Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022

# Mathematics

StemUp Model Solution

Unit M7 Paper 1
**(Non-Calculator)**
Higher Tier



**[GMC71]**

*GMC71*

**MONDAY 13 JUNE, 9.15am–10.30am**

**TIME**

1 hour 15 minutes.

**INSTRUCTIONS TO CANDIDATES**

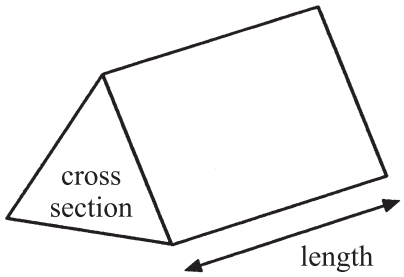
Write your Centre Number and Candidate Number in the spaces provided at the top of this page. **You are provided with Higher Tier Additional Support Materials for use with this paper.**
**You must answer the questions in the spaces provided.**
**Do not write outside the boxed area on each page, on blank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

**INFORMATION FOR CANDIDATES**

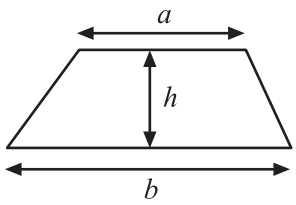
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a ruler, compasses and a protractor.
The Formula Sheet is on page 2.

# Formula Sheet

**Volume of prism** = area of cross section × length

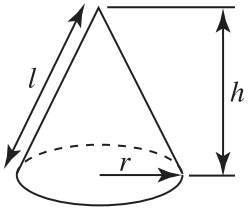



**Area of trapezium** = $\frac{1}{2}(a+b)h$



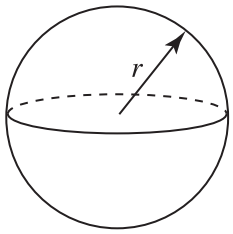

**Volume of cone** = $\frac{1}{3}\pi r^2 h$

**Curved surface area of cone** = $\pi rl$

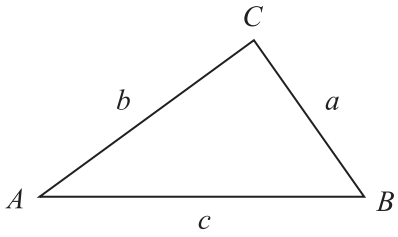



**Volume of sphere** = $\frac{4}{3}\pi r^3$

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

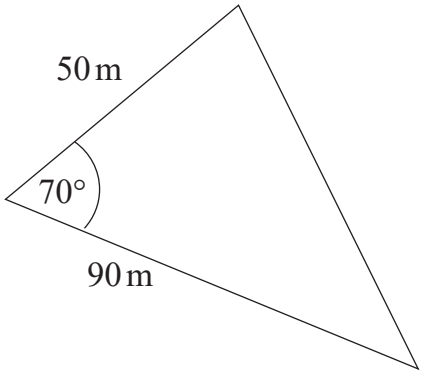
**Cosine Rule:** $a^2 = b^2 + c^2 - 2bc\cos A$

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

**1** The sketch below shows a triangular field.

Two sides have lengths of 50 m and 90 m.

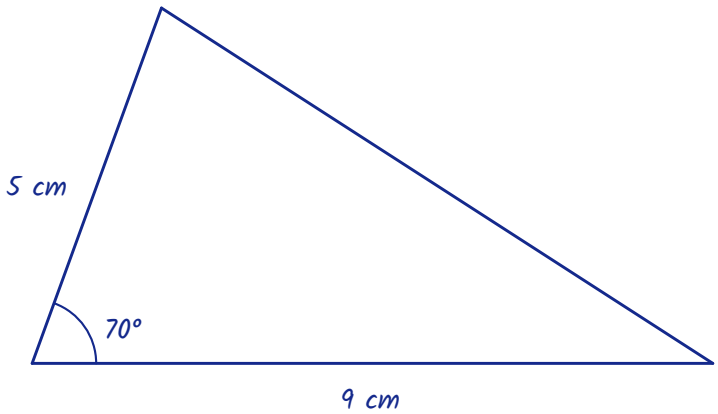
The angle between these two sides is 70°




Using a scale of 1 cm = 10 m, draw this triangular field in the space below. [3]

50 m → 5 cm

90 m → 9 cm




**[Turn over**

**2** Below is a menu from Dillies Diner.

A two-course lunch is made up of one Starter and one Main course.

## DILLIES DINER LUNCH MENU

| Starter | Main Course |
|---|---|
| Soup<br>Mushrooms<br>Ribs | Plaice<br>Beef<br>Chicken<br>Quiche |

Work out the number of different two-course lunches that can be ordered from this menu.

SP, SB, SC, SQ

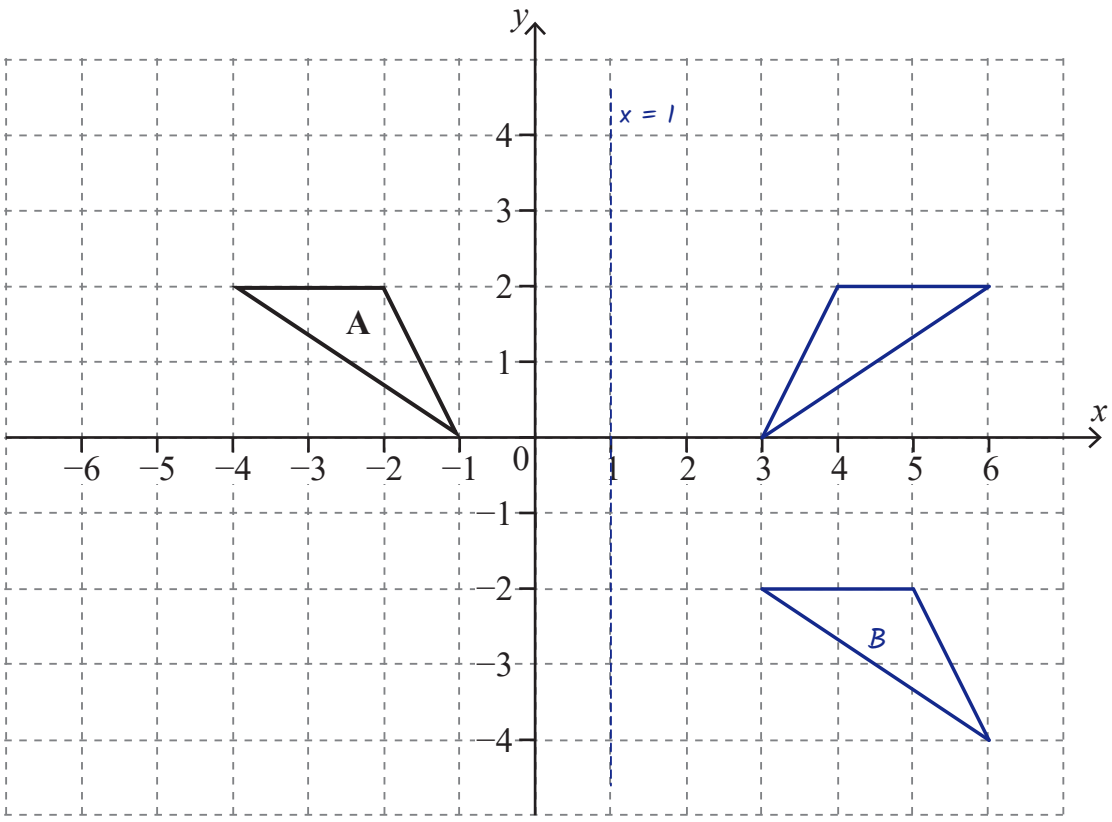
MP, MB, MC, MQ

RP, RB, RC, RQ

3 × 4 = 12

Answer 12 lunches [2]

**3**




**(a) (i)** Translate triangle **A** 7 right and 4 down. Label your answer **B**. [2]

**(ii)** Describe the translation which maps **B** to **A**.

Answer 7 left and 4 up [1]

**(b)** Reflect triangle **A** in the line $x = 1$ [2]

**[Turn over**

**4** Estimate $\dfrac{395 \times 9.88}{53}$

Show your method.

$\dfrac{395 \times 9.88}{53} \approx \dfrac{400 \times 10}{50}$

$= \dfrac{4000}{50} = 80$

Answer 80 [2]

**5** Andrew cycles at a steady speed from his home to school for a meeting.

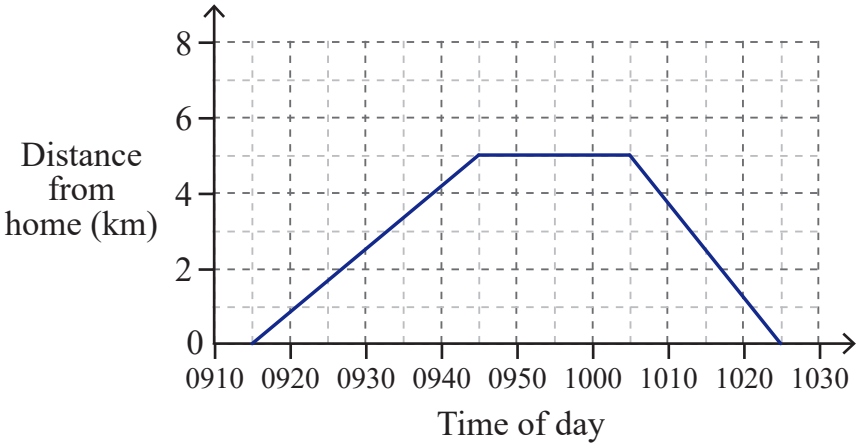
He leaves home at 0915 and arrives at school at 0945

The distance from his home to school is 5 km.

He spends 20 minutes at school before returning home again.

He arrives home at 1025

**(a)** On the grid below draw a distance–time graph for Andrew's complete journey.




[3]

**(b) (i)** Work out Andrew's average speed for his journey home.

*distance = 5 km, time = 1005 to 1025 = 20 minutes*

*speed = $5 \div \frac{20}{60} = 5 \times 3 = 15$ km/hr*

Answer *15* km/hr [2]

**(ii)** Is this Andrew's fastest average speed during his journey?

Explain why.

Answer *Yes* because *to school: 5 km in 30 min = 10 km/hr,*

*which is slower than 15 km/hr on the way home* [1]

**[Turn over**

**6** Beechgrove High School has 1200 pupils in total.

45% of the pupils are girls.

**(a)** Work out the number of girls in the school.

$\frac{45}{100} \times 1200 = 45 \times 12 = 540$

Answer 540 [2]

There are 240 pupils in Year 12

**(b)** What percentage of the pupils in the school are in Year 12?

$\frac{240}{1200} \times 100 = \frac{1}{5} \times 100 = 20$

Answer 20 % [2]

7 Students in a class were asked how many text messages they each sent in a particular week.

| Number of text messages | 0–19 | 20–39 | 40–59 | 60–79 | 80 or over |
|---|---|---|---|---|---|
| Number of students | 1 | 3 | 13 | 8 | 3 |

A student was taken at random from the class.

**(a)** What is the probability that this student sent more than 59 messages?

*Total = 1 + 3 + 13 + 8 + 3 = 28*

*More than 59: 8 + 3 = 11*

Answer $\frac{11}{28}$ [2]

A student was taken at random from those who sent less than 60 messages.

**(b)** What is the probability that this student sent 40–59 messages?

*Less than 60: 1 + 3 + 13 = 17*

*Sent 40–59: 13*

Answer $\frac{13}{17}$ [2]

**[Turn over**

**8** **(a)** What is the main difference between the Binary number system and the Decimal number system?

Answer Binary is base 2 (uses only 0 and 1); decimal is base 10 [1]

**(b)** Write the binary number 111111 as a decimal number.

32 16 8 4 2 1

1 1 1 1 1 1

32 + 16 + 8 + 4 + 2 + 1 = 63

Answer 63 [1]

**(c)** Write the decimal number 87 as a binary number.

87 = 64 + 16 + 4 + 2 + 1

64 32 16 8 4 2 1

1 0 1 0 1 1 1

Answer 1010111 [1]

**9** **(a)** Simplify

**(i)** $w^3 \times w^2$

$w^{3+2}$

Answer $w^5$ [1]

**(ii)** $\frac{y^6}{y^2}$ $y^{6-2}$

Answer $y^4$ [1]

**(b)** Work out the $n^{th}$ term of the sequence

7, 14, 21, 28, 35 …

goes up in 7s: $7 \times n$

Answer $7n$ [1]

**(c)** Work out the value of

**(i)** $5^{-2}$

$5^{-2} = \frac{1}{5^2} = \frac{1}{25}$

Answer $\frac{1}{25}$ [1]

**(ii)** $1^5 + 6^0$

$1 + 1$

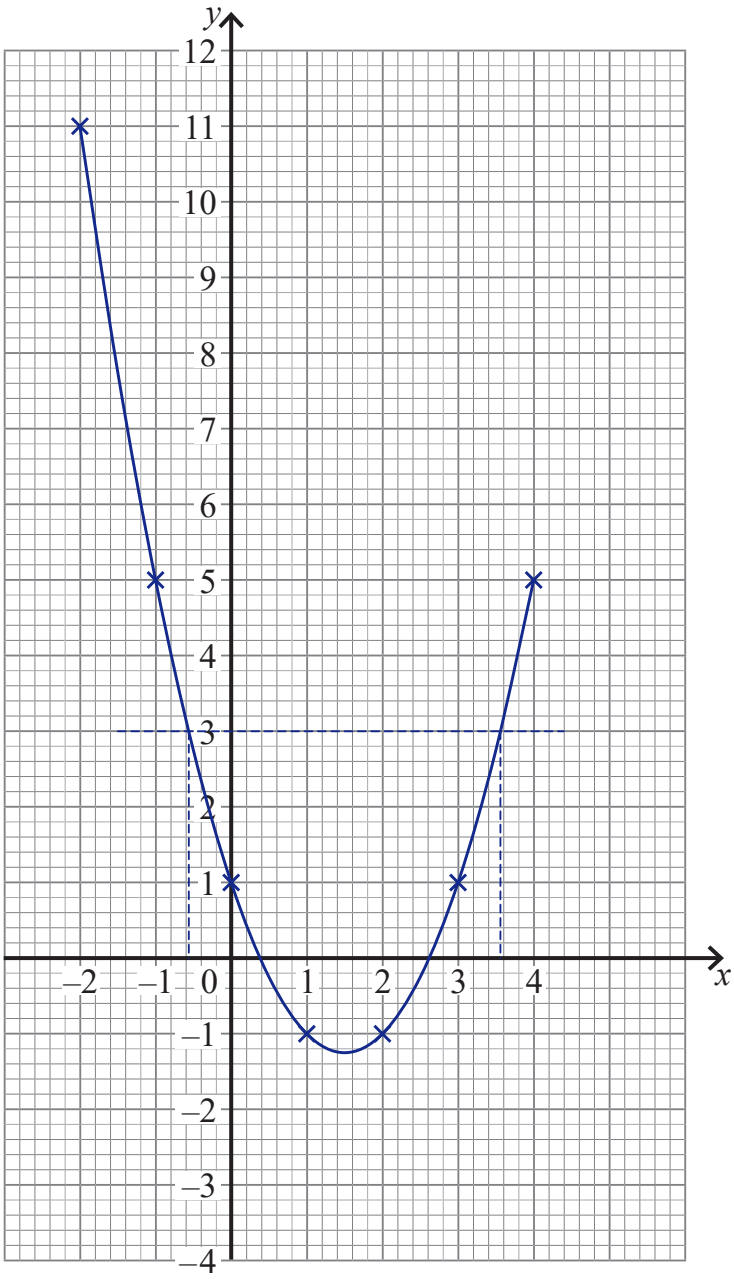
Answer 2 [1]

**[Turn over**

**10** The following table gives some values for the quadratic equation $y = x^2 - 3x + 1$

| $x$ | –2 | –1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|
| $y$ | 11 | 5 | 1 | –1 | –1 | 1 | 5 |

**(a)** On the grid below, draw the graph of $y = x^2 - 3x + 1$ for values of $x$ between –2 and 4




[2]

**(b)** Use your graph to estimate the values of $x$ for which $y = 3$

Draw the line $y = 3$; it meets the curve at

$x \approx -0.6$ and $x \approx 3.6$

Answer $x =$ $-0.6$ and $3.6$ [2]

**11** A tent in the shape of a cone has a perpendicular height of 7 m and a volume of 220 $m^3$

Using $\pi = \frac{22}{7}$, work out the base radius of this tent.

Write your answer in surd form.

$V = \frac{1}{3}\pi r^2 h$

$\frac{1}{3} \times \frac{22}{7} \times r^2 \times 7 = 220$

$\frac{22}{3} r^2 = 220$

$r^2 = 220 \times 3 \div 22 = 30$

$r = \sqrt{30}$

Answer $\sqrt{30}$ m [3]

**[Turn over**

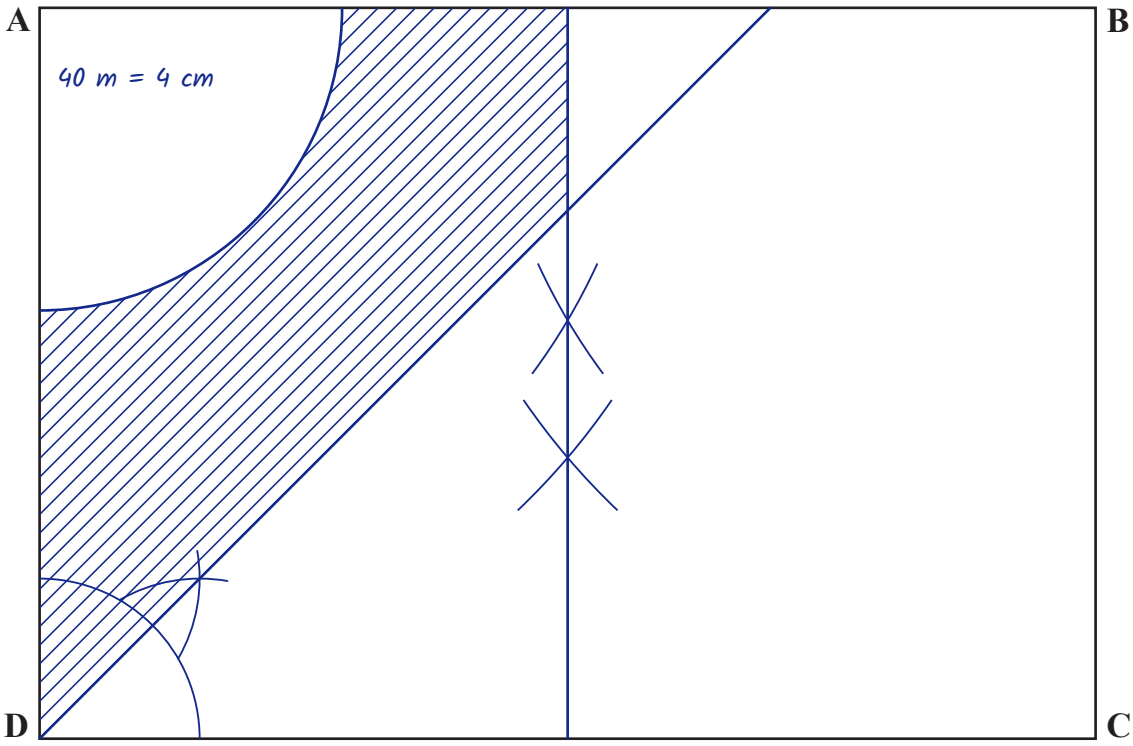
**12** Toby walks his dog in the field **ABCD** so that he is always:

more than 40 m from **A**;

nearer to **A** than **B**;

nearer to **DA** than **DC**.

Shade the area where Toby walks his dog.




Scale of diagram: 1 cm = 10 m

[4]

**13** $m = 4.5 \times 10^7$ $n = 5 \times 10^{-3}$

Work out the value of $\frac{m}{n}$, giving your answer in standard form.

$\frac{m}{n} = \frac{4.5 \times 10^7}{5 \times 10^{-3}} = 0.9 \times 10^{7-(-3)}$

$= 0.9 \times 10^{10}$

$= 9 \times 10^9$

Answer $9 \times 10^9$ [2]

**14** Make $q$ the subject of the formula

$$p = \frac{q}{r - q}$$

$p(r - q) = q$

$pr - pq = q$

$pr = q + pq$

$pr = q(1 + p)$

$q = \frac{pr}{1 + p}$

Answer $q = \frac{pr}{1 + p}$ [3]

**THIS IS THE END OF THE QUESTION PAPER**

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## DO NOT WRITE ON THIS PAGE

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| **Total Marks** | |

**Examiner Number**

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Rewarding Learning

General Certificate of Secondary Education
Summer 2022

# GCSE Mathematics

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



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**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**

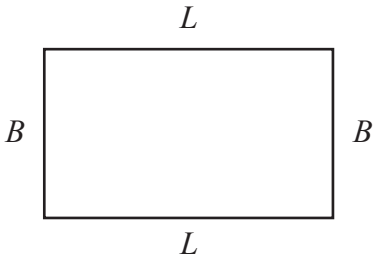
$1 \text{ ml} = 1 \text{ cm}^3$

**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**

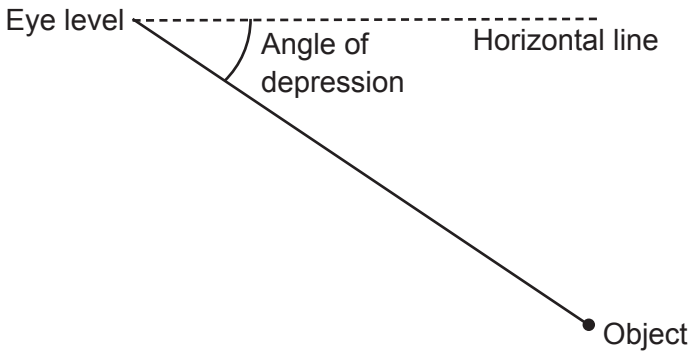
Parallel lines have the same gradient.

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.

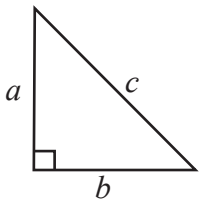
**Angle of depression**
If a person stands and looks down at an object, the **angle of depression** is the angle between the horizontal line of sight and the object.



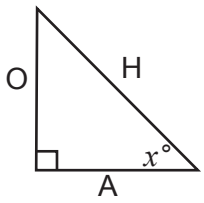

**Pythagoras' Theorem**

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**

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


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