AD|$, find $|BC|$.

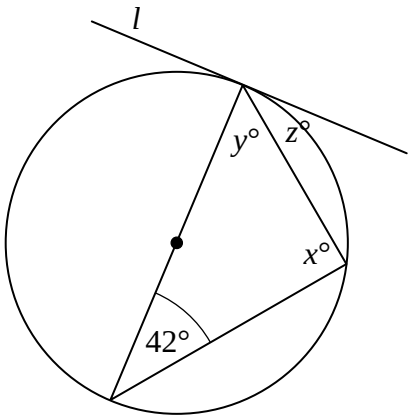
(iii) The lines *BC* and *AD* are parallel. Find the distance between these parallel lines.

(b) There is a theorem on your geometry course that can be used to construct the tangent to a circle at a given point on the circle. State this theorem and use it to construct the tangent to the circle shown at the point *P*.

Theorem:



(c) In the diagram, the line *l* is a tangent to the circle. Find the values of *x*, *y* and *z*.



x = _____

y = _____

z = _____

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Leaving Certificate – Ordinary Level

Mathematics (Project Maths) – Paper 2

Monday 14 June
Morning 9:30 – 12:00

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination
Sample Paper

Mathematics (Project Maths)

Paper 2

Ordinary 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 **three** sections in this examination paper:

Section 0	Area and Volume (old syllabus)	50 marks	1 question
Section A	Concepts and Skills	125 marks	5 questions
Section B	Contexts and Applications	125 marks	3 questions

Answer **all nine** questions, as follows:

In Section 0, answer Question 1

In Section A, answer Questions 2, 3, 4, 5 and 6

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.

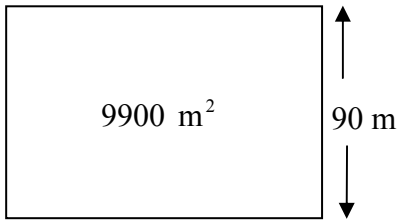
Answers should be given in simplest form, where relevant.

Section 0 Area and Volume (old syllabus) 50 marks

Answer **Question 1** from this section.

Question 1 **(50 marks)**

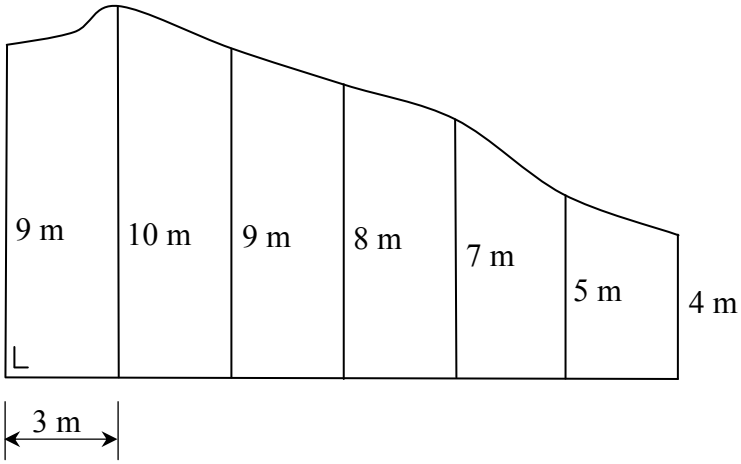
(a) The area of a rectangular playing pitch is 9900 m^2. The width of the playing pitch is 90 m.



(i) Find the length of the playing pitch.

(ii) Find the perimeter of the playing pitch.

(b) The sketch shows the garden of a house. At equal intervals of 3 m along one side, perpendicular measurements are made to the boundary, as shown on the sketch.

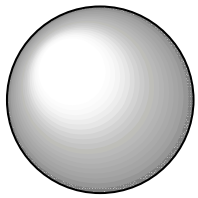


(i) Use Simpson's rule to estimate the area of the garden.

(ii) The owner of the house digs an ornamental pond in the garden. The surface area of the pond is $7\,\text{m}^2$. What percentage of the area of the garden is taken up by the pond?

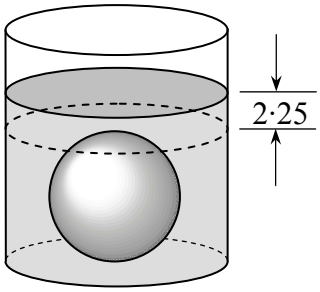
Give your answer correct to the nearest percent.

(c) **(i)** The volume of a sphere is $36\pi\ \text{cm}^3$.
Find the radius of the sphere.



(ii) When the sphere is fully immersed in a cylinder of water, the level of the water rises by 2·25 cm.

Find the radius of the cylinder.



Section A — Concepts and Skills — 125 marks

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

Question 2 **(25 marks)**

The size, mean and standard deviation of four sets of data A, B, C and D are given in this table:

	A	B	C	D
size (N)	1000	100	100	10
mean (μ)	10	100	1000	100
standard deviation (σ)	20	30	20	10

Complete the sentences below by inserting the relevant letter in each space:

(a) The set that contains more numbers than any other is ____ and the set that contains fewer numbers than any other is ____.

(b) On average, the data in set ____ are the biggest numbers and the data in set ____ are the smallest numbers.

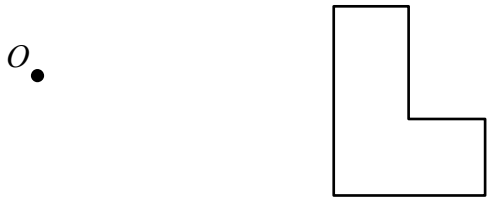
(c) The data in set ____ are more spread out than the data in the other sets.

(d) The set that **must** contain some negative numbers is set ____.

(e) If the four sets are combined, the median is most likely to be a value in set ____.

Question 3 **(25 marks)**

(a) Construct the image of the shape under the enlargement with centre O and scale factor 2·5.



(b) Given that the area of the original shape is 3·5 cm^2, find the area of the image.

Question 4 **(25 marks)**

The 2006 census shows that the number of males living in Ireland is about the same as the number of females.

(a) If a person is selected at random, write down the probability that the person is male.

Answer: _____

(b) Four people are chosen at random. We are interested in whether they are male or female.

(i) Complete the sample space below showing the sixteen equally likely outcomes.

M M M M			
M M M F			

(ii) Hence, or otherwise, complete the table of probabilities below.

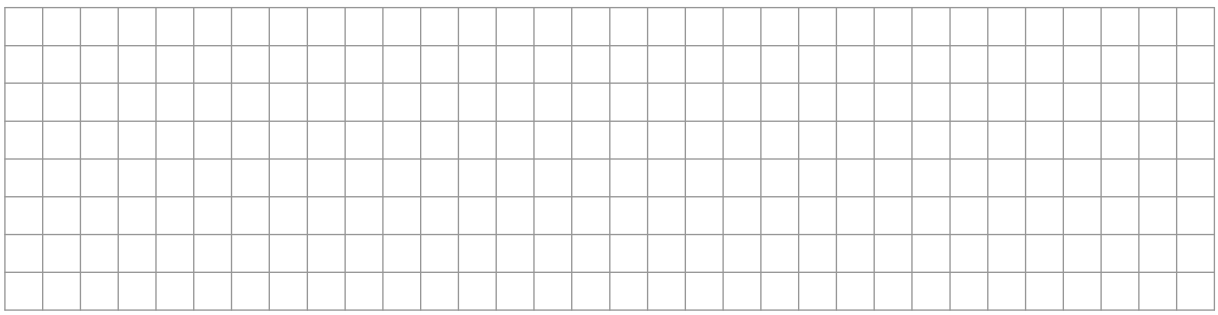
four males	three males; one female	two males; two females	one male; three females	four females
$\frac{1}{16}$				

(c) A person states the following: "If you pick four people at random, it's **more likely than not** that you'll get two males and two females."

Is this statement correct? Justify your answer using the answer(s) to part **(b)**.

Answer: _____

Justification:

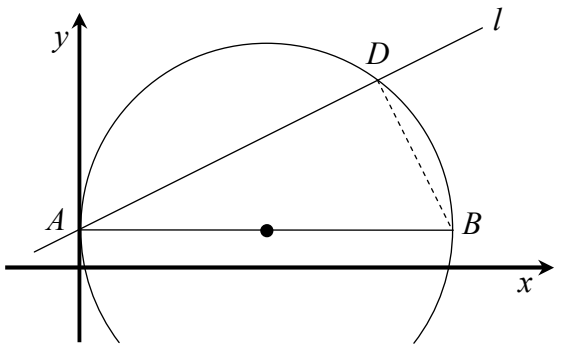


Question 5 **(25 marks)**

(a) The point A has co-ordinates (0, 1).

The line l passes through A and has slope $\frac{1}{2}$

Find the equation of l.



(b) [AB] is the diameter of a circle, where B is the point (10, 1).

Find the centre and radius of the circle, and hence write down its equation.

Centre: (,); radius: _____ Equation: _____

(c) The line l crosses the circle at the points A and D.

Write down the slope of DB, and explain how you know that this is the slope.

Answer: The slope of DB is: _____

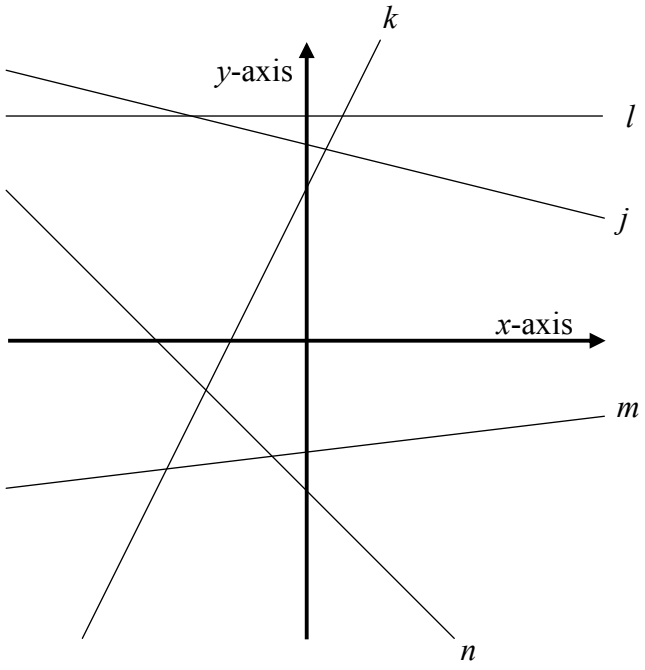
Explanation:

Question 6 **(25 marks)**

(a) Five lines j, k, l, m, and n in the co-ordinate plane are shown in the diagram.

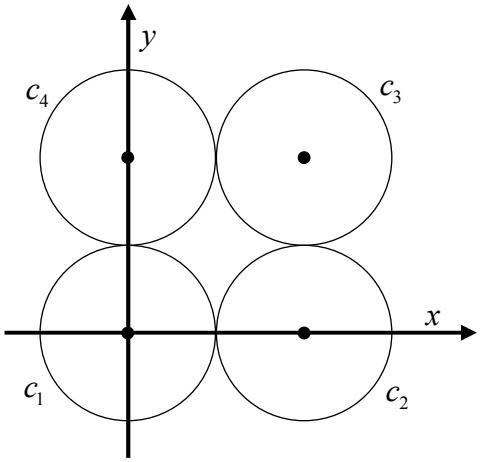
The slopes of the five lines are in the table below.

Complete the table, matching the lines to their slopes.



slope	line
2	
$\frac{1}{8}$	
0	
$-\frac{1}{4}$	
-1	

(b) The diagram shows four circles of equal radius. The circles are touching as shown.



The equation of c_1 is $x^2 + y^2 = 9$.

(i) Write down the radius of c_1.

Answer: _____

(ii) Write down the co-ordinates of the centre of c_3.

Answer: _____

(iii) Write down the equation of c_3.

Answer: _____

Section B — Contexts and Applications — 125 marks

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

Question 7 — Probability and Statistics — (40 marks)

(a) The students in a Leaving Certificate class decided to investigate their heights. They measured the height of each student, in centimetres, and the results were as follows:

173	167	180	168	180	175
171	161	164	187	176	160
170	171	167	178	174	149
157	161	176	166	167	172

(i) Construct a stem and leaf plot of the above data.

Key: 14|9 = 149 cm

(ii) Describe the distribution of the data, by making **one** statement about **each** of the three characteristics indicated below.

shape of distribution:

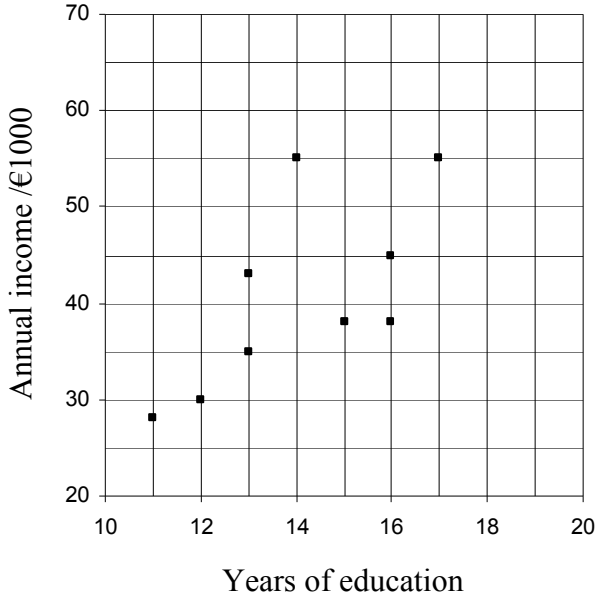
location of data (central tendency / average):

spread of data (dispersion):

(iii) State **one** additional piece of information that you would need in order to decide whether these students are unusually tall?

(b) An economics student wants to find out whether the length of time people spend in education affects how much they earn. The student carries out a small study. She asks twelve adults 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) What can you conclude from the scatter plot?

(iii) 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.

Give **one** possible problem that might make the results of the investigation unreliable. State clearly why the issue you mention could cause a problem.

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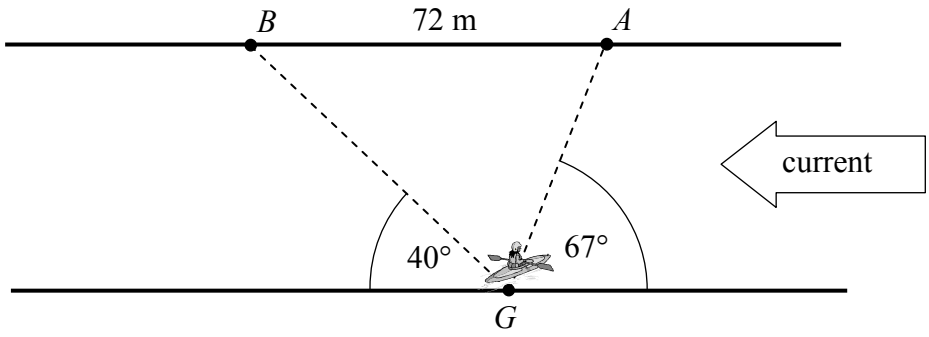
Question 8 **Geometry and Trigonometry** **(40 marks)**

Gráinne has been out on a river in a kayak and has stopped at a point on one side of the river. However, she wants to get out on the other side. Looking across, she can only see two possible places to get out. One is a bit up the river from where she is now, and one is farther down the river. Because of the current, she can go faster towards the point down the river than the one up the river.

The situation is shown in the diagram below. The banks of the river are parallel. Gráinne's position is marked *G*. The places where she can get out are marked *A* and *B*. The angles are as shown. The distance from *B* to *A* is 72 metres.

If she travels in a straight line to *A*, Gráinne can go at 0·9 m/s and if she travels in a straight line to *B* she can go at 3·2 m/s.



(a) Find the distances from *G* to *A* and from *G* to *B*.

Distance from *G* to *A*:

Distance from G to B:

(b) Find the time it will take to cross by each route.

Time from G to A:

Time from G to B:

(c) Gráinne wants to get home as fast as possible. Give one possible reason why she might **not** choose the faster of the two routes across the river.

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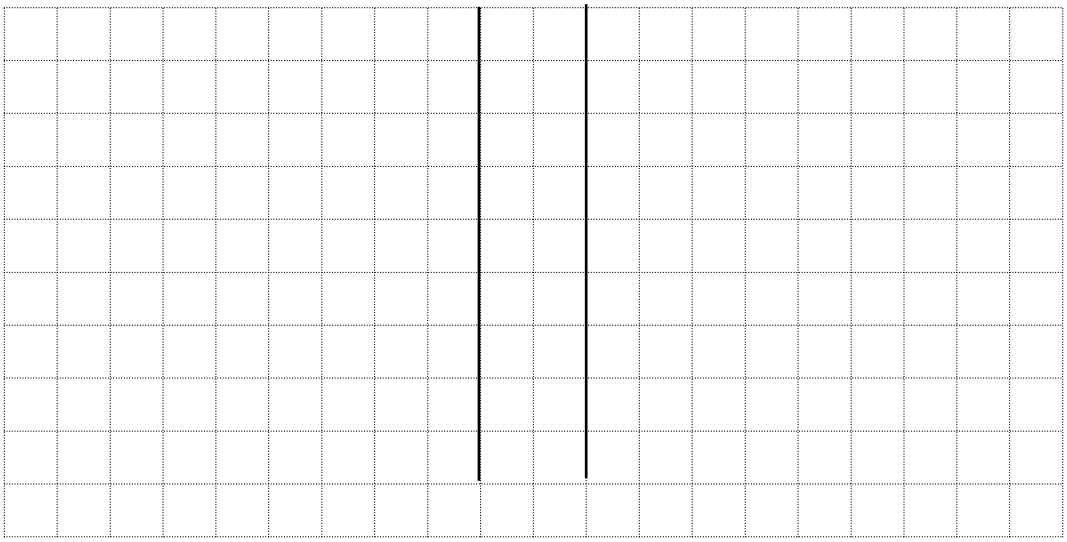
The students described in **Question 7(a)** decide to look at the heights of the boys and the girls separately. The heights of the boys and the girls in the class are given below:

Boys			Girls		
173	180	174	167	161	160
175	178	176	157	164	172
180	171	170	168	149	161
187	176	166	167	167	171

(a) Construct a back-to-back stem and leaf plot of the above data.



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

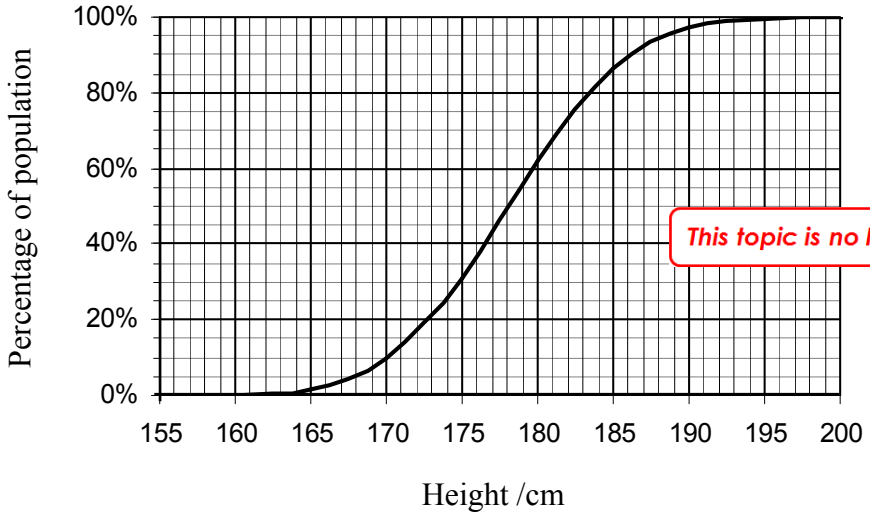
Difference:

Similarity:

(c) ~~Assume that this class can be treated as a random sample of Leaving Certificate students. Perform a *Tukey Quick Test* on the data, stating clearly what can be concluded.~~

This topic is no longer on the syllabus.

(d) ~~The following cumulative distribution curve (ogive) represents the current heights of Irish males born in 1991.~~



This topic is no longer on the syllabus.

~~From the curve, find the median height and the quartiles.~~

~~Median:~~ _____ ~~Lower quartile:~~ _____ ~~Upper quartile:~~ _____

(e) The boys in the class are a *sample*. The people in part **(d)** are a *population*. Is this is a suitable population to compare the sample to? Give a reason for your answer.

Answer: _____

Reason:

(f) Would you say that the boys in the class are taller, smaller, or about the same as the population? Use the data to justify your answer.

Answer: _____

Justification:

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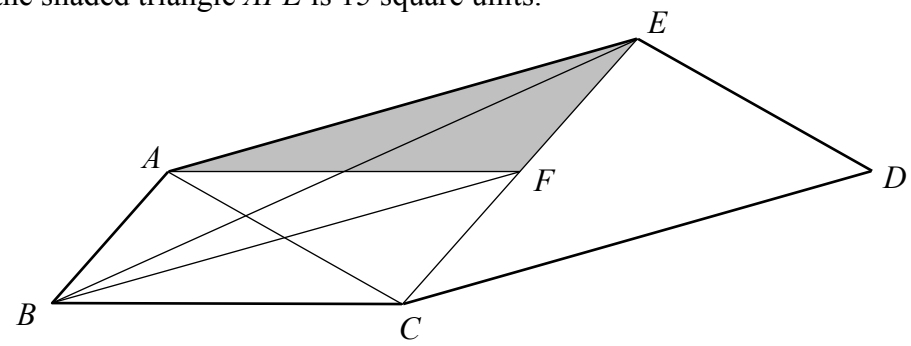
Question 9B **Geometry and Trigonometry** **(45 marks)**

(a) In the diagram below, *ABCF*, *ABFE*, and *ACDE* are parallelograms.
The area of the shaded triangle *AFE* is 15 square units.



(i) State why the area of triangle *AFB* must also be 15 square units.

(ii) Find the area of the whole figure *ABCDE*.
Show your work.

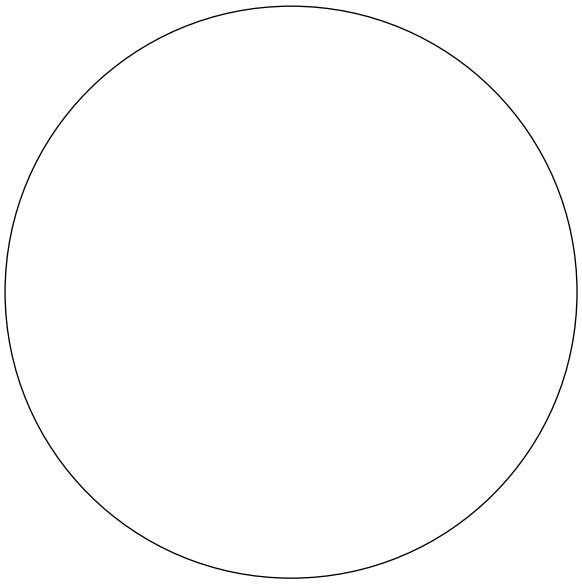
(iii) If the perpendicular distance from *D* to the line *EC* is 6, find $|AB|$.
Show your work.

(b) Dónal is making a wooden pull-along toy.
He has disks to use as wheels, but the centres are not marked on them. He needs to find the exact centre of each wheel in order to drill holes in them.

He knows that there is a geometrical method for finding the centre of a circle.

(i) State a theorem from your geometry course that could be used to locate the centre of a circle with geometrical instruments.

(ii) Find the centre of the circle below, by applying the theorem you mentioned above. Show your construction lines clearly.



(iii) Describe another way that Dónal could find the centres of the wheels.

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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 – Ordinary Level

Mathematics (Project Maths) – Paper 2

Time: 2 hours 30 minutes