TGMT

THE ULTIMATE REVISION GUIDE FOR GCSE MATHS

Everything you need to pass your GCSE maths exam

HIGHER TIER

Everything You Need to Pass GCSE Maths Higher Revision Guide

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Instructions!

Every question has a QR code that can be scanned or clicked (if using the online version) to bring up a full lesson

Try it out!

Revision Videos

Everything you need to get a Grade 5 (Higher & Foundation)

Everything you need to get a Grade 6-9 (Higher Only)

Multiplying Decimals

Work out 54.6×4.3

Full Lesson Here

Answer: 234.78

..... **3 marks**

Product of Prime Factors

Express 56 as the product of its prime factors.

Full Lesson Here

Answer: $2 \times 2 \times 2 \times 7$ or $2^3 \times 7$

..... **2 marks**

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Highest Common Factor

Find the Highest Common Factor (HCF) of 84 and 180

Full Lesson Here

Answer 12

..... **2 marks**

Lowest Common Multiple

Find the lowest common multiple (LCM) of 40 and 56

Full Lesson Here

Answer 280

..... **2 marks**

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Laws of Indices

Work out the value of $\dfrac{3^7 \times 3^{-2}}{3^3}$

Full Lesson Here

..... **2 marks**

Answer: 9

Negative and Fractional Indices

(a) Find the value of $81^{-\frac{1}{2}}$

(b) Find the value of $\left(\dfrac{64}{125}\right)^{\frac{2}{3}}$

Full Lesson Here

..... **4 marks**

Answer: a) 1/9 b) 16/25

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Indices Problems

Given that $3^{-n} = 0.2$
find the value of $(3^4)^n$

Full Lesson Here

Answer 625

..... **3 marks**

Standard Form Conversions

(a) Write 0.00562 in standard form.

(b) Write 1.452×10^3 as an ordinary number.

Full Lesson Here

Answer a) 5.62×10^{-3} b) 1452

..... **2 marks**

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Standard Form Calculations

Work out $(13.8 \times 10^{7}) \times (5.4 \times 10^{-12})$
Give your answer as an ordinary number.

Full Lesson Here

..... **2 marks**

Answer 0.00074520

Simplifying Surds

Write $5\sqrt{27}$ in the form $k\sqrt{3}$, where k is an integer.

Full Lesson Here

..... **2 marks**

Answer $15\sqrt{3}$

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Adding and Subtracting Surds

$\sqrt{5}(\sqrt{8} + \sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.

Find the value of a.

Full Lesson Here

..... **3 marks**

Answer: 5

Expanding Brackets with Surds

Write $(3 + \sqrt{5})^2$ in the form $a + b\sqrt{5}$, where a and b are integers.

Full Lesson Here

..... **2 marks**

Answer: $14+6\sqrt{5}$

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Rationalising the Denominator

Show that $\frac{6-\sqrt{8}}{\sqrt{2}-1}$ can be written in the form $a+b\sqrt{2}$ where a and b are integers.

Full Lesson Here

.....

3 marks

Answer: $2+4\sqrt{2}$

Rationalising Harder Denominators

$\frac{1+\sqrt{2}}{(3-\sqrt{2})^2}$ can be written in the form $a+b\sqrt{2}$

Find the value of a and the value of b.

Full Lesson Here

.....

5 marks

Answer: $a=\frac{23}{49}$ $b=\frac{17}{49}$

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Expanding Brackets

Expand and simplify $5(p + 3) - 2(1 - 2p)$

Full Lesson Here

Answer: 9p+13

..... **2 marks**

Factorise Expressions

(a) Factorise $5 - 10m$

(b) Factorise fully $2a^2b + 6ab^2$

Full Lesson Here

Answer: a) 5(1-2m) b) 2ab(a+3b)

..... **3 marks**

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Substitution

$v^2 = u^2 + 2as$

$u = 12 \quad a = -3 \quad s = 18$

Work out a value of v.

..... **2 marks**

Full Lesson Here

Answer: 6 or -6

Laws of Indices

(a) Simplify $m^3 \times m^4$

(b) Simplify $(5np^3)^3$

(c) Simplify $\dfrac{32q^9r^4}{4q^3r}$

..... **5 marks**

Full Lesson Here

Answer: a) m^7
b) $125n^3p^9$
c) $8q^6r^3$

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Changing the Subject

Make s the subject of $v^2 = u^2 + 2as$

Full Lesson Here

..... **2 marks**

Answer: $\frac{v^2 - u^2}{2a} = s$

Expanding Double Brackets

Expand and simplify $(5x + 2)(2x - 3)$

Full Lesson Here

..... **2 marks**

Answer: $10x^2 - 11x - 6$

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Factorising Quadratics

Factorise $x^2 + 4x + 3$

Full Lesson Here

..... **2 marks**

Answer: $(x+1)(x+3)$

Solving Equations with an Unknown One Side

Solve $3(m - 4) = 21$

Full Lesson Here

..... **2 marks**

Answer: $m = 11$

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Solving Equations with an Unknown Both Sides

Solve $5x - 6 = 3(x - 1)$

Full Lesson Here

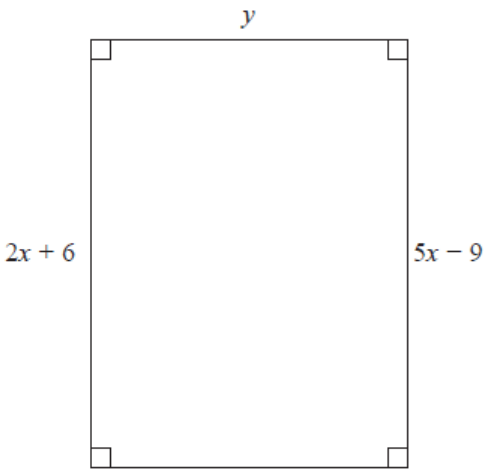
.....

3 marks

Answer: $x = 1.5$ or $\frac{3}{2}$

Forming and Solving Equations

Here is a rectangle.



All measurements are in centimetres.

The area of the rectangle is 48 cm^2.

Show that $y = 3$

Full Lesson Here

.....

4 marks

Answer: $2x+6=5x-9$ $x=5$
$2(5)+6=16$
$48 \div 16 = 3$

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Finding the nth Term of a Sequences

Here are the first four terms of an arithmetic sequence.

5 11 17 23

Write down an expression, in terms of n, for the nth term of the sequence.

Full Lesson Here

..... **2 marks**

Answer: 6n - 1

Using the nth Term of Sequences

The nth term of a sequence is $2n^2 - 1$

The nth term of a different sequence is $40 - n^2$

Show that there is only one number that is in both of these sequences.

Full Lesson Here

..... **3 marks**

Answer: $2n^2-1$= 1,7,17,**31**,49; $40-n^2$= 39,36,**31**,24,15,4

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Special Sequences

The first 3 terms of a Fibonacci type sequence are:

a , b , a + b

a) Show that the 6th term is 3a+5b

b) Given that the 3rd term is 7 and the 6th term is 29

Find the value of a and the value of b.

Full Lesson Here

Answer
a) a+2b, 2a+3b, 3a+5b
b) a=3 b=4

..... **5 marks**

Quadratic Sequences

Here are the first five terms of a sequence.

4 11 22 37 56

Find an expression, in terms of n, for the nth term of this sequence.

Full Lesson Here

Answer
$2n^2+n+1$

..... **3 marks**

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Reverse Mean

There are 10 boys and 20 girls in a class.
The class has a test.

The mean mark for all the class is 60
The mean mark for the girls is 54

Work out the mean mark for the boys.

Full Lesson Here

Answer 72

..... **3 marks**

Two Way Tables

60 people were asked if they prefer to go on holiday in Britain or in Spain or in Italy.

38 of the people were male.
11 of the 32 people who said Britain were female.
8 males said Italy.
12 people said Spain.

One of the females is chosen at random.

What is the probability that this female said Spain?

Full Lesson Here

Answer $\frac{3}{22}$

..... **4 marks**

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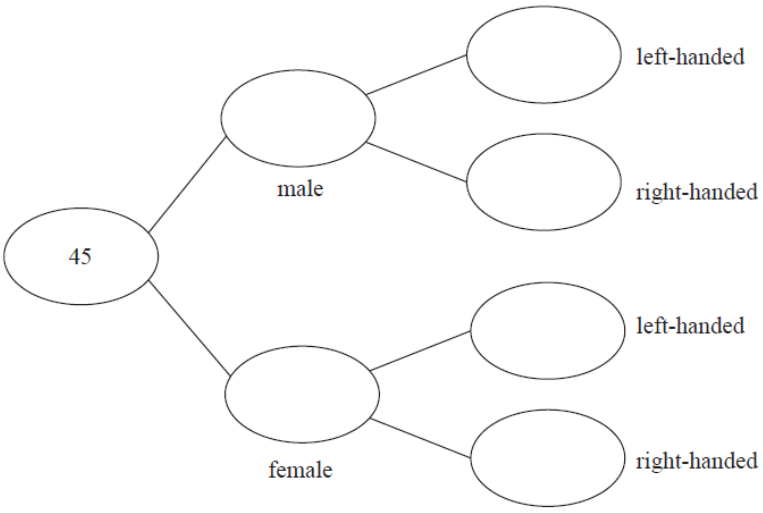
Frequency Trees

Each worker in a factory is either left-handed or right-handed.

22 of the 45 workers are male.
16 of the 34 right-handed workers are female.

Complete the frequency tree for this information.



3 marks

Full Lesson Here

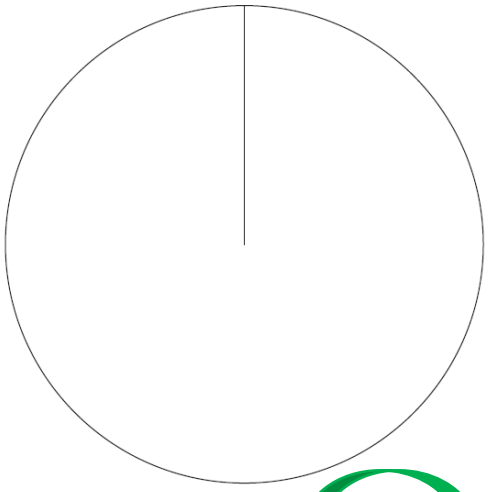
Answer
22,23
4, 18, 7, 16

Pie Charts

A group of football fans were asked what their half time snack was.

The table below gives information about their answers.

Snack	Number of fans
burger	11
pie	17
hot dog	8



Draw an accurate pie chart for this information.

.....

3 marks

Full Lesson Here

Answer
Correct labelled pie chart
with angles 110°, 170°, 80°

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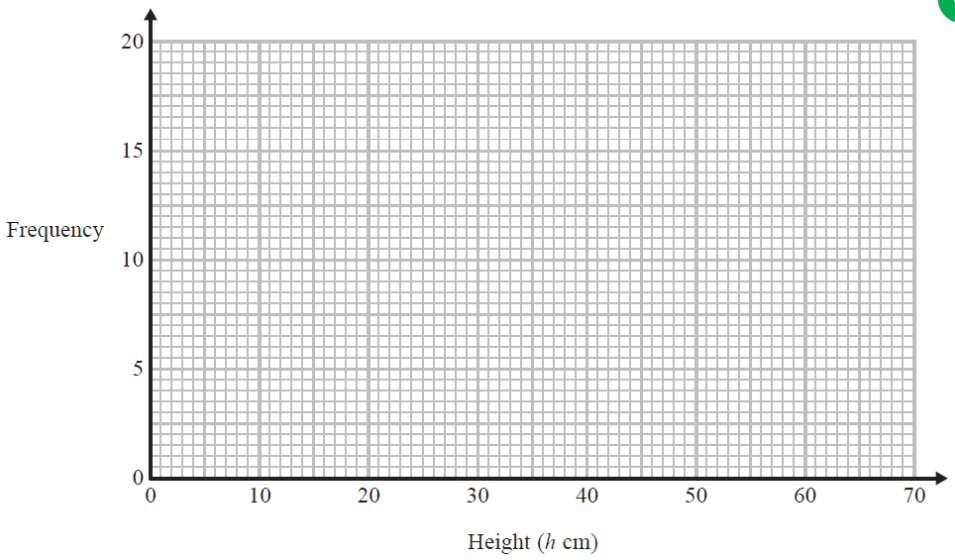
Frequency Polygons

On the grid, draw a frequency polygon for the information in the table.

Height (h cm)	Frequency
$10 < h \leqslant 20$	7
$20 < h \leqslant 30$	13
$30 < h \leqslant 40$	14
$40 < h \leqslant 50$	12
$50 < h \leqslant 60$	16
$60 < h \leqslant 70$	18

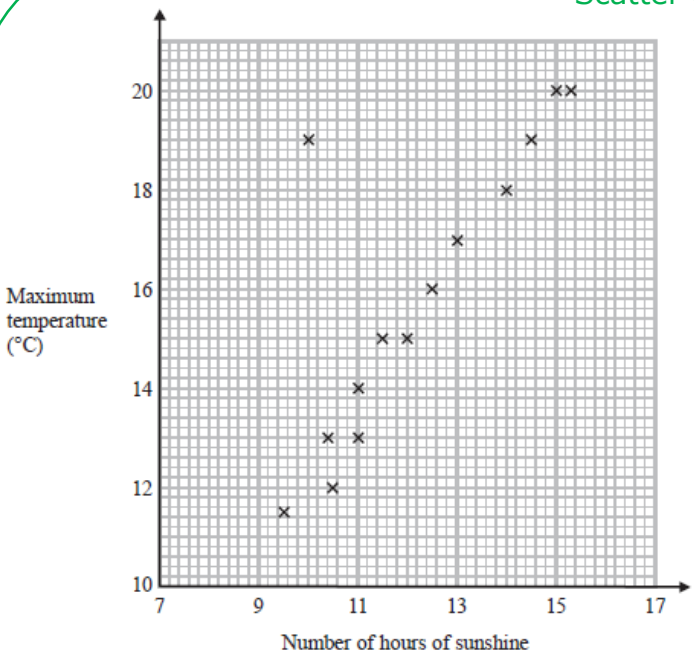


..... **2 marks**

Full Lesson Here

Answer: Diagram drawn using midpoints and connected via straight lines

Scatter Graphs



One of the points is an outlier.
Write down the coordinates

For all the other points write down the type of correlation.

On the same day, in another British town, the maximum temperature was 16.4 °C.

Estimate the number of hours of sunshine in this town on this day.

..... **4 marks**

Full Lesson Here

Answer: a) (10,19) b) Positive c) 12-13

Averages from a Table

Work out an estimate for the mean of the weekly earnings.

Weekly earnings (£x)	Frequency
$150 < x \leqslant 250$	1
$250 < x \leqslant 350$	11
$350 < x \leqslant 450$	5
$450 < x \leqslant 550$	0
$550 < x \leqslant 650$	3

Full Lesson Here

Answer £365

..... **3 marks**

Averages from a Stem and Leaf

The table shows the heights of a group of students in year 9.

least height	150 cm
median	165 cm
greatest height	170 cm

The stem and leaf shows the heights of some students in year 12.

15	8 9 9
16	4 5 7 7 8
17	0 3 4 4 7
18	0 2

Key: 15 \| 8 represents 158 cm

Compare the distribution of heights for the year 9 students with the year 12 students.

Full Lesson Here

Answer Median: Yr9 (165) < Yr12 (168)
Range: Yr9 (20) < Yr12 (24)

..... **3 marks**

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Percentage Changes

Renee buys 5 kg of sweets to sell.
She pays £10 for the sweets.

Renee puts all the sweets into bags.
She puts 250 g of sweets into each bag.
She sells each bag of sweets for 65p.

Renee sells all the bags of sweets.

Work out her percentage profit.

Full Lesson Here

..... **4 marks**

Answer: 30%

Reverse Percentages

Jules buys a washing machine.

20% VAT is added to the price of the washing machine.
Jules then has to pay a total of £600

What is the price of the washing machine with **no** VAT added?

Full Lesson Here

..... **2 marks**

Answer: £500

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Fraction Calculations

(a) Work out $2\frac{1}{7} + 1\frac{1}{4}$

(b) Work out $1\frac{1}{5} \div \frac{3}{4}$

Give your answer as a mixed number in its simplest form.

Full Lesson Here

..... **4 marks**

Answer a) $\frac{95}{28}$ or $3\frac{11}{28}$ b) $1\frac{3}{5}$

Ratio, Fraction and Percentage Problems

Daniel bakes 420 cakes.
He bakes only vanilla cakes, banana cakes, lemon cakes and chocolate cakes.

$\frac{2}{7}$ of the cakes are vanilla cakes.

35% of the cakes are banana cakes.

The ratio of the number of lemon cakes to the number of chocolate cakes is 4 : 5

Work out the number of lemon cakes Daniel bakes.

Full Lesson Here

..... **5 marks**

Answer 89

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Sharing in a Ratio

The perimeter of a right-angled triangle is 72 cm.
The lengths of its sides are in the ratio 3 : 4 : 5

Work out the area of the triangle.

Full Lesson Here

..... **4 marks**

Answer $216cm^2$

Combining Ratios

In a village

the number of houses and the number of flats are in the ratio 7 : 4
the number of flats and the number of bungalows are in the ratio 8 : 5

There are 50 bungalows in the village.

How many houses are there in the village?

Full Lesson Here

..... **3 marks**

Answer 140

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Ratios as Fractions

White shapes and black shapes are used in a game.
Some of the shapes are circles.
All the other shapes are squares.

The ratio of the number of white shapes to the number of black shapes is 3 : 7

The ratio of the number of white circles to the number of white squares is 4 : 5

The ratio of the number of black circles to the number of black squares is 2 : 5

Work out what fraction of all the shapes are circles.

Full Lesson Here

Answer $\frac{1}{3}$ or equivalent

..... **4 marks**

Direct Proportion in Context

Jack is building a wall.

He uses 300 bricks to build part of the wall.
This part of the wall is 5 metres long and 1.5 metres high.

The complete wall will be 8 metres long and 1.5 metres high.

How many more bricks does Jack need to complete the wall?

Full Lesson Here

Answer 180

..... **3 marks**

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Inverse Proportion in Context

It would take 120 minutes to fill a swimming pool using water from 5 taps.

(a) How many minutes will it take to fill the pool if only 3 of the taps are used?

(b) State one assumption you made in working out your answer to part (a).

..... **3 marks**

Full Lesson Here

Answer a) 200
b) The taps are running at the same rate/speed

Best Buys

In London, 1 litre of petrol costs 108.9p
In New York, 1 US gallon of petrol costs $2.83

1 US gallon = 3.785 litres
£1 = $1.46

In which city is petrol better value for money, London or New York?
You must show your working.

..... **3 marks**

Full Lesson Here

Answer New York

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Exchange Rates

Gina finds out the price of a CD box set in three different countries.

The price is

£98 in the UK
$134.99 in the USA
€139.99 in Germany

The exchange rates are

£1 = $1.43
€1 = £0.73

Gina wants to pay the cheapest price for the box set.

(a) From which country should Gina buy the box set?
You must show how you get your answer.

Gina lives in the UK.

(b) Why might your answer to (a) **not** be the best country for Gina to buy the box set from?

..... **4 marks**

Full Lesson Here

Answer
a) USA
b) Postage costs

Recipes

Deon needs 50 g of sugar to make 15 biscuits.

She also needs

three times as much flour as sugar
two times as much butter as sugar

Deon is going to make 60 biscuits.

(a) Work out the amount of flour she needs.

Deon has to buy all the butter she needs to make 60 biscuits.
She buys the butter in 250 g packs.

(b) How many packs of butter does Deon need to buy?

..... **5 marks**

Full Lesson Here

Answer
a) 600
b) 2

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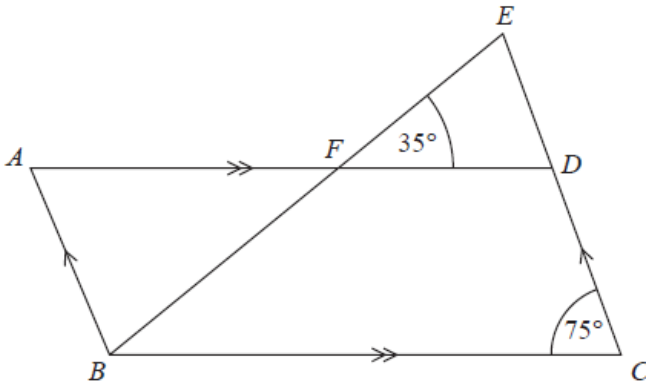
Angles in Triangles and Quadrilaterals



ABCD is a parallelogram.
EDC is a straight line.
F is the point on *AD* so that *BFE* is a straight line.

Angle *EFD* = 35°
Angle *DCB* = 75°

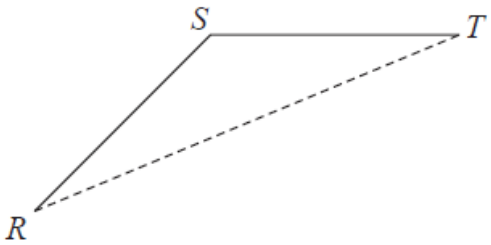
Show that angle *ABF* = 70°
Give a reason for each stage of your working.

..... **4 marks**

Full Lesson Here

Answer
Reasoning shown.
Option: AFB=35 (vertically opposite angles are equal), BAF=75 (opposite angles in a parallelogram are equal) ABF = 180 – (35+75) = 70 (angles in a triangle – 180.

Angles in Polygons



RS and *ST* are 2 sides of a regular 12-sided polygon.
RT is a diagonal of the polygon.

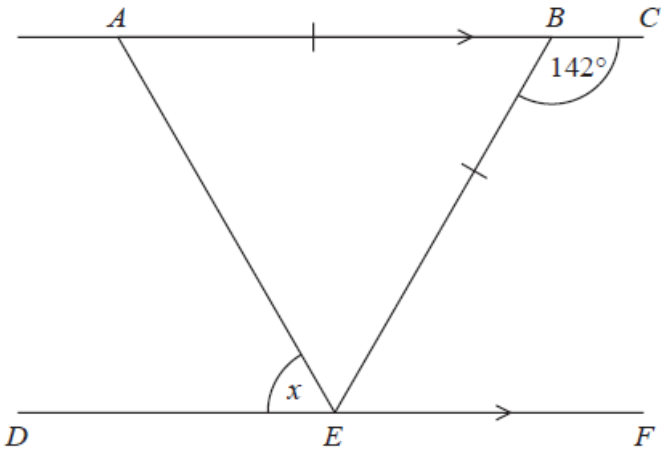
Work out the size of angle *STR*.
You must show your working.

..... **3 marks**

Full Lesson Here

Answer
15°

Angles in Parallel Lines



ABC and *DEF* are parallel straight lines.
ABE is an isosceles triangle with *AB* = *BE*.
Angle *CBE* = 142°

Work out the size of angle *x*.
Give a reason for each stage in your working.

..... **5 marks**

Full Lesson Here

Answer: 71° Reasons including: Base angles in an isosceles are equal, angles ion straight line = 180 and alternate angles are equal.

Pythagoras

Triangle *ABC* has perimeter 20 cm.

AB = 7 cm.
BC = 4 cm.

By calculation, deduce whether triangle *ABC* is a right-angled triangle.

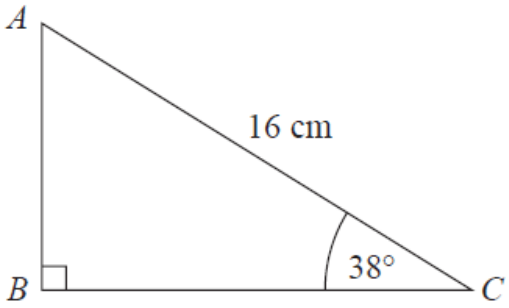
..... **4 marks**

Full Lesson Here

Answer: No, AC=9cm
$4^2+7^2=65$
$\sqrt{65} \neq 9$cm

Trigonometry (Side Lengths)

ABC is a right-angled triangle.



Calculate the length of *AB*.
Give your answer correct to 2 decimal places.

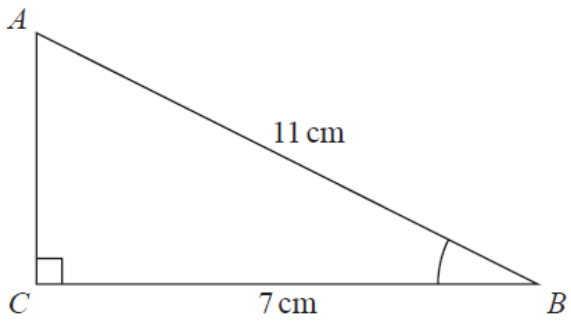
Full Lesson Here

Answer 9.85cm

..... **2 marks**

Trigonometry (Angles)

ABC is a right-angled triangle.



Work out the size of angle *ABC*.
Give your answer correct to 1 decimal place.

Full Lesson Here

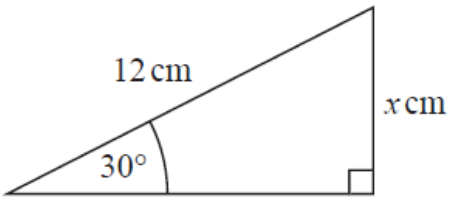
Answer 50.5°

..... **2 marks**

Using Exact Values of Trigonometry

(a) Write down the exact value of $\cos 30°$

(b)



Given that $\sin 30° = 0.5$,
work out the value of x.

..... **3 marks**

Full Lesson Here

Answer a) $\frac{\sqrt{3}}{2}$ b) 6cm

Calculations with Exact Values of Trigonometry

Find the exact value of $\tan 30° \times \sin 60°$
Give your answer in its simplest form.

..... **2 marks**

Full Lesson Here

Answer $\frac{1}{2}$ or 0.5

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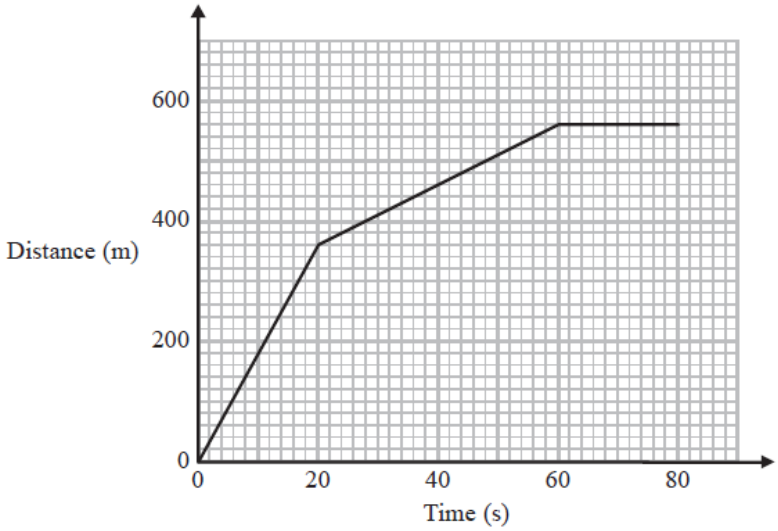
Distance-Time Graphs

Here is part of a distance-time graph for a car's journey.



(a) Between which two times does the car travel at its greatest speed?
Give a reason for your answer.

(b) Work out this greatest speed.

3 marks

Full Lesson Here

Answer
a) 0-20
has the highest gradient
b) 18m/s

Equation of a Line

A is the point with coordinates $(5, 9)$
B is the point with coordinates $(d, 15)$

The gradient of the line AB is 3

Work out the value of d.

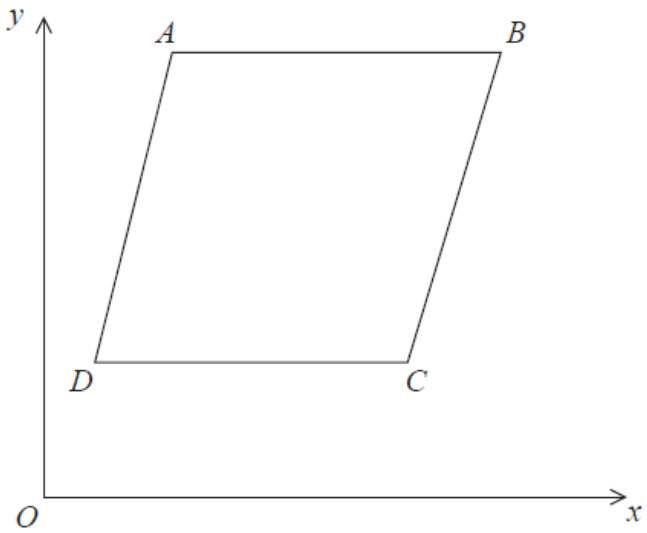
.....

3 marks

Full Lesson Here

Answer
7

Perpendicular Lines



ABCD is a rhombus.
The coordinates of *A* are (5, 11)
The equation of the diagonal *DB* is $y = \frac{1}{2}x + 6$

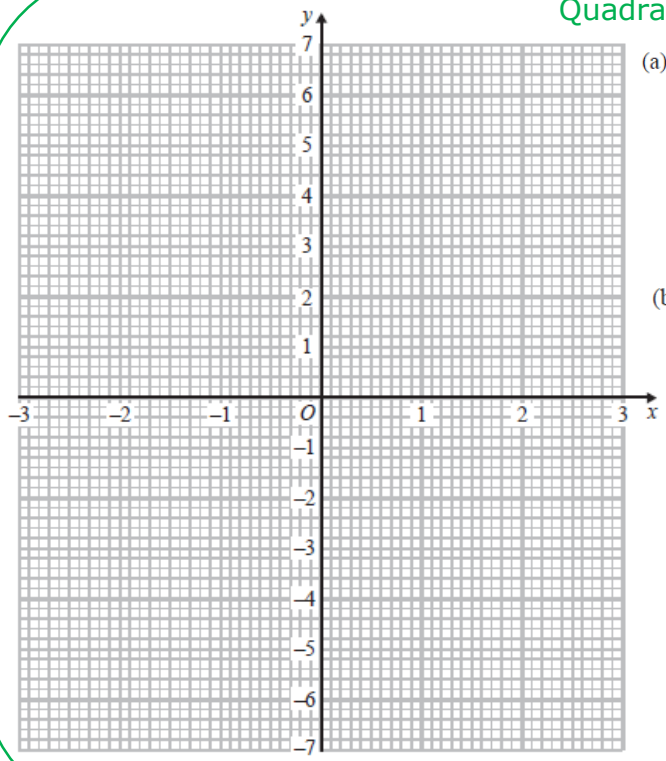
Find an equation of the diagonal *AC*.

4 marks

Full Lesson Here

Answer
y=-2x+21

Quadratic Graphs



(a) Complete the table of values for $y = x^2 - x - 6$

x	−3	−2	−1	0	1	2	3
y	6			− 6			

(b) On the grid, draw the graph of $y = x^2 - x - 6$ for values of x from −3 to 3

4 marks

Full Lesson Here

Answer
a) 0, -4, -6, -4, 0
b) Graph drawn

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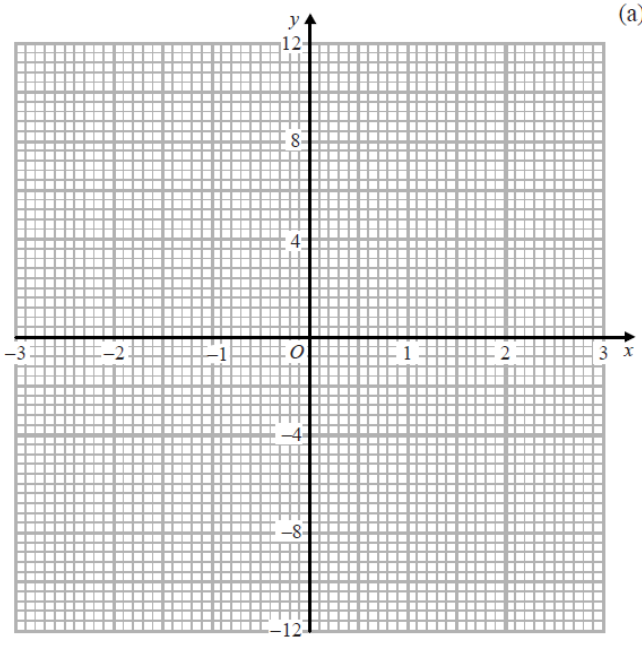
Cubic Graphs



(a) Complete the table of values for $y = x^3 + x^2 - 2x + 1$

x	−3	−2	−1	0	1	2
y		1	3		1	

(b) On the grid, draw the graph of $y = x^3 + x^2 - 2x + 1$ for values of x from −3 to 2

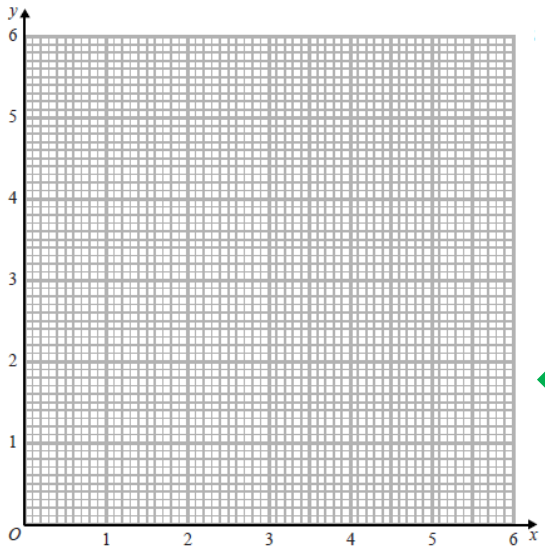
Full Lesson Here

Answer
a) -11, 1, 9
b) Graph drawn

.....

4 marks

Reciprocal Graphs



(a) Complete the table of values for $y = \frac{3}{x}$

x	0.5	1	2	3	4	5	6
y		3	1.5		0.75		

(b) On the grid, draw the graph of $y = \frac{3}{x}$ for values of x from 0.5 to 6

Full Lesson Here

Answer
a) 6, 1, 0.6, 0.5
b) graph drawn

.....

4 marks

GCSE MATHS TUTOR
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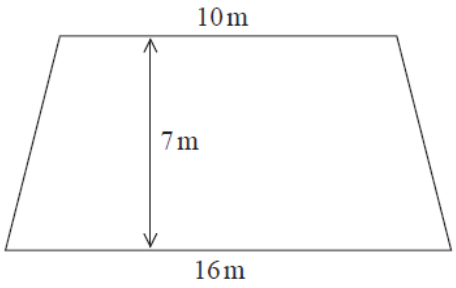
Area of Trapezia

The diagram shows a floor in the shape of a trapezium.



£16.99

John is going to paint the floor.

Each 5 litre tin of paint costs £16.99
1 litre of paint covers an area of $2\,m^2$

John has £160 to spend on paint.

Has John got enough money to buy all the paint he needs?
You must show how you get your answer.

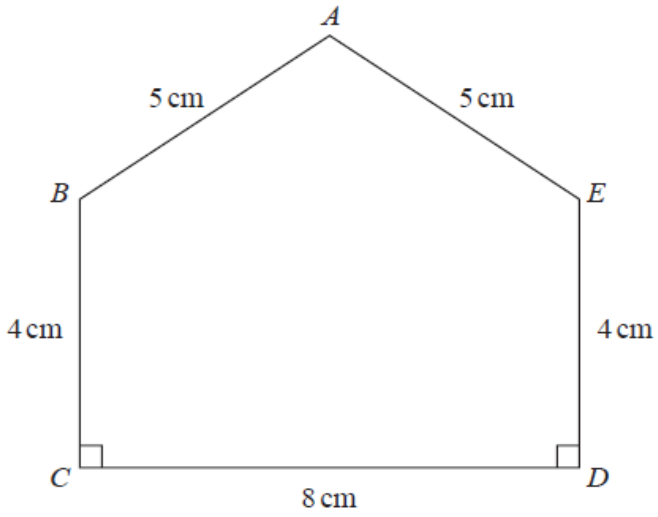
..... **5 marks**

Full Lesson Here

Answer No, £169.90 or $90m^2$

Area of Compound Shapes

ABCDE is a pentagon.



Work out the area of *ABCDE*.

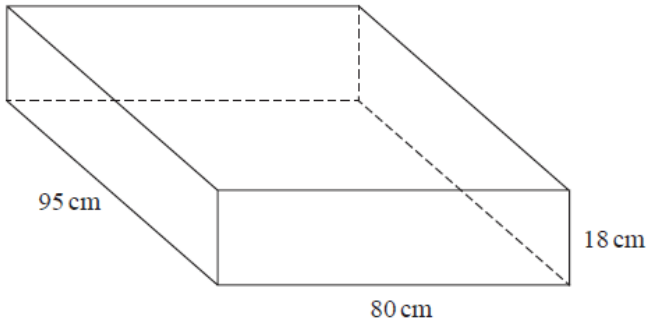
..... **5 marks**

Full Lesson Here

Answer $44cm^2$

Surface Area of Prisms

A sofa has 6 identical cushions.
Each cushion is a cuboid 18 cm by 80 cm by 95 cm.



The cushions are covered with a protective spray.
The protective spray is in cans.

The label on each can has this information.

Spray in this can covers 4 m²

Work out how many cans are needed to cover the 6 cushions with protective spray.

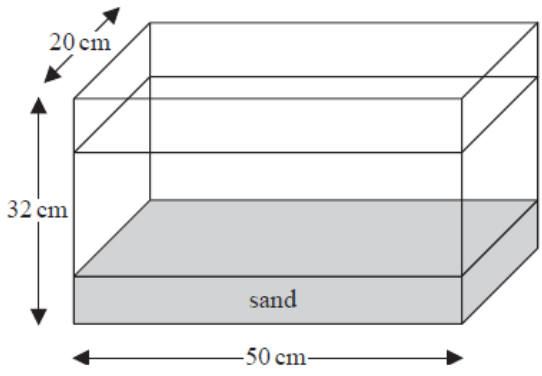
..... **5 marks**

Full Lesson Here

Answer: 4

Volume of Prisms

The diagram shows a fish tank in the shape of a cuboid.



The dimensions of the tank are 50 cm by 32 cm by 20 cm.

The tank is $\frac{3}{4}$ full of water and sand.

The ratio of the volume of water to the volume of sand is 5 : 1

Work out the number of litres of water in the tank.
You must show all your working.

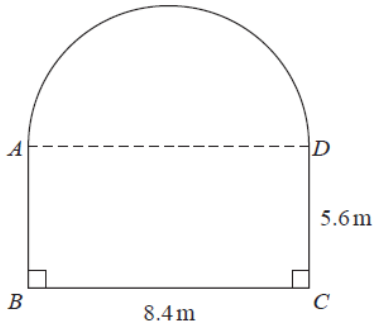
..... **5 marks**

Full Lesson Here

Answer: 20

Area and Circumference of a Circle

A garden is in the shape of a rectangle, $ABCD$, and a semicircle.
AD is the diameter of the semicircle.



Carol is going to cover the garden with fertiliser.

A box of fertiliser costs £4.99
Carol has been told that one box of fertiliser will cover 12 m^2 of garden.

(a) Work out the cost of buying enough fertiliser to cover the garden completely.

Carol finds out that one box of fertiliser will cover more than 12 m^2 of garden.

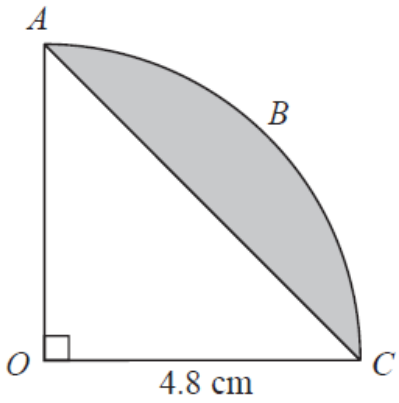
(b) Explain how this might affect the number of boxes she needs to buy.

..... **6 marks**

Full Lesson Here

Answer a) £34.93
b) May need to buy less boxes

Circle Sectors (Area)



The arc ABC is a quarter of a circle with centre O and radius 4.8 cm.
AC is a chord of the circle.

Work out the area of the shaded segment.
Give your answer correct to 3 significant figures.

..... **3 marks**

Full Lesson Here

Answer 6.56 - 6.58cm^2

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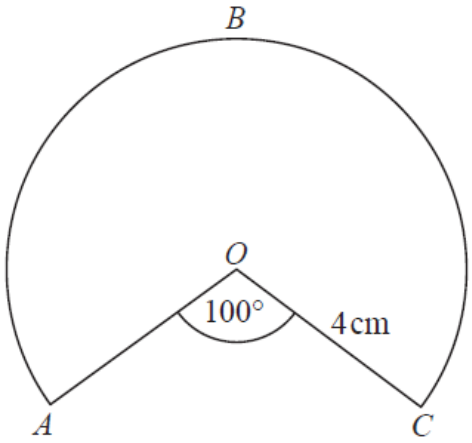
Circle Sectors (Arc Length)

The diagram shows a sector of a circle of radius 4 cm.



Work out the length of the arc ABC.
Give your answer correct to 3 significant figures.

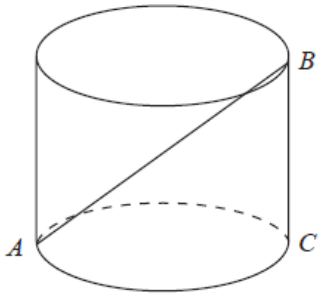
..... **2 marks**

Full Lesson Here

Answer 18.2cm

Cylinders

The diagram shows a metal rod, AB, resting inside a cylindrical tin.



The tin is on a horizontal table.
AC is a diameter of the base of the tin.
B is on the top edge of the tin.
BC is vertical.

The radius of the base of the tin is 5 cm.
The volume of the tin is 1178 cm^3

Find the angle between the rod and the base of the tin.
Give your answer correct to the nearest degree.

..... **4 marks**

Full Lesson Here

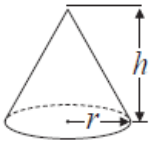
Answer 56°

Cones

A cone has a volume of 98 cm^3.
The radius of the cone is 5.13 cm.

(a) Work out an estimate for the height of the cone.

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



John uses a calculator to work out the height of the cone to 2 decimal places.

(b) Will your estimate be more than John's answer or less than John's answer?
Give reasons for your answer.

Full Lesson Here

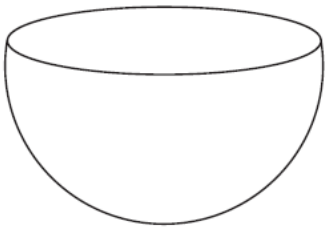
.....

4 marks

Answer
a) 3.5 - 4.5
b) More, the numerator goes up & denominator goes down.

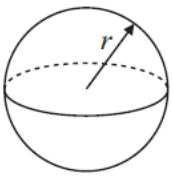
Spheres

The diagram shows a solid hemisphere.



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

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



The volume of the hemisphere is $\frac{250}{3}\pi$

Work out the exact total surface area of the solid hemisphere.
Give your answer as a multiple of π.

Full Lesson Here

.....

4 marks

Answer
75π

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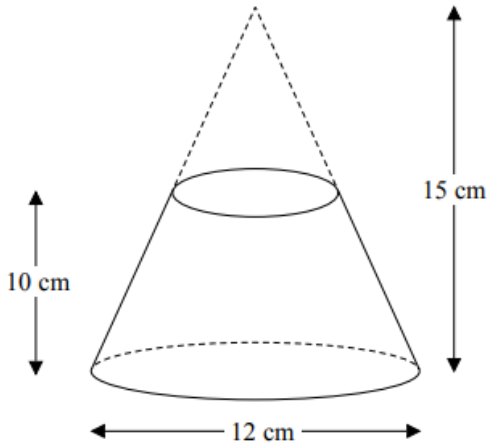
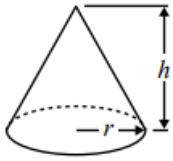
Volume of a Frustum

A frustum is made by removing a small cone from a large cone as shown in the diagram.



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



The frustum is made from glass.
The glass has a density of 2.5 g / cm^3

Work out the mass of the frustum.
Give your answer to an appropriate degree of accuracy.

..... **5 marks**

Full Lesson Here

Answer
1360 - 1362g

Error Intervals

A number, y, is rounded to 2 significant figures.

The result is 0.46

Write down the error interval for y.

..... **2 marks**

Full Lesson Here

Answer
$0.455 \leq x < 0.465$

Truncation

Kiera used her calculator to work out the value of a number x.
She wrote down the first two digits of the answer on her calculator.

She wrote down 7.3

Write down the error interval for x.

Full Lesson Here

Answer: $6.3 \leq x < 7.4$

..... **2 marks**

Bounds Calculations

$$m = \frac{\sqrt{s}}{t}$$

$s = 3.47$ correct to 3 significant figures

$t = 8.132$ correct to 4 significant figures

By considering bounds, work out the value of m to a suitable degree of accuracy.
Give a reason for your answer.

Full Lesson Here

Answer: 0.229 (3dp)

..... **5 marks**

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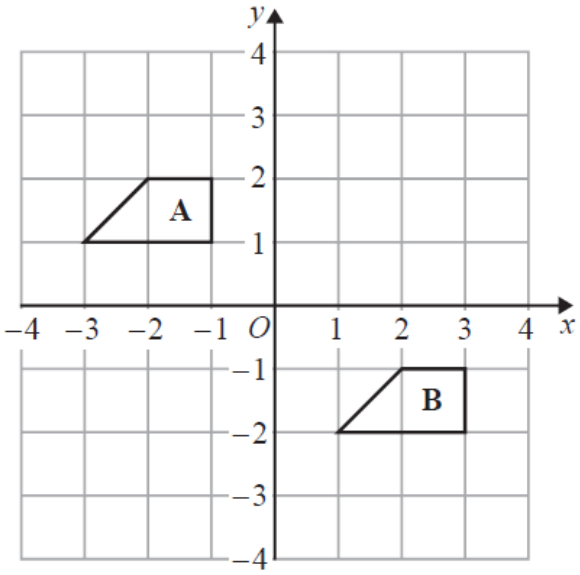
Translations



Describe the single transformation that maps shape **A** onto shape **B**.

..... **2 marks**

Full Lesson Here

Answer: Translation by the vector $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$

Column Vectors

Shape **A** is translated by the vector $\begin{pmatrix} 4 \\ -7 \end{pmatrix}$ to make Shape **B**.

Shape **B** is then translated by the vector $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$ to make Shape **C**.

Describe the single transformation that maps Shape **A** onto Shape **C**.

..... **2 marks**

Full Lesson Here

Answer: Translation by the vector $\begin{pmatrix} 1 \\ -9 \end{pmatrix}$

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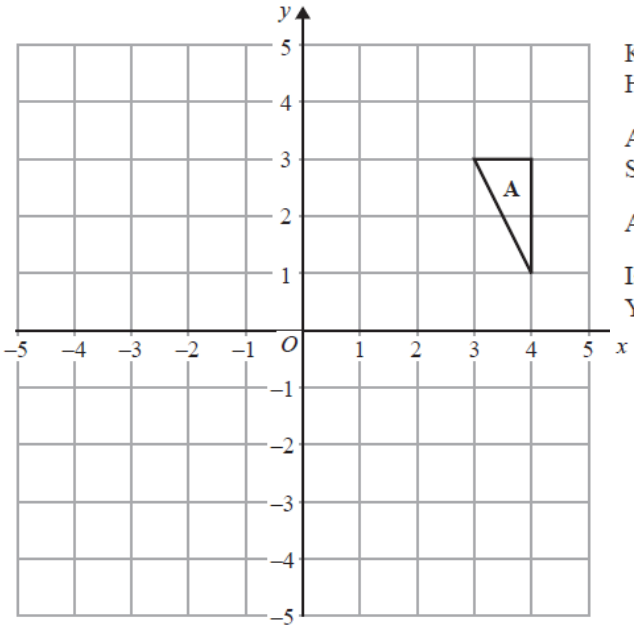
Reflections



Kyle reflects triangle **A** in the x-axis to get triangle **B**.
He then reflects triangle **B** in the line $y = x$ to get triangle **C**.

Amy reflects triangle **A** in the line $y = x$ to get triangle **D**.
She is then going to reflect triangle **D** in the x-axis to get triangle **E**.

Amy says that triangle **E** should be in the same position as triangle **C**.

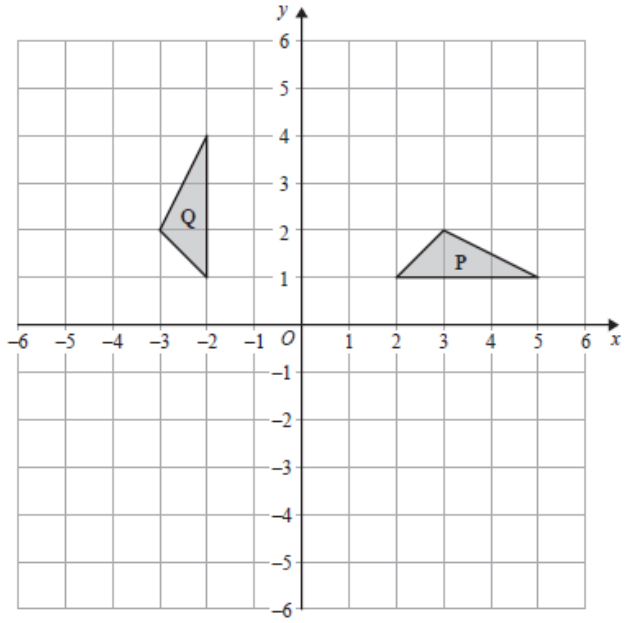
Is Amy correct?
You must show how you get your answer.

Full Lesson Here

Answer
No, C is a rotation of 90° anti-clockwise about O

..... **3 marks**

Rotations



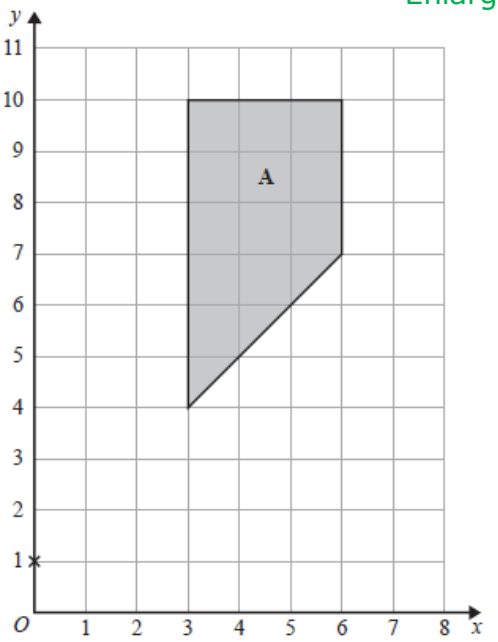
Describe fully the single transformation that maps triangle **P** onto triangle **Q**.

Full Lesson Here

Answer
Rotation, 90°, Anti-Clockwise, Centre (0,-1)

..... **2 marks**

Enlargements



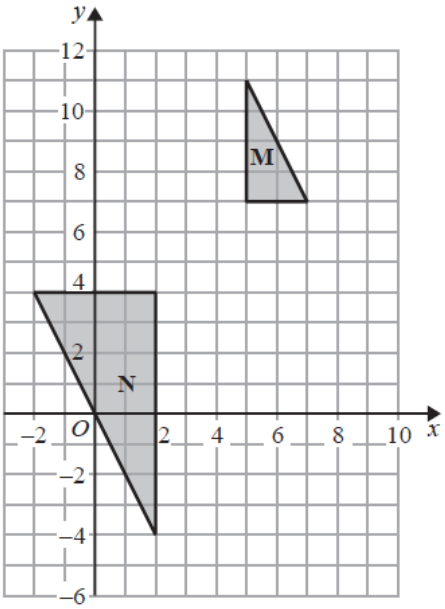
Enlarge shape **A** by scale factor $\frac{1}{3}$ centre (0, 1)

..... **2 marks**

Full Lesson Here

Answer
Correct enlargement at (1,2), (2,3), (2,4), (1,4)

Negative Enlargements



Describe fully the single transformation that maps triangle **M** onto triangle **N**.

..... **2 marks**

Full Lesson Here

Answer
Enlargement, SF -2, Centre (4,6)

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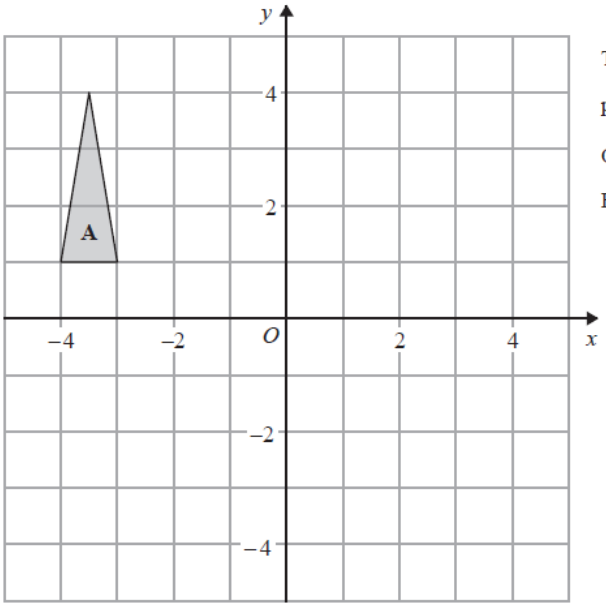
Invariant Points



Triangle **A** is transformed by the combined transformation of a rotation of 180° about the point (−2, 0) followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle **A** is invariant under the combined transformation.

Find the coordinates of this point.

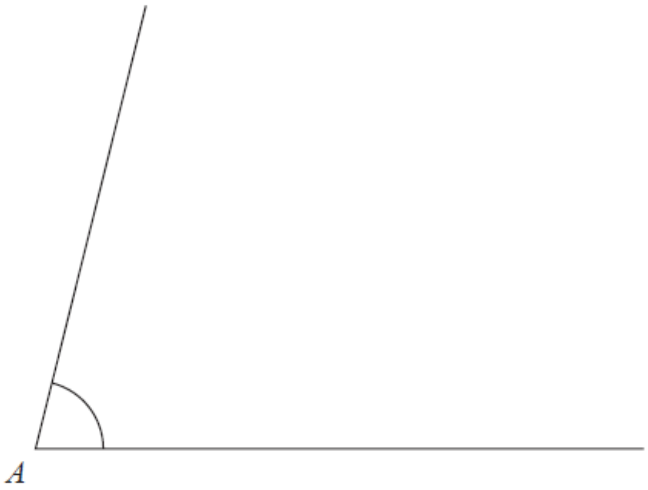
Full Lesson Here

Answer (-3.5,1)

..... **2 marks**

Angle Bisector

Use ruler and compasses to bisect the angle at A.
You must show all your construction lines.



Full Lesson Here

Answer Correct Construction Drawn

..... **2 marks**

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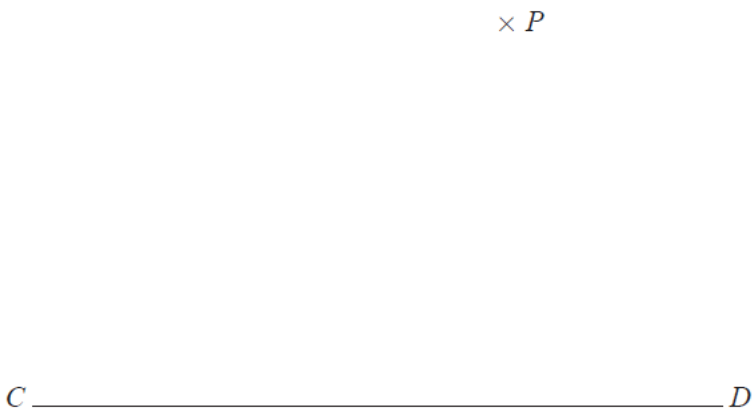
Perpendicular Bisector

Use a ruler and compasses to construct the line from the point P perpendicular to the line CD.
You must show **all** construction lines.



2 marks

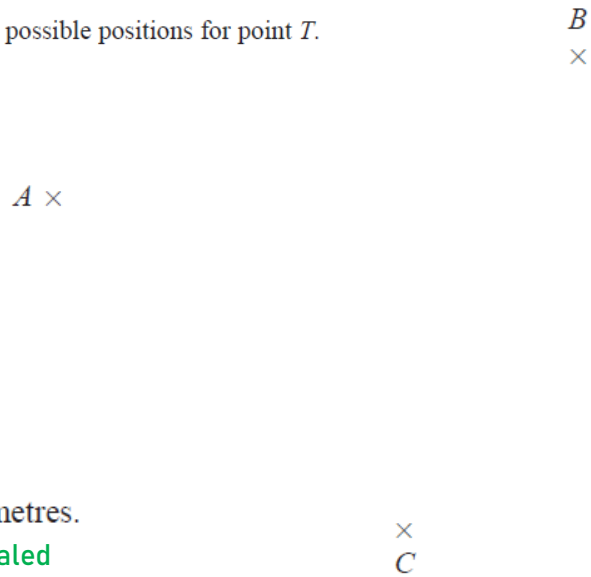
Full Lesson Here

Answer
Perpendicular line constructed through P

Loci Problems

Point T is 250 metres from point A.
Point T is equidistant from point B and point C.

On the map, show one of the possible positions for point T.



1 cm represents 100 metres.

Note: The image is scaled down so it will be different but you can still do it!

3 marks

Full Lesson Here

Answer
2.5cm circle around A and a perpendicular bisector of BC

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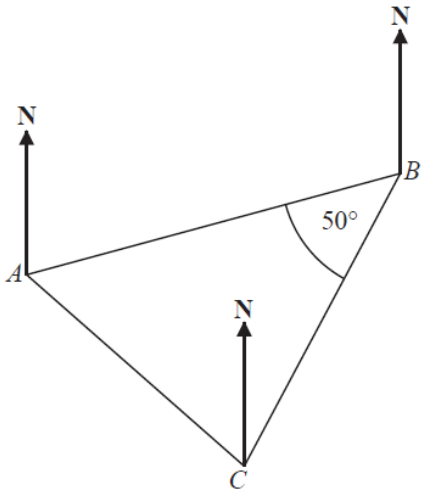
Bearings



The bearing of B from A is 070°

Angle ABC is 50°
$AB = CB$

Work out the bearing of C from A.

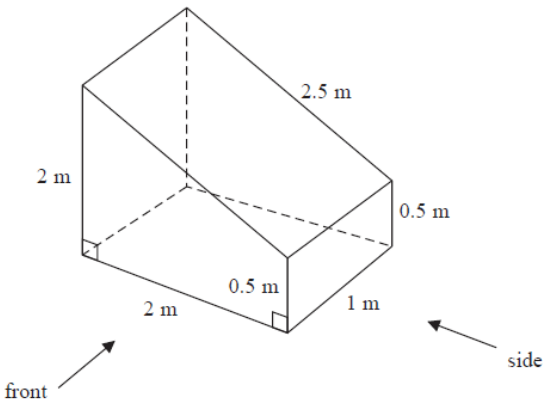
..... **3 marks**

Full Lesson Here

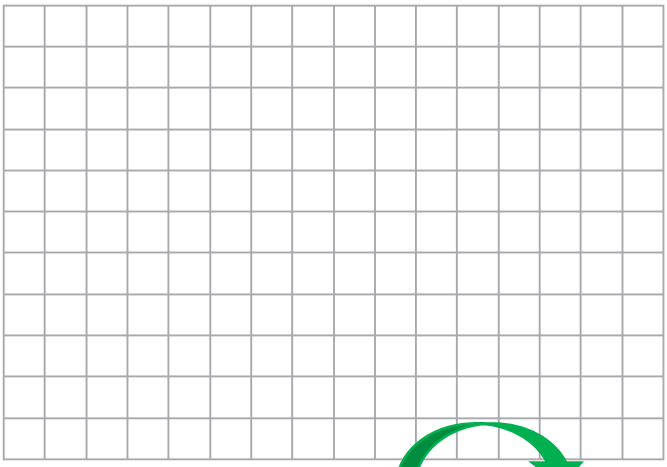
Answer: 135°

Plans and Elevations

The diagram shows a prism with a cross section in the shape of a trapezium.



On the centimetre grid below, draw the front elevation and the side elevation of the prism.
Use a scale of 2 cm to 1 m.



..... **4 marks**

Full Lesson Here

Answer: Side: 4x2 rectangle with a line drawn 1cm from the 2cm edge. Front: Trapezium base 4cm, parallel sides 1cm and 4cm

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Factorising Harder Quadratics

Factorise $2p^2 - p - 10$

Full Lesson Here

.....

2 marks

Answer: $(2p - 5)(p + 2)$

Solve Quadratic Equations by Factorising

Solve $x^2 + 5x - 24 = 0$

Full Lesson Here

.....

3 marks

Answer: $x = -8$ and $x = 3$

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Completing the Square

Write $x^2 + 2x - 8$ in the form $(x + m)^2 + n$
where m and n are integers.

Full Lesson Here

.....

2 marks

Answer
$(x + 1)^2 - 9$

Harder Completing the Square

(a) Write $2x^2 + 16x + 35$ in the form $a(x + b)^2 + c$ where a, b, and c are integers.

(b) Hence, or otherwise, write down the coordinates of the turning point of the graph of $y = 2x^2 + 16x + 35$

Full Lesson Here

.....

4 marks

Answer
a) $2(x + 4)^2 + 3$
b) $(-4, 3)$

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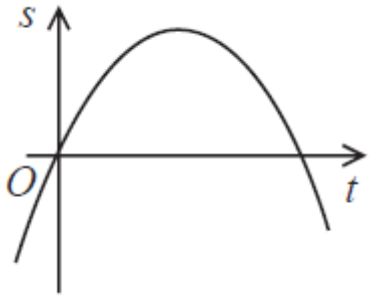
Negative Quadratics

A particle P is moving in a straight line.
O is a fixed point on the straight line.
The distance, s metres, of P from O at time t seconds is given by

$$s = 80t - 5t^2$$

Use algebra to find the greatest distance of P from O when $0 \leqslant t \leqslant 16$



Full Lesson Here

..... **4 marks**

Answer: 320

The Quadratic Formula

Solve $x^2 - 5x + 3 = 0$

Give your solutions correct to 3 significant figures.

Full Lesson Here

..... **3 marks**

Answer: 4.30 and 0.697

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Simultaneous Equations

Solve the simultaneous equations

$$2x - 4y = 19$$
$$3x + 5y = 1$$

Full Lesson Here

.....

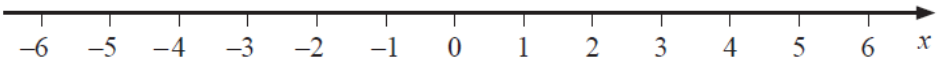
4 marks

Answer
x = 4.5
y = -2.5

Solving Inequalities and Number Lines

(a) Solve $14n > 11n + 6$

(b) On the number line below, show the set of values of x for which $-2 < x + 3 \leqslant 4$



Full Lesson Here

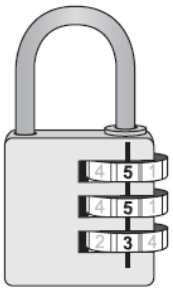
.....

4 marks

Answer
a) n > 2
b) Open circle above -5, closed circle above 1 and a line connecting them.

The Product Rule

There are three dials on a combination lock.
Each dial can be set to one of the numbers 1, 2, 3, 4, 5
The three digit number 553 is one way the dials can be set, as shown in the diagram.



(a) Work out the number of different three digit numbers that can be set for the combination lock.

(b) How many of the possible three digit numbers have three different digits?

..... **4 marks**

Full Lesson Here

Answer
a) 125
b) 60

Probability from a Table

There are only blue cubes, red cubes and yellow cubes in a box.

The table shows the probability of taking at random a blue cube from the box.

Colour	blue	red	yellow
Probability	0.2		

The number of red cubes in the box is the same as the number of yellow cubes in the box.

(a) Complete the table.

There are 12 blue cubes in the box.

(b) Work out the total number of cubes in the box.

..... **4 marks**

Full Lesson Here

Answer
a) 0.4, 0.4
b) 60

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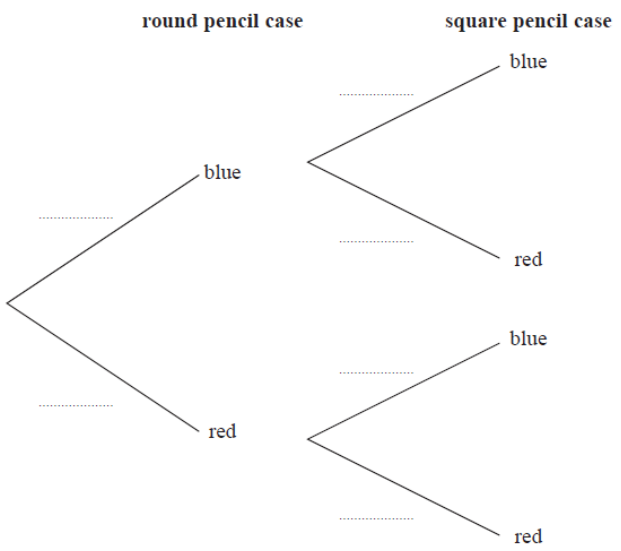
Probability Trees (Independent)



Sameena has a round pencil case and a square pencil case.

There are 4 blue pens and 3 red pens in the round pencil case.
There are 3 blue pens and 5 red pens in the square pencil case.

Sameena takes at random one pen out of each pencil case.

(a) Complete the probability tree diagram.

(b) Work out the probability that the pens Sameena takes are both red.

Full Lesson Here

.....

4 marks

Answer
a) Round: $\frac{4}{7}, \frac{3}{7}$
Square: $\frac{3}{8}, \frac{5}{8}, \frac{3}{8}, \frac{5}{8}$ b) $\frac{15}{56}$

Probability Trees (Dependent/Conditional)

There are 9 counters in a bag.

7 of the counters are green.
2 of the counters are blue.

Ria takes at random two counters from the bag.

Work out the probability that Ria takes one counter of each colour.
You must show your working.

Full Lesson Here

.....

4 marks

Answer
$\frac{28}{72}$ or equivalent

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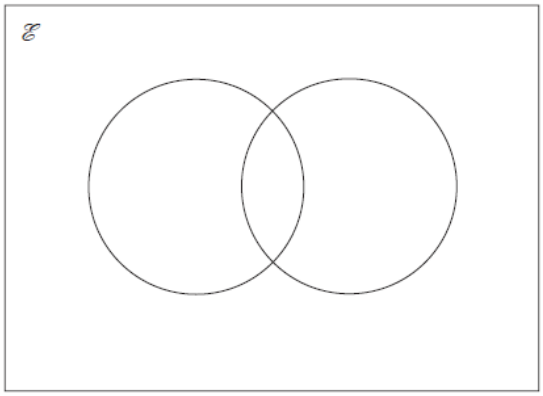
Venn Diagrams and Set Theory

$\mathscr{E}$ = {odd numbers less than 30}
A = {3, 9, 15, 21, 27}
B = {5, 15, 25}

(a) Complete the Venn diagram to represent this information.



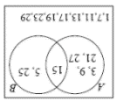
A number is chosen at random from the universal set, $\mathscr{E}$.

(b) What is the probability that the number is in the set $A \cup B$?

..... **6 marks**

Full Lesson Here

Answer a) b) $\frac{7}{15}$

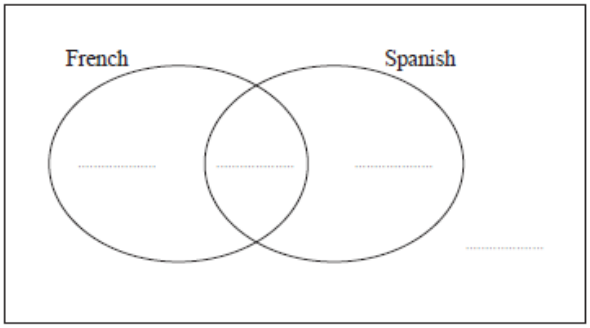


Solving Problems with Venn Diagrams 1

There are 60 students at a college.

20 students study both French and Spanish.
13 students study French but not Spanish.
A total of 43 students study Spanish.

(a) Complete the Venn diagram for this information.

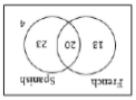


One of the students at the college is to be selected at random.

(b) Write down the probability that this student studies neither French nor Spanish.

..... **4 marks**

Full Lesson Here

Answer a)  b) $\frac{4}{60}$

Solving Problems with Venn Diagrams 2

50 people were asked if they speak French or German or Spanish.

Of these people,

31 speak French
2 speak French, German and Spanish
4 speak French and Spanish but not German
7 speak German and Spanish
8 do not speak any of the languages
all 10 people who speak German speak at least one other language

Two of the 50 people are chosen at random.

Work out the probability that they both only speak Spanish.

Full Lesson Here

Answer $\frac{6}{490}$ or equivalent

..... **5 marks**

Probability Equations

There are only green pens and blue pens in a box.

There are three more blue pens than green pens in the box.
There are more than 12 pens in the box.

Simon is going to take at random two pens from the box.

The probability that Simon will take two pens of the same colour is $\frac{27}{55}$

Work out the number of green pens in the box.

Full Lesson Here

Answer 21

..... **6 marks**

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Compound Interest without a Calculator

Toby invested £7500 for 2 years in a savings account.
He was paid 4% per annum compound interest.

How much money did Toby have in his savings account at the end of 2 years?

Full Lesson Here

Answer £8112

..... **2 marks**

Compound Interest

Katy invests £200 000 in a savings account for 4 years.
The account pays compound interest at a rate of 1.5% per annum.

Calculate the total amount of interest Katy will get at the end of 4 years.

Full Lesson Here

Answer £12,272.70 - £12,272.72

..... **3 marks**

Reverse Compound Interest

Naoby invests £6000 for 5 years.
The investment gets compound interest of x% per annum.

At the end of 5 years the investment is worth £8029.35

Work out the value of x.

Full Lesson Here

.....

3 marks

Answer

6%

Depreciation

Natalia pays £13 995 for a car.
Lauren pays £14 495 for a car.

Assume that

the rate of depreciation for Natalia's car is 12% per annum
and the rate of depreciation for Lauren's car is 13% per annum.

(a) Work out whose car will have the greater value at the end of 3 years.
You must show all your working.

The rate of depreciation assumed for Natalia's car was too low.

(b) How does this affect the value of her car at the end of 3 years?

Full Lesson Here

.....

5 marks

Answer

a) Lauren
b) Her car will be worth less

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Speed, Distance and Time (Non-Calculator)

Gary drove from London to Sheffield.
It took him 3 hours at an average speed of 80km/h.

Lyn drove from London to Sheffield.
She took 5 hours.

Assuming that Lyn
drove along the same roads as Gary
and did not take a break,

(a) work out Lyn's average speed from London to Sheffield.

(b) If Lyn did **not** drive along the same roads as Gary, explain how this could affect your answer to part (a).

Full Lesson Here

..... **4 marks**

Answer
a) 48km/h
b) She may drive a different distance / have a different average speed

Speed, Distance and Time Journeys

Olly drove 56 km from Liverpool to Manchester.
He then drove 61 km from Manchester to Sheffield.

Olly's average speed from Liverpool to Manchester was 70 km/h.
Olly took 75 minutes to drive from Manchester to Sheffield.

Work out Olly's average speed for his total drive from Liverpool to Sheffield.

Full Lesson Here

..... **4 marks**

Answer
57.1km/h

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Density, Mass and Volume

A gold bar has a mass of 12.5 kg.

The density of gold is 19.3 g/cm^3

Work out the volume of the gold bar.
Give your answer correct to 3 significant figures.

Full Lesson Here

Answer 648cm^3

..... **3 marks**

Density, Mass and Volume Mixtures

The density of apple juice is 1.05 grams per cm^3.

The density of fruit syrup is 1.4 grams per cm^3.

The density of carbonated water is 0.99 grams per cm^3.

25 cm^3 of apple juice are mixed with 15 cm^3 of fruit syrup and
280 cm^3 of carbonated water to make a drink with a volume of 320 cm^3.

Work out the density of the drink.
Give your answer correct to 2 decimal places.

Full Lesson Here

Answer 1.01g/cm^3

..... **4 marks**

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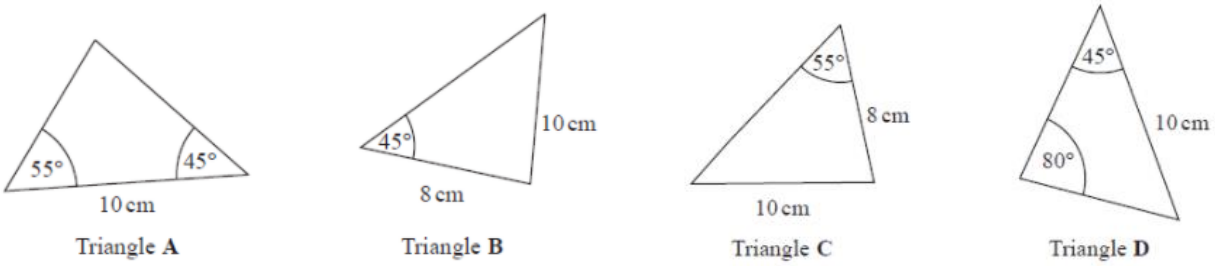
Congruent Triangles



Two of these triangles are congruent.

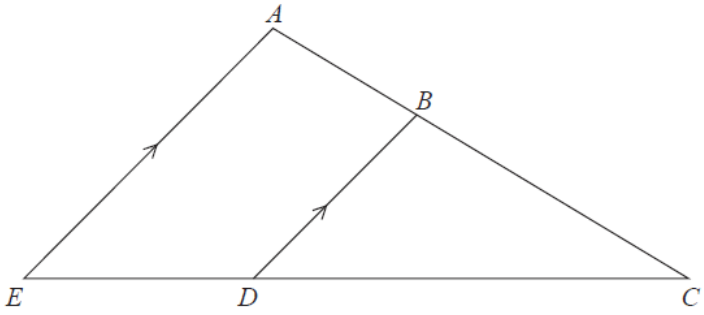
Write down the letters of these two triangles.

Full Lesson Here

Answer: A and D

..... **1 mark**

Similar Shapes (Lengths)



ABC and *EDC* are straight lines.
EA is parallel to *DB*.

EC = 8.1 cm.
DC = 5.4 cm.
DB = 2.6 cm.

(a) Work out the length of *AE*.

AC = 6.15 cm.

(b) Work out the length of *AB*.

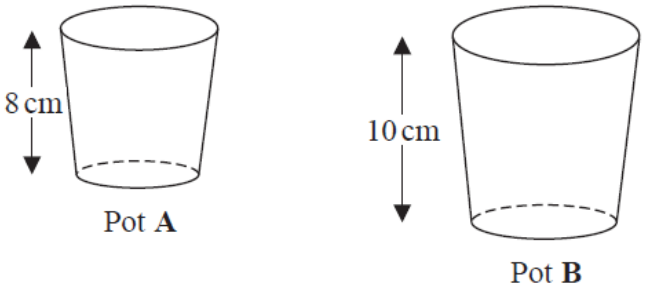
Full Lesson Here

Answer: a) 3.9cm b) 2.05cm

..... **4 marks**

Similar Shapes (Area and Volume)

Here are two pots.



Pot **A** and pot **B** are mathematically similar.

The area of the base of pot **B** is 160 cm^2.

Work out the area of the base of pot **A**.

Full Lesson Here

Answer: 102.4cm^2

..... **2 marks**

Similar Shapes with Ratios

Three solid shapes **A**, **B** and **C** are similar.

The surface area of shape **A** is 4 cm^2
The surface area of shape **B** is 25 cm^2

The ratio of the volume of shape **B** to the volume of shape **C** is 27 : 64

Work out the ratio of the height of shape **A** to the height of shape **C**.
Give your answer in its simplest form.

Full Lesson Here

Answer: 3:10

..... **4 marks**

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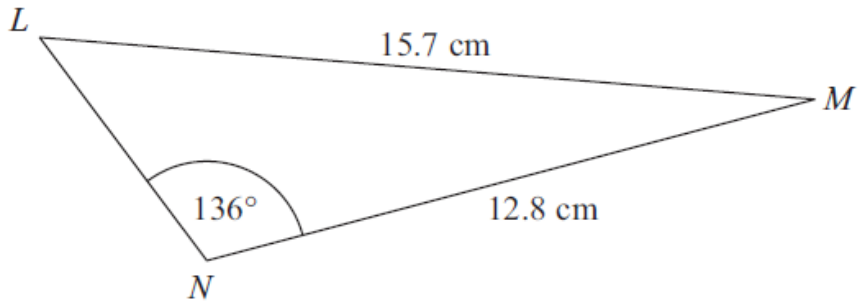
The Sine Rule

The diagram shows triangle LMN.



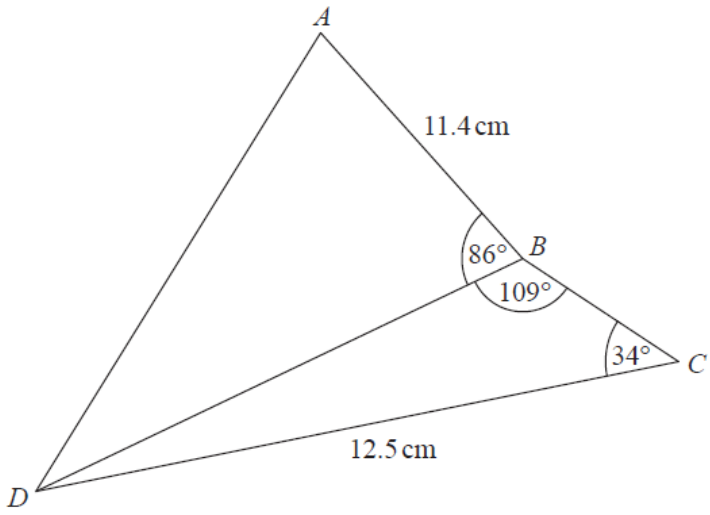
Calculate the length of LN.
Give your answer correct to 3 significant figures.

Full Lesson Here

Answer 3.73-3.74cm

..... **5 marks**

The Cosine Rule



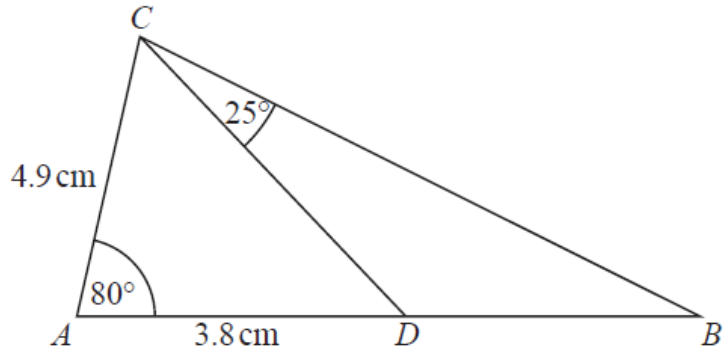
Work out the length of AD.
Give your answer correct to 3 significant figures.

Full Lesson Here

Answer 13.1cm

..... **5 marks**

Area of a Triangle



ABC is a triangle.
D is a point on *AB*.

Work out the area of triangle *BCD*.
Give your answer correct to 3 significant figures.

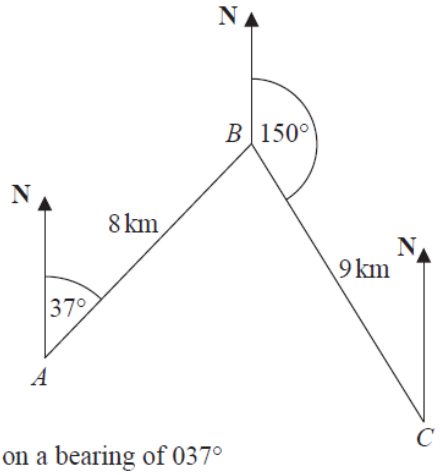
Full Lesson Here

Answer 10.4cm^2

..... **5 marks**

Bearings with Trigonometry

The diagram shows the positions of three towns, Acton (*A*), Barston (*B*) and Chorlton (*C*).



Barston is 8 km from Acton on a bearing of 037°
Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.
Give your answer correct to 1 decimal place.
You must show all your working.

Full Lesson Here

Answer 098.6°

..... **5 marks**

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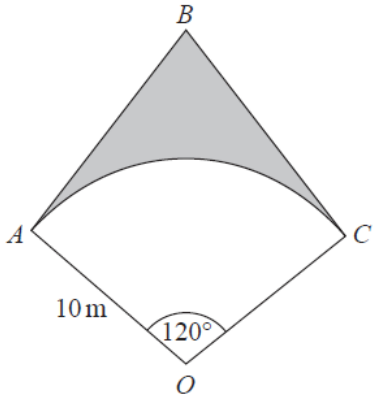
Circle Sectors with Trigonometry



OAC is a sector of a circle, centre O, radius 10 m.

BA is the tangent to the circle at point A.
BC is the tangent to the circle at point C.

Angle $AOC = 120°$

Calculate the area of the shaded region.
Give your answer correct to 3 significant figures.

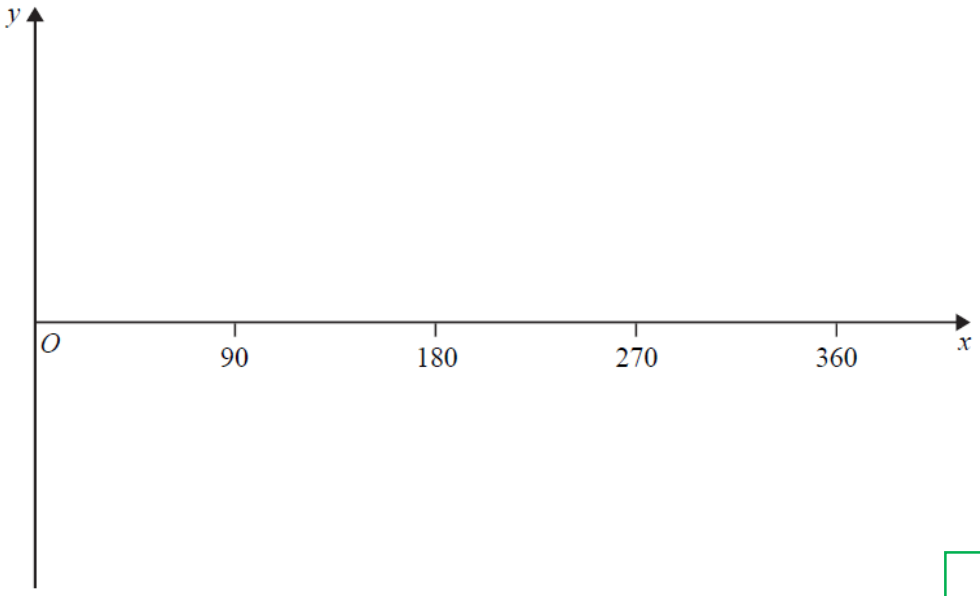
..... **5 marks**

Full Lesson Here

Answer $68.5m^2$

Trigonometric Graphs

Sketch the graph of $y = \cos x°$ for $0 \leqslant x \leqslant 360$



..... **2 marks**

Full Lesson Here

Answer Sketch Drawn

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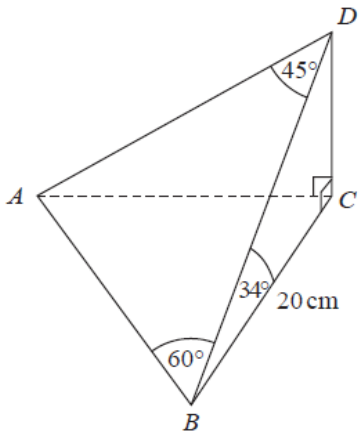
3D Trigonometry

The diagram shows a pyramid with base ABC.



CD is perpendicular to both CA and CB.
Angle $CBD = 34°$ Angle $ADB = 45°$ Angle $DBA = 60°$
$BC = 20$ cm.

Calculate the size of the angle between the line AD and the plane ABC.
Give your answer correct to 1 decimal place.

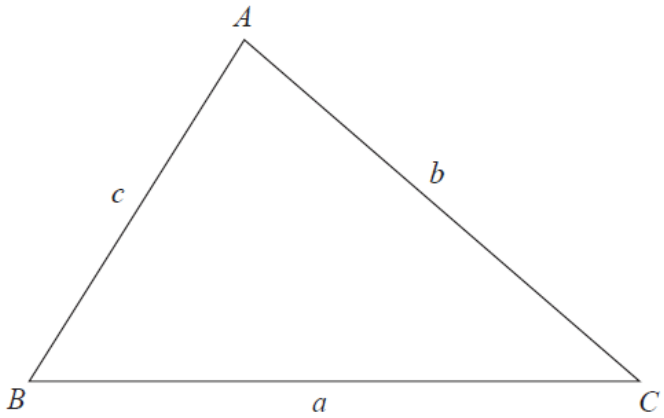
..... **5 marks**

Full Lesson Here

Answer
38.6°

Proving the Trigonometric Formulas

The diagram shows an acute-angled triangle ABC.



Prove that area of triangle $ABC = \frac{1}{2}ab\sin C$

..... **3 marks**

Full Lesson Here

Answer
Proof Shown

Sampling and Bias

Hannah is planning a day trip for 195 students.

She asks a sample of 30 students where they want to go.
Each student chooses one place.

The table shows information about her results.

Place	Number of students
Theme Park	10
Theatre	5
Sports Centre	8
Seaside	7

(i) Work out how many of the 195 students you think will want to go to the Theme Park.

(ii) State any assumption you made **and** explain how this may affect your answer.

..... **3 marks**

Full Lesson Here

Answer
a) 65
b) The sample is representative it could be more or less.

Capture Recapture

Alex wants to find out how many ducks there are in a park.

One day he puts a tag on each of 30 of the ducks.
The next day he catches 40 ducks.
8 of these ducks have tags on them.

(i) Work out an estimate for the number of ducks in the park.

Alex assumed that none of the tags fell off during the night.

(ii) If Alex's assumption is wrong, explain how this could affect your answer to part (i).

..... **4 marks**

Full Lesson Here

Answer
a) 150
b) Overestimated

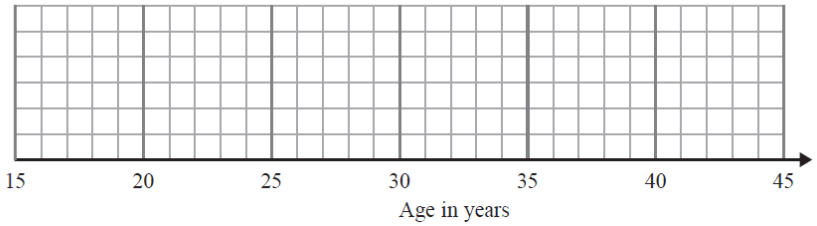
Box Plots

The stem and leaf diagram shows the ages, in years, of 25 people.

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

Key: 1|7 represents 17 years

(a) (i) On the grid, draw a box plot for this information.



One of these people is chosen at random.

(ii) What is the probability that this person is 30 years of age or older?

.....

5 marks

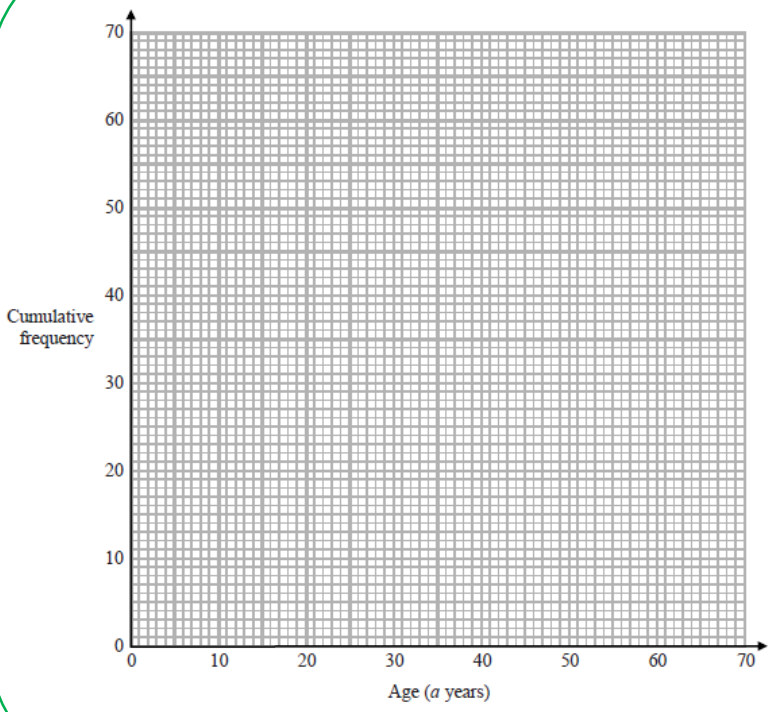
Full Lesson Here

Answer

a) LQ: 23, Med: 28, UQ: 32.5

b) $\frac{10}{25}$ or equivalent

Cumulative Frequency



Francesco carried out a survey about the ages of the people in his office.

The table shows information about his results.

Age (a years)	Cumulative frequency
$20 < a \leqslant 30$	10
$20 < a \leqslant 40$	26
$20 < a \leqslant 50$	58
$20 < a \leqslant 60$	66
$20 < a \leqslant 70$	70

(a) On the grid opposite, draw a cumulative frequency graph for this information.

(b) Use your graph to find an estimate for the median age.

.....

3 marks

Full Lesson Here

Answer

a) correct graph drawn

b) 41 - 45

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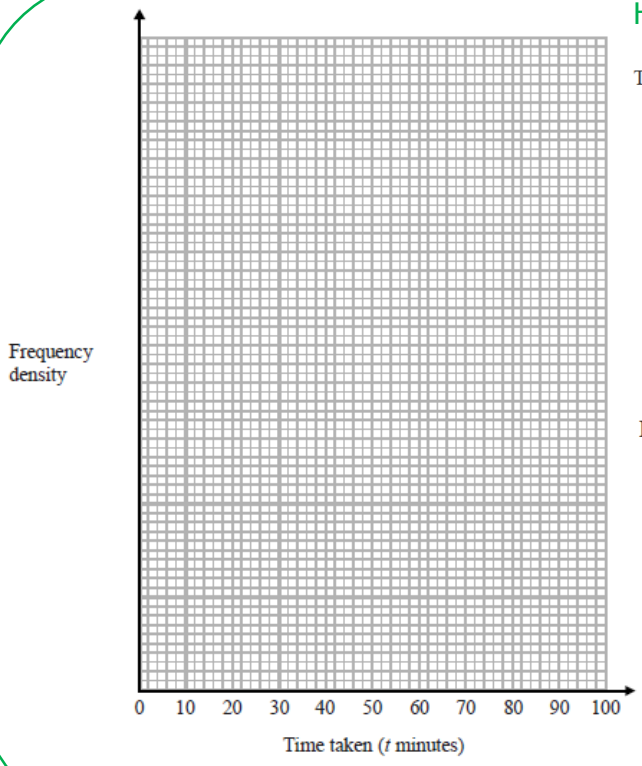
Histograms



The table shows information about the times a group of students took to do a park run.

Time taken (t minutes)	Frequency
$0 < t \leqslant 25$	20
$25 < t \leqslant 45$	35
$45 < t \leqslant 60$	45
$60 < t \leqslant 75$	87
$75 < t \leqslant 85$	10
$85 < t \leqslant 95$	8

Draw a histogram for this information.

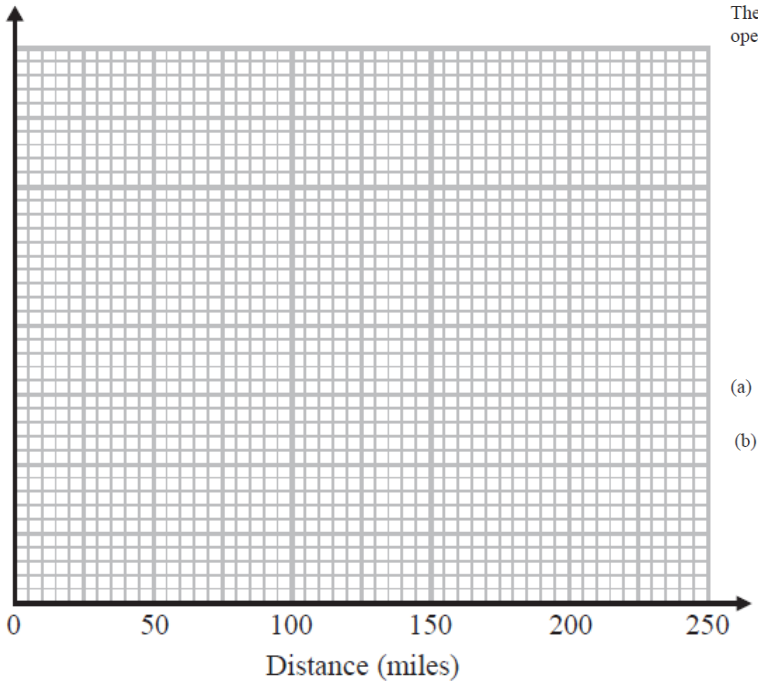
Full Lesson Here

.....

3 marks

Answer
Correct graph drawn

Averages from a Histogram



The table shows information about the distances 570 students travelled to a university open day.

Distance (d miles)	Frequency
$0 < d \leqslant 20$	120
$20 < d \leqslant 50$	90
$50 < d \leqslant 80$	120
$80 < d \leqslant 150$	140
$150 < d \leqslant 200$	100

(a) Draw a histogram for the information in the table.

(b) Estimate the median distance.

Full Lesson Here

.....

5 marks

Answer
a) Histogram drawn and labelled b) 66-71

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Expanding Triple Brackets

Show that

$$(3x - 1)(x + 5)(4x - 3) = 12x^3 + 47x^2 - 62x + 15$$

for all values of x.

Full Lesson Here

Answer
Correct expansion shown

..... **3 marks**

Completing the Square to find Turning Points

Given that $x^2 - 6x + 1 = (x - a)^2 - b$ for all values of x,

(i) find the value of a and the value of b.

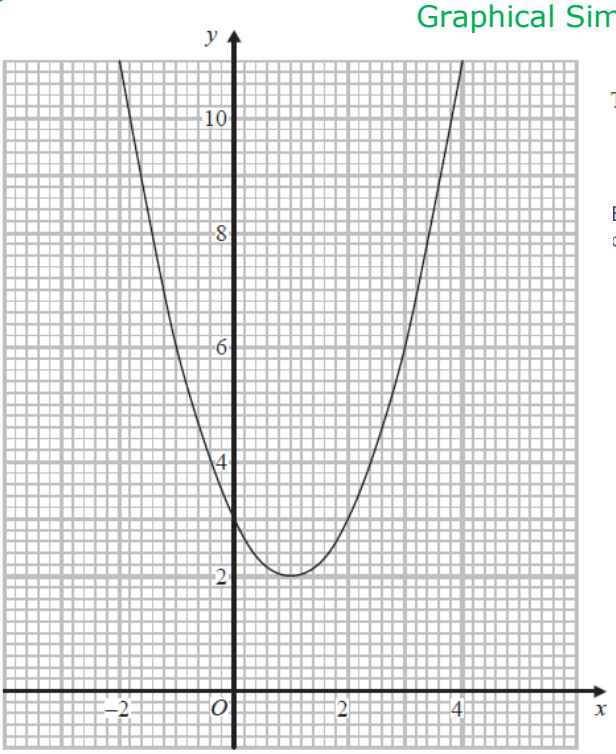
(ii) Hence write down the coordinates of the turning point on the graph of $y = x^2 - 6x + 1$

Full Lesson Here

Answer
a) a=3 b=8
b) (3,-8)

..... **3 marks**

Graphical Simultaneous Equations



The diagram shows part of the graph of $y = x^2 - 2x + 3$

By drawing a suitable straight line, use your graph to find estimates for the solutions of $x^2 - 3x - 1 = 0$

..... **2 marks**

Full Lesson Here

Answer: -0.4 to -0.2 and 3.2 to 3.4

Quadratic Simultaneous Equations

Solve algebraically the simultaneous equations

$$x^2 + y^2 = 25$$
$$y - 3x = 13$$

..... **5 marks**

Full Lesson Here

Answer: $x = -3$ $y = 4$ or $x = -\frac{24}{5}$ $y = -\frac{7}{5}$

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Iterations

(a) Show that the equation $x^3 + 5x - 4 = 0$ has a solution between $x = 0$ and $x = 1$

(b) Show that the equation $x^3 + 5x - 4 = 0$ can be arranged to give $x = \dfrac{4}{x^2 + 5}$

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \dfrac{4}{x_n^{\,2} + 5}$ twice,

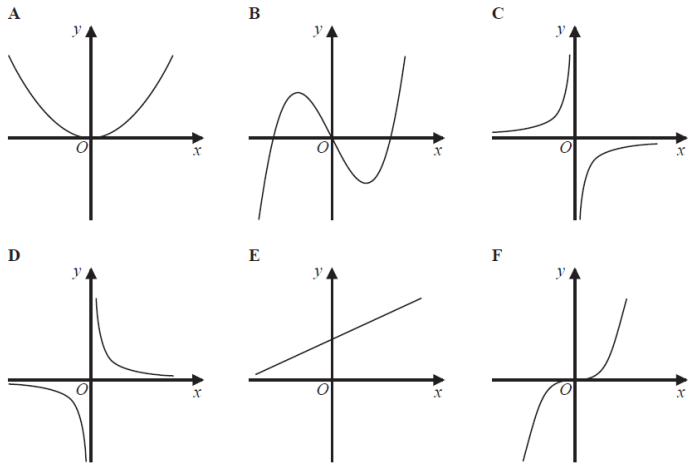
to find an estimate for the solution of $x^3 + 5x - 4 = 0$

..... **7 marks**

Full Lesson Here

Answer
a) 0 and 1 substituted in.
b) Rearrangement shown.
c) 0.709 or $^{100}/_{141}$

Recognising Different Graphs



Write down the letter of the graph that could have the equation

(a) $y = x^3$

(b) $y = \dfrac{1}{x}$

..... **2 marks**

Full Lesson Here

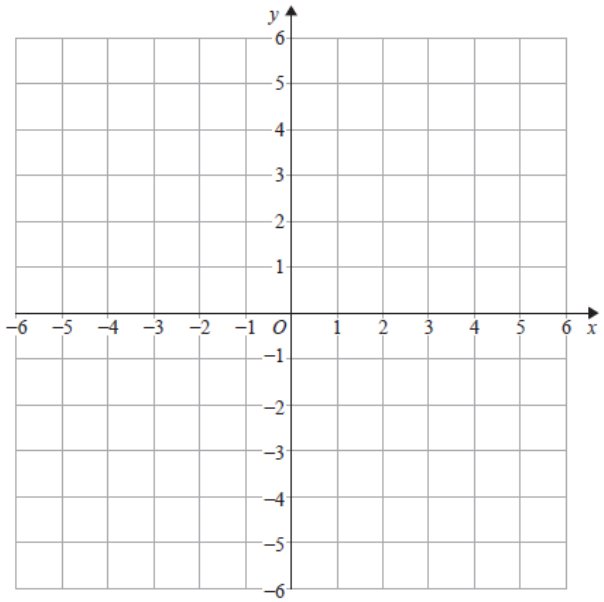
Answer
a) F b) D

Graphical Inequalities and Regions

On the grid, shade the region that satisfies all these inequalities.

$y > 1$ $x + y < 5$ $y > 2x$

Label the region **R**.



..... **3 marks**

Full Lesson Here

Answer: Region R shaded

Quadratic Inequalities

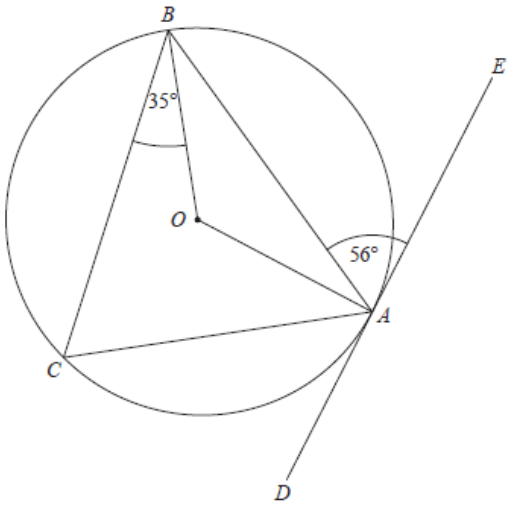
Solve $2x^2 + 3x - 2 > 0$

..... **3 marks**

Full Lesson Here

Answer: $x < -2, x > \frac{1}{2}$

Circle Theorems 1



A, B and C are points on the circumference of a circle, centre O.
DAE is the tangent to the circle at A.

Angle $BAE = 56°$
Angle $CBO = 35°$

Work out the size of angle CAO.
You must show all your working.

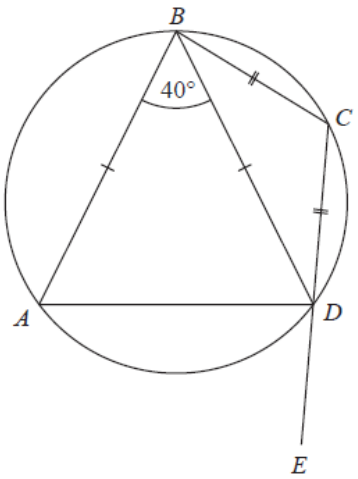
..... **3 marks**

Full Lesson Here

Answer: Region R shaded

Circle Theorems 2

The points A, B, C and D lie on a circle.
CDE is a straight line.



$BA = BD$
$CB = CD$
Angle $ABD = 40°$

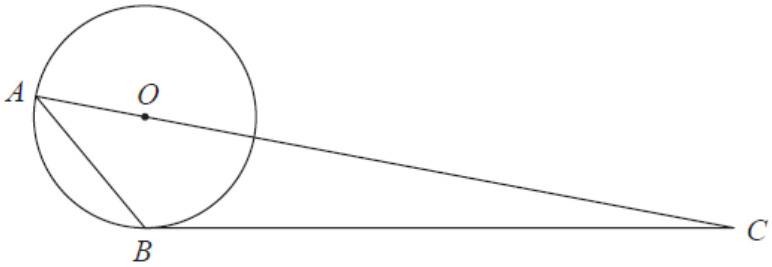
Work out the size of angle ADE.
You must give a reason for each stage of your working.

..... **5 marks**

Full Lesson Here

Answer: 75° Reasons given

Difficult Circle Theorems



A and B are points on a circle, centre O.

BC is a tangent to the circle.
AOC is a straight line.
Angle $ABO = x°$.

Find the size of angle ACB, in terms of x.
Give your answer in its simplest form.
Give reasons for each stage of your working.

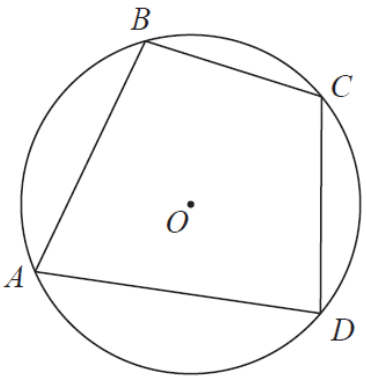
Full Lesson Here

..... **5 marks**

Answer: 90 - 2x
Reasons given

Circle Theorem Proof

A, B, C and D are points on the circumference of a circle, centre O.



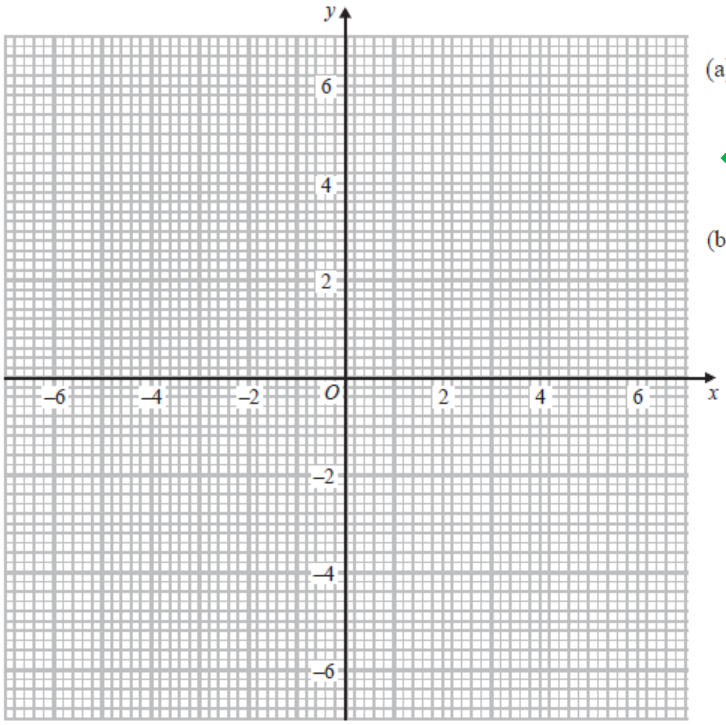
Prove that the sum of angle ABC and angle ADC is 180°

Full Lesson Here

..... **4 marks**

Answer: Proof shown

Equation of a Circle



(a) On the grid, draw the graph of $x^2 + y^2 = 12.25$

(b) Hence find estimates for the solutions of the simultaneous equations

$$x^2 + y^2 = 12.25$$
$$2x + y = 1$$

Full Lesson Here

.....

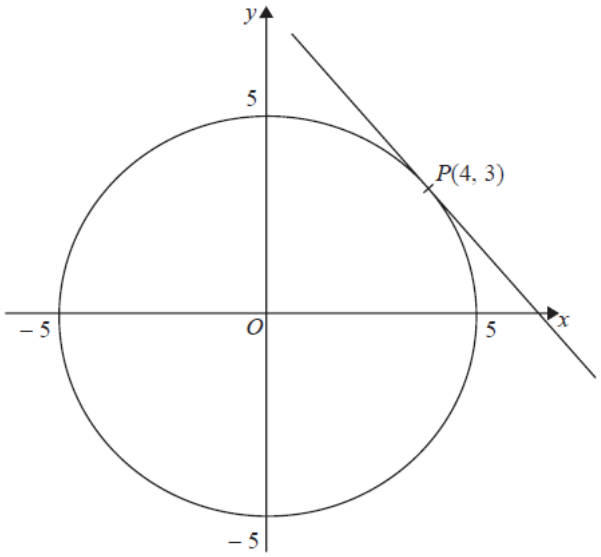
5 marks

Answer

a) radius 3.5 centre 0
b) x=2,y=-2.9 and x=-1.2, y=3.3

Equation of a Tangent to a Circle

Here is a circle, centre O, and the tangent to the circle at the point $P(4, 3)$ on the circle.



Find an equation of the tangent at the point P.

Full Lesson Here

.....

3 marks

Answer

$$y = -\frac{4}{3}x + \frac{25}{3}$$

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Changing the Subject with Factorising

Make t the subject of the formula $k = \dfrac{2(t+3)}{t-3}$

Full Lesson Here

.....

4 marks

Answer: $t = \frac{6+3k}{k-2}$ or equivalent

Simplifying Algebraic Fractions

Simplify $\dfrac{x^2 - 16}{2x^2 - 5x - 12}$

Full Lesson Here

.....

3 marks

Answer: $\frac{x+4}{2x+3}$

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Algebraic Fraction Calculations

Write

$$4 - \left[(x+3) \div \frac{x^2 + 5x + 6}{x - 2} \right]$$

as a single fraction in its simplest form.
You must show your working.

Full Lesson Here

..... **4 marks**

Answer: $\frac{3x + 10}{x + 2}$

Solve Algebraic Fraction Equations

Given that

$$2x - 1 \ : \ x - 4 \ = \ 16x + 1 \ : \ 2x - 1$$

find the possible values of x.

Full Lesson Here

..... **5 marks**

Answer: $x = -\frac{1}{12}, x = 5$

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Rationalising Harder Fractions

Show that $\dfrac{1}{1+\dfrac{1}{\sqrt{2}}}$ can be written as $2-\sqrt{2}$

Full Lesson Here

..... **3 marks**

Answer
Given result shown

Algebraic Proof

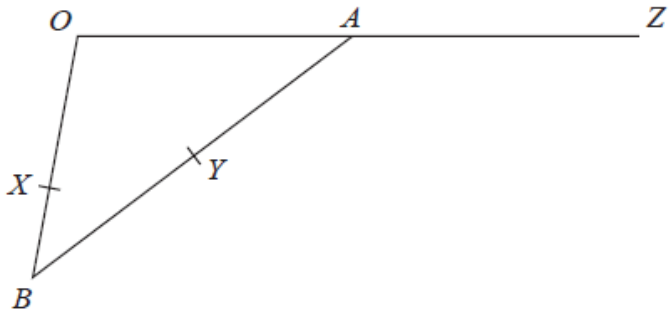
Prove that the sum of the squares of any three consecutive odd numbers is always 11 more than a multiple of 12

Full Lesson Here

..... **3 marks**

Answer
$12(n^2+3n+2)+11$

Vector Proof



OAB is a triangle.
A is the midpoint of OZ
Y is the midpoint of AB
X is a point on OB

$\overrightarrow{OA} = \mathbf{a}$ $\overrightarrow{OX} = 2\mathbf{b}$ $\overrightarrow{XB} = \mathbf{b}$

Prove that XYZ is a straight line.

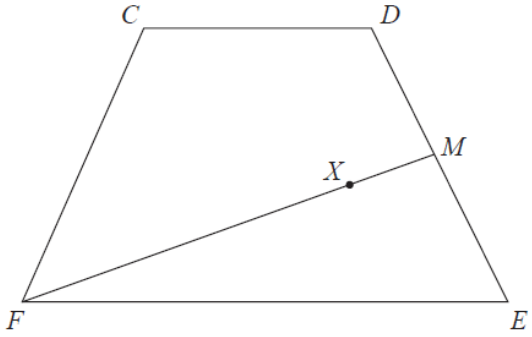
..... **5 marks**

Full Lesson Here

Answer: 2 of: $\frac{1}{2}(q-b)$, $\frac{3}{2}(q-b)$, $2(q-b)$

Vector Proof with Ratios

$CDEF$ is a quadrilateral.



$\overrightarrow{CD} = \mathbf{a}$, $\overrightarrow{DE} = \mathbf{b}$ and $\overrightarrow{FC} = \mathbf{a} - \mathbf{b}$.

(a) Express $\overrightarrow{FE}$ in terms of $\mathbf{a}$ and/or $\mathbf{b}$.
Give your answer in its simplest form.

M is the midpoint of DE.
X is the point on FM such that $FX:XM = n:1$
CXE is a straight line.

(b) Work out the value of n.

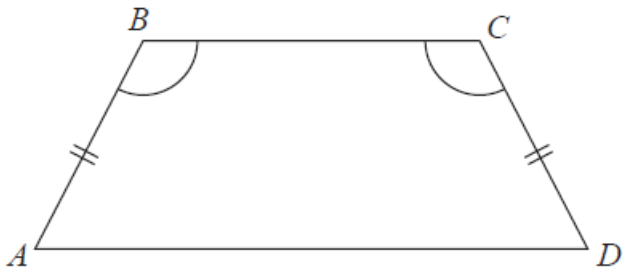
..... **6 marks**

Full Lesson Here

Answer: a) $2\mathbf{a}$ b) 4

Geometric Proof 1

$ABCD$ is a quadrilateral.



$AB = CD$.
Angle ABC = angle BCD.

Prove that $AC = BD$.

Full Lesson Here

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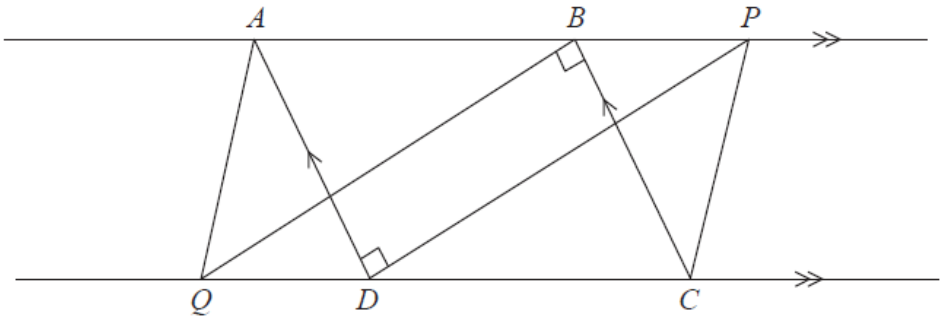
4 marks

Answer
(1) ABC=BCD (2) AC=BD (3) BC=BC (4) SAS Triangles AC=BD

Geometric Proof 2



$ABCD$ is a parallelogram.
ABP and QDC are straight lines.
Angle ADP = angle $CBQ = 90°$

(a) Prove that triangle ADP is congruent to triangle CBQ.

(b) Explain why AQ is parallel to PC.

Full Lesson Here

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5 marks

Answer
(a) (1) AD=BC (2) PAD=QCB (3) ADP=CBQ (4) ASA Triangles (b) AP=QC since triangle ADP is congruent to CBQ. Opposite sides of a parallelogram are equal

Direct Proportion

y is directly proportional to $\sqrt[3]{x}$

$y = 1\frac{1}{6}$ when $x = 8$

Find the value of y when $x = 64$

Full Lesson Here

.....

3 marks

Answer: $\frac{7}{3}$

Inverse Proportion

T is inversely proportional to the cube of u.

When $u = 5$, $T = 0.0096$

Find the value of u when $T = 0.15$

Full Lesson Here

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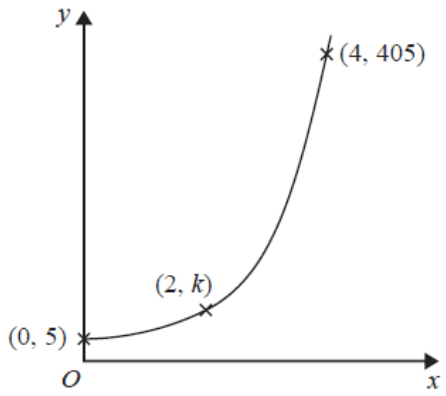
3 marks

Answer: 2

Exponential Graphs

Here is a sketch of part of the graph of $y = pq^x$ where $q > 0$



The points (0, 5), (2, k) and (4, 405) are all on the graph of $y = pq^x$

Find the value of k.

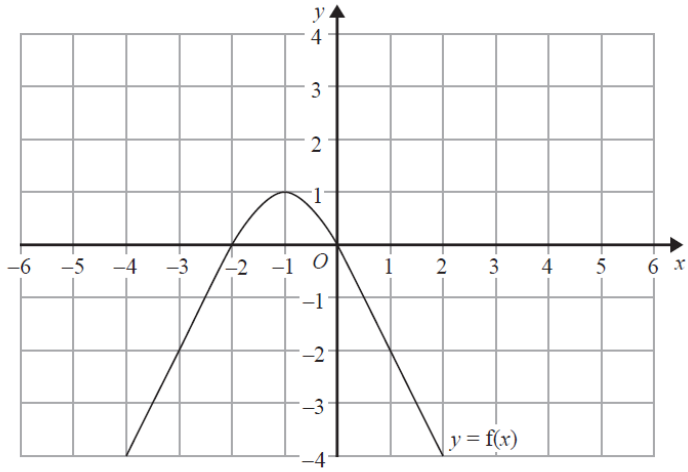
..... **4 marks**

Full Lesson Here

Answer: 45

Graph Transformations

The graph of $y = f(x)$ is shown on the grid.



(a) On the grid, sketch the graph of $y = f(x - 1)$

The graph of $y = f(x)$ has a turning point at the point (−1, 1)

(b) Write down the coordinates of the turning point of the graph of $y = f(-x) + 2$

..... **2 marks**

Full Lesson Here

Answer: $x < -2, x > \frac{1}{2}$

Composite Functions

For all values of x

$$f(x) = 2x - 3 \quad \text{and} \quad g(x) = x^2 + 2$$

(a) Find $g(-4)$

(b) Show that $gf(x) = 4x^2 - 12x + 11$

(c) Solve $fg(x) = gf(x)$

Full Lesson Here

Answer
a) 18 b) Shown
c) $x=1$ and $x=5$

..... **7 marks**

Inverse Functions

The functions f and g are such that

$$f(x) = 3(x - 4) \quad \text{and} \quad g(x) = \frac{x}{5} + 1$$

(a) Find the value of $f(10)$

(b) Find $g^{-1}(x)$

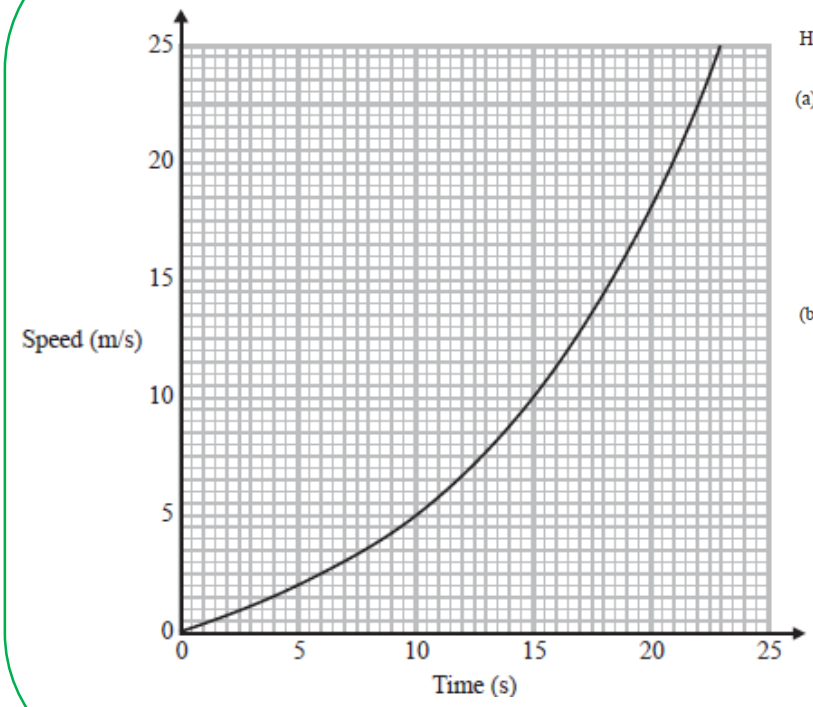
(c) Show that $ff(x) = 9x - 48$

Full Lesson Here

Answer
$x < -2, x > \frac{1}{2}$

..... **5 marks**

Area Under a Curve



Here is a speed-time graph for a train.

(a) Work out an estimate for the distance the train travelled in the first 20 seconds.
Use 4 strips of equal width.

(b) Is your answer to (a) an underestimate or an overestimate of the actual distance the train travelled?
Give a reason for your answer.

Full Lesson Here

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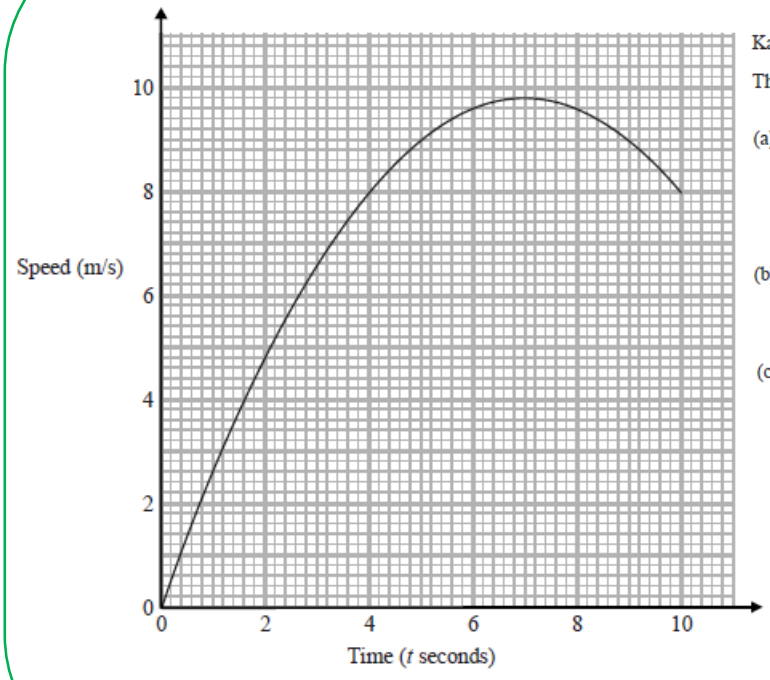
4 marks

Answer

a) 130m
b) Overestimate, area between curves and trapeziums included.

Gradient of a Curve



Karol runs in a race.

The graph shows her speed, in metres per second, t seconds after the start of the race.

(a) Calculate an estimate for the gradient of the graph when $t = 4$
You must show how you get your answer.

(b) Describe fully what your answer to part (a) represents.

(c) Explain why your answer to part (a) is only an estimate.

Full Lesson Here

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6 marks

Answer

a) 1.0 - 1.3
b) The acceleration at 4 seconds in m/s^2
c) Dependent on accuracy of the tangent

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Direct and Inverse Proportion

y is inversely proportional to d^2
When $d = 10$, $y = 4$

d is directly proportional to x^2
When $x = 2$, $d = 24$

Find a formula for y in terms of x.
Give your answer in its simplest form.

Full Lesson Here

.....

5 marks

Answer: $y = \frac{100}{9x^4}$

Bounds with Compound Measures

A high speed train travels a distance of 487 km in 3 hours.

The distance is measured correct to the nearest kilometre.
The time is measured correct to the nearest minute.

By considering bounds, work out the average speed, in km/minute, of the train to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

Full Lesson Here

.....

5 marks

Answer: 2.7 km/minute (1dp)

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GCSE Mathematics Higher Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

Here is pretty much all the Higher Tier content we could fit onto an A3 sheet of paper, including all the formulae you are required to know for GCSE. An ➔ points to an illustrative example. The codes refer to the DfE subject content. Pin this to a wall, keep it on your desk, carry it in your bag, make notes on it (sorry, don't take it into the examination)…

Listing strategies N5

Product rule for counting:
➔ **$4 \times 3 \times 2 \times 1 = 24$ ways to arrange the letters P, I, X and L**

Powers and roots N6, N7

Special indices: for any value a:

$$a^0 = 1$$
$$a^{-n} = \frac{1}{a^n}$$
$$a^{\left(\frac{p}{q}\right)} = \sqrt[q]{a^p}$$

➔ $3^{-4} = \frac{1}{3^4} = \frac{1}{81}$

➔ $8^{\left(\frac{2}{3}\right)} = \sqrt[3]{8^2} = 4$

Surds N8

Look for the biggest square number factor of the number:
➔ $\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$

Rationalise the denominator N8

Multiply the numerator and denominator by an expression that makes the denominator an integer:

➔ $\frac{4}{\sqrt{7}} = \frac{4 \times \sqrt{7}}{\sqrt{7} \times \sqrt{7}} = \frac{4\sqrt{7}}{7}$

➔ $\frac{2}{4+\sqrt{5}}$

$= \frac{2}{4+\sqrt{5}} \times \frac{4-\sqrt{5}}{4-\sqrt{5}} = \frac{2(4-\sqrt{5})}{11}$

Standard form N9

Standard form numbers are of the form $a \times 10^n$, where $1 \le a < 10$ and n is an integer.

Recurring decimals N10

Make a recurring decimal a fraction:
➔ $n = 0.2\dot{3}6$
(two digits are in the recurring pattern, so multiply by 100)
$100n = 23.\dot{6}$
(this is the same as $23.6\dot{3}6\dot{)}$
$99n = 23.6\dot{3}6 - 0.2\dot{3}6 = 23.4$
$n = \frac{23.4}{99} = \frac{234}{990} = \frac{13}{55}$

Error intervals N15

Find the range of numbers that will round to a given value:
➔ **$x = 5.83$ (2 decimal places)**
$5.825 \le x < 5.835$
➔ **$y = 46$ (2 significant figures)**
$45.5 \le y < 46.5$
Note use of ≤ and <, and that the last significant figure of each is 5

Equations and identities A3

An equation is true for some particular value of x
➔ **$2x + 1 = 7$ is true if $x = 3$**
…but an identity is true for every value of x
➔ $(x+a)^2 \equiv x^2 + 2ax + a^2$
(note the use of the symbol ≡)

Laws of indices A4

For any value a:

$$a^x \times a^y = a^{x+y}$$
$$\frac{a^x}{a^y} = a^{x-y}$$
$$(a^x)^y = a^{xy}$$

➔ $\left(\frac{2pq^4}{p^3q}\right)^3 = \frac{8p^3q^{12}}{p^9q^3} = \frac{8q^9}{p^6}$ or $8q^9p^{-6}$

Difference of two squares A4

$$a^2 - b^2 = (a+b)(a-b)$$
➔ $x^2 - 25 = (x+5)(x-5)$

Rearrange a formula A5

The subject of a formula is the term on its own. Rearrange to
➔ **Make x the subject of**

$$2x + ay = y - bx$$
$$2x + bx = y - ay$$
$$x(2+b) = y - ay$$
$$x = \frac{y-ay}{2+b}$$

Functions A7

Combining functions:
$\mathrm{fg}(x) = \mathrm{f}(\mathrm{g}(x))$
➔ **If $\mathrm{f}(x) = x + 3$ and $\mathrm{g}(x) = x^2$**
$\mathrm{fg}(x) = x^2 + 3$
$\mathrm{gf}(x) = (x+3)^2$

The inverse of f is f^{-1}
➔ **If $\mathrm{f}(x) = 2x + 5$ then**
$$\mathrm{f}^{-1}(x) = \frac{x-5}{2}$$

$y = mx + c$ A9

Equation of straight line $y = mx + c$
m is the gradient; c is the y intercept:
➔ **Find the equation of the line that joins (0 , 3) to (2 , 11)**
Find its gradient…
$$\frac{11-3}{2-0} = \frac{8}{2} = 4$$
…and its y intercept…
Passes through (0 , 3), so c = 3
Equation is $y = 4x + 3$

Parallel lines: gradients are equal; perpendicular lines: gradients are "negative reciprocals".
➔ **$y = 2x + 3$ and $y = 2x - 5$ are parallel to each other; $y = 2x + 3$ and $y = -\frac{1}{2}x + 3$ are perpendicular**

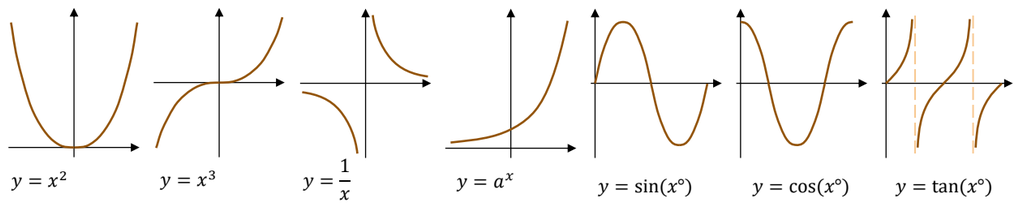
Transformations of curves A13

Starting with the curve $y = \mathrm{f}(x)$:
Translate $\begin{pmatrix}0\\a\end{pmatrix}$ for $y = \mathrm{f}(x) + a$
Translate $\begin{pmatrix}-a\\0\end{pmatrix}$ for $y = \mathrm{f}(x + a)$
Reflect in x axis for $y = -\mathrm{f}(x)$
Reflect y axis for $y = \mathrm{f}(-x)$

Velocity - time graph A15

Gradient = acceleration (you may need to draw a tangent to the curve at a point to find the gradient);
Area under curve = distance travelled.

Standard graphs A12



Quadratics A11, A18

If a quadratic equation cannot be factorised, use the formula

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

➔ **Solve $2x^2 + 3x - 7 = 0$**

$x = \frac{-3-\sqrt{9-(-56)}}{2\times2} = -2.73$

or $x = \frac{-3+\sqrt{9-(-56)}}{2\times2} = 1.23$

Complete the square to find the turning point of a quadratic graph.
➔ $y = x^2 - 6x + 2$
$y = (x-3)^2 - 9 + 2$
$y = (x-3)^2 - 7$
Turning point is (3 , –7)

Equation of a circle A16

$x^2 + y^2 = r^2$ is a circle with centre (0 ,0) and radius r.
➔ **$x^2 + y^2 = 25$ has centre (0 , 0) and radius 5**

Simultaneous equations A19

One linear, one quadratic;
➔ **Solve $\begin{cases} x + 3y = 10 \\ x^2 + y^2 = 20 \end{cases}$**
Rearrange the linear, and substitute into the quadratic
$x = 10 - 3y$
so $(10 - 3y)^2 + y^2 = 20$
Expand and solve the quadratic
$100 - 60y + 9y^2 + y^2 = 20$
$10y^2 - 60y + 80 = 0$
$y = 2$ or $y = 4$
Finally, substitute into the linear and solve, pairing values…
$x + 3 \times 2 = 10$ so $(x , y) = (4 , 2)$
$x + 3 \times 4 = 10$ so $(x , y) = (-2 , 4)$

Sequences A24, A25

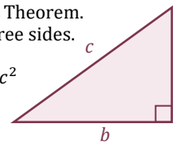
nth term of an arithmetic (linear) sequence is $bn + c$
➔ **nth term of 5, 8, 11, 14, … is $3n+2$ (always increases by 3 first term is $3 \times 1 + 2 = 5$)**
nth term of a quadratic sequence is $an^2 + bn + c$
➔ **First three terms of $n^2 + 3n - 1$ are 3, 9, 17, …**
Geometric sequence; multiply each term by a constant ratio
➔ **3, 6, 12, 24, … (ratio is 2)**
Fibonacci sequence; make the next term by adding the previous two …
➔ **2, 4, 6, 10, 16, 26, 42, …**

Iteration A20

You will be given the formula to use:
➔ **Solve $x^3 + 6x + 4 = 0$ by using the iteration $x_{n+1} = \sqrt[3]{6x_n - 4}$**
Start with $x_1 = -2.8$
$x_2 = \sqrt[3]{6 \times (-2.8) - 4} = -2.750\ldots$
$x_3 = \sqrt[3]{6 \times (-2.750\ldots) - 4} = \cdots$
Repeat until you know the solution, or you do as many as the question says.

Right angled triangles G20

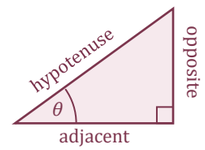
Pythagoras Theorem.
Links all three sides.
No angles.
$a^2 + b^2 = c^2$



Trigonometry.
Links two sides and one angle.
SOH | CAH | TOA

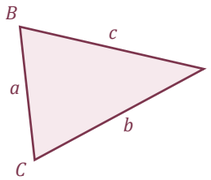
$\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$

Use "2ndF" or "SHIFT" key to find a missing angle



The longest side of any right angled triangle is the hypotenuse; check that your answer is consistent with this.

Advanced trigonometry G21, G22



A is opposite a
B is opposite b
C is opposite c

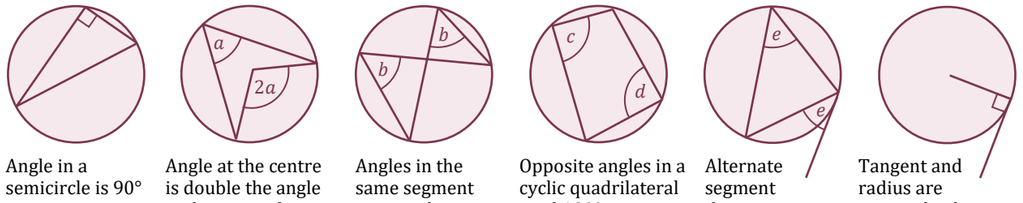
Sine Rule
Use if you are given an angle-side pair
Missing side: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
Missing angle: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Cosine Rule
Use if you can't use the sine rule
Missing side: $a^2 = b^2 + c^2 - 2bc\cos A$
Missing angle: $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Special values of sin, cos, tan
Learn (or be able to find without a calculator)…

$\theta°$	$\sin\theta°$	$\cos\theta°$	$\tan\theta°$
0	0	1	1
30	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$
45	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1
60	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
90	1	0	

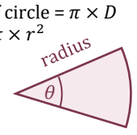
Circle theorems G10



Angle in a semicircle is 90°
Angle at the centre is double the angle at the circumference
Angles in the same segment are equal
Opposite angles in a cyclic quadrilateral total 180°
Alternate segment theorem
Tangent and radius are perpendicular

Areas and volumes G16, G17, G18, G23

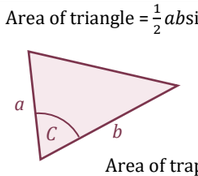
Circumference of circle = $\pi \times D$
Area of circle = $\pi \times r^2$



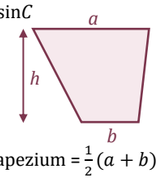
Arc length = $\frac{\theta}{360°} \times \pi \times D$

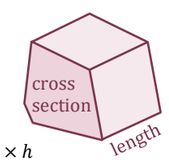
Area of sector = $\frac{\theta}{360°} \times \pi \times r^2$

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

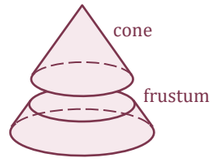


Area of trapezium = $\frac{1}{2}(a+b) \times h$





Volume of prism = area of cross section × length



Volume of cone = $\frac{1}{3}\pi r^2 h$
Volume of frustum is difference between the volumes of two cones

Transformations G7, G8

Reflection
- Line of reflection

Translation
- Vector

Rotation
- Centre of rotation
- Angle of rotation
- Clockwise or anticlockwise

Enlargement
- Centre of enlargement
- Scale factor (if $-1 < SF < 1$ the shape will get smaller).

Similar shapes G19

Ratios in similar shapes and solids:

• Length/perimeter	$1:n$	$a:b$
• Area	$1:n^2$	$a^2:b^2$
• Volume	$1:n^3$	$a^3:b^3$

Percentages: multipliers R9, R16

Percentage increase or decrease; use a multiplier (powers for repetition)
➔ **Initially there were 20 000 fish in a lake. The number decreases by 15% each year. Estimate the number of fish after 6 years.**
$20\,000 \times 0.85^6 = 7500$ (2sf)

Formula for compound interest
$$\text{Total accrued} = P\left(1 + \frac{r}{100}\right)^n$$
➔ **I invest £600 at 3% compound interest. What is my account worth after 5 years?**
$£600 \times \left(1 + \frac{3}{100}\right)^5 = £695.56$

Direct & inverse proportion R10

y is directly proportional to x:
$y = kx$ for a constant k
➔ **b is directly proportional to a^2**
$a = 6$ when $b = 90$ Find b if $a = 8$
$b = ka^2$ $a = 6$ and $b = 90$ for k
$90 = k \times 6^2$ **so** $k = 2.5$, $b = 2.5a^2$
$b = 2.5 \times 8^2 = 160$
y is inversely proportional to x
$yx = k$ or $y = \frac{k}{x}$ for a constant k

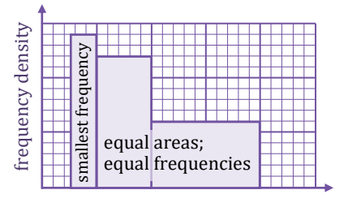
Probability rules P8, P9

Multiply for independent events
➔ **P(6 on dice and H on coin)**
$\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$
Add for mutually exclusive events
➔ **P(5 or 6 on dice)**
$\frac{1}{6} + \frac{1}{6} = \frac{2}{6}$
Apply these rules to tree diagrams.

In general…
P(A or B) = P(A) + P(B) – P(A and B)
P(A and B) = P(A given B) × P(B)

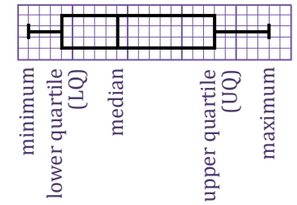
Histograms S3

Frequency = frequency density multiplied by class width. This means that bars with the same frequency have the same area.



Box plots S4

Interquartile range (IQR) = UQ – LQ



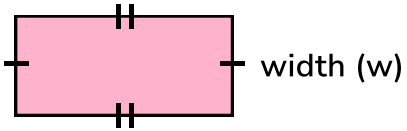
THIRD SPACE LEARNING

Higher

Area

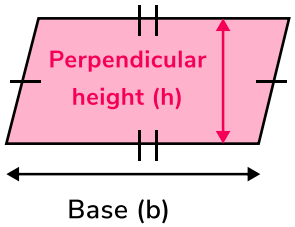
Rectangle

Area = length x width

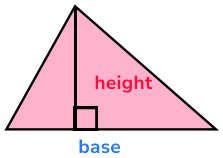


Parallelogram

Area = base x perpendicular height

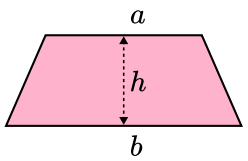


Triangle



Area = $\frac{1}{2}$ x base x height

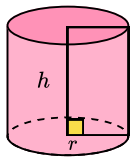
Trapezium



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

Surface Area

Cylinder



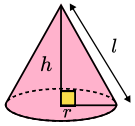
r = radius, h = height

Surface area = $2\pi rh + 2\pi r^2$

Cone

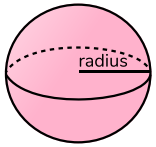
Curved surface area = πrl

Total surface area = $\pi rl + \pi r^2$



Sphere

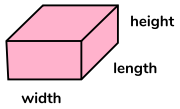
Surface area = $4\pi r^2$



Volume

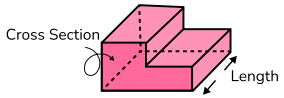
Cuboid

Volume = length x width x height

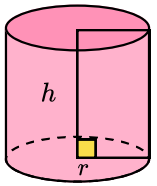


Prism

Volume = area of cross section x length



Cylinder

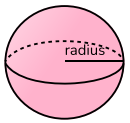


r = radius, h = height

Volume = $\pi r^2 h$

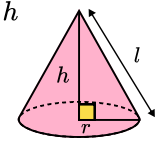
Sphere

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



Cone

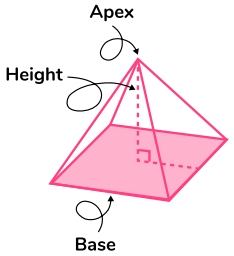
Volume = $\frac{1}{3}\pi r^2 h$



Pyramid

Volume = $\frac{1}{3}Bh$

B = area of base, h = height

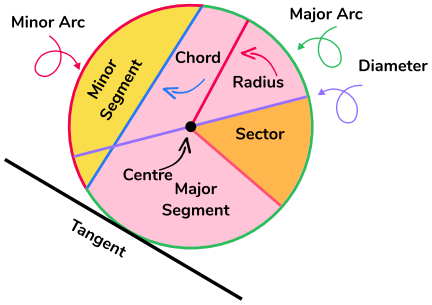


Circles

r = radius, d = diameter

Area = πr^2

Circumference = πd or $2\pi r$



Arc length = $\frac{\theta}{360} \times \pi d$

Arc sector = $\frac{\theta}{360} \times \pi r^2$

THIRD SPACE LEARNING

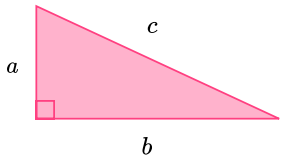
Pythagoras

Note: Right angled triangles only

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

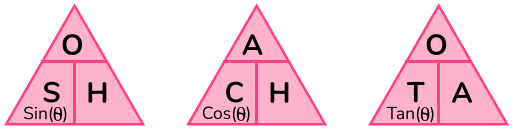
c is the **hypotenuse**
(The longest side)

a and b are the shorter sides.



Trigonometry

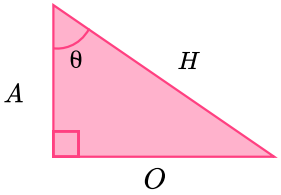
Note: Right angled triangles only



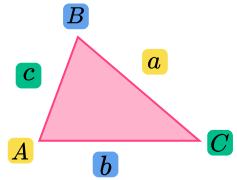
$\text{Sin}\,\theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$

$\text{Cos}\,\theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$

$\text{Tan}\,\theta = \frac{\text{Opposite}}{\text{Adjacent}}$



Further Trigonometry



Area of a triangle

$\text{Area} = \frac{1}{2}abSin(C)$

Sine Rule

To find a side:

$$\frac{a}{Sin\,A} = \frac{b}{Sin\,B} = \frac{c}{Sin\,C}$$

To find an angle:

$$\frac{Sin\,A}{a} = \frac{Sin\,B}{b} = \frac{Sin\,C}{c}$$

Cosine Rule

To find a side:

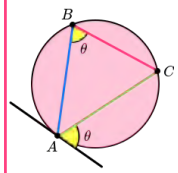
$$a^2 = b^2 + c^2 - 2bcCos(A)$$

To find an angle:

$$CosA = \frac{b^2 + c^2 - a^2}{2bc}$$

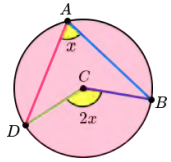
Circle Theorems

Alternate segment theorem



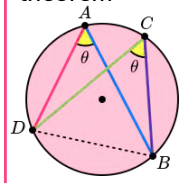
The angle that lies between a tangent and a chord is equal to the angle subtended by the same chord in the alternate segment.

Angle at the centre theorem



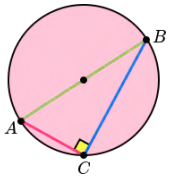
The angle at the centre is twice the angle at the circumference.

Angles in the same segment theorem



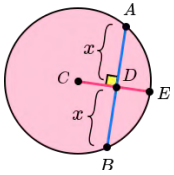
Angles in the same segment are equal.

Angles in a semicircle



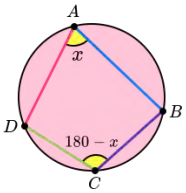
The angle in a semicircle is 90 degrees.

Chord of a circle



The perpendicular from the centre of a circle to a chord bisects the chord (splits the chord into two equal parts).

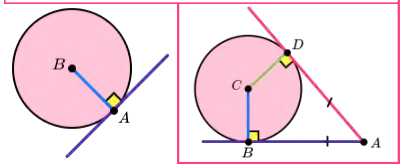
Cyclic quadrilateral



The opposite angles in a cyclic quadrilateral total 180 .

Angle at the centre theorem

Diagram A Diagram B



A. The angle between a tangent and radius is 90 degrees.

B. Tangents which meet at the same point are equal in length.

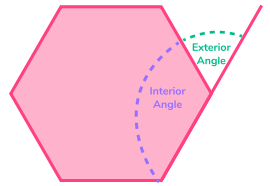
Angles in a Polygon

Exterior angle = $\frac{360}{n}$

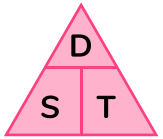
n = number of sides

Interior angle + Exterior angle = 180°

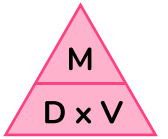
Sum of interior angles = $(n-2) \times 180$



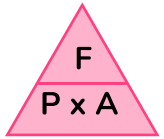
Compound Measures



Distance = Speed x Time
Speed = Distance ÷ Time
Time = Distance ÷ Speed



Mass = Density x Volume
Density = Mass ÷ Volume
Volume = Mass ÷ Density



Force = Pressure x Area
Pressure = Force ÷ Area
Area = Force ÷ Area

THIRD SPACE LEARNING

Straight Lines

Gradient

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

Equation of a line

$y = mx + c$

m = Gradient, $c = y$ intercept

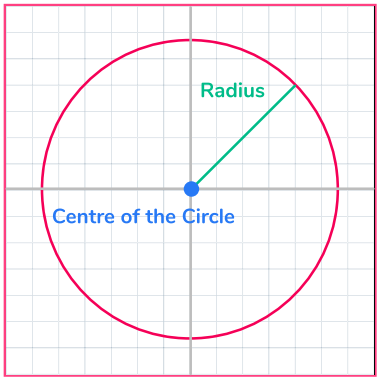
Midpoint of 2 points (x_1, y_1) and (x_2, y_2)

$$(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$$

Gradient of perpendicular to line $y = mx + c$

$$-\frac{1}{m}$$

Equation of a Circle



$$x^2 + y^2 = r^2$$

r = radius

Centre = (0,0)

Percentage Change

$$\text{Percentage change} = (\frac{\text{Difference}}{\text{Original}}) \times 100$$

Compound Growth & Decay

The amount after n years (or days, etc), where percentage rate of change is r is

$$\text{Starting amount} \times (1 \pm \frac{r}{100})^n$$

Quadratics

Quadratic equation

$$ax^2 + bx + c$$

Quadratic Formula

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

Completing the square

$$(x + p)^2 + q$$

$$x^2 \pm bx \pm c = (x \pm \frac{b}{2})^2 - (\frac{b}{2})^2 \pm c$$

Direct and Inverse Proportion

If x is directly proportional to y^n then

$$x \propto y^n \quad \text{so} \quad x = ky^n$$

If x is inversely proportional to y^n then

$$x \propto \frac{1}{y^n} \quad \text{so} \quad x = \frac{k}{y^n}$$

Probability

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A \text{ given } B)P(B)$$

Pie Charts

The angle to draw for each sector is

$$\text{Angle} = \frac{\text{Frequency}}{\text{Total}} \times 360°$$

Histogram

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

Stratified Sample

$$\text{Account in sample} = \frac{\text{Group number}}{\text{Total}} \times \text{Sample size}$$

Kinematics

s = displacement

u = initial velocity

v = final velocity

a = acceleration

t = time

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{1}{2}(u + v)t$$

$$v^2 = u^2 + 2as$$

$$s = vt - \frac{1}{2}at^2$$

Pearson Edexcel GCSE (9–1) Mathematics

May–June 2023 Assessment Window

Syllabus reference **1MA1**

Mathematics
Higher tier
Exam Aid

You are not permitted to take this notice into the examination.
A version of this equation list will be included with the May–June 2023 question papers. This document is valid if downloaded from the Pearson Qualifications website.

Instructions

- Please ensure that you have read this aid before the examination.

Information

- A formula sheet will be provided for foundation tier and for higher tier students.
- The format/structure of the assessments remains unchanged.
- This exam aid provides students with additional exam formulae which they may refer to in their examinations.
- Please note, a copy of this exam aid will be made available to all students on the day of the examination as an insert in the question paper.
- There are no restrictions on who can use this aid.
- Students and teachers can discuss this exam aid.
- This document has 2 pages.

Continue ▶

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Pearson

Higher Tier Formulae Sheet

Perimeter, area and volume

Where a and b are the lengths of the parallel sides and h is their perpendicular separation:

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

Volume of a prism = area of cross section × length

Where r is the radius and d is the diameter:

Circumference of a circle = $2\pi r = \pi d$

Area of a circle = πr^2

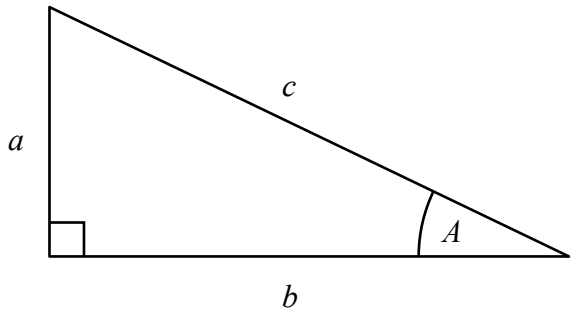
Quadratic formula

The solution of $ax^2 + bx + c = 0$

where $a \neq 0$

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

Pythagoras' Theorem and Trigonometry

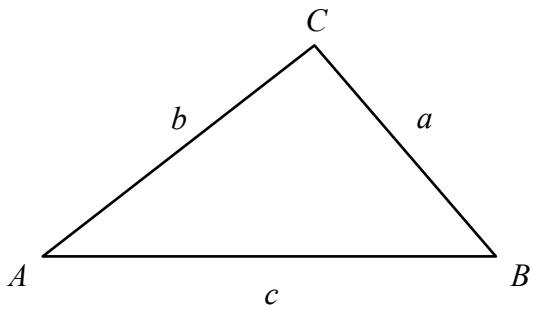


In any right-angled triangle where a, b and c are the length of the sides and c is the hypotenuse:

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

In any right-angled triangle ABC where a, b and c are the length of the sides and c is the hypotenuse:

$\sin A = \frac{a}{c}$ $\cos A = \frac{b}{c}$ $\tan A = \frac{a}{b}$



In any triangle ABC where a, b and c are the length of the sides:

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 = $\frac{1}{2}\,a\,b \sin C$

Compound Interest

Where P is the principal amount, r is the interest rate over a given period and n is number of times that the interest is compounded:

Total accrued = $P\left(1 + \frac{r}{100}\right)^n$

Probability

Where P (A) is the probability of outcome A and P (B) is the probability of outcome B:

P (A or B) = P (A) + P (B) – P (A and B)

P (A and B) = P (A given B) P(B)

END OF EXAM AID

Sparx Maths

Higher Skills List

Number

Topic	Topic code	R	A	G
Calculating with roots and fractional indices	U851, U985, U772, U299			
Converting recurring decimals to fractions	U689			
Surds	U338, U663, U872, U499			
Rationalising the denominator	U707, U281			
Error intervals	U657, U301, U587			

Algebra

Topic	Topic code	R	A	G
Expanding triple brackets	U606			
Operations with algebraic fractions	U685, U457, U824			
Factorising quadratic expressions: ax^2+bx+c	U858			
Simplifying algebraic fractions	U294			
Factorising to solve quadratics equations	U228, U960			
Using the quadratic formula	U665			
Completing the square to solve quadratics	U397, U589			
Quadratic equations in context	U150			
Quadratic simultaneous equations	U547			
Index laws	U235, U694, U662			
Equation of a straight line: Perpendicular lines	U898			
Quadratic graphs: Turning points	U769			
Quadratic simultaneous equations on graphs	U875			
Exponential graphs	U229			
Exponential growth and decay problems	U988			
Trigonometric graphs	U450			
Graph transformations	U598, U487, U455			
Velocity-time graphs	U937, U562, U611			
Rate of change graphs	U638, U652, U862			
Estimating gradient from a curve	U800			
Estimating area under a curve	U882			
Equation of a circles and tangents	U567			
Linear inequalities as graph regions	U747			
Quadratic inequalities	U133			
Functions	U637, U895, U448, U996			
Recurrence relations	U171			
Quadratic sequences	U206			
Iteration and numerical methods	U434, U168			
Algebraic proof	U582			

Sparx Maths

Higher Skills List

Ratio and proportion

Topic	Topic code	R	A	G
Algebraic direct and inverse proportion	U407, U138			
Compound units: Density problem solving	U910			

Geometry

Topic	Topic code	R	A	G
Congruence proofs	U866, U887			
Enlargements	U134			
Describe combined transformations	U766			
Circle theorems: Angles inside a circle	U459, U251			
Circle theorems: Tangents and chords	U489, U130			
Circle theorems problems	U808			
Prove circle theorems	U807			
Volume of frustums	U350			
Volume: Problem solving	U543, U426			
Similar Shapes: Area and volume	U630, U110			
Pythagoras' Theorem in 2D and 3D	U385, U541			
Right-angled trigonometry: Problem solving	U319, U283, U545, U967			
3D trigonometry	U170			
The area rule	U592			
Sine rule	U952			
Cosine rule	U591			
Trigonometry and bearings	U164			
Vectors problems	U781, U560			

Probability

Topic	Topic code	R	A	G
Product rule for counting	U369			
Conditional probability	U246, U821, U806			
Probability from Venn diagrams	U476, U748, U699			

Statistics

Topic	Topic code	R	A	G
Averages	U877, U717			
Cumulative frequency diagrams	U182, U642			
Box plots	U879, U837, U507			
Frequency polygons	U840			
Histograms	U814, U983, U267			
Capture-recapture	U328			

Sparx Maths

Crossover Skills List

Number

Topic	Topic code	R	A	G
Fractions	U224, U538, U793			
Factors, multiples and primes	U739, U250			
Percentage change	U671, U332, U988			
Standard form	U330, U534, U264, U290			
Error intervals	U657			

Algebra

Topic	Topic code	R	A	G
Linear equations	U325, U870, U599			
Linear inequalities	U759, U738, U145, U337			
Index laws	U662			
Linear simultaneous equations	U760, U757, U836, U137			
Linear graphs and coordinates	U315, U669, U477, U848, U377			
Quadratic graphs and equations	U989, U667, U228, U601			

Ratio and proportion

Topic	Topic code	R	A	G
Ratio	U687, U753, U176, U577, U921, U865			
Speed	U151			
Density and pressure	U910, U527			
Proportion	U721, U357, U610			

Geometry

Topic	Topic code	R	A	G
Area	U226, U343, U950			
Volume	U786, U174, U915			
Angles	U655, U826, U329, U427			
Pythagoras' theorem	U385			
Trigonometry	U605, U283, U545			
Transformations	U196, U799, U696, U519, U766			

Probability

Topic	Topic code	R	A	G
Calculating probabilities	U408, U510, U683, U580			
Expected outcomes	U166			
Tree diagrams	U558, U729			
Set notation	U748, U296			

Statistics

Topic	Topic code	R	A	G
Averages	U717, U569			
Averages with grouped data	U877			
Sampling	U162			
Scatter graphs	U199, U277, U128			
Frequency polygons	U840			

EVERY TOPIC ON THE MATHS GCSE

Revision Checklist (Higher)

STATISTICS

- [ ] Averages
- [ ] Reverse Mean
- [ ] Averages from a Table
- [ ] Grouped Frequency Tables
- [ ] Scatter Graphs
- [ ] Frequency Polygons
- [ ] Sampling and Bias
- [ ] Pie Charts
- [ ] Interquartile Range
- [ ] Box Plots
- [ ] Averages from a Stem and Leaf
- [ ] Cumulative Frequency Graphs
- [ ] Histograms

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- [ ] Compound Interest
- [ ] Depreciation
- [ ] Direct Proportion
- [ ] Inverse Proportion
- [ ] Speed, Distance & Time
- [ ] Mass, Density & Volume
- [ ] Pressure, Force & Area
- [ ] Velocity Time Graphs
- [ ] Area under a Graph
- [ ] Gradient of a Graph
- [ ] Equating Ratios

GEOMETRY

- [ ] Triangles & Quadrilaterals
- [ ] Area of 2D Shapes
- [ ] Angles in Parallel Lines
- [ ] Angles in Polygons
- [ ] Plans & Elevations
- [ ] Construction & Loci
- [ ] Area & Circumference of Circles
- [ ] Circle Sectors
- [ ] Surface Area of 3D Shapes
- [ ] Volume of 3D Shapes
- [ ] Cylinders, Cones & Spheres
- [ ] Transformations
- [ ] Bearings
- [ ] Similar Shapes
- [ ] Congruent Triangles
- [ ] Circle Theorems
- [ ] Vectors
- [ ] Geometric Proof

PROBABILITY

- [ ] Probability from a Table
- [ ] Relative Frequency
- [ ] Venn Diagrams
- [ ] Set Theory
- [ ] Frequency Trees
- [ ] Two Way Tables
- [ ] Probability Trees (Independent)
- [ ] Probability Trees (Dependent)
- [ ] Probability Equations

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Revision Checklist (Higher)

NUMBER

- [ ] Multiply Decimals
- [ ] Product Rule for Counting
- [ ] Estimations
- [ ] Laws of Indices
- [ ] Negative and Fractional Indices
- [ ] Highest Common Factor
- [ ] Lowest Common Multiple
- [ ] Product of Prime Factors
- [ ] Standard Form Conversions
- [ ] Standard Form Calculations
- [ ] Surds Calculations
- [ ] Rationalising Fractional Surds
- [ ] Fraction Calculations
- [ ] Recurring Decimals
- [ ] Percentages of an Amount
- [ ] Reverse Percentages
- [ ] Error Intervals
- [ ] Calculating with Bounds

ALGEBRA

- [ ] Collecting Like Terms
- [ ] Substitution
- [ ] Laws of Indices
- [ ] Expanding and Simplifying
- [ ] Factorising Expressions
- [ ] Expanding Double Brackets
- [ ] Factorising Quadratics
- [ ] Expanding Triple Brackets
- [ ] Rearranging Formulae
- [ ] Solving Equations
- [ ] Linear Sequences
- [ ] Quadratic Sequences
- [ ] Geometric Sequences
- [ ] Linear Graphs
- [ ] Quadratic/Cubic Graphs
- [ ] Reciprocal/Exponential Graphs
- [ ] Perpendicular Lines
- [ ] Equations & Tangents of Circles
- [ ] Forming and Solving Equations
- [ ] Solving Quadratic Equations
- [ ] The Quadratic Formula
- [ ] Completing the Square
- [ ] Solving Linear Inequalities
- [ ] Graphical Inequalities
- [ ] Solving Quadratic Inequalities
- [ ] Linear Simultaneous Equations
- [ ] Quadratic Sim. Equations
- [ ] Iterations
- [ ] Function Calculations
- [ ] Inverse / Composite Functions
- [ ] Simplifying Algebraic Fractions
- [ ] Algebraic Fraction Calculations
- [ ] Graph Transformations
- [ ] Algebraic Proof

TRIGONOMETRY

- [ ] Pythagoras Theorem
- [ ] 3D Pythagoras
- [ ] SOHCAHTOA Sides Lengths
- [ ] SOHCAHTOA Angles
- [ ] Sine Rule
- [ ] Cosine Rule
- [ ] 3D Trigonometry
- [ ] Area of a Triangle
- [ ] Exact Trigonometry
- [ ] Trigonometric Graphs

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