Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2012

Mathematics
(Project Maths – Phase 1)

Paper 2

Ordinary Level

Monday 11 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 **three** sections in this examination paper:

Section A	Concepts and Skills	125 marks	5 questions
Section B	Contexts and Applications	125 marks	2 questions
Section C	Area and Volume (old syllabus)	50 marks	1 question

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

In Section A, answer:

Questions 1 to 4 and

either Question 5A **or** Question 5B.

In Section B, answer Questions 6 and 7.

In Section C, answer Question 8.

Write your answers in the spaces provided in this booklet. You will lose marks if you do not do so. There is space for extra work on the back cover 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: [ ]

Section A — Concepts and Skills — 125 marks

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

Question 1 **(25 marks)**

Peter and Niamh go to a large school. One morning, they arrive early. While they are waiting, they decide to guess whether each of the next three students to come in the door will be a boy or a girl.

(a) Write out the sample space showing all the possible outcomes. For example, BGG is one outcome, representing Boy, Girl, Girl.

(b) Peter says these outcomes are equally likely. Niamh says they are not. What do you need to know about the students in the school to decide which of them is correct?

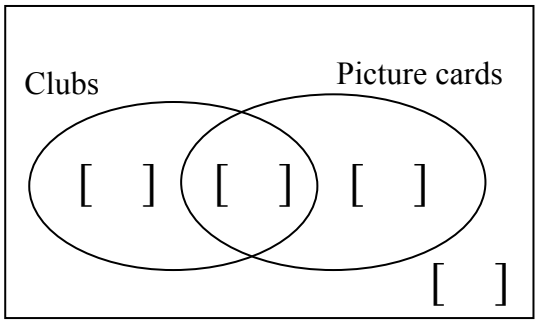
(c) If all the outcomes are equally likely, what is the probability that the three students will be two girls followed by a boy?

(d) Niamh guesses that there will be at least one girl among the next three students. Peter guesses that the next three students will be either three boys or two boys and a girl.
Who is more likely to be correct, assuming all outcomes are equally likely?
Justify your answer.

Question 2 **(25 marks)**

(a) In the Venn diagram below, the universal set is a normal deck of 52 playing cards. The two sets shown represent *clubs* and *picture cards* (kings, queens and jacks).

Show on the diagram the number of elements in each region.



(b) **(i)** A card is drawn from a pack of 52 cards.
Find the probability that the card drawn is the king of clubs.

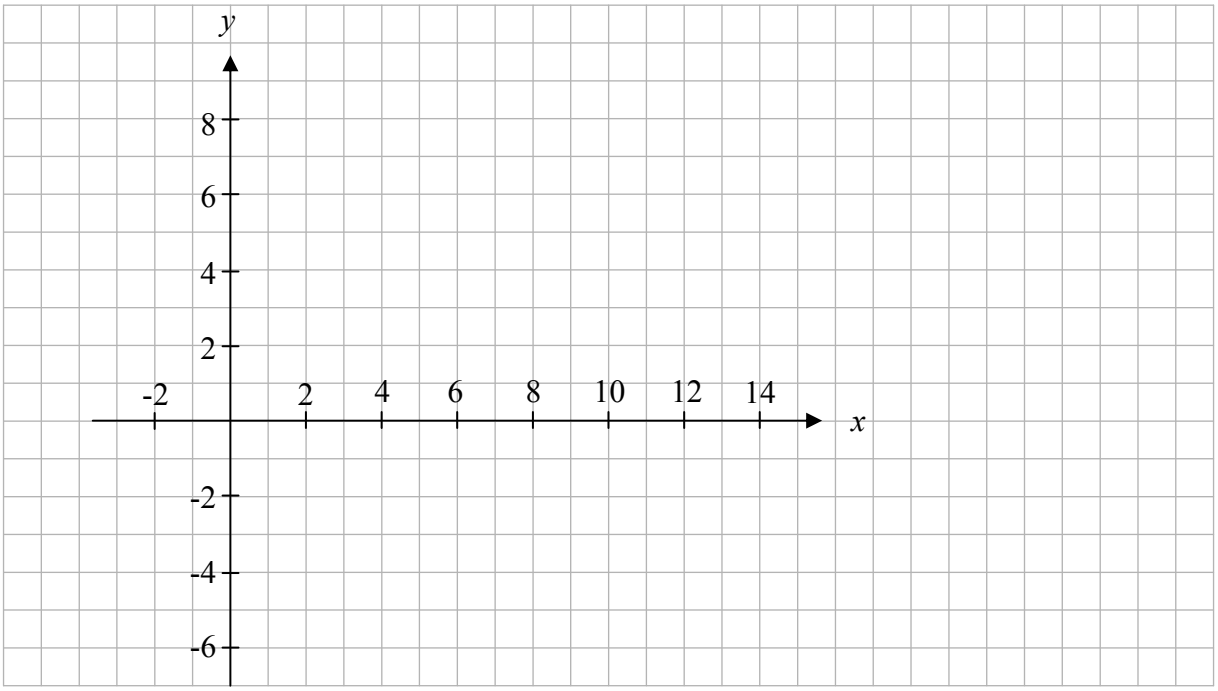
(ii) A card is drawn from a pack of 52 cards.
Find the probability that the card drawn is a club or a picture card.

(iii) Two cards are drawn from a pack of 52 cards. Find the probability that neither of them is a club or a picture card. Give your answer correct to two decimal places.

Question 3 **(25 marks)**

$A(6, -1)$, $B(12, -3)$, $C(8, 5)$ and $D(2, 7)$ are four points.

(a) Plot the four points on the diagram below.



(b) Describe two different ways of showing, using co-ordinate geometry techniques, that the points form a parallelogram *ABCD*.

First method:

Second method:

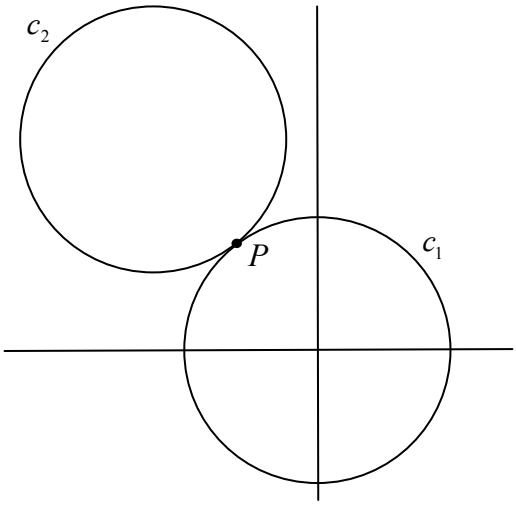
This question continues on the next page.

(c) Use one of the ways you have described to show that *ABCD* is a parallelogram.

Question 4 **(25 marks)**

The diagram shows two circles c_1 and c_2 of equal radius.

c_1 has centre (0, 0) and it cuts the *x*-axis at (5, 0).



(a) Find the equation of c_1.

(b) Show that the point $P(-3, 4)$ is on c_1.

(c) The two circles touch at $P(-3, 4)$.
P is on the line joining the two centres.
Find the equation of c_2.

(d) Find the equation of the common tangent at P.

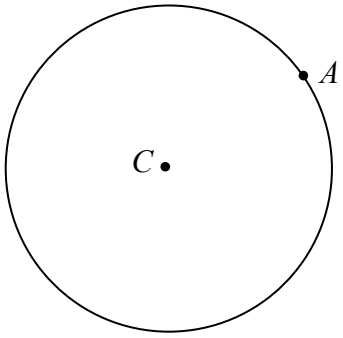
Question 5 **(25 marks)**

Answer **either** 5A **or** 5B.

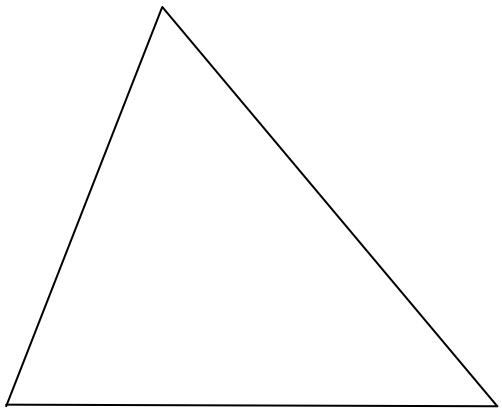
Question 5A

(a) **(i)** Write down a geometrical result that can be used to construct a tangent to a circle at a point.

(ii) On the diagram shown, construct the tangent to the circle at A.



(b) Construct the circumcentre and circumcircle of the triangle below, using only a straight edge and compass. Show all construction marks clearly.



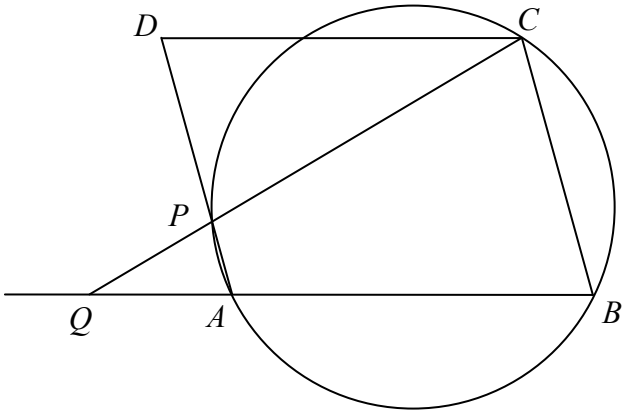
OR

Question 5B

ABCD is a parallelogram.

The points *A*, *B* and *C* lie on the circle which cuts [*AD*] at *P*.
The line *CP* meets the line *BA* at *Q*.

Prove that |*CD*| = |*CP*|.



Section B — Contexts and Applications — 125 marks

Answer Question 6 and Question 7.

Question 6 (75 marks)

The following table gives data on new private cars sold in Ireland in each quarter of each year from 2006 to 2011.

New private cars sales								
Number of cars sold						Engine type of cars sold		
Year	January to March	April to June	July to Sept.	October to Dec.	Annual Total	Petrol	Diesel	Other
2006	75 769	54 572	32 873	10 059	173 273	128 634	44 010	629
2007	81 750	57 124	32 418	9 462	180 754	128 346	50 560	1 848
2008	77 441	37 128	27 361	4 540	146 470	92 298	50 283	3 889
2009	27 140	15 225	9 049	3 018	54 432	22 802	30 645	985
2010	34 555	26 806	17 011	6 535	84 907	27 124	53 998	3 785
2011	39 484	29 770	13 467	4 211	86 932	23 246	61 730	1 956

(Source: Central Statistics Office, http://www.cso.ie)

(a) **(i)** Show the *annual total* sales of cars over the six years, using a suitable chart.

(ii) Find the mean number of cars sold per year over the six years.

(iii) Calculate the percentage increase in annual car sales between 2009 and 2011.

(iv) Aoife says that this increase shows car sales are currently going well. Paul says that car sales are currently going badly. He says that sales have fallen by 52% since 2007 and that they are well below average.
Complete the sentences below to give a criticism of each argument.

Aoife's argument does not recognise that…

Paul's argument does not recognise that…

(v) Give a more balanced description of the pattern of car sales over the six years.

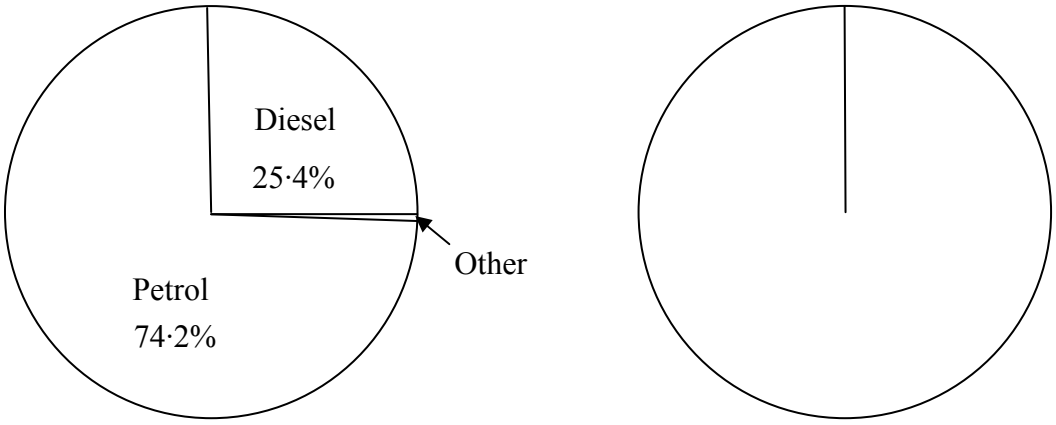
(b) **(i)** Describe how the sales of the cars are distributed over the four quarters of each year.

(ii) Suggest a reason for this pattern of sales.

(iii) The sales for the first quarter of 2012 are 36 081.
Find, with justification, an estimate for the total annual sales for 2012.

page	running

(c) **(i)** Two pie charts are being used to show the change from 2006 to 2011 in the popularity of petrol and diesel cars. Complete the second pie chart.



2006 2011

(ii) Which of the following statements best describes the change over time in the popularity of diesel cars as a percentage of the total?

A. Diesel cars have suddenly become very popular in the last year or two.

B. Diesel cars have increased very steadily in popularity over the last six years.

C. Diesel cars have become very popular since car sales started to improve.

D. Diesel cars got more popular each year, with an especially big increase in 2009.

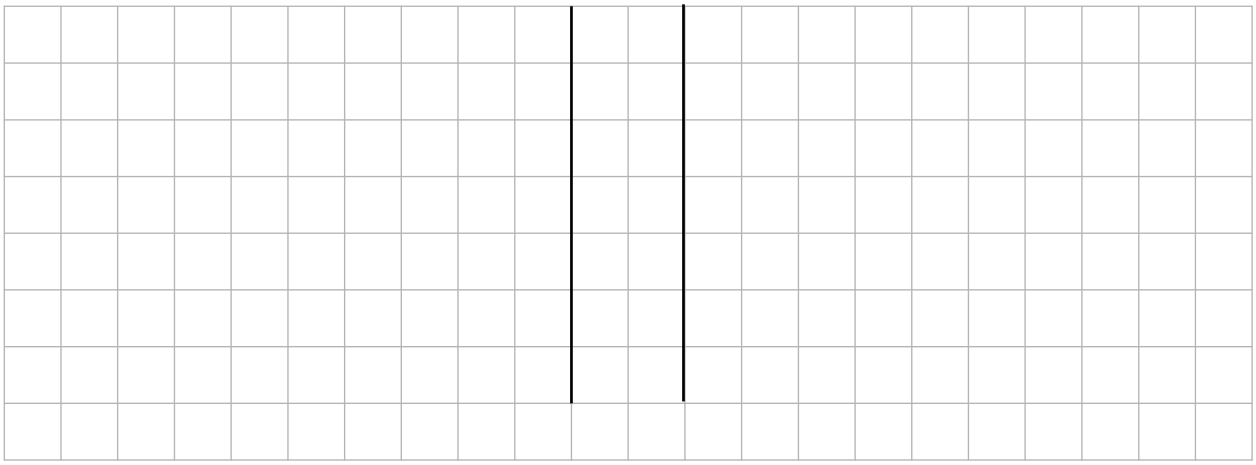
E. Diesel cars became popular as car sales fell but have been getting less popular as they rise again.

Write the letter corresponding to the correct answer in the box. ☐

(d) A survey of some of the most popular models of private cars sold in 2011 examined the CO_2 emissions in g/km from diesel engines and petrol engines. The data are as follows:

Diesel engines	Petrol engines
117, 125, 120, 125, 134, 110, 118, 114, 119, 119, 116, 107.	139, 133, 150, 157, 138, 159, 129, 138, 134, 129, 129, 136.

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



(ii) Does the information suggest that diesel engines produce lower CO_2 emissions than petrol engines? In your answer you should refer to the stem-and-leaf plot and to an appropriate measure of central tendency.

(iii) Does the information suggest that there is a greater variation in the CO_2 emissions of diesel engines than petrol engines? In your answer you should refer to the stem-and-leaf plot and an appropriate measure of variability.

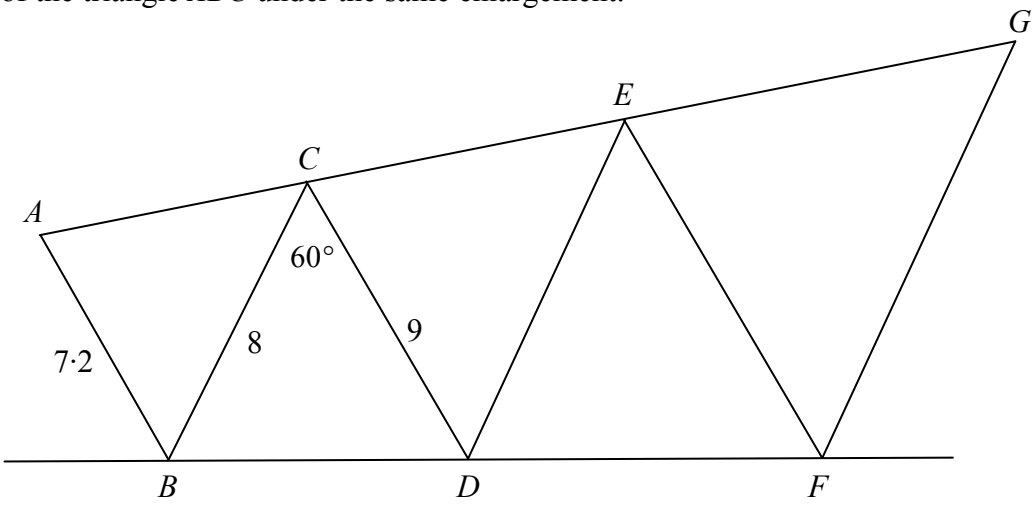
page	running

Question 7 **(50 marks)**

The planned supports for the roof of a building form scalene triangles of different sizes.

(a) Explain what is meant by a **scalene triangle**.

The triangle *EFG* is the image of the triangle *CDE* under an enlargement and the triangle *CDE* is the image of the triangle *ABC* under the same enlargement.



The proposed dimensions for the structure are $|AB| = 7{\cdot}2$ m, $|BC| = 8$ m, $|CD| = 9$ m and $|\angle DCB| = 60°$.

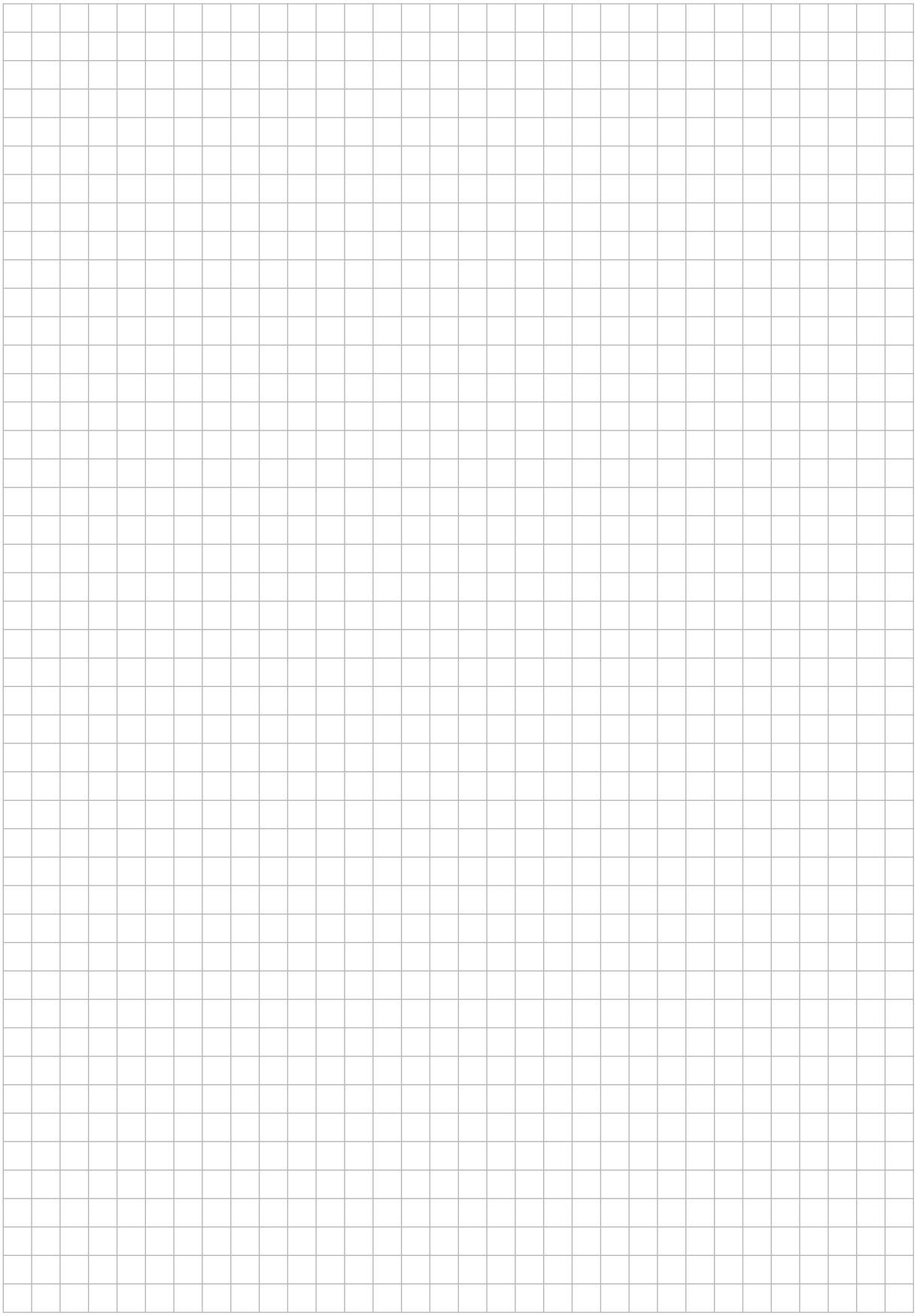
(b) Find the length of $[FG]$.

(c) Find the length of $[BD]$, correct to three decimal places.

(d) The centre of the enlargement is O. Find the distance from O to the point B.

(e) A condition of the planning is that the height of the point G above the horizontal line BF cannot exceed 11·6 m.

Does the plan meet this condition? Justify your answer by calculation.

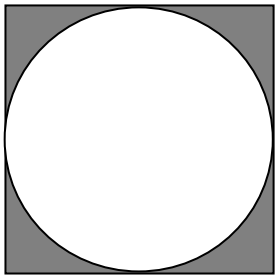


Section C — Area and Volume (old syllabus) — 50 marks

Answer Question 8 from this section.

Question 8 **(50 marks)**

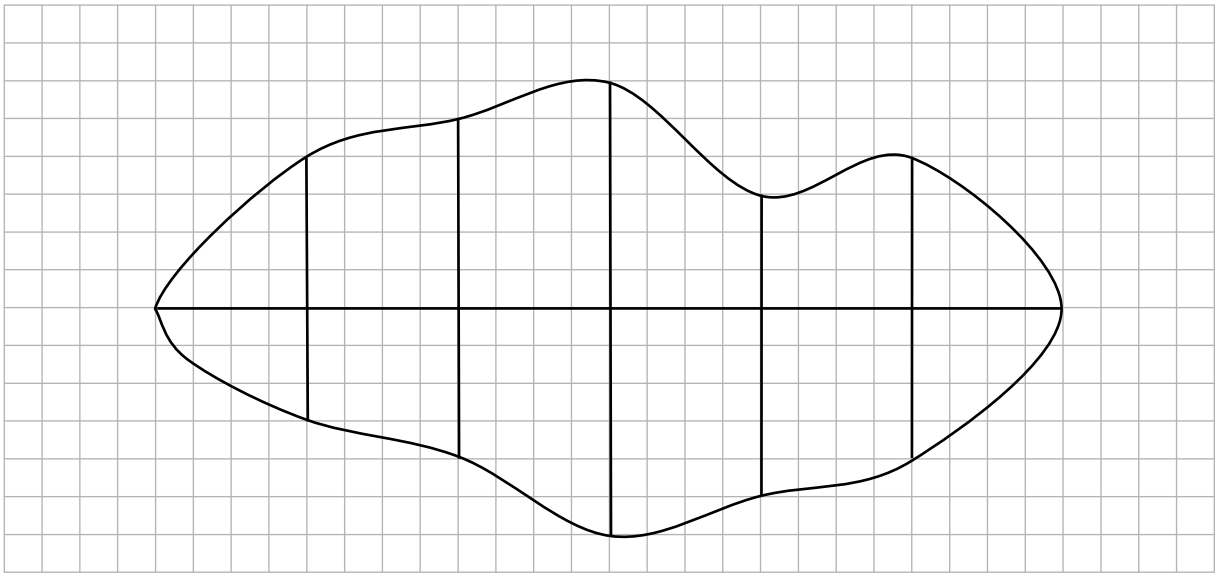
(a) The diagram shows a circle inscribed in a square.
The area of the square is 16 cm^2.



(i) Find the radius length of the circle.

(ii) Find the area of the shaded region, in cm^2, correct to one decimal place.

(b) In order to estimate the area of the irregular shape shown below, a horizontal line was drawn across the widest part of the shape and five offsets (perpendicular lines) were drawn at equal intervals along this line.



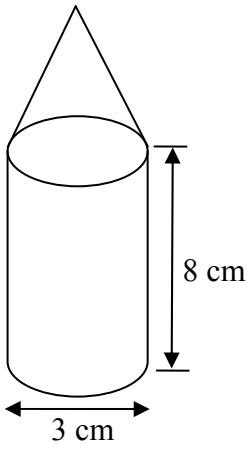
(i) Find the lengths of the horizontal line and the offsets, taking each grid unit as 5 mm, and record the lengths on the diagram.

(ii) Use Simpson's rule to estimate the area of the shape.

(c) A solid wax candle is in the shape of a cylinder with a cone on top, as shown in the diagram.

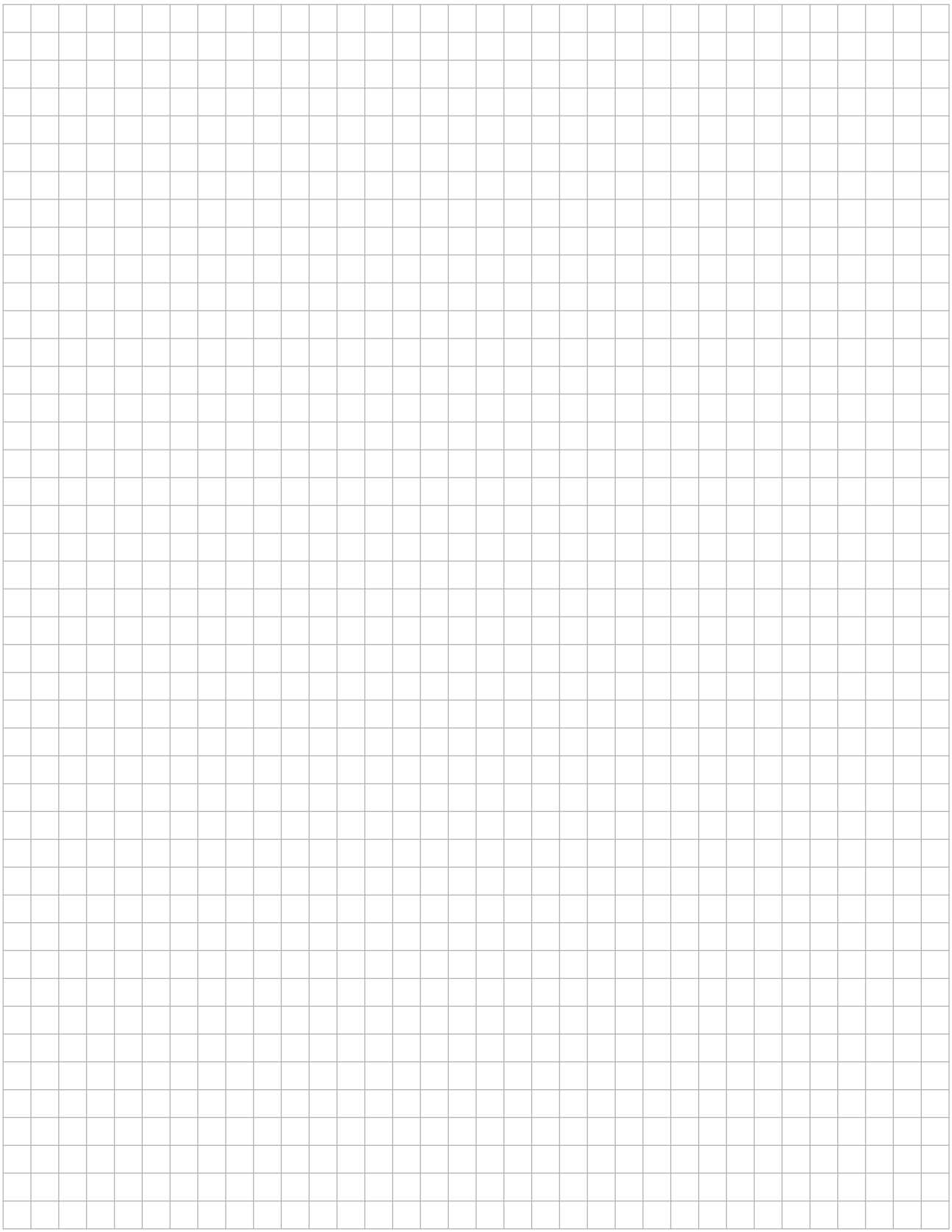
The diameter of the base of the cylinder is 3 cm and the height of the cylinder is 8 cm.

The volume of the wax in the candle is 21π cm^3.



(i) Find the height of the candle.

(ii) Nine of these candles fit into a rectangular box. The base of the box is a square. Find the volume of the smallest rectangular box that the candles will fit into.



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