

GCSE Mathematics Calculator Higher Tier Mock 3, paper 2 ANSWERS



1 hour 45 minutes

Legend used in answers

Blue dotted boxes – instructions or key points

Start with a column or row that has only one number missing

Green Box - Working out

5b means five times b
b = -3 so $5 \times -3 = -15$

Red Box and ✓ - Answer

48 %

24

Marks shown in brackets for each question (2)

Authors Note

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1. A baker sells cream buns and doughnuts. In one week the number of cream buns and the number of doughnuts were in the ratio 3:4. The total cream buns and doughnuts sold in a week was 637.

What was the number of doughnuts sold.

$$\frac{4}{7} \times 637 =$$

4 ÷ 7 x 637 =

fraction Total sold

Make a fraction from parts of doughnuts sold ÷ sum of two ratios
Multiply fraction x total

364

(2)

2. Below are the first four terms in an arithmetic sequence.

100 96 92 88

In terms of n , find an expression for the n th term of the sequence.

In terms of n , find an expression for the n th term of the sequence.

Work out what the *common difference* is between numbers: $100 - 96 = -4$

Place an n after this: $-4n$

Work out what the *number before the 1st term* would be, using the common difference: $104 - 4 = 100$. Put this with the n term: $4n - 3$

104 - 4n

(2)

3. Laura counted the number of sweets in each of 31 bags of sweets.

She put her results in a stem and leaf diagram.

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

Key 4 | 1 stands for 41 sweets

a) What percentage of the bags have more than 38 sweets.
Give your answer to 1 decimal place

There are 7 bags with more than 38 sweets. So percentage is $7/31$

22.6%

(2)

b) Write down the mode.

The number which happens most often.

48

(1)

c) Work out the range.

$$48 - 8 = 40$$

40

(1)

d) Work out the median.

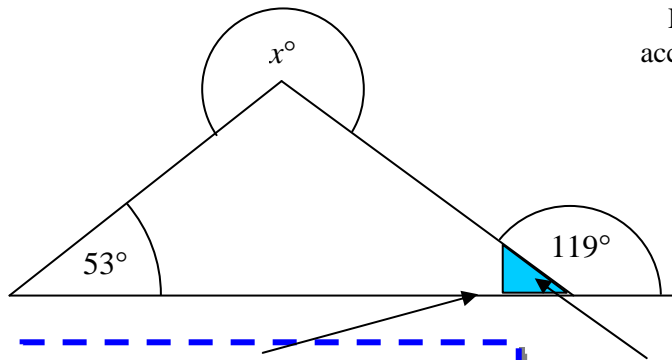
MEDIAN is the middle value
15 numbers median 15 numbers
Its the 16th starting from 08

26

(1)

4.

Diagram **NOT**
accurately drawn



Work out the value of x

This line is 180 degrees

So this angle is $180 - 119 = 61$

Now we can work out the other
angle in the triangle

Angle in triangle add up to
180 degrees

So other angle in triangle is
 $180 - 53 - 61 = 66$

At the top we have a circle
has 360 degrees

So top angle outside triangle is
 $360 - 66$

$x = \dots\dots$ **294**

(3)

5. The equation

$$x^3 + 4x = 61$$

has a solution between 3 and 4

Find this solution using a trial and improvement method.

Give your answer correct to 1 decimal place.

You must show **all** your working.

3 x^y 3 + 4 x 3 =

Use x^y button to cube

x	x^3	$+4x$	=	61?
3	27	+12	39	Too low
4	64	+16	80	Too high

61 is about half way between 3 and 4 so try $x=3.6$

3.5	42.87	14	56.87	Too low
-----	-------	----	-------	---------

Slightly low so try 3.6

3.6	46.66	14.4	61.05	Too low
-----	-------	------	-------	---------

3.6 looks correct but try 3.7 to be sure

3.7	50.65	14.8	65.45	Too high
-----	-------	------	-------	----------

$x = \dots$ 3.6 (4)

6.

$$S = \sqrt{\frac{r + t \sin x^\circ}{r - t \sin x^\circ}}$$

$$8.8 + 7.2 \times \sin 40 = 13.42807$$
$$8.8 - 7.2 \times \sin 40 = 4.1719$$

$$r = 8.8$$

$$t = 7.2$$

$$x = 40$$

Calculate the value of S . Give your answer correct to 3 significant figures.

1.79

(4)

7.



Pythagoras theorem required because we have right angle triangle with two sides given

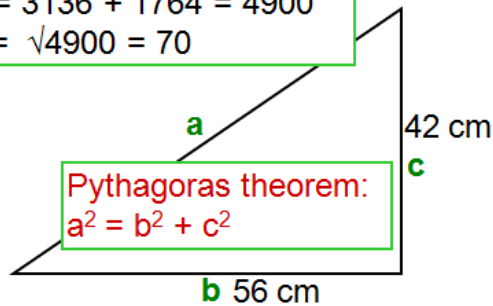
Luke wanted a TV with a diagonal screen of 72cm.

Harry thought that a TV with a screen of height 42 cm and width 56 cm would be OK.

Is Harry correct?

Show all your working.

Pythagoras theorem:
 $a^2 = 56^2 + 42^2$
 $a^2 = 3136 + 1764 = 4900$
 $a = \sqrt{4900} = 70$



Pythagoras theorem:
 $a^2 = b^2 + c^2$

5 6 x^2 + 4 2 x^2 = \sqrt =

Use x^2 button to square

(4)

No the screen is only 70cm diagonally

8. Jess had just come back from Albania.
She wanted to change her Euros (€) back to £s

She changed €46 from Euros to £.
£1 = 1.32 Euros.(€)

What is € 46 in £

First we have to work out whether
we divide or multiply by 1.32

£1 = €1.32
So we get **Less** euros than £s
That means we **DIVIDE** by 1.32

$$\begin{array}{c} \boxed{4} \quad \boxed{6} \quad \boxed{\div} \quad \boxed{1} \quad \boxed{\cdot} \quad \boxed{3} \quad \boxed{2} \quad \boxed{=} \\ \left. \begin{array}{c} \boxed{46} \end{array} \right\} \quad \left. \begin{array}{c} \boxed{\text{Exchange rate} = 1.32} \end{array} \right\} \quad \boxed{£34.85} \end{array}$$

(2)

- 9.a) Bacteria A multiplied by 25% every minute.
The number of bacteria now is 9,000.
How many bacteria were there 2 minutes ago?

Initial amount $\times 0.75 = 9000$
1 minute ago it was $9000/0.75 = 12000$
2 minutes ago it was $12000/0.75 = 16000$
or $9000/(0.75)^2$

16000

(2)

- 9.b) Bacteria B multiplied at the rate of 10% compound every minute.
The initial number of bacteria B was 100,000.

At the end of n minutes the number had increased to 161,051.

Work out the value of n

$100000 \times 1.1^n = 161051$
so $1.1^n = 1.61051$
Try $1.1^3 = 1.331$ try $1.1^4 = 1.464$, $1.1^5 = 1.61051$

5

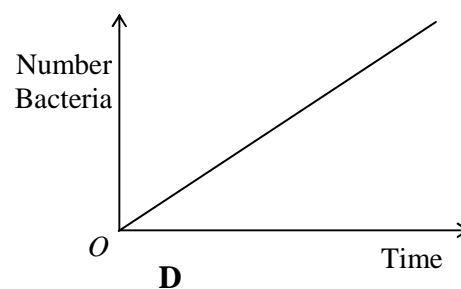
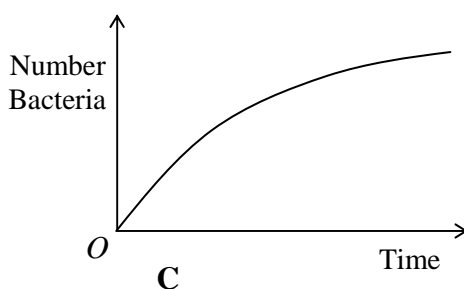
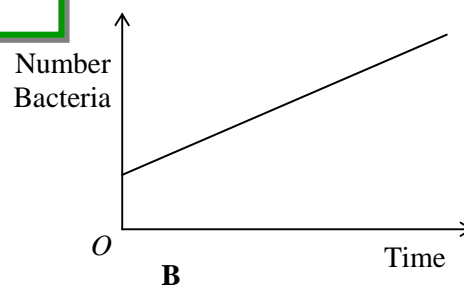
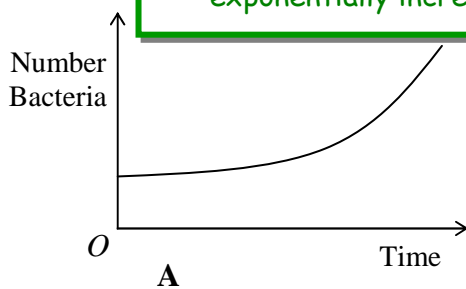
(2)

- 9.c) Write down the letter of the graph which best shows how Bacteria B multiplies with time.

starts above zero and is exponentially increasing

A

(1)



10. The table below provides information about the time taken for 100 teachers to complete a numeracy test.

Take mid-value from each class interval

Use this column to work out time as mid value x freq

- 12.5
- 17.5
- 22.5
- 27.5
- 32.5

Time (minutes)	Frequency	
$10 < t \leq 15$	8	$8 \times 12.5 = 100$
$15 < t \leq 20$	18	$18 \times 17.5 = 315$
$20 < t \leq 25$	25	$25 \times 22.5 = 562.5$
$25 < t \leq 30$	44	$44 \times 27.5 = 1210$
$30 < t \leq 35$	5	$5 \times 32.5 = 162.5$

2350

Add up the total time

Calculate an estimate for the mean time taken by the teachers.

MEAN = $\frac{\text{Total Time taken to complete test}}{\text{Number of takers}}$

DON'T add up the class intervals and divide by the total frequency (100)

For each class interval we estimate the time taken
Use the mid value from each class x frequency

Mean = $\frac{2350}{100} = 23.5$ minutes

(4)

23.5 minutes

MEAN (est) = $\frac{\sum \text{freq} \times \text{mid value}}{\sum \text{freq}}$
Where Σ means add up for all class interval

11. Lewis Hamilton drove 378 kilometres around a racing circuit

Using the conversion, 5 miles = 8 kilometre, work out the distance in miles.

$$378 \times 5 / 8 = 236.25 \text{ miles}$$

(2)

236.25

.....miles

He completed the 378 kilometres in 2 hours 15 minutes.

Calculate his average speed in miles per hour.

Using the formula triangle.
S is speed, D is distance
and T is time.



$$\text{Convert } 2 \text{ hours } 15 \text{ minutes} = 2.25 \text{ hours}$$

Cover speed in triangle to
get formula $s = d \div t$

$$s = 236.25 \div 2.25 = 105$$

105

.....mph

(2)

2 3 6 . 2 5 ÷ 2 . 2 5 =

12.

The mean of twelve numbers is 28
The mean of four of the numbers is 24.

What is the mean of the other eight numbers

$$\text{MEAN} = \frac{\text{Total}}{\text{Number of numbers}}$$

$$\text{So Total} = \text{mean} \times \text{number of numbers}$$

1. Work out the Totals

$$1^{\text{st}} \text{ Total} = 12 \times 28 = 336$$

$$2^{\text{nd}} \text{ Total} = 4 \times 24 = 96$$

2. Find total for 8 numbers:

$$= \text{total of 12 numbers} - \text{total for 4 numbers}$$

$$= 336 - 96 = 240$$

3. Work out new MEAN = $\frac{\text{Total for 8 numbers}}{8}$

$$= 240 \div 8 = 30$$

30

(3)

13. Solve

$$\begin{aligned} 6x - 4y &= 6 \\ 3x + 12y &= 24 \end{aligned}$$

Simultaneous equations are two equations with the same values for x and y

Often we can just add or subtract equations to eliminate x or y . But this time its harder - first we have multiply one equation so x or y is the same as the other equation

$$\begin{array}{r} \boxed{\times 3} \rightarrow \begin{array}{l} 6x - 4y = 6 \\ 18x - 12y = 18 \end{array} \\ \hline 3x + 12y = 24 \\ \hline 21x \quad = 42 \end{array}$$

Multiply by 3 so $4y$ becomes $12y$ then we can add to eliminate it

Now Add two equations to eliminate y

So $x = 42 \div 21 = 2$

SUBSTITUTE $x=2$

$$6x - 4y = 6$$

$$6 \times 2 - 4y = 6$$

$$12 - 4y = 6$$

Take 12 from both sides

$$12 - 12 - 4y = 6 - 12$$

$$-4y = -6 \text{ so } 4y = 6 \text{ so } y = 6 \div 4 = 1\frac{1}{2}$$

$$\begin{array}{l} x \dots \dots \dots \boxed{2} \\ y \dots \dots \dots \boxed{1\frac{1}{2}} \end{array} \quad (3)$$

b) Make p the subject of the formula

$$z + 8p = \pi p + 6q$$

$$8p - \pi p = 6q - z \text{ so } p(8 - \pi) = 6q - z$$

$$p = \dots \frac{6q - z}{8 - \pi} \quad (2)$$

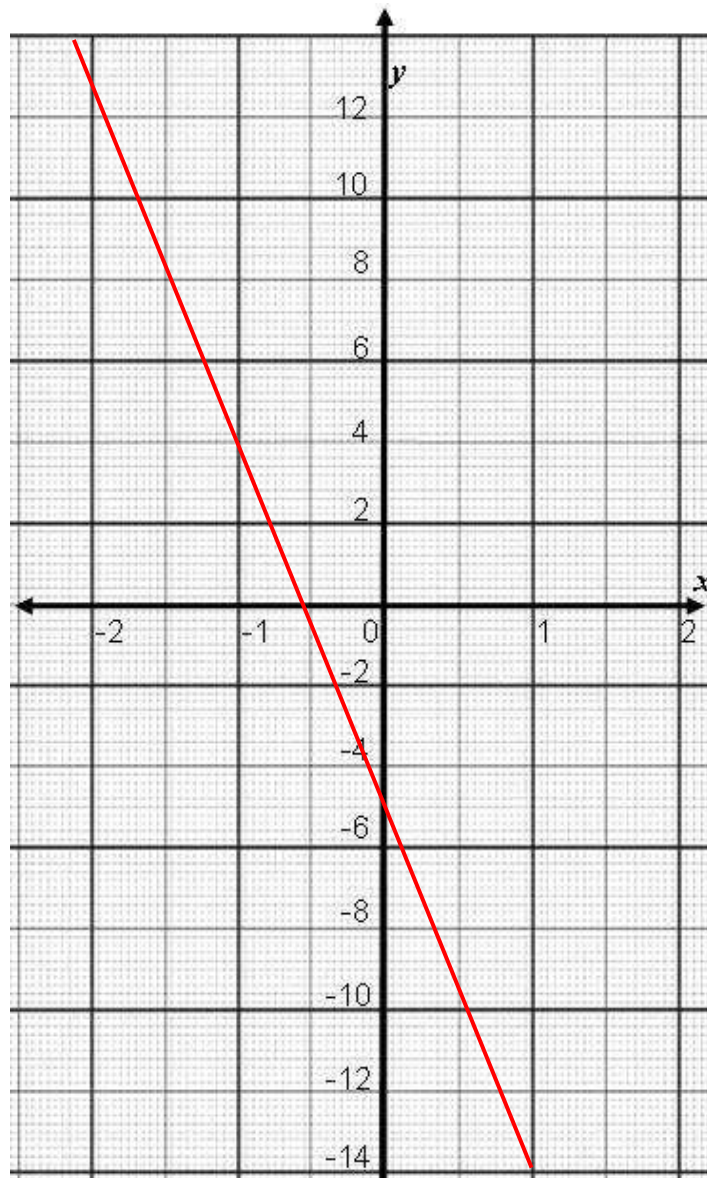
c) $y = 2x^2 - 5$

Work out the positive value of x when $y = 19$.
Give your answer exactly in the form $a\sqrt{3}$

$$19 = 2x^2 - 5 \text{ so } 24 = 2x^2 \text{ so } 12 = x^2 \text{ so } x = \sqrt{12}$$

$$x = \dots \boxed{2\sqrt{3}} \dots \quad (2)$$

14. a) Draw the graph for $y = -9x - 5$ on the grid below



(2)

14. b) Complete the table of values for $y = x^3 + 2x$

x	-2	-1	0	1	2
y	-12	-3	0	3	12

-2^3

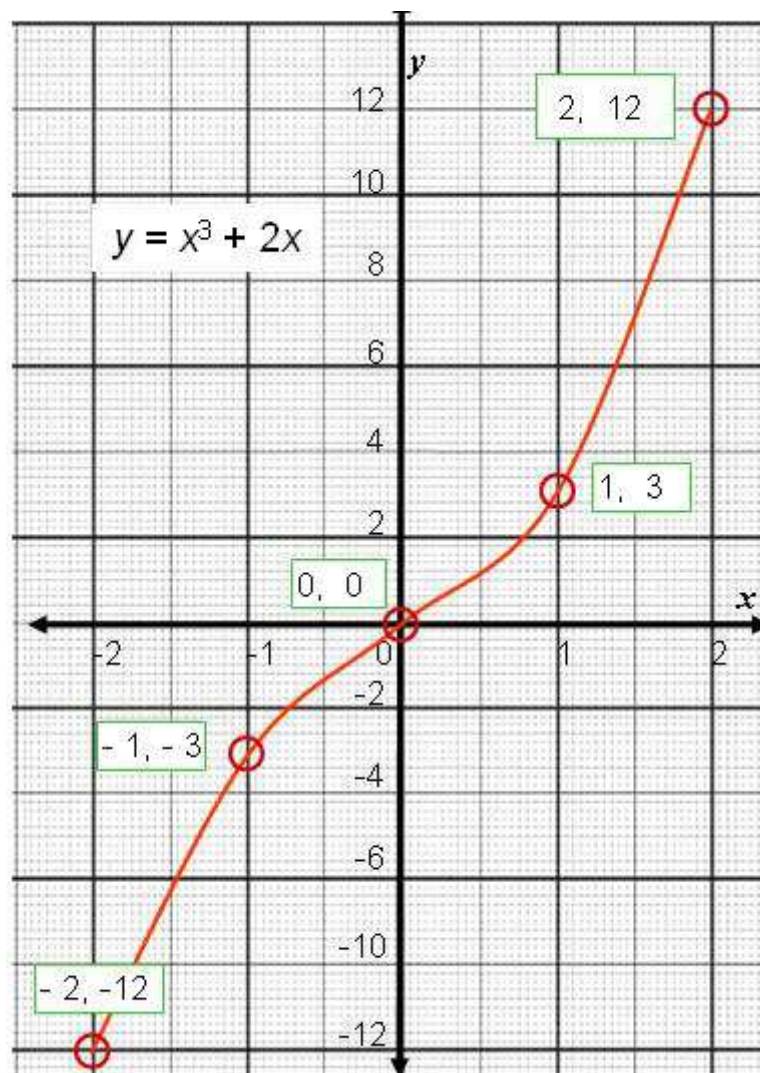
To work out $x^3 + 2x$ on your calculator
Use the x^y button and the \pm to enter -2.
Do it after entering the number!

2 | ± | x^y | 3 | + | 2 | x | 2 | ± | =

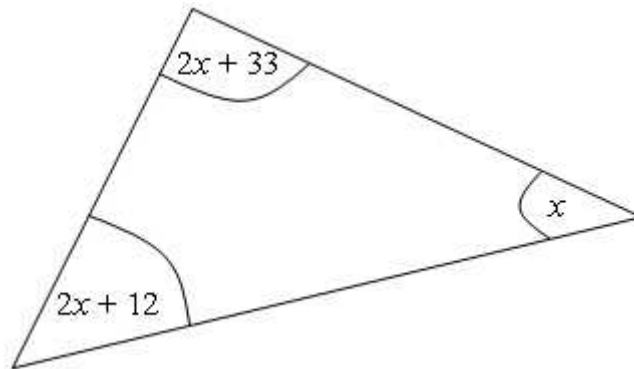
On your calculator
find the button that
forces 2 to be minus

Your calculator will work out 2×-2
before it adds the answer to -2^3

- c) On the grid below draw the graph of $y = x^3 + 2x$



15.



Not drawn accurately

The angles shown in the triangle above are:

$2x + 33$
 x
 $2x + 12$

a) Write down an equation in terms of x using this information

Add up all the angles = $2x + 33 + x + 2x + 12 = 5x + 45$

$5x + 45$

(2)

b) Using your answer above work out the value of x

In Δ all angles = 180 so $5x + 45 = 180$

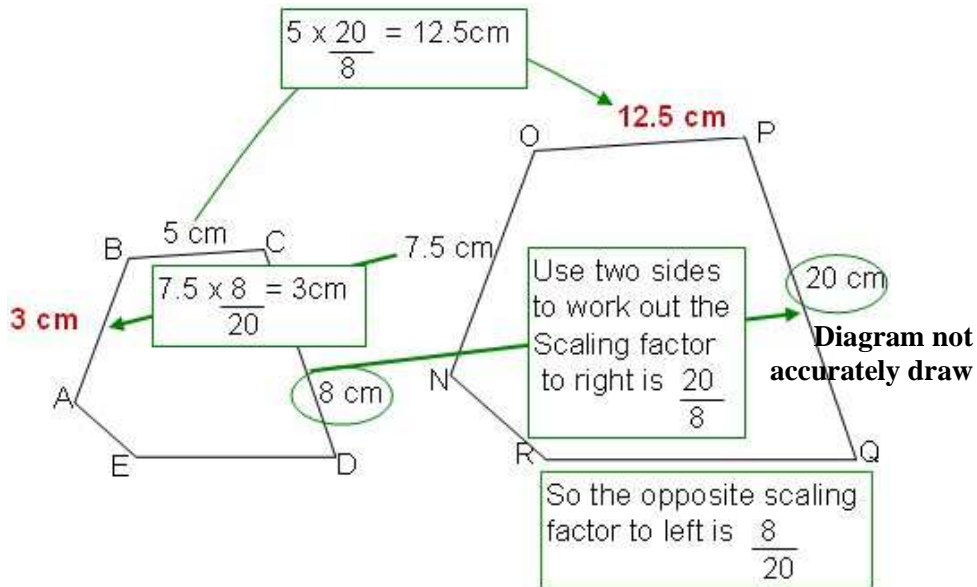
Subtract 45 from both sides, then $\div 5$: $5x = 135 \rightarrow x = 27$

27

$x = \dots\dots\dots$

(2)

16. The two shapes below are mathematically **similar**.



In ABCDE , BC = 5 cm, CD = 8 cm
 In NOPQR, ON = 7.5 cm, PQ = 20 cm
 Angle AED = angle NRQ
 Angle EAB = angle RNO

a) Calculate the length of OP

The shape on the right is a larger copy of the one on the left and is made by multiplying by a scaling factor.
 To work out the scaling factor use the same side from both shapes ie CD and PQ. If the final shape is larger than the original then the scaling factor will be bigger than 1. Otherwise it is less than 1
 Going from small → large it is $20 \div 8$

Scaling factor \times known side BC = unknown sides OP **12.5**cm. (2)

$$5 \times \frac{20}{8} = 12.5$$

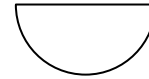
b) Calculate the length of AB

This time we go large → small so Scaling factor < 1

Scaling factor \times known side NO = unknown side AB **3**cm. (2)

$$7.5 \times \frac{8}{20} = 3$$

17. Jane bought some inserts for her hanging baskets.
They were shaped like hemispheres with diameter 12 inches.



- a) Using the conversion 1 inch = 2.54 cm work out the volume of the insert in millilitres.

$$\text{volume of hemisphere} = \text{half of } \frac{4}{3} \pi r^3$$
$$\text{Volume} = 2 \times \pi \times (6 \times 2.54)^3 \div 3 =$$

74133.3

.....ml.

(3)

Jane has twenty basket to fill with compost. Compost comes in bags of 50 litres.

- b) How many bags of compost will she need to fill all her baskets.

$$V = 20 \times 74133.3 = 148266.6 \text{ml}$$

1 litre = 1000 ml so $V = 148$ litres

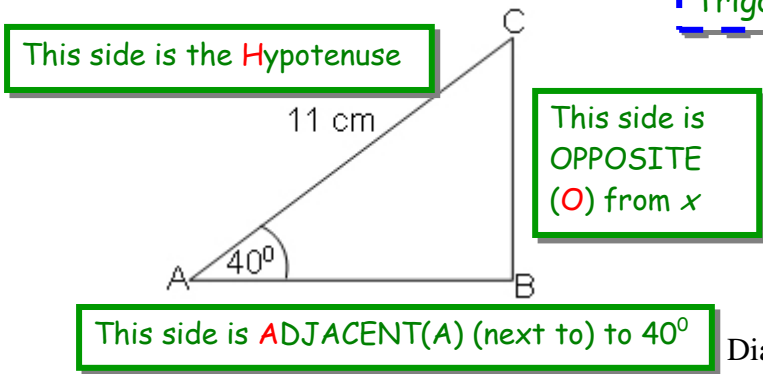
$$148/50 \approx 3 \text{ bags}$$

3 bags

.....

(2)

18.



Trigonometry ALERT!

Keep forgetting SOHCAHTOA? Try: Some Old Hags Cant Always Handle Their Old Age

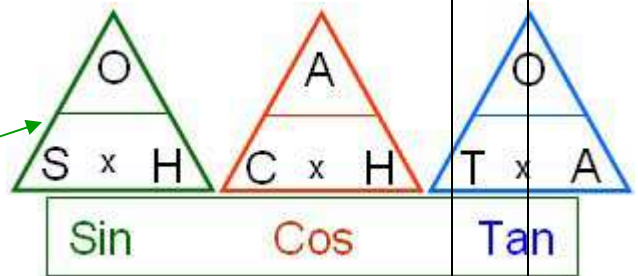
Diagram not drawn accurately

AC = 11 cm
Angle ABC = 90°
Angle CAB = 40°

Calculate the length of BC
Give your answer to 3 significant figures

Using the Trig formulae

Which Trig formula do we want?
We have H and we want to find O.
It's SIN



Cover up O because we want to find this and the formula is $O = \text{Sin } x \times H$

$$\text{Sin } x \times H = \text{Sin } 40 \times 11 = 7.070$$

3 significant figures

$$\text{BC} = 7.07 \text{ cm} \quad (3)$$

sin 40 x 11 =

19. Simplify fully

$$\frac{4x^2 - 9}{6x^2 + 5x - 21}$$

$$\frac{(2x - 3)(2x + 3)}{(2x + 3)(3x - 7)}$$

$$\frac{2x - 3}{3x - 7}$$

..... (3)

20. There are 650 pupils at Toddington Middle Boys School.
The table shows information about the pupils.

Year	Boys
Year 7	180
Year 8	240
Year 9	230

'Strata' means 'layer'. A stratified sample is made up of different 'layers'. The sample size is proportional to the size of the 'layer'.

50 out of 650 is 1 in 13 ($650 \div 50$).
So, to get sample of each year group divide by 13

An inspector is carrying out a survey into pupils' views about the school.
He takes a stratified sample of 50 of the 650 pupils.

(a) Calculate the number of boys in each year group to be sampled.

Year 7 is $180 \div 13 = 13.84$
Year 8 is $240 \div 13 = 18.46$
Year 9 is $230 \div 13 = 17.69$

Round to nearest whole number
and make sure they add up to 50

Alternatively:

5	0	÷	6	5	0	x	1	8	0	=
5	0	÷	6	5	0	x	2	4	0	=
5	0	÷	6	5	0	x	2	3	0	=

Year 7... 14
Year 8... 18
Year 9... 18 (3)

21.

Solve the equation

$$\frac{2x}{x-3} + \frac{4}{x+1} = 1$$

Get rid of everything at the bottom by multiplying through by these terms

x by $(x-3)(x+1)$

$$\frac{(x-3)(x+1) \times 2x}{x-3} + \frac{(x-3)(x+1) \times 4}{x+1} = (x-3)(x+1) \times 1$$

The terms at the bottom Cancel out

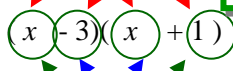
$$(x+1) \times 2x + (x-3) \times 4 = (x-3)(x+1)$$

$$\rightarrow 2x^2 + 2x + 4x - 12 = x^2 - 2x - 3$$

$$x \times x = x^2$$

$$-3 \times 1 = -3$$

Double Brackets mean FOUR multiplications



$$x \times 1 = +x$$

$$-3 \times x = -3x$$

Simplify - collect like terms together

$$+x - 3x + x^2 - 3 = x^2 - 2x - 3$$

$$2x^2 + 6x - 12 = x^2 - 2x - 3$$

Subtract x^2

$$x^2 + 6x - 12 = -2x - 3$$

Add $2x$

$$x^2 + 8x - 12 = -3$$

Add 3

$$x^2 + 8x - 9 = 0$$

Solve this Quadratics - by factorising.

1. Start with:
 $(x \quad A)(x \quad B)$

2. To find A and B look at the quadratic

3. A and B are two numbers which

make +8 by adding or subtracting

and multiply to make -9

$$-9 = +9 \times -1 \text{ and } +8 = 9 - 1$$

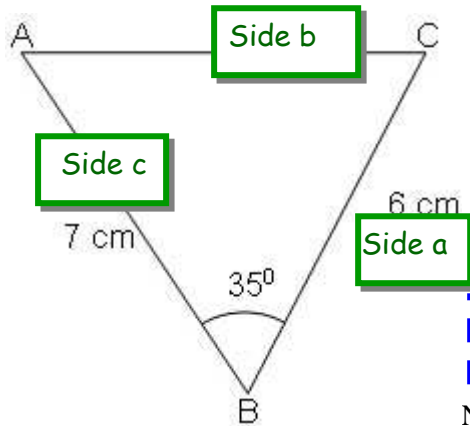
$$x^2 + 8x - 9 = (x+9)(x-1) = 0$$

$$x = -9 \text{ or } x = 1$$

$$(x+9)(x-1) = 0 \text{ so } x = -9 \text{ or } x = 1$$

(3)

22.



This Δ is not a right angled one so we must use the sine or cosine rule

We have 2 sides and an angle and need to find another side so it's the cosine rule

Not accurately drawn

ABC is a triangle with:
AB = 7 cm
BC = 6 cm
Angle ABC = 35°

We have angle B and need to find side b so use
 $b^2 = a^2 + c^2 - 2ac \cos B$

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

Substitute values in $b^2 = a^2 + c^2 - 2ac \cos$

$$b^2 = 6^2 + 7^2 - 2 \times 6 \times 7 \cos 35 = 16.19$$

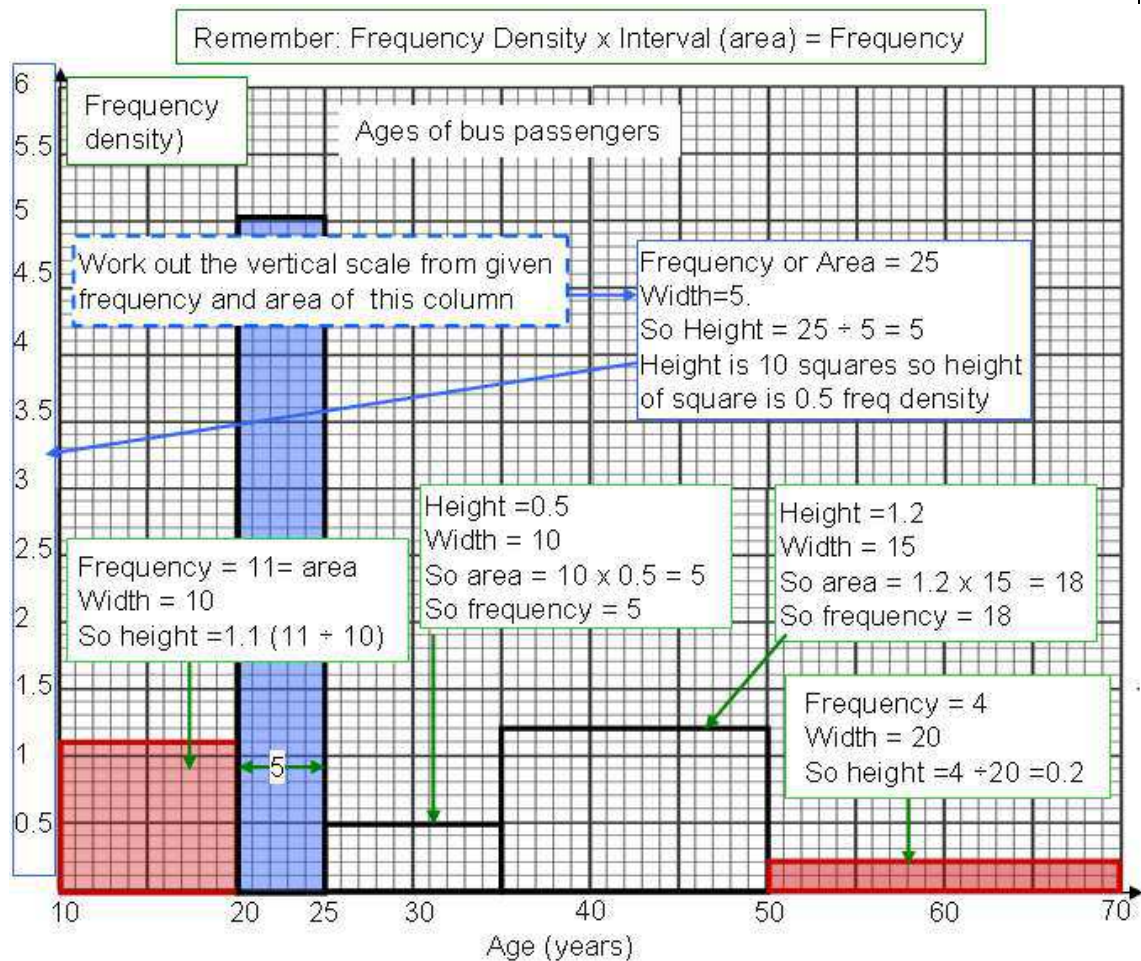
6 x² + 7 x² - 2 x 6 x 7 x cos 35

$$b = \sqrt{16.19} = 4.023 \text{ or } 4.02 \text{ to 3 sf}$$

4.02

(3)

23. The table and histogram show information about the age of passengers on a bus



(2)

a) Use the histogram to complete the table

Time (t years)	Frequency
$10 < t \leq 20$	11
$20 < t \leq 25$	25
$25 < t \leq 35$	5
$35 < t \leq 50$	18
$50 < t \leq 70$	4

b) Use the table to complete the histogram

(2)

24. Nina walks 50 metres in a time of 35.6 seconds

The distance of 50 metres was measured to the nearest metre.

The time of 35.6 seconds was measured to the nearest tenth of a second.

a) What is the upper bound for the distance of 50 metres

Upper and Lower Bounds are related to accuracy. Once you know the degree of accuracy to which a measurement has been rounded, you can then find the Upper and Lower bounds. The Upper Bound is the biggest possible value the measurement could have been before it was rounded down. The Lower Bound is the smallest possible value the measurement could have been before it was rounded up

50 m to the nearest metre.
The largest possible value is 50.5m.
This is rounded down to 50m
Above 50.5 and it becomes 51 m

50.5
..... m (1)

b) What is the lower bound for the time of 35.6 seconds

35.6s to the nearest $1/10^{\text{th}}$ sec.
The lowest possible value is 35.55
Below this and it becomes 35.5s.
This is rounded up to 35.6m

35.55
.....seconds (1)

c) Calculate the upper bound for Nina's average speed
Show all the figures on your calculator display

The upper bound for S is when we have an upper bound for D and a lower bound for t.
This will give the biggest answer.



$$50.5 \div 35.55 = 1.4205344$$

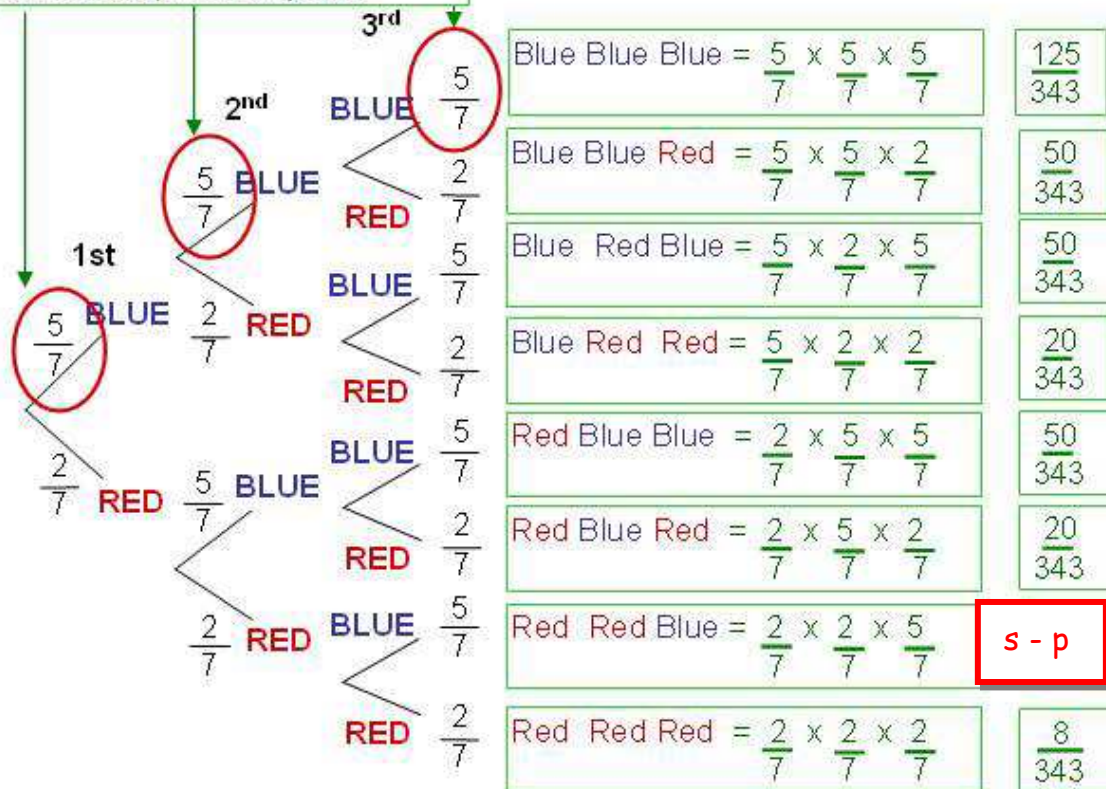
1.4205344
...metres per second

25. Jane has a box which contains 5 blue cushions and 2 red cushions
Jane picks a cushion at random from the box. She notes the colour and then replaces it.
She does this two more times.

Calculate the probability that when Jane takes three cushions that exactly two are the same colour.

Because Jane replaces the cushions the probability of getting a blue or red never changes.

Multiply the probabilities as go across the probability tree



Get two of the same colour by getting
Blue Red Red; Red Red Blue; Red Blue Red
Blue Blue Red; Blue Red Blue; Red Blue Blue – work out each probability separately and then Add them together.

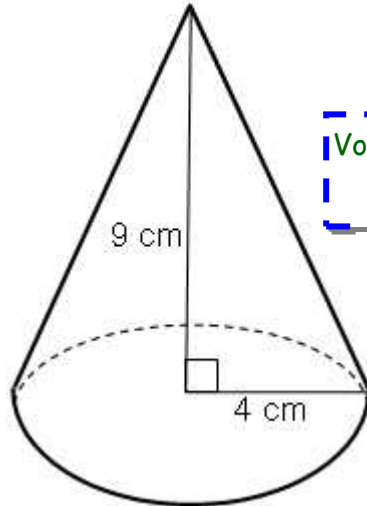
The only other possibilities are Blue, Blue Blue; or Red, Red, Red
Work out these probabilities and subtract from 1

$$1 - \frac{125}{343} - \frac{8}{343} = \frac{210}{343}$$

$$\frac{210}{343}$$

(3)

26.



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

The cone above has a base radius of 4 cm and a vertical height of 9 cm.

- a) Calculate the volume of the cone
Give your answer correct to 3 significant figures.

$$\text{Putting values into equation: } \frac{1}{3} \times \pi \times 4^2 \times 9 =$$

$$\pi \times 4 \times 4^2 \times 9 \div 3 = 150.796$$

Find π on your calculator or use 3.142

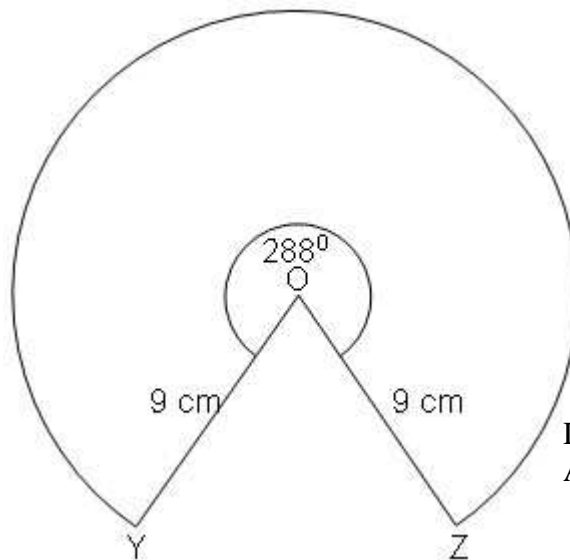
Squares the 4

3rd sig fig goes up to 1

151

(2)

26b. Below is a net for a different cone



Area of sector
 $= \text{area of circle} \times \frac{288}{360}$

Surface area of cone
 $= \pi \times r \times L$
 L is slant height = 9cm

Diagram not
 Accurately drawn

The net is a sector of a circle centre O and radius 9 cm
 Reflex angle YOZ is 288°
 When folded together the net makes a cone of slant height 9 cm

b) Work out the vertical height of the cone

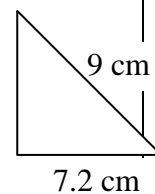
Work out the radius first
 Area of sector is the same
 as surface area of cone

$$\text{Area of sector} = \pi r^2 \times \frac{288}{360} = \frac{\pi \times 9 \times 9 \times 288}{360 \times 10} = 72\pi$$

$$\text{Surface area of cone} = \pi \times r \times 9 = \frac{\pi \times 9 \times 72}{10}$$

$$\text{So } r = \frac{\pi \times 9 \times 72}{\pi \times 9 \times 10} = 7.2 \text{ (radius of cone)}$$

We have a right angled triangle with base = 7.2cm and slant height = 9cm so use **Pythagoras** to find vertical height $v^2 = L^2 - r^2$



√ (9 x² - 7.2 x²) =

5.4 (4)
cm