Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022

Mathematics

Unit M8 Paper 2
(With calculator)
Higher Tier

[GMC82]

GMC82

MONDAY 13 JUNE, 10.45am–12 NOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

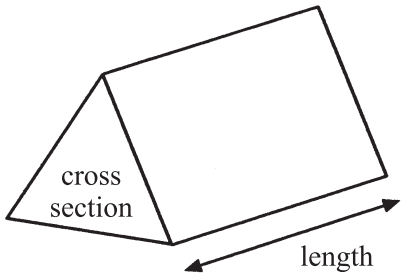
Write your Centre Number and Candidate Number in the spaces provided at the top of this page. **You are provided with Higher Tier Additional Support Materials for use with this paper.**
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all eleven** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

INFORMATION FOR CANDIDATES

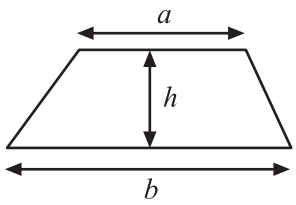
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

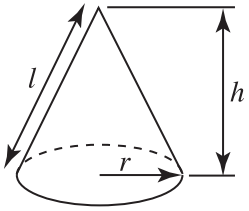


Area of trapezium = $\frac{1}{2}(a+b)h$



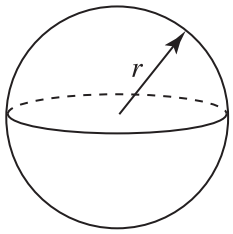
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

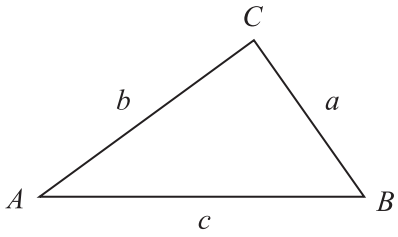


Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$

1 The equation $x^3 - 3x = 34$ has a solution between 1 and 5

Use a trial and improvement method to find this solution.

Give your answer correct to one decimal place.

You must show ALL your working.

x	$x^3 - 3x$	

Answer x = _____ [4]

[Turn over

2 **(a)** When a spinner was spun 50 times, it landed on red 12 times.
When spun another 50 times, it landed on red another 9 times.

Calculate the relative frequency for red

(i) after the first 50 spins,

Answer _____ [1]

(ii) after the 100 spins.

Answer _____ [1]

(b) When spun another 50 times the spinner landed on red another 9 times.

What value of relative frequency gives the best estimate of the probability of this spinner landing on red?

Explain your answer.

Answer _____ because _____

_____ [2]

(c) The spinner landed on yellow 40 times in the first 100 spins.

(i) Estimate the probability for this spinner landing on yellow.

Answer _____ [1]

(ii) Estimate how many times the spinner will land on yellow in 300 spins.

Answer _____ [1]

3 A **solid** cone has a vertical height of 12 cm, a slant height of 13 cm and a base radius of 5 cm.

Work out the **total** surface area of the cone, leaving your answer in terms of π

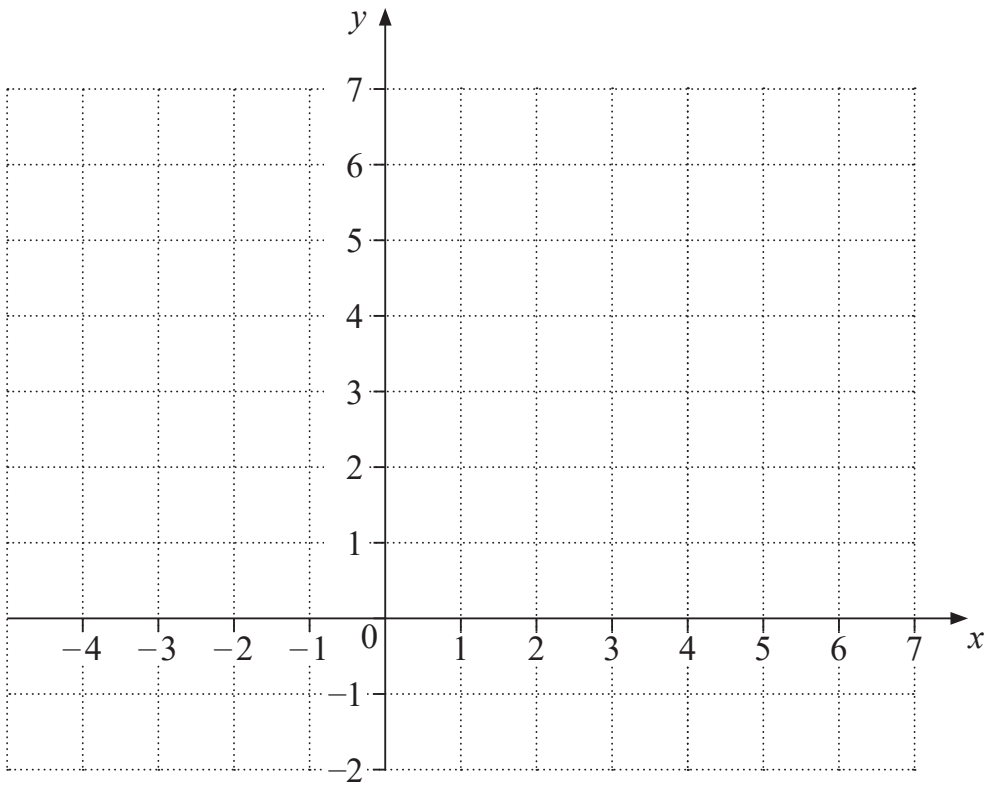
Answer _____ cm^2 [2]

[Turn over

4 The following linear inequalities represent a closed region.

$$x + y \geqslant 3$$
$$2y - x \geqslant 4$$
$$y \leqslant 5$$

(a) By drawing straight lines and shading, show this region on the grid below. Label the region R.



[3]

(b) Hence work out the maximum value of $3x + 2y$ in this region.

Answer _____ [2]

5 A book club offers 26 **different** books for sale.

Five of the books cost £3 each
Six of the books cost £4 each
Seven of the books cost £6 each
Eight of the books cost £7 each.

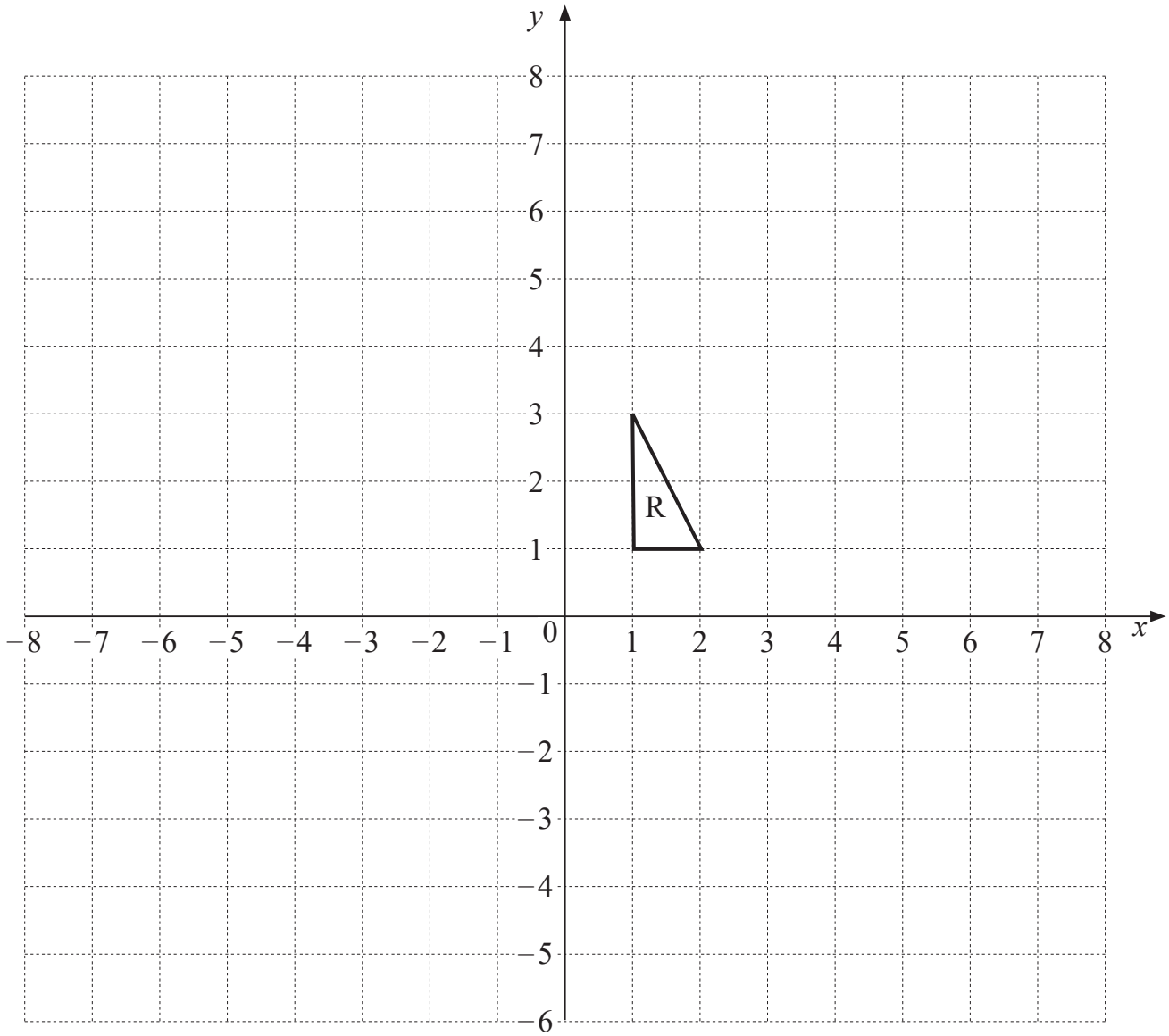
Abi wants to buy two books for exactly £10

How many combinations of books can she choose from?

Answer _____ [2]

[Turn over

6



(a) Triangle R is reflected in the line $y = -1$ and its image rotated 90° clockwise about the point $(1, -1)$

Draw the final image after these two transformations and label it S. [4]

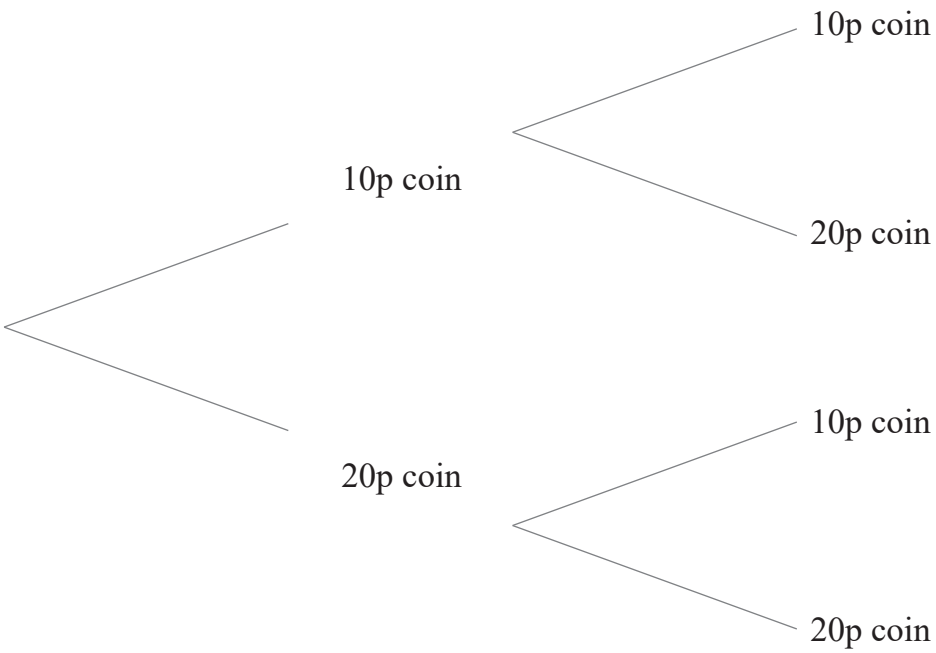
(b) Describe fully the single transformation which maps R to S.

Answer _____ [2]

7 A box contains five 10p coins and four 20p coins.

One coin is taken at random from the box and not replaced. A second coin is taken at random from the box.

(a) Complete the tree diagram below.



[3]

(b) What is the probability that the two coins taken have the same value as each other?

Answer _____ [2]

(c) What is the probability that at least 30p is taken?

Answer _____ [2]

[Turn over

8 A container of radioactive waste, with an initial radioactivity of 100, is buried deep underground.

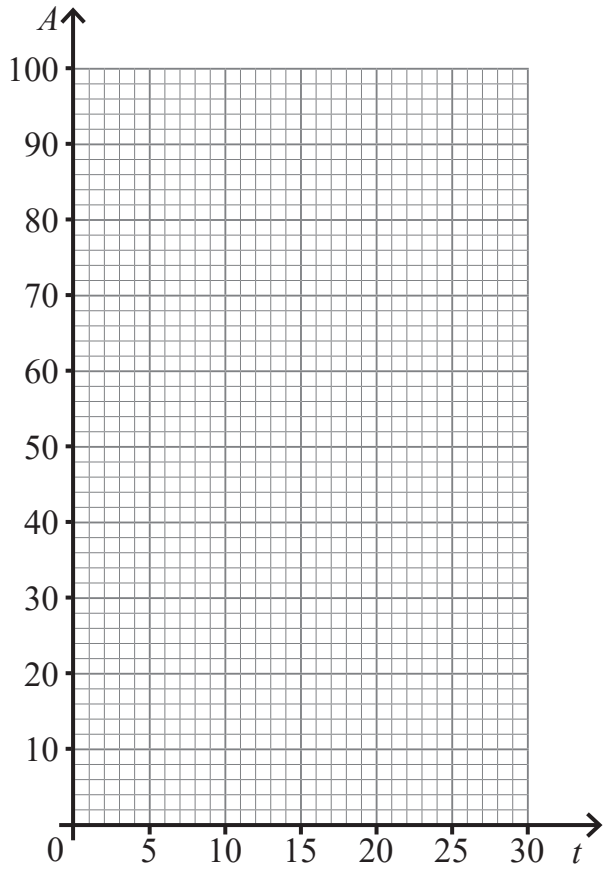
It decays by 5% each year.

After t years, its radioactivity A is given by the equation

$$A = 100 \times 0.95^t$$

(a) Complete the following table and use it to draw the graph of A against t on the grid below.

t	0	5	10	15	20	25	30
A							



[4]

(b) The half-life of a radioactive substance is defined as the time taken for the radioactivity of the material to decay to half its initial value.

Use your graph to estimate the expected half-life of this container of radioactive waste.

Answer _____ years [1]

9 Simplify

(a) $(3a^5 b^{-1})^3$

Answer _____ [2]

(b) $\dfrac{x^{\frac{1}{2}}}{x^{\frac{3}{2}}}$

Answer _____ [1]

[Turn over

10 B is 30 km East and 20 km North of A.
C is 40 km from B and 60 km from A.

Calculate the bearing of C from B.

A solution by scale drawing will not be accepted.

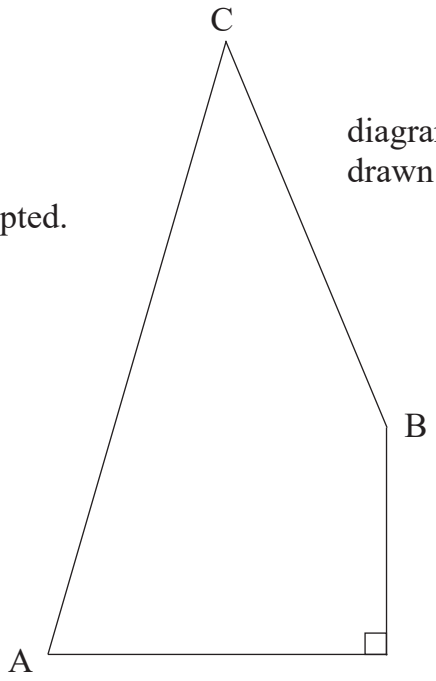


diagram not drawn accurately

Answer _____° [7]

11 **A** y is directly proportional to x

B y is directly proportional to x^2

C y is directly proportional to $\sqrt{x}$

D y is indirectly proportional to x

E y is indirectly proportional to x^2

(a) Which of the cases **A**, **B**, **C**, **D** or **E** leads to each statement below?

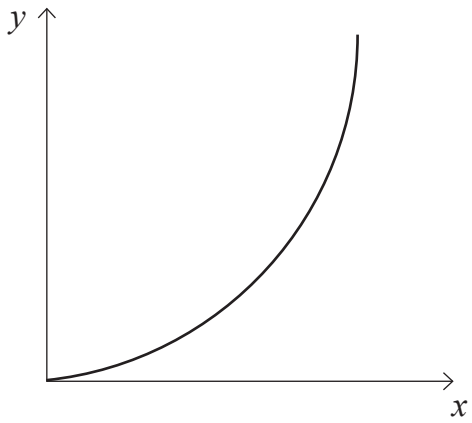
If x is halved, y is halved, Answer _____

If x is halved, y is doubled, Answer _____

If x is halved, y is four times as large. Answer _____

[2]

(b) Which of **A**, **B**, **C**, **D** or **E** is represented by the sketch graph below?



Answer _____ [1]

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
Total Marks	

Examiner Number

Rewarding Learning

General Certificate of Secondary Education
Summer 2022

GCSE Mathematics

HIGHER TIER
ADDITIONAL SUPPORT MATERIALS
(For use in Summer 2022)

HIGHER TIER ADDITIONAL SUPPORT MATERIALS (Summer 2022)

Numbers

Lowest common multiple (LCM): The lowest common multiple is the lowest multiple shared by 2 or more numbers.

Trial and Improvement

This is a method of trying different values in an equation until you get a suitable solution (e.g to 1 decimal place).

Metric units

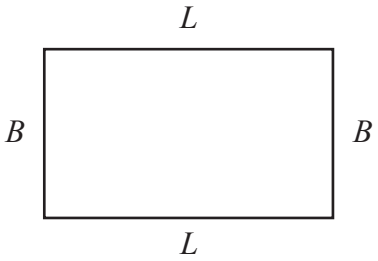
$1 \text{ ml} = 1 \text{ cm}^3$

Compound Measures

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

Perimeter, Area and Volume



The perimeter of a rectangle is the distance around the outside of the rectangle. It is found by adding the lengths of the 4 sides of the rectangle.

$P = 2L + 2B$ where P is perimeter, L is length and B is breadth.

The area of a rectangle is found by multiplying the length of the rectangle by the breadth.

$A = L \times B$ where L is length and B is breadth.

The volume of a cuboid is found by multiplying the length by the breadth by the height of the cuboid.

$V = L \times B \times H$ where V is volume, L is length, B is breadth and H is height.

The area of a circle is $A = \pi r^2$ where r is the radius of the circle.

The circumference (perimeter) of a circle is $C = 2\pi r$ where r is the radius of the circle. An alternative formula is $C = \pi d$ where d is the diameter of the circle.

Mid point of a line

If (x_1, y_1) and (x_2, y_2) are the end points of a line, then the coordinates of the midpoint M of the line are

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Gradient of a line

If (x_1, y_1) and (x_2, y_2) are two points on a line, then the gradient m of the line is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Lines

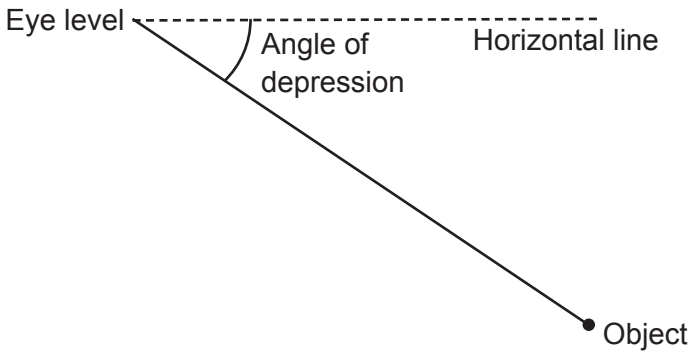
Parallel lines have the same gradient.

If a straight line has gradient m, then a line which is perpendicular to this line has a gradient $-\frac{1}{m}$

Geometry and Angles

There are 180° on a straight line.
There are 180° inside a triangle.
An isosceles triangle is a triangle with 2 equal sides and 2 equal angles.
The sum of all the angles inside a polygon is given by $180(n - 2)$ where n is the number of sides in the polygon.

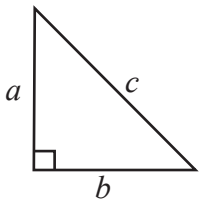
Angle of depression
If a person stands and looks down at an object, the **angle of depression** is the angle between the horizontal line of sight and the object.



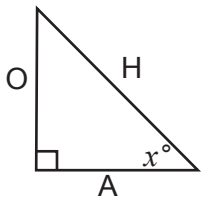
Pythagoras' Theorem

If *a, b* and *c* are the sides of a right angled triangle shown below, then

$$a^2 + b^2 = c^2$$



Trigonometric ratios in right angled triangles



$\sin x° = \frac{O}{H}$ $\cos x° = \frac{A}{H}$ $\tan x° = \frac{O}{A}$

Tangent/Radius property

The tangent to a circle is perpendicular to the radius at the point of contact with the circle.

Alternate Segment Theorem
In a circle, the angle between a chord and a tangent through one of the end points of the chord is equal to the angle in the alternate segment.

Range
The range of a set of data is the difference between the largest value and the smallest value in the data set.

Mean

The mean of a set of data is the sum of all the data values divided by the number of data values.

Estimate for the mean of a grouped frequency distribution

Estimated mean = sum of (mid interval values multiplied by their frequency) divided by the sum of all the frequencies.

Pie Chart

In a pie chart, the total angle that corresponds to the entire data set is 360°

Probability

The sum of the probabilities of all outcomes equals 1

Frequency density in histograms

$\text{Frequency density} = \frac{\text{Frequency}}{\text{Class width}}$