



## 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 Question 6 and Question 7.

In Section C, answer 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.

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**Question 5**

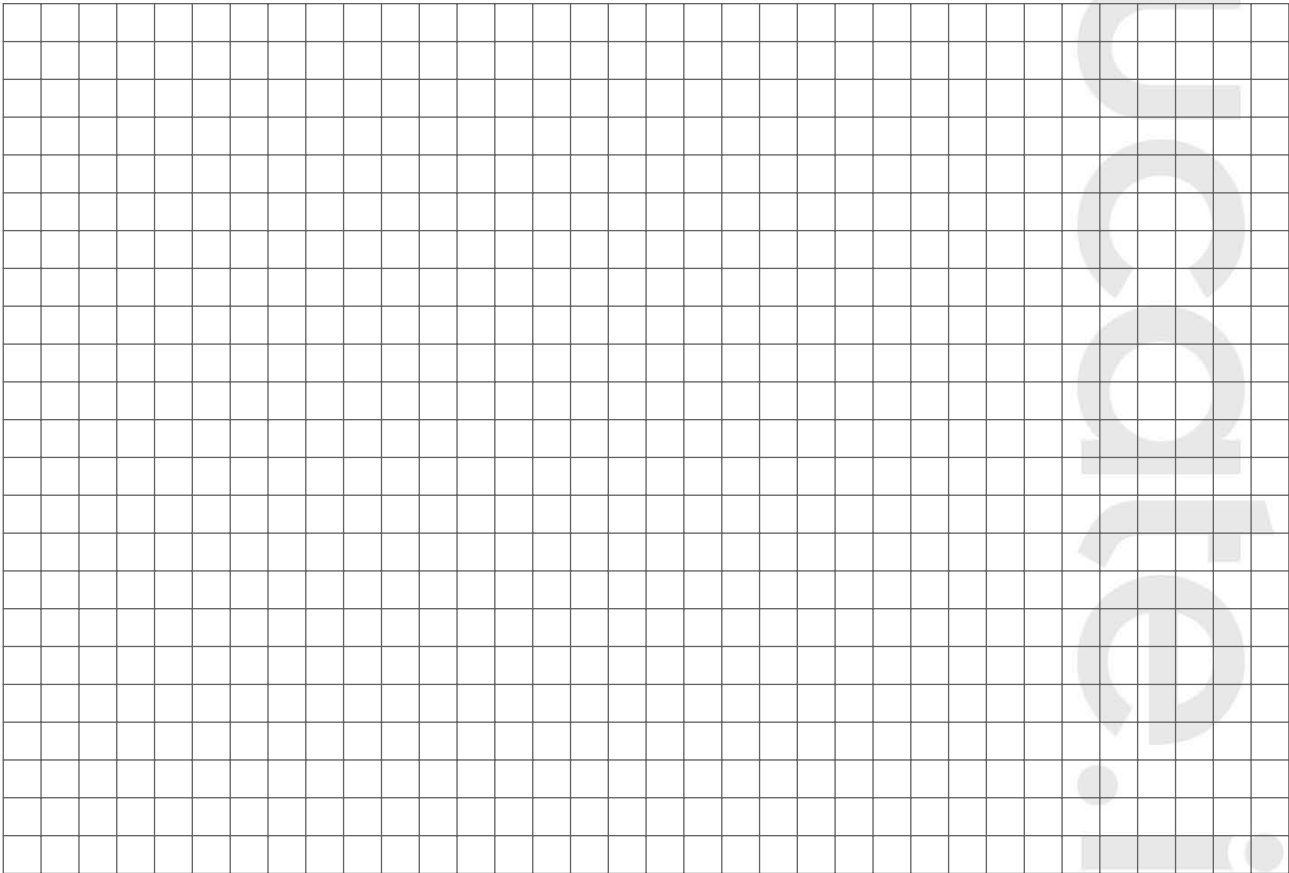
(25 marks)

Answer either 5A or 5B.

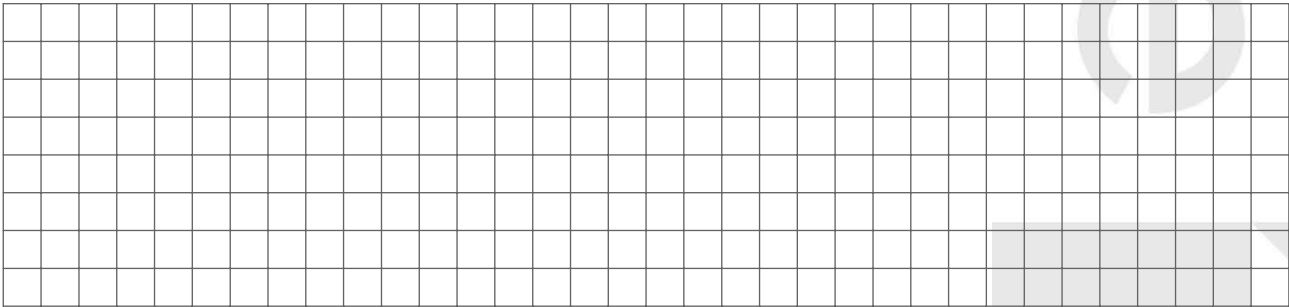
**Question 5A**

(a)(i) Construct a triangle ABC where  $|\angle ABC| = 45^\circ$ ,  $|AB| = 70\text{mm}$  and  $|AC| = 55\text{mm}$ .

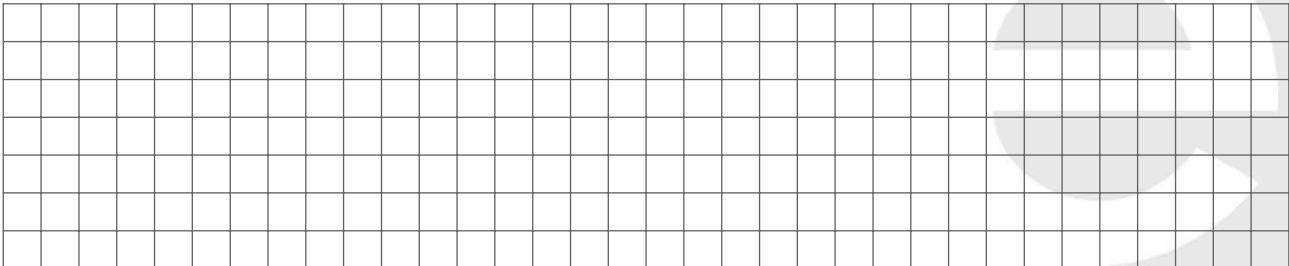
(ii) Construct the circumcentre of a triangle ABC, showing all construction lines.



(b)(i) State what is meant by “theorem” and “converse of a theorem”.



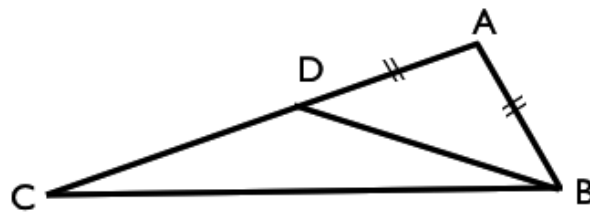
(ii) State whether the converse of the the theorem below is true or false.  
“Vertically opposite angles are equal in measure.”



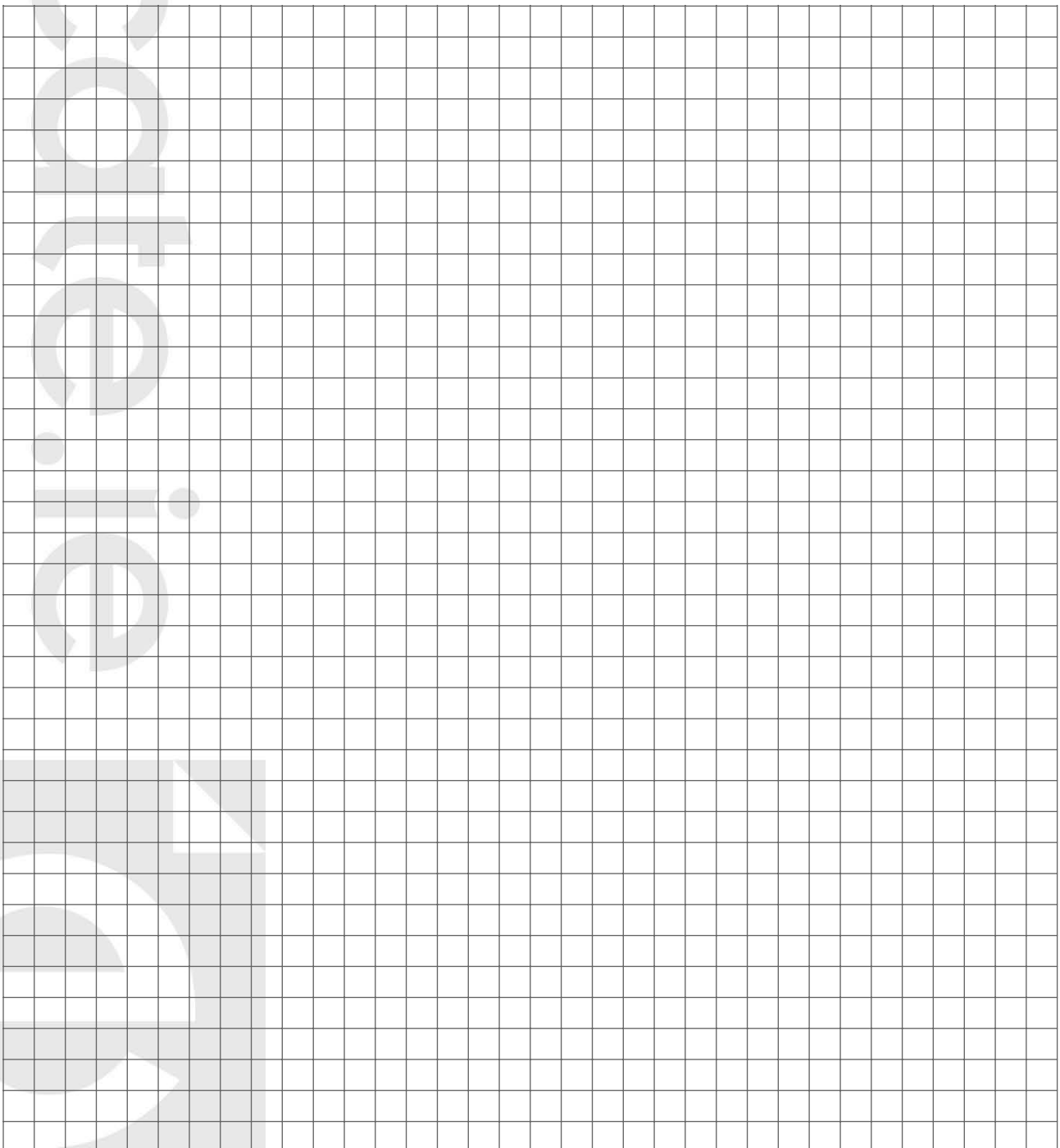
Sample 1  
P2

OR

Question 5B



The triangle  $\triangle ABC$  shown satisfies the relations  $|AB| = |AD|$  and  $|\angle ABC| = 60^\circ$  and  $|\angle ACB| = 30^\circ$ . Find  $|\angle DBC|$ .







**Question 7**

**(65 marks)**

The IQ of 36 male and 36 female students were measured with the following results:

Male	Female	Male	Female	Male	Female
105	97	94	114	85	106
112	108	116	106	87	83
95	108	113	115	106	86
101	111	107	85	98	109
87	115	81	78	89	106
95	114	101	82	121	116
97	100	112	114	106	103
92	101	110	107	98	111
92	105	97	94	99	127
119	107	110	84	77	84
124	81	99	121	110	85
96	90	100	68	117	101

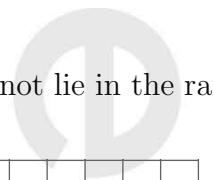
(i) Compare the data for males and females in the form of a back-to-back stem-and-leaf plot.

(ii) Calculate the mean for males **and** females.

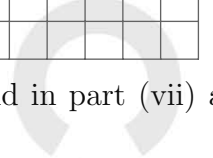
(iii)(1) Find how many male students have an IQ greater than 110.

(2) Find the probability that a male student selected at random has an IQ greater than 110.



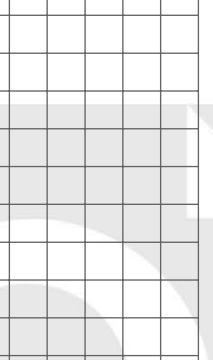


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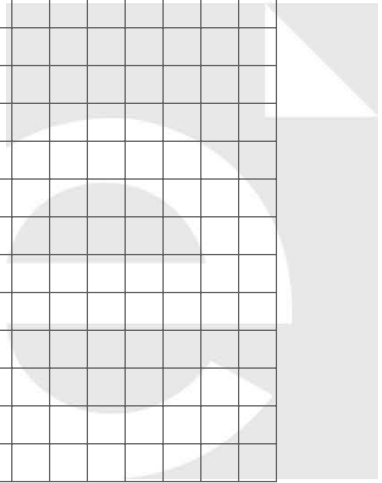


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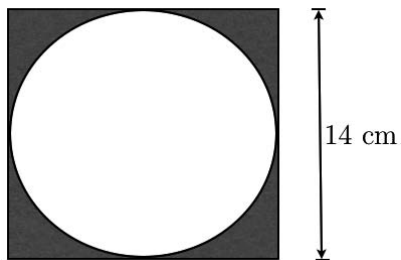
(viii) Find the probability that a student from the data in the table above does not lie in the range found in (vii).

(ix) Write down one reason why there maybe a difference in probabilities found in part (vii) and part (viii) above.

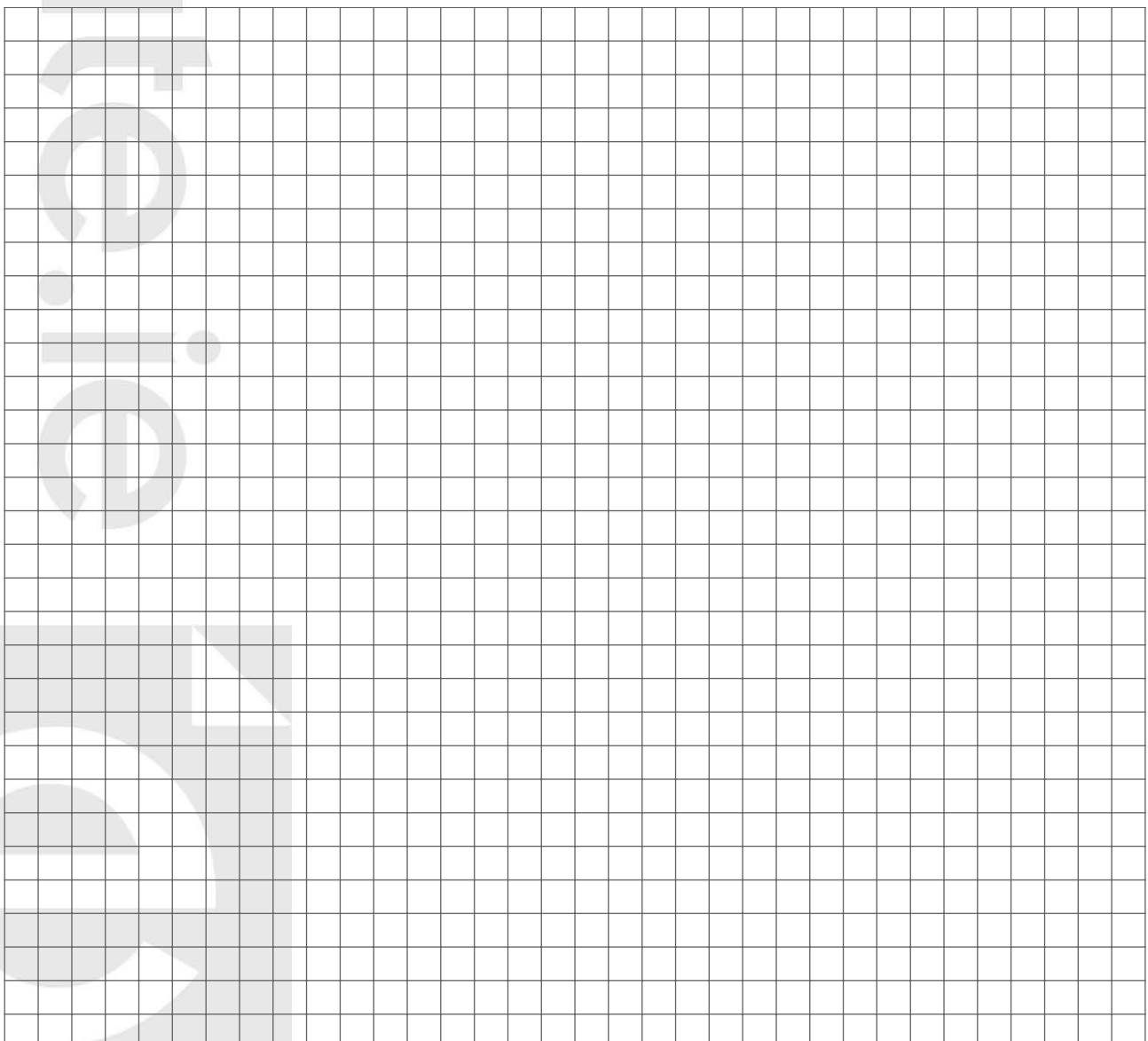
Answer Question 8 from this section.

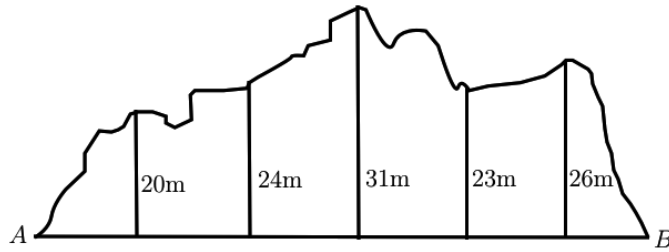
Question 8

(50 marks)

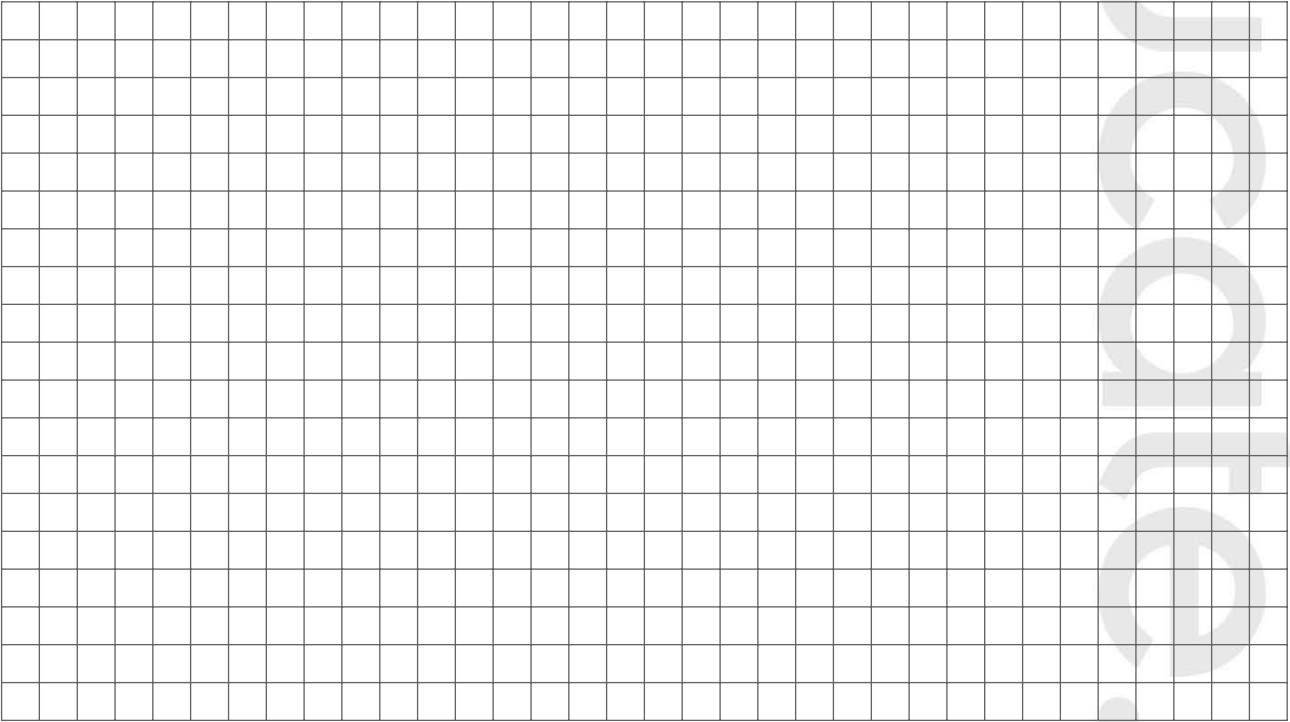


- (a) A circle is inscribed in a square as shown.  
Find the area of the shaded region correct to the nearest  $\text{cm}^2$ .

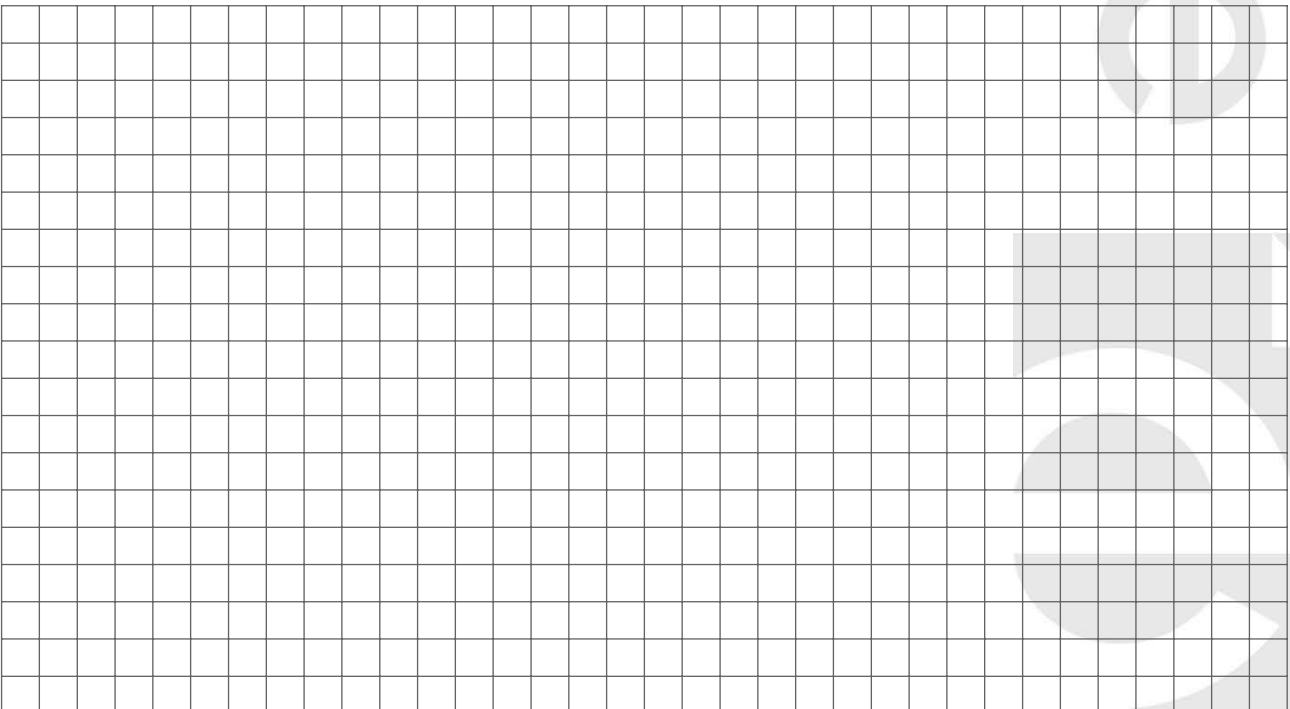




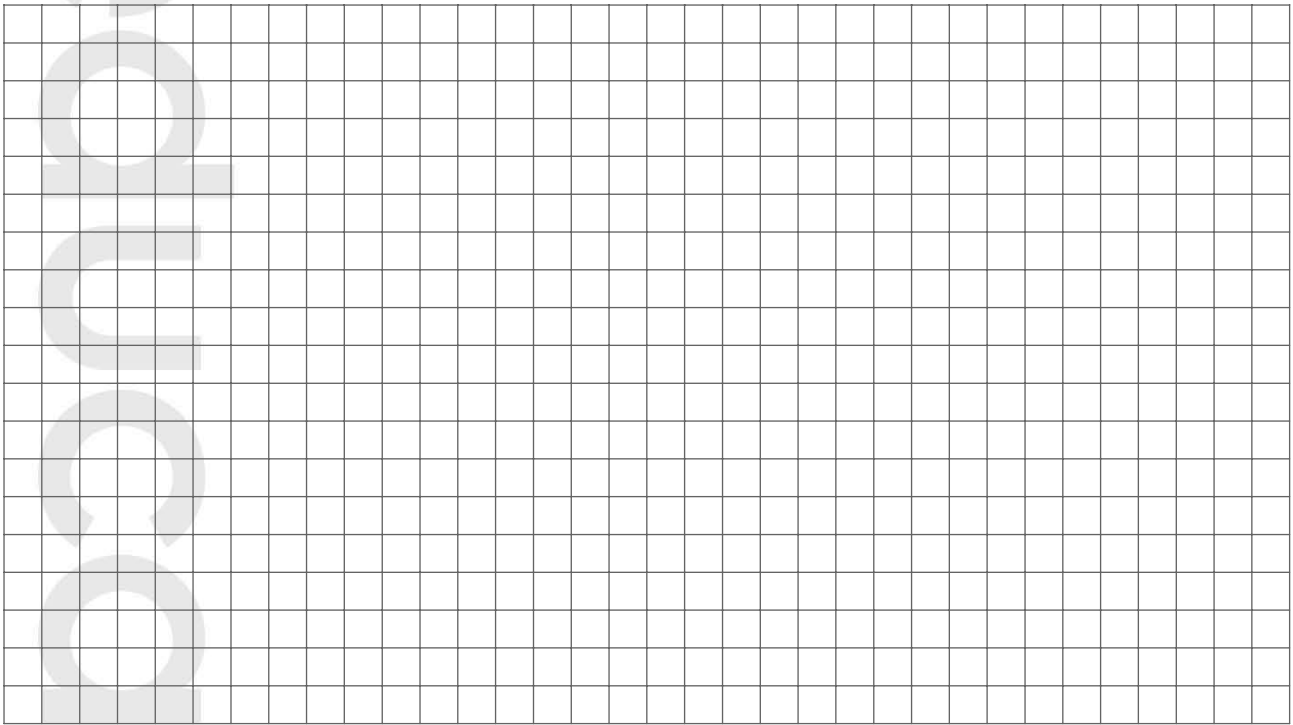
- (b) The diagram shows a sketch of a field with a straight line road frontage  $[AB]$  of 90m.  
 (i) Use Simpson's Rule to estimate the area of the field in  $\text{m}^2$ .



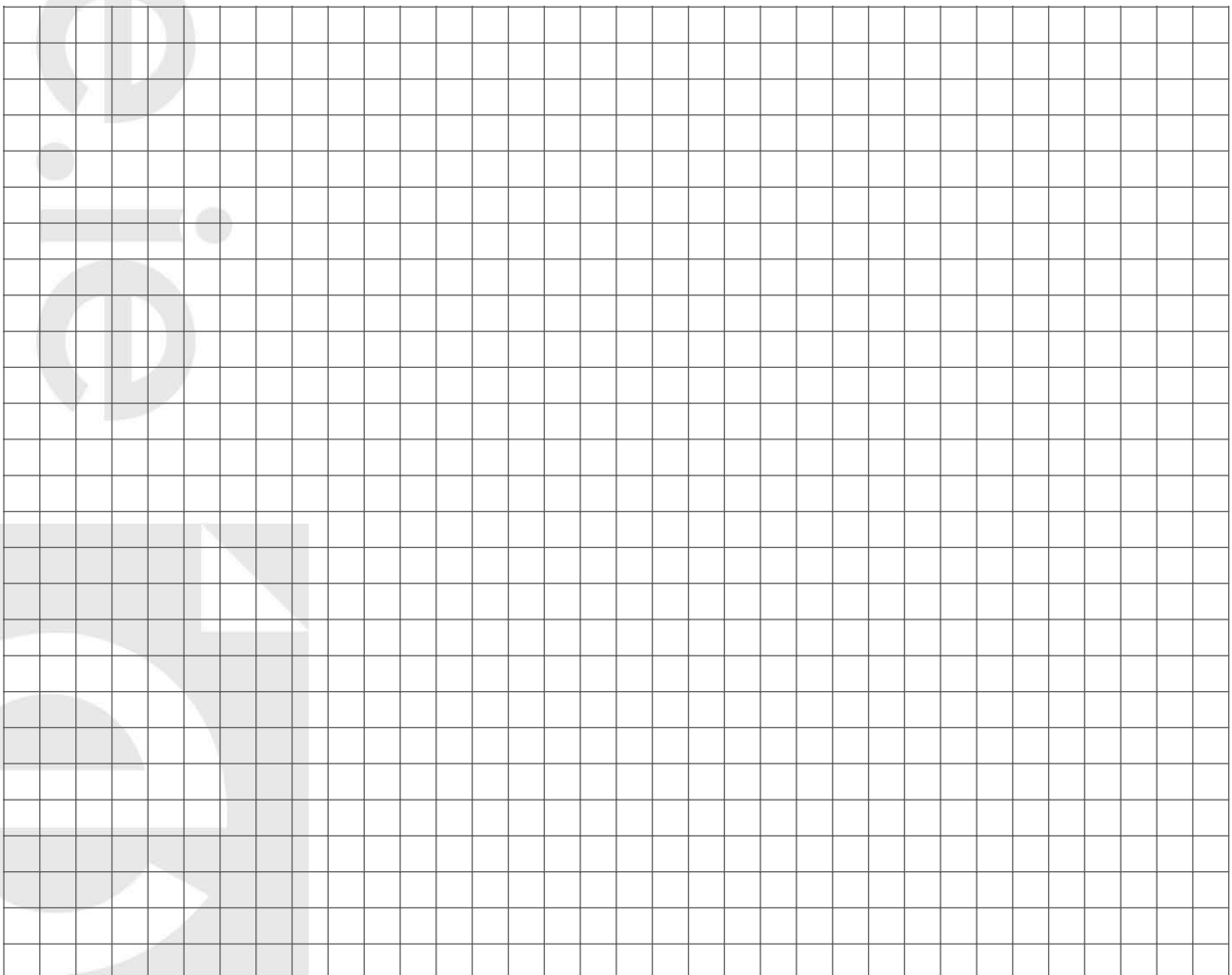
- (ii) The actual area of the field is  $2100\text{m}^2$ . Find the percentage error in the estimate correct to one decimal place.



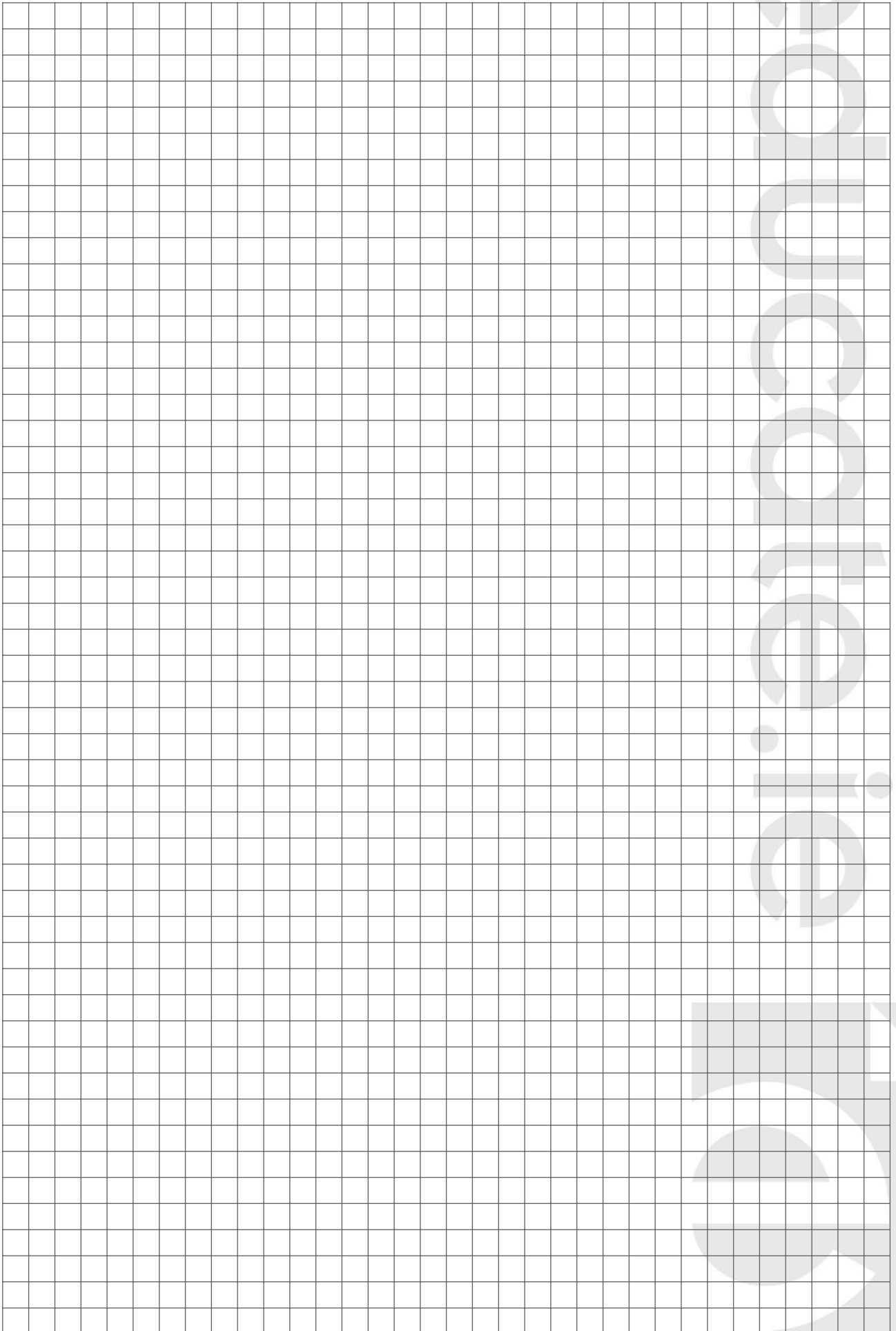
- (c) The diameter of a solid metal sphere is 18 cm.  
(i) Find the volume of the sphere in terms of  $\pi$ .



- (ii) Four such spheres fit exactly into a watertight closed cylindrical box; the remaining space in the box is filled with water. Calculate the volume of water correct to the nearest  $\text{cm}^3$ .



You may use this page for extra work



Sample 1  
P2



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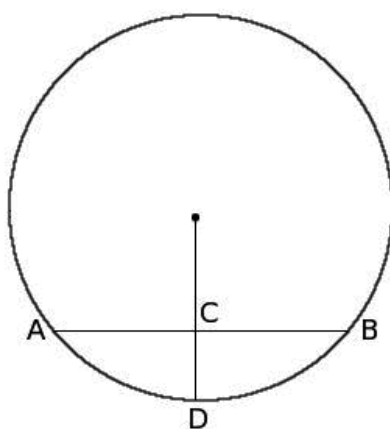




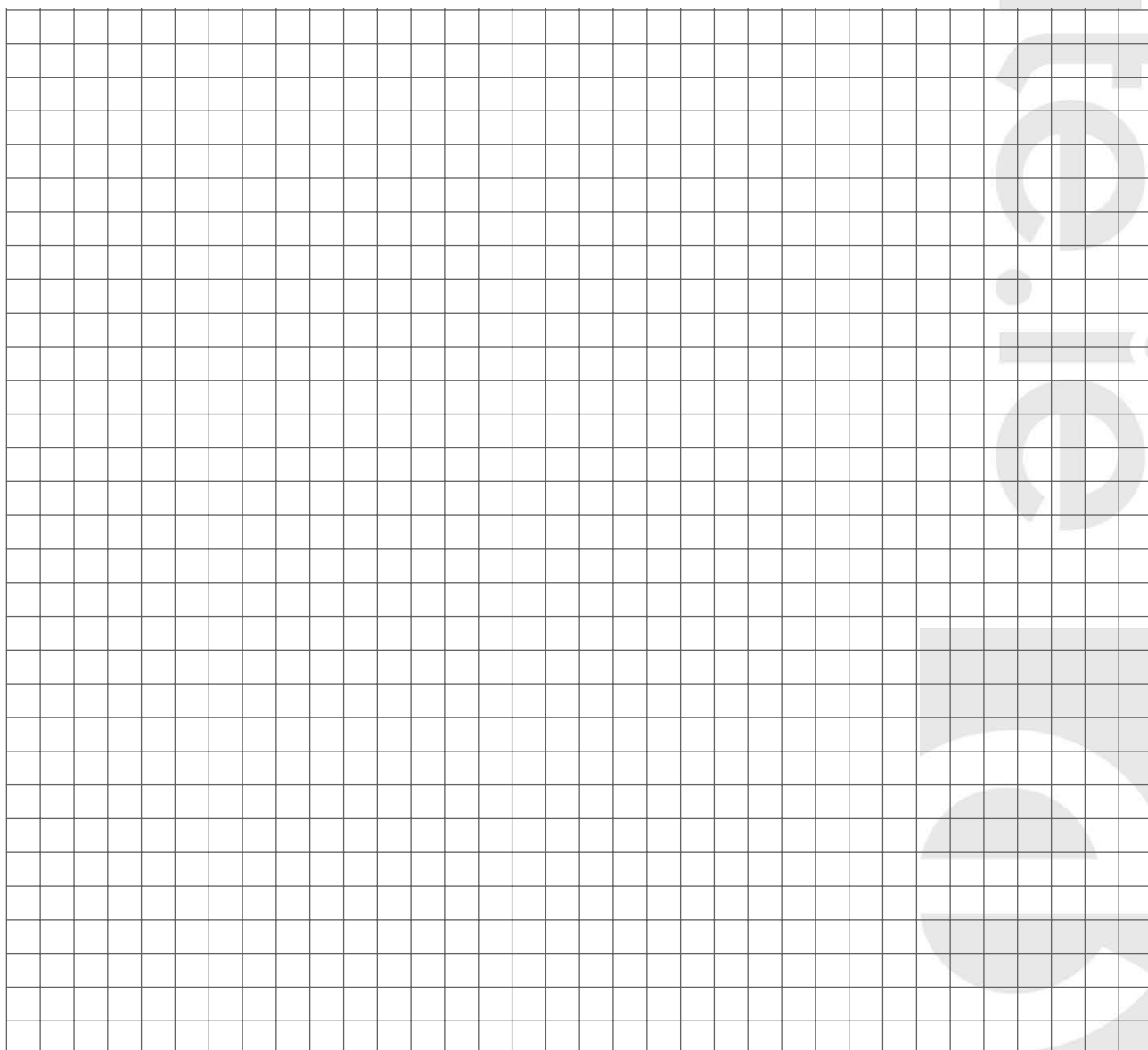


OR

Question 5B



The radius of the circle is 35cm,  $AB$  and  $CD$  are perpendicular, and  $|AB| = 56\text{cm}$ . Find the length of  $|CD|$ .



Sample 2  
P2







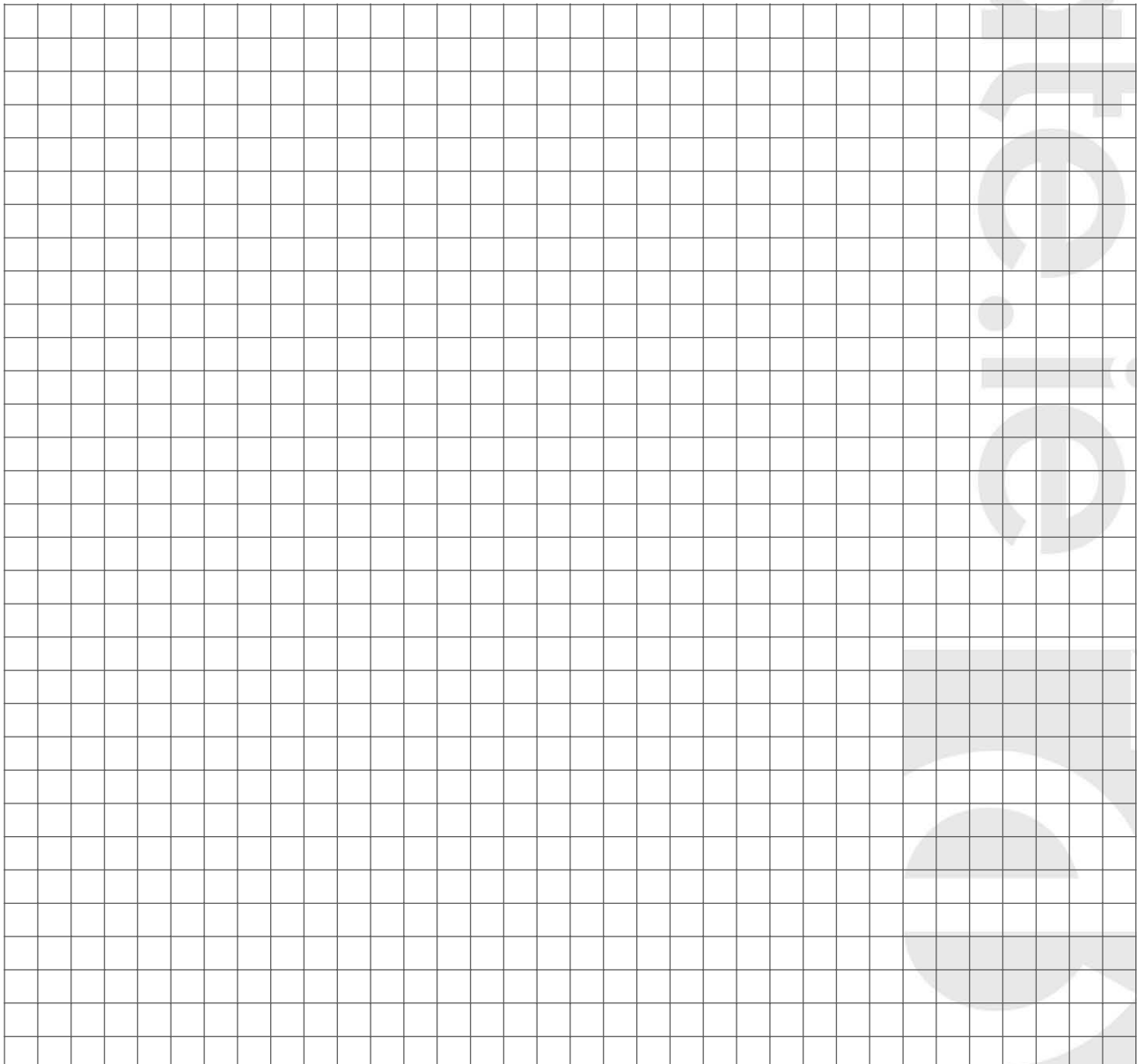
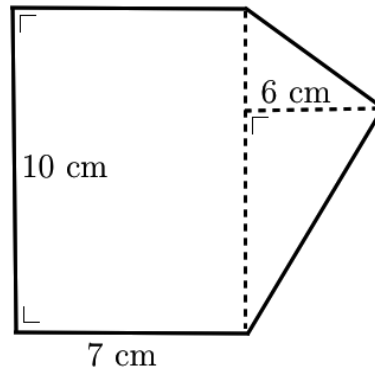


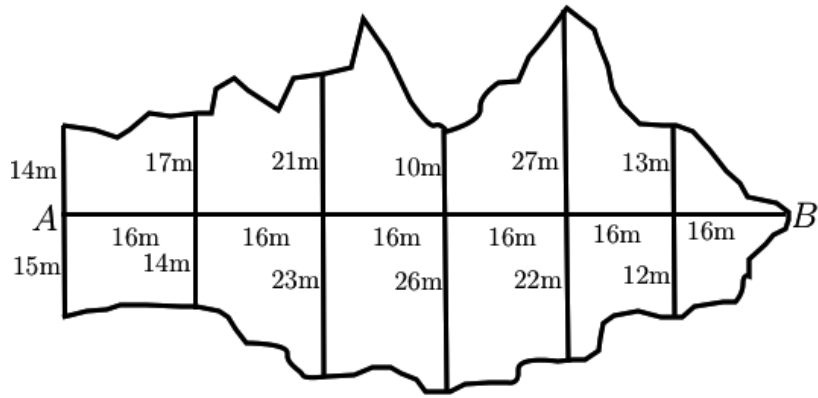


Answer Question 8 from this section.

**Question 8****(50 marks)**

(a) Calculate the area of the figure shown in the diagram.

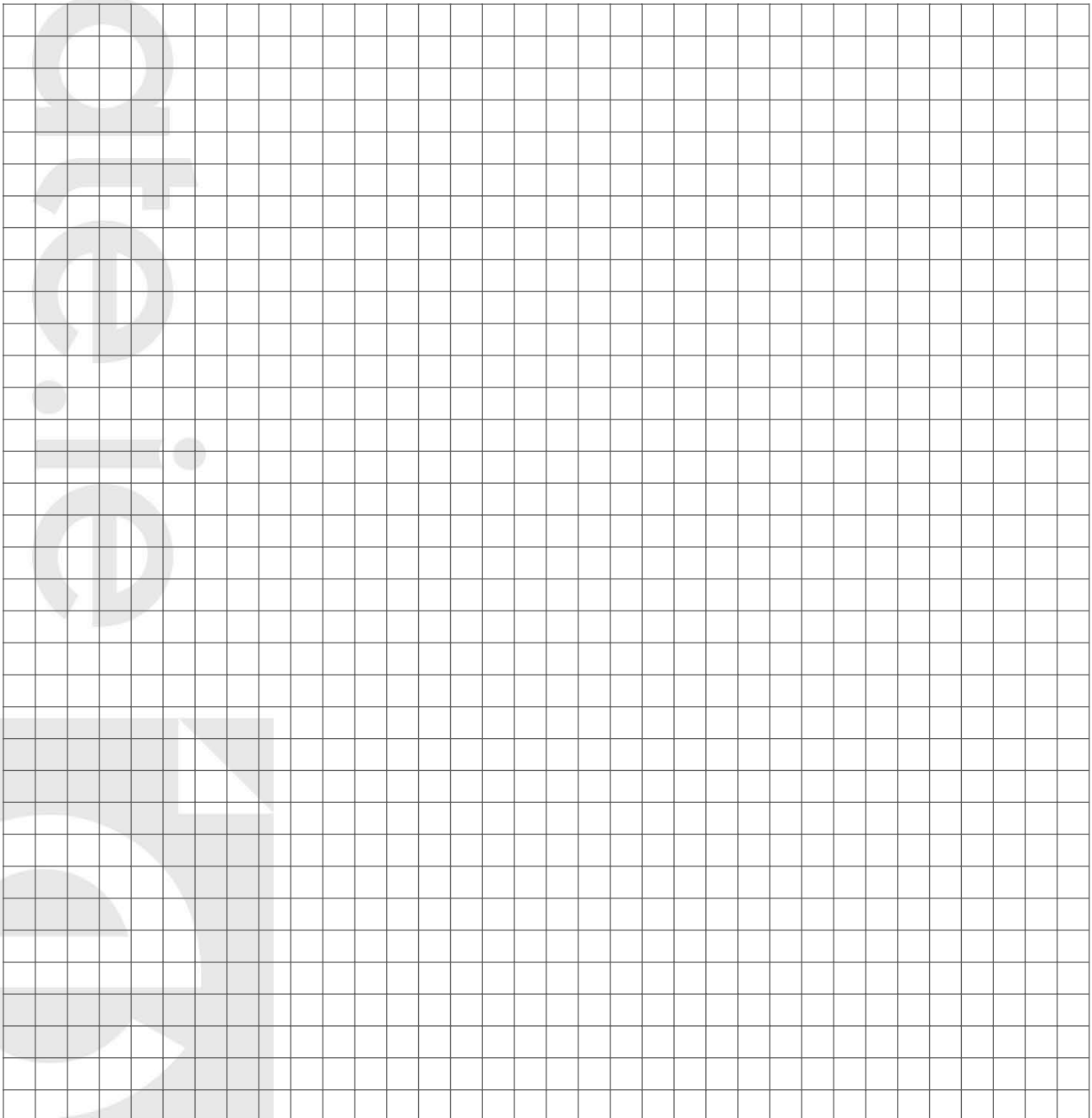




(b) The sketch shows a piece of land.

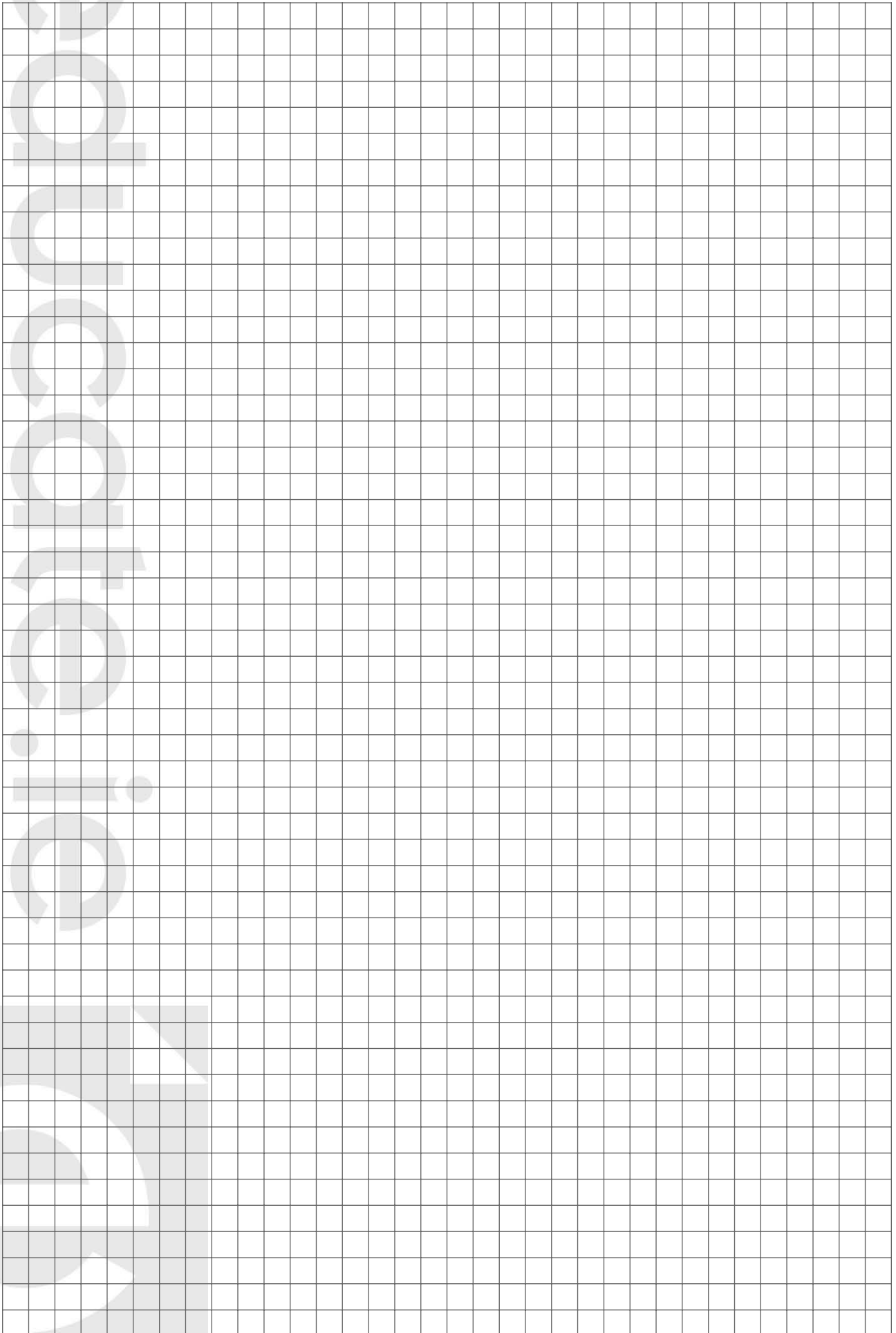
An engineer uses a base line  $[AB]$  and at equal intervals of 16 m along this line, perpendicular measurements are made to the boundaries at either side as shown.

Use Simpson's Rule to estimate the area of the piece of land to the nearest  $m^2$ .





You may use this page for extra work





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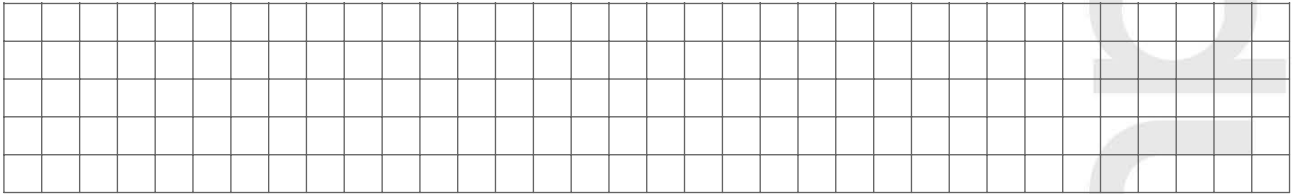


**Question 3**

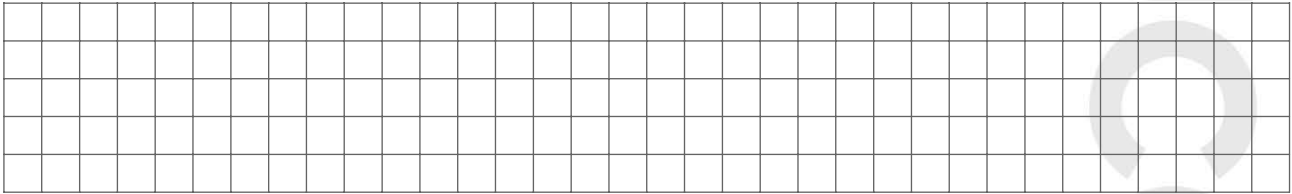
**(25 marks)**

The line  $f$  has the co-ordinates  $M(0, -6)$  and  $N(3, 0)$ .

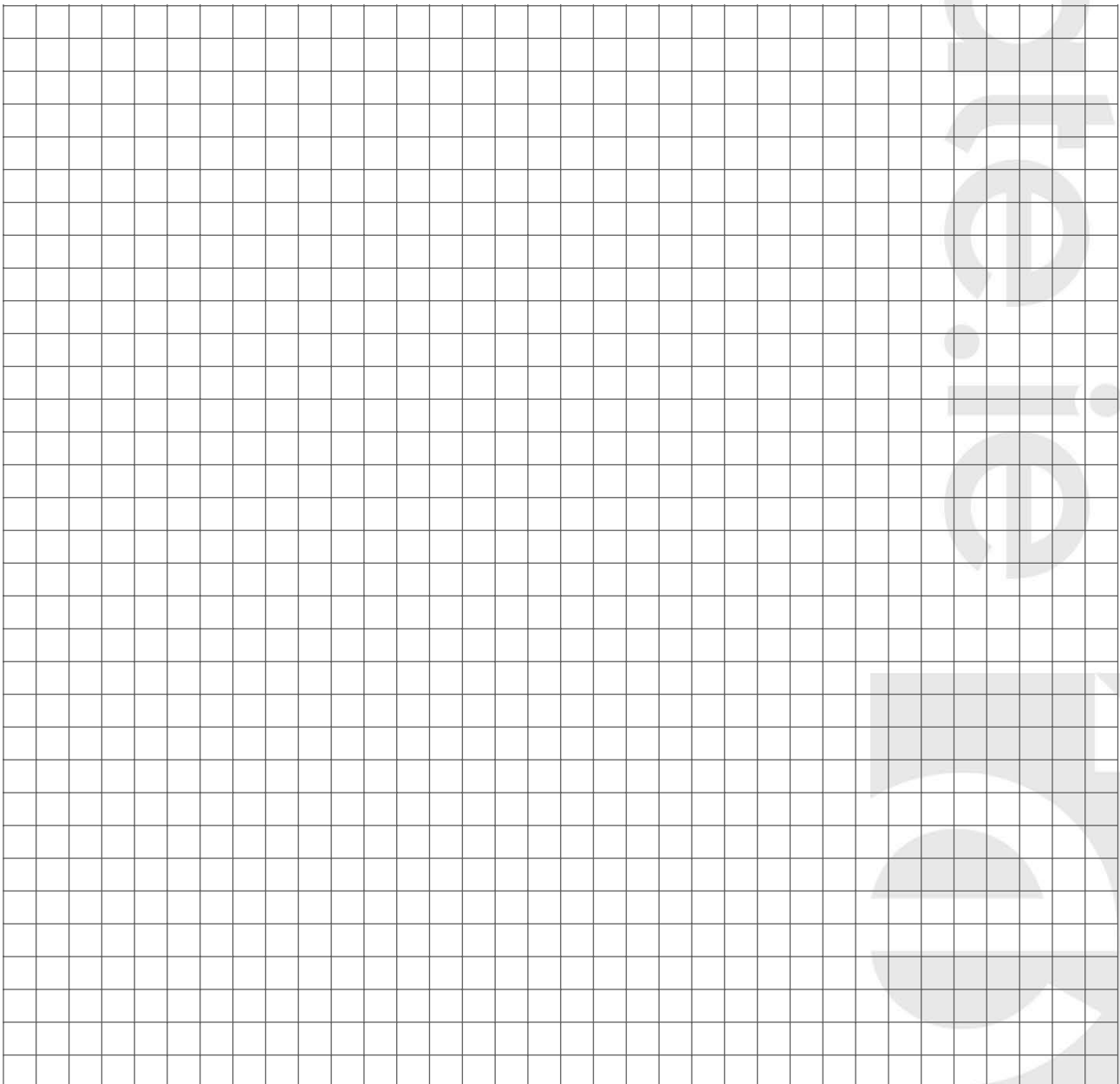
(a) Find the midpoint of the line segment  $[MN]$ .



(b) Find the slope of  $f$ .



(c) Find the equation of the line which forms a perpendicular to  $f$  at the midpoint of  $[MN]$ .



Question 4

(25 marks)

$c$  is a circle of centre  $(3, 4)$  and radius 5. The line  $l$  has equation  $y = -x + 2$ . The line,  $l$ , intersects with the circle,  $c$ , at two points  $A$  and  $B$  forming a chord  $[AB]$ .

(i) Find the equation of  $c$ .

(ii) Find the equation of the radius line,  $k$ , which is perpendicular to the chord,  $[AB]$ .

(iii) Find the midpoint of the points of intersection of chord  $[AB]$  with the circle  $c$ .

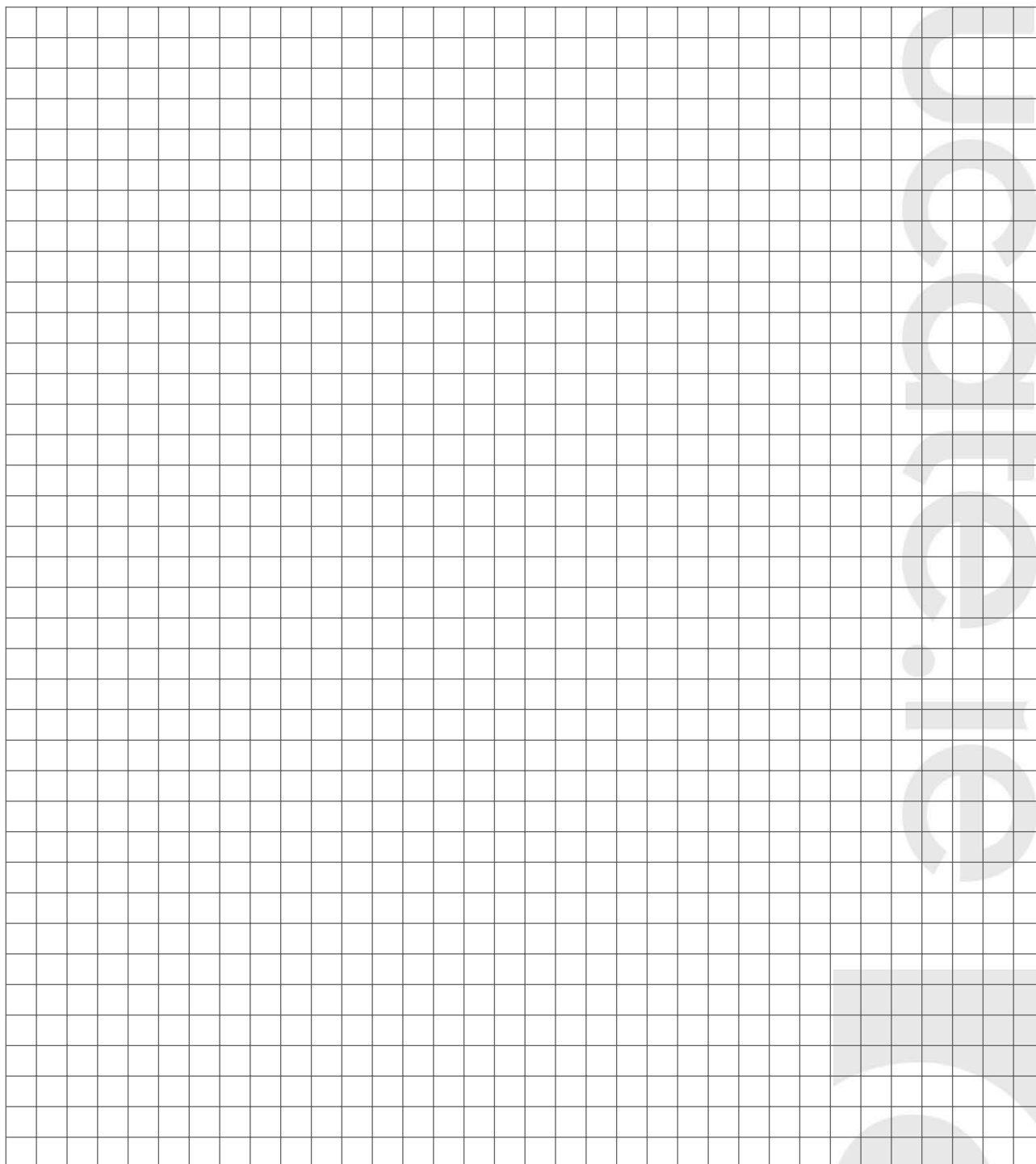
**Question 5**

**(25 marks)**

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

**Question 5A**

(a) Construct a triangle ABC where  $|AB| = 55\text{mm}$ ,  $|BC| = 9\text{cm}$  and  $|AC| = 6\text{cm}$  and construct the incentre of the triangle ABC.



(b) Fill in the spaces in the following theorems:

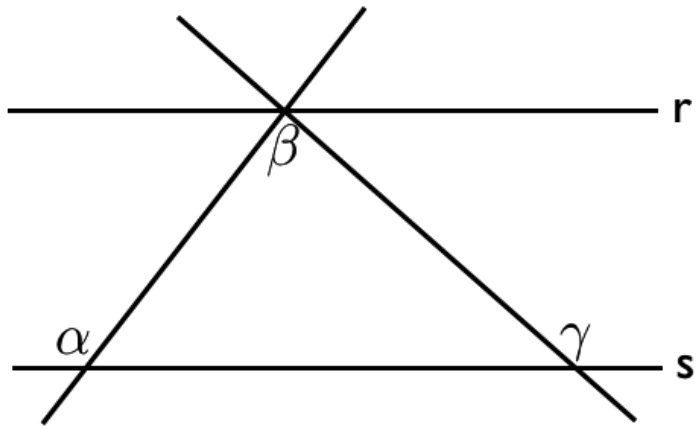
“The perpendicular from the centre to a chord bisects the \_\_\_\_\_.”

“Each tangent is \_\_\_\_\_ to the radius that goes to the point of contact.”

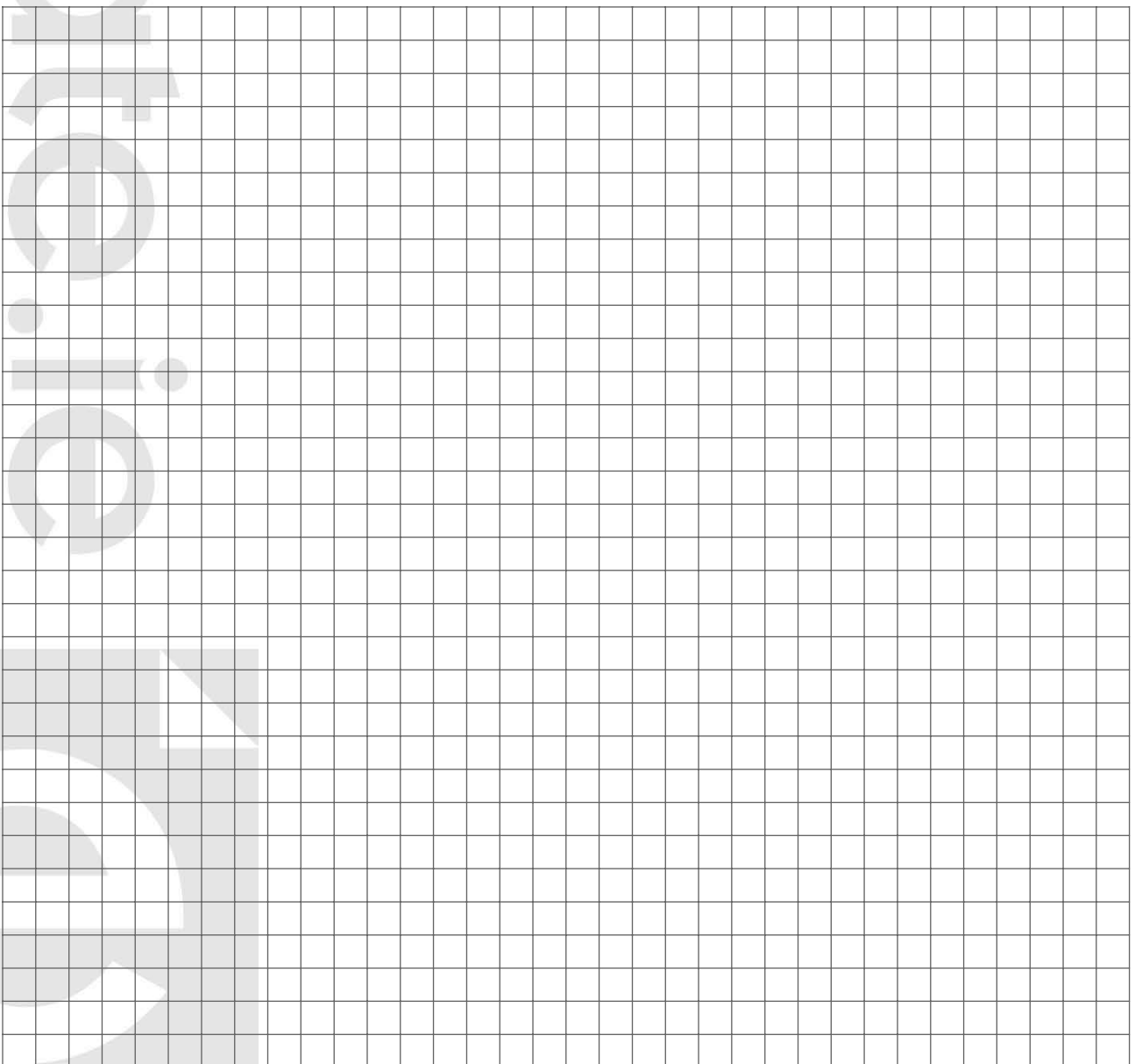
“For a triangle, base times height does not depend on the choice of \_\_\_\_\_.”

OR

Question 5B



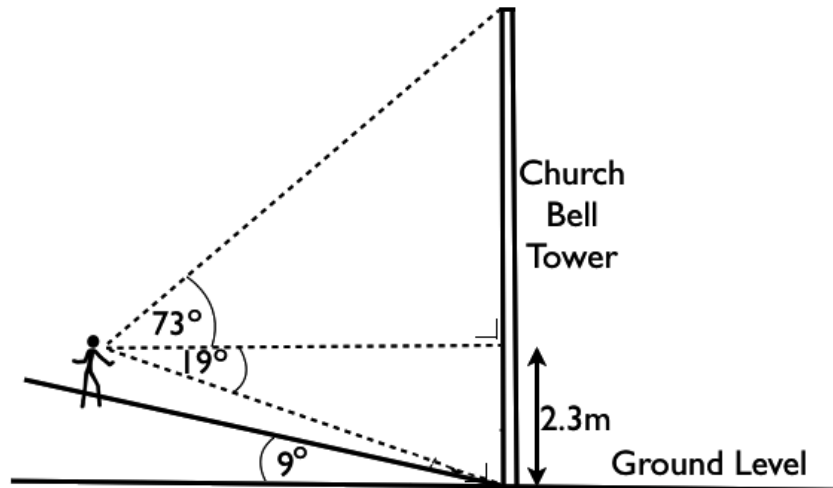
The lines  $r$  and  $s$  are parallel. Show that  $\alpha + \gamma = 180^\circ + \beta$ .



Answer Question 6 and Question 7.

## Question 6

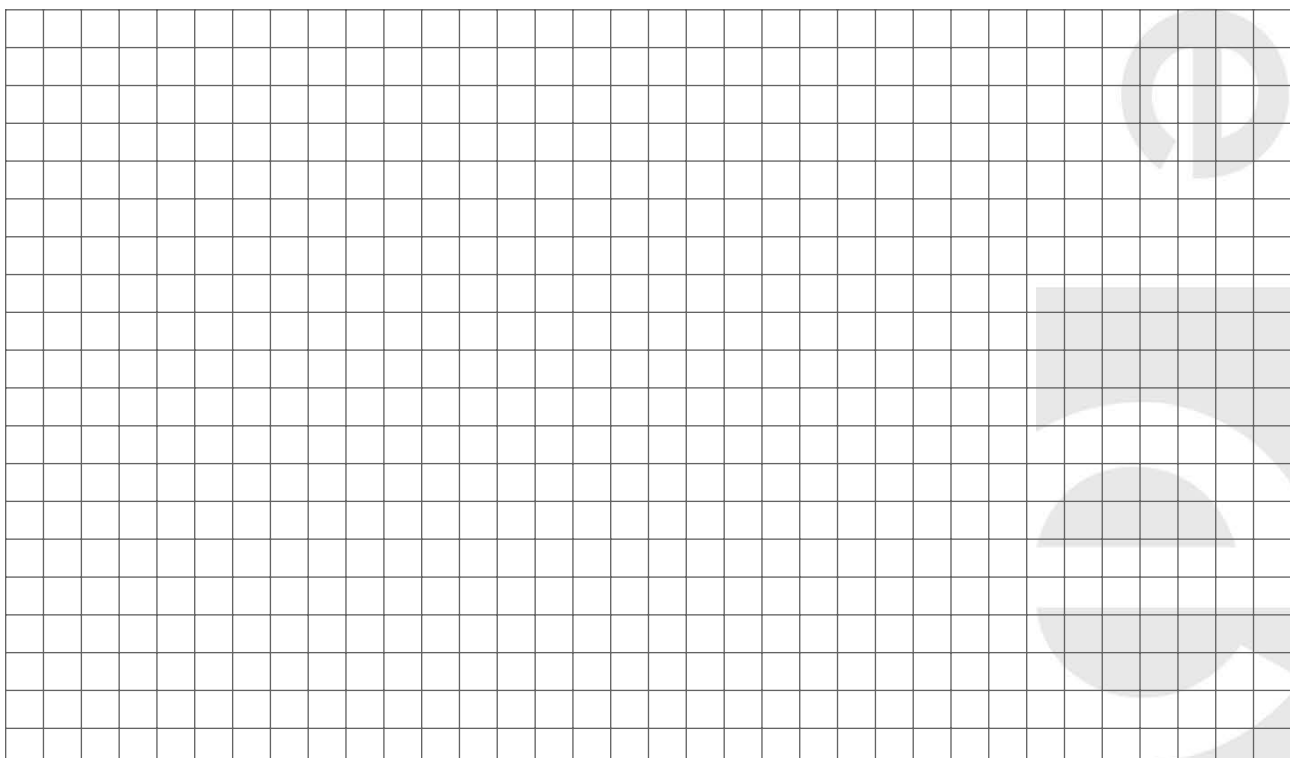
(60 marks)



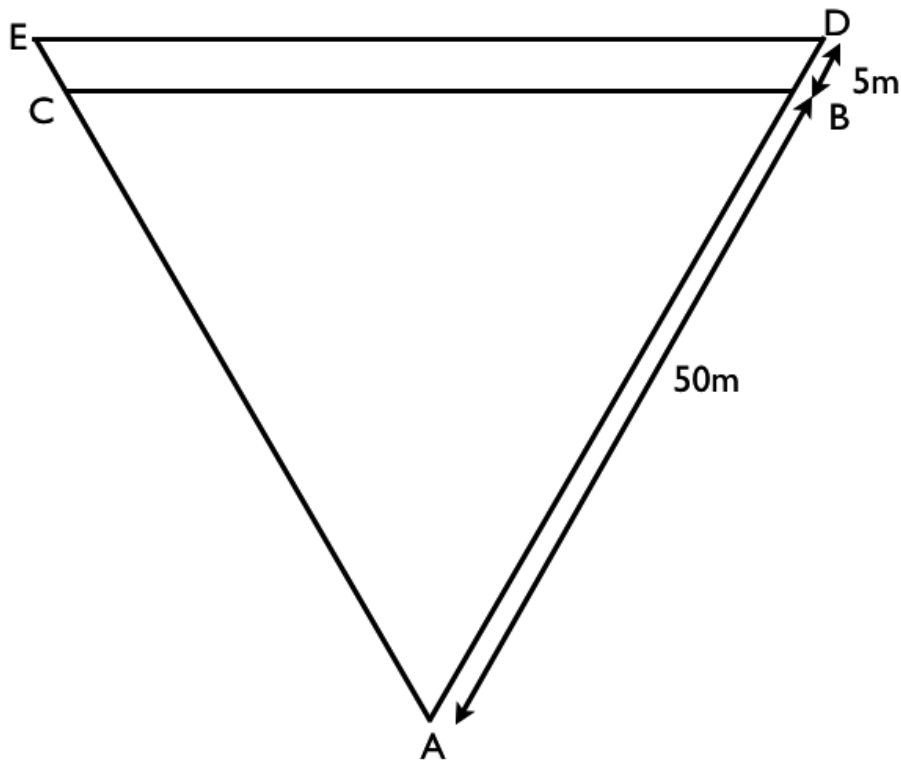
(a) An architect is concerned with the stability of the top area of the bell tower of an old church. To get quotations from firms of steeplejacks who will carry out detailed investigations, she must calculate the overall height of the bell tower.

Using a clinometer and taking into account the slight incline which exists in front of the church, she sets out the measures as shown in the sketch.

Find the height of the bell tower in metres correct to one decimal place.

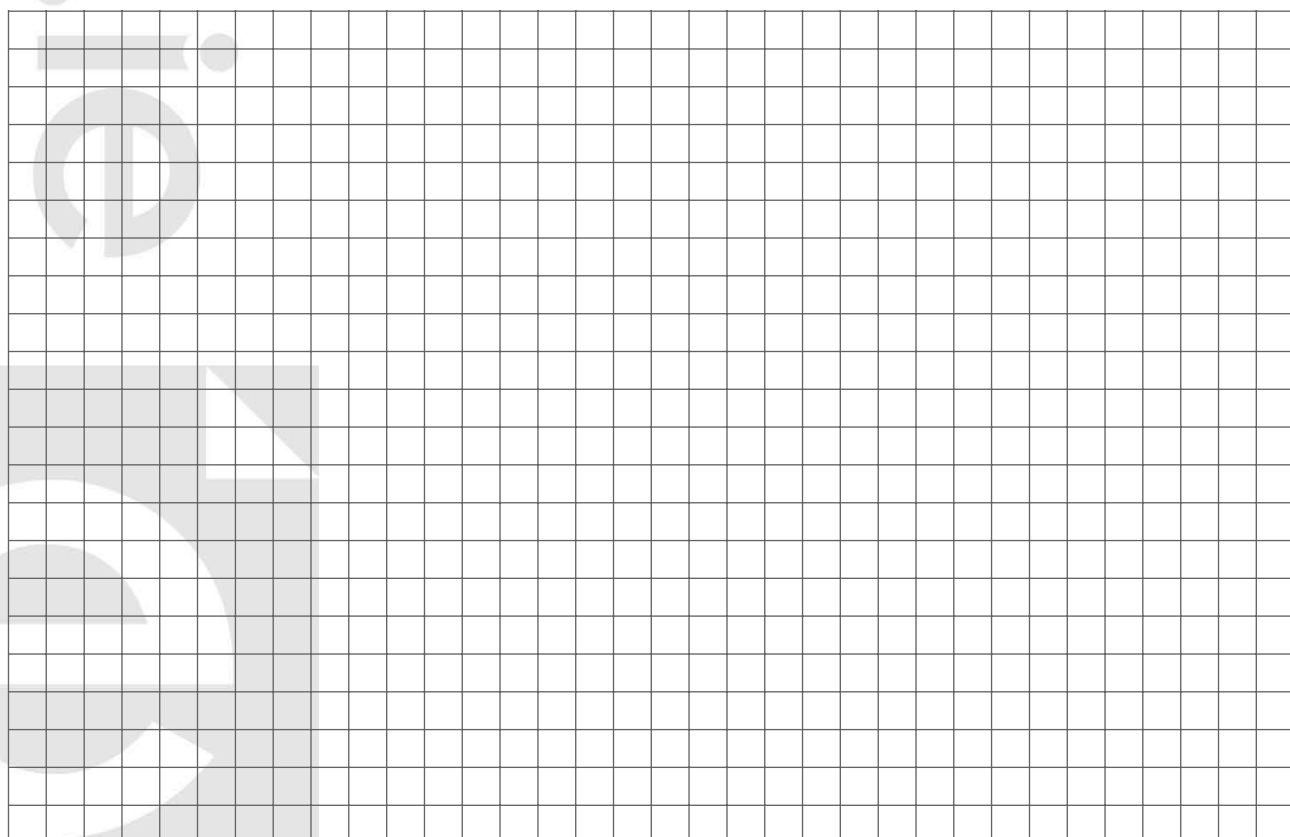


(b) The church is in the shape of an equilateral triangle ( $\triangle ABC$ ), with a corridor partitioned from the main church at one side as indicated in the diagram. It has been decided to lay out the seating in a series of concentric circles.



(i) Draw the incircle of the triangle  $\triangle ABC$ , showing all construction lines. This will give the architect the largest possible circumference for the last row of seating.

(ii) Calculate the area of the corridor  $BDEC$ , correct to the nearest metre.



**Question 7**

**(65 marks)**

(a) The following data was collected in 3 different hospital wards.

Ward	Number of Patients	Number of Smokers
A	25	5
B	35	20
C	15	4

(i) A patient is picked at random. Which is more likely: (1) the person is in ward A and smokes, or (2) the person is in ward C and does not smoke? Explain your answer.

(ii) A patient is picked at random. What is the probability that they smoke?

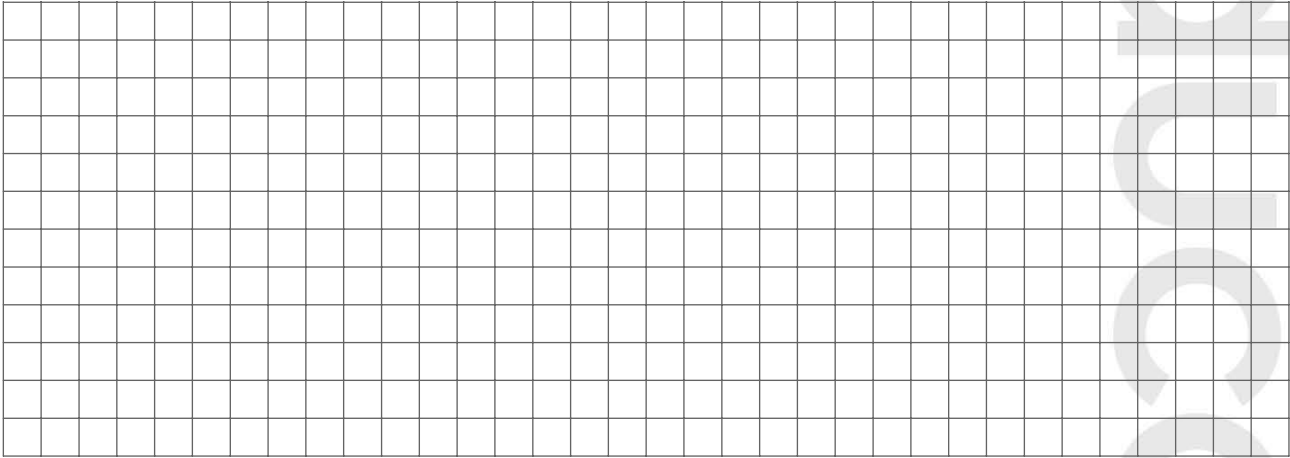
(b) A ward has all its beds arranged in a row. There are 9 beds and they are lined from the ward door to the window. There are the same number of patients as beds.

(i) How many ways can the patients be assigned to beds if there are no restrictions?



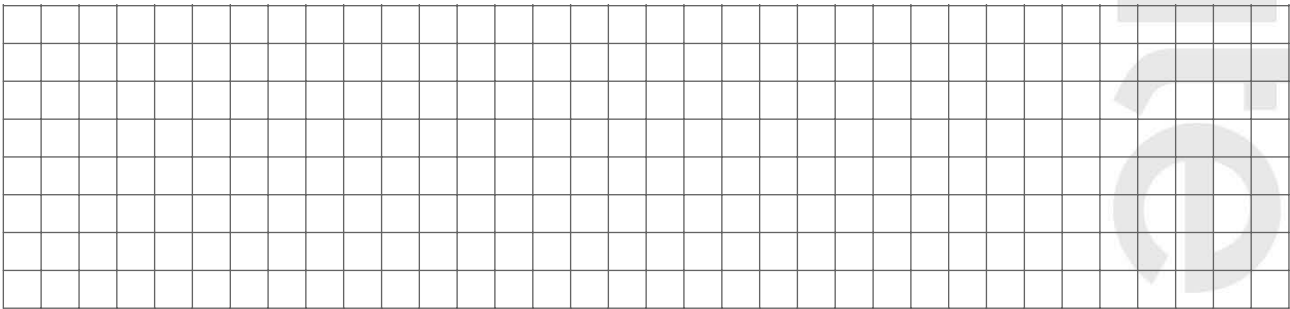
(c) It's found that people in a certain population each have a 2% chance of having a particular disease. A blood screening test has been developed. If a person has the disease the test reports a positive with 95% accuracy. If a person does not have the disease the test reports a negative with 100% accuracy.

(i) Draw a tree diagram to represent the information.

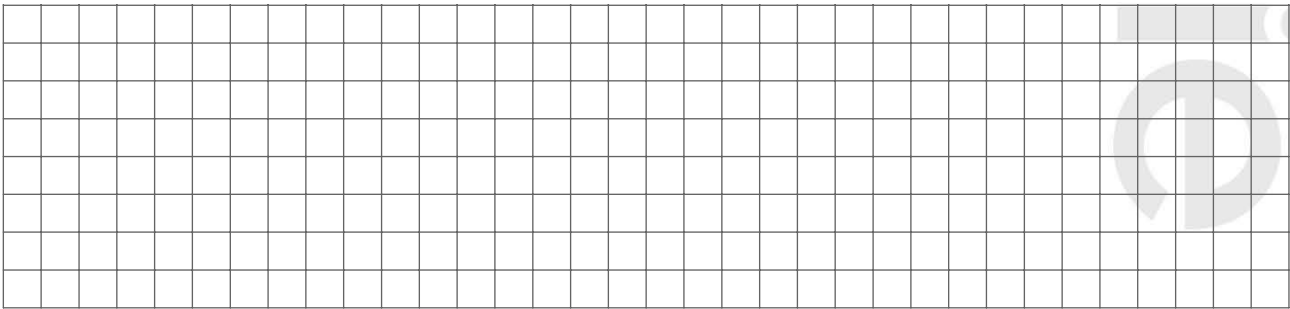


1000 people are to be randomly screened for the disease.

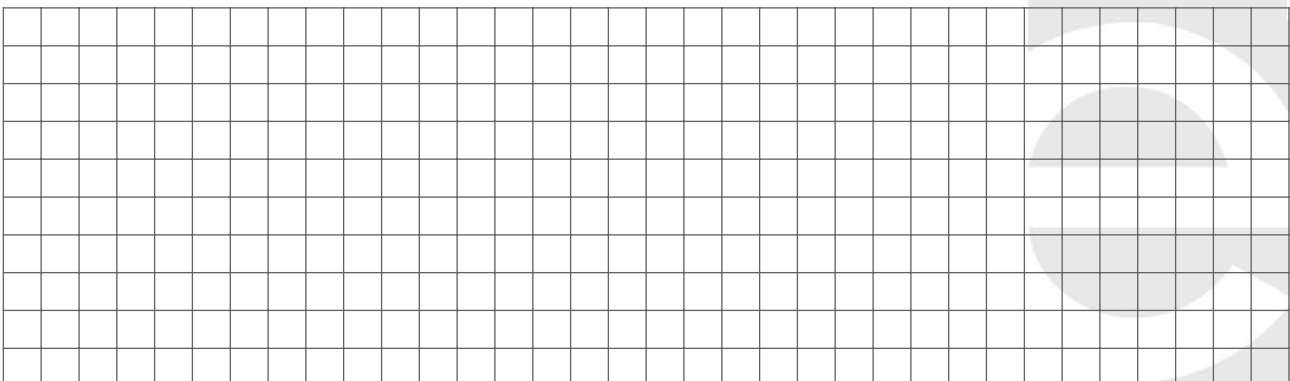
(ii) For how many people is the test expected to report a positive.



(iii) For how many people is the test expected to report a negative.

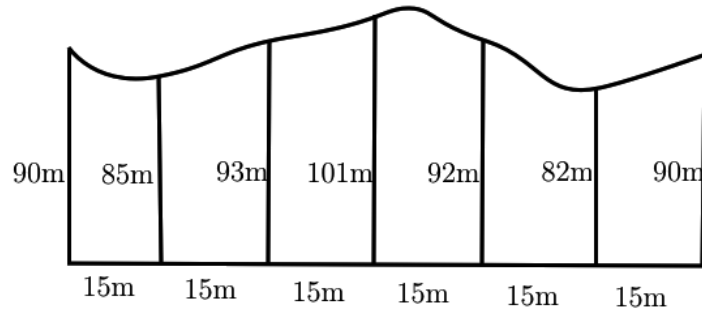


(iv) The test is deemed reliable if out of every thousand people tested only 2 people or fewer are expected to be given incorrect test reports. Is this test reliable? Justify your answer.



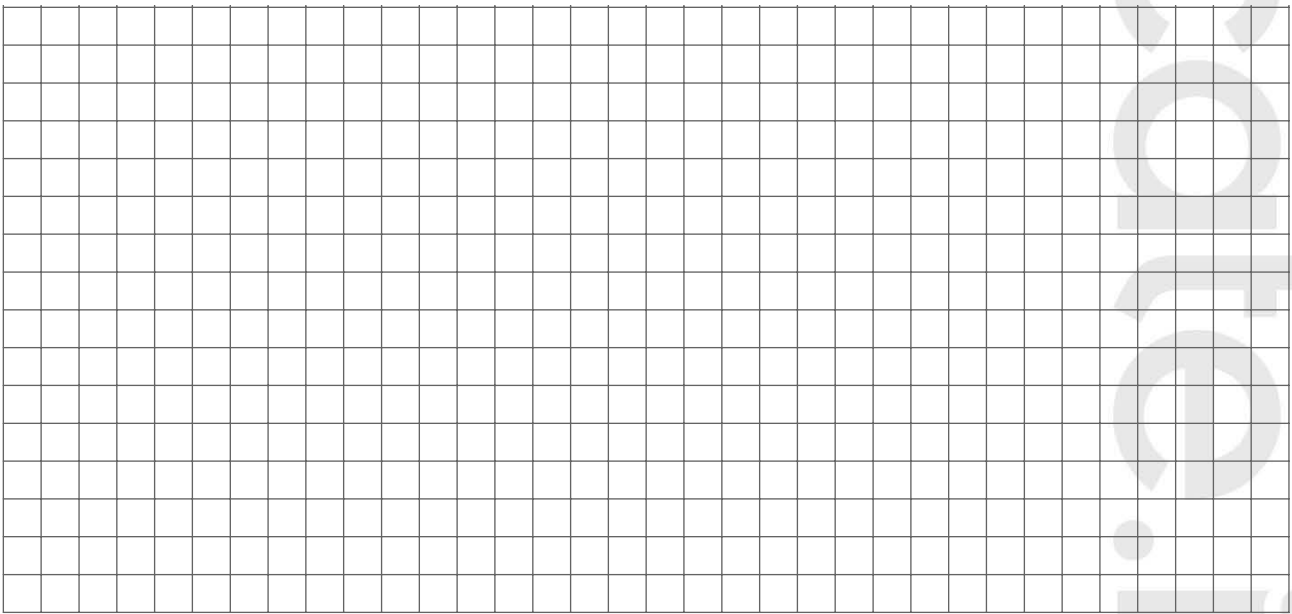


(b)

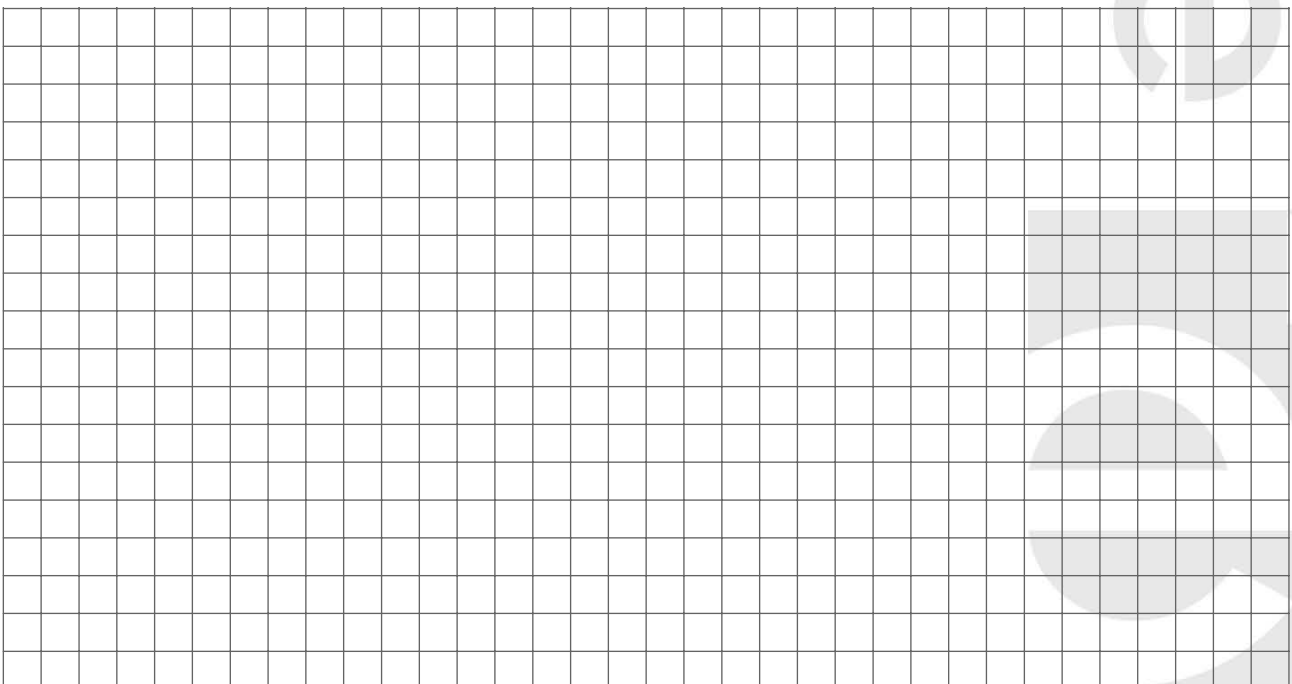


A site, as shown, is fenced on three sides by stone walls, while a stream forms the fourth boundary.

(i) Use Simpson's Rule to estimate the area of the site.



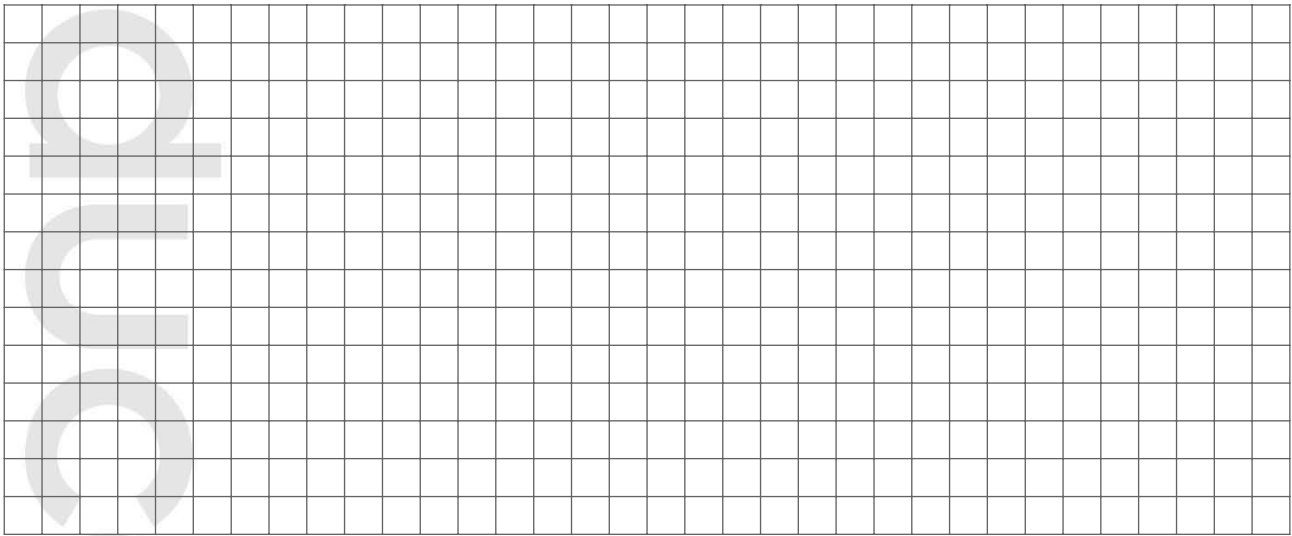
(ii) If the actual area of the field is  $8250\text{m}^2$ , find the percentage error in the estimate correct to one decimal place.



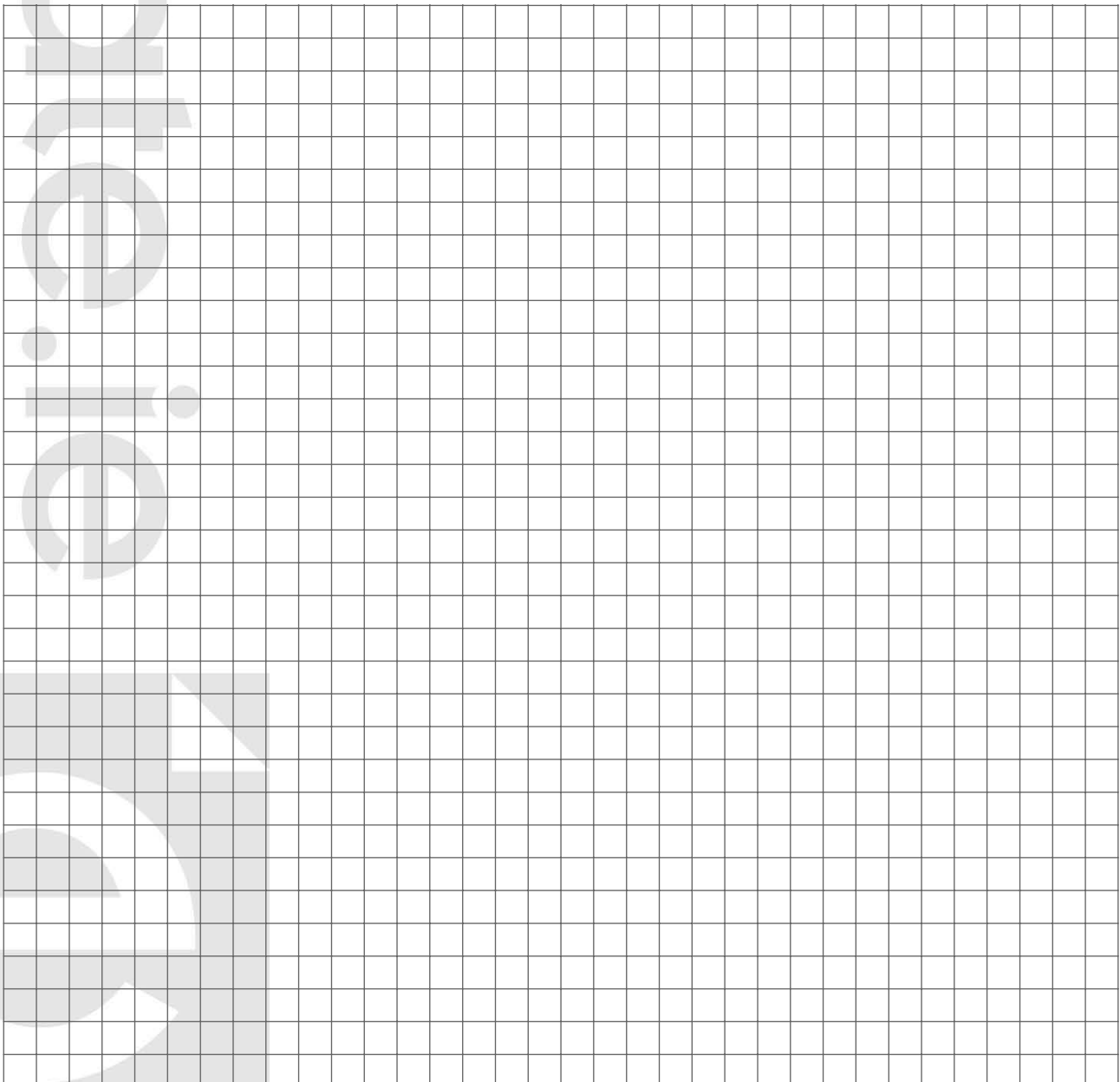
Sample 3  
P2

(c) A metal sphere is completely immersed in a cylindrical can of water of radius 6cm.

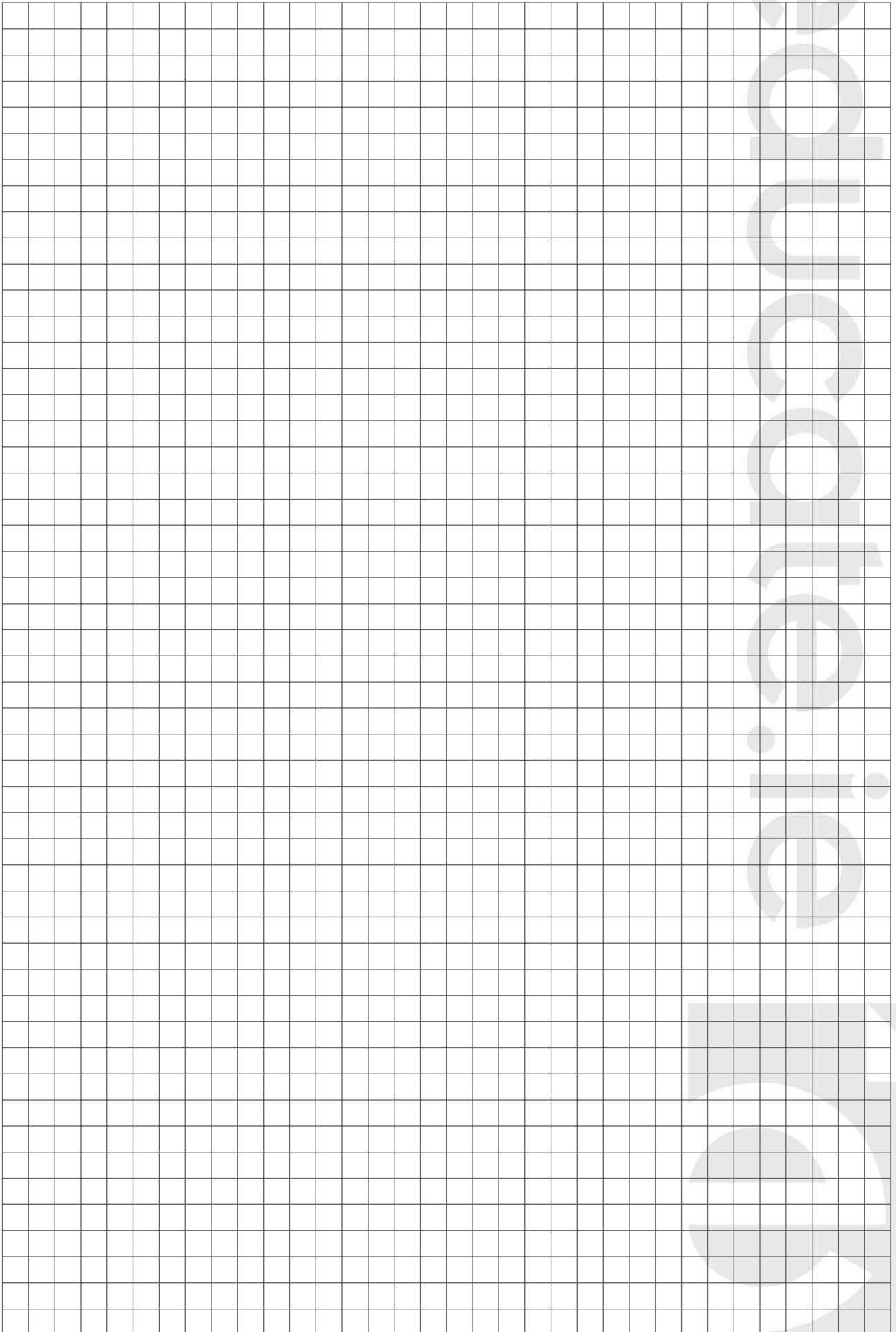
(i) If the water rises by 8cm, find the radius of the sphere.



(ii) Find the volume of the smallest rectangular box that the sphere will fit into.



You may use this page for extra work



Sample 3  
P2



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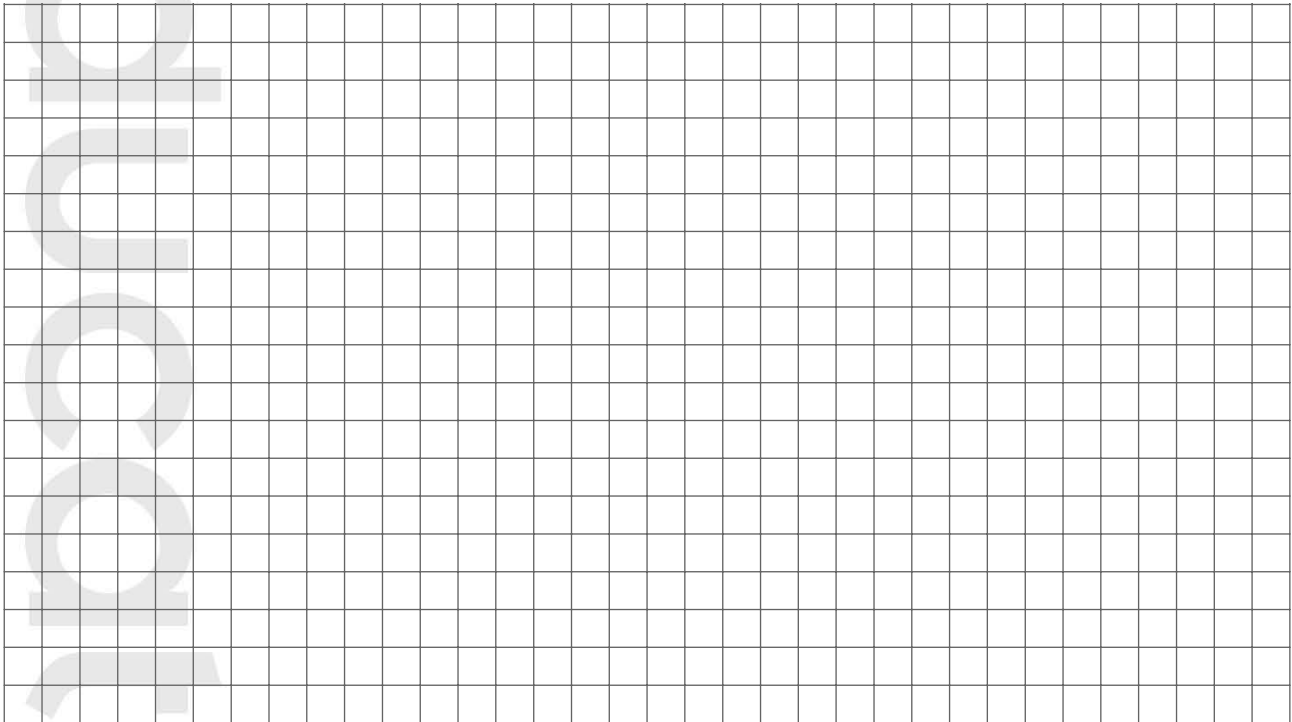


**Question 3**

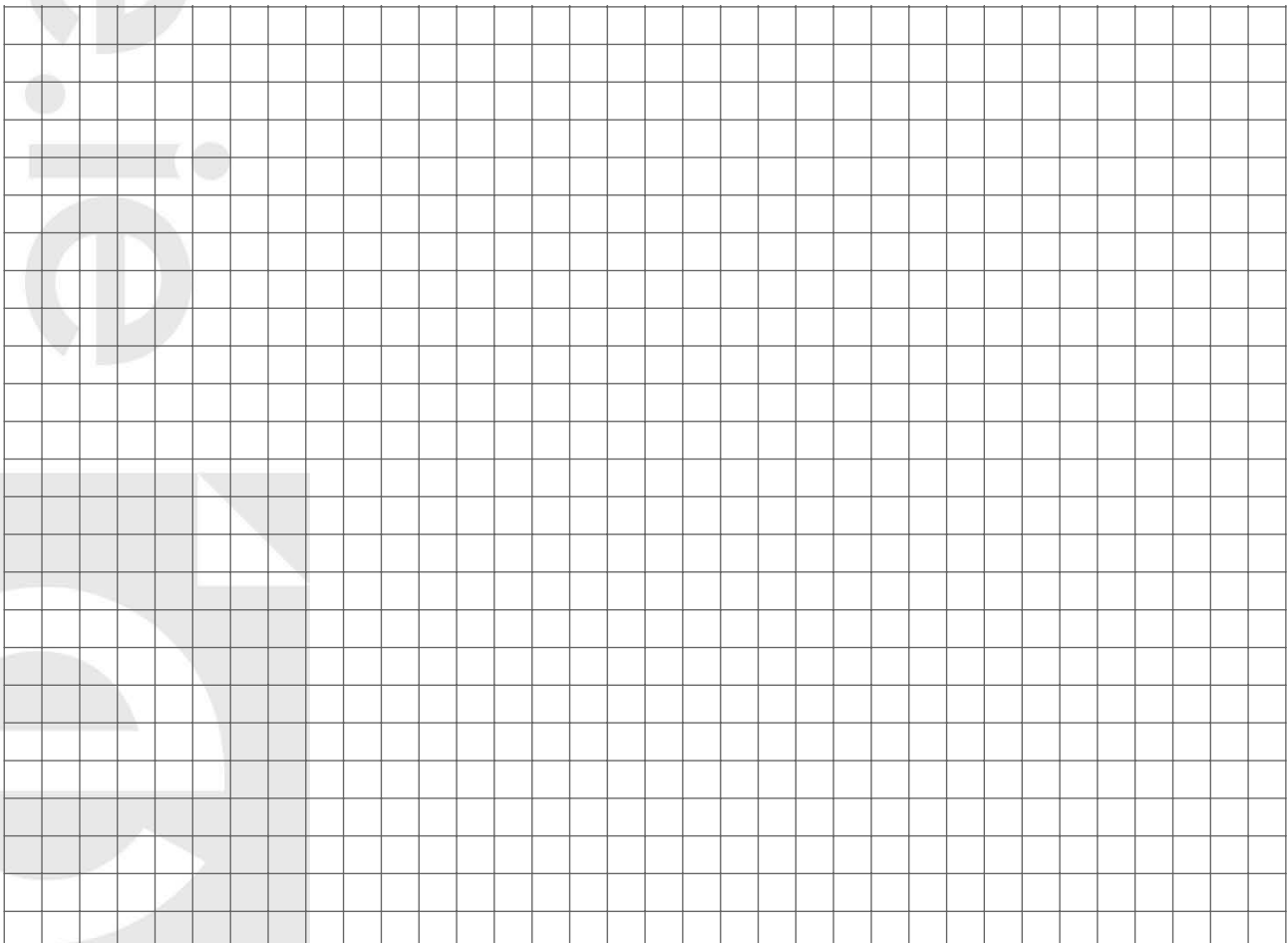
**(25 marks)**

The area of a triangle  $\triangle ABC$  with vertices  $A(1, 1)$ ,  $B(2, -4)$  and  $C(4, x)$  is equal to 10.

**(a)** Find the value of  $x$ , where  $x > 0$ .



**(b)** A vertex  $D$  is inserted such that  $ABCD$  forms a rectangle with  $D$  opposite to  $A$ . Find the co-ordinates of  $D$ .

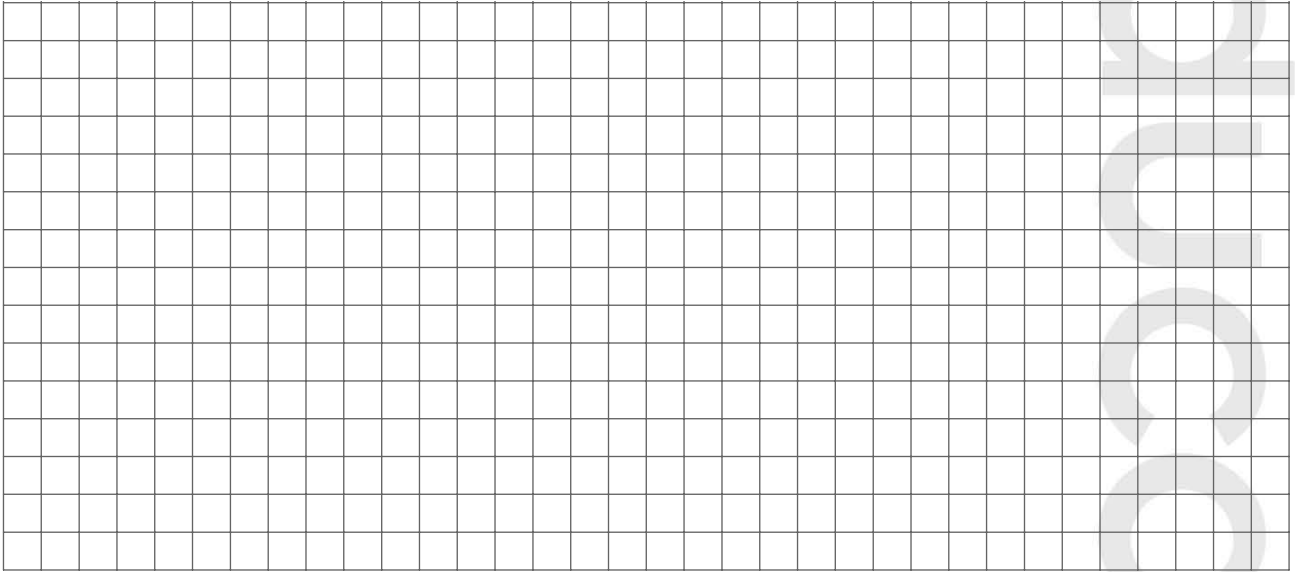


**Question 4**

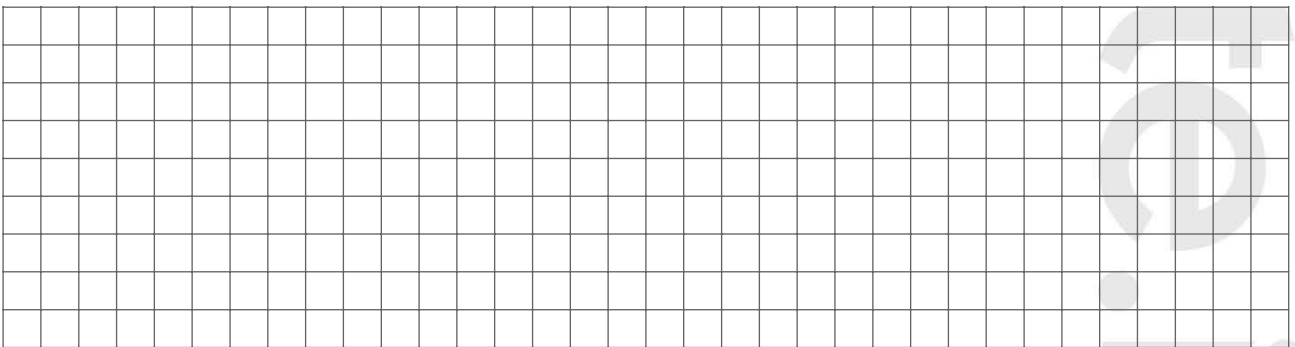
**(25 marks)**

$s$  is the circle  $(x - 3)^2 + (y - 2)^2 = 10$ .

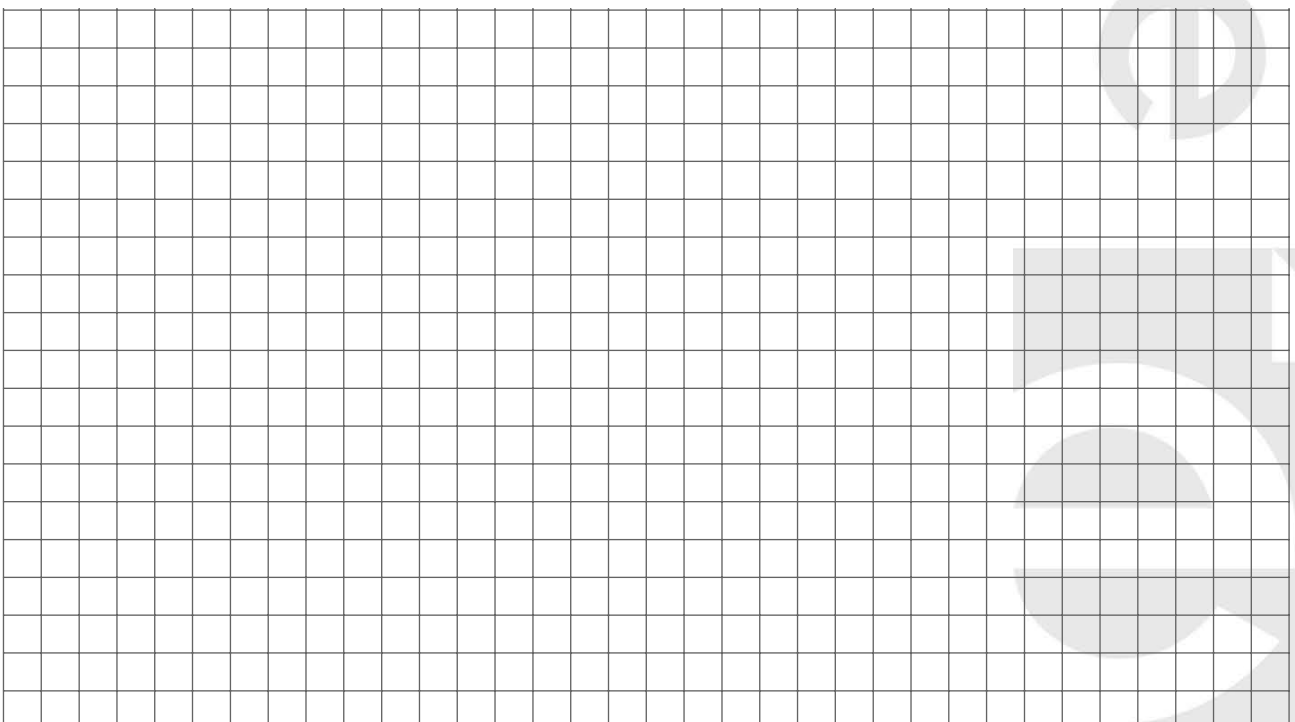
**(a)** Draw  $s$  on a co-ordinate diagram.



**(b)** Find the co-ordinates  $A$  and  $B$ , where the circle,  $s$ , intersects the  $y$ -axis.



**(c)** If  $A$  and  $B$  are the end points of a diameter of the circle  $c$ , then find the equation of  $c$ .



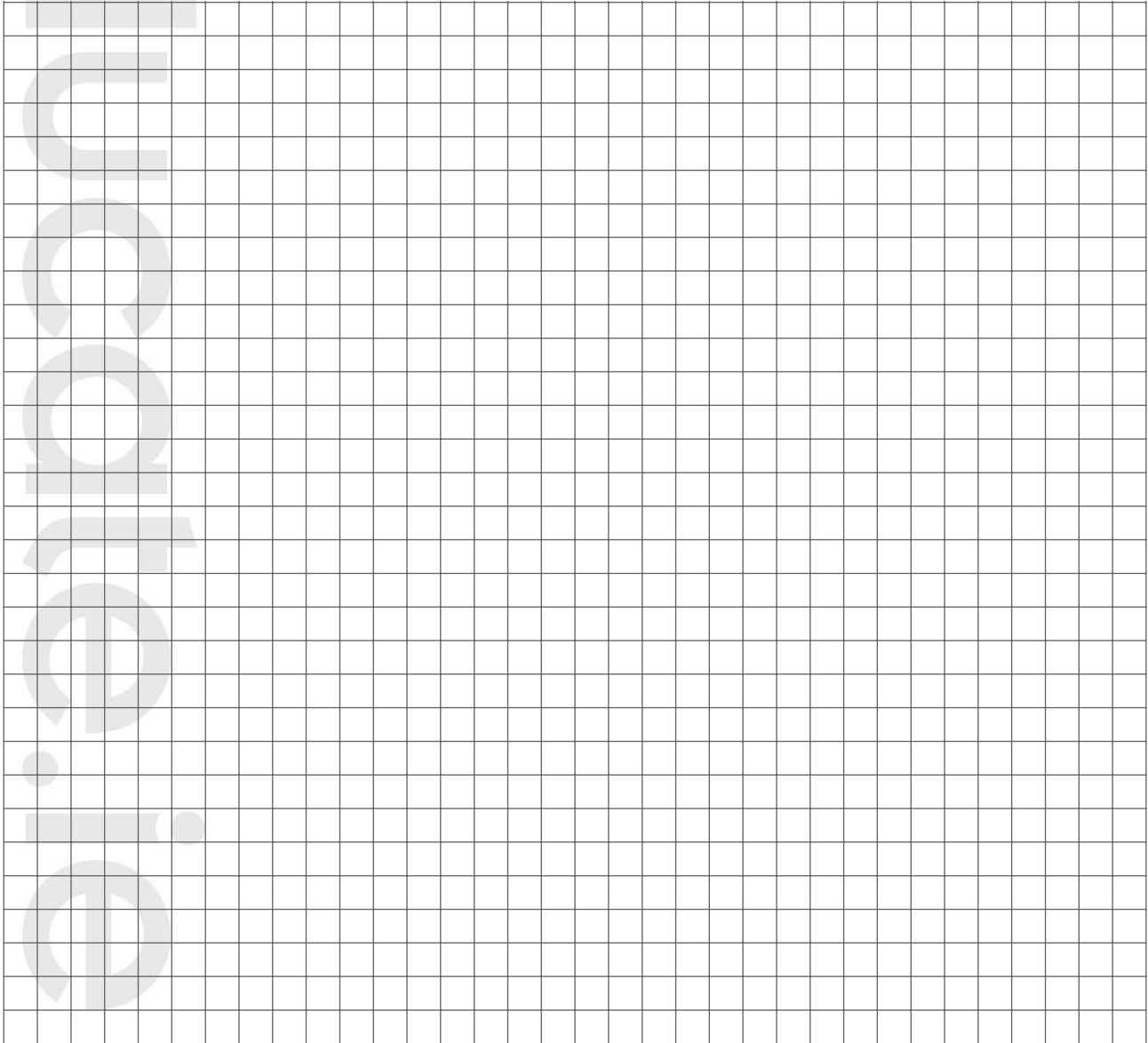
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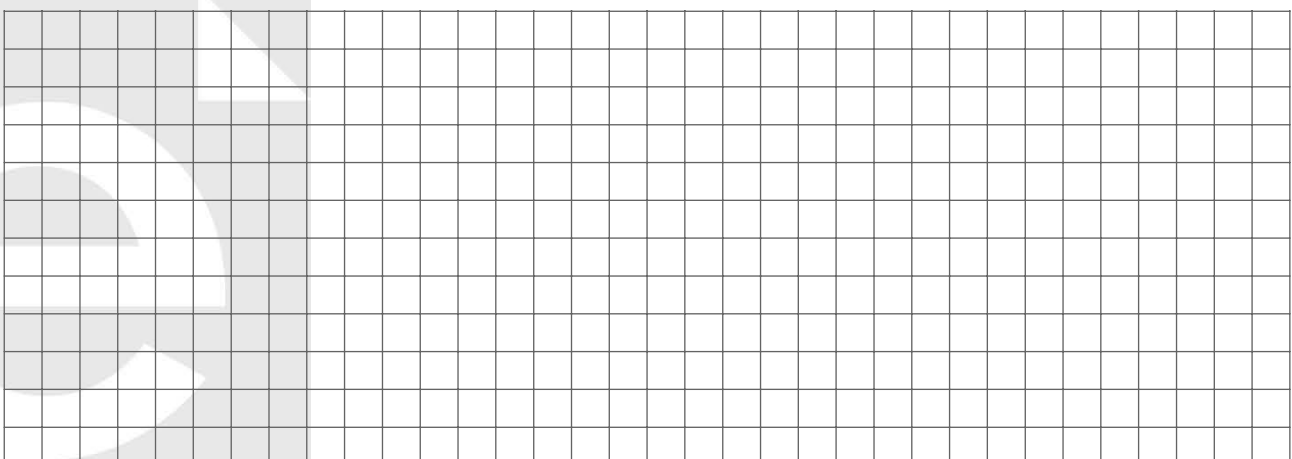
Answer **either** 5A or 5B.

**Question 5A**

**(a)** Construct the incircle of a triangle ABC.

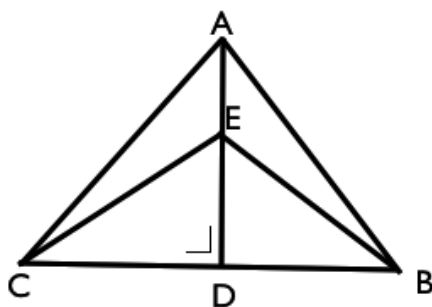


**(b)** State Pythagoras' theorem. Illustrate the theorem by means of an example.

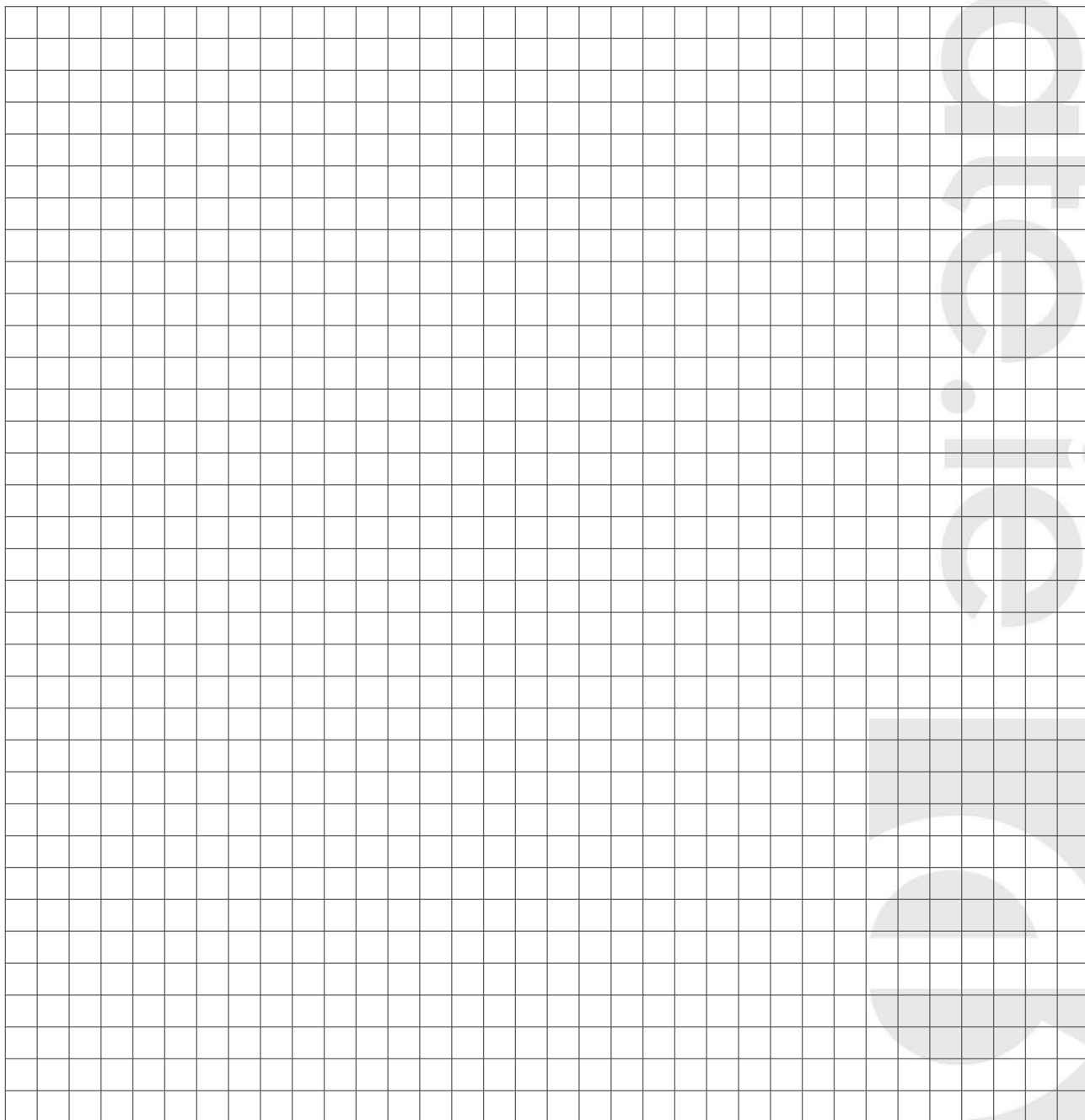


OR

Question 5B



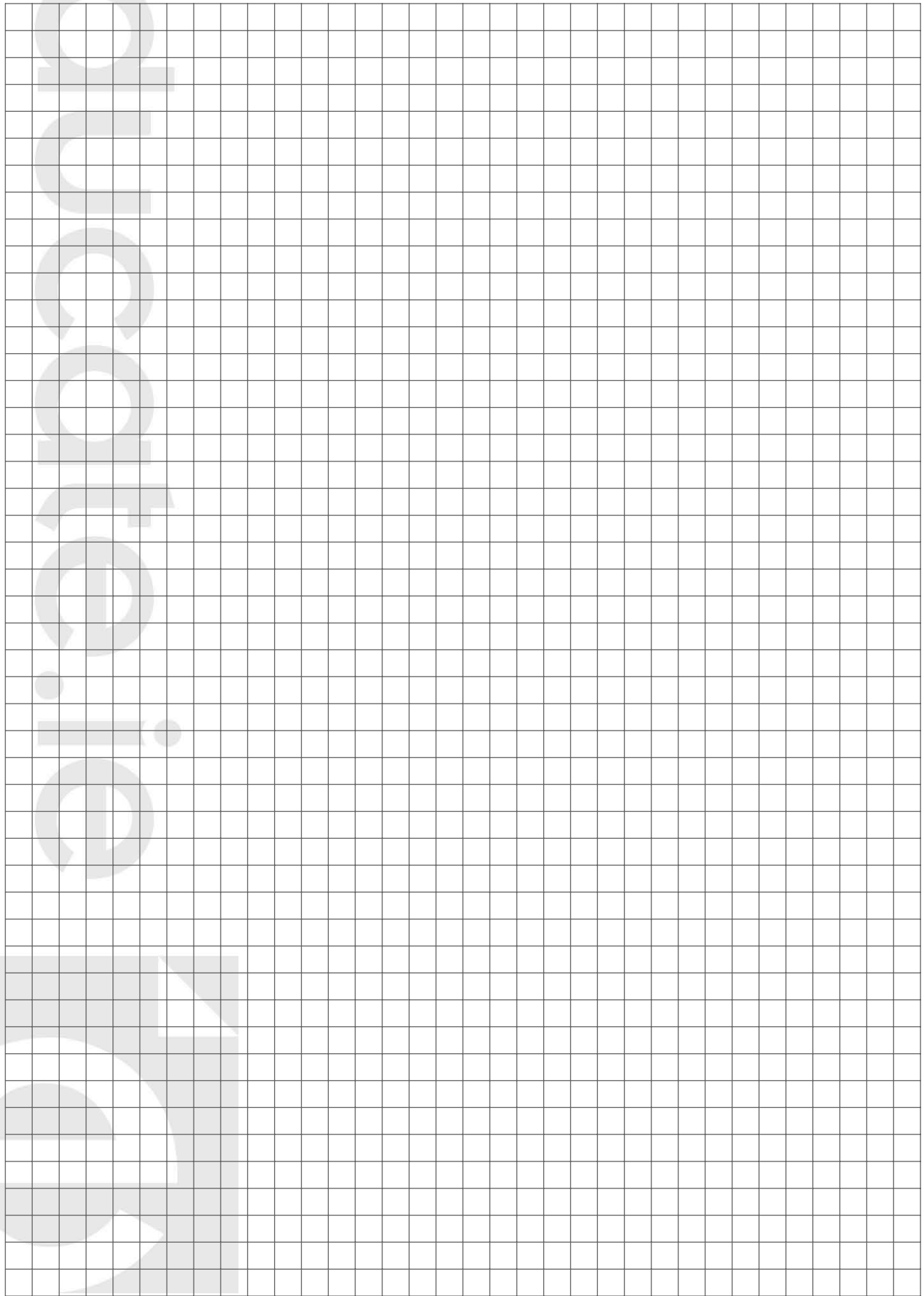
The line segment  $[AD]$  is perpendicular to the line segment  $[BC]$ . Show that  $|AC|^2 - |AB|^2 = |CE|^2 - |EB|^2$ .





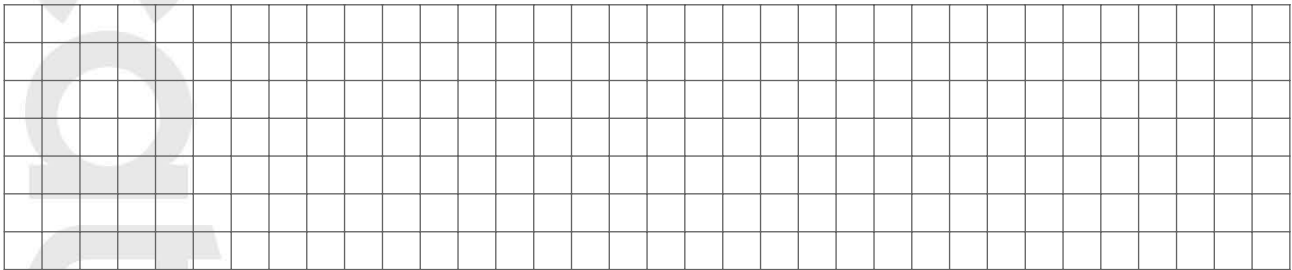
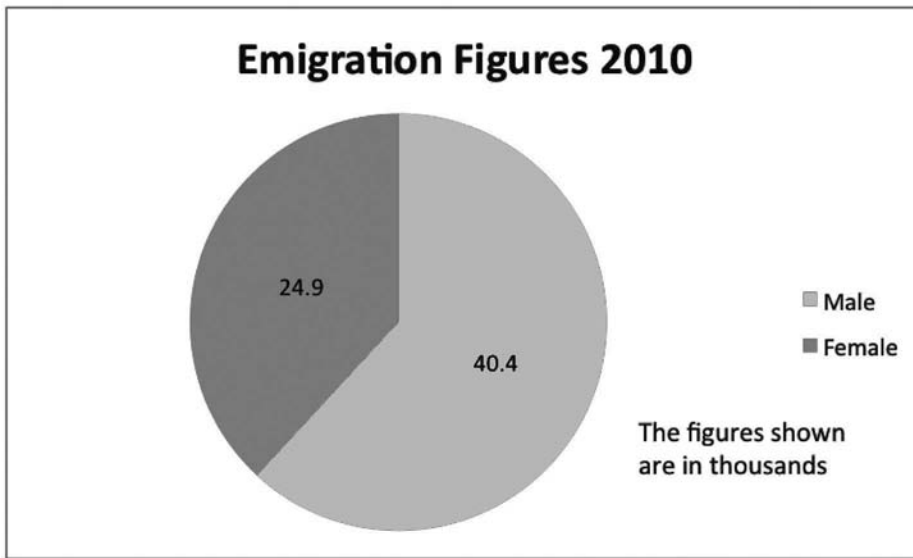


(b) The ferry company is also constructing a one storey building at  $A$  which will provide facilities and teas/coffees etc. The internal floor area in the shape of a triangle enclosed by a circumcircle. The sides of the triangle are 24m, 20m and 16m. Using a scale of  $1\text{cm} = 4\text{m}$ , construct the triangle and then construct the circumcircle of this triangle. Show all construction lines.

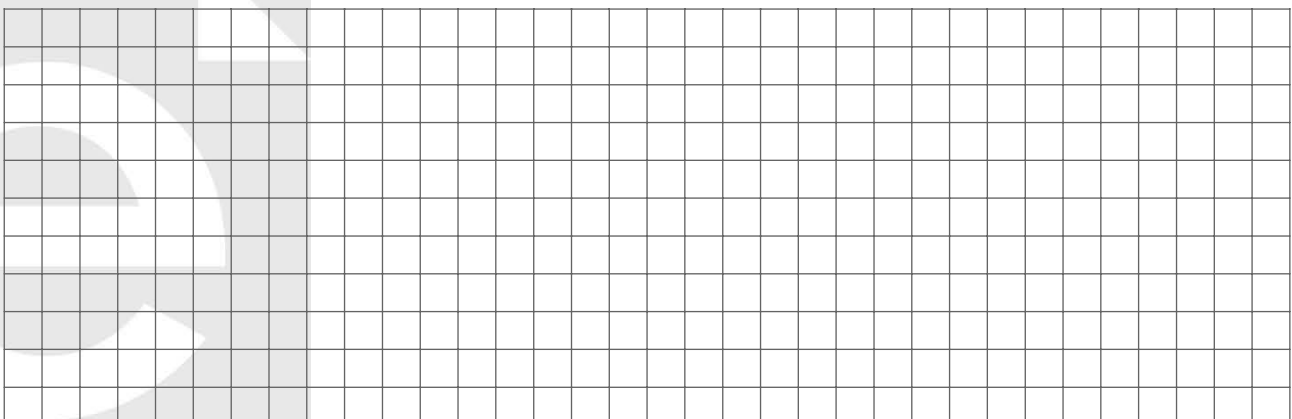
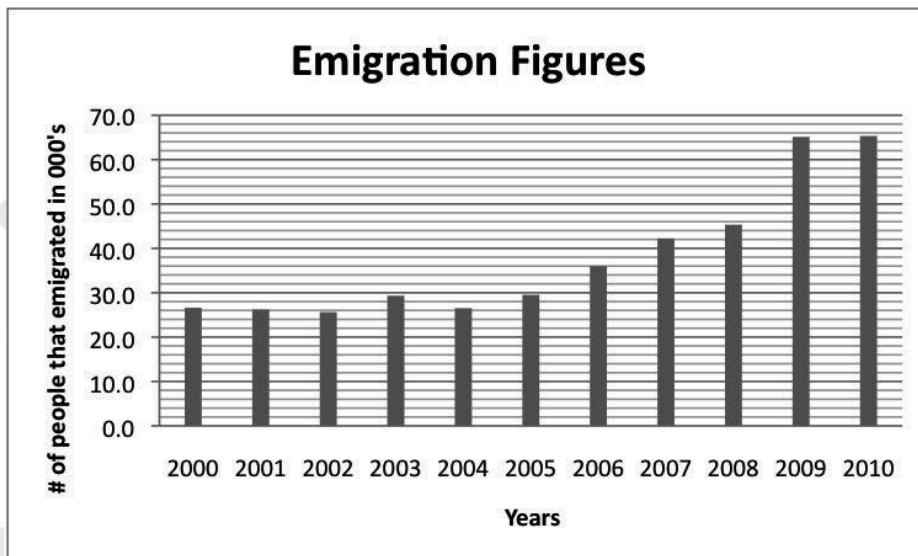




(i)



(ii)



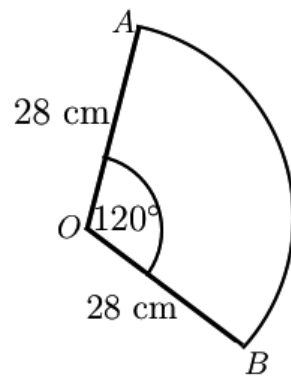




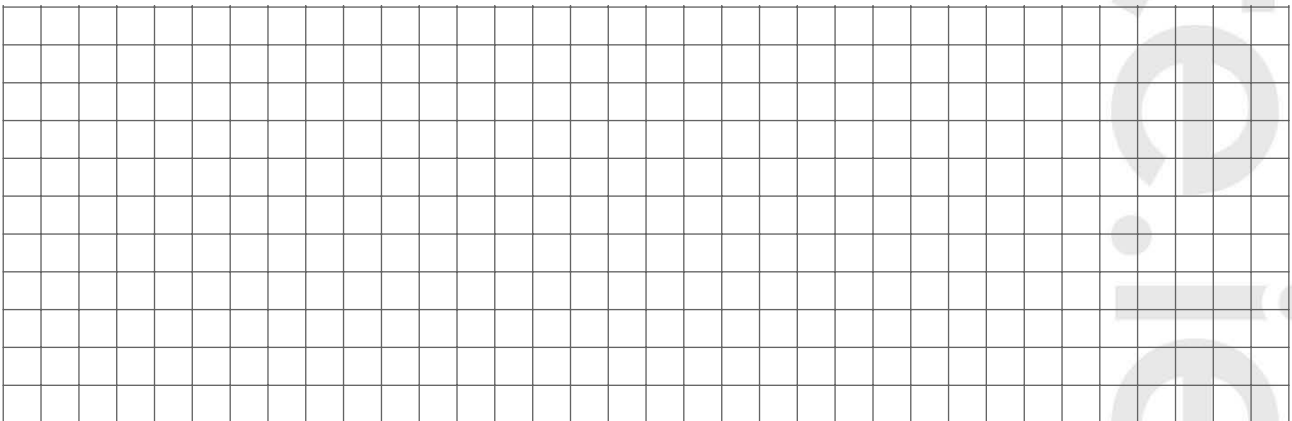
Answer **Question 8** from this section.

**Question 8****(50 marks)**

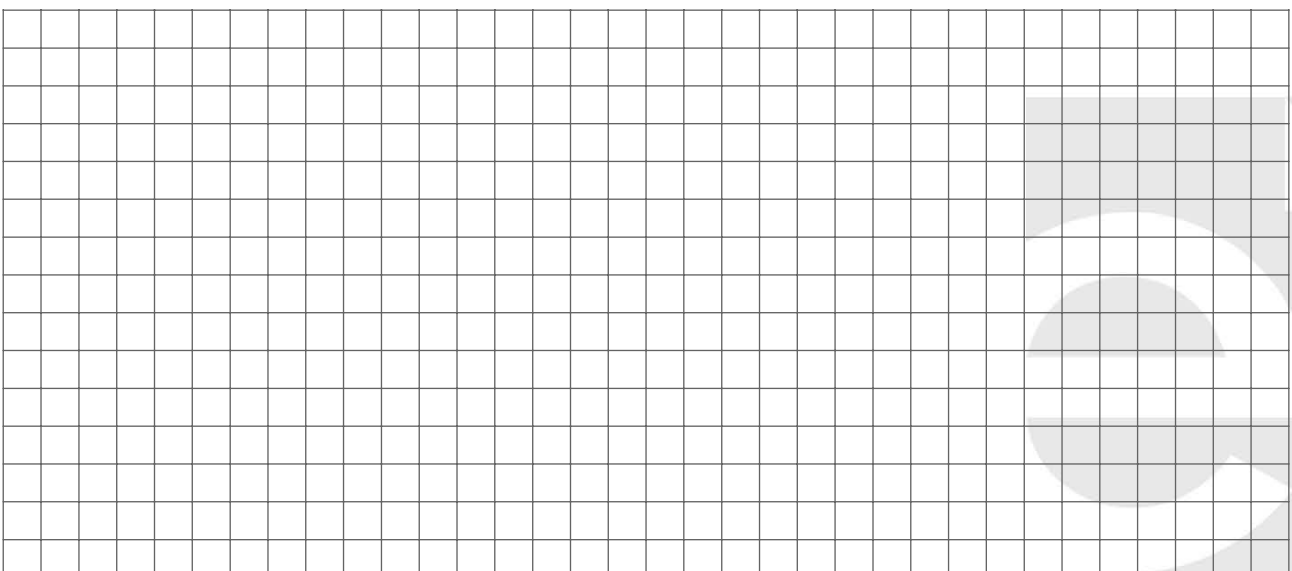
(a) Consider the diagram shown.

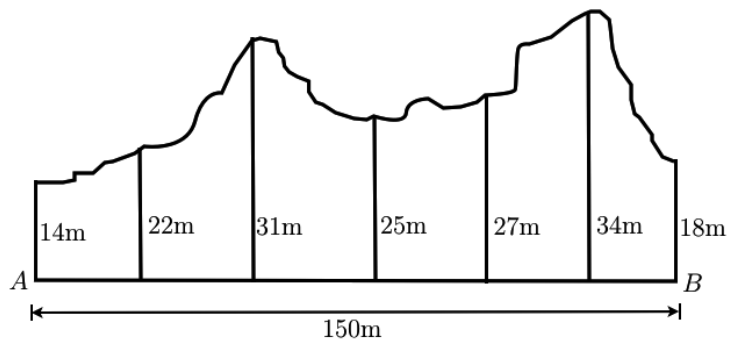


(i) Find the length of the arc  $AB$ .



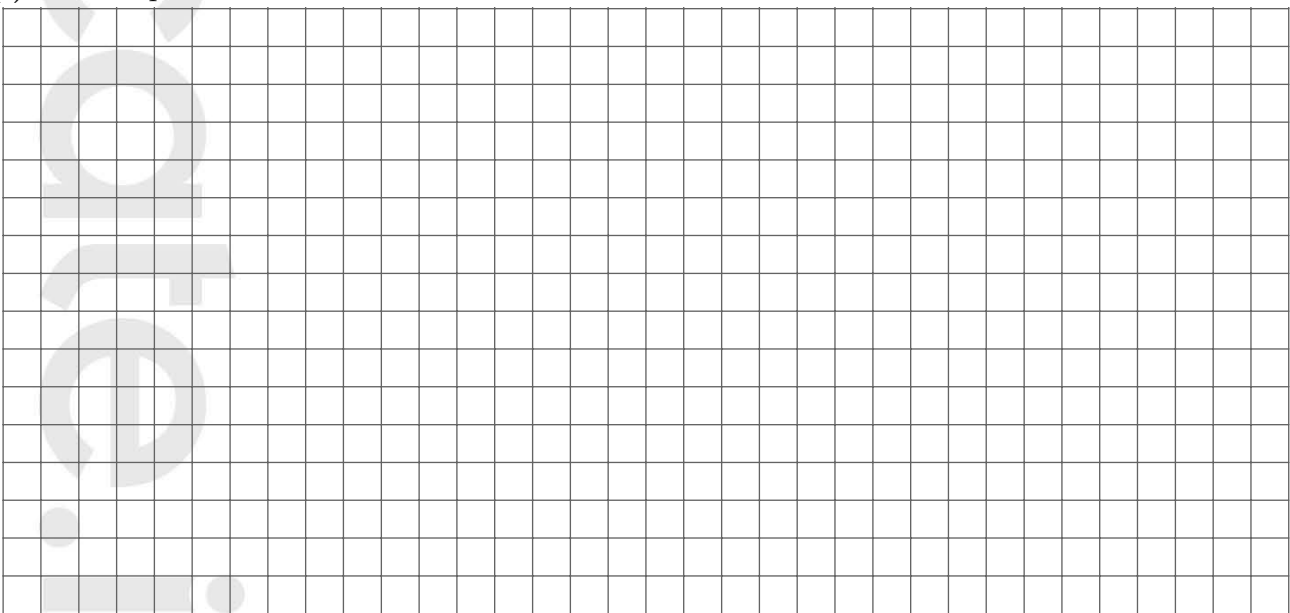
(ii) Find the area of the sector  $AOB$ .



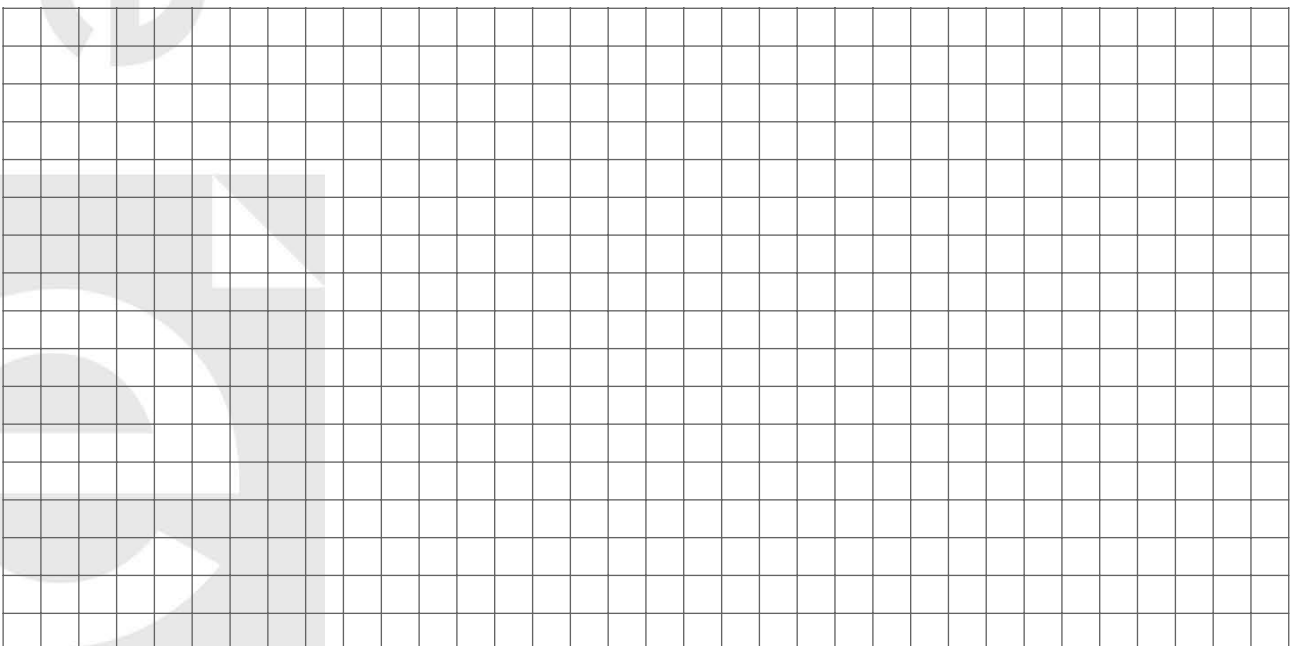


(b) The sketch shows the site of a house, the front boundary of which lies along a straight road  $[AB]$ . At equal intervals along  $[AB]$  perpendicular measurements are made to the boundary at the other side of the site as shown on the sketch.

(i) Use Simpson's Rule to estimate the area of the site to the nearest  $\text{m}^2$ .

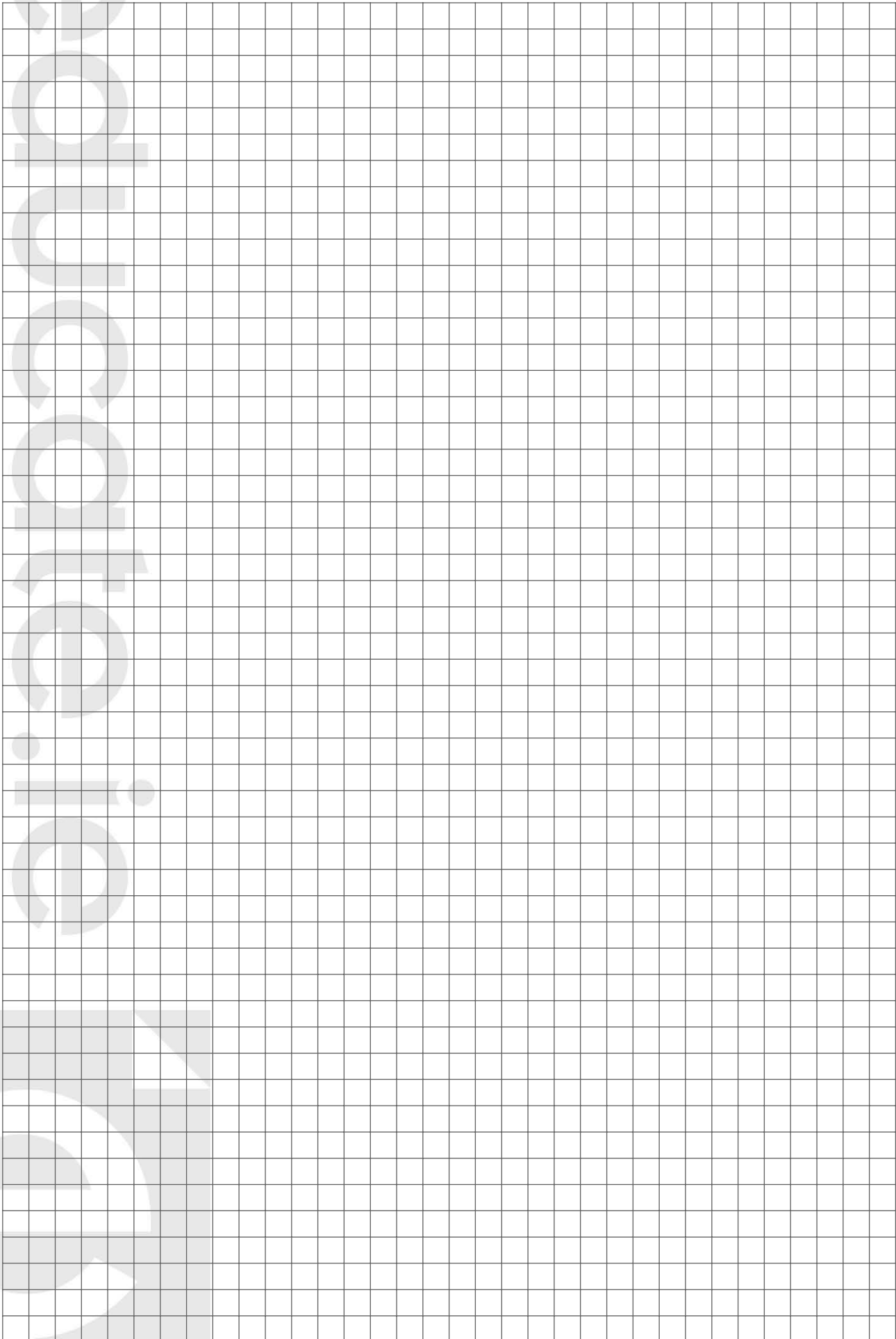


(ii) The land is valued at €110,000 per hectare. Find the value of the site to the nearest €. (Note: 1hectare= $10,000\text{m}^2$ .)





You may use this page for extra work



# Leaving Certificate Solutions - Sample Paper 1

## Ordinary Level - Project Maths - Paper 2

### Question 1

- (a) 1 is categorical, 2 is numerical, 3 is numerical, 4 is categorical  
(b) 1  
(c) [3, 9]  
(d) 37,500

### Question 2

- (a) See definition.  
(b) 0.05  
(c) 50  
(d) 0.12

### Question 3

- (a)  $-\frac{4}{7}$   
(b)  $B(7, 0)$ ,  $C(0, 4)$   
(c) 8

### Question 4

- (a)  $(1, -2)$ ,  $2\sqrt{2}$   
(b)  $(2, 4)$  is outside  $s$ .  $(1, -4)$  is inside  $s$ .  
 $(-1, 0)$  is on  $s$ .  
(c) 25.13

### Question 5A

- (a) Construction  
(b) (i) See definitions (ii) False

### Question 5B

15°

### Question 6

- (a) (i) 99°, (ii) 2094m<sup>2</sup>  
(b) (i)  $|\angle ABC| = 90^\circ$  (ii) 10m  
(iii) 24m<sup>2</sup> (iv) 15.27m<sup>2</sup>

### Question 7

(i)

	Male	Female
	6	8
	7	7
9,7,7,5,1	8	1,2,3,4,4,5,5,6
9,9,8,8,7,7,6,5,5,4,3,2	9	0,4,7
7,6,6,5,1,1,0,0,0,0	10	0,1,1,3,5,6,6,6,7,7,8,8,9
9,7,6,3,2,2	11	1,1,4,4,4,5,5,6
4,1	12	1,7

(ii) Female 100.61, Male 101.33

(iii) (1) 10 (2)  $\frac{5}{18}$

(iv) (1) 8 (2)  $\frac{2}{9}$

(v)  $\frac{2}{3}$

(vi)  $\frac{3}{648}$

(vii) [85, 115], 0.32

(viii) 0.42

(ix) One reason could be the small sample space used.

Question 8 (a) 42cm<sup>2</sup>

(b) (i) 2010m<sup>2</sup> (ii) 4.5%

(c) (i) 972πcm<sup>3</sup> (ii) 6104cm<sup>3</sup>

# Leaving Certificate Solutions - Sample Paper 2

## Ordinary Level - Project Maths - Paper 2

### Question 1

- (i) Discrete
- (ii) 10%
- (iii)  $Q_1 = 32, Q_3 = 72, \text{Range} = [32, 72]$

### Question 2

- (i) 0.4
- (ii) 0.288
- (iii)  $E(X) = -\text{€}0.56$ . A player would lose €0.56 per game on average. Therefore this is an unfair game.

### Question 3

- (a) 7
- (b)(i)  $7y = 2x + 21$
- (ii)  $Q$  and  $L$  are parallel as they both have slope  $\frac{2}{7}$
- (c)  $Q$  and  $P$  intersect at the co-ordinate (35, 13).

### Question 4

- (a) (3, -2)
- (b)  $(-3 - 3)^2 + (6 + 2)^2 = 100 \checkmark$
- (c)  $-\frac{4}{3}$
- (d)  $4y - 3x = 33$ . Sub  $3x = 4y - 33$  into the equation for  $s$  and find  $y^2 - 12y + 36 = 0$ . Solution is  $y = 6 \implies x = -3$ , i.e. intersection is at point A only.

### Question 5A

- (a) Construction
- (b)(i) See definitions (ii) right

### Question 5B

7 cm

### Question 6

- (a)(i) Student on left, 48.2m from mast.  
Student on right, 36.8m from mast.
- (ii) 67.9m
- (b)(i)  $|AB| = |CD|; |AD| = |BC|;$   
 $|\angle BAD| = |\angle BCD|$   
 $\implies$  triangles are congruent.
- (ii)  $\triangle ABD$  and  $\triangle BCD,$   
 $\triangle ABC$  and  $\triangle ACD,$   
 $\triangle AED$  and  $\triangle BEC,$   
 $\triangle AEB$  and  $\triangle DEC$

- (iii) 150m
- (iv) 13,972m<sup>2</sup>

### Question 7

- (a)(i) 0.6
- (ii) Tree Diagram
- (iii) 0.216
- (iv) 0.432
- (v) 0.288
- (vi) 0.064
- (vii)  $0.216 + 0.432 + 0.288 + 0.064 = 1$
- (viii) €1008

(b)(i)

	On time	Late
Car	$\frac{4}{10}$	$\frac{1}{10}$
Bicycle	$\frac{1}{10}$	$\frac{1}{15}$
On foot	$\frac{3}{10}$	$\frac{1}{30}$

- (ii)(1)  $\frac{1}{30}$  (2)  $\frac{8}{10}$
- (iii)  $\frac{2}{5}$
- (iv)  $\frac{3}{500}$

### Question 8

- (a) 100cm<sup>2</sup>
- (b) 3109m<sup>2</sup>
- (c)(i) 11cm (ii)  $90\pi\text{cm}^3$  (iii) 9.8cm

# Leaving Certificate Solutions - Sample Paper 3

## Ordinary Level - Project Maths - Paper 2

### Question 1

- (i)  $\bar{x}_{2009} = 14, \bar{x}_{2010} = 16$
- (ii)  $\text{Range}_{2009} = 12, \text{Range}_{2010} = 12$
- (iii)  $\sigma_1 \approx 4.28, \sigma_2 \approx 4.32$

### Question 2

- (a) See definition
- (b) No
- (c)(i) Plot (ii)  $\frac{4}{15}$  (iii)  $\frac{27}{30}$

### Question 3

- (a)  $(\frac{3}{2}, -3)$
- (b) 2
- (c)  $4y = -2x - 3$

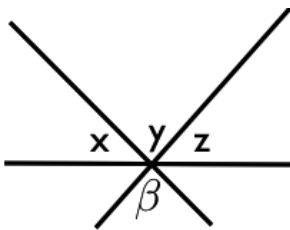
### Question 4

- (i)  $(x - 3)^2 + (y - 4)^2 = 25$
- (ii)  $y = x + 1$
- (iii)  $(\frac{1}{2}, \frac{3}{2})$

### Question 5A

- (a) Construction.
- (b) chord, perpendicular, base

### Question 5B



Denote angles above  $\beta$  in the diagram as  $x, y, z$ .  
 $\gamma = y + z$  (adjacent angles).  
 $\alpha = x + y$  (adjacent angles).  
Thus,  $\alpha + \gamma = x + y + y + z$ .  
However,  $x + y + z = 180^\circ$ , and  $y = \beta$  (opposite angles). Hence,  $\alpha + \gamma = 180^\circ + \beta$ .

### Question 6

- (a) 24.1m
- (b)(i) Construction (ii)  $206\text{m}^2$

### Question 7

- (a)(i) The probability of (1) is  $\frac{1}{15}$ ,  
the probability of (2) is  $\frac{5}{30}$ ,  
therefore (2) is more likely to happen.
- (ii)  $\frac{5}{18}$
- (b)(i) 362,880 (ii) 5,040 (iii) 5,760  
(iv) 80,640 (v) 282,240
- (c)(i) Tree diagram (ii) 19 (iii) 981  
(iv) Reliable as only 1 per thousand get an incorrect result.

### Question 8

- (a)(i) 20cm
- (ii)  $|\angle ABC| = |\angle XBY|$ ,  
 $|\angle BAC| = |\angle BXY|$  (adjacent),  
 $|\angle BCA| = |\angle BYX|$  (adjacent).
- (iii)  $3150\text{cm}^2$
- (b)(i)  $8110\text{m}^2$  (ii) 1.7%
- (c)(i)  $r = 6\text{cm}$  (ii)  $144\text{cm}^3$

# Leaving Certificate Solutions - Sample Paper 4

## Ordinary Level - Project Maths - Paper 2

### Question 1

- (a) Continuous  
(b)

Rainfall	20-40	40-60	60-80	80-100	100-120
Frequency	4	3	1	1	1

- (c)  $\bar{x} = 54, \sigma = 41.52$

### Question 2

- (a) 20  
(b) 14  
(c) 74

### Question 3

- (a) 6  
(b) (5,1)

### Question 4

- (a) Plot  
(b)  $A(0, 3), B(0, 1)$   
(c)  $x^2 + (y - 2)^2 = 1$

### Question 5A

- (a) Construction  
(b) Statement. Example:  $3^2 + 4^2 = 5^2$

### Question 5B

Use Pythagoras' Theorem to find

$$|AC|^2 = |AD|^2 + |CD|^2 \text{ and}$$

$$|AB|^2 = |AD|^2 + |BD|^2.$$

$$\text{This implies } |AC|^2 - |AB|^2 = |CD|^2 - |BD|^2.$$

Similarly,  $|CE|^2 = |ED|^2 + |CD|^2$  and

$$|EB|^2 = |ED|^2 + |BD|^2.$$

$$\text{This implies } |CE|^2 - |EB|^2 = |CD|^2 - |BD|^2.$$

$$\text{Thus, } |AC|^2 - |AB|^2 = |CE|^2 - |EB|^2.$$

### Question 6

- (a)(i) 3.763km (ii) 2.373km  
(iii) 21mins (iv) 18mins  
(v) Impact of tidal currents particularly in stormy and severe weather conditions, etc.  
(b) Construction.

### Question 7

- (a)(i) 36,000 (ii) 398,100 (iii) 20,920  
(b)(i) Many more males emigrated than females (almost 2:1).  
(ii) Emigration was steady at around 30,000 between 2000 and 2005. Since then the number has increased dramatically and in 2010 was around 65,000.  
(iii) In 2000 more immigrated than emigrated (approx 2:1) with the situation reversing by 2010.  
(iv) Less. There's a clear downward trend and the total in 2010 was 30800.  
(v) Female immigrant. In 2002 35,600 females immigrated compared to 12,700 males emigrating.  
(vi) 4809  
(c) 0.23  
(d) 271  
(e) In 2000 the vast majority of those emigrating were in the 15-24 age group. The trend in 2010 has been towards more emigrating in the 25-44 age group, with slightly more (approx 30,000) emigrating than those in the 15-24 age group (approx 28,000).

### Question 8

- (a)(i) 58.6cm (ii) 820.6cm<sup>2</sup>  
(b)(i) 3933m<sup>2</sup> (ii) €43,266  
(c)(i) 361m<sup>2</sup> (ii) 287.81cm<sup>3</sup>