

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier Paper 1 Non-Calculator

Thursday 16 May 2024

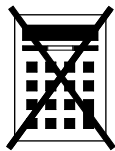
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments
- the Formulae Sheet (enclosed).



You must **not** use a calculator.

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue should be written in the exam.

Anything written in green in a rectangle doesn't have to be written in the exam.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer **all** questions in the spaces provided.

1 Work out $12^2 \div \left(\frac{1}{3} \times \sqrt{36}\right)$

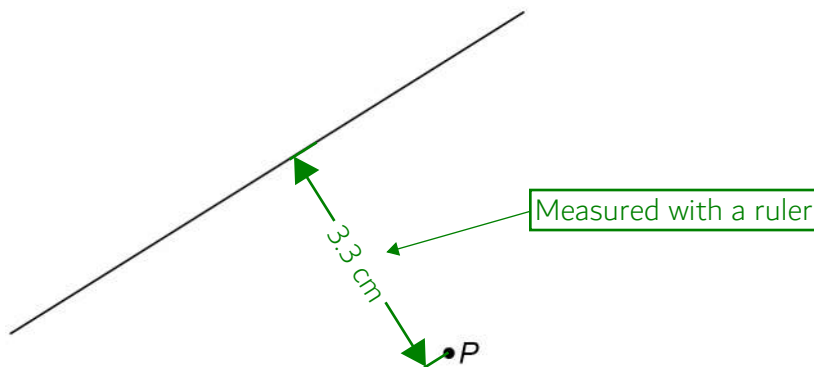
$$2 \overline{) 144} \begin{array}{r} 072 \\ 144 \\ \hline 000 \end{array}$$

$$\begin{array}{l} 12^2 = 12 \times 12 = 144 \\ \sqrt{36} = 6 \text{ as } 6^2 = 36 \\ 1/3 \times 6 = 6 \div 3 = 2 \\ \text{So it becomes } 144 \div 2 \end{array}$$

[3 marks]

Answer _____ 72 _____

- 2 Measure the **shortest** distance from point P to the line.
Give your answer in millimetres.

[1 mark]

Answer _____ 33 _____ mm

There are 10 mm in 1 cm so multiplying the 3.3 cm by 10 converts it into millimetres



- 3 The vector $\begin{pmatrix} -3 \\ 7 \end{pmatrix}$ translates A to B.

Write down the vector that translates B to A.

[1 mark]

Answer $\begin{pmatrix} 3 \\ -7 \end{pmatrix}$

The vector $\begin{pmatrix} -3 \\ 7 \end{pmatrix}$ means 3 to the left and 7 up. The opposite of this is 3 to the right and 7 down

- 4 The attendance for a rugby match is 8400 people to the nearest 100

- 4 (a) Write down the minimum possible attendance.

[1 mark]

Answer _____ 8350 _____

Subtracting half of the 100 from the 8400 works out the lower bound, which is $8400 - 50 = 8350$. The lower bound is the minimum possible attendance

- 4 (b) Write down the maximum possible attendance.

[1 mark]

Answer _____ 8449 _____

Adding half of the 100 to the 8400 works out the upper bound, which is $8400 + 50 = 8450$. The upper bound rounds to 8500 to the nearest 100 so it needs to be 1 less than this in order to still round to 8400 to the nearest 100

Turn over for the next question

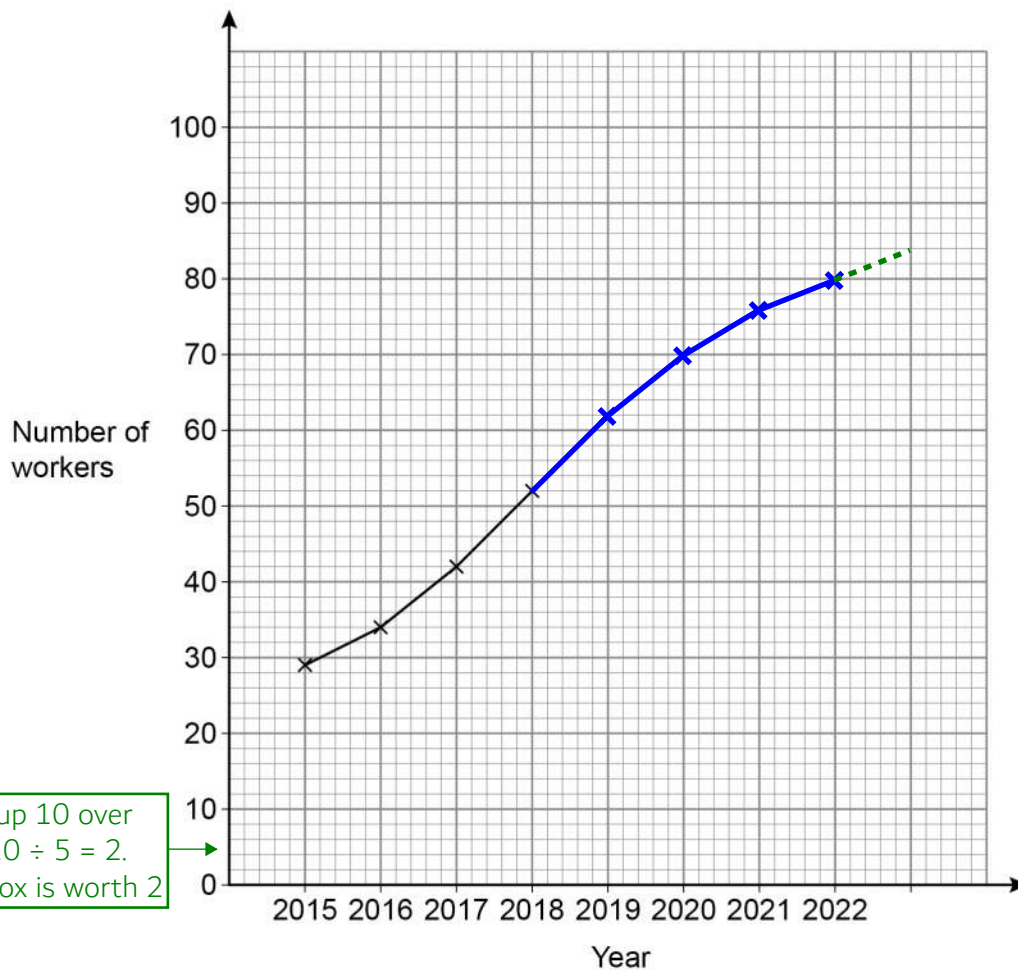


- 6 The table shows the number of workers at a company in different years.

Year	2015	2016	2017	2018	2019	2020	2021	2022
Number of workers	29	34	42	52	62	70	76	80

A time-series graph is drawn to represent the data.

The first four points have been plotted.



- 6 (a) Complete the graph.

[2 marks]

- 6 (b) Estimate the number of workers at the company in 2023

[1 mark]

Answer _____ 84 _____

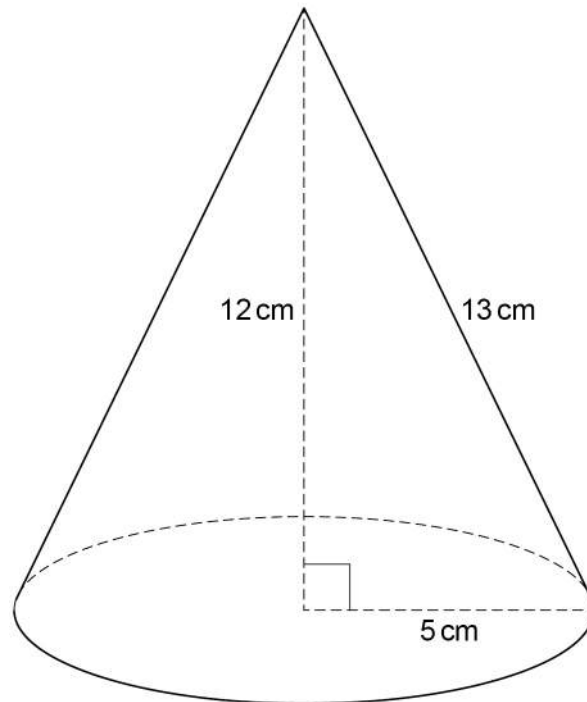
This can be estimated visually from the graph. It looks like if the trend continued it would be 84 in 2023

7

Turn over ►



7 Here is a cone.



7 (a)

Curved surface area of a cone = $\pi r l$
where r is the radius and l is the slant height

Beth tries to work out the curved surface area in terms of π

$$\begin{aligned} \text{Curved surface area of the cone} &= \pi \times 5 \times 12 \\ &= 60\pi \text{ cm}^2 \end{aligned}$$

What mistake has she made?

[1 mark]

The slant height is 13 cm ← She has used 12 cm as the slant height



7 (b) Adam uses $\pi = 3$ to estimate the area of the **base** of the cone.

Work out his estimate.

$$3 \times 5^2 \leftarrow \text{Area of circle} = \pi \times \text{radius}^2. \pi = 3 \text{ for the estimate and the radius is } 5 \text{ cm}$$

[2 marks]

$$25$$

$$\begin{array}{r} \times 3 \\ \hline 75 \\ 1 \end{array}$$

$$5^2 = 5 \times 5 = 25. \text{ Then multiplying this by the } 3$$

Answer 75 cm²

7 (c) Beth uses $\pi = 3.14$ to estimate the area of the **base** of the cone.

Is Beth's estimate more than or less than Adam's estimate?

Tick a box.

More than

Less than

Give a reason for your answer.

$$3.14 > 3$$

3.14 is greater than 3 so the estimate will be more as multiplying by more results in a greater value

[1 mark]

Turn over for the next question

Turn over ►



8 Solve $7x - 22 = 4x + 29$

[3 marks]

$$3x - 22 = 29 \leftarrow \text{Subtracting } 4x \text{ from both sides to get all the } x \text{ on the same side}$$

$$\begin{array}{r} 29 \\ + 22 \\ \hline 51 \end{array} \leftarrow \text{Adding 22 to both sides finds that } 3x = 51$$

$$3 \overline{) 51} \leftarrow \text{Dividing both sides by 3 finds that } x = 17$$

$$x = \underline{\hspace{10em}} 17$$

9 In a house

the floor area of the living room is 26 m^2

the floor area of the kitchen is 16.4 m^2

Express the area of the living room as a fraction of the area of the kitchen.

Give your answer in its simplest form.

[3 marks]

$$\frac{260}{164} \leftarrow \text{Multiplying both the numerator and denominator of the fraction } 26/16.4 \text{ by 10 eliminates the decimal}$$

$$\begin{array}{r} 130 \\ 2 \overline{) 260} \\ \underline{082} \\ 2 \overline{) 164} \end{array} \leftarrow \text{Dividing both the numerator and denominator by 2 simplifies the fraction to } 130/82$$

$$\begin{array}{r} 65 \\ 2 \overline{) 130} \\ \underline{41} \\ 2 \overline{) 82} \end{array} \leftarrow \text{Dividing both the numerator and denominator by 2 simplifies the fraction to } 65/41$$

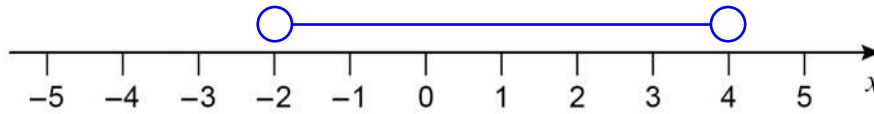
$$\text{Answer } \underline{\hspace{10em}} \frac{65}{41}$$

The fraction cannot go any simpler as 65 and 41 cannot be divided by the same amount to get smaller whole numbers



10 (a) Represent $-2 < x < 4$ on the number line.

[1 mark]



The circles are not shaded in as x cannot be equal to either -2 or 4

10 (b) Solve $5y + 14 \geq 11$

[2 marks]

$5y \geq -3$ ← Subtracting 14 from both sides to get the y term on its own

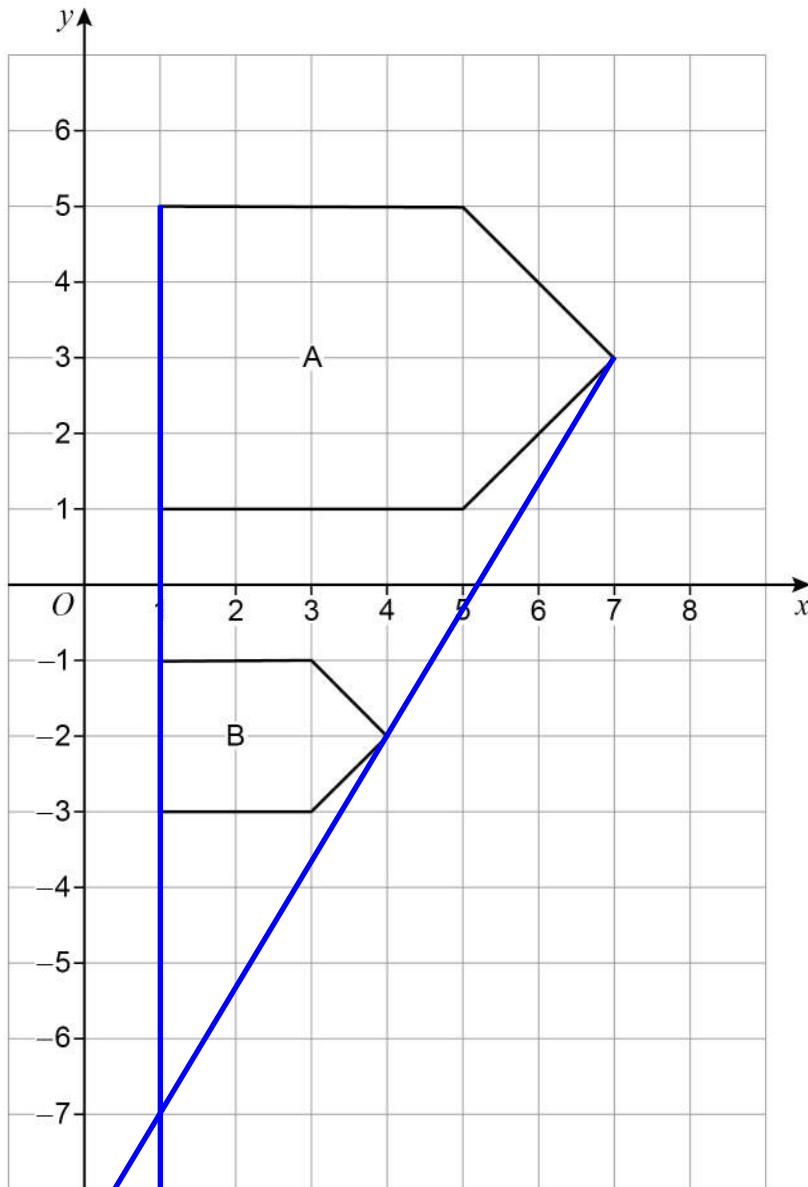
Answer $y \geq \frac{-3}{5}$

Dividing both sides by 5 to get y on its own

Turn over for the next question



11



Describe fully the **single** transformation that maps shape A to shape B.

[3 marks]

Enlargement, scale factor $\frac{1}{2}$, centre (1, -7)

It must be an enlargement as it has changed size. The scale factor is $\frac{1}{2}$ as B is half of the size of A. The centre of enlargement is found by drawing straight lines through two of the corners and finding where they meet



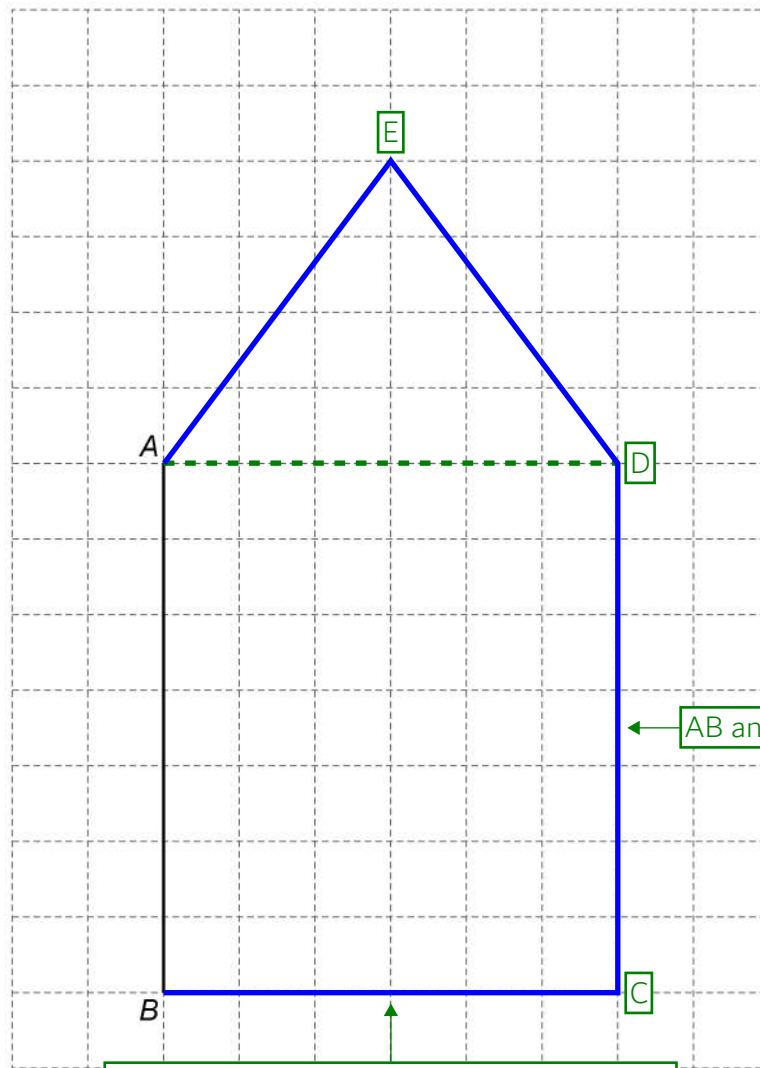
13

$ABCDE$ is a pentagon with $AB = 7$ cm

- $BC = 6$ cm
- AB and BC are perpendicular.
- AB and DC are equal **and** parallel.
- Area of the pentagon = 54 cm²
- The pentagon has exactly **one** line of symmetry.

Complete a **labelled** drawing of the pentagon.

[4 marks]



$BC = 6$ cm and AB and BC are perpendicular

AB and DC are equal and parallel

See next page for an explanation to find where E is



- 7×6 ← ABCD forms a rectangle. Area of rectangle = length \times width. The length is 7 cm and the width is 6 cm so the area of the rectangle is 42 cm^2
- $54 - 42$ ← ADE will form a triangle. Subtracting the area of the rectangle from the area of the whole shape works out that that area of the triangle must be 12 cm^2
- $\frac{1}{2} \times 6h$ ← Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is 6 cm and let the height be h
- $3h = 12$ ← $\frac{1}{2} \times 6 = 3$ so an expression of the area of the triangle is $3h$.
This must be equal to the area of the triangle which was 12 cm^2
- $h = 4$ ← Dividing both sides by 3 finds that the height is 4 cm

E needs to be 4 cm above the midpoint of line AD so that the triangle has a height of 4 cm and so that the pentagon has exactly one line of symmetry

- 14 4 chocolate bars and 3 packets of mints cost £4.70
5 chocolate bars and 1 packet of mints cost £4.50

Work out the cost of a chocolate bar and the cost of a packet of mints.

[4 marks]

$$4C + 3M = 470 \leftarrow \text{The first equation. 4 chocolate bars and 3 packets of mints cost 470p}$$

$$5C + M = 450 \leftarrow \text{The second equation. 5 chocolate bars and 1 packet of mints cost 450p}$$

$$\begin{array}{r} 450 \\ \times 3 \\ \hline 1350 \\ \hline \end{array}$$

$$15C + 3M = 1350 \leftarrow \text{The third equation. Multiplying everything on both sides of the second equation by 3 to get the number of M the same as in the first equation}$$

$$\begin{array}{r} 012 \\ 1350 \\ - 470 \\ \hline 880 \end{array}$$

$$11C = 880 \leftarrow \text{Subtracting the first equation from the third equation cancels out the M terms to leave an equation only in terms of C}$$

$$11 \overline{) 880} \leftarrow \text{Dividing both sides by 11 finds that } C = 80. \text{ This is the cost of a chocolate bar in pence}$$

$$\begin{array}{r} 80 \\ \times 5 \\ \hline 400 \end{array} \leftarrow \text{This works out that } 5C = 400$$

$$450 - 400 \leftarrow \text{Subtracting } 5C \text{ from both sides of the second equation finds that } M = 50. \text{ This is the cost of a packet of mints in pence}$$

chocolate bar 80p

packet of mints 50p

Turn over for the next question



15 (a) Between which two **consecutive** integers does the square root of 210 lie?

[1 mark]

$$\begin{array}{r} 13 \\ \times 13 \\ \hline 39 \\ 130 \\ \hline 169 \end{array} \quad \begin{array}{r} 14 \\ \times 14 \\ \hline 56 \\ 140 \\ \hline 196 \end{array} \quad \begin{array}{r} 15 \\ \times 15 \\ \hline 75 \\ 150 \\ \hline 225 \end{array}$$

Going through the square numbers greater than 144 to find the square numbers on either side of 210. $14^2 = 196$, which is less than 210 and $15^2 = 225$, which is more than 210. So something between 14 and 15 must be squared to get 210. The square root of 210 must be between the consecutive integers 14 and 15

Answer 14 and 15

15 (b) Here are two calculations, A and B.

A

$$1.92^7 + 6.9^3$$

B

$$5 \times \sqrt[3]{1\,000\,350}$$

Use approximations to show that answer to A < answer to B

[3 marks]

$2^7 + 7^3$ ← 1.92 is approximately 2 and 6.9 is approximately 7

2, 4, 8, 16, 32, 64, 128 ← Listing out the powers of 2 by starting with 2 and keep multiplying by 2 to find that $2^7 = 128$

$\begin{array}{r} 49 \\ \times 7 \\ \hline 343 \end{array}$ ← $7^3 = 7 \times 7 \times 7 = 49 \times 7 = 343$

$\begin{array}{r} 343 \\ +128 \\ \hline 471 \end{array}$ ← Adding 2^7 to 7^3 finds that the answer to A is approximately 471. As both the 1.92 and 6.9 are rounded up, the answer to A must be less than 471

$5 \times \sqrt[3]{10^6}$ ← 1000350 is approximately 1000000, which is 10^6

$5 \times 100 = 500$ ← $\sqrt[3]{10^6} = (10^6)^{1/3} = 10^{6/3} = 10^2 = 100$. So the answer to B is approximately 500. As 100350 was rounded down, the answer to B must be more than 500

The answer of A is less than 471 and the answer to B is more than 500. So answer to A < answer to B



- 16 The table shows information about the ages of members of two clubs.

	Median age (years)	Interquartile range of ages (years)
Swimming club	21.2	7.3
Cycling club	29.7	4.6

Compare the average age and consistency of ages for the members of the two clubs.

[2 marks]

Average The average age for the cycling club was higher

As the median was greater

Consistency The ages for the cycling club were more consistent

As the interquartile range was less. They are less spread out

Turn over for the next question

Turn over ►



17 Rearrange $y = \frac{3x+7}{x}$ to make x the subject.

[4 marks]

$$yx = 3x + 7 \leftarrow \text{Multiplying both sides by } x \text{ to eliminate } x \text{ as the denominator on the right}$$

$$yx - 3x = 7 \leftarrow \text{Subtracting } 3x \text{ from both sides to get all the terms involving } x \text{ on the same side}$$

$$x(y - 3) = 7 \leftarrow \text{Factorising the left side by bringing } x \text{ out as a factor and leaving the result in a bracket}$$

Answer _____ $x = \frac{7}{y-3}$

↑

Dividing both sides by $(y - 3)$ to get x on its own



19

 A , B and C are numbers.Here is some information about B and C .

B	$\frac{7}{4}$ of A
C	A increased by 150%

Work out C as a fraction of B .**[4 marks]**

$$\frac{250}{100} A \div \frac{7}{4} A \leftarrow \begin{array}{l} 100\% + 150\% = 250\%. \text{ Putting } 250 \text{ over } 100 \text{ converts it into a fraction. Doing this} \\ \text{fraction of } A \text{ expresses } C \text{ in terms of } A. C \text{ as a fraction of } B \text{ can be written as } C \div B \end{array}$$

$$\frac{250}{100} \div \frac{7}{4} \leftarrow \begin{array}{l} \text{The } A \text{ cancels out as } A \div A = 1 \end{array}$$

$$\frac{250}{100} \times \frac{4}{7} \leftarrow \begin{array}{l} \text{To divide by a fraction: keep the first part, change} \\ \text{the division to a multiply, flip the second fraction} \end{array}$$

Answer $\frac{1000}{700}$

To multiply fractions: multiply the numerators and multiply the denominators. $250 \times 4 = 1000$ and $100 \times 7 = 700$



$$20 \quad 5x^3 + ax^2 + bx + c \equiv kx^3 + (2-k)x^2 + (a^2-1)x + \frac{b}{2}$$

Work out the values of a , b and c .

[3 marks]

$$k = 5 \quad \leftarrow \text{Equating the coefficients of the } x^3 \text{ terms. There is } 5x^3 \text{ on the left so there must also be } 5x^3 \text{ on the right. } k \text{ must be } 5$$

$$a = 2 - 5 = -3 \quad \leftarrow \text{Equating the coefficients of the } x^2 \text{ terms (shown in pink). Substituting } 5 \text{ for } k$$

$$b = (-3)^2 - 1 = 9 - 1 = 8 \quad \leftarrow \text{Equating the coefficients of the } x \text{ terms (shown in green). Substituting } -3 \text{ for } a$$

$$c = 8/2 = 4 \quad \leftarrow \text{Equating the constants (shown in blue). Substituting } 8 \text{ for } b$$

$$a = \underline{\quad -3 \quad} \quad b = \underline{\quad 8 \quad} \quad c = \underline{\quad 4 \quad}$$

Turn over for the next question

Turn over ►



21 Prove algebraically that $1.0\dot{1}\dot{8} = \frac{56}{55}$

[3 marks]

$$x = 1.0\dot{1}\dot{8} \leftarrow \text{Let } x \text{ be the recurring decimal}$$

$$100x = 101.8\dot{1}\dot{8} \leftarrow \text{There are two recurring digits so multiplying both sides by 10 twice enables the decimal to be rewritten with the recurring digits in the same places}$$

$$99x = 100.8 \leftarrow \text{Subtracting } x \text{ from } 100x \text{ cancels out the recurring digits}$$

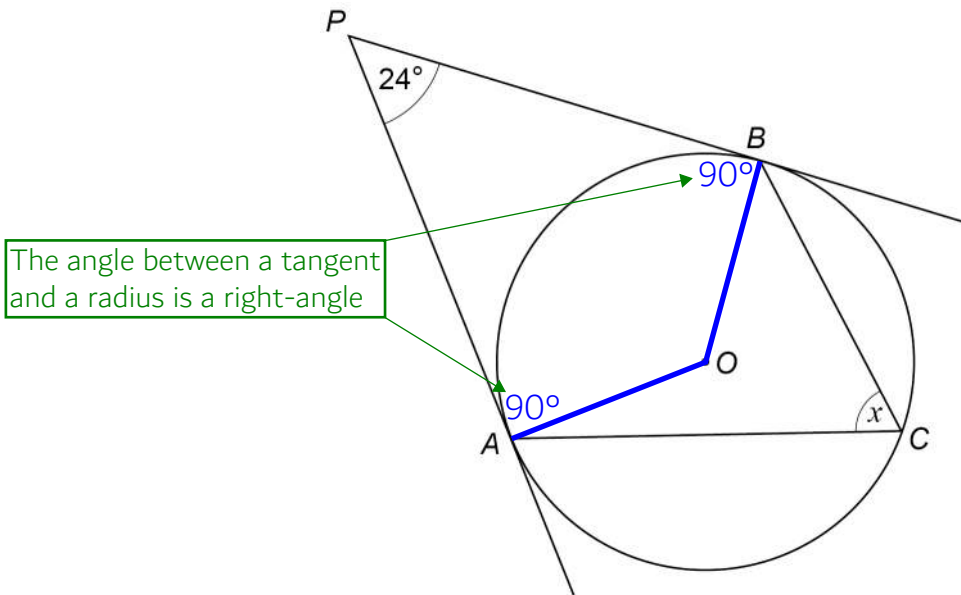
$$x = \frac{100.8}{99} \leftarrow \text{Dividing both sides by 99 expresses } x \text{ as a fraction}$$

$$= \frac{56}{55} \leftarrow \text{The fraction will simplify to } 56/55. \text{ There is no need to show all the steps of simplifying the fraction}$$



- 22 A, B and C are points on a circle, centre O .
 AP and BP are tangents to the circle.

Not drawn
accurately



Work out the size of angle x .

[3 marks]

$$\begin{array}{r} 90 \\ + 90 \\ + 24 \\ \hline 204 \end{array}$$

← Adding up the known angles in quadrilateral AOBP

$$\begin{array}{r} 3 \overset{5}{6} 10 \\ - 204 \\ \hline 156 \end{array}$$

← There are 360° in total in quadrilateral AOBP. Subtracting the sum of the known angles from 360° leaves 156° . This is angle AOB

$$2 \overline{) 156} \begin{array}{r} 078 \\ \underline{156} \\ 0 \end{array}$$

← The angle at the circumference is half the angle at the centre. AOB is the angle at the centre and x is the angle at the circumference. So halving angle AOB works out x

Answer 78 °

Turn over ►



24 (a) $9k + 7$ and $2k^2 + 3$ are consecutive integers.

$9k + 7$ is the smaller integer.

Work out the value of the **next** consecutive integer.

[5 marks]

$$2k^2 + 3 - 9k - 7 = 1$$

The difference of two consecutive integers is 1. Subtracting the expression of the smaller integer from the expression of the larger integer expresses the difference, which must be equal to 1

$$2k^2 - 9k - 5 = 0$$

Rearranging into the quadratic form by collecting like terms on the left and subtracting 1 from both sides

$$2k^2 - 10k + k - 5$$

Multiplying the 2 by the -5 gives -10. Two numbers which multiply to this -10 and add to the -9 are -10 and 1. Splitting the middle k term into these numbers of k

$$2k(k - 5) + 1(k - 5)$$

Factorising the left two terms and the right two terms. A factor must be brought out so bringing out 1 as there are no other common factors

$$(2k + 1)(k - 5) = 0$$

Writing the left side in the factorised form and now writing the right side again

$$2k + 1 = 0 \text{ or } k - 5 = 0$$

One of the two brackets must be equal to 0 in order to multiply to 0

$$k = -\frac{1}{2} \text{ or } k = 5$$

Rearranging both equations to find k . Ignoring the $k = -1/2$ as substituting this into the expressions of the integers will not give integers

$$9 \times 5 + 7$$

Substituting 5 for k in the expression of the smaller integer works out that the smaller integer must be 52

$$52 + 2$$

The next consecutive integer is 2 after the smaller integer

Answer 54

24 (b) x is a square number.

Show that the **next** square number is $x + 2\sqrt{x} + 1$

[2 marks]

$$(\sqrt{x} + 1)^2$$

Square rooting x expresses the whole number which was squared to give x . Adding 1 to this expresses the next whole number. Squaring this expresses the next square number

$$x + 2\sqrt{x} + 1$$

Expanding the square bracket by squaring the first term, doubling the product of the two terms, squaring the last term. $(\sqrt{x})^2 = x$. $\sqrt{x} \times 1 = \sqrt{x}$ then doubling gives $2\sqrt{x}$. $1^2 = 1$



25 Show that the value of $6 \sin 30^\circ + 2 \cos 30^\circ \times 4 \tan 30^\circ$ is an integer.

[4 marks]

0	30	45	60	90
0	1	2	3	4
4	3	2	1	0

Listing out the angles of 0, 30, 45, 60, 90 degrees. Listing 0, 1, 2, 3, 4 under these for the sin values and 4, 3, 2, 1, 0 under these for the cos values. Square rooting the 1 and putting it over 2 works out that $\sin 30 = 1/2$. Square rooting the 3 and putting it over 2 works out that $\cos 30 = \sqrt{3}/2$

$$\frac{1}{2} \div \frac{\sqrt{3}}{2}$$

Working out $\tan 30$ by dividing $\sin 30$ by $\cos 30$

$$\frac{1}{2} \times \frac{2}{\sqrt{3}}$$

To divide by a fraction: keep the first part, change the division to a multiplication, flip the second fraction. Both of the 2s cancel out so $\tan 30 = 1/\sqrt{3}$

$$6 \times \frac{1}{2} + 2 \times \frac{\sqrt{3}}{2} \times 4 \times \frac{1}{\sqrt{3}}$$

Substituting the values of $\sin 30$, $\cos 30$ and $\tan 30$ into the expression

$$3 + \sqrt{3} \times \frac{4}{\sqrt{3}}$$

Simplifying

$$3 + 4$$

The $\sqrt{3}$ cancel out

$$7$$

It simplifies to 7, which is an integer

END OF QUESTIONS

