



**Pre-Leaving Certificate Examination, 2016**  
**Triailscrúdú na hArdteistiméireachta, 2016**

**Mathematics**

**Paper 2**

**Higher Level**

**2½ hours**

**300 marks**

Name:
School:
Address:
Class:
Teacher:

For examiner	
Question	Mark
1	
2	
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Total	

Running total	
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Grade
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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	3 questions

Answer all nine questions.

Write your answers in the spaces provided in this booklet. You may lose marks if you do not do so. 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 *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.

**You will lose marks 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.**

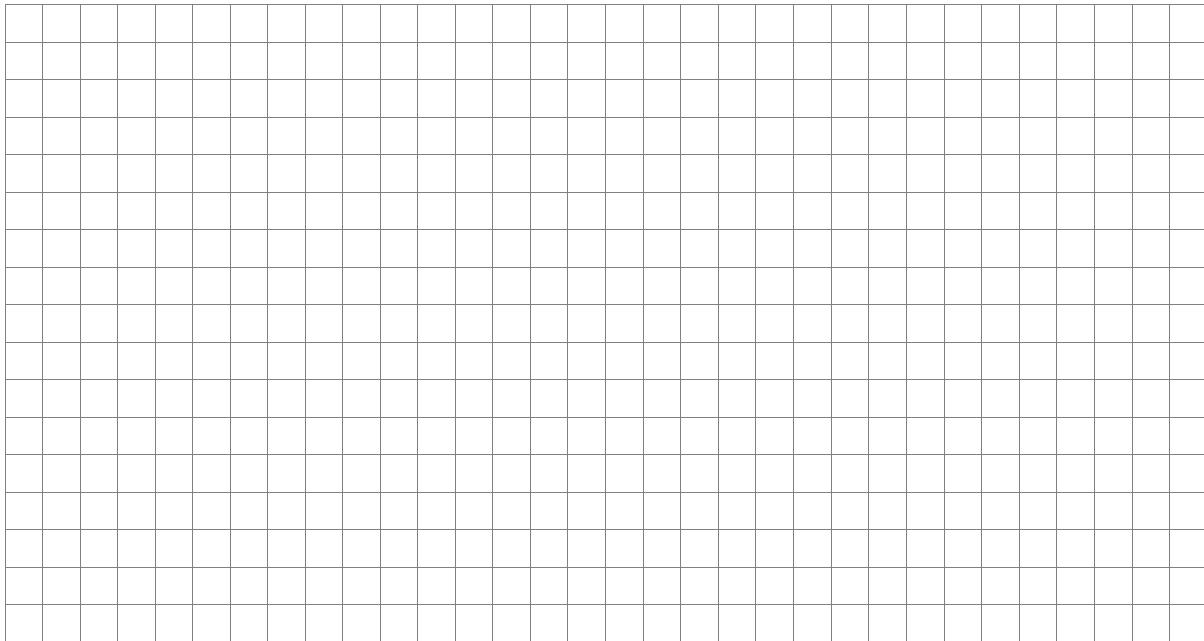
Write down the make and model of your calculator(s) here:

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

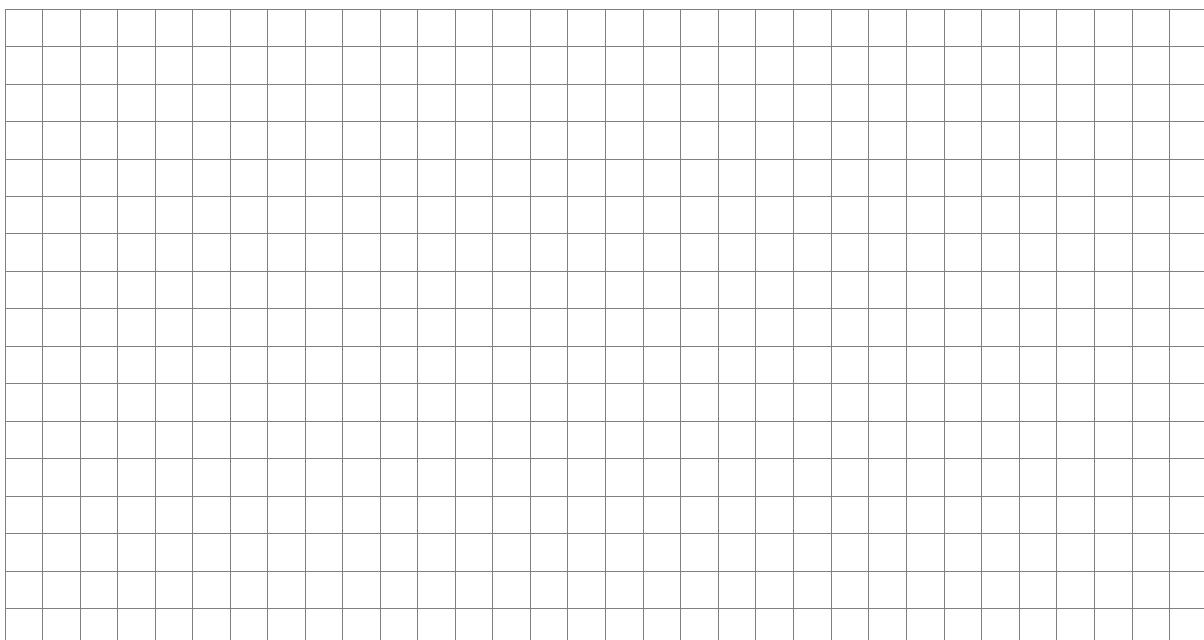
**Question 1****(25 marks)**

- (a) In a biology experiment, a group of sixth year students planted 50 cress seeds. 37 of the seeds germinated.

- (i) Calculate the probability that 6 out of 10 seeds will germinate, correct to four decimal places.



- (ii) Calculate the probability that the eighth seed will be the fifth seed to germinate.



- (b) A bag contains 3 red marbles, 4 blue marbles and  $x$  green marbles. Given that the probability of choosing 2 green marbles is  $\frac{5}{26}$  calculate the number of marbles in the bag.

**Question 2****(25 marks)**

- (a) The weights of the players,  $W$ , at a football match are normally distributed with a mean of 79 kg and a standard deviation of 3 kg.

(i) Find  $P(W \leq 80.1 \text{ kg})$ .

(ii) Find  $P(75.5 \text{ kg} \leq W \leq 81 \text{ kg})$ .

- (b)** The attendance at a GAA match depends on the weather. The probability of a large crowd attending the match is 0.9. The probability of large crowd attending if it is raining is 0.3. The probability of it raining on match day is 0.2. Calculate the probability of a large crowd attending the match given it is raining.

**Question 3****(25 marks)**

The line  $L$  passes through the point  $(6, 4)$  and has a slope of  $m$ .

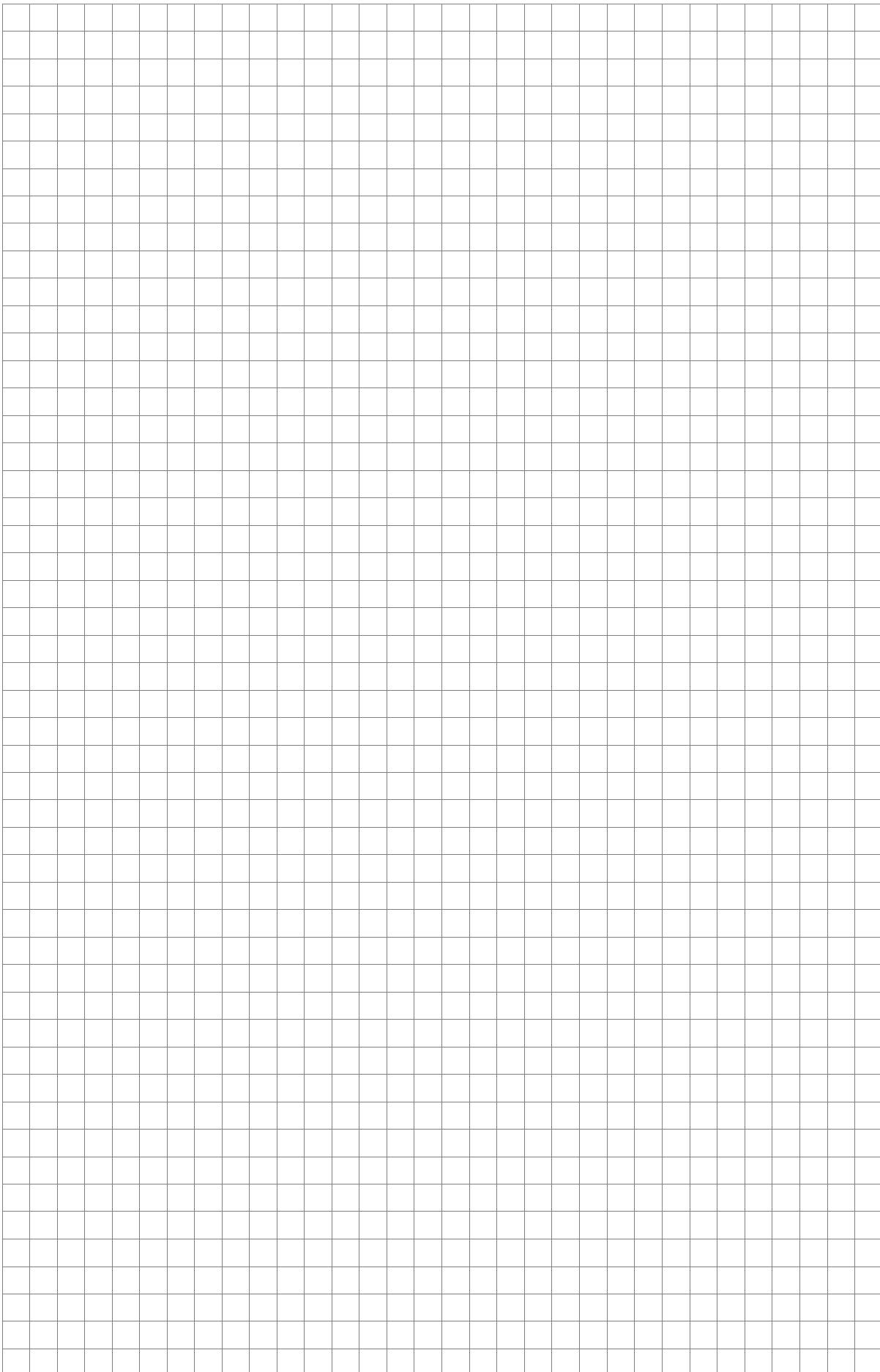
- (a)** Write down the equation of the line  $L$ , in terms of  $m$ , in the form  $ax + by + c = 0$ .

- (b)** Find, in terms of  $m$ , the co-ordinates of the points where  $L$  cuts:

- (i)** The  $x$ -axis.

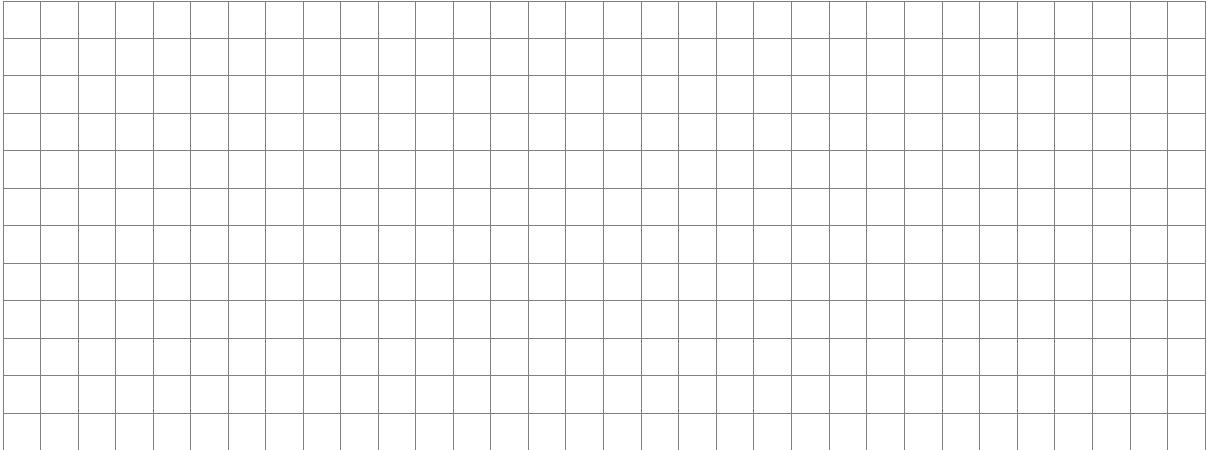
- (ii)** The  $y$ -axis.

- (c) The line  $L$  forms a triangle of area 49 square units with the axes. Find two values of  $m$ .

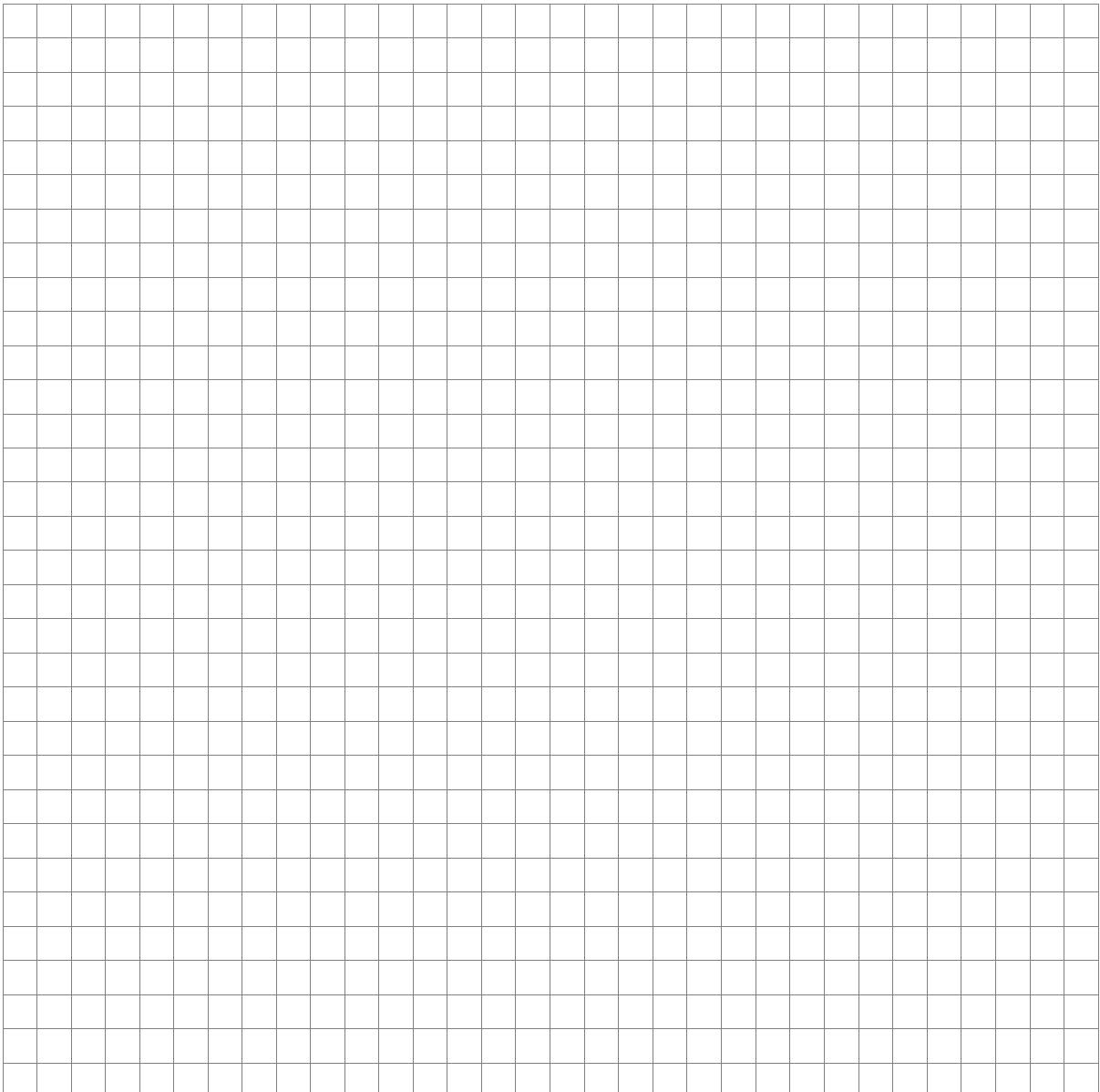


**Question 4****(25 marks)**

- (a) Find the centre and radius of the circle  $C_1 : x^2 + y^2 - 4x + 6y - 21 = 0$ .



- (b) Construct the circle  $C_1$ .



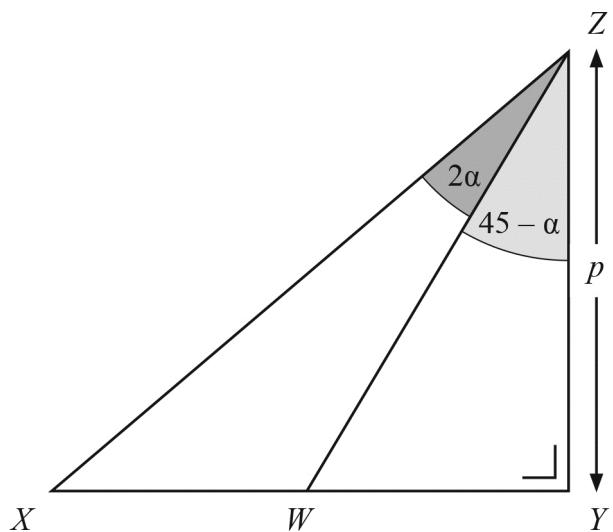
- (c) A second circle  $C_2$ , has radius length half of  $C_1$  and touches  $C_1$  internally at the point  $(5, 2)$ . Find the equation of the circle  $C_2$ .



**Question 5****(25 marks)**

- (a) In the triangle  $XYZ$ ,  $|\angle XYZ| = 90^\circ$  and  $|YZ| = p$ .

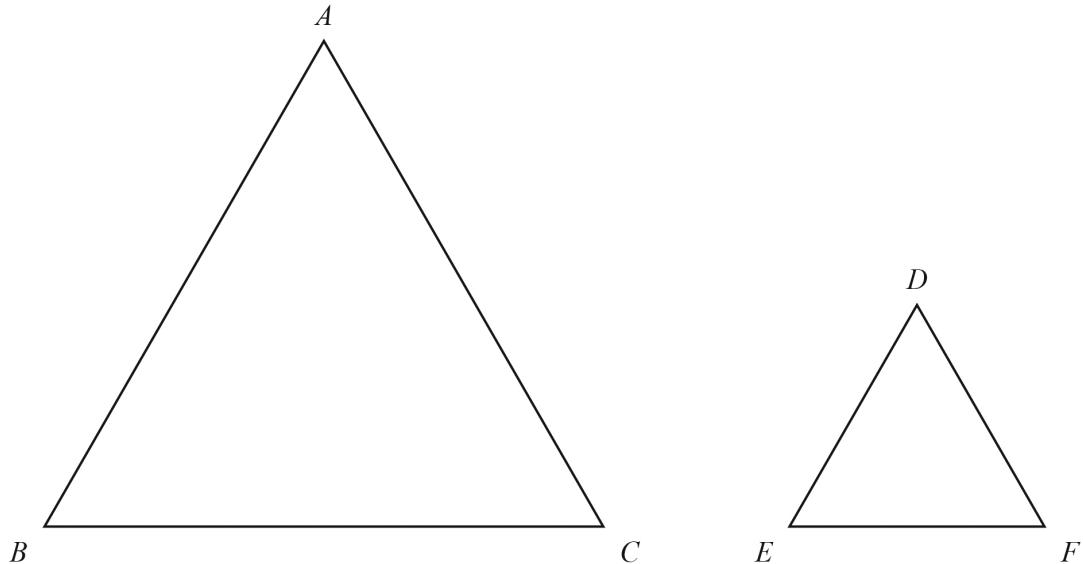
- (i) Show that  $|WY| = p \tan(45^\circ - \alpha)$ .



- (ii) Hence, or otherwise, show that  $|XW| = 2p \tan 2\alpha$ .

- (b) Prove that if two triangles  $ABC$  and  $DEF$  are similar, then their sides are proportional in order

$$\frac{|AB|}{|DE|} = \frac{|AC|}{|DF|} = \frac{|BC|}{|EF|}.$$

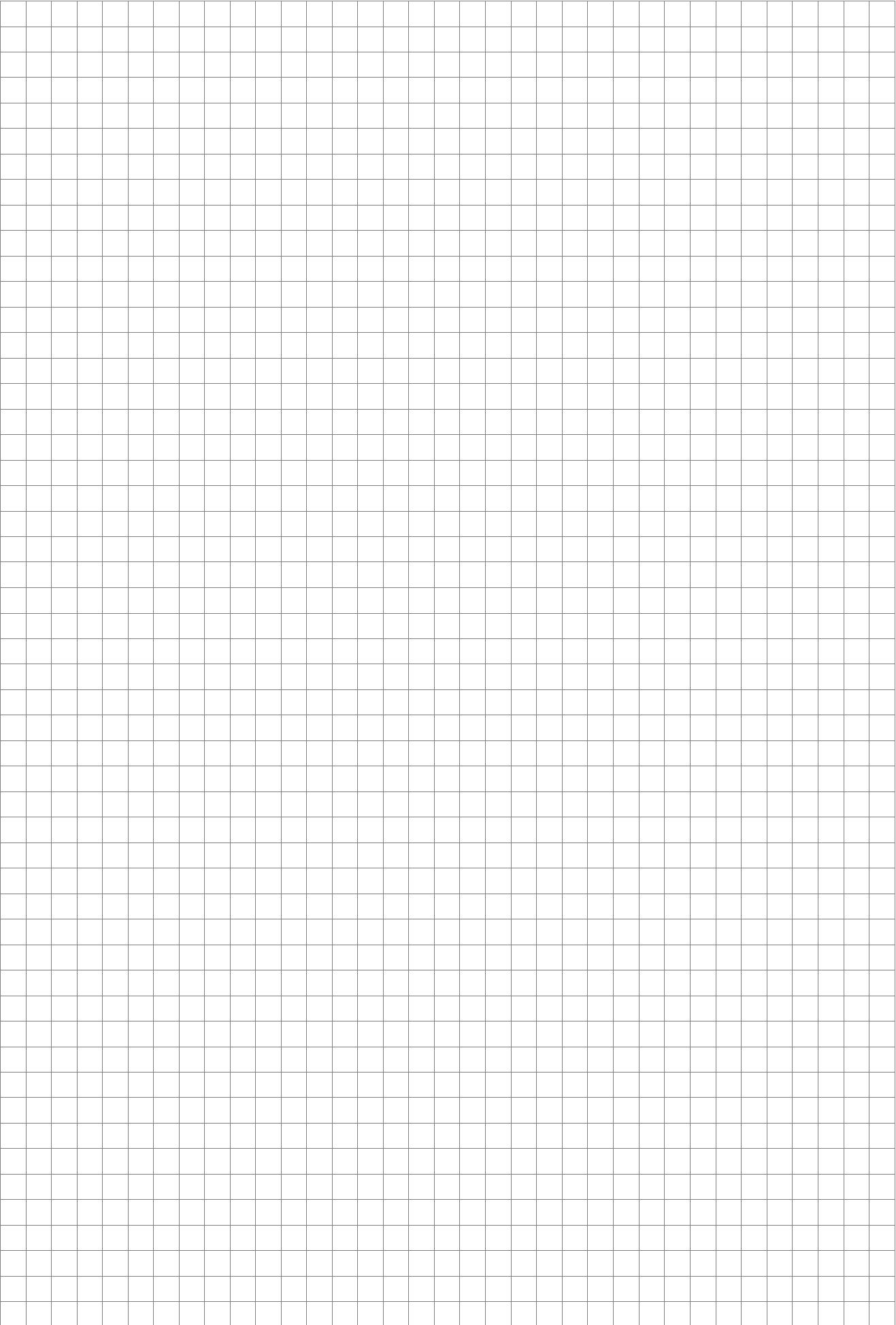


Given:

To Prove:

Construction:

Proof:



**Question 6****(25 marks)**

- (a) The area of a sector of a circle of radius 9 cm is  $13.5 \text{ cm}^2$ . Find, in radians, the measure of the acute angle in the sector.

- (b) Show that  $(\cos \alpha + \sin \alpha)^2 = 1 + \sin 2\alpha$ .

- (c) Solve the equation  $\cos 3\theta = \frac{1}{\sqrt{2}}$  for  $0^\circ \leq \theta \leq 360^\circ$ .

A large grid of squares, approximately 20 columns by 30 rows, intended for考生 to show their working for the problem.

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

## Question 7

(55 marks)

Red C Marketing and Research Ltd. were set up in 2003. They carry out market research for many different companies. Red C carries out political polls for The Sunday Business Post newspaper and carried out a General Election Opinion Poll on the 25th of October 2015.



**Red C carried out the poll under the following methods:**

- A random sample of 1004 adults aged 18+ was contacted by telephone between the 19th and 21st of October 2015.
  - A random number digit dial was used to ensure random households were contacted.
  - Half of the samples were landlines and the other half were mobiles.
  - Interviews were conducted across the country.

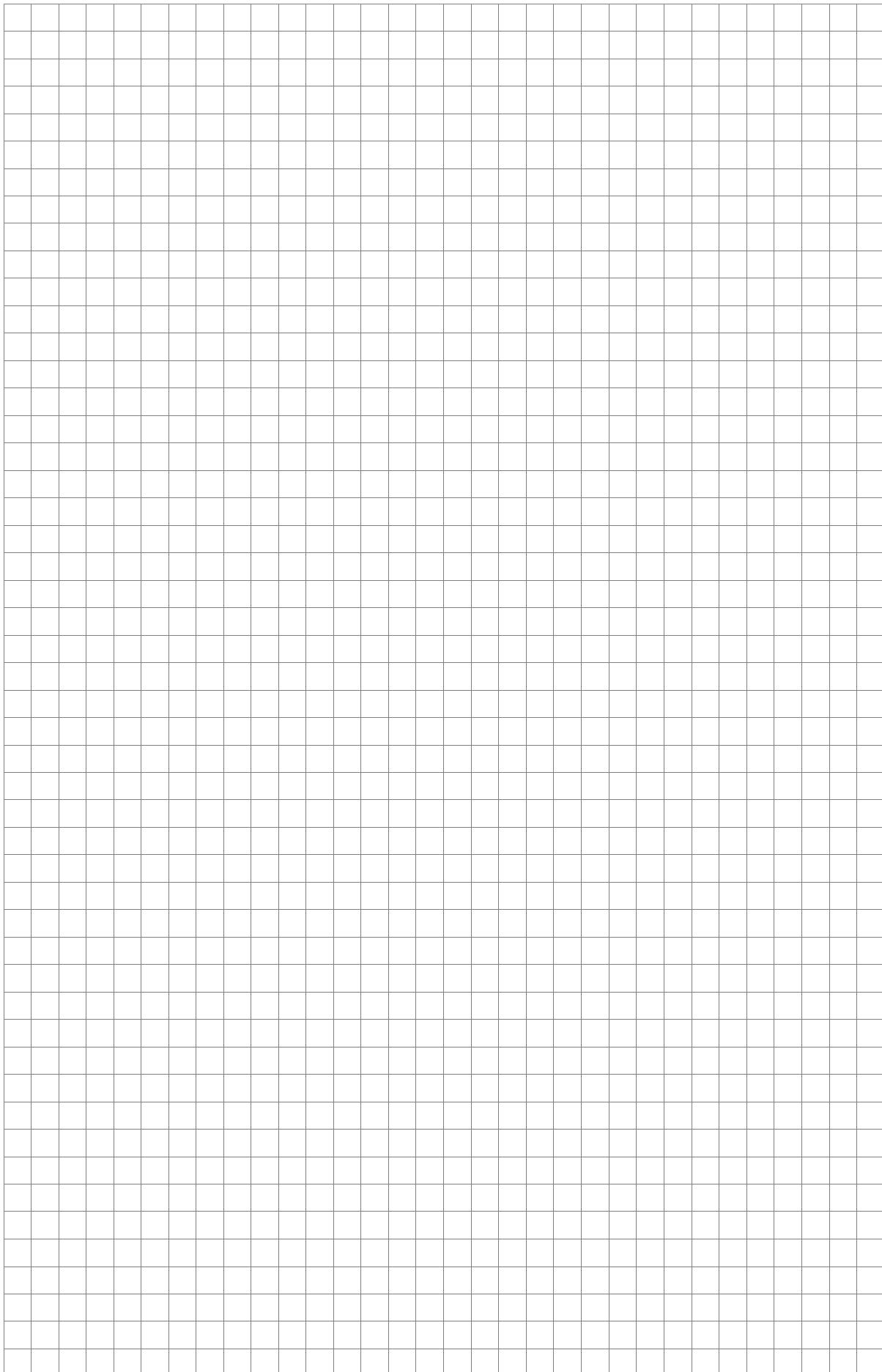
(a) Discuss any three advantages/disadvantages of the sample chosen by Red C.

The following table shows the current first preference vote for the sample.

CURRENT FIRST PREFERENCE SUPPORT					
	Core Figures	Impact of Past Vote Weighting	Likely Voters	Excluding Undecided	2011 Election Results
	%	%	%	%	%
Fine Gael	25	24	26	30	36
Labour	5	6	6	7	19
Fianna Fáil	16	16	17	20	17
Sinn Féin	15	15	14	16	10
Independent candidates	17	17	18	20	13
Green Party	2	2	2	2	2
Renua	2	2	2	2	
AAA-PBP	1	1	1	1	1*
Social Democrats	1	1	1	1	
Other Party	1	1	1	1	1
Undecided	15	15	12	n/a	

- (b) How many likely voters from the sample will support Fianna Fáil?

- (c) Display the number of likely voters on a suitable graphical display.

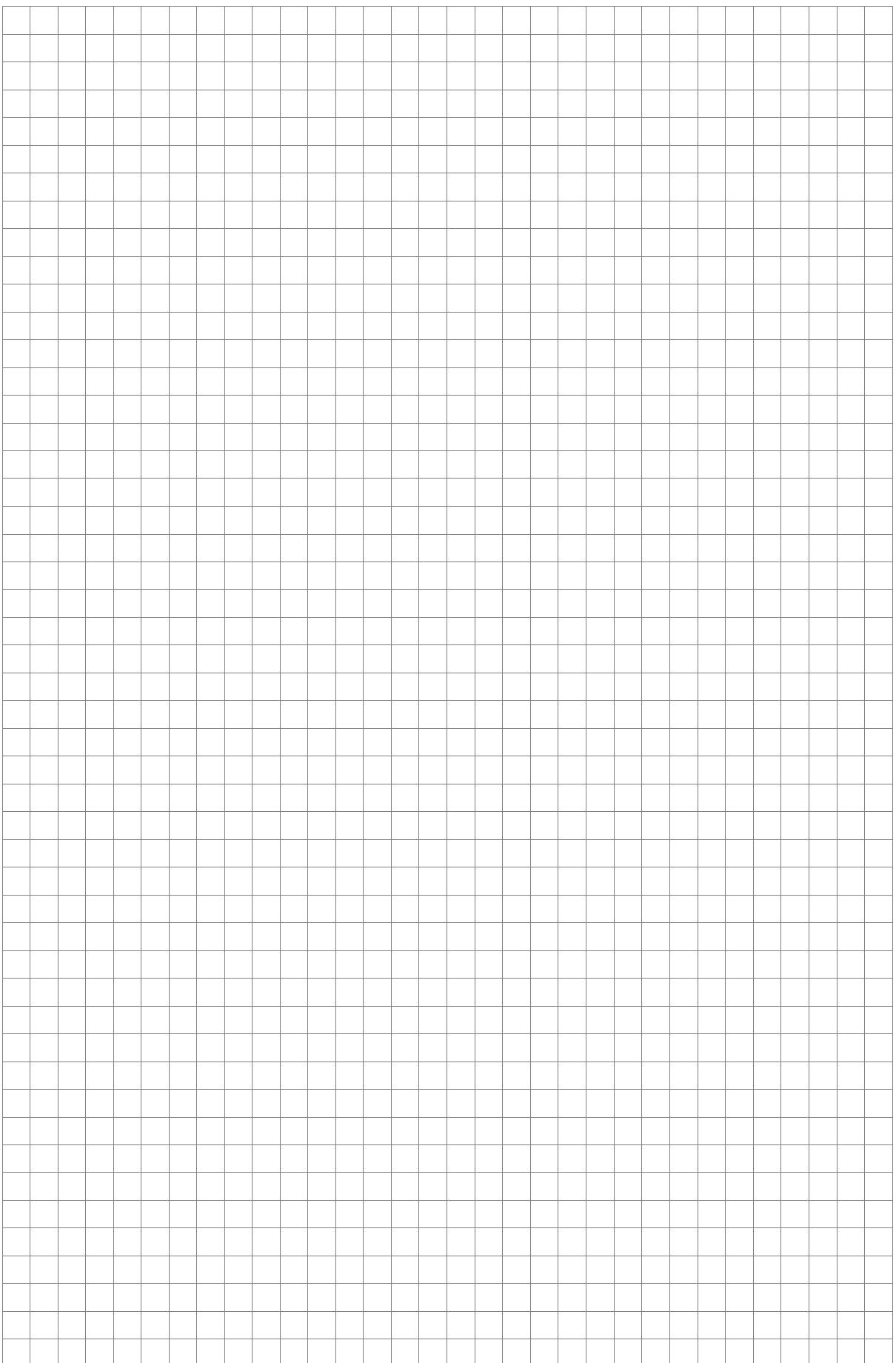


- (d) In a poll carried out by a rival marketing and research company, a sample of  $x$  voters was surveyed. 60% of the sample claimed that they voted in the last general election. A 95% confidence interval for the proportion of voters who said they voted was:

$$0.55706 \leq p \leq 0.64294$$

- (i) Calculate the number of voters who were surveyed.

- (ii)** How many voters would have to be sampled in order to cut the margin of error by 25% at the 95% confidence interval?

A large grid of squares, approximately 20 columns by 25 rows, intended for students to show their work for the question.

## Question 8

(50 marks)

A veterinary team are performing an operation on a large mammal in a zoo. They note that under anaesthetic the animal's temperature varies sinusoidally ie. it can be modelled using a sine wave, over time.

A maximum temperature of 48°C is reached 15 minutes after they begin the procedure. The minimum temperature of 24°C occurs 45 minutes into the procedure.

They wish to be able to predict the variance in the temperature of the animal by using a suitable graph.



- (a) Using the information above:

- (i) Write down the temperature of the animal at the start of the procedure.

- (ii) Hence, or, otherwise, write down the equation of the midway line for the sinusoidal curve.

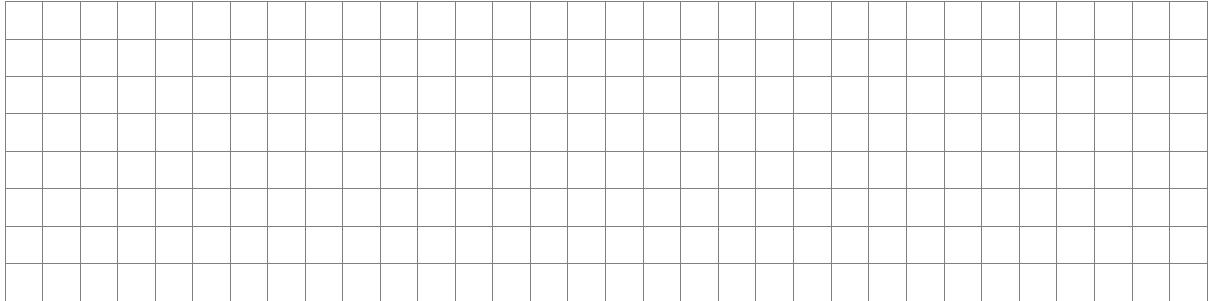
- (iii) Write down the maximum height of the graph above the midway line.

- (iv) Write down the period of the graph.

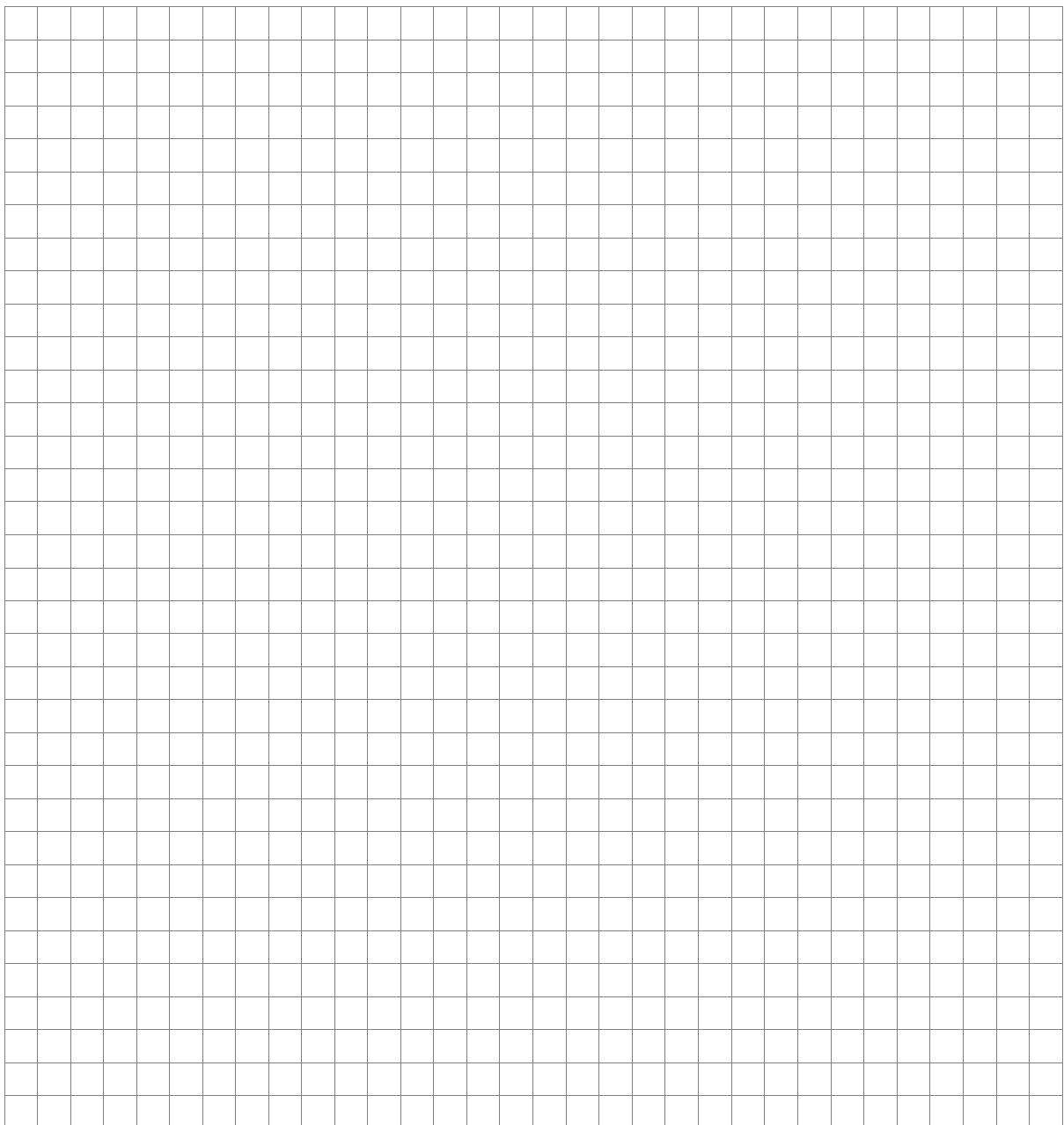
- (b)** The graph of the animal's temperature over time can be represented as the function:

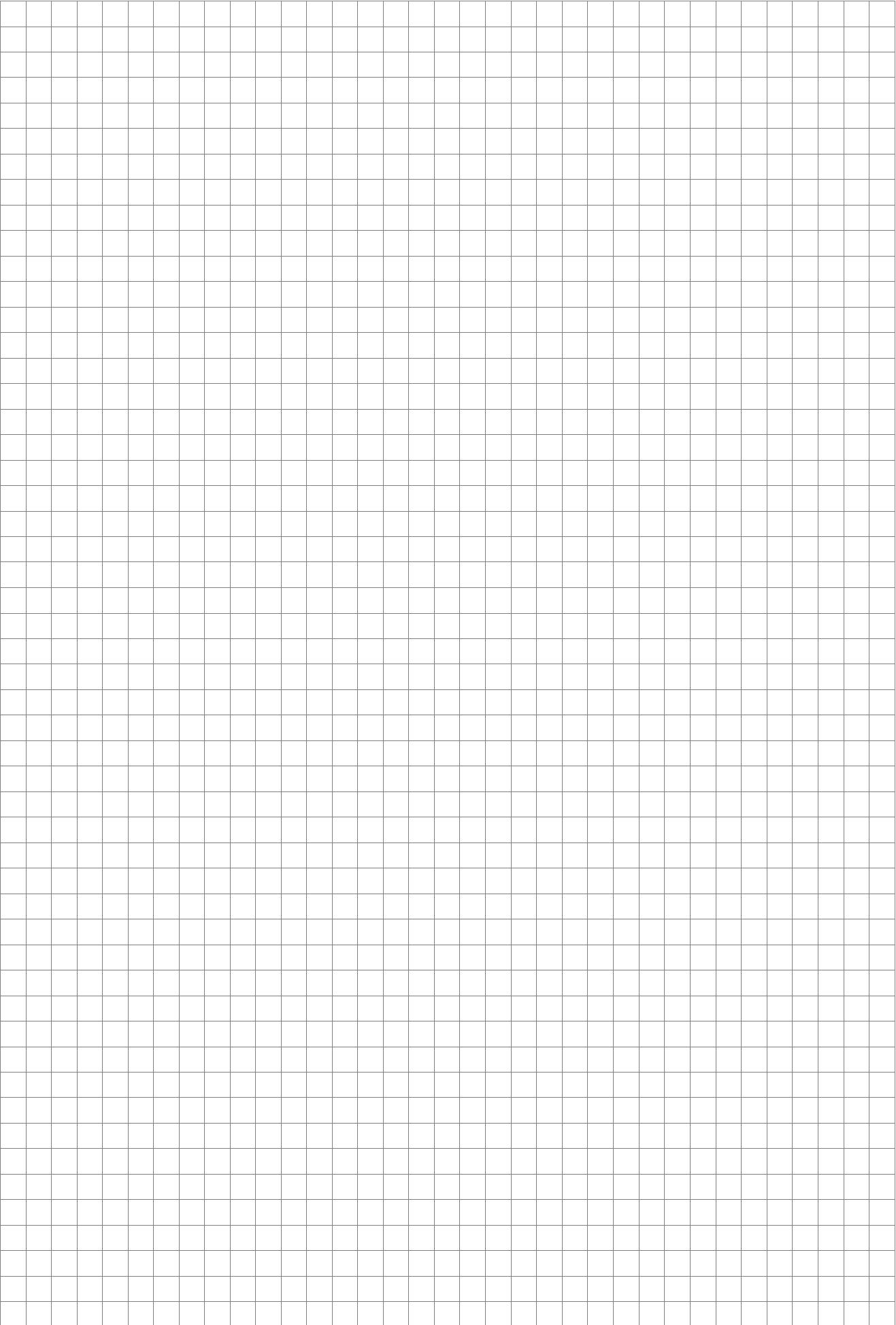
$$f(t) = a + b \sin(ct).$$

- (i)** Using the information in part **(a)** Write down the function  $f(t)$ .



- (ii)** Draw the function  $f(t)$  over the period of the two hour operation.

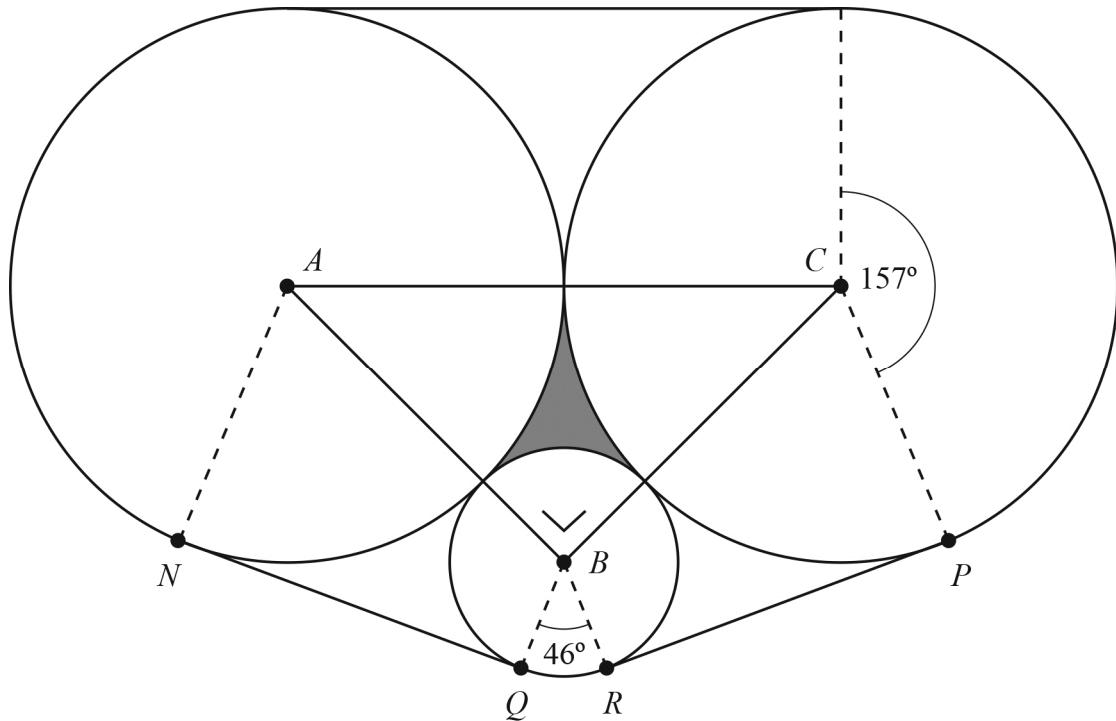




(iii) What is the animal's temperature after 26 minutes?

**Question 9****(45 marks)**

Three cogs in a machine are designed as shown. The centres of the cogs are connected with metal bars. A belt runs on the outside of the three cogs. The larger cogs both have radius  $3\sqrt{2}$  cm.

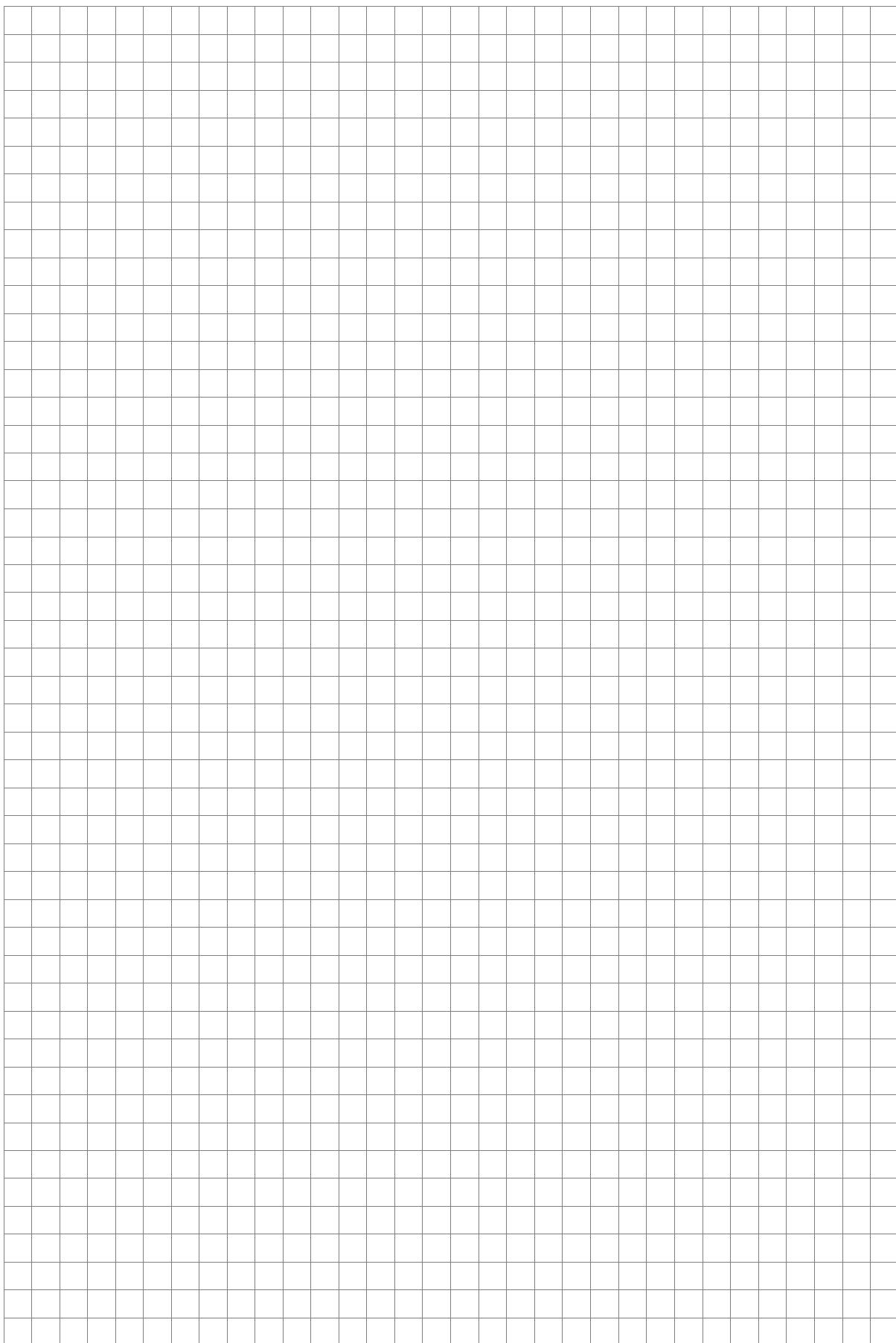


- (a) Show that the radius of the small cog is  $(6 - 3\sqrt{2})$  cm.

- (b)** Given that  $|CP| \parallel |BR|$ , show that  $|RP| = 5.46$  cm.

- (c) Calculate the length of the belt that runs over the cogs, correct to two decimal places.

- (d) The cogs are lubricated by oil, which is stored in the shaded region of the mechanism. If the container is 3 cm in depth, find the volume of oil it contains.



**You may use this page for extra work.**

