



General Certificate of Secondary Education
2023

Centre Number

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Candidate Number

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Mathematics

Unit M8 Paper 2
(With calculator)

Higher Tier



[GMC82]

GMC82

WEDNESDAY 7 JUNE, 10.45 am–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 thirteen** 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.

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Formula Sheet

Volume of prism = area of cross section \times length

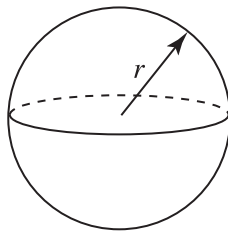


Area of trapezium = $\frac{1}{2}(a+b)h$



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

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

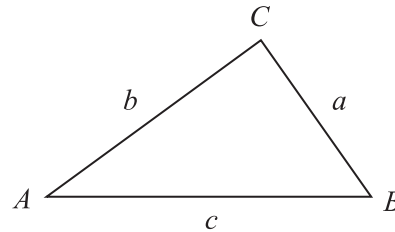


Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$



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 (a) Simplify $y^8 \div y^2$

Answer _____ [1]

(b) Solve the inequality $7x > 3x - 12$

Answer _____ [2]

2 (a) Write the decimal number 19 as a binary number.

Answer _____ [1]

(b) Rearrange $h - 3m = y$ to make m the subject.

Answer _____ [2]

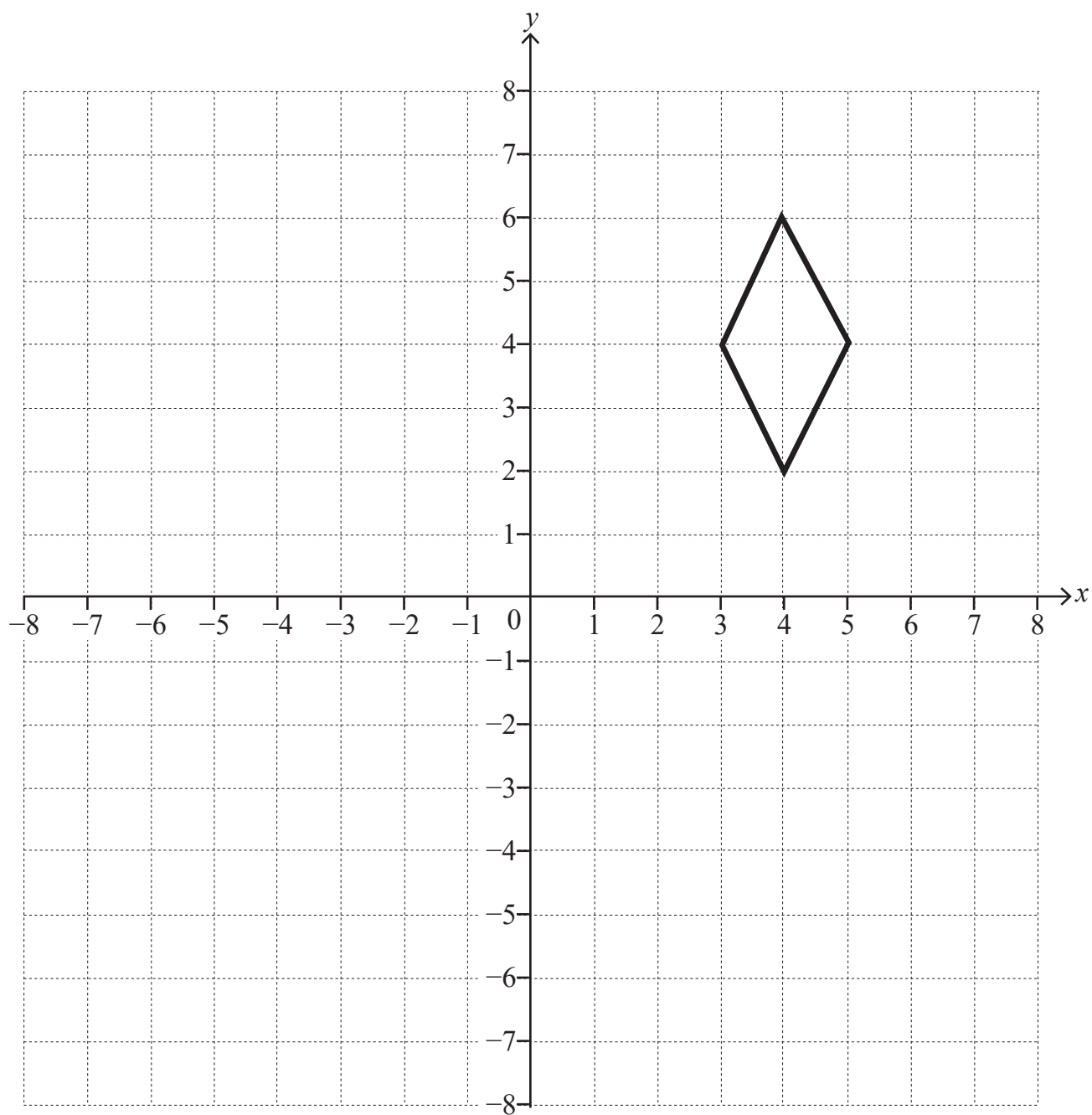
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3 Rotate the shape 90° anticlockwise about $(0, -2)$



[2]



4 A regular polygon has exterior angles of size 15°

(a) How many sides has the polygon?

Answer _____ [2]

(b) Bailey thinks all regular pentagons are congruent.

Is he correct?

Circle your answer.

yes no more information needed [1]

5 Draw the locus of all points which are the same distance from **A** and **B**.

A
×

×

B

[2]

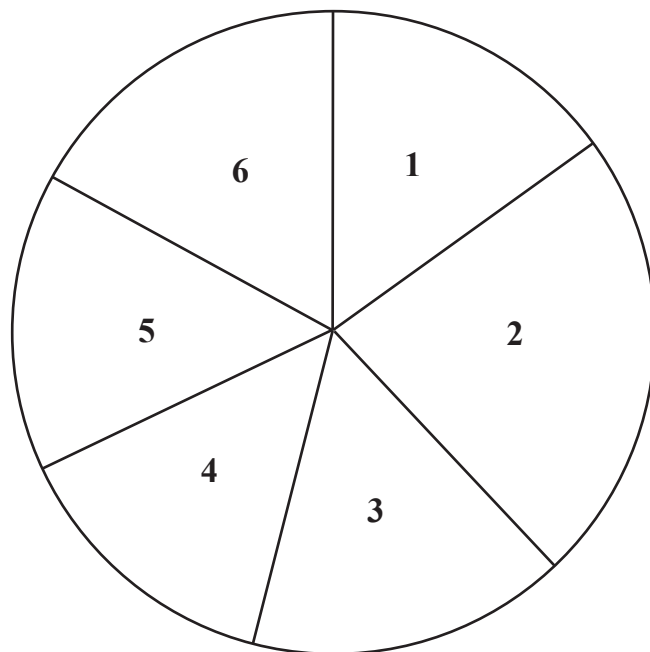
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- 6 Georgia rolls a dice a number of times and records the outcome each time. She displays her results in this pie chart.



Alice thinks Georgia's dice is biased.

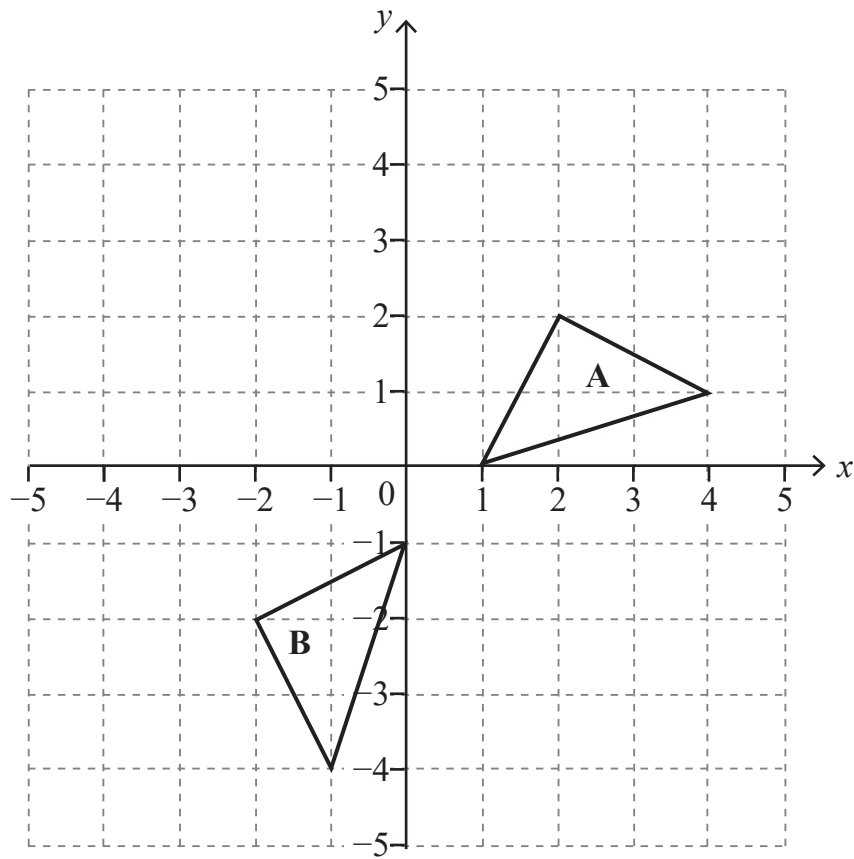
Bob disagrees.

What information is needed to decide who is correct?

Answer _____ [1]



7 (a) Describe fully the single transformation that maps triangle A to triangle B.

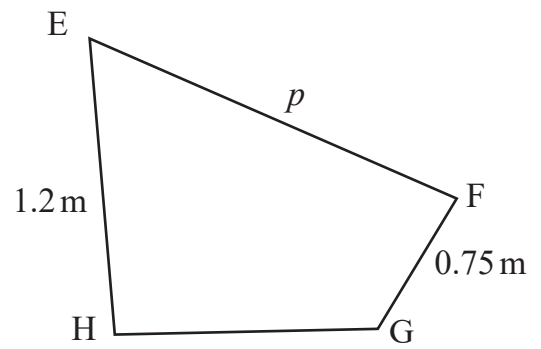
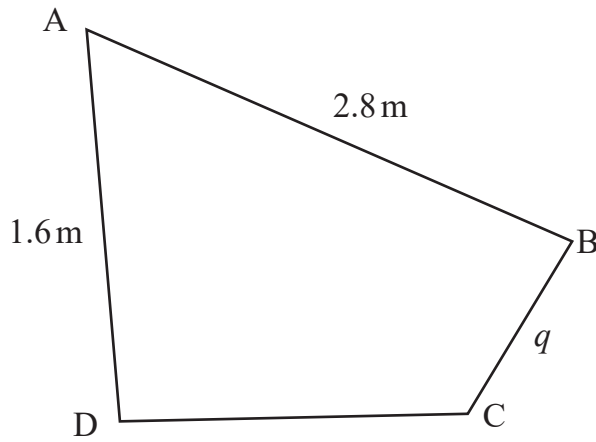


Answer _____ [2]

[Turn over



(b) Two similar shapes are shown.



Diagrams are not drawn to scale.

(i) Find the value of p .

Answer _____ [2]

(ii) Find the value of q .

Answer _____ [1]



8 When a body is moving through the air, the air resistance R Newtons (N) is proportional to the square of the velocity v m/s.

At a velocity of 100 m/s, the air resistance is 50 N.

(a) Find R in terms of v .

Answer _____ [2]

(b) Find R when $v = 120$ m/s.

Answer _____ N [1]

[Turn over

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10

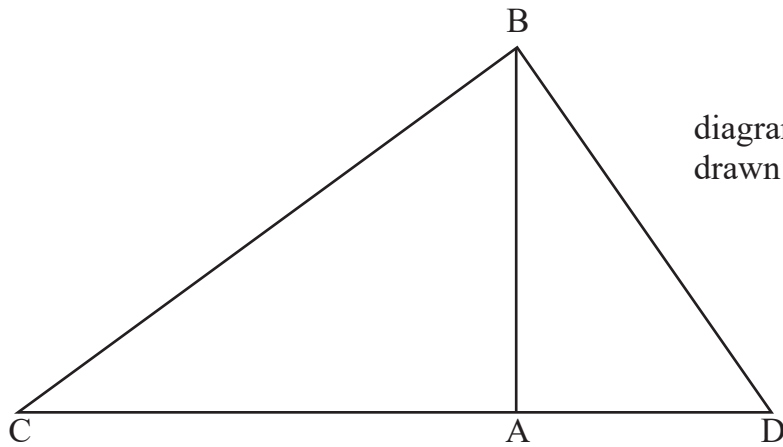


diagram not
drawn accurately

AB is a vertical mast and CAD is horizontal.

The angle of elevation of B from C is 36°

The angle of elevation of B from D is 48°

The distance CD is 100 metres.

Calculate the height of AB.

Answer _____ m [5]

[Turn over

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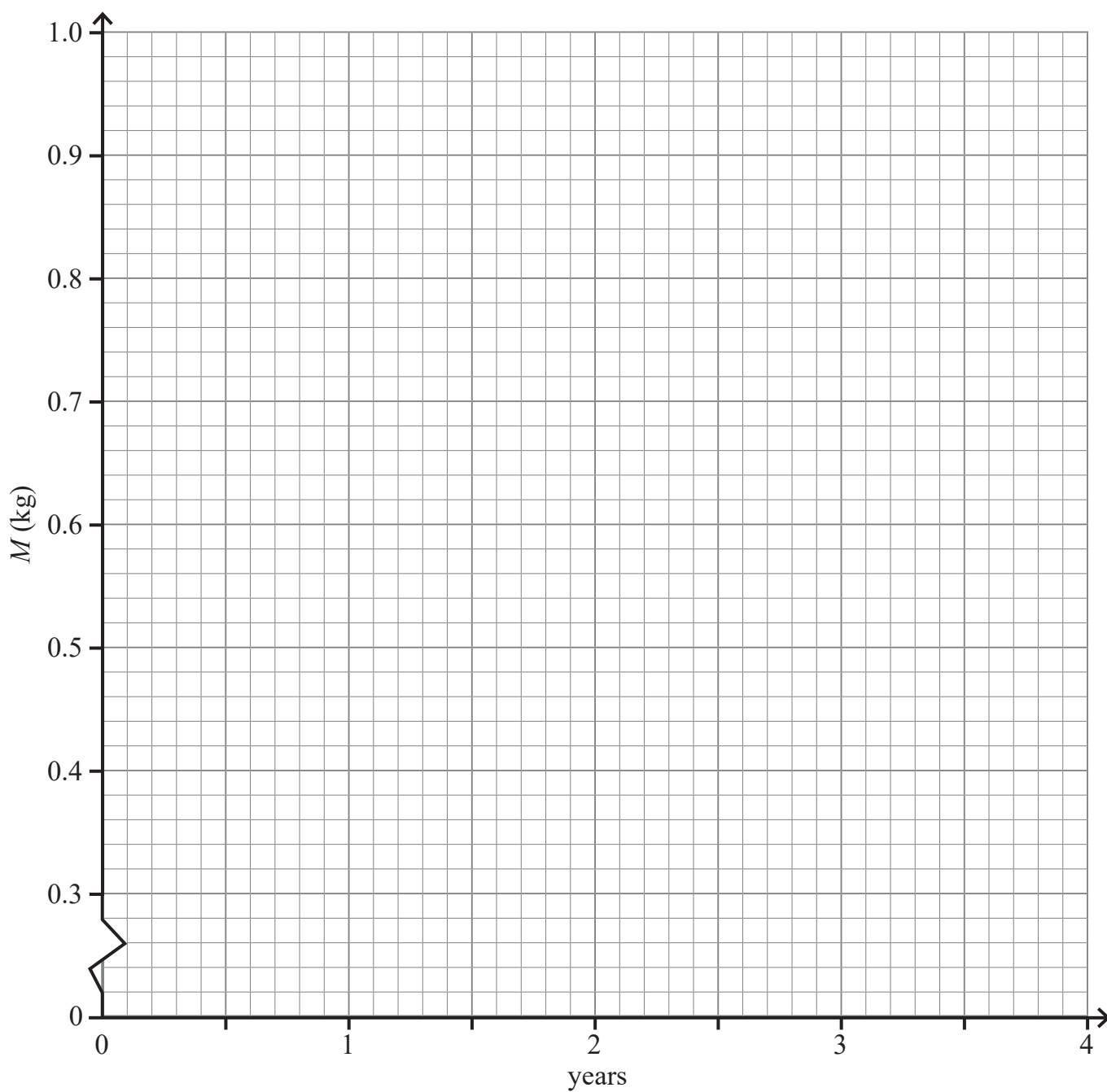
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11 The mass M kg of a decaying substance, x years after its manufacture, is given by the formula

$$M = (0.8)^x$$

(a) Sketch a graph to show the mass over the first 4 years.

[4]



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(b) By drawing appropriate lines on the graph, find

(i) after how many months the mass was 70% of its original value,

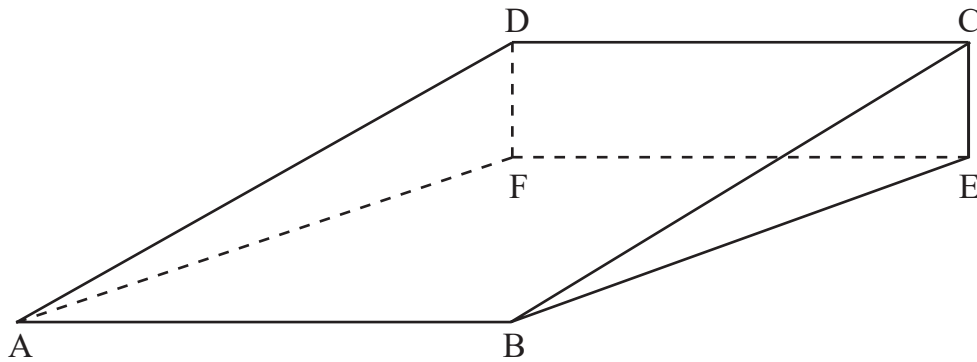
Answer _____ months [2]

(ii) the rate of decay when $x = 3$

Answer _____ kg/year [2]



12



The rectangular ramp ABCD is inclined to the horizontal rectangular base ABEF. CDFE is vertical. $AB = 6\text{ m}$, $CE = 4\text{ m}$ and $BE = 9\text{ m}$.

(a) Calculate the length of the line AC.

Answer _____ m [2]

(b) Calculate the angle between AC and the base.

Answer _____ ° [3]



13 P is inversely proportional to the square of x .

When the value of x is increased from a to $(a + 1)$, the value of P is halved.

Find the exact values of a .

Answer _____ [6]

THIS IS THE END OF THE QUESTION PAPER

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Question Number	Marks
1	
2	
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9	
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11	
12	
13	

Total Marks	
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Examiner Number

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Rewarding Learning

**General Certificate of Secondary Education
Summer 2023**

GCSE Mathematics

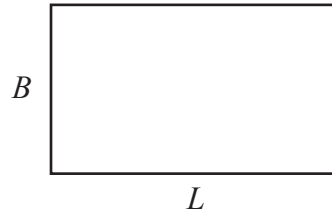
HIGHER TIER ADDITIONAL SUPPORT MATERIALS (For use in Summer 2023)

HIGHER TIER ADDITIONAL SUPPORT MATERIALS (Summer 2023)

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

Perimeter, Area and Volume

The perimeter of a polygon is the distance around the outside of the polygon.



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.

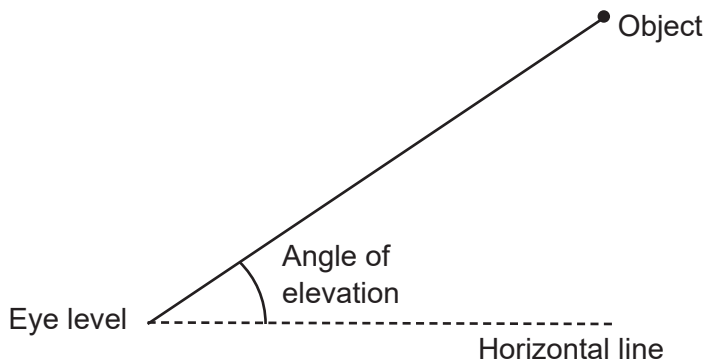
There are 180° inside a triangle.

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 elevation

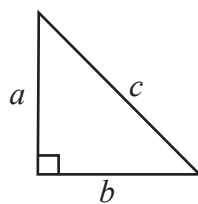
If a person stands and looks up at an object, the **angle of elevation** is the angle between the horizontal line of sight and the object.



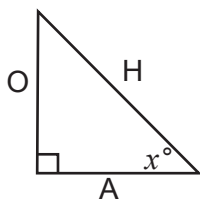
Pythagoras' Theorem

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



$$\sin x^\circ = \frac{O}{H} \quad \cos x^\circ = \frac{A}{H} \quad \tan x^\circ = \frac{O}{A}$$

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.

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

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

