

Edexcel IGCSE 4MA1

Paper 2F (Foundation Tier) – November 2024

100 marks · 2 hours · Calculator allowed

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Full original worked solutions and mark schemes for every question on this paper.

Original worked solutions for Edexcel International GCSE Mathematics A (4MA1), Paper 2F (Foundation Tier), November 2024 – 100 marks, 2 hours, calculator allowed. The questions have been reworded; all numerical values match the original paper. The official question paper and mark scheme are published by Pearson Edexcel. This resource reproduces neither the exam paper nor the official mark scheme.

Both are PDF files hosted by Pearson: [official question paper \(PDF\)](#) and [official mark scheme \(PDF\)](#).

Practice Questions

Try each question on paper first. Full worked solutions and mark schemes follow in the next section.

1. (a) Round 7823 to the nearest hundred. [1 mark]



- (b) Write the missing number in each box.

(i) $0.4 \times \square = 4000$ [1 mark]

(ii) $\frac{3600}{\square} = 3.6$ [1 mark]

- (c) Write down any four factors of 18. [1 mark]

- (d) One of these numbers is a prime number. Write it down. [1 mark]

6 12 17 22 27

(a)

(c)

(d)

[Total 5 marks]

2. Here are the first five terms of a number sequence.



11 15 19 23 27

(a)

(i) Write down the next term of the sequence. *[1 mark]*

(ii) Explain how you worked out your answer to part (a)(i). *[1 mark]*

The 14th term of this sequence is 63.

(b) Work out the sum of the 16th term and the 17th term. *[2 marks]*

Oscar says that 98 is a term of this sequence.

Oscar is wrong.

(c) Explain why Oscar is wrong. *[1 mark]*

(a)(i)

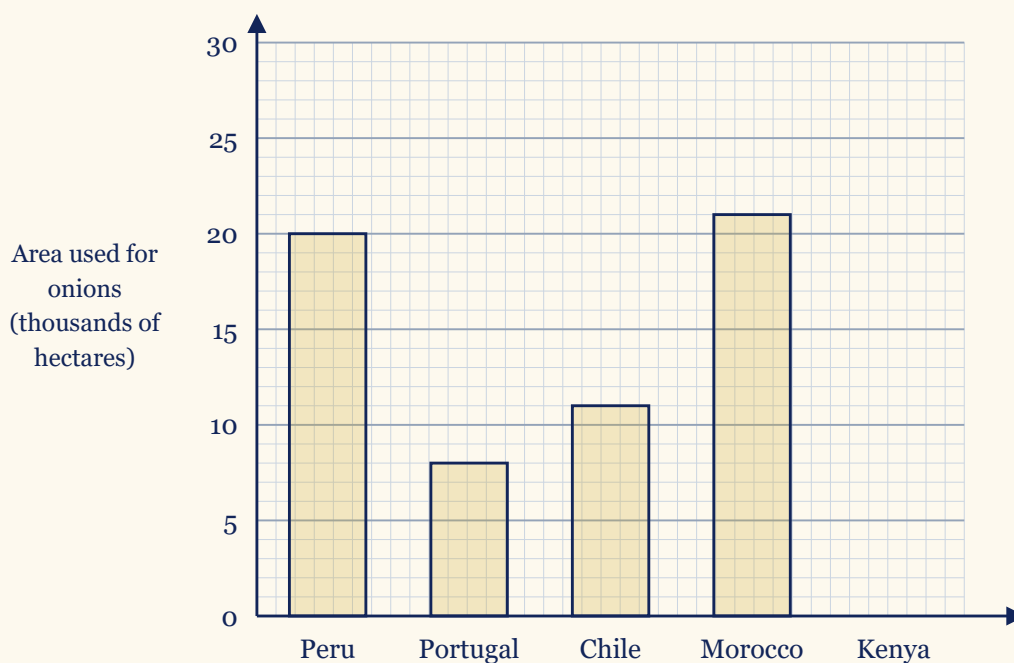
(a)(ii)

(b)

(c)

[Total 5 marks]

3. The bar chart shows the area, in thousands of hectares, that was used to grow onions in each of four countries in 2022.



(a) Write down the number of hectares that were used to grow onions in Morocco. [1 mark]

More hectares were used to grow onions in Peru than in Portugal.

(b) How many more? [1 mark]

In Kenya, 17 thousand hectares were used to grow onions.

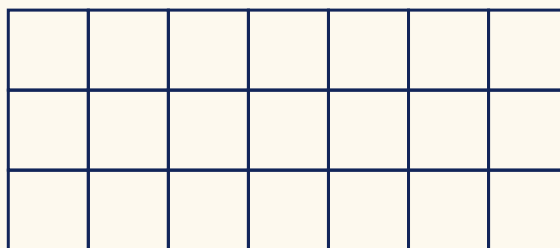
(c) Show this information on the bar chart. [1 mark]

(a) thousand

(b) thousand

[Total 3 marks]

4. Here is a rectangle made of squares.



- (a) Shade $\frac{3}{7}$ of the rectangle. [1 mark]

Here are five fractions.

$$\frac{33}{43} \quad \frac{18}{24} \quad \frac{16}{20} \quad \frac{21}{27} \quad \frac{12}{16}$$

- (b) Write down the two fractions that are equivalent to $\frac{3}{4}$. [2 marks]

- (c) Write $\frac{24}{7}$ as a mixed number. [1 mark]

- (d) Write $\frac{9}{10}$ as a percentage. [1 mark]

There are 80 beads in a jar.

$\frac{2}{5}$ of the beads are blue.

- (e) Work out the number of beads that are not blue. [2 marks]

(b) and

(c)

(d) %

(e)

[Total 7 marks]

5. The table shows the marks scored by the 25 students in a class in a spelling test.



Mark	Frequency
18	2
19	4
20	5
21	6
22	8

Find the median mark. *[2 marks]*

.....
[Total 2 marks]

6. Cushions cost \$14 each.



Ruth has \$250 to spend.

Ruth buys as many cushions as she can.

How much of the \$250 does she have left? *[3 marks]*

..... dollars

[Total 3 marks]

7. Last weekend, Clara took her dog for four walks.



Here are the distances they walked

3.5 kilometres

950 metres

1.8 kilometres

1200 metres

Over the same weekend, Yusuf walked his dog a total of 8 kilometres.

Yusuf walked a greater distance than Clara walked.

How much greater?

Give your answer in metres. *[4 marks]*

..... metres

[Total 4 marks]

8. (a) Simplify $7g + 3h + 4g - 5h$ [2 marks]



(b) Simplify $7a \times 4m$ [1 mark]

(c) Solve $5x - 7 = 12$ [2 marks]

(d) Expand $5(7k + 3)$ [1 mark]

(e) Factorise $9y + 12$ [1 mark]

Owen has c stickers.

Sari has 3 times as many stickers as Owen.

Priya has 7 more stickers than Owen.

(f) Write an expression, in terms of c , for the total number of stickers that Owen, Sari and Priya have.

Simplify your answer. [3 marks]

(a)

(b)

(c) $x =$

(d)

(e)

(f)

[Total 10 marks]

9. Martin got on a train at 0735



He got off the train at 1325

How long was Martin on the train?

Give your answer in hours and minutes. [2 marks]

..... hours minutes

[Total 2 marks]

10. Here is a cuboid.

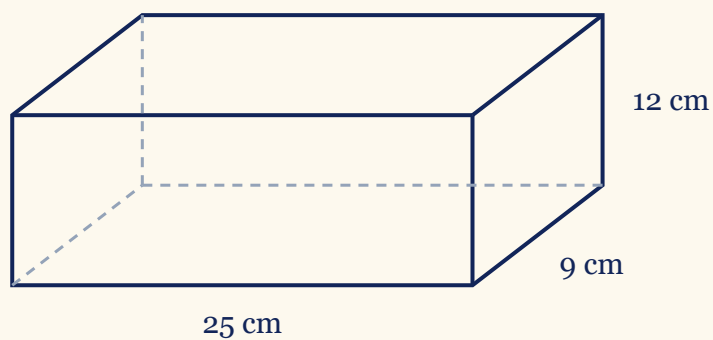


Diagram NOT
accurately drawn

Work out the volume of the cuboid. *[2 marks]*

..... cm^3

[Total 2 marks]

11.

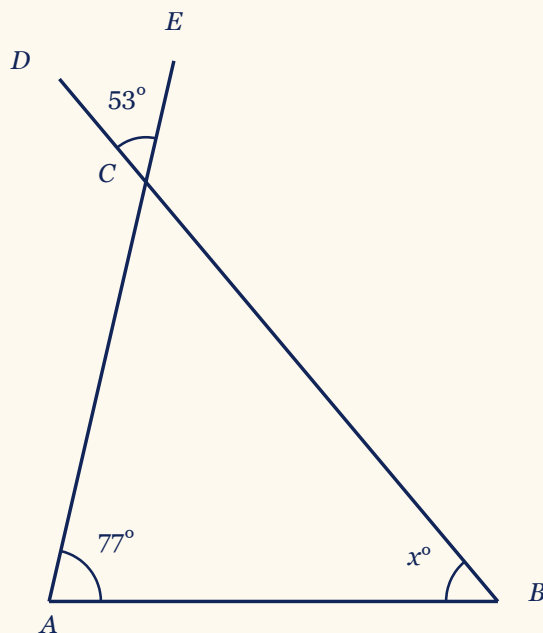


Diagram NOT
accurately drawn

ABC is a triangle.

BCD and ACE are straight lines.

Work out the value of x . [2 marks]

$x =$

[Total 2 marks]

12. A car park contains 240 vehicles.



There are only cars and vans in the car park such that

number of cars : number of vans = 5 : 3

64% of the cars are electric.

Work out the number of cars that are electric. [4 marks]

.....

[Total 4 marks]

13.

(a) Use your calculator to work out the value of $\frac{7.93 - 2.34^2}{0.14}$



Give your answer as a decimal.

Write down all the figures on your calculator display. [2 marks]

(b) Write your answer to part (a) correct to one decimal place. [1 mark]

(a)

(b)

[Total 3 marks]

14. The diagram shows a shape ABCDE made from a square ABDE and an isosceles triangle BCD

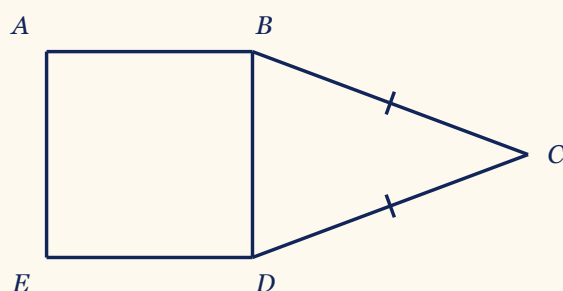


Diagram NOT
accurately drawn

$$BC = DC$$

The area of square ABDE is 49 cm^2

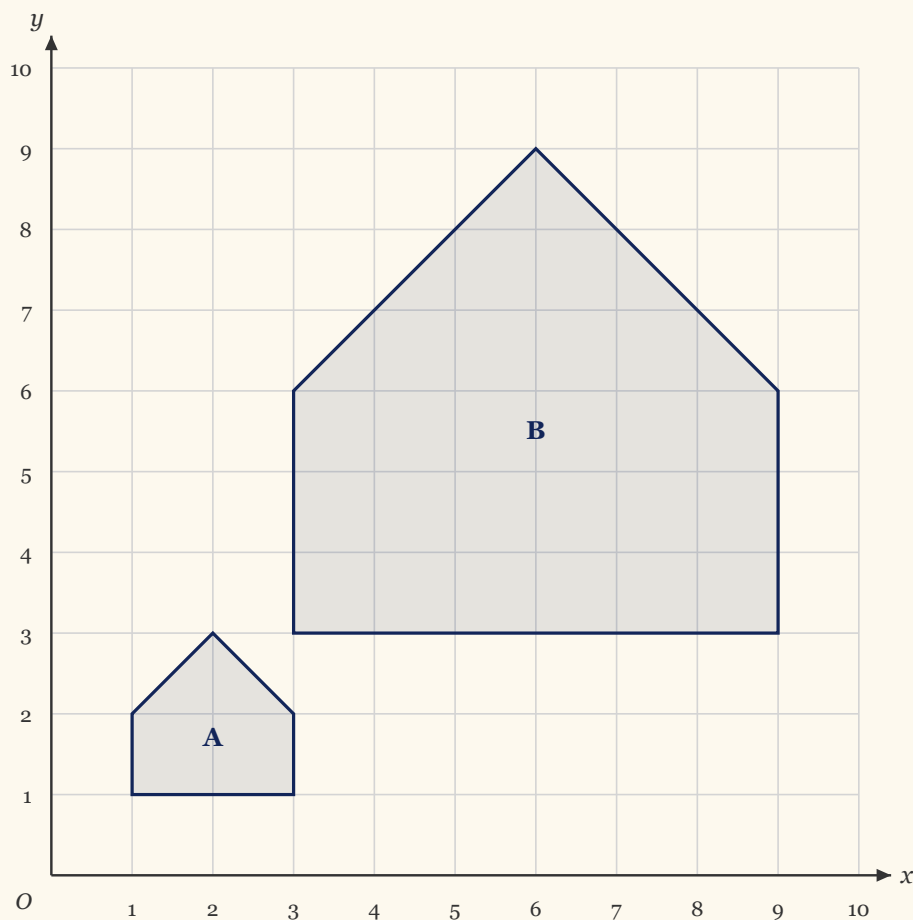
The perimeter of triangle BCD is 27 cm

Work out the perimeter of ABCDE [3 marks]

..... cm

[Total 3 marks]

15.



Describe fully the single transformation that maps shape A onto shape B. [3 marks]

.....
[Total 3 marks]

16. A circle has radius 9 cm



Work out the area of the circle.

Give your answer correct to 3 significant figures. [2 marks]

..... cm²

[Total 2 marks]

17. Show that

$$1\frac{5}{7} \times 2\frac{3}{16} = 3\frac{3}{4}$$



[3 marks]

[Total 3 marks]

18. The length of a shelf is measured as 1.4 metres correct to one decimal place.



(a) Write down the upper bound of the length of the shelf. *[1 mark]*

(b) Write down the lower bound of the length of the shelf. *[1 mark]*

(a) metres

(b) metres

[Total 2 marks]

19. The diagram shows triangle PQR

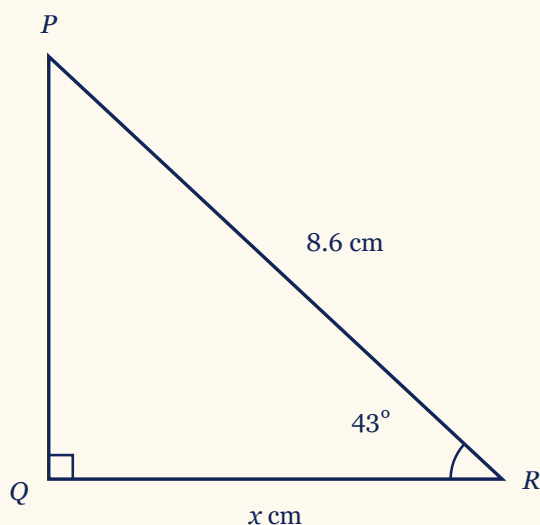


Diagram NOT
accurately drawn

Work out the value of x

Give your answer correct to one decimal place. [3 marks]

$x =$

[Total 3 marks]

20. N is a number.



17% of N is 357

- (a) Work out the value of N [2 marks]

In 2022, a swimming club had 650 members.

In 2023, the club had 806 members.

- (b) Work out the percentage increase in the number of members. [3 marks]

(a) $N =$

(b) %

[Total 5 marks]

21. Erin has a biased 5-sided spinner, numbered 1, 2, 3, 4, 5



The table gives the probabilities that when the spinner is spun it will land on 2 or on 3 or on 5

Number	1	2	3	4	5
Probability		0.14	0.17		0.21

The probability that the spinner will land on 1 is the same as the probability that the spinner will land on 4

Erin is going to spin the spinner 400 times.

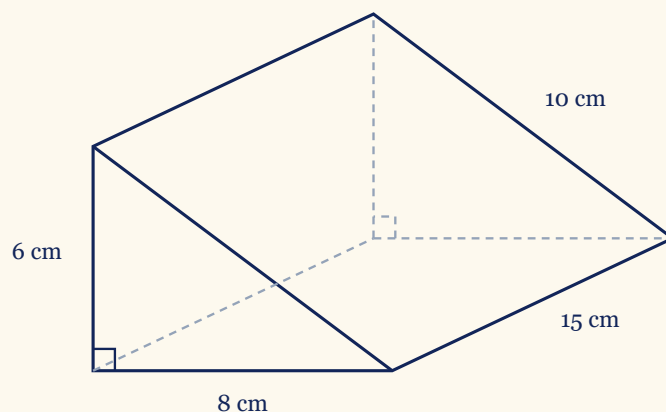
Work out an estimate for the number of times the spinner will land on 4 [4 marks]

.....
[Total 4 marks]

22. The diagram shows a solid triangular prism.



Diagram NOT
accurately drawn



Work out the **total** surface area of the triangular prism. [3 marks]

..... cm²

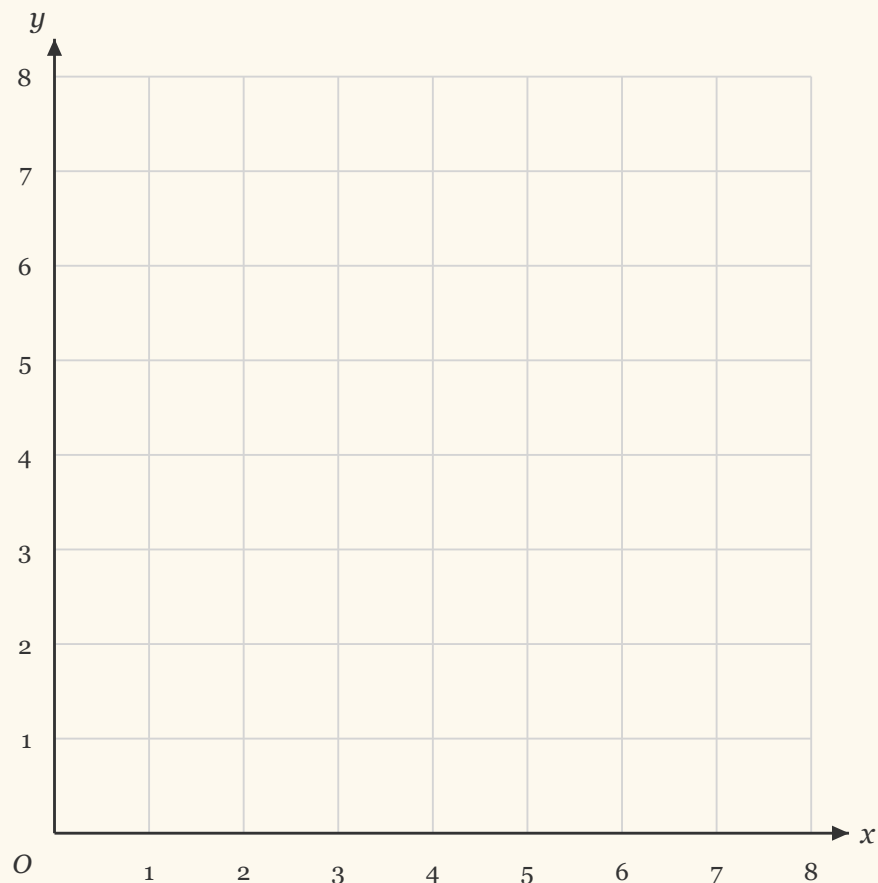
[Total 3 marks]

23. (a) On the grid, draw the straight line with equation



(i) $x = 3$ (ii) $y = 1$ (iii) $x + y = 7$

Label each line with its equation. *[3 marks]*



(b) Show, by shading on the grid, the region that satisfies all three of the inequalities

$$x \geq 3 \quad y \geq 1 \quad x + y \leq 7$$

Label the region **R** *[1 mark]*

[Total 4 marks]

24. Grace puts 4 oranges in a bag.



The mean weight of the 4 oranges in the bag is 145 grams.

Neil puts one more orange into the bag.

The mean weight of the 5 oranges in the bag is 142 grams.

Work out the weight of the orange that Neil puts into the bag. *[3 marks]*

..... grams

[Total 3 marks]

25. Meera invests 20 000 euros for 3 years in a savings bond.



She gets 3.5% per year compound interest.

Work out how much money Meera will have in her savings bond at the end of the 3 years.

Give your answer correct to the nearest euro. *[3 marks]*

..... euros

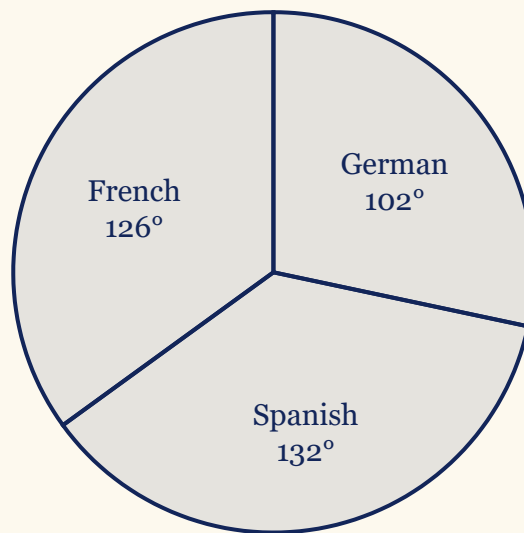
[Total 3 marks]

- 26.** All the students in year 10 and all the students in year 11 named their favourite language from French, German and Spanish.



The pie chart shows information about the results for the year 10 students.

The table shows information about the results for the year 11 students.



Pie chart for year 10

language	number of students
French	$3x + 6$
German	$5x + 8$
Spanish	$7x - 9$

Table for year 11

There are 300 students in year 10

There are 320 students in year 11

More students in year 10 than in year 11 said French was their favourite language.

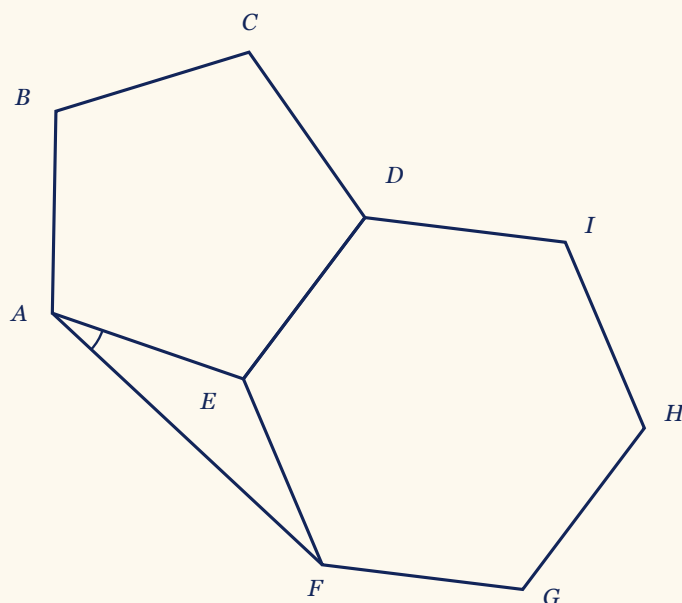
How many more? [5 marks]

.....
[Total 5 marks]

27.



Diagram NOT
accurately drawn



$ABCDE$ is a regular pentagon.

$DEFGHI$ is a regular hexagon.

AF is a straight line.

Work out the size of angle EAF [5 marks]

..... °

[Total 5 marks]

Worked Solutions & Mark Schemes

Every mark (M for method, A for accuracy) is shown, just like a real examiner.

Question 1 - Exam Solution

Understanding the Question

Given

the number 7823; two calculations each with one missing number; the number 18; the list 6, 12, 17, 22, 27.

Find

a rounded value, the two missing numbers, four factors, and the one prime.

Plan the Solution

- Part (a): look at the digit immediately to the right of the hundreds column.
- Part (b): each box is recovered by the inverse operation.
- Part (c): build factors in pairs that multiply to 18.
- Part (d): test each number for a factor other than 1 and itself.

Worked Solution [5 marks]

Rounding: look at the digit immediately to the right of the place you are rounding to. 5 or more rounds up, 4 or less rounds down.

Inverse operations: if $a \times b = c$ then $b = \frac{c}{a}$; if $\frac{a}{b} = c$ then $b = \frac{a}{c}$.

Factors: a factor divides into the number exactly, leaving no remainder.

Prime numbers: a prime number has exactly two factors, 1 and itself. 1 is not prime.

Step 1 - Part (a): round to the nearest hundred.

The hundreds digit is 8, so the answer is either 7800 or 7900.

The tens digit is 2, and $2 < 5$, so round down.

$$7823 \approx 7800$$

(Reason: the tens digit decides which hundred is nearer.)

Step 2 - Part (b)(i).

$$\square = \frac{4000}{0.4} = 10000$$

(Reason: multiplication is undone by division, so divide the answer by the number given.)

Step 3 - Part (b)(ii).

$$\square = \frac{3600}{3.6} = 1000$$

(Reason: when the unknown is the divisor, divide the top number by the answer.)

Step 4 - Part (c): factors of 18.

Pair the numbers that multiply to 18:

$$1 \times 18 = 18, \quad 2 \times 9 = 18, \quad 3 \times 6 = 18$$

Full list: 1, 2, 3, 6, 9, 18. Any four of these earn the mark.

(Reason: working in pairs guarantees no factor is missed.)

Step 5 - Part (d): the prime number.

$$6 = 2 \times 3, \quad 12 = 2 \times 6, \quad 22 = 2 \times 11, \quad 27 = 3 \times 9$$

Each of these has a factor other than 1 and itself.

17 has no such factor, so 17 is prime.

(Reason: only 17 survives the test.)

(a) 7800

(b)(i) 10000

(b)(ii) 1000

(c) 1, 2, 3, 6

(d) 17

Verification

✓ **Check 1 - part (a):** $7823 - 7800 = 23$ and $7900 - 7823 = 77$. Since $23 < 77$, 7800 is the nearer hundred.

✓ **Check 2 - part (b)(i):** substitute back, $0.4 \times 10000 = 4000$.

✓ **Check 3 - part (b)(ii):** substitute back, $\frac{3600}{1000} = 3.6$.

✓ **Check 4 - part (c):** 18 divided by each of 1, 2, 3 and 6 is exact, with no remainder.

✓ **Check 5 - part (d):** $\sqrt{17} \approx 4.1$, so only 2 and 3 need testing, and 17 is divisible by neither. Every other number in the list is even or a multiple of 3.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) 7800	B1	cao	✓
(b)(i) 10 000	B1	accept 10000 or 10,000 in the box	✓
(b)(ii) 1000	B1	accept 1,000, and accept it written in the area around the box	✓
(c) any four from 1, 2, 3, 6, 9, 18	B1	more than four is allowed, but all must come from this list, and if exactly four are given they must not include a repeat	✓
(d) 17	B1	accept it circled or underlined in the list, provided no other number is indicated	✓

Full marks: 5/5

Question 2 - Exam Solution

Understanding the Question

Given

the first five terms 11, 15, 19, 23, 27; the 14th term is 63; the claim that 98 is a term of the sequence.

Find

the next term and the rule behind it, the sum of the 16th and 17th terms, and a reason why 98 cannot be a term.

Plan the Solution

- Subtract consecutive terms to find the common difference.
- Step forward from 27 for part (a)(i), and from the 14th term for part (b), rather than writing out every term.
- For part (c), find one property shared by every term of the sequence, then test 98 against it.

Worked Solution [5 marks]

Arithmetic sequences: each term is found by adding the same common difference d to the term before it. The n th term is $a + (n - 1)d$, where a is the first term. A number

belongs to the sequence only if that rule reaches it at a whole-numbered position.

Step 1 - Part (a)(i): the next term.

$$15 - 11 = 4, \quad 19 - 15 = 4, \quad 23 - 19 = 4, \quad 27 - 23 = 4$$

The common difference is $d = 4$.

$$\text{next term} = 27 + 4 = 31$$

(Reason: the same gap of 4 is added every time, so the term after 27 is 27 plus 4.)

Step 2 - Part (a)(ii): explaining the method.

The sequence goes up by 4 each time, so add 4 to the previous term.

(Reason: the mark is for naming the operation and the number. Saying only that the difference is 4 is not enough, because it does not say what to do with the 4.)

Step 3 - Part (b): the 16th and 17th terms.

$$14\text{th term} = 63$$

$$15\text{th term} = 63 + 4 = 67$$

$$16\text{th term} = 67 + 4 = 71$$

$$17\text{th term} = 71 + 4 = 75$$

$$71 + 75 = 146$$

(Reason: counting on from the 14th term in steps of 4 is far quicker than building the sequence from the start.)

Step 4 - Part (c): why 98 is not a term.

The first term 11 is odd, and adding 4 to an odd number leaves it odd.

So every term of the sequence is odd.

98 is even, so 98 cannot be a term.

(Reason: one property that every term shares, and that 98 fails, settles the question completely.)

(a)(i) 31

(a)(ii) Add 4 to the previous term

(b) 146

(c) Every term is odd, and 98 is even

Verification

✓ **Check 1 - the rule:** $4n + 7$ gives $4(1) + 7 = 11$ and $4(5) + 7 = 27$, and $4(14) + 7 = 63$, matching the 14th term stated in the question.

- ✓ **Check 2 - part (a)(i):** $4(6) + 7 = 31$, agreeing with counting on from 27.
- ✓ **Check 3 - part (b):** $4(16) + 7 = 71$ and $4(17) + 7 = 75$, so the sum is 146, agreeing with counting on from 63.
- ✓ **Check 4 - part (c), a second way:** solving $4n + 7 = 98$ gives $\frac{91}{4} = 22.75$, which is not a whole number, so 98 has no position in the sequence.
- ✓ **Check 5 - part (c), a third way:** the 22nd term is 95 and the 23rd term is 99, so the sequence steps straight from 95 to 99 and skips 98.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)(i) 31	B1	accept a longer list beginning 31, e.g. 31, 35, 39	✓
(a)(ii) +4	B1	accept "add 4", "it goes up in 4", " $27 + 4$ ", or the rule $4n + 7$. Also awarded for +4 written between the numbers in the list. "The difference between the numbers is 4" on its own is not sufficient	✓
(b) 71 and 75 identified	M1		✓
(b) 146	A1	a correct answer scores full marks unless it clearly follows incorrect working	✓
(c) any correct reason	B1	e.g. every term in the sequence is odd. Also accepted: 98 is even; the sequence goes 95, 99; the 23rd term is 99, not 98; it can only be an odd number; the sequence goes up in 4s from an odd start; $\frac{98 - 7}{4}$ is not a whole number; the rule is $4n + 7$; every term ends in 1, 3, 5, 7 or 9	✓

Full marks: 5/5

Question 3 - Exam Solution

Understanding the Question

Given

Find

a bar chart of the area, in thousands of hectares, used to grow onions in Peru, Portugal, Chile and Morocco in 2022, and the fact that Kenya used 17 thousand hectares.

the reading for Morocco, the difference between Peru and Portugal, and the missing bar for Kenya.

Plan the Solution

- Read each bar against the vertical scale, using the small squares to fix a value between labels.
- For part (b), subtract the smaller reading from the larger.
- For part (c), locate 17 on the scale and draw a bar up to that height over the Kenya label.

Worked Solution [3 marks]

Reading a bar chart: the height of each bar is measured against the vertical scale. Where a bar does not finish on a labelled line, count the small squares from the nearest label.

Step 1 - Part (a): the reading for Morocco.

The labelled lines go up in 5s and each small square is 1 thousand hectares.

The Morocco bar finishes one small square above the line labelled 20.

Area = 21 thousand hectares

(Reason: the top of the bar sits one gridline above 20, so the value is 20 plus 1.)

Step 2 - Part (b): how much more Peru used than Portugal.

Peru = 20 thousand hectares

Portugal = 8 thousand hectares

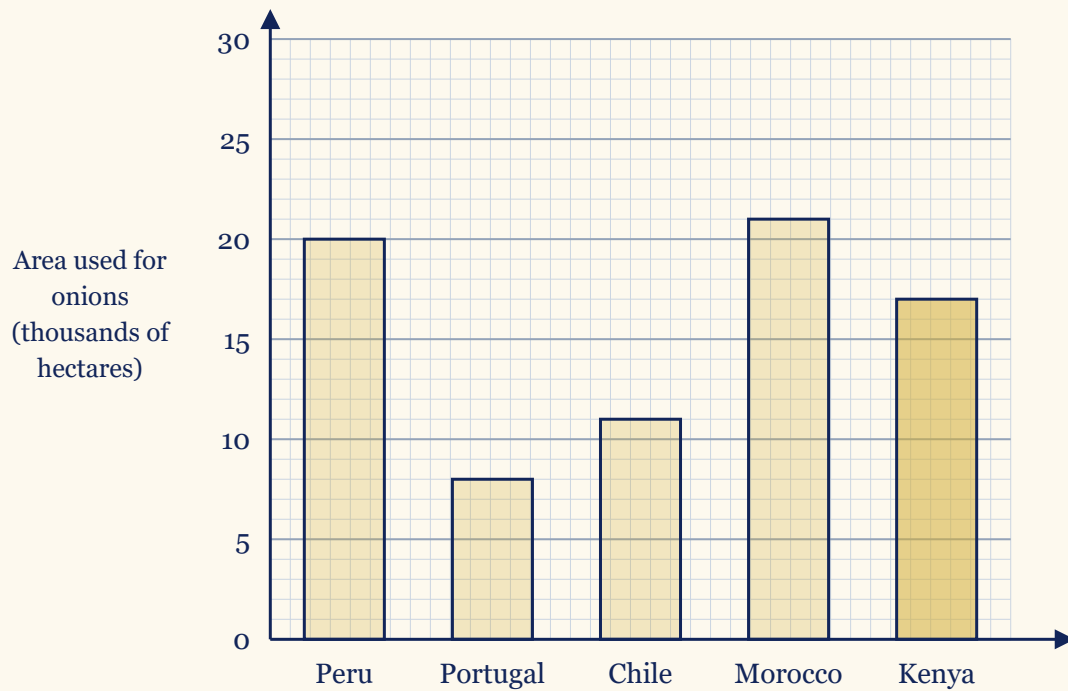
$$20 - 8 = 12$$

(Reason: "how many more" asks for the difference, so subtract the smaller reading from the larger.)

Step 3 - Part (c): drawing the bar for Kenya.

17 is two small squares above the line labelled 15.

Draw a bar over the Kenya label reaching that height.



(Reason: only the height is marked, so the bar must stop exactly on 17.)

(a) 21 thousand hectares

(b) 12 thousand hectares

(c) A bar over Kenya reaching 17 thousand hectares

Verification

- ✓ **Check 1 - part (a):** Morocco is the tallest of the four bars, and 21 is greater than 20, 11 and 8, so the reading agrees with the picture.
- ✓ **Check 2 - part (b):** add the difference back, $8 + 12 = 20$, which is the Peru reading.
- ✓ **Check 3 - part (b):** count squares directly - from the top of the Portugal bar to the top of the Peru bar is 12 small squares, each worth 1 thousand hectares.
- ✓ **Check 4 - part (c):** 17 lies between 15 and 20, so the new bar must be taller than Chile at 11 but shorter than Peru at 20 and Morocco at 21.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) 21	B1	accept "21 thousand". Also accepted if written at the top of the Morocco bar rather than on the answer line	✓
(b) 12	B1		✓
(c) Bar completed to show 17 thousand	B1	the bar can be of any width	✓

Full marks: 3/3

Question 4 - Exam Solution

Understanding the Question

Given

a rectangle made of squares; five fractions; the improper fraction $\frac{24}{7}$; the fraction $\frac{9}{10}$; and a jar of 80 beads of which $\frac{2}{5}$ are blue.

Find

a shading of $\frac{3}{7}$, the two fractions equal to $\frac{3}{4}$, a mixed number, a percentage, and the number of beads that are not blue.

Plan the Solution

- Count the squares first, then work out what three sevenths of that count is.
- Cancel each of the five fractions to its simplest form and compare.
- Divide to convert the improper fraction, and scale to a denominator of 100 for the percentage.
- For part (e), work with the fraction that is NOT blue rather than finding the blue beads first.

Worked Solution [7 marks]

Working with fractions: a fraction of a quantity is found by dividing by the denominator and multiplying by the numerator. Two fractions are equivalent when they cancel to the same simplest form. An improper fraction becomes a mixed number by

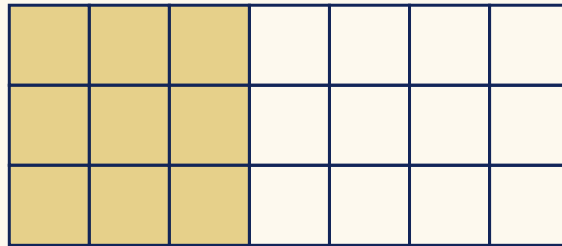
dividing the numerator by the denominator, with the remainder left over the same denominator. A fraction becomes a percentage by rewriting it with a denominator of 100.

Step 1 - Part (a): shading three sevenths.

The rectangle is 7 squares wide and 3 squares tall, so it holds $7 \times 3 = 21$ squares.

$$\frac{21}{7} \times 3 = 3 \times 3 = 9$$

Shade any 9 squares. Three full columns is the tidiest choice.



(Reason: each column is one seventh of the rectangle, so three columns is three sevenths.)

Step 2 - Part (b): the two fractions equal to three quarters.

$\frac{33}{43}$ - 43 is prime and is not a factor of 33, so this is already in its simplest form.

$$\frac{18}{24} = \frac{3}{4} \quad (\text{divide both by 6})$$

$$\frac{16}{20} = \frac{4}{5} \quad (\text{divide both by 4})$$

$$\frac{21}{27} = \frac{7}{9} \quad (\text{divide both by 3})$$

$$\frac{12}{16} = \frac{3}{4} \quad (\text{divide both by 4})$$

(Reason: two fractions are equivalent exactly when they cancel to the same simplest form.)

Step 3 - Part (c): writing the improper fraction as a mixed number.

$$24 = 7 \times 3 + 3$$

$$\frac{24}{7} = 3\frac{3}{7}$$

(Reason: the 3 whole sevens give the whole-number part, and the remainder of 3 stays over 7.)

Step 4 - Part (d): writing the fraction as a percentage.

$$\frac{9}{10} = \frac{90}{100} = 90\%$$

(Reason: multiplying the numerator and the denominator by 10 gives a denominator of 100, and per cent means "out of 100".)

Step 5 - Part (e): the beads that are not blue.

$$1 - \frac{2}{5} = \frac{3}{5} \text{ of the beads are not blue.}$$

$$\frac{80}{5} \times 3 = 16 \times 3 = 48$$

(Reason: switching to the fraction that is not blue reaches the answer in one calculation instead of two.)

(a) Any 9 squares shaded

(b) $\frac{18}{24}$ and $\frac{12}{16}$

(c) $3\frac{3}{7}$

(d) 90%

(e) 48

Verification

✓ **Check 1 - part (a):** one column is $\frac{1}{7}$ of the rectangle, so three columns is $\frac{3}{7}$, and $3 \times 3 = 9$ squares out of 21.

✓ **Check 2 - part (b):** as decimals, $\frac{3}{4} = 0.75$, and $\frac{18}{24} = 0.75$ and $\frac{12}{16} = 0.75$, while $\frac{33}{43} \approx 0.767$, $\frac{16}{20} = 0.8$ and $\frac{21}{27} \approx 0.778$. Exactly two match.

✓ **Check 3 - part (c):** reverse it, $3\frac{3}{7} = \frac{3 \times 7 + 3}{7} = \frac{24}{7}$.

✓ **Check 4 - part (d):** reverse it, $\frac{90}{100}$ cancels to $\frac{9}{10}$.

✓ **Check 5 - part (e):** the other way round, blue = $\frac{2}{5}$ of 80 = 32, and $80 - 32 = 48$. The two groups add back to $32 + 48 = 80$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) Any 9 squares shaded	B1	three full columns is the natural choice	✓
(b) $\frac{18}{24}$ and $\frac{12}{16}$	B2	for both and no others. B1 for one correct with no more than one incorrect	✓
(c) $3\frac{3}{7}$	B1	must be written as a mixed number, not as a decimal	✓
(d) 90	B1	accept 90% written in the answer space, and allow "ninety"	✓
(e) $\frac{2}{5} \times 80$, or $1 - \frac{2}{5} = \frac{3}{5}$, or divide by 5 then multiply by 3, or 32. Accept $\frac{32}{80}$ or $\frac{48}{80}$	M1		✓
(e) 48	A1	a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 7/7

Question 5 - Exam Solution

Understanding the Question

Given

a frequency table of the marks scored by 25 students, with marks 18, 19, 20, 21 and 22 occurring 2, 4, 5, 6 and 8 times.

Find

the median mark.

Plan the Solution

- Check the frequencies add to 25.
- Locate the position of the median, the middle value of the 25 marks in order.

- Build a running total of the frequencies to see which mark occupies that position, instead of writing out all 25 marks.

Worked Solution [2 marks]

The median from a frequency table: for n values placed in order, the median is the value in position $\frac{n+1}{2}$. Adding the frequencies cumulatively shows which value occupies that position.

Step 1 - Check the total frequency.

$$2 + 4 + 5 + 6 + 8 = 25$$

(Reason: the total must match the 25 students given in the question, or the table has been misread.)

Step 2 - Find the position of the median.

$$\frac{25 + 1}{2} = \frac{26}{2} = 13$$

The median is the 13th mark when all 25 are placed in order.

(Reason: with an odd number of values there is a single middle value, and that formula locates it.)

Step 3 - Find which mark occupies position 13.

Running totals down the table:

mark 18 - positions 1 to 2

mark 19 - positions 3 to 6

mark 20 - positions 7 to 11

mark 21 - positions 12 to 17

mark 22 - positions 18 to 25

Position 13 lies in the row for mark 21.

(Reason: the running total first reaches 13 in the mark-21 row, so the 13th value is 21.)

Median mark = 21

Verification

- ✓ **Check 1 - count from the other end:** working down from the highest marks, mark 22 fills positions 1 to 8 and mark 21 fills positions 9 to 14. With 25 values the 13th from the top is also the 13th from the bottom, and it is 21 either way.
- ✓ **Check 2 - cumulative frequencies:** the cumulative frequencies are 2, 6, 11, 17, 25. The first total to reach 13 is 17, which belongs to mark 21.

- ✓ **Check 3 - test the definition directly:** 11 students scored below 21 and 8 scored above it. For 21 to be the median, neither group may exceed 12, and 11 is at most 12 and 8 is at most 12.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Position of the median	M1	a correct method to locate the median: $\frac{25 + 1}{2} = 13$, and allow 12.5. Also accepted: writing the marks out in order and reaching the second 21 from the lower end, or adding the frequencies cumulatively to give 2, 6, 11, 17 or 8, 14	✓
Median	A1	21, from correct working	✓

Full marks: 2/2

Question 6 - Exam Solution

Understanding the Question

Given

cushions cost \$14 each, and Ruth has \$250 to spend.

Find

how much of the \$250 is left once she has bought as many cushions as possible.

Plan the Solution

- Divide 250 by 14 to see how far the money stretches.
- The result will not be a whole number, so round DOWN, because part of a cushion cannot be bought.
- Multiply that whole number by 14 to find the amount spent, then subtract from 250.

Worked Solution [3 marks]

Buying as many as possible: divide the money available by the cost of one item, then round DOWN to a whole number. Rounding up would spend more money than is available.

Step 1 - How many cushions can be bought.

$$\frac{250}{14} = 17.857...$$

Ruth can buy 17 cushions.

(Reason: 17 cushions are affordable, an 18th would take her past \$250, and part of a cushion cannot be bought.)

Step 2 - The amount spent.

$$17 \times 14 = 238$$

(Reason: 17 cushions at \$14 each.)

Step 3 - The amount left.

$$250 - 238 = 12$$

(Reason: subtract what she spends from what she started with.)

12 dollars

Verification

- ✓ **Check 1 - test 18 cushions:** $18 \times 14 = 252$, which is more than 250, so 17 really is the most she can buy.
- ✓ **Check 2 - add back:** $238 + 12 = 250$, the amount she started with.
- ✓ **Check 3 - a structural check:** the money left must be less than the price of one cushion, or she could have bought another. 12 is less than 14.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Divide: $\frac{250}{14}$ (= 17.85...)	M1	or 17, or 18, or adding 14 repeatedly seventeen or eighteen times	✓
Multiply: 17×14 (= 238)	M1	this mark assumes the previous M1	✓
Subtract: 12	A1	a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 3/3

Question 7 - Exam Solution

Understanding the Question

Given

four distances, 3.5 km, 950 m, 1.8 km and 1200 m, and a total of 8 km walked by Yusuf.

Find

how much further Yusuf walked, in metres.

Plan the Solution

- The distances are in two different units, so convert everything to one unit first.
- Metres is the sensible choice, because the answer is asked for in metres.
- Add the four distances, then subtract that total from Yusuf's total.

Worked Solution [4 marks]

Working with mixed units: 1 kilometre = 1000 metres. Convert every quantity to a single unit before adding or subtracting, and give the answer in the unit the question asks for.

Step 1 - Convert everything to metres.

$$3.5 \text{ km} = 3.5 \times 1000 = 3500 \text{ m}$$

$$1.8 \text{ km} = 1.8 \times 1000 = 1800 \text{ m}$$

$$8 \text{ km} = 8 \times 1000 = 8000 \text{ m}$$

950 m and 1200 m are already in metres.

(Reason: multiply by 1000 to change kilometres into metres.)

Step 2 - The total distance Clara walked.

$$3500 + 950 + 1800 + 1200 = 7450 \text{ m}$$

(Reason: add the four converted distances, now that they share a unit.)

Step 3 - The difference.

$$8000 - 7450 = 550$$

(Reason: Yusuf walked further, so subtract Clara's total from his.)

550 metres

Verification

- ✓ **Check 1 - work in kilometres instead:** $950 \text{ m} = 0.95 \text{ km}$ and $1200 \text{ m} = 1.2 \text{ km}$, so Clara walked $3.5 + 0.95 + 1.8 + 1.2 = 7.45 \text{ km}$. Then $8 - 7.45 = 0.55 \text{ km} = 550 \text{ m}$. The two unit choices agree.
- ✓ **Check 2 - add back:** $7450 + 550 = 8000 \text{ m}$, which is the 8 km Yusuf walked.
- ✓ **Check 3 - estimate:** rounding 950 up to 1000 gives roughly $3500 + 1000 + 1800 + 1200 = 7500 \text{ m}$, about 500 m short of 8000. The exact answer of 550 sits where the estimate predicts.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Convert: $3.5 \text{ km} = 3500 \text{ m}$	B1	one correct conversion, e.g. $950 \text{ m} = 0.95 \text{ km}$, or $1.8 \text{ km} = 1800 \text{ m}$, or $1200 \text{ m} = 1.2 \text{ km}$, or $8 \text{ km} = 8000 \text{ m}$	✓
Add: $3500 + 950 + 1800 + 1200 = 7450$	M1	or $3.5 + 0.95 + 1.8 + 1.2 (= 7.45)$. This mark can be earned for adding the converted figures even if a conversion is wrong, provided an attempt has been made to convert at least two relevant values	✓
Subtract: $8000 - 7450 = 550$	M1ft	or $8 - 7.45 (= 0.55)$, in compatible units. Follow through on their total, provided Clara's distance is less than Yusuf's	✓
Answer: 550	A1	a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 4/4

Question 8 - Exam Solution

Understanding the Question

Given

five short algebra instructions, and a sticker problem in which Owen has c , Sari has $3c$ and Priya has $c + 7$.

Find

a simplified expression, a product, the solution of an equation, an expansion, a factorisation, and a simplified total.

Plan the Solution

- Part (a): collect the g terms and the h terms separately.
- Part (b): multiply the numbers, then write the letters together.
- Part (c): move the number term across, then divide.
- Part (d): multiply everything inside the bracket by 5.
- Part (e): take out the highest common factor of 9 and 12.
- Part (f): write each amount in terms of c , add them, then collect like terms.

Worked Solution [10 marks]

Working with algebra: like terms share exactly the same letter, and only like terms can be collected. To solve a linear equation, do the same operation to both sides until the letter stands alone. To expand, multiply every term inside the bracket by the term outside. To factorise, take the highest common factor outside a bracket, leaving what remains inside.

Step 1 - Part (a).

$$g \text{ terms: } 7g + 4g = 11g$$

$$h \text{ terms: } 3h - 5h = -2h$$

$$7g + 3h + 4g - 5h = 11g - 2h$$

(Reason: g and h are different letters, so their terms are collected separately.)

Step 2 - Part (b).

$$7 \times 4 = 28, \text{ and } a \times m = am$$

$$7a \times 4m = 28am$$

(Reason: multiplication can be done in any order, so gather the numbers and the letters separately.)

Step 3 - Part (c).

$$5x - 7 = 12$$

$$5x = 12 + 7 = 19$$

$$x = \frac{19}{5} = 3.8$$

(Reason: add 7 to both sides to leave $5x$ alone, then divide both sides by 5.)

Step 4 - Part (d).

$$5 \times 7k = 35k \text{ and } 5 \times 3 = 15$$

$$5(7k + 3) = 35k + 15$$

(Reason: the 5 multiplies both terms inside the bracket, not just the first.)

Step 5 - Part (e).

The highest common factor of 9 and 12 is 3.

$$\frac{9y}{3} = 3y \text{ and } \frac{12}{3} = 4$$

$$9y + 12 = 3(3y + 4)$$

(Reason: taking out the highest common factor leaves no further common factor inside the bracket.)

Step 6 - Part (f).

Owen has c , Sari has $3c$, Priya has $c + 7$.

$$\begin{aligned}\text{Total} &= c + 3c + c + 7 \\ &= 5c + 7\end{aligned}$$

(Reason: three lots of c come from Owen, Sari's $3c$ and Priya's c , giving $5c$ in all, and the 7 is a number on its own.)

(a) $11g - 2h$

(b) $28am$

(c) $x = 3.8$

(d) $35k + 15$

(e) $3(3y + 4)$

(f) $5c + 7$

Verification

- ✓ **Check 1 - part (a):** substitute $g = 1$ and $h = 1$. The original gives $7 + 3 + 4 - 5 = 9$, and $11 - 2 = 9$.
- ✓ **Check 2 - part (c):** substitute back, $5 \times 3.8 - 7 = 19 - 7 = 12$, the right-hand side.
- ✓ **Check 3 - parts (d) and (e) are opposite operations:** expanding the answer to part (e) gives $3 \times 3y + 3 \times 4 = 9y + 12$, the original expression.
- ✓ **Check 4 - part (f):** take $c = 10$. Owen has 10, Sari has 30 and Priya has 17, so the total is 57. The expression gives $5(10) + 7 = 57$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) $11g - 2h$	B2	B1 for one correct term, and B1 only for $11g + (-2h)$	✓

Step	Mark	Description	Got it?
(b) $28am$	B1	or equivalent	✓
(c) $5x = 12 + 7$, or $\frac{12 + 7}{5}$	M1	a correct equation with the number terms on one side and x on the other, or a correct process to find x	✓
(c) 3.8	A1	or equivalent: $\frac{19}{5}$ or $3\frac{4}{5}$	✓
(d) $35k + 15$, or $15 + 35k$	B1	allow $35x + 15$	✓
(e) $3(3y + 4)$	B1	allow a missing closing bracket, and allow $3(3x + 4)$	✓
(f) $3c$ (allow $3 \times c$ or $c3$), or $c + 7$	M1	allow $3c + 7$	✓
(f) $c + 3c + c + 7$	M1	a correct unsimplified expression	✓
(f) $5c + 7$	A1	allow $5 \times c + 7$	✓

Full marks: 10/10

Question 9 - Exam Solution

Understanding the Question

Given

the train is boarded at 0735 and left at 1325, both on the 24-hour clock.

Find

the length of the journey, in hours and minutes.

Plan the Solution

- Count on from 0735 to the next whole hour.
- Then count on in whole hours to 1300.
- Then count on the last few minutes to 1325, and gather the minutes together.

Worked Solution [2 marks]

Time intervals: there are 60 minutes in an hour, not 100, so a time difference cannot be found by ordinary column subtraction. Count on in steps, or convert both times to minutes past midnight first.

Step 1 - Count on to the next whole hour.

0735 → 0800 is 25 minutes.

(Reason: from 35 minutes past to the next hour is $60 - 35$ minutes.)

Step 2 - Count on in whole hours.

0800 → 1300 is 5 hours.

(Reason: whole hours are easy to count once the awkward minutes are out of the way.)

Step 3 - Count on the last minutes.

1300 → 1325 is 25 minutes.

(Reason: the final stretch runs from the last whole hour to the arrival time.)

Step 4 - Gather the parts.

Minutes: $25 + 25 = 50$

Total: 5 hours 50 minutes

(Reason: the 50 minutes is under a full hour, so no extra hour is carried.)

5 hours 50 minutes

Verification

- ✓ **Check 1 - a completely different method:** convert both times to minutes past midnight. $0735 = 7 \times 60 + 35 = 455$ and $1325 = 13 \times 60 + 25 = 805$. Then $805 - 455 = 350$ minutes, and $350 = 5 \times 60 + 50$, so 5 hours 50 minutes.
- ✓ **Check 2 - add the answer back:** 5 hours after 0735 is 1235, and 50 minutes later is 1325, the time he got off.
- ✓ **Check 3 - bracket the answer:** 5 hours after 0735 is 1235, which is too early, and 6 hours is 1335, which is too late. The journey must therefore be between 5 and 6 hours, and 5 hours 50 minutes is.
- ✓ **Check 4 - why column subtraction fails here:** writing $1325 - 0735 = 590$ and reading it as 5 hours 90 minutes gives 6 hours 30 minutes, which is 40 minutes too long. Time is not base 10.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Hours	B1	5 (hours)	✓
Minutes	B1	50 (minutes)	✓

Full marks: 2/2

Question 10 - Exam Solution

Understanding the Question

Given

a cuboid measuring 25 cm long, 9 cm deep and 12 cm high.

Find

its volume.

Plan the Solution

- Pick out the three dimensions from the diagram.
- Multiply all three together.
- Give the answer in cubic centimetres.

Worked Solution [2 marks]

Volume of a cuboid: $\text{volume} = \text{length} \times \text{width} \times \text{height}$. All three measurements must be in the same unit, and because three lengths are multiplied the answer is in CUBIC units.

Step 1 - Identify the three dimensions.

Length = 25 cm, depth = 9 cm, height = 12 cm.

(Reason: a cuboid has three different edge lengths meeting at each corner, and all three are labelled on the diagram.)

Step 2 - Multiply the three dimensions.

$$9 \times 12 = 108$$

$$108 \times 25 = 2700$$

(Reason: multiplying two dimensions first keeps the numbers manageable, and multiplication can be done in any order.)

2700 cm³

Verification

- ✓ **Check 1 - multiply in a different order:** $25 \times 12 = 300$, and $300 \times 9 = 2700$.
- ✓ **Check 2 - a third order:** $9 \times 25 = 225$, and $225 \times 12 = 2700$.
- ✓ **Check 3 - use the prism formula:** the cross-section is the 9 by 12 face, with area 108 cm². Volume = area of cross section $\times$ length = $108 \times 25 = 2700$ cm³.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Multiply	M1	$9 \times 12 \times 25$ or equivalent, in any order	✓
Answer	A1	2700 - a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 2/2

Question 11 - Exam Solution

Understanding the Question

Given

triangle ABC; BCD and ACE are straight lines; angle DCE = 53° and angle BAC = 77° .

Find

the value of x, which is the size of angle ABC.

Plan the Solution

- Notice that the two straight lines cross at C, so a pair of vertically opposite angles is formed.
- Use that to find the third angle of the triangle.
- Then use the angle sum of a triangle.

Worked Solution [2 marks]

Two facts are needed: when two straight lines cross, vertically opposite angles are equal. And the three angles of a triangle add up to 180° .

Step 1 - Find angle ACB.

BCD and ACE are straight lines, and they cross at C.

Angle ACB and angle DCE are therefore vertically opposite.

Angle ACB = 53°

(Reason: vertically opposite angles are equal, so the 53° marked above C is repeated inside the triangle.)

Step 2 - Use the angle sum of the triangle.

$$77 + 53 = 130$$

$$x = 180 - 130 = 50$$

(Reason: the three angles of triangle ABC must total 180° .)

$$x = 50$$

Verification

- ✓ **Check 1 - the three angles:** $77 + 53 + 50 = 180$.
- ✓ **Check 2 - reach 53° a different way:** ACE is a straight line, so angle ACD = $180 - 53 = 127^\circ$. And BCD is a straight line, so angle ACB = $180 - 127 = 53^\circ$, agreeing with the vertically opposite result.
- ✓ **Check 3 - the exterior angle theorem:** extending BC to D makes angle ACD an exterior angle of the triangle, and an exterior angle equals the sum of the two opposite interior angles. So $77 + x = 127$, giving $x = 50$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Third angle	M1	Angle ACB = 53, or a correct calculation for angle ACD or angle BCE, $180 - 53 (= 127)$, which must be seen on the diagram or the angle stated. Or a correct calculation for x: $180 - (77 + 53)$	✓
Answer	A1	50 - a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 2/2

Question 12 - Exam Solution

Understanding the Question

Given

240 vehicles in total, split between cars and vans in the ratio 5 : 3, and 64% of the cars are electric.

Find

the number of cars that are electric.

Plan the Solution

- Add the ratio parts to see how many equal shares the 240 splits into.
- Find the size of one share, then the number of cars.
- Take 64% of that number.

Worked Solution [4 marks]

Sharing in a ratio, then taking a percentage: add the ratio parts to find the total number of shares, divide the quantity by that total to find one share, then multiply by the number of shares wanted. To find a percentage of an amount, multiply by the percentage written as a decimal.

Step 1 - Find the total number of shares.

$$5 + 3 = 8$$

(Reason: the ratio splits the 240 vehicles into 8 equal shares, 5 of them cars and 3 of them vans.)

Step 2 - Find one share.

$$\frac{240}{8} = 30$$

(Reason: dividing the total by the number of shares gives the size of one share.)

Step 3 - Find the number of cars.

$$5 \times 30 = 150$$

(Reason: cars take 5 of the 8 shares.)

Step 4 - Find 64% of the cars.

$$0.64 \times 150 = 96$$

(Reason: 64% written as a decimal is 0.64, and "of" means multiply.)

Verification

- ✓ **Check 1 - check the split first:** vans = $3 \times 30 = 90$, and $150 + 90 = 240$, the total given. Also $150 : 90$ cancels to $5 : 3$.
- ✓ **Check 2 - a completely different route:** 64% of all 240 vehicles is $0.64 \times 240 = 153.6$. Dividing that into 8 shares gives 19.2, and 5 shares is $19.2 \times 5 = 96$.
- ✓ **Check 3 - a third route, working in fractions:** the fraction of all vehicles that are electric cars is $0.64 \times \frac{5}{8} = \frac{2}{5}$, and $\frac{2}{5}$ of 240 is 96.
- ✓ **Check 4 - the complement:** 36% of the cars are not electric, so $0.36 \times 150 = 54$, and $150 - 54 = 96$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Start the ratio	M1	$\frac{240}{5+3}$ (= 30). Or 0.64×5 (= 3.2), or $0.36 \times 5 + 3$ (= 4.8). Or 0.64×240 (= 153.6), allowing 153 or 154. M2 is given straight away for $\frac{5}{8} \times 240$ (= 150)	✓
Reach the cars	M1	5×30 (= 150), and $150 : 90$ may be seen. Or $\frac{3.2}{8}$ (= $\frac{2}{5}$) or $\frac{4.8}{8}$ (= $\frac{3}{5}$), where 3.2 or 4.8 must already have been seen. Or $\frac{153.6}{5+3}$ (= 19.2)	✓
A fully correct method	M1	0.64×150 , or 1.5×64 , or $150 - 150 \times 0.36$ (150 - 54). Or 3.2×30 , or $\frac{2}{5} \times 240$, or $240 - \frac{3}{5} \times 240$. Or 19.2×5 . Every figure must come from correct working	✓
Answer	A1	96 cao. Writing $150 - 96$, with the 96 shown, is worth M3. Special case: B2 if no other marks are earned, for an answer of 95.625 or 96.25	✓

Full marks: 4/4

Question 13 - Exam Solution

Understanding the Question

Given

the expression $\frac{7.93 - 2.34^2}{0.14}$.

Find

the full calculator display, and then that value rounded to one decimal place.

Plan the Solution

- Square first, because indices come before subtraction.
- Then subtract, to complete the numerator.
- Only then divide by 0.14.
- For part (b), look at the second decimal place to decide the rounding.

Worked Solution [3 marks]

Order of operations, and the fraction bar: indices are worked out before addition and subtraction. A fraction bar acts as a bracket, so the whole numerator must be completed before dividing.

Step 1 - Square the 2.34.

$$2.34^2 = 5.4756$$

(Reason: the index belongs to the 2.34 alone, not to the whole numerator.)

Step 2 - Complete the numerator.

$$7.93 - 5.4756 = 2.4544$$

(Reason: the fraction bar groups the numerator, so it must be finished before dividing.)

Step 3 - Divide.

$$\frac{2.4544}{0.14} = 17.53142857...$$

(Reason: the question asks for every figure on the display, so nothing is rounded here.)

Step 4 - Part (b), round to one decimal place.

$$17.53142857...$$

The second decimal place is 3, which is less than 5, so the first decimal place is unchanged.

17.5

(Reason: the digit immediately after the place being rounded to decides whether it goes up.)

(a) 17.53142857...

(b) 17.5

Verification

✓ **Check 1 - reverse the division:** $17.53142857... \times 0.14 = 2.4544$, the numerator.

✓ **Check 2 - reverse the subtraction:** $2.4544 + 5.4756 = 7.93$, the number the question started with.

✓ **Check 3 - work exactly instead of in decimals:** $\frac{2.4544}{0.14} = \frac{3068}{175}$, and

$\frac{3068}{175} = 17.53142857...$, so the decimal is a genuine recurring value rather than a rounding artefact.

✓ **Check 4 - test the common misreading:** if the expression were read as $\frac{(7.93 - 2.34)^2}{0.14}$ the answer would be 223.2, nowhere near. The square belongs to the 2.34 only.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	M1	2.4544, or 17.5, or 17.53, or $\frac{3068}{175}$	✓
(a)	A1	17.531(...) - at least 5 significant figures	✓
(b)	B1	17.5, follow through from a number with 2 or more decimal places	✓

Full marks: 3/3

Question 14 - Exam Solution

Understanding the Question

Given

Find

shape ABCDE made from square ABDE and isosceles triangle BCD with $BC = DC$; the square has area 49 cm^2 ; the triangle has perimeter 27 cm .

the perimeter of ABCDE.

Plan the Solution

- Find the side of the square from its area.
- BD is a side of the square and also the base of the triangle, so subtracting it from the triangle's perimeter leaves the two equal sides.
- Halve that to get one of them.
- Add only the outside edges. BD is inside the shape.

Worked Solution [3 marks]

Perimeter of a compound shape: the perimeter is the total length of the OUTSIDE edge only. Where two shapes are joined, the shared edge lies inside the finished shape and is not counted.

Step 1 - Find the side of the square.

Area = 49 cm^2 , so side = $\sqrt{49} = 7 \text{ cm}$

So $AB = BD = DE = EA = 7 \text{ cm}$

(Reason: a square's area is side squared, so the side is the square root of the area.)

Step 2 - Find the two equal sides of the triangle.

The base of the triangle is $BD = 7 \text{ cm}$.

$$BC + DC = 27 - 7 = 20$$

$$BC = DC = \frac{20}{2} = 10 \text{ cm}$$

(Reason: the triangle is isosceles with $BC = DC$, so what is left after removing the base splits equally.)

Step 3 - Add the outside edges only.

Perimeter = $AB + BC + CD + DE + EA$

$$= 7 + 10 + 10 + 7 + 7$$

$$= 41 \text{ cm}$$

(Reason: BD is where the square and the triangle join, so it is inside the shape and is not part of the perimeter.)

41 cm

Verification

- ✓ **Check 1 - trace the outline:** going A to B to C to D to E and back to A uses five sides, and $7 + 10 + 10 + 7 + 7 = 41$.
- ✓ **Check 2 - check the triangle:** $BC + CD + DB = 10 + 10 + 7 = 27$, the perimeter given.
- ✓ **Check 3 - check the square:** side 7 gives area $7^2 = 49 \text{ cm}^2$, the area given.
- ✓ **Check 4 - add the two perimeters instead:** square 28 plus triangle 27 is 55, but that counts BD once in each shape. Removing it twice gives $55 - 14 = 41$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Side of the square	M1	$\sqrt{49}$ (= 7). This may be written on the diagram, or appear inside a calculation such as $7 + 7 + 7 \dots$	✓
Sides of the triangle	M1	$\frac{27 - 7}{2}$ (= 10), or $27 - 7$ (= 20) for the two equal sides together. Dependent on the first M1. The 10 or 20 may appear inside a calculation such as $7 + 7 + \dots + 10 + 10$. A candidate who wrongly treats 49 as the perimeter is still allowed this mark, for example $\frac{27 - 12.25}{2}$ (= 7.375) or $27 - 12.25$ (= 14.75)	✓
Answer	A1	41 - a correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 3/3

Question 15 - Exam Solution

Understanding the Question

Given

Find

shape A with vertices (1,1), (3,1), (3,2), (2,3), (1,2), and shape B with vertices (3,3), (9,3), (9,6), (6,9), (3,6).

a full description of the single transformation that maps A onto B.

Plan the Solution

- Compare the two shapes: same shape, different size, so it is an enlargement.
- Compare a pair of matching sides to find the scale factor.
- Check what each vertex of A has been multiplied by, which locates the centre.

Worked Solution [3 marks]

Describing an enlargement fully: three things are needed, and all three must be given: the word ENLARGEMENT, the SCALE FACTOR, and the CENTRE of enlargement. Naming any second transformation alongside it loses the first mark.

Step 1 - Identify the transformation.

B has exactly the same shape as A but is larger, so this is an enlargement.

(Reason: the shape is unchanged and only the size differs, which rules out reflection, rotation and translation.)

Step 2 - Find the scale factor.

The base of A runs from (1,1) to (3,1), so it is 2 units long.

The base of B runs from (3,3) to (9,3), so it is 6 units long.

$$\text{Scale factor} = \frac{6}{2} = 3$$

(Reason: the scale factor is the image length divided by the matching object length.)

Step 3 - Find the centre of enlargement.

Compare each vertex with its image:

$$(1, 1) \rightarrow (3, 3), (3, 1) \rightarrow (9, 3), (3, 2) \rightarrow (9, 6)$$

$$(2, 3) \rightarrow (6, 9), (1, 2) \rightarrow (3, 6)$$

Every coordinate has simply been multiplied by 3, with nothing added, so the centre is the origin.

$$\text{Centre} = (0, 0)$$

(Reason: multiplying both coordinates by the scale factor and adding nothing is exactly what an enlargement centred on the origin does.)

Enlargement, scale factor 3, centre (0, 0)

Verification

- ✓ **Check 1 - test every vertex, not just one:** all five vertices map by multiplying by 3, and the x ratio matches the y ratio each time. If they differed it would be a stretch, not an enlargement.
- ✓ **Check 2 - the ray test:** a line drawn from the origin through any vertex of A passes through the matching vertex of B. This holds for all five, which is what fixes the centre at (0,0).
- ✓ **Check 3 - check the areas:** an enlargement of scale factor k multiplies area by k squared. Shape A has area 3 squares and shape B has area 27 squares, and $\frac{27}{3} = 9 = 3^2$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Transformation	B1	Enlargement, or equivalent. NO mark if reflection, translation, rotation, move, flip, left, up or any other transformation is mentioned as well	✓
Scale factor	B1	Scale factor 3, or equivalent. Allow times 3 or "three times"	✓
Centre	B1	Centre (0,0), or equivalent. Allow "the origin", "O", or "x = 0, y = 0", and allow (0,0) without the word "centre". Do NOT allow it written as a column vector	✓

Full marks: 3/3

Question 16 - Exam Solution

Understanding the Question

Given

a circle of radius 9 cm.

Find

its area, correct to 3 significant figures.

Plan the Solution

- Use the formula for the area of a circle.
- Square the radius first, then multiply by pi.

- Round at the very end, not part-way through.

Worked Solution [2 marks]

Area of a circle: $A = \pi r^2$, where r is the RADIUS. This formula is NOT on the Foundation formulae sheet, which gives only the trapezium, the prism and the cylinder, so it has to be known. The squaring applies to the radius only, so square first and multiply by pi afterwards. Round only at the final step.

Step 1 - Square the radius.

$$9^2 = 81$$

(Reason: in πr^2 the index belongs to the r , not to the whole expression.)

Step 2 - Multiply by pi.

$$\pi \times 81 = 254.4690049...$$

(Reason: use the calculator's pi key rather than a rounded value, so no accuracy is lost before the final rounding.)

Step 3 - Round to 3 significant figures.

The first three significant figures are 2, 5 and 4.

The next digit is 4, which is less than 5, so the third figure stays as it is.

$$254 \text{ cm}^2$$

(Reason: the digit immediately after the last figure kept decides whether it rounds up.)

$$254 \text{ cm}^2$$

Verification

- ✓ **Check 1 - reverse it:** $\frac{254.4690}{\pi} = 81$, and $\sqrt{81} = 9$, the radius given.
- ✓ **Check 2 - estimate:** pi lies between 3 and 4, so the area lies between $3 \times 81 = 243$ and $4 \times 81 = 324$. The answer 254 sits inside that range.
- ✓ **Check 3 - the approximations the mark scheme allows:** $3.14 \times 81 = 254.34$, which rounds to 254; and $\frac{22}{7} \times 81 = 254.57$, which rounds to 255. Both fall inside the accepted range.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Method	M1	$\pi \times 9^2$. Allow 3.14 or $\frac{22}{7}$ in place of pi	✓
Answer	A1	254 - accept anything from 254 to 255, which covers the approximations for pi. A correct answer scores full marks unless it clearly follows incorrect working	✓

Full marks: 2/2

Question 17 - Exam Solution

Understanding the Question

Given

the statement $1\frac{5}{7} \times 2\frac{3}{16} = 3\frac{3}{4}$.

Find

working that starts from the left-hand side and arrives at the right-hand side.

Plan the Solution

- Write both mixed numbers as improper fractions.
- Multiply, cancelling first so the numbers stay small.
- Convert back to a mixed number and check it is the right-hand side.

Worked Solution [3 marks]

Multiplying mixed numbers: never multiply the whole-number parts and the fraction parts separately. Change each mixed number to an improper fraction first, multiply the numerators and multiply the denominators, then convert back. In a SHOW THAT question the working carries the marks; writing down the given answer on its own earns nothing.

Step 1 - Write both as improper fractions.

$$1\frac{5}{7} = \frac{1 \times 7 + 5}{7} = \frac{12}{7}$$

$$2\frac{3}{16} = \frac{2 \times 16 + 3}{16} = \frac{35}{16}$$

(Reason: a mixed number becomes improper by multiplying the whole number by the denominator and adding the numerator.)

Step 2 - Multiply, cancelling first.

$$\frac{12}{7} \times \frac{35}{16}$$

7 divides into 35 five times, and 4 divides into both 12 and 16:

$$= \frac{3}{1} \times \frac{5}{4} = \frac{15}{4}$$

(Reason: cancelling before multiplying keeps the arithmetic small; multiplying first gives $\frac{420}{112}$, which then needs simplifying anyway.)

Step 3 - Convert back to a mixed number.

$$15 = 4 \times 3 + 3, \text{ so } \frac{15}{4} = 3\frac{3}{4}$$

This is the right-hand side, as required.

(Reason: dividing the numerator by the denominator gives the whole-number part, and the remainder stays over the denominator.)

$$1\frac{5}{7} \times 2\frac{3}{16} = \frac{15}{4} = 3\frac{3}{4} \text{ as required}$$

Verification

✓ **Check 1 - multiply without cancelling:** $12 \times 35 = 420$ and $7 \times 16 = 112$, giving $\frac{420}{112}$. The HCF of 420 and 112 is 28, and $\frac{420}{28} = 15$ with $\frac{112}{28} = 4$, so the fraction is $\frac{15}{4}$.

✓ **Check 2 - start from the right-hand side instead:** $3\frac{3}{4} = \frac{3 \times 4 + 3}{4} = \frac{15}{4}$, and the left-hand side also came to $\frac{15}{4}$, so the two sides meet.

✓ **Check 3 - as decimals:** $1\frac{5}{7} = 1.714285...$ and $2\frac{3}{16} = 2.1875$, and $1.714285... \times 2.1875 = 3.75 = 3\frac{3}{4}$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Improper fractions	M1	$\frac{12}{7} \times \frac{35}{16}$ - both mixed numbers written as improper fractions	✓
Multiply or cancel	M1	Multiplying the numerators and the denominators, $\frac{12}{7} \times \frac{35}{16} = \frac{420}{112}$ or equivalent. Or cancelling the fractions fully. Or partial cancelling then multiplying, for example $\frac{12}{1} \times \frac{5}{16} = \frac{60}{16}$	✓
Completion	A1	Completion to the given result: $\frac{420}{112} = \frac{15}{4} = 3\frac{3}{4}$, or equivalent. Dependent on both method marks. Working is required. If the working clearly shows that $3\frac{3}{4} = \frac{15}{4}$, it is enough to show that the left-hand side comes to $\frac{15}{4}$	✓

Full marks: 3/3

Question 18 - Exam Solution

Understanding the Question

Given

a length measured as 1.4 metres, correct to one decimal place.

Find

the upper bound and the lower bound of the true length.

Plan the Solution

- Work out the size of the rounding unit, then halve it.
- Add that half to the measurement for the upper bound, and subtract it for the lower bound.

Worked Solution [2 marks]

Bounds of a rounded measurement: a value rounded to one decimal place could really be anything within HALF of that rounding unit either side. Halve the rounding unit,

then add and subtract.

Step 1 - Halve the rounding unit.

The measurement is given to one decimal place, so the rounding unit is 0.1.

Half of it is 0.05.

(Reason: any true length within half a rounding unit of 1.4 rounds to 1.4.)

Step 2 - Part (a), the upper bound.

$$1.4 + 0.05 = 1.45$$

Upper bound = 1.45 metres

Step 3 - Part (b), the lower bound.

$$1.4 - 0.05 = 1.35$$

Lower bound = 1.35 metres

(a) 1.45 metres

(b) 1.35 metres

Verification

- ✓ **Check 1 - test the lower end:** 1.35 rounds to 1.4, but anything just below it, such as 1.34999, rounds to 1.3. So 1.35 really is the smallest length that fits.
- ✓ **Check 2 - test the upper end:** 1.44999 rounds to 1.4, so the true length can get as close to 1.45 as you like.
- ✓ **Check 3 - the width of the interval:** the two bounds are $1.45 - 1.35 = 0.1$ apart, which is exactly one rounding unit, as it must be.
- ✓ **Note on why the bound is written 1.45:** 1.45 itself rounds up to 1.5, so it is never actually reached. The largest length that really does round to 1.4 is 1.4499..., and the convention is to write the upper bound as 1.45 anyway. That is why the mark scheme also allows the recurring form.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	B1	1.45. Also allow 1.4499... (1.4 followed by a recurring 9)	✓
(b)	B1	1.35 cao	✓

Step	Mark	Description	Got it?
Special case	SC	If the two answers are swapped, giving 1.35 for (a) and 1.45 for (b), score B0 then B1, so 1 mark of the 2. This row carries no mark of its own	✓

Full marks: 2/2

Question 19 - Exam Solution

Understanding the Question

Given

triangle PQR with the right angle at Q, hypotenuse PR = 8.6 cm, angle R = 43°, and QR = x cm.

Find

the value of x, correct to one decimal place.

Plan the Solution

- Label the three sides relative to the 43 degree angle.
- QR is next to that angle and PR is the hypotenuse, so cosine is the ratio to use.
- Rearrange, evaluate, and round only at the end.

Worked Solution [3 marks]

Right-angled trigonometry: label the sides relative to the angle you are using. The HYPOTENUSE is opposite the right angle, the ADJACENT is next to the angle, and the OPPOSITE faces it. With the adjacent and the hypotenuse, use cosine:

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}.$$

Step 1 - Label the sides relative to the 43° angle.

The right angle is at Q, so PR is the hypotenuse, 8.6 cm.

QR lies next to the 43° angle, so it is the adjacent side, x cm.

(Reason: the hypotenuse is always the side opposite the right angle, whichever angle you are working from.)

Step 2 - Choose the ratio.

Adjacent and hypotenuse together means cosine:

$$\cos 43^\circ = \frac{x}{8.6}$$

Step 3 - Rearrange and evaluate.

$$x = 8.6 \cos 43^\circ = 6.28964\dots$$

$x = 6.3$ to one decimal place

(Reason: keep the full display value until the final line, then round once.)

$$x = 6.3$$

Verification

- ✓ **Check 1 - Pythagoras:** the third side is $PQ = 8.6 \sin 43^\circ = 5.8652$ cm. Then $6.2896^2 + 5.8652^2 = 73.96$, and $8.6^2 = 73.96$, so the triangle closes exactly.
- ✓ **Check 2 - a different ratio:** the angle at P is $90 - 43 = 47$ degrees, and QR is opposite it, so $x = 8.6 \sin 47^\circ = 6.28964$, the same value by a different route.
- ✓ **Check 3 - sense check:** a leg must be shorter than the hypotenuse, and 6.29 is less than 8.6. Also 43 degrees is less than 45 degrees, so the side opposite it, $PQ = 5.87$, must be shorter than the adjacent side, $x = 6.29$, which it is.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Trig statement	M1	A correct trig statement for x or QR, or a correct Pythagoras statement for x squared. For example $\cos 43 = \frac{x}{8.6}$, or $\tan 43 = \frac{8.6 \sin 43}{x}$, or $\sin(90 - 43) = \frac{x}{8.6}$, or $\frac{x}{\sin(90 - 43)} = \frac{8.6}{\sin 90}$, or $x^2 = 8.6^2 - (8.6 \sin 43)^2$	✓
Full calculation	M1	A fully correct calculation for x: $8.6 \cos 43$, or $\frac{8.6 \sin 43}{\tan 43}$, or $8.6 \sin(90 - 43)$, or $\frac{8.6 \sin 47}{\sin 90}$, or $\sqrt{8.6^2 - 5.8652^2}$. Some students go straight to this and gain both method marks	✓
Answer	A1	6.3 - anything which rounds to 6.3 must be seen, even if it is then rounded incorrectly	✓

Full marks: 3/3

Question 20 - Exam Solution

Understanding the Question

Given

17 per cent of a number N is 357; and a club whose membership rises from 650 to 806.

Find

the value of N , and the percentage increase in membership.

Plan the Solution

- Part (a): write 17 per cent as a decimal, form an equation, and divide.
- Part (b): find the actual increase first, then write it as a fraction of the ORIGINAL amount and multiply by 100.

Worked Solution [5 marks]

Reverse percentages and percentage change: the sentence 17 per cent of N is 357 becomes $0.17 \times N = 357$, so $N = \frac{357}{0.17}$. For a percentage change,
$$\text{percentage change} = \frac{\text{change}}{\text{original}} \times 100$$
 - the ORIGINAL amount always goes on the bottom.

Step 1 - Part (a): form an equation.

17 per cent written as a decimal is 0.17, so

$$0.17 \times N = 357$$

(Reason: writing the percentage as a decimal turns the sentence into an equation that can be solved.)

Step 2 - Part (a): solve it.

$$N = \frac{357}{0.17} = 2100$$

(Reason: divide both sides by 0.17 to leave N on its own.)

Step 3 - Part (b): find the increase.

$$806 - 650 = 156$$

(Reason: the percentage change is built from the actual change, so find that first.)

Step 4 - Part (b): write it as a percentage of the original.

$$\frac{156}{650} = 0.24$$

$$0.24 \times 100 = 24$$

(Reason: 650 is the amount before the change, so it is the one that goes on the bottom.)

$$(a) N = 2100$$

$$(b) 24\%$$

Verification

- ✓ **Check 1, part (a) - substitute back:** $0.17 \times 2100 = 357$, the value given.
- ✓ **Check 2, part (a) - a different route:** 1 per cent of N is $\frac{357}{17} = 21$, so 100 per cent is $21 \times 100 = 2100$.
- ✓ **Check 3, part (b) - the multiplier route:** $\frac{806}{650} = 1.24$, and a multiplier of 1.24 is a 24 per cent increase.
- ✓ **Check 4, part (b) - reverse it:** increasing 650 by 24 per cent gives $650 \times 1.24 = 806$, the new membership.
- ✓ **Check 5, part (b) - test the classic error:** dividing by the NEW value instead gives $\frac{156}{806} \times 100 = 19.35$ per cent, which is wrong. This is exactly why the mark scheme carries a special case for answers between 19.3 and 19.4.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	M1	$\frac{357}{0.17}$ or equivalent, or a correct equation in N such as $0.17N = 357$ or $\frac{17}{100} \times N = 357$, or $\frac{357 \times 100}{17}$, for example $357 \times 5.8823...$ NOT $17\% \times N = 357$	✓
(a)	A1	2100 cao	✓
(b)	M1	$806 - 650 (= 156)$, or $\frac{806}{650} (= 1.24)$ or equivalent	✓

Step	Mark	Description	Got it?
(b)	M1	A correct calculation for the percentage increase: $\frac{806 - 650}{650} \times 100$, or $1.24 \times 100 (= 124)$, or $(1.24 - 1) \times 100$. Also awarded for seeing 124 or 0.24 as the answer or anywhere in the working	✓
(b)	A1	24 cao	✓
Special case	SC	B1 if no other marks are scored, for an answer between 19.3 and 19.4. This row carries no mark of its own	✓

Full marks: 5/5

Question 21 - Exam Solution

Understanding the Question

Given

a biased 5-sided spinner; the probability of landing on 2 is 0.14, on 3 is 0.17 and on 5 is 0.21; the probability of landing on 1 equals the probability of landing on 4; and 400 spins.

Find

an estimate for the number of times the spinner lands on 4.

Plan the Solution

- The five probabilities must add to 1, so subtract the three known ones to find what is left for 1 and 4 together.
- Since 1 and 4 are equally likely, halve what is left.
- Multiply by the number of spins.

Worked Solution [4 marks]

Two facts are needed: the probabilities of all possible outcomes add to 1. And an estimate for how often an outcome happens is the probability multiplied by the number of trials.

Step 1 - Add the three known probabilities

$$0.14 + 0.17 + 0.21 = 0.52$$

(Reason: these three account for landing on 2, 3 or 5.)

Step 2 - Find what is left for 1 and 4 together

$$1 - 0.52 = 0.48$$

(Reason: all five probabilities total 1, so whatever is not used by 2, 3 and 5 belongs to 1 and 4.)

Step 3 - Split it equally

Landing on 1 and landing on 4 are equally likely, so

$$P(4) = \frac{0.48}{2} = 0.24$$

(Reason: the question states the two probabilities are the same, so the 0.48 divides evenly between them.)

Step 4 - Estimate the number of spins landing on 4

$$0.24 \times 400 = 96$$

(Reason: expected frequency is the probability multiplied by the number of trials.)

96

Verification

✓ Check 1 - do all five probabilities total 1?

$$0.24 + 0.14 + 0.17 + 0.24 + 0.21 = 1.00$$

✓ Check 2 - work in frequencies instead of probabilities: $0.14 \times 400 = 56$,

$0.17 \times 400 = 68$ and $0.21 \times 400 = 84$, which total 208. That leaves

$$400 - 208 = 192 \text{ spins for 1 and 4 together, and } \frac{192}{2} = 96.$$

✓ Check 3 - test the classic error: halving 0.52 instead of 0.48 gives 0.26, and $0.26 \times 400 = 104$. This is exactly why the mark scheme carries a special case for 104. The half must be taken from what is LEFT, not from what is already used.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Use the total of 1, or find a frequency	M1	$1 - (0.14 + 0.17 + 0.21) (= 0.48)$, or $0.14 + 0.17 + 0.21 + 2x = 1$ or equivalent. Or a correct estimate for the number of times it lands on 2, 3 or 5: $0.14 \times 400 (= 56)$, or $0.17 \times 400 (= 68)$, or $0.21 \times 400 (= 84)$, or $(0.14 + 0.17 + 0.21) \times 400 (= 208)$	✓

Step	Mark	Description	Got it?
Reach P(4) or the pair	M1	A completely correct method for the probability of landing on 4: $\frac{0.48}{2}$ ($= 0.24$), which may be written in the table. Or a completely correct method for the number of times it lands on 1 or on 4: $400 - 56 - 68 - 84 (= 192)$, or $400 - 208 (= 192)$, or $0.48 \times 400 (= 192)$	✓
The estimate	M1	0.24×400 or equivalent, or $\frac{192}{2}$. Or an answer leading from 96 seen, for example $\frac{96}{400}$	✓
Answer	A1	96 cao	✓
Special case	SC	B1 for 104 if no other marks have been awarded. This row carries no mark of its own	✓

Full marks: 4/4

Question 22 - Exam Solution

Understanding the Question

Given

a solid triangular prism whose cross-section is a right-angled triangle with legs 6 cm and 8 cm and hypotenuse 10 cm, and whose length is 15 cm.

Find

the total surface area.

Plan the Solution

- The surface of a prism is the two identical ends plus one rectangle for each edge of the cross-section.
- Find the area of one triangular end and double it.
- Find each rectangle: its edge multiplied by the length 15.
- Add all five faces.

Worked Solution [3 marks]

Surface area of a prism: the surface is made of the two identical ends plus one rectangle for every edge of the cross-section, each rectangle being that edge times the length of the prism. Surface area is measured in SQUARE units, so every face is an area and none is a volume.

Step 1 - Area of the two triangular ends

$$\frac{1}{2} \times 8 \times 6 = 24 \text{ cm}^2$$

$$2 \times 24 = 48 \text{ cm}^2$$

(Reason: the triangle is right-angled, so the two shorter sides are the base and the height.)

Step 2 - Area of the three rectangles

$$15 \times 8 = 120$$

$$15 \times 6 = 90$$

$$15 \times 10 = 150$$

$$120 + 90 + 150 = 360 \text{ cm}^2$$

(Reason: each edge of the triangle sweeps out a rectangle 15 cm long.)

Step 3 - Add the five faces

$$48 + 360 = 408 \text{ cm}^2$$

(Reason: a triangular prism has exactly five faces, two triangles and three rectangles.)

408 cm²

Verification

- ✓ **Check 1 - confirm the triangle is right-angled:** Pythagoras gives $6^2 + 8^2 = 36 + 64 = 100 = 10^2$, so the right angle holds and half of 8 times 6 is the correct area.
- ✓ **Check 2 - count the faces:** five areas were used, 24, 24, 120, 90 and 150, which is exactly the five faces of a triangular prism, and they total 408.
- ✓ **Check 3 - the rectangles share their length:** their total is $(6 + 8 + 10) \times 15 = 24 \times 15 = 360$, agreeing with adding them one at a time.
- ✓ **Check 4 - test the classic error:** using $8 \times 6 = 48$ for each end instead of $\frac{1}{2} \times 8 \times 6 = 24$ gives $360 + 48 + 48 = 456$. That is exactly why the mark scheme carries a special case for 456: forgetting the half.

- ✓ **Check 5 - why the mark scheme is cautious about 360:** the volume of this prism is also $24 \times 15 = 360$, in cubic centimetres. Because the three rectangles happen to total the same number, an examiner seeing 360 alone cannot tell whether the student added three faces or worked out the volume, which is why that mark is only given when a triangular end has clearly been added as well.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Two different faces	M1	a correct method for the areas of two DIFFERENT faces, that is, not two triangles. Allow 8×6 as one area. For example $8 \times 6 (= 48)$, $\frac{1}{2} \times 8 \times 6 (= 24)$, $15 \times 8 (= 120)$, $15 \times 6 (= 90)$, $15 \times 10 (= 150)$. Allowed even if it appears alongside incorrect areas	✓
Add the faces	M1	adding together 4 or 5 area values, at least 3 of which come from a correct method, for example $120 + 90 + 150 + 24 + 24$. Also allow $120 + 90 + 150 + 48 + 48 (= 456)$. Note that $(6 + 8 + 10) \times 15 (= 360)$ is three faces, but award it only if it is clearly not intended as the volume, for example because the area of a triangular end has been added to it	✓
Answer	A1	408 cao	✓
Special case	SC	B2 for an answer of 456 if no other marks are awarded. This row carries no mark of its own	✓

Full marks: 3/3

Question 23 - Exam Solution

Understanding the Question

Given

a grid from 0 to 8 on both axes; three equations to draw; and three inequalities.

Find

the three lines drawn and labelled, and the region satisfying all three inequalities shaded and labelled R.

Plan the Solution

- $x = 3$ and $y = 1$ run parallel to the axes, so they can be drawn straight away.
- For $x + y = 7$, find where it crosses each axis and join those two points.
- For the region, work out which side of each line satisfies its inequality, then shade where all three overlap.

Worked Solution [4 marks]

Lines and regions: $x = a$ is a VERTICAL line through a on the x axis, and $y = b$ is a HORIZONTAL line through b on the y axis. For a line such as $x + y = c$, the quickest route is the two axis intercepts: set $x = 0$ for the y axis crossing and $y = 0$ for the x axis crossing. For an inequality using the greater-than-or-equal or less-than-or-equal signs, the line itself is part of the region, and a test point decides which side.

Step 1 - Draw $x = 3$

A vertical line passing through 3 on the x axis, running the full height of the grid.

(Reason: every point on it has $x = 3$, whatever y is.)

Step 2 - Draw $y = 1$

A horizontal line passing through 1 on the y axis, running the full width of the grid.

Step 3 - Draw $x + y = 7$

When $x = 0$: $y = 7$, giving $(0, 7)$.

When $y = 0$: $x = 7$, giving $(7, 0)$.

Join those two points with a straight line.

(Reason: two points fix a straight line, and the axis crossings are the easiest two to find.)

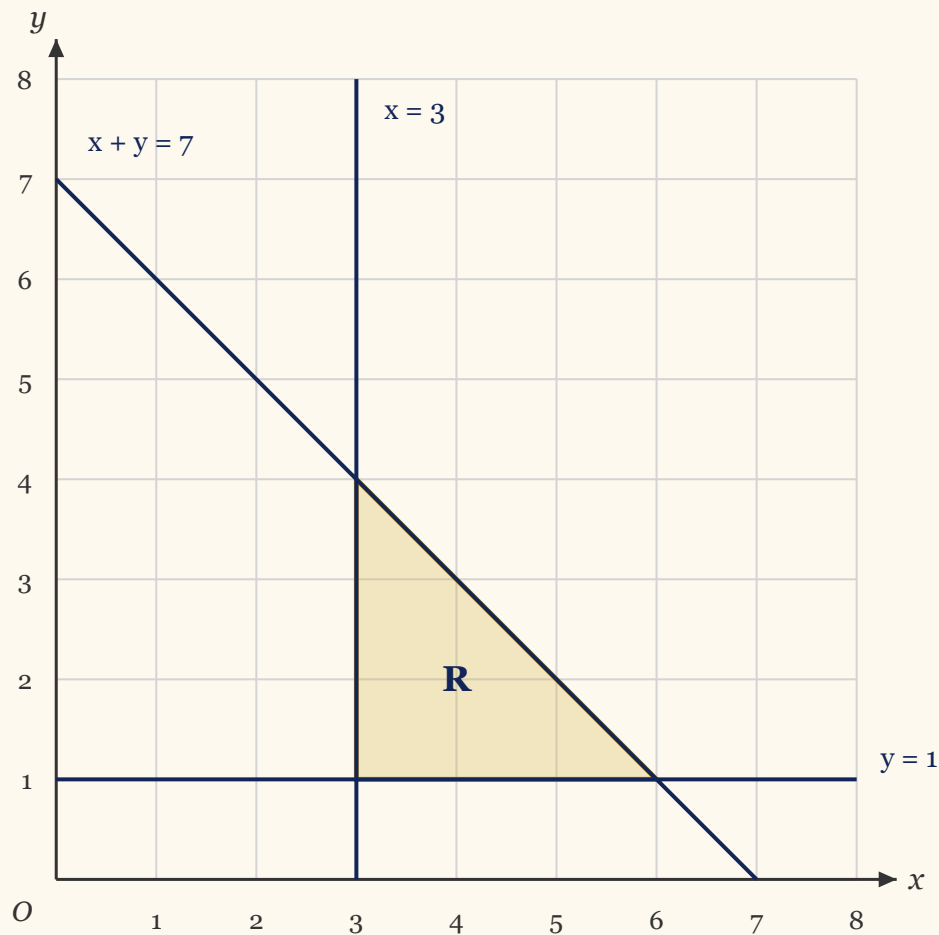
Step 4 - Find and shade the region

$x \geq 3$ is the side to the RIGHT of $x = 3$.

$y \geq 1$ is the side ABOVE $y = 1$.

$x + y \leq 7$ is the side BELOW $x + y = 7$; testing the origin gives $0 + 0 = 0$, which is at most 7, so it is the side containing the origin.

Where all three overlap is a triangle with corners $(3, 1)$, $(3, 4)$ and $(6, 1)$. Shade it and label it R.



The three lines drawn and labelled, and the triangle with corners $(3, 1)$, $(3, 4)$ and $(6, 1)$ shaded and labelled R.

Verification

- ✓ **Check 1 - the corners are the pairwise intersections:** $x = 3$ meets $y = 1$ at $(3, 1)$; $x = 3$ meets $x + y = 7$ at $(3, 4)$, since $3 + 4 = 7$; and $y = 1$ meets $x + y = 7$ at $(6, 1)$, since $6 + 1 = 7$. Three lines give three intersections, so the region is a triangle.
- ✓ **Check 2 - every corner satisfies all three inequalities:** $(3, 1)$ gives $3 + 1 = 4$, which is at most 7; $(3, 4)$ and $(6, 1)$ both sit exactly on $x + y = 7$, which the less-than-or-equal sign allows.
- ✓ **Check 3 - test a point inside:** $(4, 2)$ gives $x = 4$ at least 3, $y = 2$ at least 1, and $x + y = 6$ at most 7. All three hold.
- ✓ **Check 4 - test one point outside each edge:** $(2, 2)$ fails x at least 3; $(4, 0)$ fails y at least 1; and $(5, 4)$ gives $x + y = 9$, failing $x + y$ at most 7. Each edge is genuinely a

boundary.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)(i)	B1	$x = 3$ drawn	✓
(a) (ii)	B1	$y = 1$ drawn	✓
(a) (iii)	B1	$x + y = 7$ drawn. Allow dashed or solid lines of minimum length 2 squares. Missing labels are condoned if the lines are unambiguous	✓
(b)	B1	the correct region shaded, either shaded in or shaded out, labelled R or with a clear intention that it is the required region. Follow through only for one vertical line other than $x = 0$, one horizontal line other than $y = 0$, and one line with a negative gradient	✓
Note	--	if the lines are unlabelled and two of the same orientation appear, the examiner cannot tell which was intended and that mark is lost. For example $x = 3$ with $y = 3$ scores B1 then B0; $x = 3$ together with $x = 1$ and $y = 1$ scores B0 then B1; and $x = 3$ with $x = 1$, plus $y = 1$ with $y = 3$, scores B0 B0. This row carries no mark of its own	✓

Full marks: 4/4

Question 24 - Exam Solution

Understanding the Question

Given

4 oranges with a mean weight of 145 grams; then a fifth orange is added and the mean of all 5 becomes 142 grams.

Find

the weight of the orange that was added.

Plan the Solution

- The mean is the total divided by how many, so rearranging gives total = mean times number.
- Work out the total weight before, and the total weight after.

- The difference between the two totals is the weight of the added orange.

Worked Solution [3 marks]

Working backwards from a mean: since the mean is the total divided by the number, it follows that the total is the mean multiplied by the number. When one more item is added, the new total minus the old total is the weight of that item.

Step 1 - Total weight of the first 4 oranges

$$4 \times 145 = 580 \text{ g}$$

(Reason: the mean of 145 across 4 oranges means the four together weigh 4 times 145.)

Step 2 - Total weight of all 5 oranges

$$5 \times 142 = 710 \text{ g}$$

(Reason: the same rule applied to the new mean and the new number of oranges.)

Step 3 - The weight of the added orange

$$710 - 580 = 130 \text{ g}$$

(Reason: the only difference between the two bags is the one orange Neil added, so the difference in the totals is its weight.)

130 grams

Verification

- ✓ **Check 1 - put it back:** the five oranges now total $580 + 130 = 710 \text{ g}$, and $\frac{710}{5} = 142$ g, the new mean given.
- ✓ **Check 2 - as an equation:** writing the added weight as x gives $145 + 145 + 145 + 145 + x = 5 \times 142$, so $580 + x = 710$ and $x = 130$.
- ✓ **Check 3 - reason from the drop in the mean:** the mean fell by $145 - 142 = 3 \text{ g}$, and that drop applies across all 5 oranges, so the total is $5 \times 3 = 15 \text{ g}$ lighter than five oranges of 145 g would be. The added orange must therefore be $145 - 15 = 130 \text{ g}$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
One correct total	M1	one correct product: $4 \times 145 (= 580)$ or $5 \times 142 (= 710)$. Or a correct equation for the weight of the last orange, such as $\frac{145 + 145 + 145 + 145 + x}{5} = 142$ or equivalent	✓
A fully correct method	M1	$5 \times 142 - 4 \times 145$, or $710 - 580$. Or a fully correct equation with NO denominator, such as $145 + 145 + 145 + 145 + x = 5 \times 142$	✓
Answer	A1	130	✓

Full marks: 3/3

Question 25 - Exam Solution

Understanding the Question

Given

20 000 euros invested for 3 years, earning 3.5 per cent compound interest each year.

Find

the amount in the bond after 3 years, to the nearest euro.

Plan the Solution

- Turn the 3.5 per cent increase into a single multiplier.
- Apply that multiplier once for each year, so three times in all.
- Round only at the very end.

Worked Solution [3 marks]

Compound interest: an increase of r per cent gives a multiplier of $1 + \frac{r}{100}$.

Compound interest applies that multiplier to the NEW amount each year, so after n years the total is the starting amount multiplied by the multiplier raised to the power n . Round only at the final step.

Step 1 - Find the multiplier

An increase of 3.5 per cent means multiplying by $1 + \frac{3.5}{100} = 1.035$.

(Reason: the 1 keeps the original amount and the 0.035 adds the interest, so one multiplication does both.)

Step 2 - Apply it once for each of the 3 years

$$20\,000 \times 1.035^3 = 20\,000 \times 1.108717875 = 22\,174.3575$$

(Reason: compound interest is charged on the new balance each year, which is exactly what raising the multiplier to a power does.)

Step 3 - Round to the nearest euro

22 174.3575 rounds to 22 174 euros.

(Reason: the digit after the decimal point is 3, which is less than 5, so the whole-euro figure stays.)

22 174 euros

Verification

- ✓ **Check 1 - work through year by year:** end of year 1, $20\,000 \times 1.035 = 20\,700$; end of year 2, $20\,700 \times 1.035 = 21\,424.5$; end of year 3, $21\,424.5 \times 1.035 = 22\,174.3575$. Identical to the power method.
- ✓ **Check 2 - the interest earned:** $22\,174.36 - 20\,000 = 2\,174.36$, which is 10.87 per cent of the original. That is more than $3 \times 3.5\% = 10.5\%$, exactly as it should be, because the interest itself earns interest.
- ✓ **Check 3 - test the classic error:** simple interest would give $20\,000 \times 0.035 \times 3 = 2\,100$, a total of 22 100. That is 74 euros short of the compound answer, and 22 100 appears in the special-case list of the mark scheme for precisely that reason.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Find 103.5% or 3.5%	M1	$20\,000 \times 1.035 (= 20\,700)$, or $20\,000 \times 0.035 (= 700)$. Accept $\left(1 + \frac{3.5}{100}\right)$ for 1.035, but NOT $(1 + 3.5\%)$. M2 is given straight away for $20\,000 \times 1.035^3$, where $1.035^3 = 1.108717\dots$, or for $20\,000 \times 1.035^4 (= 22\,950\dots)$	✓

Step	Mark	Description	Got it?
A complete method	M1	Dependent on the first. $20\,700 \times 1.035 (= 21\,424.5)$ then $21\,424.5 \times 1.035$, or the same in two stages, such as $20\,700 \times 0.035 = 724.5$ with $20\,700 + 724.5 = 21\,424.5$. Some rounding may have occurred, but award it if the intention is clear	✓
Answer	A1	22 174. Allow 22 174 to 22 175. If the correct answer is seen and then 20 000 subtracted to give 2 174, award full marks; 2 174 with no working gains 2 marks	✓
Special cases	SC	B2 for $2\,000 \times 1.035^3 (= 2\,217 \dots)$ as a misread; B2 for 22 160 ($20\,000 \times 1.108$); B2 for 22 180 ($20\,000 \times 1.109$). B1 if no marks are otherwise awarded and any of these is seen, not necessarily as the answer: $20\,000 \times 0.035^n$, $20\,000 \times 0.965^3 (= 17\,972 \dots)$, $20\,000 \times 0.105 (= 2\,100)$, $20\,000 \times 1.105 (= 22\,100)$, or $20\,000 \times 1.035^2 (= 21\,424.5)$. This row carries no mark of its own	✓

Full marks: 3/3

Question 26 - Exam Solution

Understanding the Question

Given

a pie chart of the year 10 results with angles 126° , 102° and 132° ; a table of the year 11 results with the expressions $3x + 6$, $5x + 8$ and $7x - 9$; and totals of 300 year 10 students and 320 year 11 students.

Find

how many more year 10 students than year 11 students chose French.

Plan the Solution

- The three year 11 expressions must add to 320, which gives an equation in x . Solve it.
- Substitute back to find the year 11 French figure.
- For year 10, the French sector is 126° out of 360° , so take that fraction of 300.

- Subtract the smaller from the larger.

Worked Solution [5 marks]

Pie charts and forming equations: the angles of a pie chart total 360° , so a sector of θ degrees represents $\frac{\theta}{360}$ of the whole. When quantities are given as expressions, their sum equals the stated total, and that gives an equation to solve.

Step 1 - Form an equation for year 11

$$(3x + 6) + (5x + 8) + (7x - 9) = 320$$

$$15x + 5 = 320$$

(Reason: every year 11 student picked exactly one language, so the three expressions account for all 320 of them.)

Step 2 - Solve it

$$15x = 315$$

$$x = 21$$

Step 3 - Year 11 students who chose French

$$3x + 6 = 3(21) + 6 = 63 + 6 = 69$$

Step 4 - Year 10 students who chose French

The French sector is 126° out of 360° .

$$\frac{126}{360} \times 300 = 105$$

(Reason: the fraction of the circle a sector takes is the fraction of the students it represents.)

Step 5 - The difference

$$105 - 69 = 36$$

36

Verification

- ✓ **Check 1 - the pie chart is complete:** $126 + 102 + 132 = 360$, a full circle.
- ✓ **Check 2 - the table really totals 320:** French = 69, German = $5(21) + 8 = 113$, Spanish = $7(21) - 9 = 138$, and $69 + 113 + 138 = 320$, the figure given.

✓ **Check 3 - year 10 really totals 300:** French = 105, German = $\frac{102}{360} \times 300 = 85$,

Spanish = $\frac{132}{360} \times 300 = 110$, and $105 + 85 + 110 = 300$.

✓ **Check 4 - a different route for year 10:** $\frac{300}{360} = \frac{5}{6}$, so each degree stands for $\frac{5}{6}$ of a student, and $126 \times \frac{5}{6} = 105$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Equation for x	M1	A correct method to find x for the year 11 students, for example the equation $3x + 6 + 5x + 8 + 7x - 9 = 320$ or equivalent, such as $15x + 5 = 320$. May be implied by $\frac{320 - 5}{15}$	✓
Value of x	A1	$x = 21$, or $3x = 63$. A correct answer of 21 or 63 scores both of these marks unless it clearly follows incorrect working	✓
Year 11 French	M1ft	Dependent on the first M1. A correct method for the year 11 French figure: 3 times their 21 plus 6 (= 69), or their 63 plus 6 (= 69). Follow through their value of x , provided only one value is offered and it is clearly intended as x . Look for 69 written beside the table	✓
Year 10 French	M1	Independent of the above. A correct method for the year 10 French figure: $\frac{126}{360} \times 300 (= 105)$, or $\frac{300}{360} = \frac{5}{6}$ with $\frac{5}{6} \times 126 (= 105)$, or $\frac{360}{300} = 1.2$ with $\frac{126}{1.2} (= 105)$. Note $\frac{300}{360} = 0.83$ recurring, so 0.83 is allowed	✓
Answer	A1	36 cao, dependent on the earlier A1 having been scored, that is on 21 or 63 having been seen	✓

Full marks: 5/5

Question 27 - Exam Solution

Understanding the Question

Given

a regular pentagon $ABCDE$ and a regular hexagon $DEFGHI$ which share the side DE , with AF drawn as a straight line.

Find

the size of angle EAF .

Plan the Solution

- Find the interior angle of a regular pentagon, then of a regular hexagon.
- Angles round the point E total 360° , which gives angle AEF .
- Note that EA and EF are the same length, so triangle AEF is isosceles, and split what is left of 180° equally.

Worked Solution [5 marks]

Interior angles and angles at a point: the interior angle of a regular polygon with n sides is $\frac{(n-2) \times 180}{n}$. Angles round a point total 360° . In an isosceles triangle the two base angles are equal, and all three angles total 180° .

Step 1 - Interior angle of the pentagon

$$\frac{(5-2) \times 180}{5} = \frac{540}{5} = 108^\circ$$

So angle $AED = 108^\circ$

(Reason: this is the angle inside the pentagon at E , between the sides EA and ED .)

Step 2 - Interior angle of the hexagon

$$\frac{(6-2) \times 180}{6} = \frac{720}{6} = 120^\circ$$

So angle $DEF = 120^\circ$

Step 3 - Angle AEF , using angles at a point

The three angles at E fill the whole turn:

$$\text{angle } AEF = 360 - 108 - 120 = 132^\circ$$

(Reason: angles round a point add to 360 degrees, and the pentagon's angle, the hexagon's angle and angle AEF are the three of them.)

Step 4 - Use the isosceles triangle

DE is a side of BOTH polygons, so every side of both is the same length. In particular $EA = EF$, which makes triangle AEF isosceles.

The two base angles are therefore equal:

$$\text{angle } EAF = \frac{180 - 132}{2} = \frac{48}{2} = 24^\circ$$

(Reason: this is the step most often missed. The two polygons must share a side length, otherwise they could not share the edge DE .)

24°

Verification

- ✓ **Check 1 - the exterior-angle route:** the exterior angle of the pentagon is $\frac{360}{5} = 72^\circ$ and of the hexagon is $\frac{360}{6} = 60^\circ$. Their sum is $72 + 60 = 132^\circ$, which is angle AEF by a completely different route.
- ✓ **Check 2 - the triangle closes:** $24 + 24 + 132 = 180^\circ$.
- ✓ **Check 3 - the interior and exterior angles pair up:** $108 + 72 = 180$ and $120 + 60 = 180$, as an interior and exterior angle at the same vertex must.
- ✓ **Check 4 - sense check on the figure:** angle AEF at 132° is obtuse, so the two base angles must be small and equal, and 24° each fits what the diagram shows.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Pentagon angle	M1	Interior angle of the pentagon = $\frac{3 \times 180}{5}$ (= 108) or equivalent, or exterior angle = $\frac{360}{5}$ (= 72). Allowed in the working, but not if labelled in the wrong place on the diagram, unless the candidate has clearly started again	✓
Hexagon angle	M1	Interior angle of the hexagon = $\frac{4 \times 180}{6}$ (= 120), or exterior angle = $\frac{360}{6}$ (= 60). Same condition about labelling	✓
Angle AEF	M1	A fully correct method for angle AEF : $360 - (108 + 120)$ (= 132), or $60 + 72$ (= 132), or $(180 - 108) + (180 - 120)$ (=	✓

Step	Mark	Description	Got it?
		132). Not if labelled in the wrong place. Figures carried forward must come from correct working	
Angle EAF	M1	A fully correct method for angle EAF : $\frac{180 - (60 + 72)}{2}$, or $\frac{180 - 132}{2}$, or $\frac{180 - (180 - 108) - (180 - 120)}{2}$. Figures carried forward must come from correct working	✓
Answer	A1	24 cao	✓

Full marks: 5/5

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