

GCSE Mathematics

Calculator

Higher Tier

Free Practice Set 6

1 hour 45 minutes



ANSWERS

Marks shown in brackets for each question (2)

A*	A	B	C	D	E
88	75	60	45	25	15

Legend used in answers

Green Box - Working out

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

Red Box and ✓ - Answer

48 % ✓

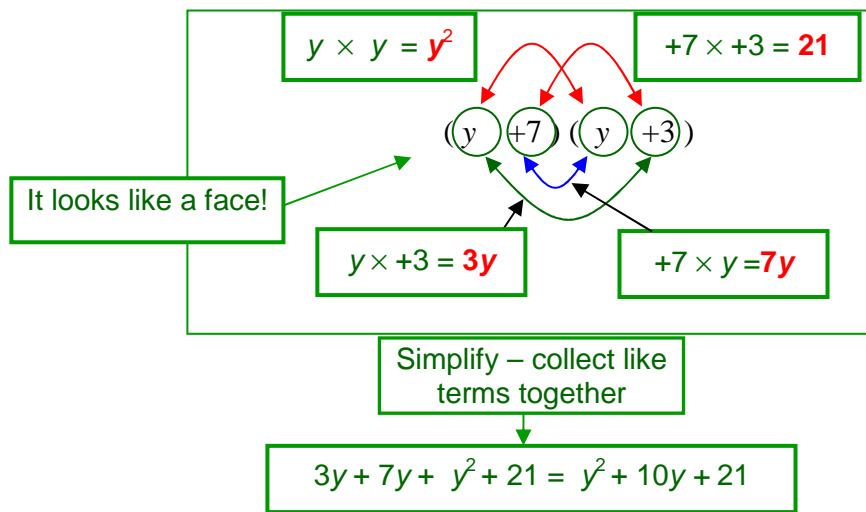
Authors Note

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1. a) Expand and Simplify $(y + 7)(y + 3)$



Double Brackets mean FOUR multiplications

Use **FOIL** to help you remember the 4 multiplications:
First terms
Outer terms
Inner terms
Last terms

OR use a 2x2 grid Then simplify

x	y	+3
y	y^2	$+3y$
+7	$+7y$	$+21$

$y^2 + 10y + 21$ ✓

.....

(2)

b) Simplify $2a^2 \times a$

$2a^2 \times a = 2 \times a \times a \times a = 2a^3$

$2a^3$ ✓

.....

(1)

c) Factorise $y^2 - 8y - 48$

y^2 $-8y$ -48 = 0

1. Start with:
(y A)(y 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 -48

The two values are 4 and -12
Because:
-48 = +4 × -12
-8 = +4 - 12

Rewriting the quadratic using 4 and -12 we get:
 $y^2 - 8y - 48 = (y + 4)(y - 12)$

(y + 4)(y - 12) ✓ (2)

d) Simplify $\frac{16 a^2 b^3 c^4 d^2}{4 a b^3 c^5 d}$

Cancel top and bottom

Rewrite $\frac{16 a^2 b^3 c^4 d^2}{4 a b^3 c^5 d} = \frac{16 \cancel{x} \cancel{a} \cancel{x} \cancel{a} \cancel{x} \cancel{b} \cancel{x} \cancel{b} \cancel{x} \cancel{b} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{d} \cancel{x} \cancel{d}}{4 \cancel{x} \cancel{a} \cancel{x} \cancel{b} \cancel{x} \cancel{b} \cancel{x} \cancel{b} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{c} \cancel{x} \cancel{d}}$

$= \frac{4 \times a \times d}{c}$

$\frac{4 a d}{c}$ ✓ (2)

e) Simplify $(3 a^2)^4$

Rewrite $(3 a^2)^4 = 3 \times a \times a \times 3 \times a \times a \times 3 \times a \times a \times 3 \times a \times a$

$= 81 \times a^8$

$81a^8$ ✓ (2)

f) $x = 5.1(a^2 - b^2)$

Find the value of x when a = 6 and b = 7

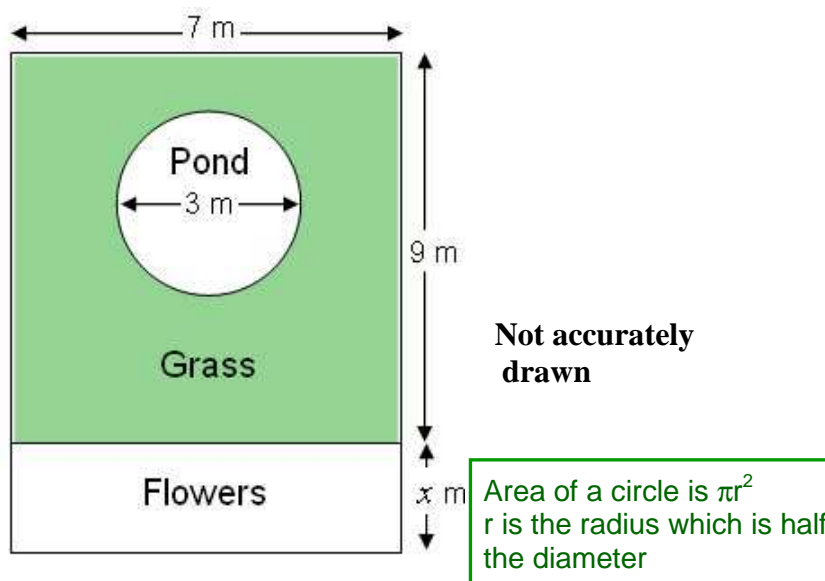
$x = 5.1 \times (a^2 - b^2)$

using a = 6 and b = 7 $c = 5.1 \times (6 \times 6 - 7 \times 7)$

5 . 1 x (6 x² - 7 x²) =

x = **- 66.3** ✓ (2)

2. The diagram below shows a plan of a rectangular garden with measurements in metres. There is a circular pond and an area for flowers.



- a) Work out the area of the circular pond to 2 decimal places

get π using shift π

The x^2 button squares 1.5

or

shift π x 1 . 5 x^2 =

shift π x 1 . 5 x 1 . 5 = 7.07

To 2 decimal places 7.0695 is 7.07

7.07 m² (1)

- b) Express the perimeter of the garden in terms of x .
 Give your answer in its simplest form.

The perimeter is the total distance around the garden

$$= 7 + 9 + x + 7 + 9 + x$$

$$= 32 + 2x$$

32 + 2x (1)

- c) The perimeter of the garden is 40 metres.
 Find the value of x .

$$\begin{array}{rcl} \text{Perimeter} & 32 + 2x & = 40 \\ \text{(Subtract 32)} & 32 - 32 + 2x & = 40 - 32 \\ & 2x = 8 & \text{so } x = 4 \end{array}$$

$x = \dots$ 4 (2)

3. Laura bought 25 cups and 8 plates.
The total cost was £35.07.
Each plate cost £1.79.
Find the cost of each cup.



8 plates cost $8 \times £1.79$

$$8 \times 1.79 =$$

14.32

Find the cost of 25 cups by subtracting this from the total cost

$$35.07 - 14.32 =$$

20.75

Find the cost of each cup by dividing this by 25

$$20.75 \div 25 =$$

0.83

0.83 ✓

£.....

(3)

4. The equation

$$x^3 - 4x = 9$$

Trial and improvement means trying out different values for the letters in an equation to see how close you get to the given answer

has a solution between 2 and 3

Use a trial and improvement method to find this solution correct to 1 decimal place

You must show **all** your working.

For this equation make a table with columns for the x , x^3 , $-4x$ and answer

Use the power button to get x^3

4×3^3 gives $4^3 = 64$

 x^y

x	x^3	$-4x$	$=$	
2	8	-8	0	Too low

2 x^y 3
 - 4 x 2
 =

3	27	-12	15	Too high
---	----	-----	----	----------

3 x^y 3
 - 4 x 3
 =

15 is closer to 9 than 0 so x is nearer 3 than 2. Try $x = 2.7$ next

2.7	19.68	-10.8	8.88	Almost
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2 . 7 x^y 3
 - 4 x 2 . 7
 =

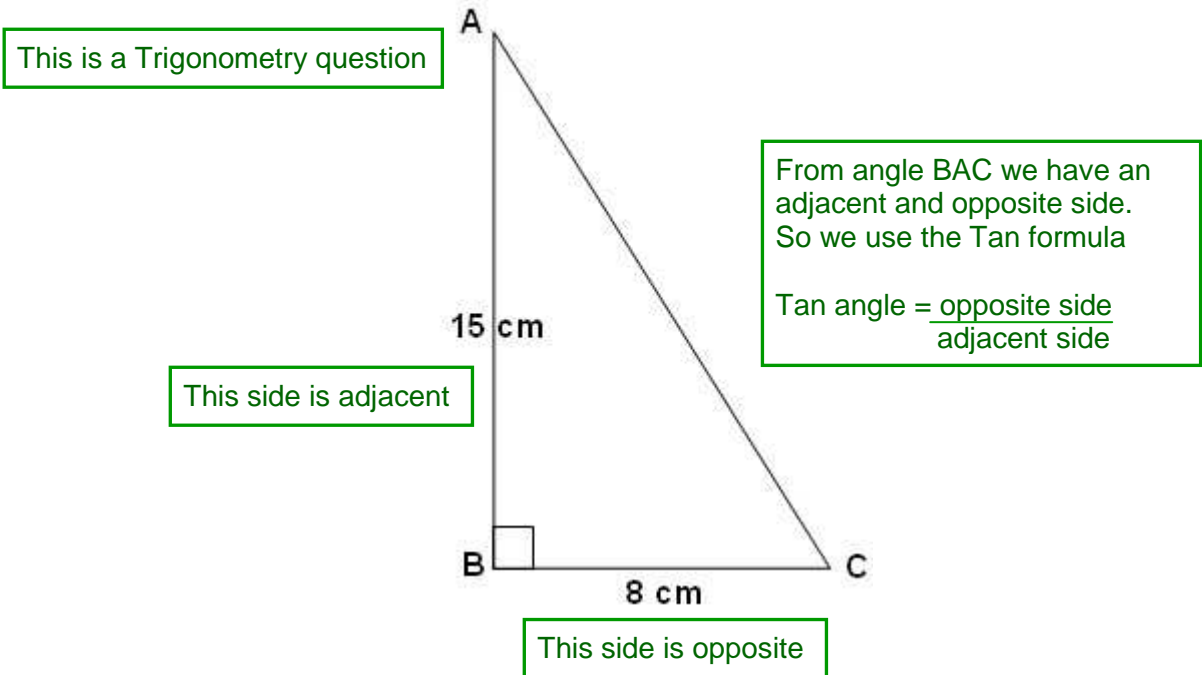
This is too low so try a higher value for x . Go up by one decimal point $x = 2.8$

2.8	21.95	-11.2	10.75	Too high
-----	-------	-------	-------	----------

2 . 8 x^y 3
 - 4 x 2 . 8
 =

$x =$
2.7
) (4)

5. ABC is a right angled triangle with side AB = 15 and side BC = 8 cm

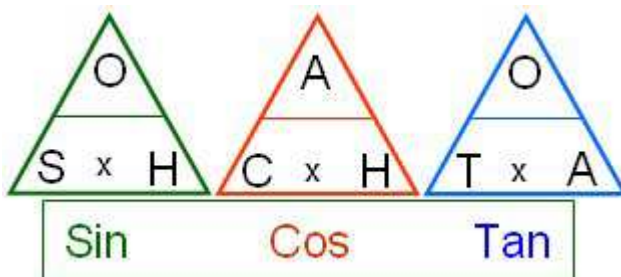


a) Work out the angle BAC. . Give your answer to 1 decimal place.

After doing $8 \div 15$ use Tan^{-1} to convert to an angle

$$8 \div 15 = \text{Tan}^{-1} =$$

28.1⁰
(2)



6. Zack went to Zambia.

He changed £250 into Zambian Kwacha (ZMK)
The exchange rate was £1 = ZMK 7280

a) How many Zambian Kwacha will he get?

We have to decide whether to
Multiply 250 by 7280 or divide 250 by 7280

We know that we get more ZMK for each pound.
So you multiply by 7280 to convert pounds into ZMK

$$£250 \times 7280 = \text{ZWK}1820000$$

2 5 0 x 7 2 8 0 =

ZWK. **1,820,000** ✓
(2)

When he came home she changed 152,750 ZMK back to pounds
The exchange rate was now £1 = ZMK 7380

b) How many pounds did he get?
Give your answer to the nearest pence.

When we convert ZWK back into pounds we get fewer pounds
So you divide by 7380 to convert ZWK into pounds:

$$\text{ZWK}152,750 \div 7380 = £20.70$$

1 5 2 7 5 0 ÷ 7 3 8 0 =

£..... **20.70** ✓
(2)

c) Before 1971 the UK currency was in pounds, shillings and pennies (£ s d)

1 shilling = 12 pennies

1 pound = 20 shillings.

Convert 268 pennies into pounds, shillings and old pence.

First convert pennies into shillings.

Since we get fewer shillings, divide 268 pennies by 12 to get shillings

$268 \div 12 = 22 \text{ .}3333$ shillings = 22 shillings and 4 pennies

$$\boxed{2} \boxed{6} \boxed{8} \div \boxed{1} \boxed{2} =$$

$22 \text{ .}3333$ shillings = 22 shillings $\frac{1}{3}$ shilling
= 22 shillings + 4pennies

Second convert shillings into pounds.

Since we get fewer pounds, divide 22 shillings by 20 to get pounds

$22 \div 20 = 1$, remainder 2 = 1 pound and 2 shillings

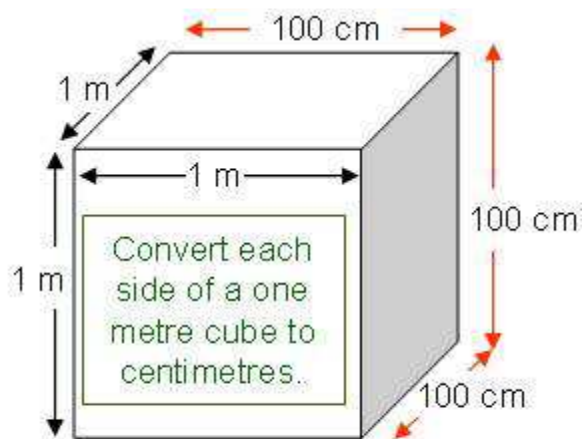
Altogether we have 2 pounds 2 shillings and 4 pennies

pounds .. 2 [✓] shillings 2 [✓] pennies. 4 [✓]
(2)

d) Convert 2.1m^3 to cm^3

The answer is NOT 210!!

Don't fall into the trap of thinking that $2.1\text{ m}^3 = 210\text{ cm}^3$
This is wrong because we have only converted metres into centimetres when we have to cube 100



$$\begin{aligned} 1\text{m}^3 &= 1\text{ m} \times 1\text{ m} \times 1\text{ m} \\ &= 100\text{ cm} \times 100\text{ cm} \times 100\text{ cm} \\ &= 1000000\text{ cm}^3. \end{aligned}$$

$$1\text{ m}^3 = 1000000\text{ cm}^3 \therefore 2.1\text{ m}^3 = 2,100,000\text{ cm}^3$$

2,100,000

cm^3
(1)

7. a) Draw a prime number tree for 112 and 70

A prime factor tree breaks a number down into its prime number factors.

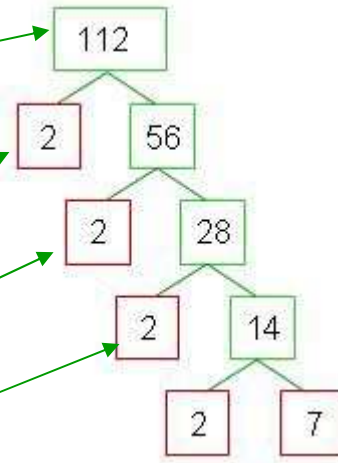
2 is the first prime number

Start with your number at the top.
See if it can be halved
This halves into 2 and 56

56 can be halved again = 2×28

28 can be halved again = 2×14

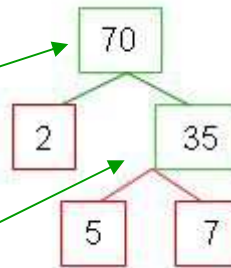
$14 = 2 \times 7$ both prime numbers



$112 = 2 \times 2 \times 2 \times 2 \times 7$
These are all prime numbers

Start with your number at the top.
See if it can be halved
This halves into 2 and 35

$35 = 5 \times 7$ both prime numbers



$70 = 2 \times 5 \times 7$
These are all prime numbers

(2)

- b) Using your prime factor tree or otherwise work out the Highest Common Factor for 112 and 70

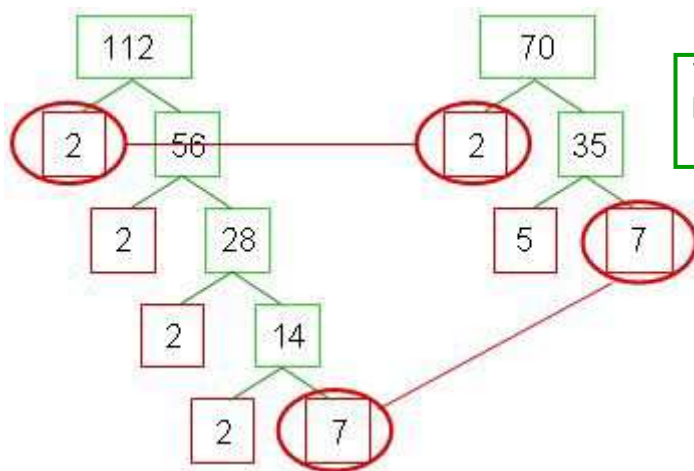
The highest common factor is the biggest number that will go into both 112 and 70.

Look at the prime numbers that we got for 112 and 70 and mark the common ones.

$$112 = 2 \times 2 \times 7 \times 2 \times 2$$

$$70 = 2 \times 5 \times 7 \times 5$$

The common factors in both are $2 \times 7 = 14$



The common factors in both trees are shown
For one tree just multiply them together them
 $2 \times 7 = 14$

14

(2)

- c) Using your prime factor tree or otherwise work out the Lowest Common Multiple for 112 and 70

The lowest common multiple is the value which both 70 and 112 will divide into

Look at the prime numbers that we got for 112 and 70 and mark those that **do not** appear in both. Cross multiply these with the top of the opposite prime factor tree

$$112 = 2 \times 7 \times 2 \times 2 \times 2 \quad 8 \times 70 = 560$$

$$70 = 2 \times 7 \times 5 \quad 5 \times 112 = 560$$

560

(2)

8. Laura recorded the types of tableware she had in her crockery business. She had 90 items.

To work out the number of degrees for one item, divide 140 by 35 = 4

Tableware	Frequency	Angle
Plates	35	140
Cups & saucers	30	120
Milk Jugs	11	44
Sugar bowls	14	56

- a) Complete the table above

This angle = 30×4 degrees

$$30 \times 4 =$$

This frequency = $44 \div 4$

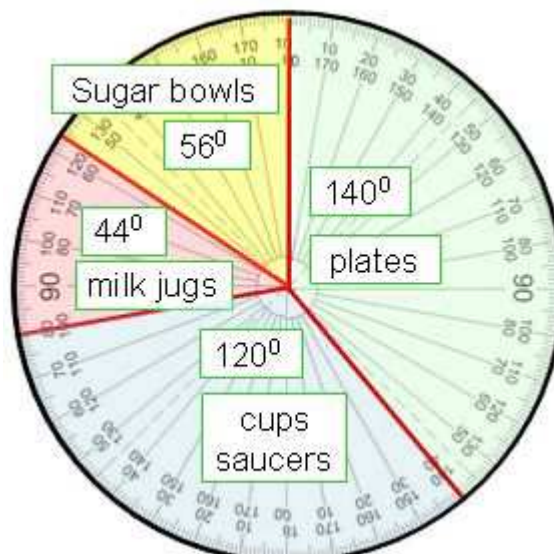
$$44 \div 4 =$$

This frequency = $14 \times 4 = 56$

$$14 \times 4 =$$

(2)

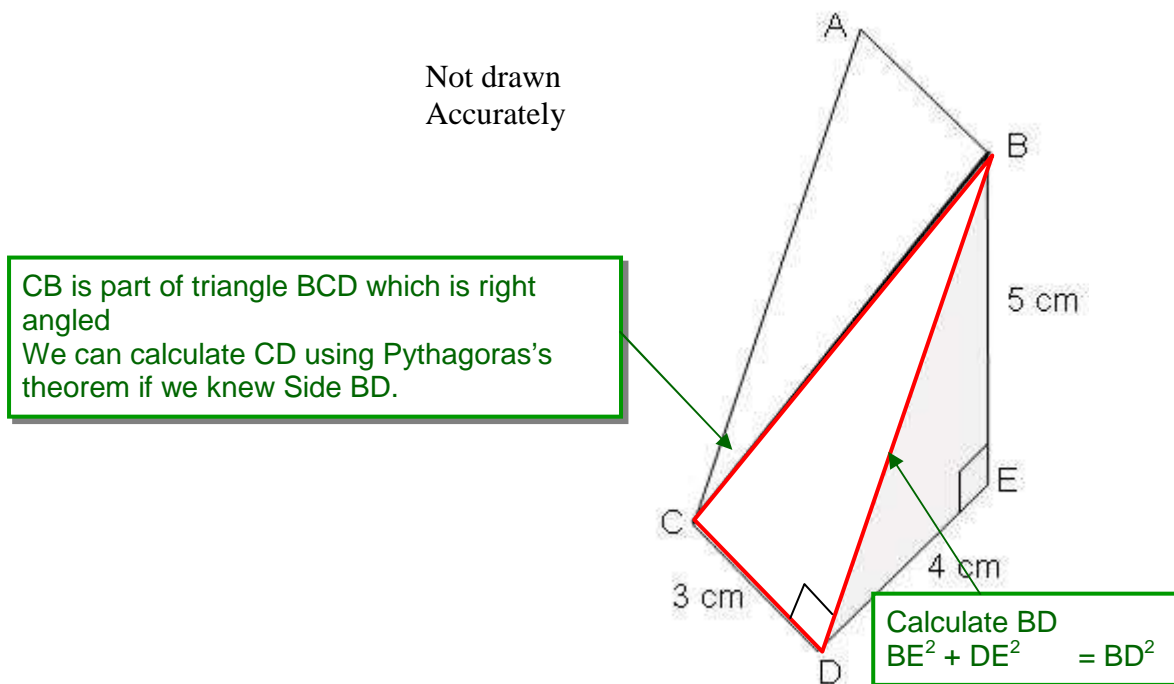
- b) Draw an accurate pie chart to show this information. The first one has been done for you.



(2)

9. A cuboid is cut through four of its vertices, A, B, C and D, into two identical pieces.

The diagram below shows one of the pieces.



Find the length of the line **BC** to one decimal place

$$BE^2 + DE^2 = BD^2$$

5 x^2 + 4 x^2 = 25 + 16 = 41 $BD = \sqrt{41}$

This button squares the number

Calculate BC

$$BD^2 + CD^2 = BC^2$$

41 + 3 x^2 = 41 + 9 = 50

We know that $BD^2 = 41$

$\sqrt{50} = 7.07$

This button square roots the number

7.1 ✓

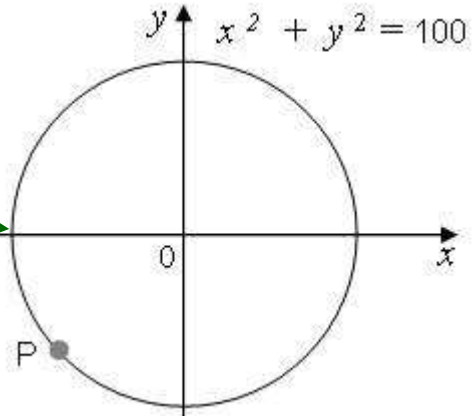
.....cm
(3)

10. The diagram shows a circle with centre (0, 0)

The circle has the equation:

$$x^2 + y^2 = 100$$

Anywhere on this line $y = 0$



a) There are two points on the circumference of the circle with an **x-coordinate of 8**

What are the coordinates of these two points.

Put $x = 8$ into the equation to find y

$$\begin{array}{rcl} x^2 & + & y^2 = 100 \\ 8^2 & + & y^2 = 100 \\ (-64) & & y^2 = 36 \end{array} \text{ so } y = \sqrt{36} = +6 \text{ or } -6$$

Remember the square root of a number can be plus or minus

(8, **6**) and (8, **-6**)
(2)

b) What is the **radius** of the circle?

Put $y = 0$ so we are only on the x line. x will be the radius

$$\begin{array}{rcl} x^2 & = & 100 \\ x^2 & = & 100 \\ & = & 10 \end{array}$$

We only use the plus value since a length cannot be negative

10

(1)

c) Point P is on the circumference of the circle.
Its **x-coordinate is equal** to its **y-coordinate**.

What are the coordinates of point P, correct to **1 decimal place**?

If $x = y$ then

$$\begin{array}{rcl} x^2 & + & y^2 = 100 \\ 2x^2 & & = 100 \\ x^2 & & = 50 \\ x & & = \sqrt{50} = \pm 7.1 \end{array}$$

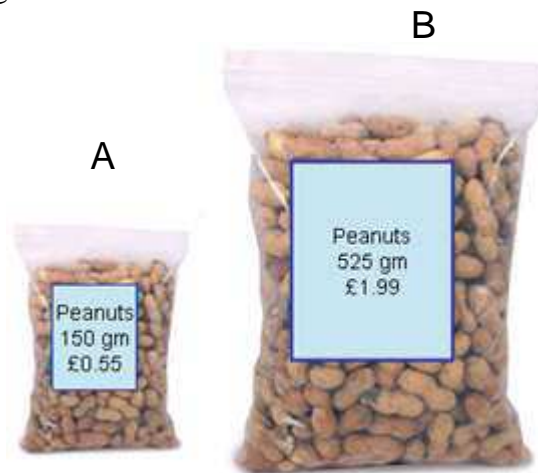
$x = y = \sqrt{50} = +7.071$ or -7.071
Since P is at the bottom of the graph it must be the negative values

P (**-7.1, -7.1**)
(2)

11. Peanuts comes in small bags and large bags.

A small bag of 150 grams costs £0.55

A large bag of 525 grams costs £1.99



Which bag is better value for money?

You **must** show working to explain your answer.

Work out the cost per gram

Bag A : cost in pence \div weight in grams

Bag B $55 \div 150 = 0.366$

$199 \div 525 = 0.379$

Bag A has a lower cost in pence per gram than Bag B
Bag A is better value.

Bag A

(2)

12. a) The n th term for a sequence is given by

$$\frac{3n^2 - 3n + 6}{2}$$

What is the 5th term of this sequence?

Remember to use **BODMAS**
and do the calculations in the
correct order

$$\begin{aligned} \text{5th term} &= \frac{3 \times 5 \times 5 - 3 \times 5 + 6}{2} \\ &= \frac{75 - 15 + 6}{2} = \frac{66}{2} = 33 \end{aligned}$$

33

(1)

- b) The first four terms in a sequence are:

$$-1 \quad -4 \quad -7 \quad -10$$

Write an expression for the n th term of the sequence

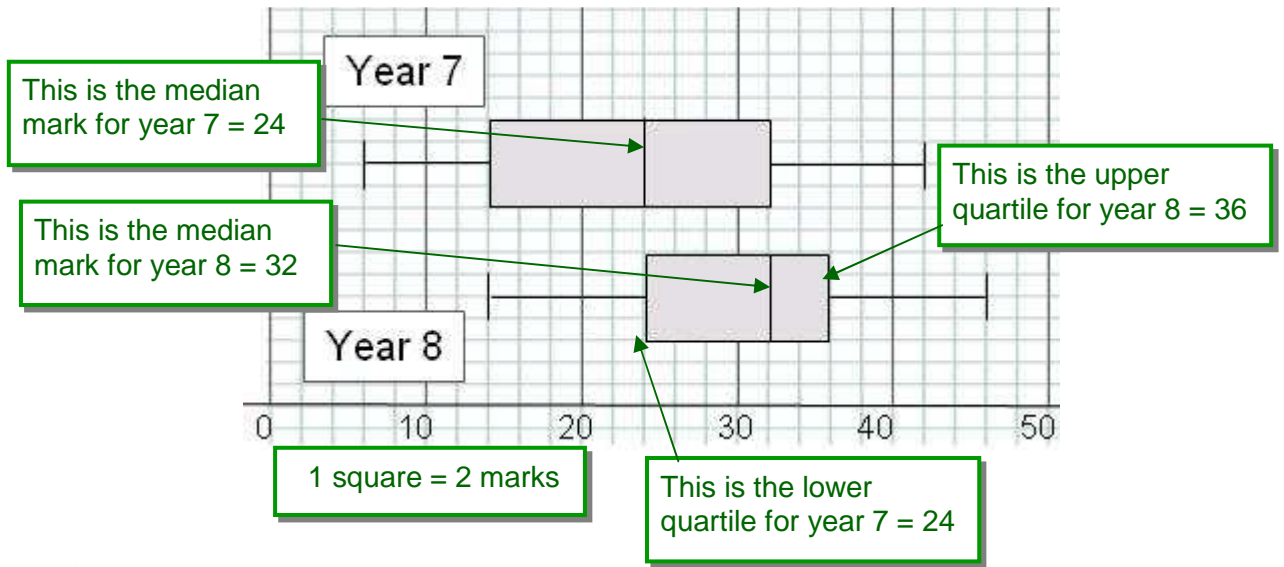
These numbers are decreasing by 3 each time as we move right so we write $-3n$

Work out the value **before** the beginning = $-1 + 3 = 2$ because
we increase by 3 when we move to the left
Put this in front of the value you found above

$2 - 3n$

(1)

13. The box plots below show the marks in a test for pupils in Year 7 and Year 8.



a) What is the median value for year 7?

24

(1)

b) What is the inter quartile range for year 8?

$$\begin{aligned} \text{The inter quartile range} &= \text{upper quartile} - \text{lower quartile} \\ &= 36 - 24 = 12 \end{aligned}$$

12

(1)

c) In year 7 there were 124 students.
How many students got 32 marks or more in year 7?

32 marks is the upper quartile for year 7.
This means that a quarter of students got 32 marks or more
 $\frac{1}{4}$ of 124 = 31

31

(2)

14. a) Simplify 4^0

Anything to power zero is always 1

1

(1)

b) Simplify 4^{-4}

The power 4 means quadruple power. When it also has a minus it means a reciprocal (one over the amount)

$$4^{-4} \text{ is } \frac{1}{4^4} = \frac{1}{256}$$

4 x^y 4 =

Use the power button x^y

$\frac{1}{256}$

(1)

c) Simplify $(16)^{\frac{3}{4}}$

The power $\frac{1}{4}$ means fourth root of the number. Then we cube it

$$(16)^{\frac{3}{4}} = (\sqrt[4]{16})^3 = (2)^3 = 8$$

1 6 x^y 0 . 7 =

Use the power button x^y with $y = \frac{3}{4} = 0.75$

8

(2)

15. 120 batteries were tested to see how long they lasted.

The table below shows how long in hours the batteries lasted.

Time (t hours)	Midpoint	Frequency	Product
$0 < t \leq 6$	Midpoint is 3	1	$1 \times 3 = 3$
$6 < t \leq 12$	Midpoint is 9	12	$9 \times 12 = 108$
$12 < t \leq 18$	Midpoint is 15	32	$15 \times 32 = 480$
$18 < t \leq 24$	Midpoint is 21	52	$21 \times 52 = 1092$
$24 < t \leq 30$	Midpoint is 27	19	$27 \times 19 = 513$
$30 < t \leq 36$	Midpoint is 33	4	$33 \times 4 = 132$

Add this column to get total time
 $3+108+480+1092+5113+132=2328$

a) Work out an estimate for the mean time in hours that a battery lasts

Mean time battery lasts = total time for all batteries \div number of batteries

To work out the total time for all batteries we work down the rows in the table. Take the midpoint for the time and multiply it by how many batteries took that time (frequency) Then we add all the values in the final column

Mean time that battery lasts = $2328 \div 120 = 19.4$ hours

Warning:
DON'T DIVIDE THE TOTAL TIME BY 6 : the number of rows

19.4 hours
hours
 (3)

16.

In this triangle we don't know enough angles opposite sides so we can't use the sine rule. Use the cosine rule

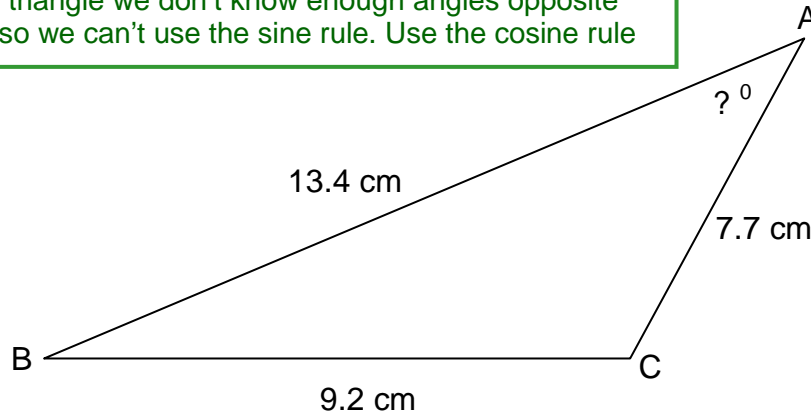


Diagram NOT drawn accurately

ABC is a triangle
 AC = 7.7 cm
 AB = 13.4 cm
 BC = 9.2 cm

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

Calculate angle BAC of the triangle.
 Give your answer correct to 1 decimal place.

Since we need to find an angle, use the Cosine rule for an angle. You will need to know how to rearrange it as they only give the other form of the cosine rule.

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos A \\ (-b^2 - c^2) \quad a^2 - b^2 - c^2 &= -2bc \cos A \\ (\div 2bc) \quad \frac{a^2 - b^2 - c^2}{2bc} &= -\cos A \\ \text{Reverse signs} \quad \frac{b^2 + c^2 - a^2}{2bc} &= \cos A \end{aligned}$$

Side a = 9.2cm, side b = 7.7, side c = 13.4.

$$\begin{aligned} \cos A &= \frac{b^2 + c^2 - a^2}{2bc} \\ &= \frac{7.7^2 + 13.4^2 - 9.2^2}{2 \times 7.7 \times 13.4} \\ &= \frac{59.29 + 179.56 - 84.64}{206.36} \\ \cos A &= 0.7473 \end{aligned}$$

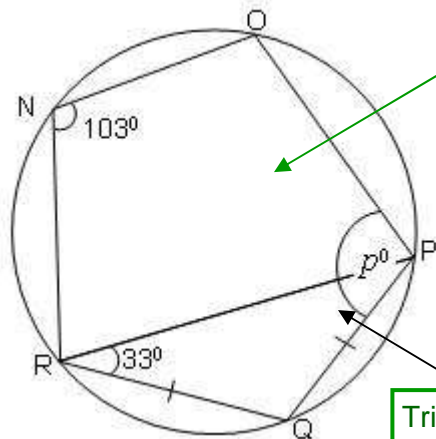
But we have to convert this to an angle – use the **Cos⁻¹** button
 Cos⁻¹ 0.7473 = 41.6

7 . 7 x² + 1 3 . 4 x² - 9 . 2 x² =

÷ (2 x 7 . 7 x 1 3 . 4) = Cos⁻¹ 41.6

..... (3)

17. a) A five sided shape NOPQR is shown inside a circle.
 $\text{ONR} = 103^\circ$
 $\text{PRQ} = 33^\circ$



NOPR is a **cyclic quadrilateral** – a four sided shape where each corner touches the circumference of a circle
Opposite angles add up to 180°

$\text{OPR} = 180 - 103 = 77^\circ$

Triangle PRQ is isosceles so $\text{RPQ} = 33^\circ$

Work out the value of angle OPQ

The shape ABOD is symmetrical

$\text{Angle } p = \text{OPR} + \text{RPQ} = 77 + 33 = 110^\circ$

110
⁰
 (2)

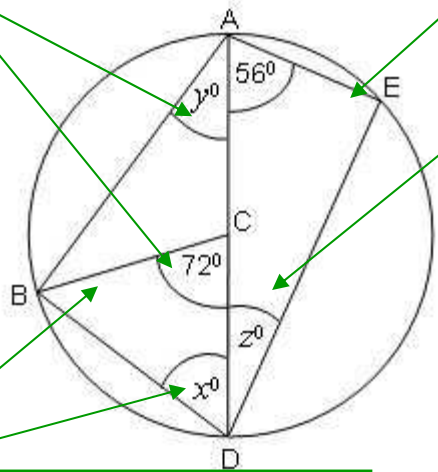
- b) A four sided shape ABDE is shown inside a circle.
 C is the centre of the circle.
 $\text{BCD} = 72^\circ$
 $\text{DAE} = 56^\circ$

BCD is an angle at the centre of the circle
 BAD (y) is an angle at the circumference.
 They both start at the same sector.
Angle at the circumference = $\frac{1}{2}$ Angle at centre

ACD is the diameter passing through the centre
 Triangle AED is in a semi-circle so $\text{AED} = 90^\circ$

$y = \frac{1}{2} \times \text{BCD}$
 $y = \frac{1}{2} \times 72 = 36^\circ$

$z = 180 - 56 - 90 = 34^\circ$



Triangle BCD is isosceles because $\text{BC} = \text{CD}$ – both are radii.
 So $72 + x + x = 180$ or $2x = 108$ and $x = 54^\circ$

Work out the value of angle x , y and z

$x =$ **54** $. y =$ **36** $. z =$ **34**
⁰
 (3)

18. Solve $x^2 + 8x - 7 = 0$ using the quadratic formula

Give your answer correct to 2 significant figures

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

$$a = 1, b = 8, c = -7$$

$$x = \frac{-8 \pm \sqrt{64 - 4 \times 1 \times -7}}{2} = \frac{-8 \pm \sqrt{64 + 28}}{2} = \frac{-8 \pm \sqrt{92}}{2} = \frac{-8 \pm 9.592}{2}$$

$$x = \frac{1.592}{2} \text{ or } \frac{-17.59}{2}$$

$x =$ **0.80** $.$ or $x =$ **- 8.8** (3)

19. The activity of a radioisotope falls by 2% every year. If the initial activity is 5,000 counts per minute what will it be after one hundred years?

Give your answer to 3 significant figures

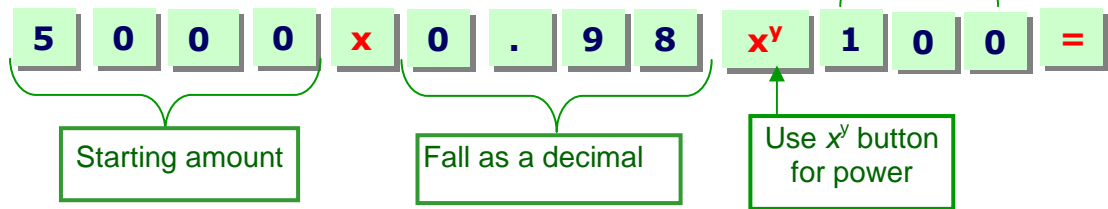
You have to use the compound interest formula for this question

Number of years

$$\begin{aligned} \text{Amount after N years} &= \text{starting amount} \times (1 - \text{change as a decimal})^N \\ &= 5000 \times (1 - 0.02)^{100} \\ &= 5000 \times (0.98)^{100} \\ &= \end{aligned}$$

Percentage change is a fall of 2%. As a decimal it is 0.02

100 years



663 (3)

20. There are 10 coloured buttons in a bag

1 buttons is white
3 buttons are green
6 buttons are red.

$$\text{Total number buttons is } 1 + 3 + 6 = 10$$

If you take *three* buttons at random from the bag *without replacement*

What is the probability that you pick

a) Three red buttons

$$\text{Probability (1}^{\text{st}} \text{ red)} = \frac{\text{number of red buttons}}{\text{total number buttons}} = \frac{6}{10}$$

$$\text{Probability (2}^{\text{nd}} \text{ red)} = \frac{5}{9}$$

REMEMBER: we have already taken one red out so have 5 left out of a total of 9

$$\text{Probability (3}^{\text{rd}} \text{ red)} = \frac{4}{8}$$

$$\text{Probability (three reds)} = \frac{6^2}{10^2} \times \frac{5^1}{9^1} \times \frac{4^1}{8^1} = \frac{2}{12}$$

$$\frac{1}{6}$$

(2)

b) Another bag has 2 white, 3 green and 6 red buttons.

If you take *two* buttons at random from the bag *without replacement*

What is the probability that you pick *No white* buttons

To get no white buttons means we can select buttons in several ways:

$$P(\text{green: green}) + P(\text{red: red}) + P(\text{red: green}) + P(\text{green: red})$$

$$\text{Probability (green - green)} = \frac{3}{11} \times \frac{2}{10} = \frac{6}{110}$$

$$\text{Probability (red - red)} = \frac{6}{11} \times \frac{5}{10} = \frac{30}{110}$$

$$\text{Probability (red - green)} = \frac{6}{11} \times \frac{3}{10} = \frac{18}{110}$$

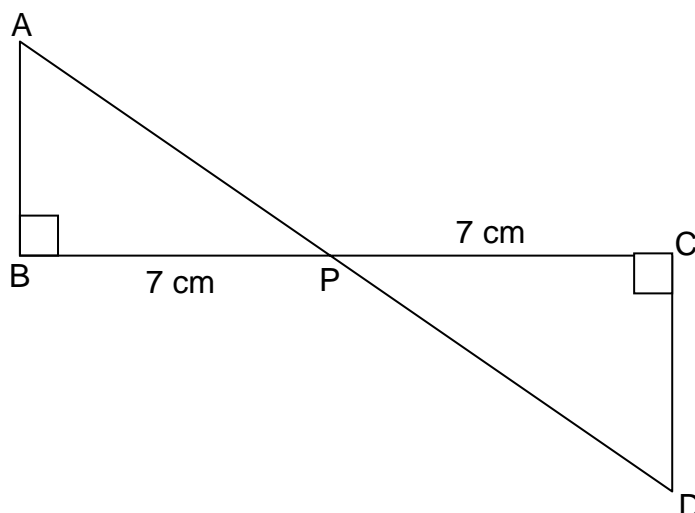
$$\text{Probability (green - red)} = \frac{18}{110}$$

$$\frac{36}{55}$$

(2)

$$\text{Add probabilities} = \frac{6 + 30 + 18 + 18}{110} = \frac{72}{110} = \frac{36}{55}$$

21. Prove that triangle BAP is congruent to triangle CDP.



Congruent means identical. There are several ways to prove congruency:
SSS – three sides the same;
AAS – two angles and a side the same;
SAS – two sides and an angle between them the same;
RHS – right angle, the hypotenuse and one other side all the same

Angle B equals angle C because they are both right angles.

Side BP equals side PC because both have length of 7cm

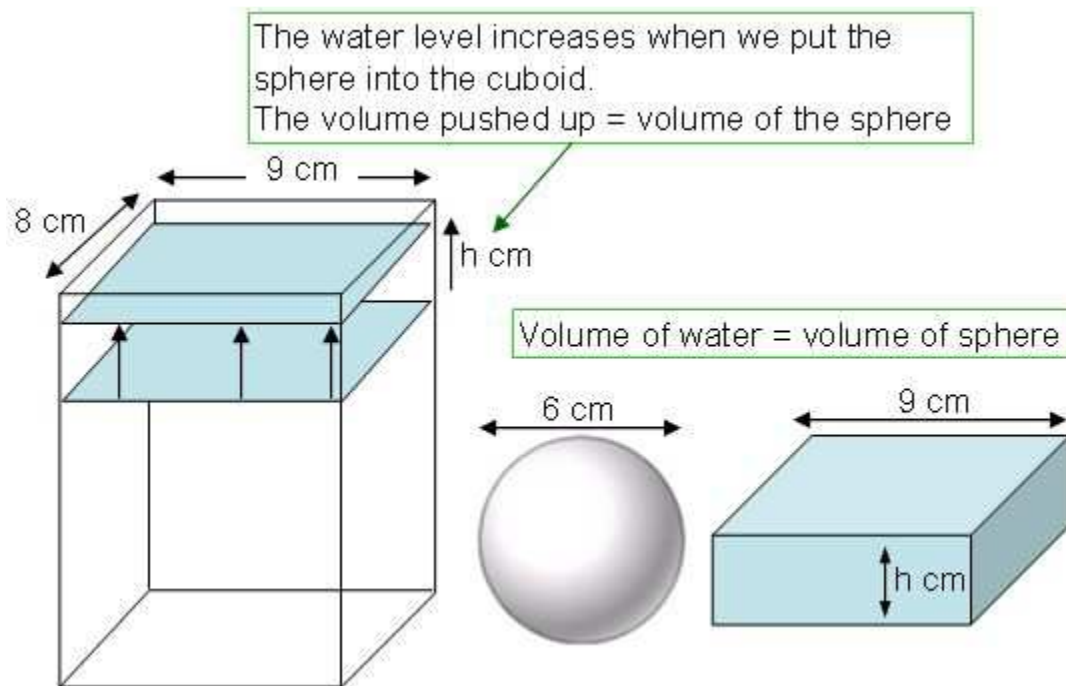
Angle APB equals angle CPD because they are opposite

Angles BAP and CDP must be equal if all other angles are equal.

We have AAS

(2)

22. A sphere diameter of 6cm is dropped into a cuboid of width 8 cm and length 9 cm part filled with water.
 Calculate the increase in the height of the water in the cuboid
 Leave your answer in terms of π .



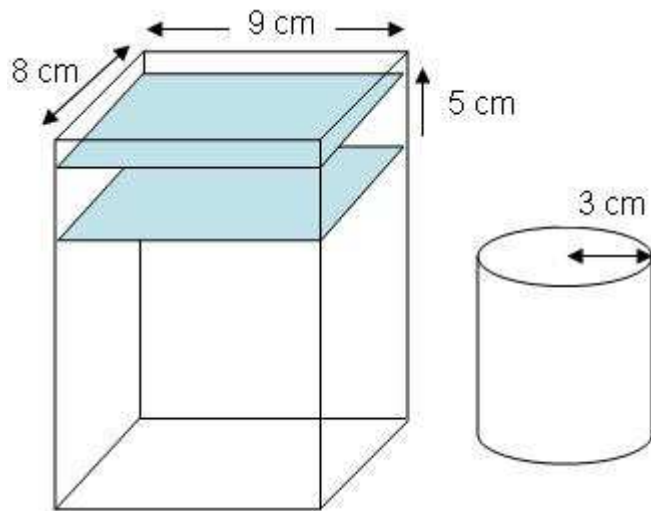
Not drawn accurately

Volume water pushed out (cuboid)	=	Volume sphere	
$8 \times 9 \times h$	=	$\frac{4}{3} \pi r^3$	Radius sphere = 3 cm
h	=	$\frac{4}{72 \times 3} \pi \times 3^3$	
h	=	$\frac{4 \times 3 \times 3 \times 3}{72 \times 3} \pi$	$\frac{\pi}{2}$ ✓

Cancels down

.....cm
(3)

The sphere was removed and a cylinder of radius 3cm was dropped into the cuboid.
 The depth of water in the cuboid increased by 5 cm.
 Calculate the height of the cylinder. Leave your answer in terms of π .



Not drawn accurately

Volume water pushed out (cuboid)	=	Volume cylinder
$8 \times 9 \times 5$	=	$\pi r^2 h$
$8 \times 9 \times 5$	=	$9\pi h$
h	=	$\frac{40 \times 9}{9 \times \pi}$

$$\frac{40}{\pi}$$

(2)

23. The resistance of an electrical component is given by:

$$\text{Resistance } R = \frac{\text{Voltage } V}{\text{Current } I}$$

The voltage $V = 34.4$ to three significant figures

The current $I = 2.5$ to one decimal place.

- a) What is the upper bound for the voltage V

A value can be as much as half the rounded unit above and below the rounded off value.

Be careful though. If there are 20 people to the nearest 10 the lower bound = 15, but the upper bound = 24. The real upper bound is 24.9999 etc which we usually round it to 25. Since we can't have part of a person we say it is 24.

The rounded unit is in tenths. So we can have one twentieth above or below 34.4. The upper bound is the largest value 34.4 can be before it becomes 34.5 to 3 sfs. If the upper bound was 34.46 it is 34.5, to 3 sf, but if it is 34.45 it is 34.4 to 3 sf

34.45

(1)

- b) Calculate the lower bound for the resistance R
Show all the figures on your calculator display

$$\text{Resistance } R = \frac{\text{Voltage } V}{\text{Current } I}$$

$$\text{Lower bound for } R = \frac{\text{Lower bound for Voltage } V}{\text{Upper bound for Current } I}$$

The upper bound for $I = 2.55$. Above this it is 2.6 to 1 decimal place

The lower bound for $V = 34.35$. Below this it is 34.3 to 3 sf

$$\text{Lower bound for } R = \frac{34.35}{2.55} = 13.470588$$

13.470588

(2)

3 4 . 3 5 ÷ 2 . 5 5 =

24. Simplify the following, giving each answer in the form $a\sqrt{6}$

Since they are looking for $\sqrt{6}$ in the answer, we need a way to form 6 from the two numbers we have in the square root signs

i) $4\sqrt{12} \times \sqrt{2}$

Use the rule: $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$

Take 4 outside of $\sqrt{\quad}$

$$4\sqrt{12} \times \sqrt{2} = 4\sqrt{12 \times 2} = 4\sqrt{4 \times 6} = 4 \times 2\sqrt{6} = 8\sqrt{6}$$

$8\sqrt{6}$

(2)

ii) $\sqrt{600} + \sqrt{150}$

Again the answer involves $\sqrt{6}$ so we need to find a product (two numbers times each other) for 600 and 150 that includes a 6. If the other number in the product can be square rooted then we know we are on the right track.

$$\sqrt{600} = \sqrt{6 \times 100} \quad \text{and} \quad \sqrt{150} = \sqrt{6 \times 25}$$

$$\sqrt{6 \times 100} = 10\sqrt{6} \quad \text{and} \quad \sqrt{6 \times 25} = 5\sqrt{6}$$

$$10\sqrt{6} + 5\sqrt{6} = (10 + 5)\sqrt{6} = 15\sqrt{6}$$

utilise this rule:

$$a\sqrt{a} + b\sqrt{a} = (a + b)\sqrt{a}$$

$15\sqrt{6}$

(2)

iii) Express $\frac{26}{5 - \sqrt{12}}$ in the form $a + b\sqrt{3}$

We need to rationalise the denominator by multiplying top and bottom by $5 + \sqrt{12}$

26 and 13 at bottom cancel

$$\frac{26}{5 - \sqrt{12}} \times \frac{(5 + \sqrt{12})}{(5 + \sqrt{12})} = \frac{26 \times (5 + \sqrt{12})}{25 - 12} = 2 \times (5 + \sqrt{12}) = 10 + 2\sqrt{12}$$

Simplify this to form $a + b\sqrt{3}$

$$10 + 2\sqrt{12} = 10 + 2\sqrt{3 \times 4} = 10 + 2 \times 2\sqrt{3} = 10 + 4\sqrt{3}$$

$10 + 4\sqrt{3}$

(3)

TOTAL FOR PAPER: 100 MARKS
END