# Pre-Leaving Certificate Examination, 2025

# Mathematics

## Paper 2

## Ordinary Level

## Time: 2 hours, 30 minutes

### 300 marks

**CANDIDATE DETAILS**

**DAY and MONTH of BIRTH** ✍ ☐☐ / ☐☐  For example, 3rd February is entered as 03/02

**NAME** ✍

**SCHOOL** ✍

**TEACHER** ✍

**School Stamp**

| For Examiner only | |
|---|---|
| Question | Mark |
| A.    1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |
| B.    7. | |
| 8. | |
| 9. | |
| 10. | |
| **Total** | |
| **%** | |

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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 | 4 questions |

Answer questions as follows:
- any **five** questions from Section A — Concepts and Skills
- any **three** questions from Section B — Contexts and Applications.

Write your Name and Individual Details in the grid on the front cover.

Write your answers in blue or black pen. You may use pencil in graphs and diagrams only.

This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write all answers into this booklet. There is space for extra work at the back of the booklet. If you need to use it, 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.

In general, diagrams are not to scale.

You will lose marks if your solutions do not include relevant supporting work.

You may lose marks if the appropriate units of measurement are not included, where relevant.

You may lose marks if your answers are not given in simplest form, where relevant.

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

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

**Question 1**        **(30 marks)**

A company has a staff of twenty people.
The ages, in years, of staff members are shown in the stem-and-leaf diagram below.

| | 1 | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 | 3 | 3 | 5 | 7 | 9 | |
| | 3 | 0 | 1 | 3 | 4 | | |
| | 4 | 0 | 2 | 4 | 7 | 7 | 7 |
| | 5 | 2 | 3 | 8 | | | |
| | 6 | 0 | 2 | | | | |

Key:    3 | 1 = 31 years

**(a)**    Find the mode **and** the median of the data.

Mode = _____        Median = _____

**(b)** **(i)**    Work out the mean **and** the standard deviation of ages of staff members in the company.
Give your answers correct to 2 decimal places.

Mean = _____        Standard deviation = _____

     **(ii)**    Find the percentage of staff members whose ages are **not** within one standard deviation of the mean.

**(c)** **(i)** Complete the following grouped frequency table to illustrate the data in the stem-and-leaf diagram on the previous page.

| Age (years) | 20 – 30 | 30 – 40 | 40 – 50 | 50 – 60 | 60 – 70 |
|---|---|---|---|---|---|
| Number of staff members | | | | 3 | |

Note: 30 – 40 means "30 years old or more, but less than 40 years old", and so on.

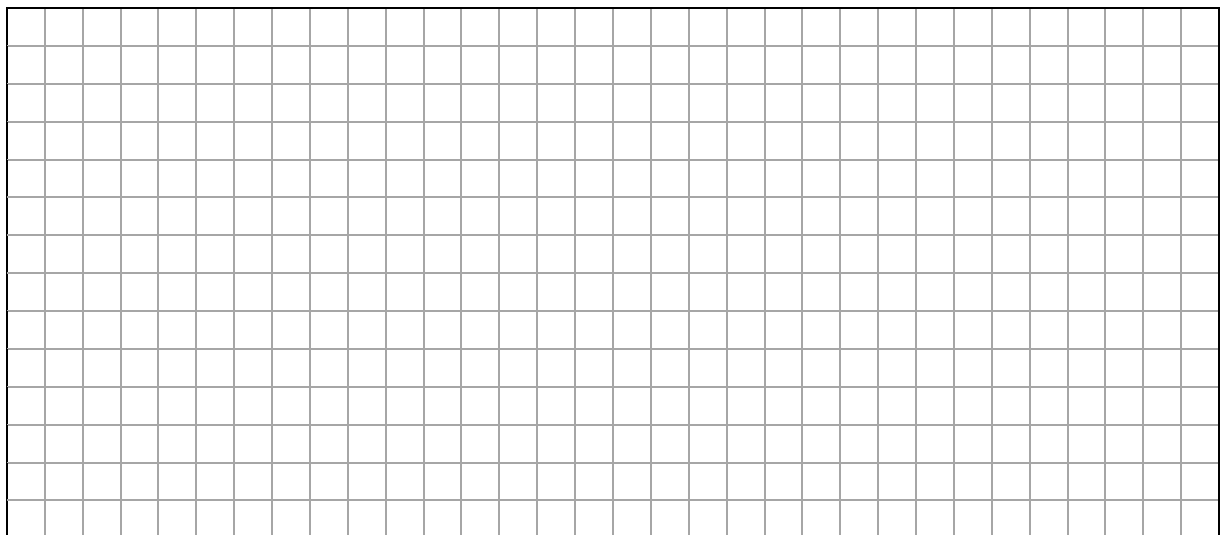**(ii)** Draw a **histogram** to represent this data.

Number of staff members

Age (years)
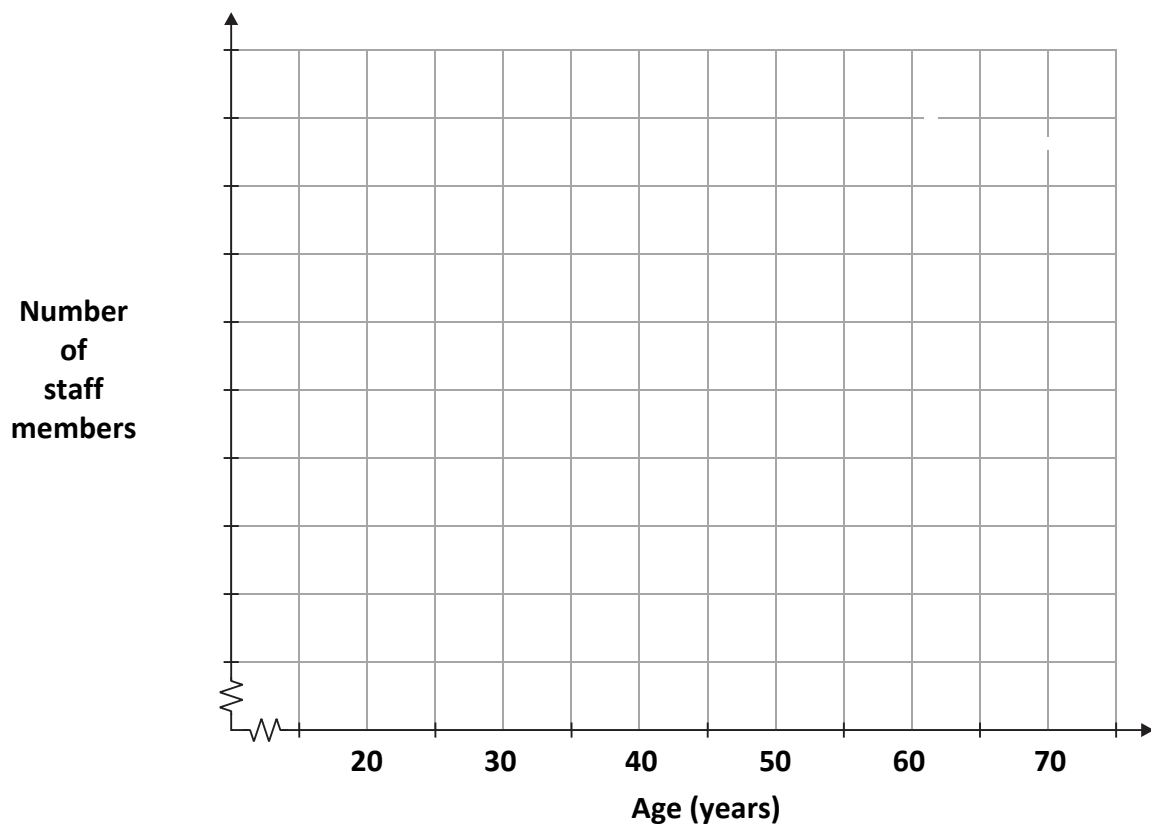
**Question 2** (30 marks)

The points $P(1, 7)$, $Q(3, -2)$ and $R(5, -1)$ are the vertices of a triangle.

**(a)** Draw the triangle $PQR$ on the co-ordinate diagram below.
Label each vertex clearly.
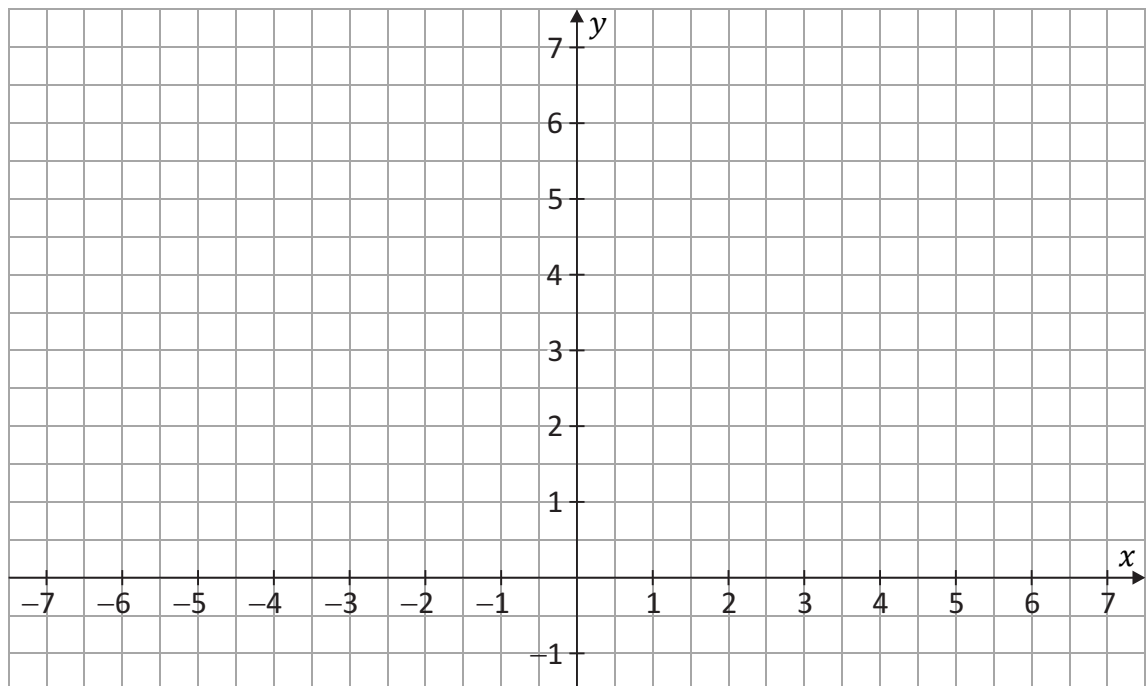
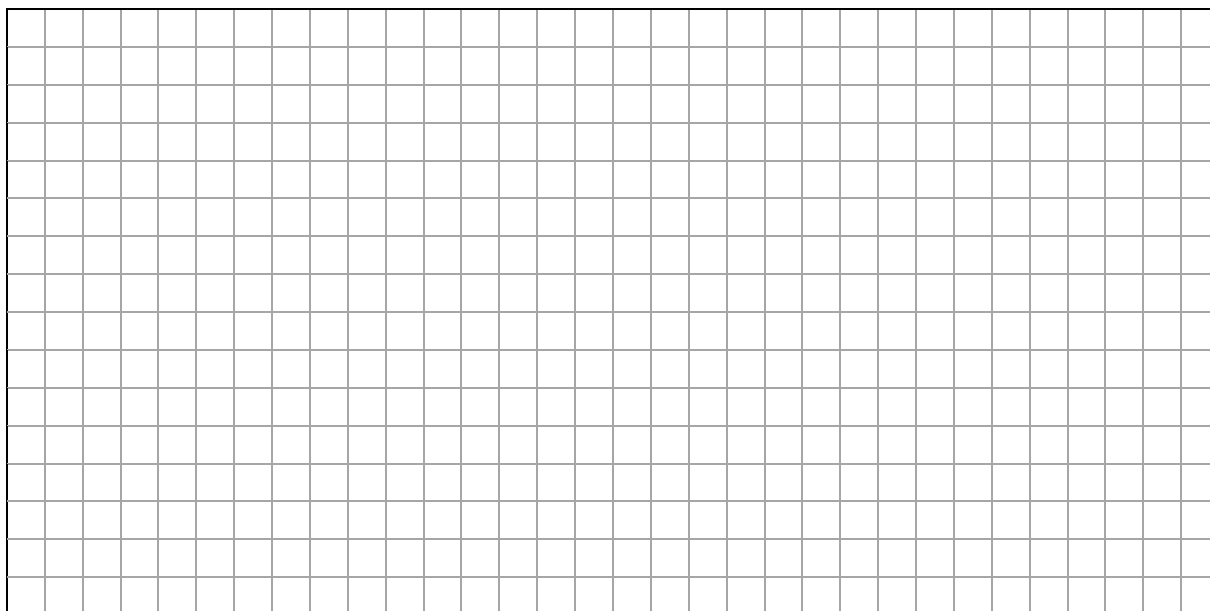**(b)** Show, using slopes, that $PR$ is perpendicular to $QR$.

**(c)** Use co-ordinate geometry to find the area of the triangle $PQR$.
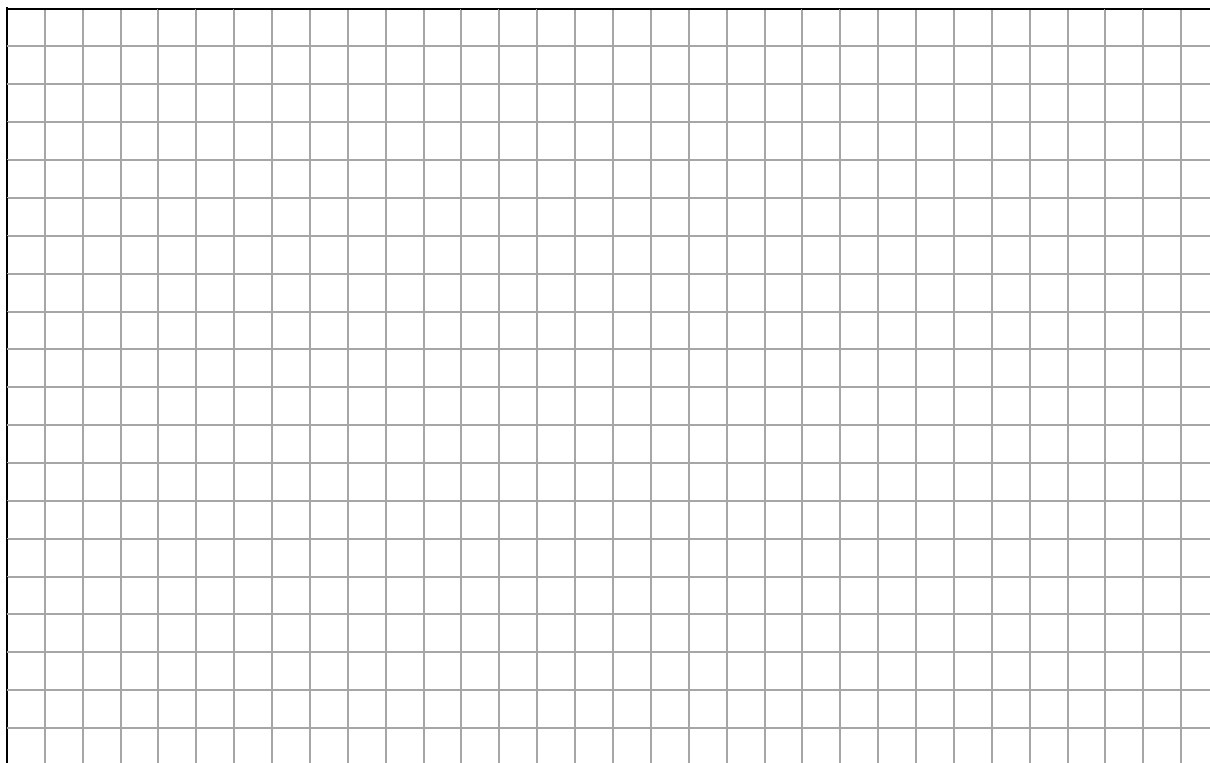
**(d)** Use trigonometry to work out the size of the angle $\angle PQR$.
Give your answer correct to the nearest degree.

*Hint:* use $|PR|$ and $|QR|$ to find $|\angle PQR|$.

**Question 3** **(30 marks)**

**(a)** The circle $c$ has equation $x^2 + y^2 = 20$.

**(i)** Write down the centre and the radius of circle $c$.

Centre of $c = ($ ____ , ____ $)$ Radius of $c =$ _____

**(ii)** Show, by calculation, that the point $P(-2, 4)$ is on circle $c$.

**(b)** The points $A(-2, 7)$ and $B(6, 1)$ are the end-points of a diameter of the circle $s$, as shown in the diagram.

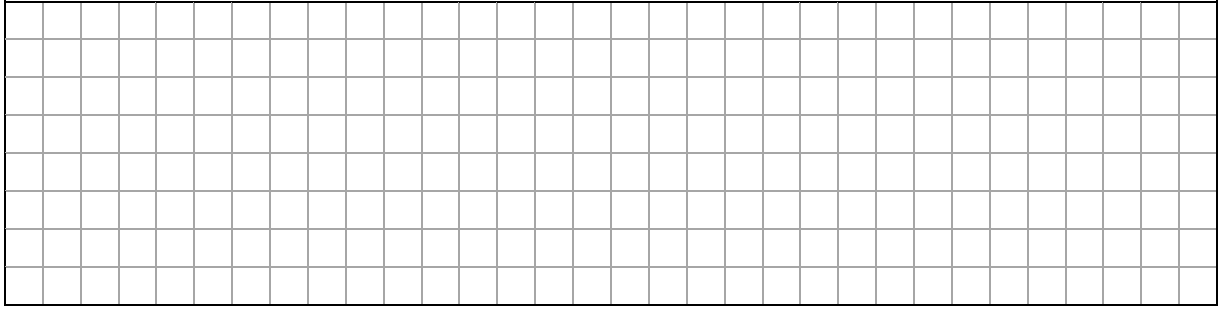**(i)** Find the co-ordinates of $O$, the centre of circle $s$.

$A(-2, 7)$

$B(6, 1)$
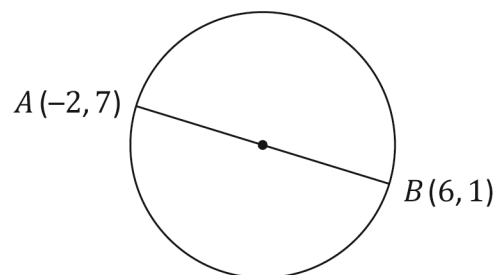
**(ii)** Find the length of the radius of circle $s$.

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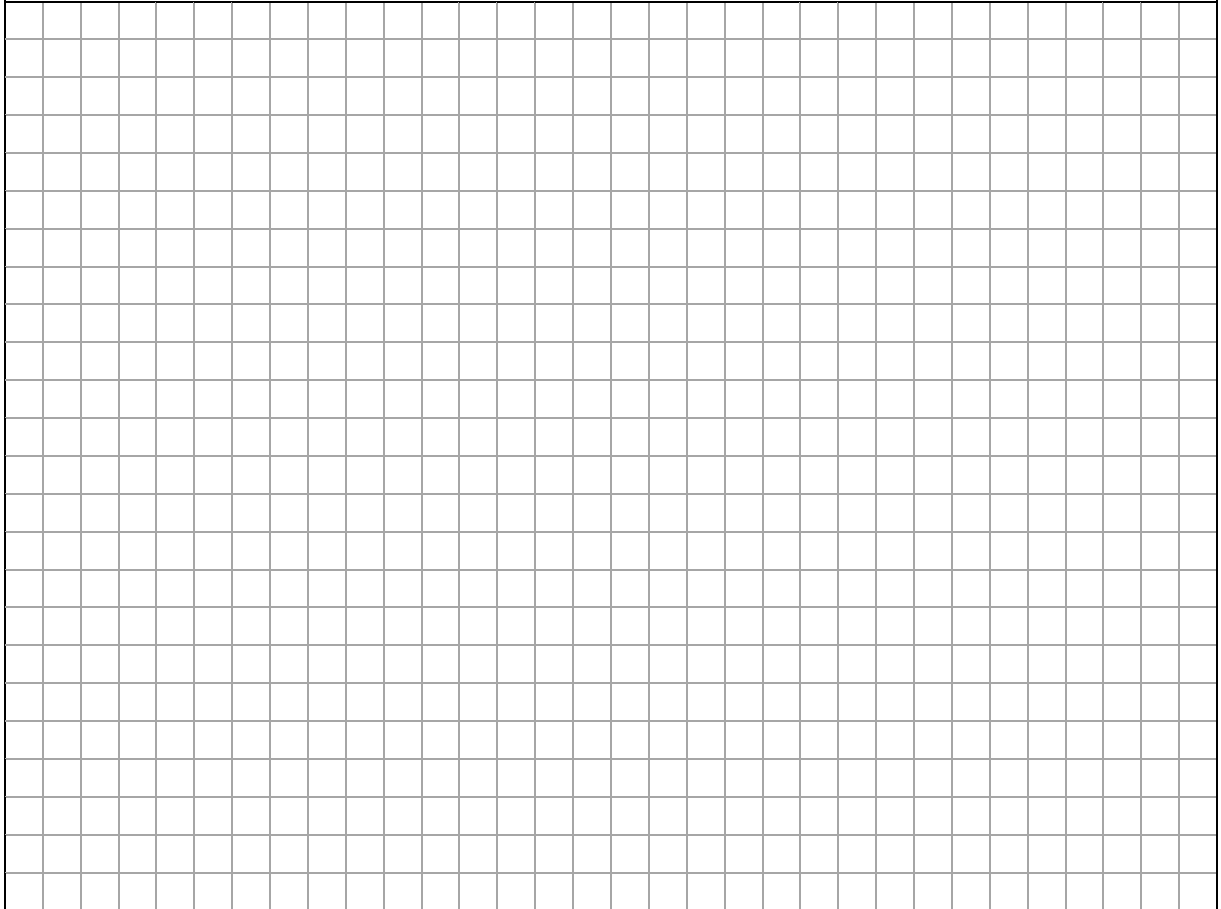
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**(iii)** Hence, write down the equation of circle $s$.

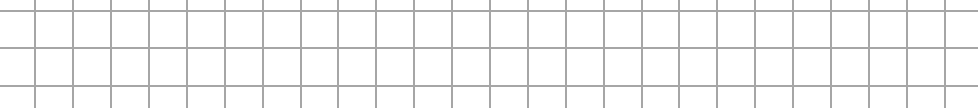**(iv)** Find, using algebra, the co-ordinates of the two points at which circle $s$ cuts the $x$-axis.

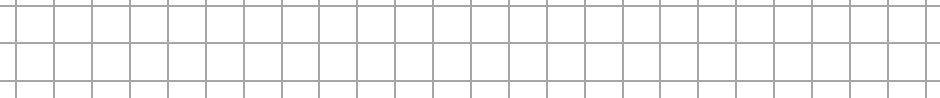**Question 4** **(30 marks)**

**(a)** The letters of the word NUMERACY are arranged at random.
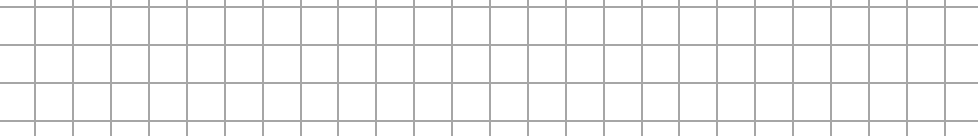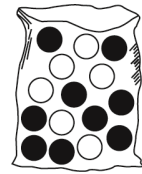
**(i)** How many different arrangements are possible?

**(ii)** How many of these arrangements begin **and** end with a vowel (U, E or A)?

**(iii)** How many of these arrangements do **not** begin with the letter N?

**(b)** A bag contains 9 black discs and 6 white discs.
Two discs are drawn at random from the bag and **not replaced**.
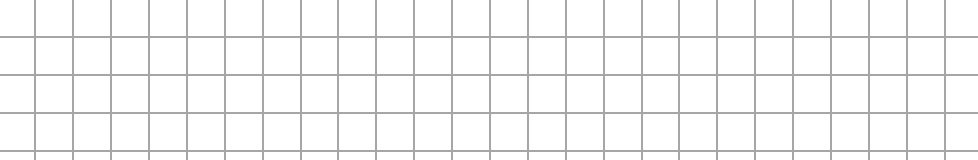
Find, as a fraction, the probability that:

**(i)** the first disc drawn is black;
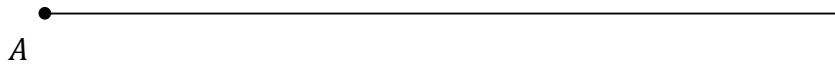
**(ii)** both discs drawn are black;

**(iii)** the two discs drawn are different colours.

**Question 5**                                                              **(30 marks)**

**(a)**   **(i)**   Construct the triangle $ABC$, where $|AB| = 9$ cm, $|AC| = 7$ cm and $|\angle CAB| = 60°$.
                The point $A$ is given to you, as is part of the line $AB$.
                Show all your construction lines and arcs clearly.
                Label each vertex clearly.

$A \bullet \!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-\!\!\!-$

**(ii)**   Measure $|\angle ABC|$, and give your answer correct to the nearest degree.

**(iii)**   Explain why you would expect this angle to be the smallest angle in triangle $ABC$.

**(b)** The triangle $ORS$ is the image of the triangle $OPQ$ under an enlargement.
(The diagram is not drawn to scale.)
$ORS$ is a right-angled triangle.
$|OP| = 6$ cm, $|PR| = 9$ cm, $|RS| = 12$ cm
and $|\angle RSO| = 90°$.

Draft diagram



**(i)** Show that the scale factor of the enlargement, $k$, is 2·5.

**(ii)** Using the Theorem of Pythagoras, find $|OS|$ **and** hence, show that the area of the triangle $ORS$ is 54 cm².

$|OS| = $ _____

**(iii)** Hence, work out the area, in cm², of the triangle $OPQ$.

Area of triangle $OPQ = $ _____

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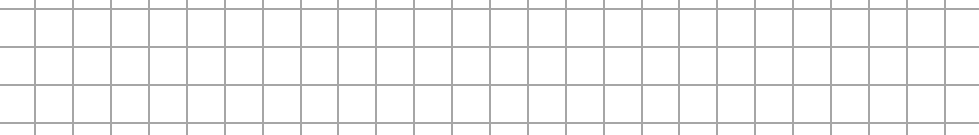
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**Question 6** **(30 marks)**

A community group has created an open-space area, *ABCD*, in the shape of a square.
The space has four equal right-angled triangular flowerbeds and a central patio, *PQRS*,
also in the shape of a square, as shown in the diagram below (not to scale).
The vertices of *PQRS* lie on the perimeter of *ABCD*, with $|AP| = 10$ m and $|PB| = 24$ m.



Draft diagram
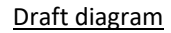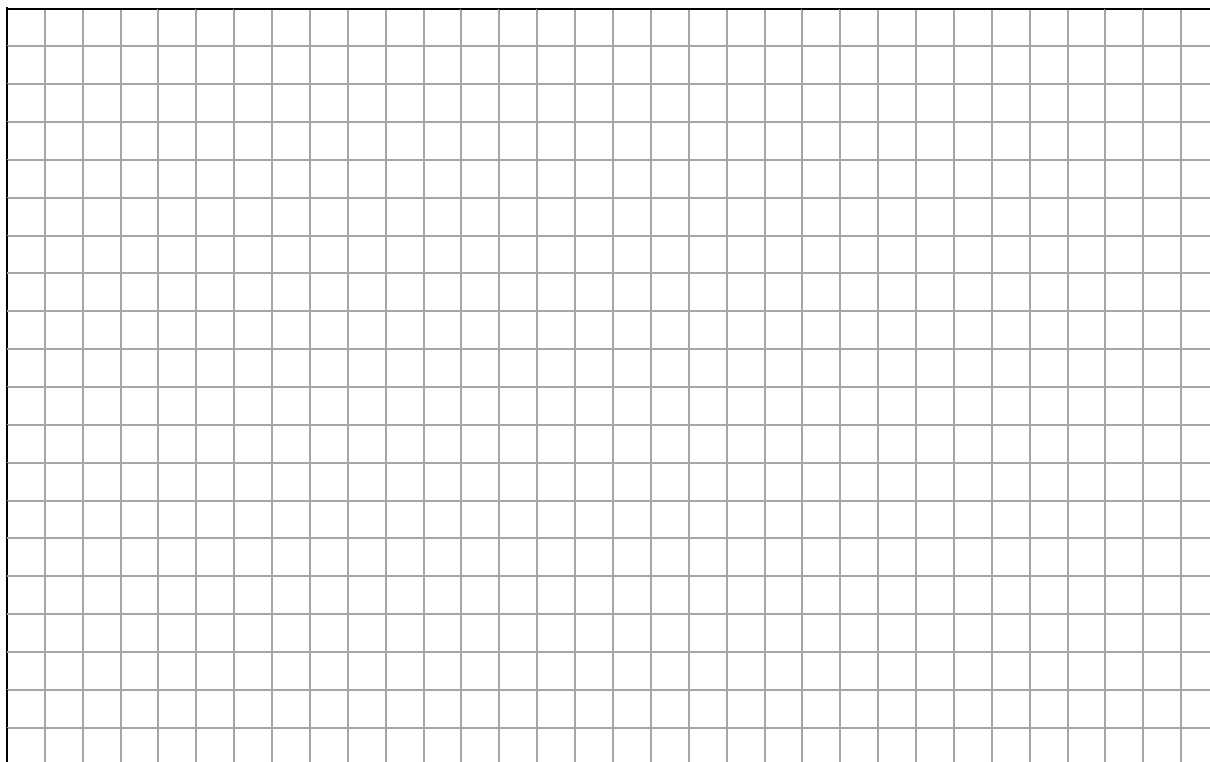
**(a)** **(i)** Work out the area, in m², of the square *ABCD*.

**(ii)** Find the length of the hypotenuse of the right-angled triangle *BQP*.

**(iii)** Hence, find the area, in m², of the central patio, *PQRS*.

**(b)** The central patio is to be covered with rectangular flagstones measuring 80 cm by 50 cm.

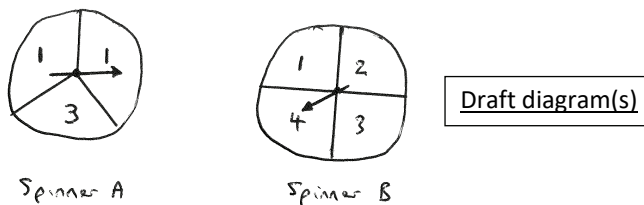Work out how many flagstones are required to cover the patio, allowing an extra 20% for waste.

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

**Question 7**                                                                                      **(50 marks)**

**(a)**   A game uses two unbiased circular spinners, as shown below.
          The spinners are spun at the same time, and the numbers that the arrows stop at are recorded.



Draft diagram(s)

Spinner A          Spinner B

**(i)**   Complete the table below to show all the possible outcomes.  One is already given.
          For example, (3, 1) means that spinner **A** stopped at 3 and spinner **B** stopped at 1.

|  |  | Spinner A | | |
|---|---|---|---|---|
|  |  | **1** | **1** | **3** |
| Spinner B | **1** |  |  | (3, 1) |
|  | **2** |  |  |  |
|  | **3** |  |  |  |
|  | **4** |  |  |  |

The two numbers that the arrows stop at on the spinners are then added to give the score.
Each outcome in the table above is equally likely.

**(ii)**   Work out the probability that the **sum** of the two numbers is less than 4.

**(iii)**   The arrow on spinner **B** stops at 3.

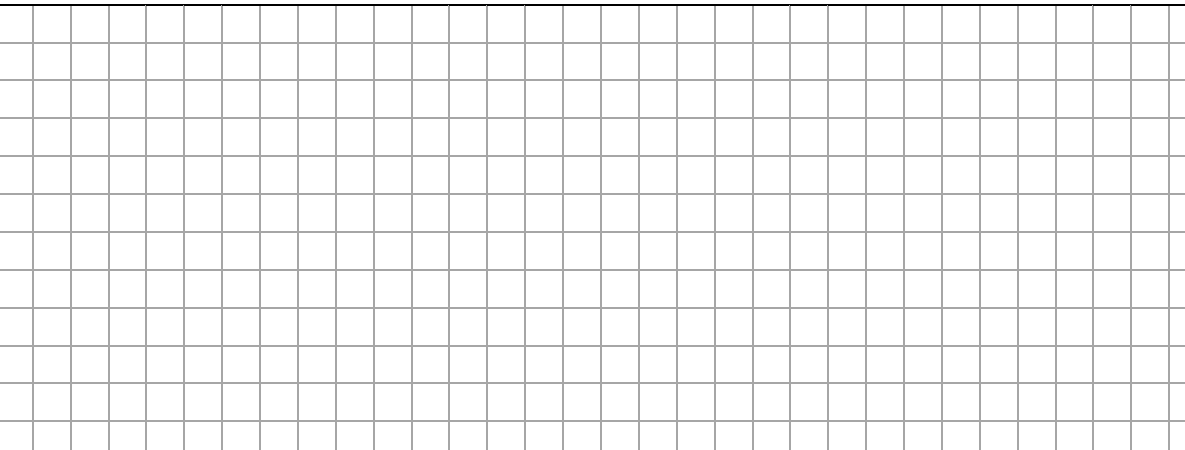          Work out the probability that the **sum** of the two numbers is 4.

**(iv)** Find the probability that the **sum** of the two numbers is a prime number.

**(v)** It costs €2 to play the game each time.
The amount of money won depends on the outcome:

- Win €10 for a score of 7;

- Win €2 for a score of 4, 5 or 6;

- Lose for a score of less than 4.

Is this game **fair**? Justify your answer.
Work out the **expected value** of this game as part of your solution.

Expected value:

Is this game fair?

Justification:

*This question continues on the next page.*

**(b)** A nationwide survey was carried out to investigate the popularity of electric and plug-in hybrid vehicles in Ireland in 2024.

**(i)** A random sample of 800 motorists responded to the survey.

Show that the margin of error for this survey is 3·54%, correct to 2 decimal places.

**(ii)** 68% of the sample indicated that they would consider buying an electric or plug-in hybrid vehicle when purchasing their next vehicle.

Work out the number of motorists in the sample who said that they would consider buying an electric or plug-in hybrid vehicle.

**(iii)** Use the percentages given in **parts (b)(i)** and **(b)(ii)** to write down a 95% confidence interval for the percentage of motorists in Ireland in 2024 who said that they would consider an electric or plug-in hybrid vehicle when buying their next vehicle.

**(iv)** According to a similar survey conducted by the Society of the Irish Motor Industry (SIMI) in 2021, 74% of motorists indicated that they would consider an electric or plug-in hybrid vehicle when buying their next vehicle.

Carry out a Hypothesis Test, at the 5% level of significance, to find out if this figure has changed since 2021, based on the results of the more recent survey. Clearly state your null hypothesis, your alternative hypothesis, give your conclusion in the context of the question **and** suggest a reason for your conclusion.

Null hypothesis:                    Alternative hypothesis:

Conclusion:

Reason:

**(v)** The most recent figures released by the Central Statistics Office (CSO) show that, in 2023, 19% of all new cars purchased in Ireland were electric vehicles.
Four owners of new cars purchased in 2023 are picked at random.

Find the probability that exactly one of these people purchased an electric vehicle. Give your answer as a percentage, correct to 2 decimal places.

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

The diagram below shows the outline of a ski lift system from point $A$, at the bottom of a mountain, to point $C$, at the top of the mountain (not to scale).

The system comprises two ski lifts, from point $A$ to an intermediate point $B$ and then from there to point $C$.

The altitudes (heights above sea level) of points $A$ and $C$ are 650 m and 2727 m, respectively.

The following measurements were also recorded on site:

$\quad |AB| = 1500$ m,
$\quad |BC| = 1725$ m,
$\quad |\angle BAD| = 33°,$
$\quad |\angle ADB| = 90°$ and
$\quad |\angle AEC| = 90°.$

Draft diagram

1725 m

$h_2$

2727 m

$\alpha$

1500 m

$h_1$

33°

$A$

$D$

$E$

$B$

650 m
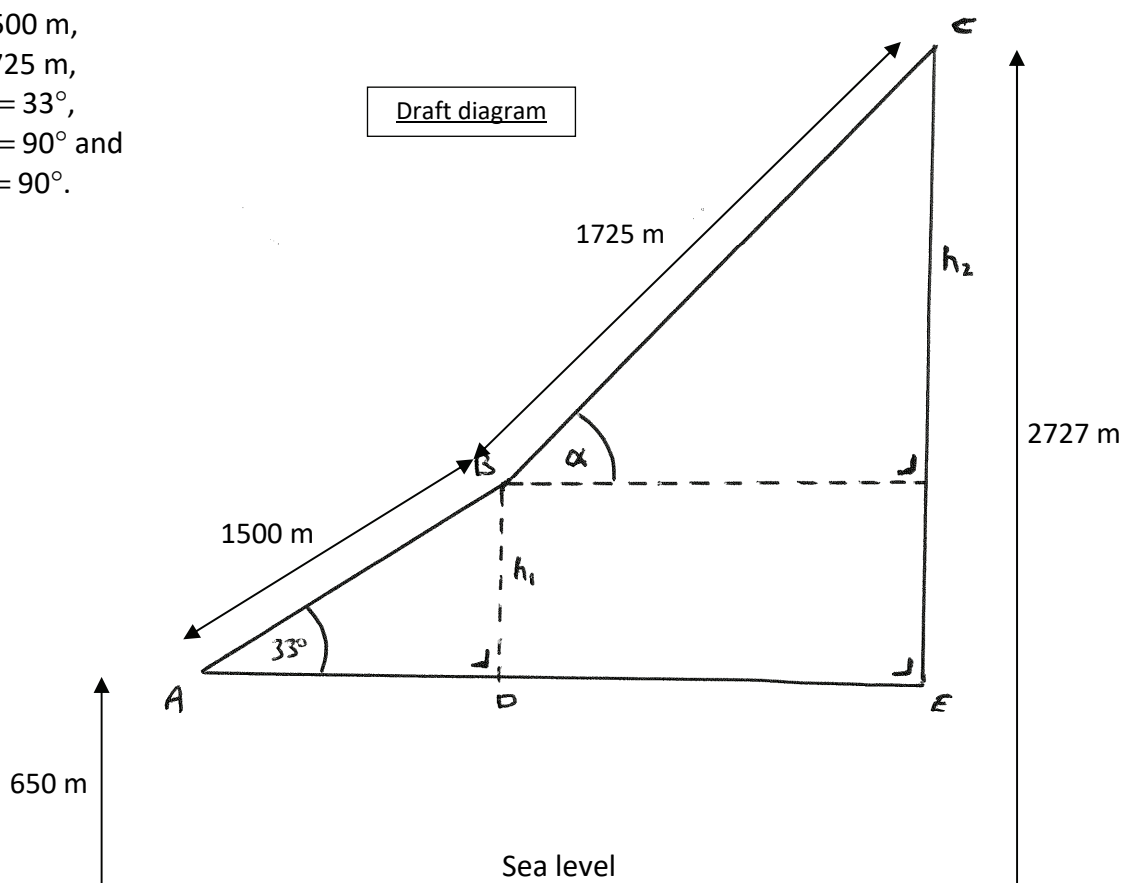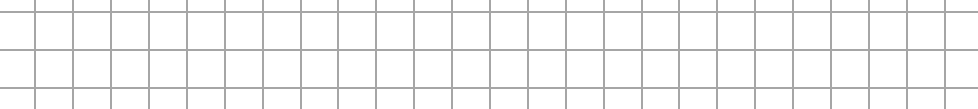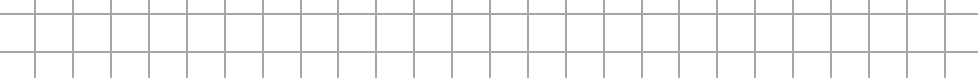
Sea level

**(a)**   **(i)**   Work out $h_1$, the elevation gain of the first ski lift, between points $A$ and $B$.
Give your answer correct to the nearest metre.

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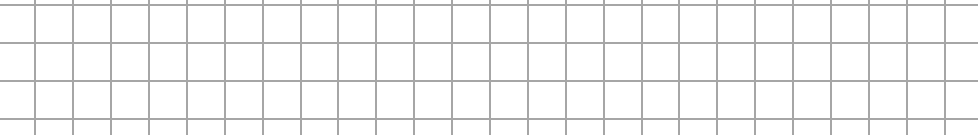
**(ii)** Work out the altitude (height above sea level) of point $B$.
Give your answer in metres.

**(iii)** Hence, work out $h_2$, the elevation gain of the second ski lift, between points $B$ and $C$.
Give your answer in metres.

**(iv)** Find $\alpha$, the angle of elevation of point $C$, at the top of the mountain, from point $B$.
Give your answer correct to the nearest degree.

*This question continues on the next page.*

**(b)** A new, direct ski lift from point $A$ to point $C$ is proposed, as shown in the diagram below (not to scale).
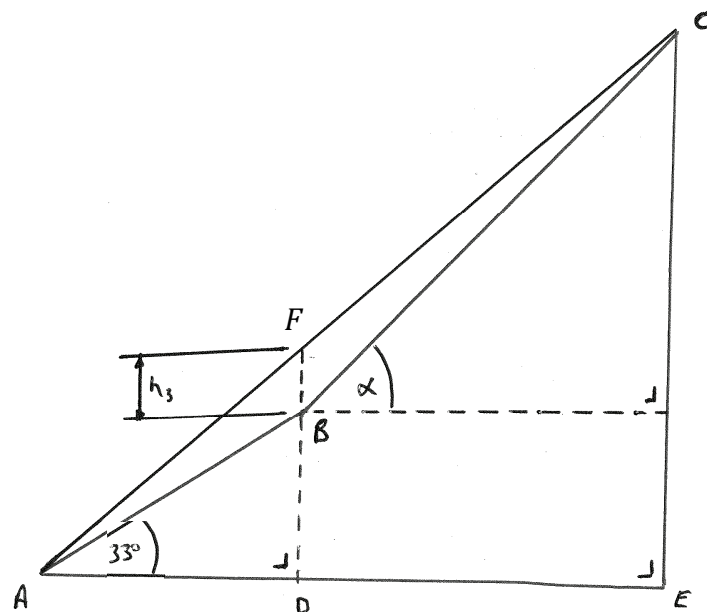


Draft diagram

**(i)** Show that $|\angle ABC|$, the size of the obtuse angle $ABC$, is $166°$.
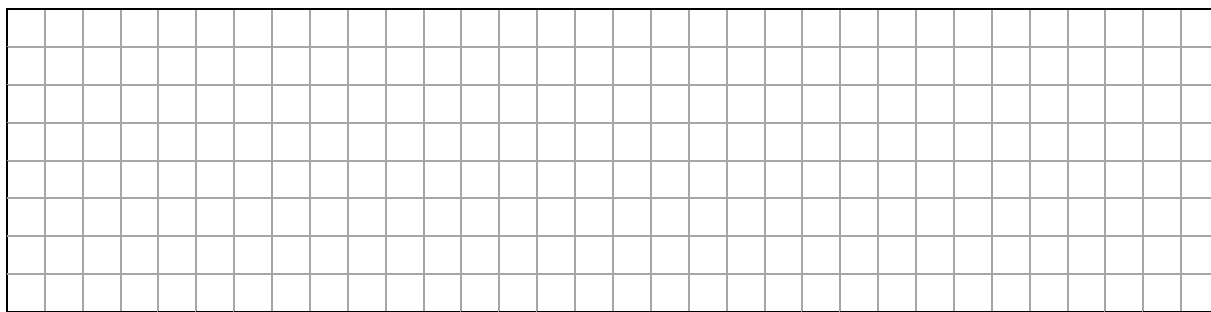
**(ii)** Consider the triangle $ABC$.

Use the Cosine Rule to work out the length of $[AC]$.
Give your answer correct to the nearest metre.
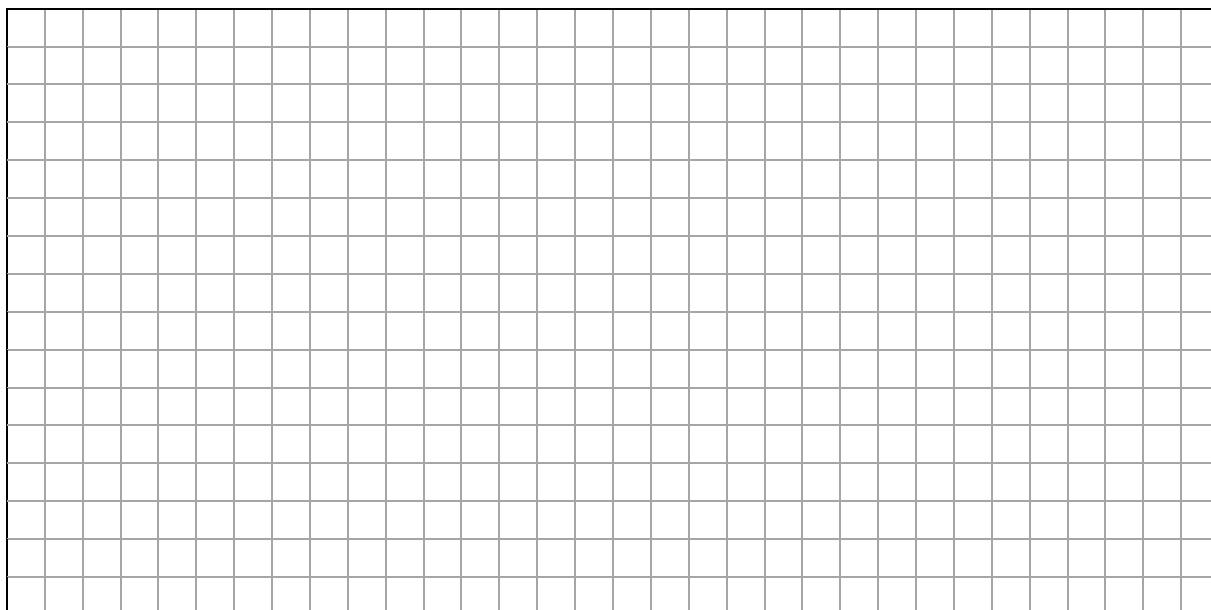
**(iii)** Consider again the triangle $ABC$.

Use the Sine Rule to find $|\angle CAB|$, the size of the angle $CAB$.
Give your answer in degrees, correct to 1 decimal place.
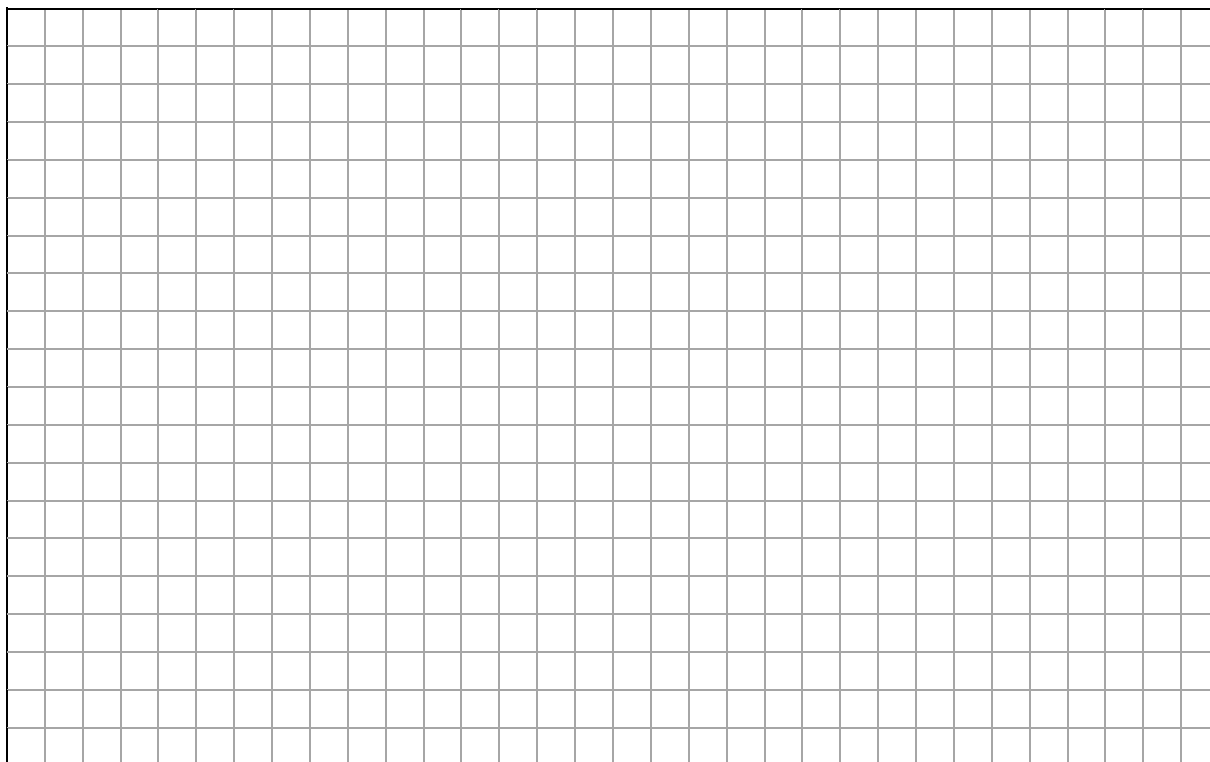
**(iv)** Hence, find $h_3$, the elevation of the new ski lift above point $B$ as it passes over that point.
Give your answer correct to the nearest metre.

Note that the line segment $[DB]$ is extended to point $F$ and $h_3 = |FB|$, as shown.

**Question 9** (50 marks)

A wind turbine, used to generate electricity, has three equally spaced blades, which are 52 m in length. When the turbine is operating normally, the blades rotate at a constant speed.

The diagram below shows the pathway of each of the blades, $A$, $B$, and $C$, of the turbine.



Draft diagram(s)

**(a)** On a particular day, the blades rotate 12 times per minute.

**(i)** Find the distance travelled by the tip of each blade in one full revolution.
Give your answer in metres, correct to 2 decimal places.

**(ii)** Work out the time taken for each blade to complete one revolution **and** hence, find the speed of the blade tips in m/s, correct to 1 decimal place.

**(iii)** The wind turbine shuts down when the speed of the blade tips reaches 76 m/s.

Find the number of **full** revolutions per minute that each blade must complete to exceed this limit.

**(b)** The blades are mounted on a tower, which is 72 m in height, as shown in the diagram below.



**(i)** Work out the maximum **and** minimum heights above ground level that the tip of blade $A$ reaches.

Maximum height = _____     Minimum height = _____

*This question continues on the next page.*

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**(ii)** Find the height of the tips of the other blades, $B$ and $C$, above ground level when the tip of blade $A$ is closest to the ground.

Note that the blades are equally spaced.
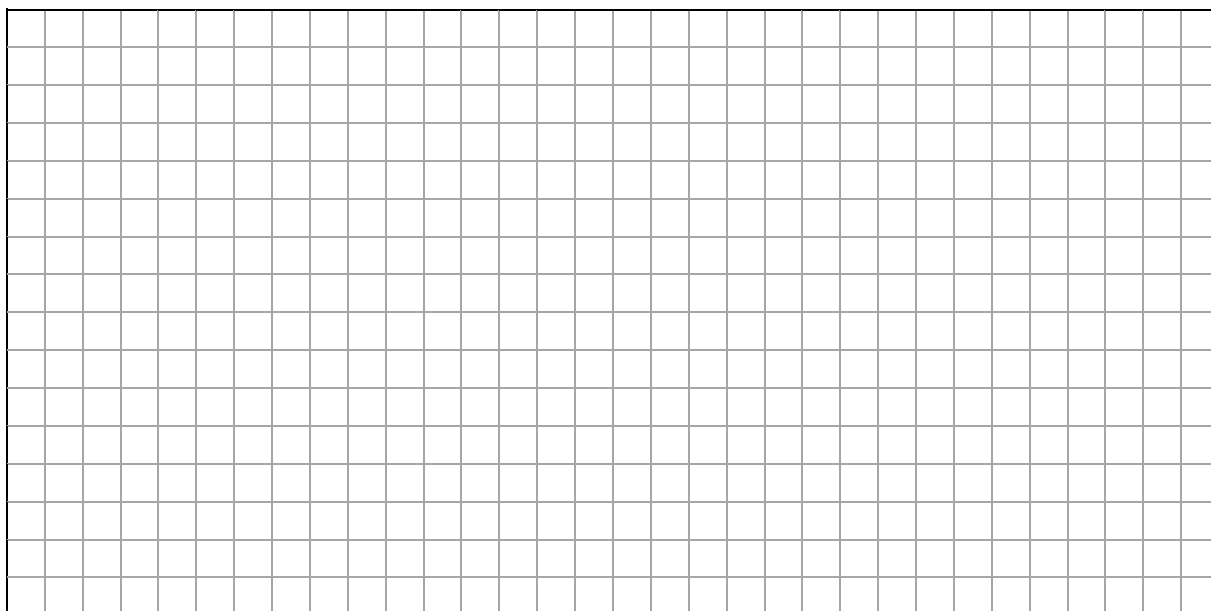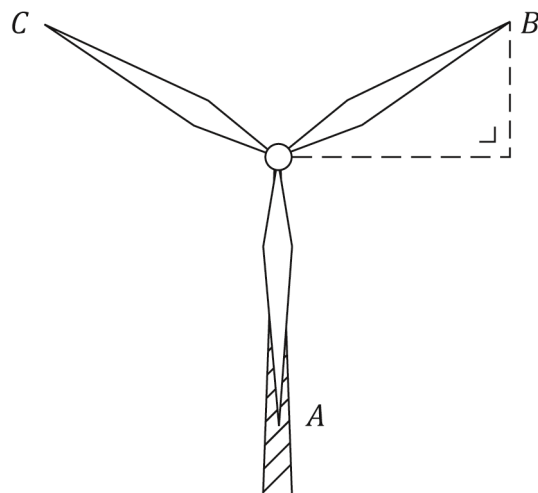
**(c)** The power ($P$) generated by a wind turbine is measured in watts (W) using the formula:

$$P = 0.61\pi R^2 V^3,$$

where $R$ is the length of each blade in metres and $V$ is the wind speed in m/s.

**(i)** Find the power generated by a wind turbine which has three equally spaced blades, 52 m in length, when the wind speed is 10 m/s.
Give your answer in megawatts (MW), where 1 MW = $10^6$ watts, correct to 1 decimal place.

**(ii)** Find the wind speed required for the turbine to generate 8·954 MW in power.
Give your answer in m/s, correct to the nearest whole number.

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**Question 10** **(50 marks)**

A new water trough for cattle needs to hold a minimum of 2000 litres of water.

The trough has a uniform cross-section and is 3 m in length, as shown in **Figure 1**.

The cross-section of the trough is a trapezium $ABCD$, as shown in **Figure 2**.
The height of the trough is 0·6 m.
$|AB| = 1·1$ m, $|DC| = 2$ m and $|AD| = |BC|$.

The trough is made of sheet metal and the inside of the trough is lined with a membrane
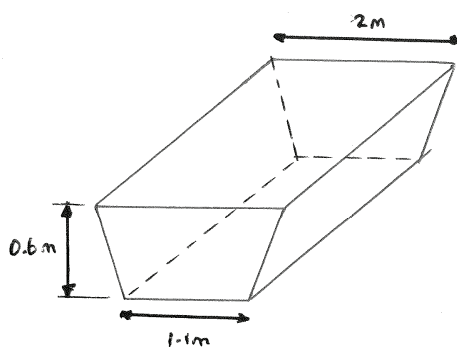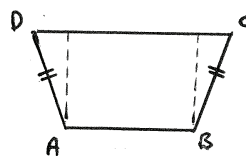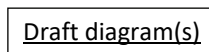to prevent leakage.



Figure 1          Figure 2

**(a)** **(i)** Work out the area of the **trapezium** $ABCD$.
Give your answer in m², correct to 2 decimal places.

**(ii)** Use the Theorem of Pythagoras to find the length of side $[AD]$.
Give your answer in metres, correct to 2 decimal places.

**(iii)** Find the **total area** of sheet metal required to make the water trough.
Give your answer in m², correct to 2 decimal places.
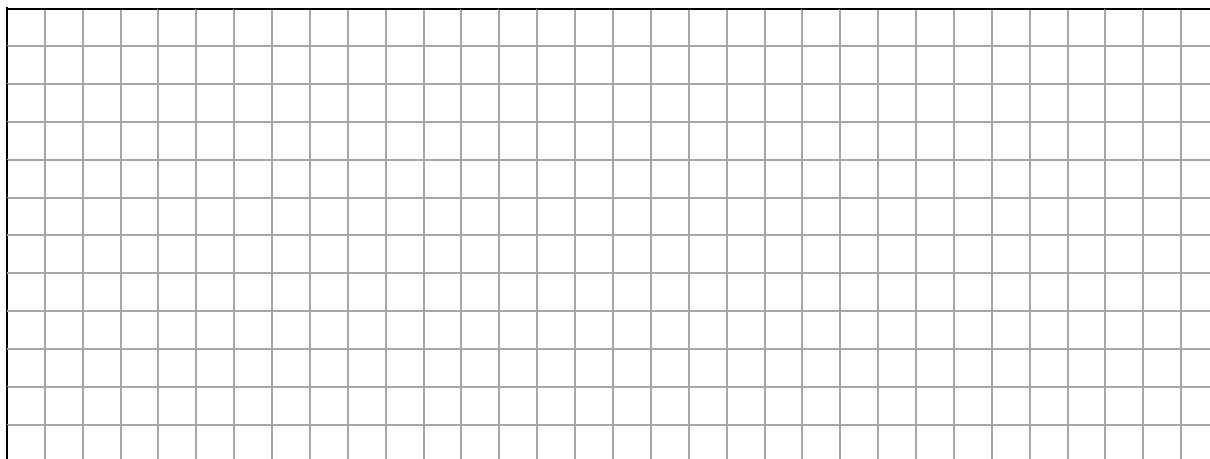
**(iv)** The sheet metal costs €65 per square metre, and the membrane to line the trough costs €12 per square metre. The adhesive used to attach the membrane to the inside of the trough costs €50. VAT at 23% is included in these prices.

Find the **total cost** of the materials required **before** VAT is included.
Give your answer correct to the nearest cent.
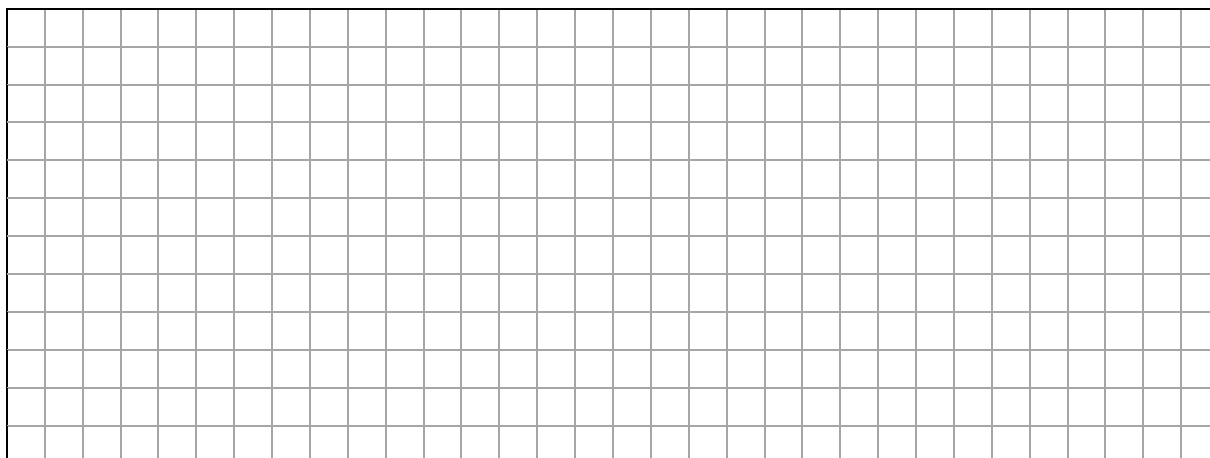
**(b)** **(i)** Using your answer to **part (a)(i)**, or otherwise, find the capacity (volume) of the water trough.
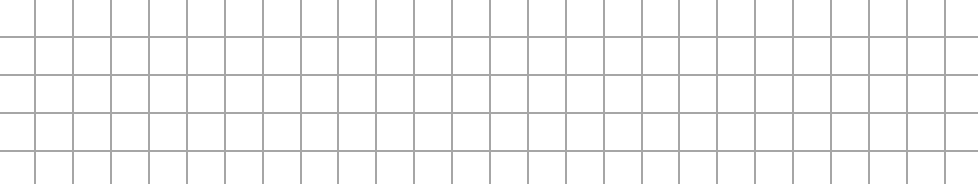Give your answer in litres. [Note: 1 m³ = 1000 litres.]
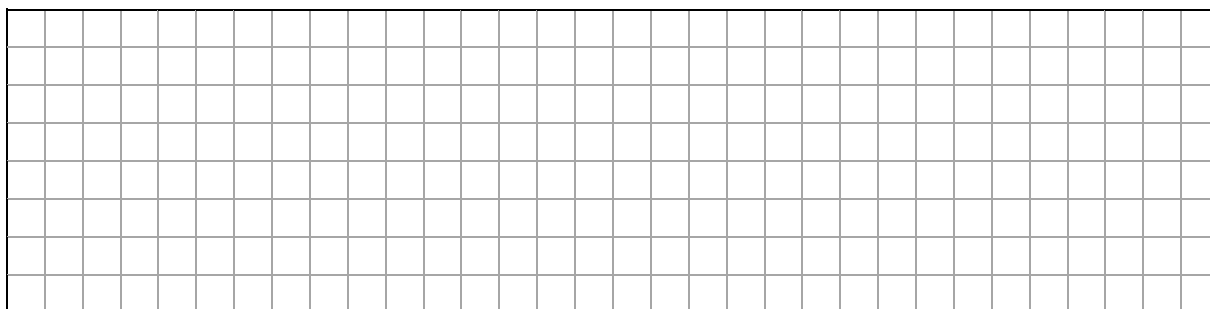
*This question continues on the next page.*

**(ii)** What percentage of the water trough needs to be filled to satisfy the minimum requirement of 2000 litres?
Give your answer correct to the nearest percent.

**(iii)** The trough is filled by a cylindrical pipe of radius 2·5 cm, through which water flows at a constant rate of 20 cm/s.

Work out the volume of water that flows into the trough in 1 minute.
Give your answer in cm³, correct to 2 decimal places.

**(iv)** Find the time it takes to fill an **empty** water trough up to the minimum requirement.
Give your answer in minutes and seconds. [Note: 1 litre = 1000 cm³.]

You may use this page for extra work.
Label any extra work clearly with the question number and part.

| Q. & part | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Do not write on this page

Pre-Leaving Certificate Examination, 2025

# Mathematics – Ordinary Level – Paper 2

Time: 2 hours, 30 minutes