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Edexcel IGCSE 4MA1

4MA1/1F (Foundation Tier) – Thursday 15 May 2025

100 marks · 2 hours · Calculator allowed

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

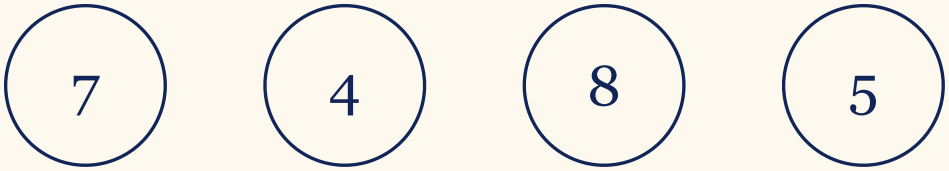
Original worked solutions for Edexcel International GCSE Mathematics A, Paper 4MA1/1F (Foundation Tier), June 2025 series, sat Thursday 15 May 2025 –100 marks, 2 hours, calculator allowed. The questions have been reworded; all numerical values match the original paper. The official question paper and 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. Write a number in each box to make each calculation correct.



(a) $475 + \square = 1200$ *[1 mark]*

(b) $180 \times \square = 5760$ *[1 mark]*

Here are four counters.
Each counter has a number on it.

Using each counter once,

(c)(i) write down the smallest number that can be made, *[1 mark]*

(ii) write down the largest even number that can be made. *[1 mark]*

(c)(i) .....

(c)(ii) .....

[Total 4 marks]

2. The pictogram shows some information about the number of tins of paint sold by a hardware shop each month from January to April.

January	
February	
March	
April	
May	

Key:  represents 8 tins

(a) How many tins of paint were sold in January? *[1 mark]*

(b) Work out the total number of tins of paint sold in the four months from January to April. *[2 marks]*

In May, 22 tins of paint were sold.

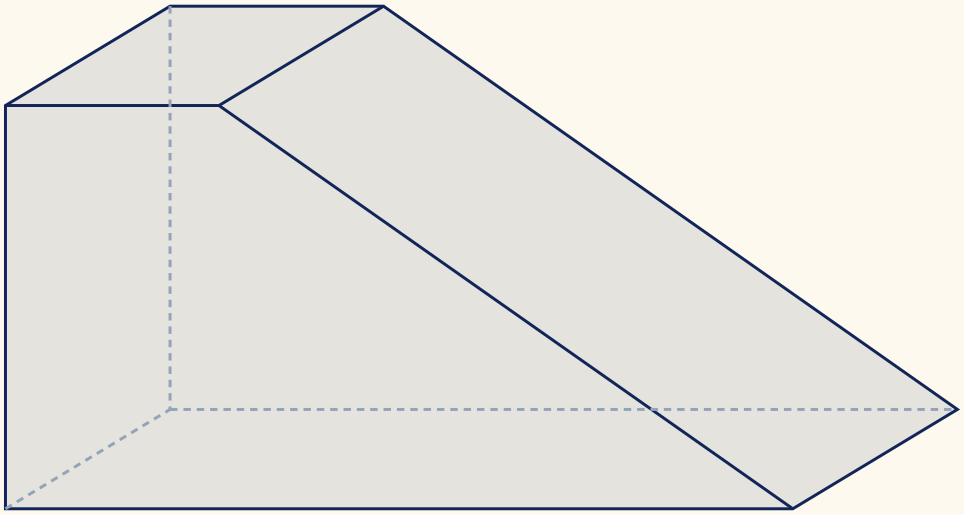
(c) Show this information on the pictogram. *[1 mark]*

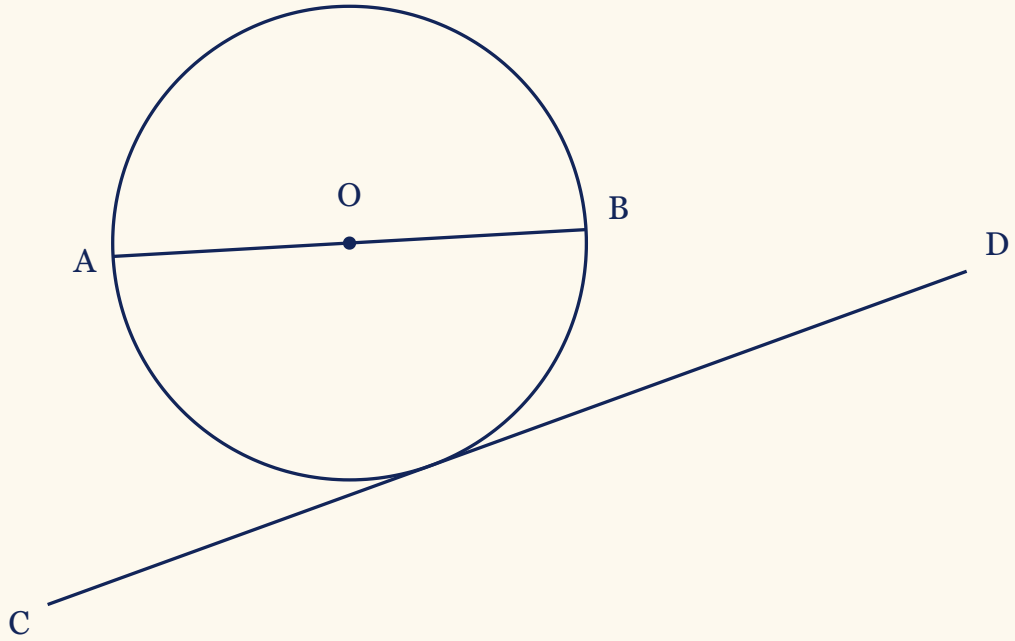
(a) .....

(b) .....

[Total 4 marks]

3. The solid drawn below is a prism.





(a) Write down the number of faces the prism has. *[1 mark]*

(b) Write down the number of vertices the prism has. *[1 mark]*

The points A and B both lie on a circle with centre O

(c) Write down the mathematical name of the straight line AB *[1 mark]*

(d) Write down the mathematical name of the straight line CD *[1 mark]*

(a) .....

(b) .....

(c) .....

(d) .....

[Total 4 marks]

4. (a) Write $4 \times 5e$ in its simplest form. *[1 mark]*

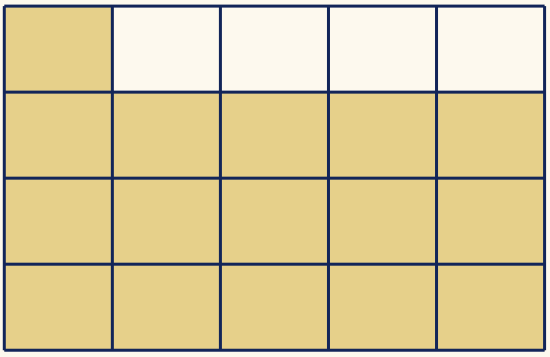
(b) Find the value of f in the equation $f + 14 = 29$ *[1 mark]*

(a) .....

(b) f = ...

[Total 2 marks]

5. (a) Change 0.6 into a percentage. *[1 mark]*



(b) Change $\frac{19}{100}$ into a decimal. *[1 mark]*

Here is a rectangle divided into equal parts.
Some of the parts are shaded.

(c) What fraction of the rectangle is shaded?
Give your fraction in its simplest form. *[2 marks]*

(a) % .....

(b) .....

(c) .....

[Total 4 marks]

6. The first four terms of a number sequence are shown below.

7 11 15 19

(a) Write down the next term of this sequence.
[1 mark]
(b) Explain how you worked out your answer to part (a).
[1 mark]
(c) Work out the 12th term of this sequence. *[1 mark]*

(a) .....
(b) .....
(c) .....

[Total 3 marks]

7. The normal price of a desk lamp is £26.80

Claire has a student discount card that takes $\frac{1}{4}$ off the normal price.

Claire buys 2 of these desk lamps.
She pays with a £50 note.

Work out how much change Claire should receive. *[4 marks]*

£ .....

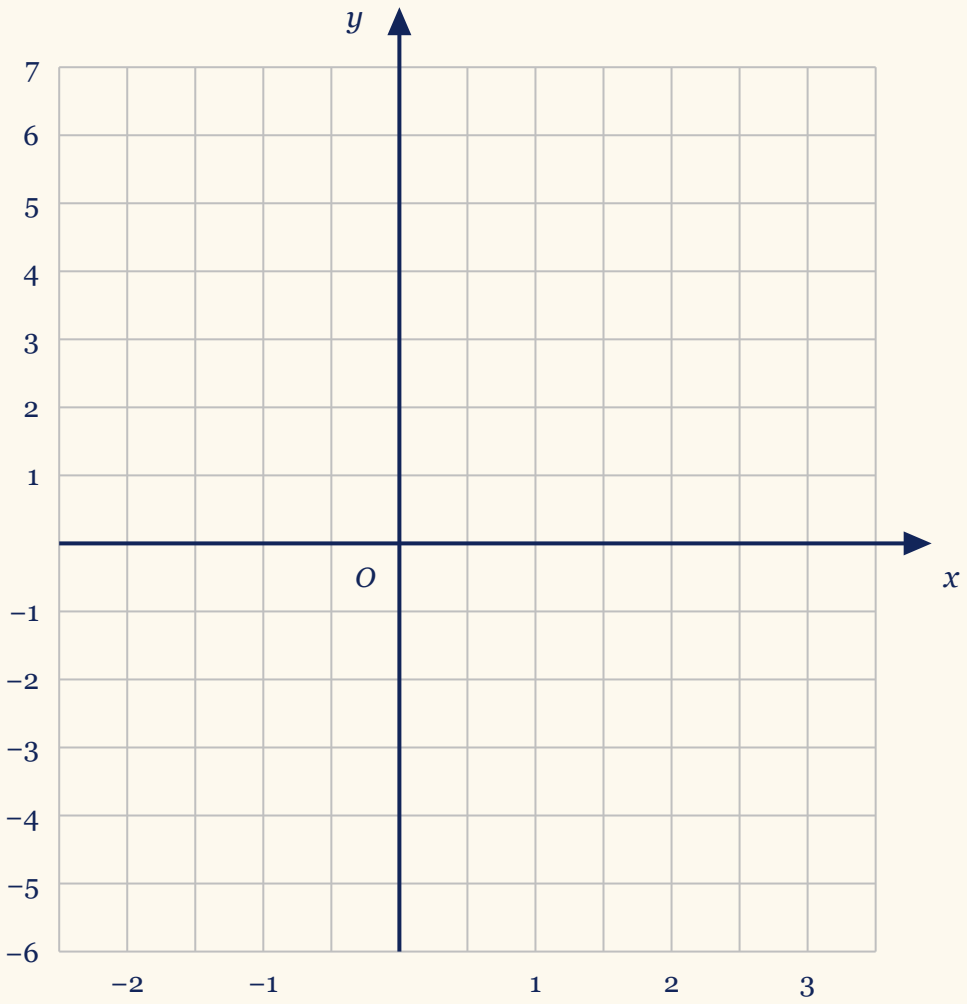
[Total 4 marks]

8. (a) Fill in the missing values in the table below for $y = 2x - 1$

x	-2	-1	0	1	2	3
y			-1			5

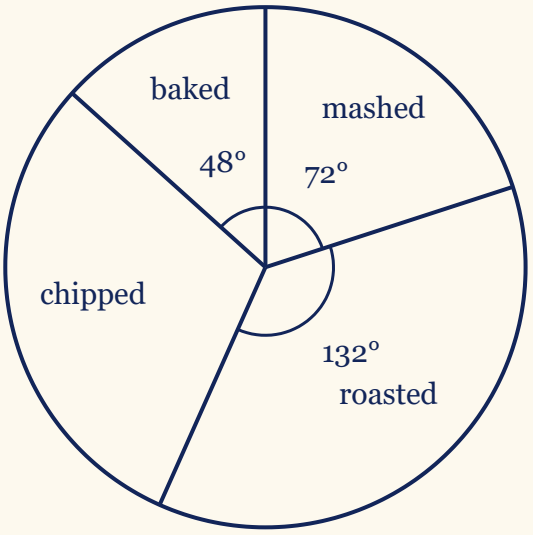
[2 marks]

(b) Draw the graph of $y = 2x - 1$ on the grid below, for values of x from -2 to 3 *[2 marks]*



[Total 4 marks]

9. Rosalind asked some people how they prefer their potatoes cooked.
They could choose mashed or roasted or chipped or baked.



The pie chart shows some information about their answers.

(a) Use the pie chart to complete the table.

Potato	Frequency	Angle of sector
mashed	6	72°
roasted	.....	132°
chipped	.....	.....
baked	.....	48°

[3 marks]

One of these people is selected at random.

(b) Write down the probability that this person chose mashed. *[1 mark]*

(b) .....

[Total 4 marks]

10. Packets of tea are loaded into a shipping carton.

Diagram NOT accurately drawn

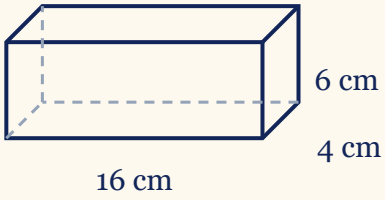
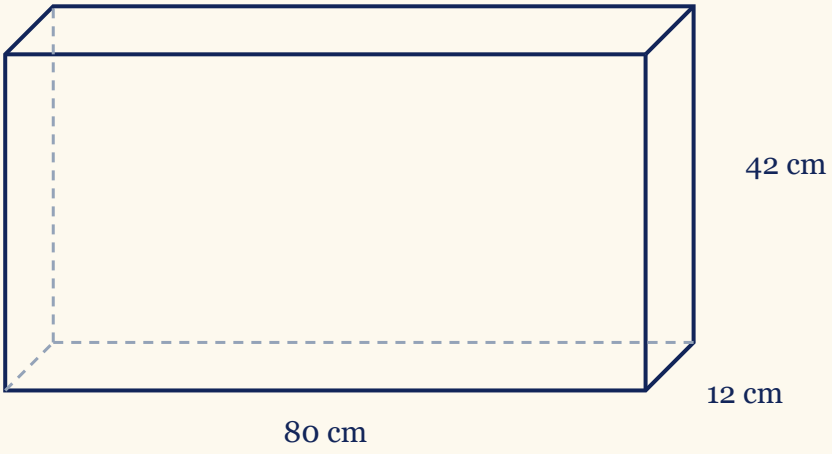


Diagram NOT accurately drawn



Each packet is a cuboid, 16 cm by 4 cm by 6 cm
The carton is a cuboid, 80 cm by 12 cm by 42 cm

Work out the greatest number of packets that can be put into the carton. *[3 marks]*

.....

[Total 3 marks]

11. A market stall sells trays of dates.
The total cost of 12 of these trays is 708 dirhams.
Work out the cost of 5 of these trays. *[2 marks]*

..... dirhams

[Total 2 marks]

12. Callum went into a bistro at 18 15
He left the bistro at 21 40

(a) Work out the length of time that Callum spent in the bistro.
Give your answer in hours and minutes. *[2 marks]*

On Saturday, the bistro sold 120 meals.
48 of these meals were vegetarian meals.

(b) What percentage of the meals sold on Saturday were vegetarian? *[2 marks]*

(a) hours and minutes .....

(b) % .....

[Total 4 marks]

13. Show that $\frac{3}{7} + \frac{1}{4} = \frac{19}{28}$
You must show all your working. *[2 marks]*

[Total 2 marks]

14. (a) Multiply out $x(x - 7)$ *[1 mark]*

(b) Factorise $8y - 10$ *[1 mark]*

Here is a formula.
$m = 5a + 7b$

(c) Find the value of a when $m = 48$ and $b = 3$ *[3 marks]*

(a) .....

(b) .....

(c) a = ...

[Total 5 marks]

15. Marcus sells lavender candles and vanilla candles on a market stall.

The ratio
number of lavender candles he sells : number of vanilla candles he sells
$= 5 : 7$

He sells 40 lavender candles.

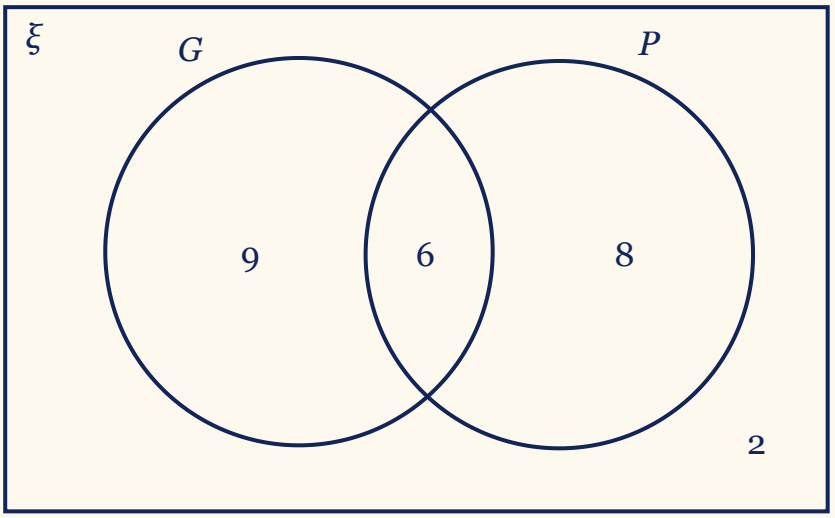
Marcus sells each lavender candle for $\$8.50$
He sells each vanilla candle for $\$12.75$

Work out the total amount of money Marcus gets for selling the candles. *[4 marks]*

$ .....

[Total 4 marks]

16. Some members of a music club were asked whether they play the guitar (G) or the piano (P)
The Venn diagram gives information about the results.
The values shown represent numbers of members.



(a) How many of these members play only the guitar or only the piano? *[1 mark]*

One of these members is chosen at random.

(b) Find the probability that this member plays both the guitar and the piano. *[2 marks]*

(a) .....

(b) .....

[Total 3 marks]

17. The diagram shows the plan of a wooden deck.
The deck is made up of a rectangle and an isosceles triangle.

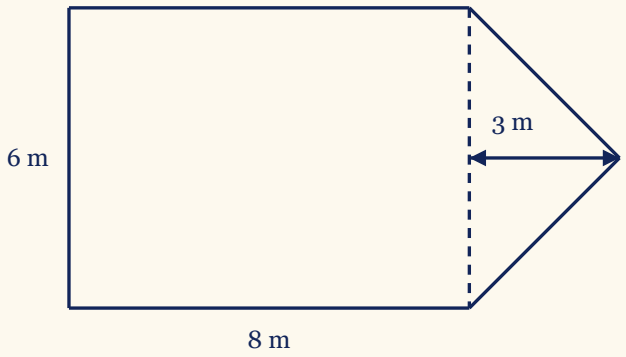


Diagram NOT accurately drawn

Haruka is going to cover the deck with wood sealer.
Enough tins of sealer must be bought to give the whole deck one coat.

Each tin of sealer covers an area of $4\ \text{m}^2$

Work out the smallest number of tins of sealer that Haruka needs to buy.
Show your working clearly. *[4 marks]*

.....

[Total 4 marks]

18. A large supermarket asked each of its 100 members of staff how far they travel to work.
The distance, d km, was recorded for every member of staff.
The table gives information about these distances.

Distance (d km)	Frequency
$0 < d \leq 5$	26
$5 < d \leq 10$	40
$10 < d \leq 15$	16
$15 < d \leq 20$	10
$20 < d \leq 25$	8

(a) Write down the modal class. *[1 mark]*

(b) Work out an estimate for the mean distance. *[4 marks]*

(a) .....

(b) km .....

[Total 5 marks]

19. Lena makes candles.
Each candle costs 6 Swiss francs to make.

Lena packs the candles into boxes to sell.
Each box contains 4 candles.

Lena sells 80 boxes of candles for a total of 2160 Swiss francs.

(a) Work out the percentage profit Lena makes.
Show your working clearly. *[4 marks]*

The height of each candle is 9 cm, correct to the nearest cm

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

The weight of each candle is 120 g, correct to the nearest 10 g

(c) Write down the upper bound of the weight. *[1 mark]*

(a) % .....

(b) cm .....

(c) g .....

[Total 6 marks]

20. The diagram shows two sides AB and BC of a regular polygon with n sides.
A third straight line is drawn from B, and the two angles it makes are marked on the diagram.

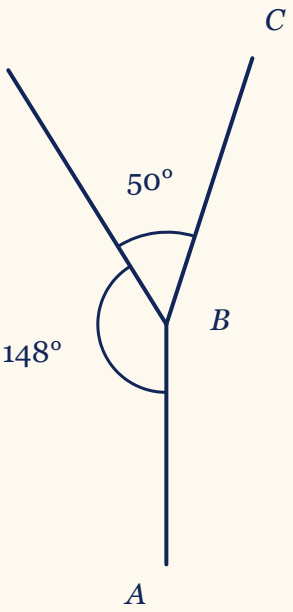


Diagram NOT accurately drawn

Work out the value of n.
You must show your working clearly. *[4 marks]*

n = ...

[Total 4 marks]

21. $x^5 \times x^7 = x^m$

(a) Work out the value of m. *[1 mark]*

$$\frac{y^8}{y^3} = y^n$$

(b) Work out the value of n. *[1 mark]*

(c) Simplify fully $(5a^4r^2)^3$ *[2 marks]*

(a) m = ...

(b) n = ...

(c) .....

[Total 4 marks]

22. A sports shop is holding a clearance sale.
In the sale, all normal prices are reduced by 28%
The sale price of a rucksack is 198 euros.

Work out the normal price of the rucksack. *[3 marks]*

..... euros

[Total 3 marks]

23. (a) Solve $x - 4 = \dfrac{3 + 2x}{6}$

You must show clear algebraic working. *[3 marks]*

(b) (i) Factorise $y^2 - 11y + 30$ *[2 marks]*

(ii) Hence solve $y^2 - 11y + 30 = 0$ *[1 mark]*

(a) x = ...

(b)(i) .....

(b)(ii) .....

[Total 6 marks]

24. Here is a solid candle in the shape of a cylinder.

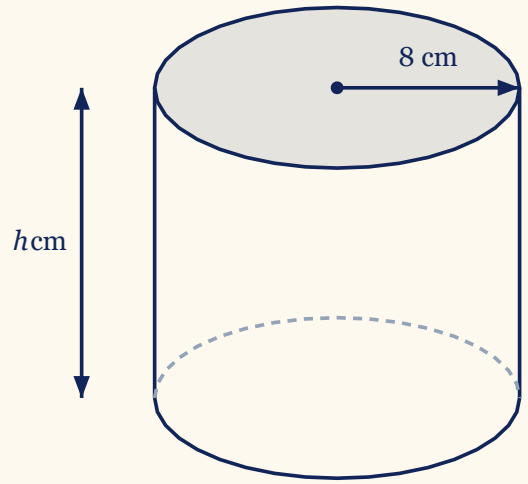


Diagram NOT accurately drawn

The radius of the candle is 8 cm.
The height of the candle is h cm.

The volume of the candle is 3892 cm³.

Work out the value of h.
Give your answer correct to one decimal place. *[3 marks]*

h = ...

[Total 3 marks]

25. (a) Express 520 million in standard form. *[1 mark]*

(b) Express 8.79×10^{-5} as an ordinary number. *[1 mark]*

(c) Work out $(5 \times 10^{42}) \times (7 \times 10^{-180})$
Write your answer in standard form. *[2 marks]*

(a) .....

(b) .....

(c) .....

[Total 4 marks]

26. The diagram shows a trapezium $ABCD$ that has exactly one line of symmetry.

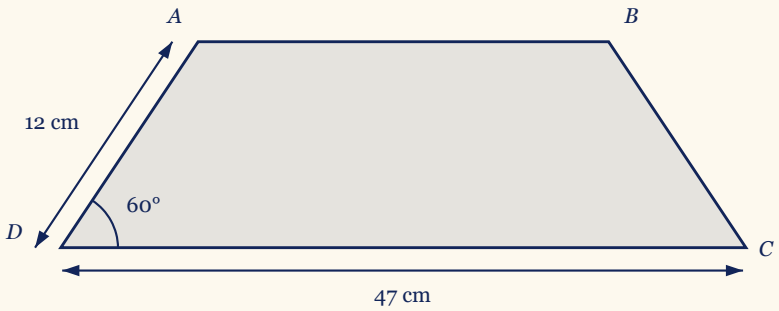


Diagram NOT accurately drawn

angle $ADC = 60°$
$AD = 12$ cm
$DC = 47$ cm

Calculate the area of the trapezium.
Give your answer correct to 3 significant figures.
You must show your working clearly. *[5 marks]*

..... cm^2

[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

(a) 475 and the number in the box add up to 1200
(b) 180 multiplied by the number in the box gives 5760
(c) four counters showing 7, 4, 8 and 5, each one used once

Find

(a) and (b): the number that belongs in each box. (c)(i): the smallest number the four counters can make. (c)(ii): the largest even number the four counters can make.

Plan the Solution

- Parts (a) and (b) are missing-number calculations, so undo the operation on show: subtract in (a), divide in (b).
- Every counter is used in part (c), so each number made there has four digits.
- For the smallest, start at the thousands column and use the smallest counter left each time. For the largest even, settle the units column first, because the units digit is what decides whether the number is even, and only then fill the front with what is left.

Worked Solution [4 marks]

> Rule - Undo, then order: a missing number is found with the inverse operation, subtraction undoing addition and division undoing multiplication; and a number built from given digits is ordered by place value, thousands column first. A number is even exactly when its units digit is even.

Step 1: the box in part (a)

$$1200 - 475 = 725$$

(Reason: Adding and subtracting undo each other, so the missing part is the total 1200 less the part already there, 475. Counting on gives the same number: 25 to reach 500, then 700 more to reach 1200.)

Step 2: the box in part (b)

$$\frac{5760}{180} = 32$$

$$\frac{576}{18} = 32$$

(Reason: Multiplying and dividing undo each other, so divide 5760 by 180. Cancelling one zero from each number first keeps the division the same and makes it easier: 576 shared into 18 groups.)

Step 3: the smallest number, part (c)(i)

$4,\ 5,\ 7,\ 8$

4578

(Reason: All four counters are used, so the number has four digits, and the thousands column is worth the most. Put the smallest counter, 4, there, then 5 in the hundreds, 7 in the tens and 8 in the units.)

Step 4: the largest even number, part (c)(ii)

$8,\ 7,\ 5,\ 4$

8754

$8754 > 7548$

(Reason: An even number ends in an even digit, so the units counter is 4 or 8. Spending the 8 on the units column leaves only 7, 5 and 4 for the front and gives 7548. Using the 4 there instead keeps the 8 for the thousands column and gives 8754, which is the bigger of the two.)

(a) 725

(b) 32

(c)(i) 4578

(c)(ii) 8754

Verification

- ✓ **Check 1:** Put 725 back into part (a) and add. $475 + 725 = 1200$
- ✓ **Check 2:** Put 32 back into part (b), multiplying the other way round. $32 \times 180 = 5760$
- ✓ **Check 3:** Hunt for an arrangement smaller than 4578. Any other one has a bigger counter in the thousands column, or the same 4 there and a bigger counter in the hundreds. The next smallest arrangement is 4587, which is bigger.
- ✓ **Check 4:** Hunt for an even arrangement bigger than 8754. 8754 is the biggest arrangement of all, and it already ends in 4, so nothing even can beat it.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) 725 written in the box	B1	The number that completes the addition: $1200 - 475 = 725$	✓
(b) 32 written in the box	B1	The number that completes the multiplication: $\frac{5760}{180} = 32$	✓
(c)(i) 4578	B1	The four counters in ascending order, smallest counter in the thousands column	✓
(c)(ii) 8754	B1	The largest arrangement of the four counters. It ends in 4, so it is already even.	✓

Full marks: 4/4

Question 2 - Exam Solution

Understanding the Question

Given

A pictogram of the tins of paint sold each month from January to April, read against a key in which one whole symbol represents 8 tins
January 3 whole symbols, February 4 whole symbols, March 5 whole symbols and a quarter symbol, April 3 whole symbols and a half symbol
The May row is empty, and 22 tins were sold in May

Find

(a) the number of tins of paint sold in January. (b) the total for the four months from January to April. (c) what to draw in the May row of the pictogram.

Plan the Solution

- Start at the key. It fixes what one whole symbol is worth, and every reading on the pictogram is built from it.
- Value the two part symbols before reading any row that carries one: a quarter of a symbol is a quarter of 8, and a half of a symbol is half of 8.

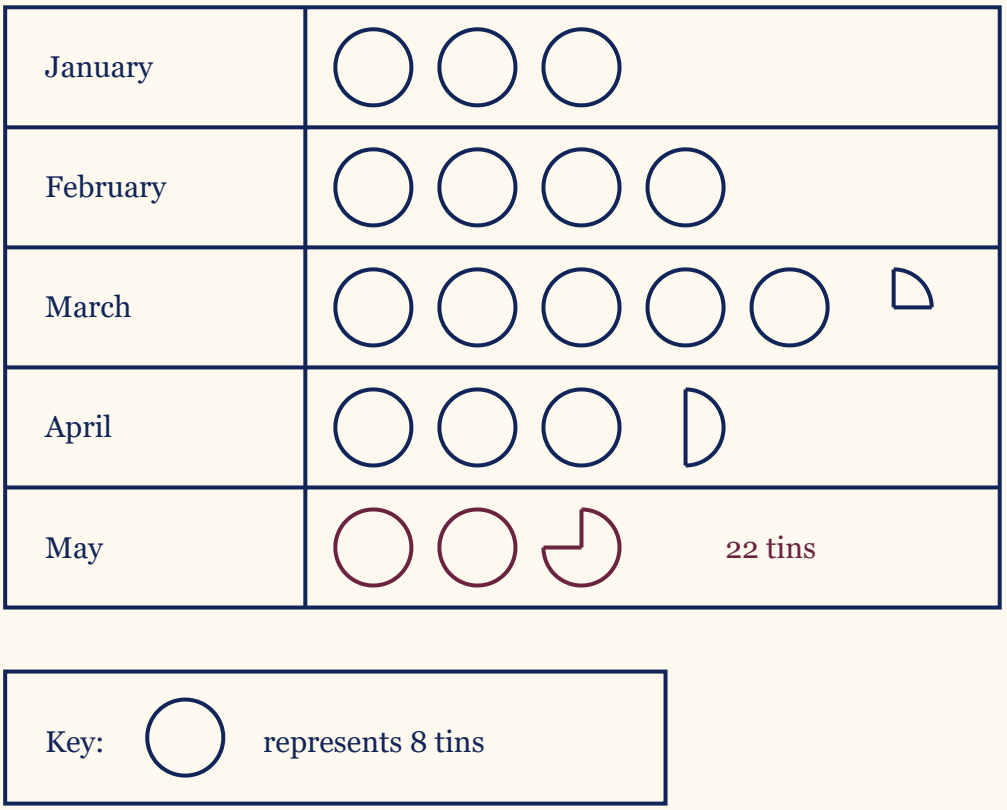
- Read the four months one at a time, then add the four readings for part (b).
- Part (c) runs the key backwards: take 22 apart into whole eights and a remainder, then turn the remainder into a fraction of a symbol.

Worked Solution [4 marks]

> Rule - The key sets the scale: a reading is the number one whole symbol stands for, multiplied by the count of symbols in that row, and a part symbol is worth the same fraction of that number as the fraction of the symbol that is drawn.

Step 1: read the key, then January

$3 \times 8 = 24$



(Reason: The key fixes the scale: one whole symbol stands for 8 tins. The January row holds 3 whole symbols and no part symbol, so the reading is three lots of 8.)

Step 2: what a part symbol is worth

$\frac{1}{4} \times 8 = 2$

$\frac{1}{2} \times 8 = 4$

(Reason: A part symbol is worth the same fraction of 8 as the fraction of the symbol that is drawn. March carries a quarter symbol and April carries a half symbol, so both of these are needed before either row can be read.)

Step 3: February and April

$4 \times 8 = 32$

$3 \times 8 + 4 = 28$

(Reason: February is 4 whole symbols and nothing else. April is 3 whole symbols, worth 24, and then the half symbol beside them adds the 4 from Step 2.)

Step 4: March

$5 \times 8 + 2 = 42$

(Reason: March is the longest row and the one with the smallest part symbol. The 5 whole symbols are worth 40 between them, and the quarter symbol beside them adds the 2 from Step 2.)

Step 5: add the four months

$24 + 32 + 42 + 28 = 126$

(Reason: Part (b) asks for the four months together, so add the four readings. The 24 and the 32 make 56, the 42 takes that to 98, and the 28 finishes it.)

Step 6: showing May on the pictogram

$22 = 2 \times 8 + 6$

$\frac{6}{8} = \frac{3}{4}$

(Reason: This step runs the key backwards. Two whole symbols account for 16 tins and leave 6 over. Six out of the 8 that a whole symbol is worth is three quarters of one, so the May row is drawn as 2 whole symbols followed by a three-quarter symbol.)

(a) 24 tins

(b) 126 tins

(c) the May row drawn as 2 whole symbols and a $\frac{3}{4}$ symbol

Verification

✓ **Check 1:** Total the four months a different way round: count every whole symbol first, then add the two part symbols on their own. January to April hold 15 whole symbols between them, one half symbol and one quarter symbol. $15 \times 8 + 4 + 2 = 126$

✓ **Check 2:** Change the unit and count in quarter symbols, so no row needs a part symbol of its own. A quarter symbol is worth 2 tins, and the four rows hold $12 + 16 + 21 + 14 = 63$ quarter symbols. $63 \times 2 = 126$

✓ **Check 3:** Read the completed May row straight back off the pictogram: 2 whole symbols and three more quarter symbols. $2 \times 8 + 3 \times 2 = 22$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) 24	**B1**	The January row holds 3 whole symbols, and the key gives $3 \times 8 = 24$.	✓
(b) $24 + 32 + 42 + 28$ or $15 \times 8 + 4 + 2$	**M1**	The four monthly readings added, or every whole symbol counted together with the half and the quarter added on. Follow through on the candidate's own answer to part (a), and allow one error or omission in adding the values.	✓
(b) 126	**A1**	The total for the four months from January to April.	✓
(c) 2 whole symbols and a $\frac{3}{4}$ symbol drawn in the May row	**B1**	Or equivalent, so 2 whole symbols with a $\frac{1}{2}$ symbol and a $\frac{1}{4}$ symbol beside them scores as well. The mark is for the drawing, so there is no answer line for this part.	✓

Full marks: 4/4

Question 3 - Exam Solution

Understanding the Question

Given

A prism. Its end face is a four-sided shape with one pair of parallel sides, and the three edges that cannot be seen are drawn dashed.
A circle with centre O.
The straight line AB, with A and B on the circle and the line running through O.

Find

(a) the number of faces of the prism (b) the number of vertices of the prism (c) the mathematical name of the line AB (d) the mathematical name of the line CD

The straight line CD, which reaches the circle at one point and stays outside it everywhere else.

Plan the Solution

- Start from the end face. A prism is that one shape swept straight backwards, so every side of the end face carries one flat face, and every corner of the end face turns up twice, once at each end.
- Count the sides of the end face first, then feed that one number through both counting rules and check the pair against Euler's formula.
- Ask what AB does to the circle: it joins two points of the circle, and it runs through the centre.
- Ask what CD does to the circle: it reaches the circle at a single point and never crosses inside it.

Worked Solution [4 marks]

> For a prism whose end face has n sides: faces $= n + 2$, vertices $= 2n$ and edges $= 3n$. On a circle, a straight line joining two points of the circle is a chord, a chord that passes through the centre is a diameter, and a straight line that meets the circle at exactly one point is a tangent.

(a) Count the faces

$4 + 2 = 6$

(Reason: The end face is a four-sided shape, so it has 4 sides. One flat face runs back along each of those 4 sides, and the two end faces themselves make 2 more.)

(b) Count the vertices

$2 \times 4 = 8$

(Reason: Each end face is a four-sided shape, so it has 4 corners, and the prism has 2 end faces. No other corners are made by sweeping the shape backwards, so every vertex of the solid is a corner of one end face.)

(c) Name the line AB

$OA = OB = r$

$AB = OA + OB = 2r$

(Reason: A and B are both on the circle, so AB is a chord. This chord also passes through the centre O, which makes it the longest chord the circle has, twice the radius. A chord through the centre is called a diameter.)

(d) Name the line CD

$OT = r$

$OT \perp CD$

(Reason: Call T the one point where CD reaches the circle. The radius drawn to that point is at right angles to the line, and every other point of CD lies further than r from O, so the line never crosses inside. A straight line that meets a circle at exactly one point is called a tangent.)

(a) 6

(b) 8

(c) diameter

(d) tangent

Verification

✓ **Check 1:** Count the edges instead. There are 4 round the front end face, 4 round the back one and 4 joining the two, so $E = 12$. Euler's formula for a solid like this one is $F + V - E = 2.\ 6 + 8 - 12 = 2$

✓ **Check 2:** Count off the drawing rather than from a rule: the flat top, the long sloping face, the base and the back face are four, and the two end faces make the rest. $4 + 2 = 6$ faces, and the 4 corners of the front end face together with the 4 sitting behind them give 8 vertices

✓ **Check 3:** Count how many points each line has in common with the circle. AB has both of its ends on the circle, so it meets the circle twice. CD meets it once and stays outside it everywhere else. two points in common for a chord, and a chord through the centre is a diameter; one point in common for a tangent

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	**B1**	6	✓
(b)	**B1**	8	✓
(c)	**B1**	diameter	✓
(d)	**B1**	tangent	✓

Full marks: 4/4

Question 4 - Exam Solution

Understanding the Question

Given

(a) The expression $4 \times 5e$.
(b) The equation $f + 14 = 29$.

Find

(a) the expression $4 \times 5e$ written in its simplest form (b) the value of f

Plan the Solution

- Part (a) is a multiplication and nothing else. The $5e$ means $5 \times e$, so the expression is a string of multiplications; gather the two numbers together, multiply them, and write the letter after the result.
- Part (b) is an equation, so ask what has been done to f. A number has been added to it, so undo that with the inverse operation, and do it to both sides so the two sides stay equal.
- Put each answer back into what the question gave, and check that the two sides still agree.

Worked Solution [2 marks]

> Rule - Multiplying a term by a number: multiply the numbers and keep the letter, so $a \times bx = (ab)x$. Rule - Solving a one-step equation: do the inverse operation to both sides, so $x + c = d$ gives $x = d - c$.

(a) Multiply the numbers and keep the letter

$$4 \times 5e = 4 \times 5 \times e$$

$$4 \times 5 = 20$$

$$4 \times 5e = 20e$$

(Reason: The term $5e$ already means $5 \times e$, so the whole expression is $4 \times 5 \times e$. Multiplication can be carried out in any order, so the two numbers are multiplied first and the letter is written straight after the 20. The multiplication sign between a number and a letter is never written down.)

(b) Take 14 off both sides

$$f + 14 = 29$$

$$f = 29 - 14 = 15$$

(Reason: The 14 has been added to f, and the inverse of adding is subtracting. Taking 14 off the left-hand side leaves f on its own, and taking the same 14 off the right-hand side keeps the equation balanced.)

(a) $20e$

(b) $f = 15$

Verification

✓ **Check 1:** Part (a) again as repeated addition. $4 \times 5e$ means $5e$ added four times over, so add the four coefficients instead of multiplying. $5 + 5 + 5 + 5 = 20$, so the expression is $20e$

✓ **Check 2:** Put a number in place of the letter. With $e = 3$, work out the question's expression and the answer separately and compare the two values. $4 \times 5 \times 3 = 60$ and $20 \times 3 = 60$

✓ **Check 3:** Put $f = 15$ back into the equation the question gave and work out the left-hand side. $15 + 14 = 29$, which is the right-hand side

✓ **Check 4:** Count on instead of subtracting. From 14 up to 20 is 6, and from 20 up to 29 is 9. $6 + 9 = 15$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	**B1**	$20e$	✓
(b)	**B1**	15	✓

Full marks: 2/2

Question 5 - Exam Solution

Understanding the Question

Given

(a) The decimal 0.6.

(b) The fraction $\frac{19}{100}$.

(c) A rectangle divided into equal parts, with some of those parts shaded.

Find

(a) 0.6 written as a percentage (b) $\frac{19}{100}$ written as a decimal (c) the fraction of the rectangle that is shaded, in its simplest form

Plan the Solution

- Per cent means out of 100, so part (a) is a change of units and not a change of value. Write the decimal as a number of hundredths, which is the same as multiplying it by 100.
- Part (b) is the same idea running backwards. The denominator is already 100, so the fraction is a number of hundredths, and hundredths are the second column after the decimal point.
- Part (c) is a counting question before it is a fraction question. Count how many equal parts the whole rectangle is divided into, count how many of them are shaded, write the shaded count over the total count, then cancel that fraction down.
- Nothing in this question needs a calculator, so check each answer by turning it back into what the question gave.

Worked Solution [4 marks]

> Rule - Per cent means out of 100: a decimal becomes a percentage when it is multiplied by 100, and a percentage becomes a decimal when it is divided by 100. Rule - Simplest form: a fraction is in its simplest form when the numerator and the denominator share no factor except 1, which is reached by dividing both of them by their highest common factor.

(a) Write the decimal as a number of hundredths

$$0.6 = \frac{6}{10} = \frac{60}{100}$$

$$0.6 \times 100 = 60$$

(Reason: Six tenths and sixty hundredths are the same amount, because the top and the bottom of $\frac{6}{10}$ *have both been multiplied by* 10*. A percentage is a number of hundredths, so* 0.6 *is* 60 *parts out of* 100 *. Multiplying by* 100 *does the same work in one step, and the per cent sign is what records that the* 100 *is there.)*

(b) Read the fraction off the decimal columns

$$\frac{19}{100} = \frac{10}{100} + \frac{9}{100}$$

$$\frac{19}{100} = 0.19$$

(Reason: Nineteen hundredths splits into ten hundredths, which is one tenth, and nine hundredths. The first column after the decimal point counts tenths and the second counts hundredths, so the 1 *goes in the tenths column and the* 9 *in the hundredths column. A denominator of* 100 *always gives a decimal with two figures after the point, which is why* 0.19 *and not* 0.019 *is right.)*

(c) Count the equal parts in the whole rectangle

$5 \times 4 = 20$

(Reason: The rectangle is ruled into 5 parts across and 4 parts down, and every part is the same size, which is what lets them be counted rather than measured. Multiplying the two counts gives the number of parts in the whole rectangle, and that number is the denominator of the fraction.)

(c) Count the shaded parts

$1 + 5 + 5 + 5 = 16$

(Reason: Take the rows one at a time. The top row has 1 shaded part and 4 white ones, so it contributes 1. Each of the three rows underneath it is shaded the whole way across, so each of those contributes 5. Adding the four rows gives the number of shaded parts, and that number is the numerator.)

(c) Write the fraction and cancel it down

$$\frac{16}{20} = \frac{4 \times 4}{5 \times 4} = \frac{4}{5}$$

(Reason: Shaded parts over total parts is $\frac{16}{20}$, which is a correct fraction but not yet the simplest one. Both 16 and 20 are multiples of 4, and 4 is the highest number that divides into both, so taking that factor out of the top and the bottom leaves $\frac{4}{5}$. Now 4 and 5 share no factor except 1, so the cancelling has gone as far as it can. The question asks for a fraction, so stop here and do not turn it into 0.8.)

(a) 60%

(b) 0.19

(c) $\frac{4}{5}$

Verification

- ✓ **Check 1:** Part (a) backwards. A percentage is a number of hundredths, so put the answer over 100 again and see whether the decimal the question gave comes back. $\frac{60}{100} = 0.6$, which is the decimal in the question
- ✓ **Check 2:** Part (b) backwards, by place value rather than by division. Read 0.19 off the columns: 1 tenth and 9 hundredths, then add the two fractions. $\frac{1}{10} + \frac{9}{100} = \frac{19}{100}$, which is the fraction in the question
- ✓ **Check 3:** Part (c) counted the other way round. Count the white parts instead: there are 4 of them out of 20, which is $\frac{1}{5}$ of the rectangle. The shaded part and the white part must

make one whole rectangle between them. $\frac{4}{5} + \frac{1}{5} = 1$, so the two fractions account for the whole rectangle

✓ **Check 4:** Part (c) tested against the count. If $\frac{4}{5}$ of the rectangle is shaded, then taking $\frac{4}{5}$ of the 20 parts must give back the number of parts that were counted as shaded. $\frac{4}{5} \times 20 = 16$, which is the shaded count

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	**B1**	60	✓
(b)	**B1**	0.19	✓
(c)	**M1**	for a correct unsimplified fraction, $\frac{16}{20}$ or equivalent such as $\frac{8}{10}$, or for an answer of $\frac{1}{5}$ or 0.8 or 80%, or for any fraction that will cancel written in its simplest form, such as $\frac{15}{20} = \frac{3}{4}$ or $\frac{4}{16} = \frac{1}{4}$	✓
(c)	**A1**	$\frac{4}{5}$. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
(c)	**Note**	Do not ignore subsequent working here: $\frac{4}{5}$ followed by an answer of 0.8 or 80% scores M1A0, because the question asks for a fraction.	✓
(c)	**Note**	The $\frac{1}{5}$ that earns the method mark is the error worth naming: it is $\frac{4}{20}$, the fraction left white. The counting and the cancelling are both right and the wrong region has been counted.	✓

Full marks: 4/4

Question 6 - Exam Solution

Understanding the Question

Given

The first four terms of the sequence:
$7 \quad 11 \quad 15 \quad 19$
The terms climb by the same amount every time, so this is an arithmetic sequence.

Find

(a) the term that comes straight after 19 (b) a sentence saying how that term was worked out (c) the 12th term

Plan the Solution

- Subtract each term from the one after it. If every gap is the same, the sequence has a common difference.
- Add that difference on to 19 for part (a). Part (b) is then just that sentence written down: the mark is for saying what was ADDED, not for saying what the gap is.
- Writing out all twelve terms would work for part (c), but it is slow and easy to miscount, so build the nth term rule and substitute $n = 12$.

Worked Solution [3 marks]

> Rule - Arithmetic sequence: the terms go up in equal steps of d, so each term is the one before it plus d, and the nth term is $dn + (\text{first term} - d)$.

Step 1: Find the gap between the terms

$11 - 7 = 4$

$15 - 11 = 4$

$19 - 15 = 4$

(Reason: Every consecutive pair is 4 apart, so the sequence rises in equal steps and the common difference is $d = 4$.)

Step 2: Add one more step on to the last term shown

$19 + 4 = 23$

(Reason: The next term follows 19, so it sits one step of 4 further on. This answers part (a), and stating that 4 was added on to the previous term is exactly what part (b) asks for. Writing only that the difference is 4 does not answer part (b), because it never says what was done with it.)

Step 3: Build a rule for the nth term

$7 - 4 = 3$

$n\text{th term} = 4n + 3$

(Reason: Each step adds 4, so the sequence runs alongside the 4 times table $4, 8, 12, 16, \ldots$ and every term sits 3 above the matching multiple. That 3 is the first term less one step, $7 - 4$.)

Step 4: Substitute $n = 12$ into the rule

$4 \times 12 + 3 = 51$

(Reason: The rule reaches any term in one line, so the 12th term needs no listing and no counting.)

(a) 23

(b) Add 4 to the previous term

(c) 51

Verification

✓ **Check 1:** Reach the 12th term without the rule. From the 4th term to the 12th term is 8 more steps of 4. $19 + 8 \times 4 = 51$

✓ **Check 2:** Test the rule on terms that are already printed. Put $n = 4$ and $n = 5$ into $4n + 3$ and compare with the paper and with part (a). $4 \times 4 + 3 = 19$ and $4 \times 5 + 3 = 23$

✓ **Check 3:** Sanity check the parity. $4n$ is always even, so $4n + 3$ is always odd, and the printed terms $7, 11, 15, 19$ are all odd. 51 is odd, so it belongs to this sequence

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) The next term	**B1**	cao. The only answer accepted is 23.	✓
(b) The explanation	**B1**	Acceptable: add 4, +4, $19 + 4$ $(= 23)$, (rule is) $4n + 3$, goes up by 4, $4 \times 5 + 3$ $(= 23)$, $(n) + 4$, $(3n) + 4$. Not acceptable: $11 - 7 = 4$, difference is 4, we subtract the first number and the next number and it gives us the answer.	✓
(b)	**Note**	The three rejected answers all find the gap between the terms but never say it was added on to 19. $(3n) + 4$ is accepted even though it is not a correct rule for this sequence: the mark is for saying what was DONE to reach the next term, not for a correct nth term.	✓
(c) The 12th term	**B1**	cao. The only answer accepted is 51. No working is needed for the mark, so a correct answer from listing all twelve terms scores it in full.	✓

Full marks: 3/3

Question 7 - Exam Solution

Understanding the Question

Given

Normal price of one desk lamp: £26.80

The student discount card takes $\frac{1}{4}$ off that normal price.

Claire buys 2 lamps and hands over a £50 note.

Find

The change Claire should receive, in pounds.

Plan the Solution

- Take a quarter off the normal price, so you know what one lamp actually costs her.
- Double that reduced price, because she buys two identical lamps.
- Subtract the total cost from the amount she hands over.

Worked Solution [4 marks]

> Rule - Discount, then change: taking $\frac{1}{4}$ off leaves $\frac{3}{4}$ of the normal price, and the change is the amount handed over minus the total cost.

Step 1: Work out the discount on one lamp

$$\frac{1}{4} \times 26.80 = 6.70$$

(Reason: the card takes a quarter off, so a quarter of £26.80 is the money Claire saves on each lamp)

Step 2: Work out the reduced price of one lamp

$$26.80 - 6.70 = 20.10$$

(Reason: taking the discount off the normal price leaves what Claire actually pays for one lamp)

Step 3: Work out the cost of two lamps

$$2 \times 20.10 = 40.20$$

(Reason: both lamps are the same, so double the price she pays for one of them)

Step 4: Work out the change

$50 - 40.20 = 9.80$

(Reason: the change is whatever is left of the £50 note once the total cost has been taken off)

£9.80

Verification

✓ **Check 1:** Add the change back on to the total cost. It has to rebuild the £50 note exactly.
$40.20 + 9.80 = 50$

✓ **Check 2:** Discount the whole bill instead of each lamp. Two lamps at the normal price come to $2 \times 26.80 = 53.60$, and the card takes a quarter off that.
$53.60 - \frac{1}{4} \times 53.60 = 40.20$

✓ **Check 3:** Redo the whole calculation in pence, where no decimal point can slip.
$5000 - 4020 = 980$ pence, which is £9.80

Mark Scheme Breakdown

Step	Mark	Description	Got it?
$\frac{1}{4} \times 26.80$ $(= 6.70)$ or $\frac{3}{4} \times 26.80$ $(= 20.10)$ or 2×26.80 $(= 53.60)$	M1	For a method to find the discount on one lamp ($\frac{1}{4} \times 26.80 = 6.70$), or the reduced price of one lamp ($\frac{3}{4} \times 26.80 = 20.10$), or the cost of two lamps at the normal price ($2 \times 26.80 = 53.60$). Any one of the three earns it, or an equivalent.	✓
2×20.10 $(= 40.20)$ or $(26.80 - 6.70) \times 2$ $(= 40.20)$ or $\frac{3}{4} \times 53.60$ $(= 40.20)$	M1	For a method to find the reduced price of the two lamps, reaching 40.20. Awarded on the candidate's own value from the first mark, so $53.60 - \frac{1}{4} \times 53.60 = 40.20$ earns it just as $2 \times 20.10 = 40.20$ does.	✓

Step	Mark	Description	Got it?
or $6.70 \times 3 \times 2$ $(= 40.20)$			
$50 - 40.20$ (using their cost of two lamps)	**M1**	For a complete method: the amount handed over minus the total cost, $50 - 40.20 = 9.80$.	✓
Correct answer £ 9.80	**A1**	For $9.8(0)$. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
Special case	**SC B2**	for an answer of $29.9(0)$ or $36.6(0)$	✓
Special case	**SC B1**	for an answer of $23.2(0)$ or $\pm 3.1(0)$	✓
The four special-case answers	**Note**	$29.9(0)$ comes from $50 - 20.10 = 29.90$, the price of one lamp taken off instead of two. $36.6(0)$ comes from $50 - 2 \times 6.70 = 36.60$, the money saved doubled instead of the money paid. $23.2(0)$ comes from $50 - 26.80 = 23.20$, one lamp at the normal price with the discount forgotten. $3.1(0)$ comes from $50 - (53.60 - 6.70) = 3.10$, one discount taken off a bill for two lamps.	✓

Full marks: 4/4

Question 8 - Exam Solution

Understanding the Question

Given

The straight-line rule $y = 2x - 1$

A table whose x row runs $-2, -1, 0, 1, 2, 3$

Two y cells already printed: -1 under $x = 0$, and 5 under $x = 3$

A grid reaching from -6 to 7 up the y-axis, so every value of the table fits on it

Find

(a) The four missing y values (b) The graph of $y = 2x - 1$, drawn between $x = -2$ and $x = 3$

Plan the Solution

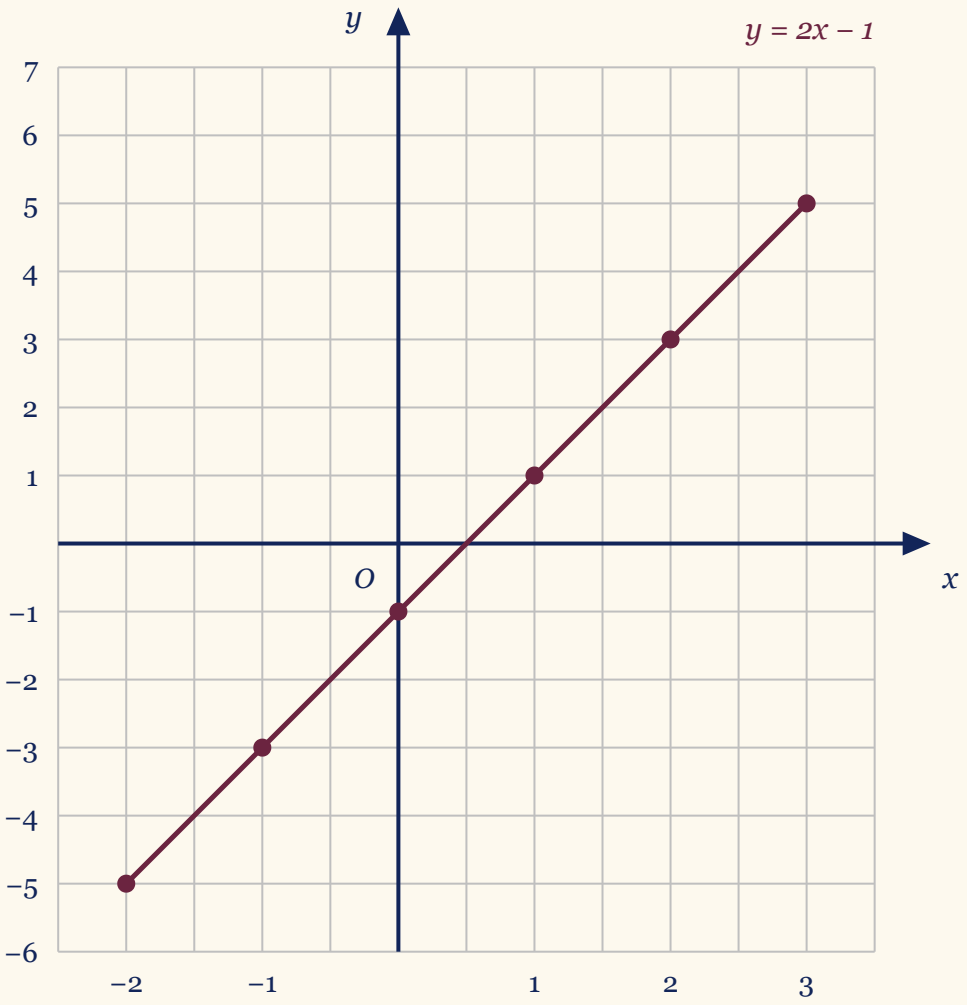
- Take the columns one at a time: double the x value, then subtract 1.
- Use the two printed cells as a check - the same rule has to produce them.
- Read each column as a coordinate pair and plot the six points.
- Join them with one ruled straight line, stopping at $x = -2$ and $x = 3$.

Worked Solution [4 marks]

> Rule - a table of values: substitute each x into the equation in turn. Because $y = 2x - 1$ is linear, the points all lie on one straight line, and the y values climb in equal steps of 2.

Step 1: Substitute $x = -2$

$2 \times (-2) - 1 = -4 - 1 = -5$



(Reason: (Reason: doubling -2 gives -4, and the rule then takes 1 away from it.))

Step 2: Substitute $x = -1$ and $x = 1$

$2 \times (-1) - 1 = -2 - 1 = -3$

$$2 \times 1 - 1 = 2 - 1 = 1$$

(Reason: (Reason: every column uses the same two operations, in the same order - double, then subtract 1.))

Step 3: Substitute $x = 2$

$$2 \times 2 - 1 = 4 - 1 = 3$$

(Reason: (Reason: that is the last blank cell. The paper had already printed -1 under $x = 0$ and 5 under $x = 3$.))

Step 4: Write the completed table

x	-2	-1	0	1	2	3
y	-5	-3	-1	1	3	5

(Reason: (Reason: read along the y row and the values rise by 2 every column. A linear rule must do that, so an uneven gap would mean a cell was worked out wrongly.))

Step 5: Plot the six points

$(-2, -5)$
$(-1, -3)$
$(0, -1)$
$(1, 1)$
$(2, 3)$
$(3, 5)$

(Reason: (Reason: each column of the table is one point - the x value across, the y value up or down from the x-axis.))

Step 6: Rule one line from $x = -2$ to $x = 3$

$$\frac{5 - (-5)}{3 - (-2)} = \frac{10}{5} = 2$$

(Reason: (Reason: the six points are in a straight line of gradient 2, so one ruled line through all of them is the graph. Stop it at the ends of the range the question gives.))

(a) y row: $-5, -3, -1, 1, 3, 5$

(b) A straight line through $(-2, -5)$ and $(3, 5)$, drawn on the grid

Verification

✓ **Check 1:** Put the two cells the paper had already filled in back through the rule. If $x = 0$ and $x = 3$ give the printed numbers, the rule has been read off the question correctly.

$2 \times 0 - 1 = -1$ and $2 \times 3 - 1 = 5$

✓ **Check 2:** Read along the completed y row. Each column steps 1 across, so each y value should step 2 up. $-5 \to -3 \to -1 \to 1 \to 3 \to 5$ - every gap is 2

✓ **Check 3:** Read the drawn line back. Its gradient from end to end must be the 2 in $y = 2x - 1$, and it must cross the y-axis at -1. $\dfrac{5-(-5)}{3-(-2)} = 2$, and the line passes through $(0, -1)$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) Every value in the y row correct: -5, -3, -1, 1, 3, 5	**B2**	B2 for all correct values in the table. The official scheme brackets -1 and 5 because the paper prints those two cells already.	✓
(a) Only two or three of the values correct	**(B1)**	(B1 for 2 or 3 correct values)	✓
(b) At least five points plotted correctly, or a correct line segment through at least three of $(-2, -5)$, $(-1, -3)$, $(0, -1)$, $(1, 1)$, $(2, 3)$, $(3, 5)$	**M1ft**	For at least five points plotted correctly (within the circles on the overlay), followed through on the candidate's own incorrect table provided B1 was scored in part (a); or for a correct line segment through at least three of the six points; or for a straight line of gradient 2; or for a straight line through $(0, -1)$ with a positive gradient.	✓
(b) One correct straight line drawn between $x = -2$ and $x = 3$	**A1**	For a correct line between $x = -2$ and $x = 3$, with clear intention to go through all the points, and it must be a line - freehand is allowed. Anything drawn to the left of $x = -2$ or to the right of $x = 3$ is ignored.	✓
Guidance from the official scheme: a correct graph with an empty table	**Note**	If a fully correct graph is shown but the table in part (a) is left blank, award 2 marks for part (a) and 2 marks for part (b).	✓

Full marks: 4/4

Question 9 - Exam Solution

Understanding the Question

Given

A pie chart in four sectors: mashed $72°$, roasted $132°$, baked $48°$, and chipped left unmarked.
The table gives the frequency for mashed as 6.
The four sector angles add to $360°$.

Find

(a) The three missing frequencies and the one missing sector angle. (b) The probability that a person picked at random chose mashed.

Plan the Solution

- Every person takes up the same angle, so start from the one row that is complete: 6 people fill $72°$.
- Divide to find the angle that stands for one person.
- Divide each of the two other given angles by that to get its frequency.
- Take the three given angles off a whole turn to find the angle that is missing, then divide that by the angle for one person.
- For (b), the probability is the mashed frequency out of the total frequency, which is the same as the mashed angle out of the whole turn.

Worked Solution [4 marks]

> Rule - Pie chart: the sector angles add to $360°$, and every person takes up the same angle, so frequency and angle are in proportion.

Step 1: find the angle that stands for one person

$$\frac{72}{6} = 12$$

(Reason: The mashed row is the only complete one: 6 people fill $72°$, so one person is worth $12°$.)

Step 2: turn the two other given angles into frequencies

$$\frac{132}{12} = 11$$

$$\frac{48}{12} = 4$$

(Reason: A sector holds as many people as there are lots of $12°$ inside its angle.)

Step 3: find the missing angle

$360 - (72 + 132 + 48) = 108$

(Reason: The four sectors fill a whole turn, so take all three of the given angles off a whole turn.)

Step 4: turn that angle into a frequency

$$\frac{108}{12} = 9$$

(Reason: The chipped sector is $108°$ and one person is worth $12°$, so it stands for 9 people.)

Step 5: write down the probability for part (b)

$$\frac{72}{360} = \frac{1}{5}$$

(Reason: The mashed sector is $72°$ out of the whole $360°$, which is the same as 6 people out of 30.)

(a) roasted 11, chipped 9, baked 4, chipped angle $108°$

(b) $\frac{72}{360} = \frac{1}{5}$

Verification

✓ **Check 1:** Add all four sector angles. A pie chart must close, so they have to make one whole turn. $72 + 132 + 108 + 48 = 360$

✓ **Check 2:** Add the four frequencies, then multiply the total by the angle for one person. $6 + 11 + 9 + 4 = 30$ and $30 \times 12 = 360$

✓ **Check 3:** Work out part (b) the other way round, from the completed frequency column instead of from the angles. $\frac{6}{30} = \frac{1}{5}$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) eg $\frac{72}{6} = 12$ or $\frac{132}{72} = \frac{11}{6}$ or $\frac{48}{72} = \frac{2}{3}$ or $360 - (48 + 72 + 132) = 108$	M1	For a correct first step, or for one correct value. Values may be seen on the pie chart.	✓

Step	Mark	Description	Got it?
eg (frequency roasted =) $\frac{132}{12}\ (=11)$ or $6 \times \frac{11}{6}\ (=11)$ OR (frequency chipped =) $\frac{108}{12}\ (=9)$ OR (angle chipped =) $9 \times 12\ (=108)$ or $360 - (48 + 72 + 132)\ (=108)$ OR (frequency baked =) $\frac{48}{12}\ (=4)$ or $6 \times \frac{2}{3}\ (=4)$	**M1**	For a method to work out three of the values. The official scheme prints the 12, the $\frac{11}{6}$, the 108, the 9 and the $\frac{2}{3}$ in quotation marks, which means the candidate's own earlier value may be used in place of each. That is what makes this mark a follow-through.	✓
$11, 9, 4, 108°$	**A1**	cao. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
$\frac{72}{360}$	**B1ft**	(b) oe, eg $\frac{1}{5}$, $\frac{6}{30}$, 20%, 0.2. Allow 6 over their total frequency, dependent on a complete frequency column.	✓

Full marks: 4/4

Question 10 - Exam Solution

Understanding the Question

Given

Each packet is a cuboid, 16 cm by 4 cm by 6 cm.
The carton is a cuboid, 80 cm by 12 cm by 42 cm.

Find

The greatest number of packets that can be put into the carton.

The packets are all the same size, so they can be set out in rows and stacked in layers.

Plan the Solution

- Lay one edge of the packet along each edge of the carton: 16 cm along the 80 cm side, 4 cm along the 12 cm side, 6 cm up the 42 cm side.
- Divide each carton edge by the packet edge lying along it to see how many fit in that direction.
- Every one of those divisions comes out exact, so no space is wasted and no packet has to be cut.
- Multiply the three counts together, then check the total against the two volumes.

Worked Solution [3 marks]

> Rule - Packing a cuboid: when each edge of the small cuboid divides exactly into the carton edge it lies along, the number that fit is the three counts multiplied together, and that is also $\dfrac{\text{carton volume}}{\text{packet volume}}$.

Step 1: how many fit along the 80 cm side

$$\frac{80}{16} = 5$$

(Reason: The 16 cm edge of the packet lies along the 80 cm side of the carton, and it goes in exactly 5 times with nothing left over.)

Step 2: how many fit across the 12 cm side

$$\frac{12}{4} = 3$$

(Reason: The 4 cm edge of the packet lies across the 12 cm side of the carton, so divide the 12 by that edge.)

Step 3: how many layers fit up the 42 cm side

$$\frac{42}{6} = 7$$

(Reason: The 6 cm edge stands upright, and 6 divides into 42 exactly, so the packets stack in 7 layers.)

Step 4: multiply the three counts

$$5 \times 3 \times 7 = 105$$

(Reason: Each of the 5 places along the carton pairs with each of the 3 places across it, and that whole layer is repeated 7 times, so the three counts multiply.)

105 packets

Verification

✓ **Check 1:** Work with volumes instead. The packets leave no gaps, so the carton's volume divided by one packet's volume must give the same count. $80 \times 12 \times 42 = 40\,320$ and $16 \times 4 \times 6 = 384$, so $\dfrac{40\,320}{384} = 105$

✓ **Check 2:** Count one layer on the floor of the carton first, then count the layers. $\dfrac{80 \times 12}{16 \times 4} = 15$ packets in a layer, and $15 \times 7 = 105$

✓ **Check 3:** Turn the packets the other way round to confirm this really is the greatest: put the 6 cm edge across the 12 cm side, so only 2 fit across, and stand the 4 cm edge upright. $\dfrac{42}{4} = 10.5$, so only 10 layers fit, giving $5 \times 2 \times 10 = 100$ packets, which is fewer.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
eg $80 \times 12 \times 42 = 40\,320$ or $16 \times 4 \times 6 = 384$ or $\dfrac{42}{6} = 7$ or $\dfrac{12}{4} = 3$ or $\dfrac{80}{16} = 5$ or $\dfrac{80 \times 12}{16 \times 4} = 15$ or $\dfrac{80 \times 42}{16 \times 6} = 35$ or $\dfrac{42 \times 12}{6 \times 4} = 21$	M1	For a method to find the volume of the carton or the volume of one packet, or a method to find the number of packets along one dimension of the carton, or for dividing the areas of corresponding faces.	✓
eg $\dfrac{40\,320}{384}$ or $7 \times 3 \times 5$ or 15×7	M1	For a complete method to find the number of packets. The values used may be the candidate's own from the first mark.	✓

Step	Mark	Description	Got it?
or 35×3 or 21×5			
105	A1	cao. A correct answer scores full marks unless it comes from obviously incorrect working.	✓

Full marks: 3/3

Question 11 - Exam Solution

Understanding the Question

Given

12 trays cost 708 dirhams altogether. Every tray costs the same, so cost and number of trays are in direct proportion.

Find

The cost of 5 of these trays, in dirhams.

Plan the Solution

- Divide the total by 12 to get the cost of one tray.
- Multiply that one-tray cost by 5 to get the cost of five trays.
- Confirm it a second way, by scaling 708 straight down with the fraction $\frac{5}{12}$.

Worked Solution [2 marks]

> Rule - Unitary method: find the cost of ONE item first, then multiply by how many are wanted. cost of one $= \dfrac{\text{total cost}}{\text{number of trays}}$

Step 1: Find the cost of one tray

$$\frac{708}{12} = 59$$

(Reason: 12 equal trays cost 708 dirhams, so one tray costs a twelfth of that. Dividing by 12 strips the total back to a single tray, which is the value every later step is built from.)

Step 2: Multiply the one-tray cost by the number of trays wanted

$$5 \times 59 = 295$$

(Reason: Each tray costs the same 59 dirhams, so several trays cost 59 multiplied by how many there are. The answer is in dirhams because a number of trays multiplied by a cost per tray is a cost.)

295 dirhams

Verification

✓ **Check 1:** Multiply back. If one tray really costs 59 dirhams, then 12 trays must rebuild the total the question printed. $12 \times 59 = 708$

✓ **Check 2:** A different route to the same answer: scale the total straight to 5 trays with a fraction, without ever finding the cost of one tray. $\frac{5}{12} \times 708 = 295$

✓ **Check 3:** Size check. 5 trays is fewer than half of 12 trays, so the cost must come out under half of 708 dirhams, which is 354 dirhams. $295 < 354$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Start to work with proportion, eg the cost of one tray $\frac{708}{12} = 59$	M1	Any correct start to the proportion scores this mark, eg $\frac{708}{6} = 118$ for 2 trays, $\frac{708}{4} = 177$ for 3 trays, $\frac{708}{3} = 236$ for 4 trays, $\frac{708}{2} = 354$ for 6 trays, or $\frac{12}{5} = 2.4$, or $\frac{708}{2.4}$, or $708 \times \frac{5}{12}$, or $708 \times 5 = 3540$.	✓
The cost of 5 trays	A1	cao 295. A correct answer scores full marks unless it comes from obviously incorrect working, so the two marks are earned by 295 on the answer line even with no working shown.	✓

Full marks: 2/2

Question 12 - Exam Solution

Understanding the Question

Given	Find

Callum went into the bistro at 18 15 and left at 21 40
On Saturday the bistro sold 120 meals
48 of those meals were vegetarian

(a) how long Callum was inside, written in hours and minutes (b) the vegetarian meals as a percentage of all 120 meals

Plan the Solution

- (a) An hour on the clock is 60 minutes, not 100, so change both readings into minutes after midnight, subtract, then turn the answer back into hours and minutes.
- (b) Write the vegetarian meals as a fraction of the total, then multiply by 100.
- A calculator is allowed, so check each answer by working backwards from it.

Worked Solution [4 marks]

> Rule - Elapsed time and percentage: an hour is 60 minutes, so a clock reading is $\text{hours} \times 60 + \text{minutes}$ minutes after midnight; and a part written as a percentage is $\frac{\text{part}}{\text{whole}} \times 100$.

Step 1: (a) Change each clock reading into minutes after midnight

$$18 \times 60 + 15 = 1095$$
$$21 \times 60 + 40 = 1300$$

(Reason: 18 15 is 18 whole hours and 15 minutes after midnight, and every hour is 60 minutes.)

Step 2: (a) Subtract to find how many minutes he was inside

$$1300 - 1095 = 205$$

(Reason: The gap between the two readings is the time Callum spent in the bistro, measured in minutes.)

Step 3: (a) Write 205 minutes as hours and minutes

$$3 \times 60 = 180$$
$$205 - 180 = 25$$

(Reason: Three whole hours use up 180 minutes and leave 25 minutes over. A fourth hour will not fit, because $4 \times 60 = 240$ is more than 205.)

Step 4: (b) Write the vegetarian meals as a fraction of all the meals

$$\frac{48}{120} = \frac{2}{5}$$

(Reason: 48 of the 120 meals were vegetarian, so the fraction is 48 out of 120. Dividing top and bottom by 24 simplifies it.)

Step 5: (b) Turn the fraction into a percentage

$$\frac{48}{120} \times 100 = 40$$

(Reason: A percentage is a number out of 100, so multiplying the fraction by 100 gives the percentage.)

(a) 3 hours 25 minutes

(b) 40%

Verification

- ✓ **Check 1 - part (a):** Count on from 18 15. Add 3 whole hours, then add 25 minutes. 18 15 goes to 21 15, and 21 15 goes to 21 40, which is when Callum left.
- ✓ **Check 2 - part (a):** Turn the answer back into minutes and add it on to the starting reading. $3 \times 60 + 25 = 205$ and $1095 + 205 = 1300$, which is 21 40.
- ✓ **Check 3 - part (b):** Take the answer as a percentage of the whole and see whether the vegetarian meals come back. 40% is 0.4 as a decimal. $0.4 \times 120 = 48$, the number of vegetarian meals sold.
- ✓ **Check 4 - part (b):** The vegetarian and the non-vegetarian percentages must add up to 100. $120 - 48 = 72$ meals were not vegetarian and $\frac{72}{120} = 0.6$, so 60% were not vegetarian. $40 + 60 = 100$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) Both numbers correct: 3 hours and 25 minutes	**B2**	for 3 (hours) and 25 (minutes)	✓
(a) Only one of the two numbers correct	**B1**	for 3 (hours) or 25 (minutes)	✓
(b) A correct first step, for example $\frac{48}{120}$ or $\frac{48}{120} \times 100$	**M1**	for a correct first step. Also allow $\frac{48}{120} = 0.4$, the simplified fraction $\frac{2}{5}$, or the complement $\frac{120 - 48}{120} \times 100$ which gives 60, or equivalent	✓

Step	Mark	Description	Got it?
(b) 40	A1	cao. A correct answer scores full marks, unless it comes from obviously incorrect working.	✓

Full marks: 4/4

Question 13 - Exam Solution

Understanding the Question

Given

The two fractions $\frac{3}{7}$ and $\frac{1}{4}$.

Their denominators, 7 and 4, are different, so the fractions count parts of different sizes and cannot be added as they stand.

Find

Show that these two fractions add to exactly $\frac{19}{28}$. The answer is already printed in the question, so it is the working that earns both marks - a bare restatement of it scores nothing.

Plan the Solution

- Find a denominator that both 7 and 4 divide into.
- Rewrite each fraction as an equivalent fraction over that denominator.
- Add the numerators, keep the denominator, and compare the result with $\frac{19}{28}$.

Worked Solution [2 marks]

> Rule - Adding fractions: rewrite both fractions over a common denominator, then add the numerators and leave the denominator alone. $\frac{a}{b} + \frac{c}{d} = \frac{ad}{bd} + \frac{cb}{bd} = \frac{ad + cb}{bd}$

Step 1: Choose a common denominator

$7 \times 4 = 28$

(Reason: 7 and 4 share no factor other than 1, so the smallest number both of them divide into is simply their product, 28. Twenty-eighths are the common unit both fractions can be counted in.)

Step 2: Write each fraction over 28

$$\frac{3}{7} = \frac{3 \times 4}{7 \times 4} = \frac{12}{28}$$
$$\frac{1}{4} = \frac{1 \times 7}{4 \times 7} = \frac{7}{28}$$

(Reason: Multiplying the top and the bottom of a fraction by the same number does not change its value, only the size of the parts it is counted in. Each denominator needs its own multiplier: 7 has to be scaled by 4 to reach 28, while 4 has to be scaled by 7.)

Step 3: Add the numerators

$$\frac{12}{28} + \frac{7}{28} = \frac{12 + 7}{28} = \frac{19}{28}$$

(Reason: Both amounts are now counted in twenty-eighths, so 12 of them plus 7 of them is 19 of them. The denominator records how big each part is, not how many there are, so it does not change when the parts are added.)

Step 4: Compare with what the question printed

$$\frac{3}{7} + \frac{1}{4} = \frac{19}{28}$$

(Reason: The sum has come out as exactly the fraction the question asked for. 19 is prime and is not a factor of 28, so nothing cancels and the fraction is already in its simplest form. That completes the demonstration.)

$$\frac{3}{7} + \frac{1}{4} = \frac{12}{28} + \frac{7}{28} = \frac{19}{28}$$ **as required**

Verification

✓ **Check 1:** Leave fractions behind and work in decimals instead, rounding to 4 decimal places: $\frac{3}{7} \approx 0.4286$, $\frac{1}{4} = 0.25$ and $\frac{19}{28} \approx 0.6786$. $0.4286 + 0.25 = 0.6786$

✓ **Check 2:** Run the statement backwards. If the sum really is $\frac{19}{28}$, then taking $\frac{1}{4}$, which is $\frac{7}{28}$, back off it must return the first fraction. $\frac{19}{28} - \frac{7}{28} = \frac{12}{28} = \frac{3}{7}$

✓ **Check 3:** A different route to the same place: add in a single line with the general rule, without writing the two equivalent fractions down separately. $\frac{3 \times 4 + 1 \times 7}{7 \times 4} = \frac{19}{28}$

✓ **Check 4:** Size check. $\frac{3}{7}$ is a little under a half, and a quarter is added to it, so the total must land between a half and three quarters. Written in twenty-eighths those two

boundaries are $\frac{14}{28}$ and $\frac{21}{28}$. $\frac{14}{28} < \frac{19}{28} < \frac{21}{28}$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Find a common denominator, with at least one fraction correct, eg $\frac{12}{28}$ and $\frac{7}{28}$	**M1**	Any correct start to the common denominator scores this mark: $\frac{12}{28}$ and $\frac{7}{28}$, or the unsimplified $\frac{12n}{28n}$ and $\frac{7n}{28n}$, or $4 \times 3 = 12$ and $1 \times 7 = 7$ and $4 \times 7 = 28$, or $\frac{3 \times 4}{4 \times 7}$ and $\frac{1 \times 7}{4 \times 7}$. Calculations that would lead to 12 and 7 and 28 also score it, even if they are not yet written as fractions.	✓
A complete correct method leading to $\frac{19}{28}$, eg $\frac{12}{28} + \frac{7}{28} = \frac{19}{28}$	**A1**	Dependent on the M1. Also accepted: $\frac{12n}{28n} + \frac{7n}{28n} = \frac{19n}{28n} = \frac{19}{28}$, or $12 + 7 = 19$ together with $\frac{19}{28}$, or $4 \times 3 + (1\times)7\ (= 19)$ and $4 \times 7\ (= 28)$ and $\frac{19}{28}$, or $\frac{3 \times 4}{4 \times 7} + \frac{(1\times)7}{4 \times 7} = \frac{19}{28}$, or the one-line $\frac{3 \times 4 + 1 \times 7}{4 \times 7} = \frac{19}{28}$.	✓
Working	**Note**	A correct final line with no common denominator anywhere earns nothing. $\frac{19}{28}$ is printed in the question, so copying it out is not a method.	✓

Full marks: 2/2

Question 14 - Exam Solution

Understanding the Question

Given

(a) the product $x(x - 7)$, a single term multiplying a bracket

Find

(a) the expanded form, with no brackets left (b) $8y - 10$ written as a number

(b) the expression $8y - 10$, two terms that share a factor
(c) the formula $m = 5a + 7b$, with $m = 48$ and $b = 3$

outside a bracket (c) the value of a, which need not be a whole number

Plan the Solution

- (a) Multiply the x outside the bracket by each term inside it.
- (b) Find the highest common factor of 8 and 10, put it outside the bracket, and divide each term by it.
- (c) Put the two known values into the formula, then undo the $+21$ and the $\times 5$ in that order to leave a on its own.

Worked Solution [5 marks]

> Rule - Expanding: multiply the term outside the bracket by every term inside it. Factorising: take the highest common factor outside the bracket, and divide each term by it. Substituting: replace the letters with their values, then undo each operation in the reverse order to leave the unknown by itself.

Step 1: multiply the outside term by each term inside the bracket

$$x(x - 7) = x \times x - x \times 7 = x^2 - 7x$$

(Reason: Both terms inside the bracket are multiplied by the x outside it, and $x \times x$ is x^2.)

Step 2: take the highest common factor out of the two terms

$$8 = 2 \times 4$$
$$10 = 2 \times 5$$
$$8y - 10 = 2(4y - 5)$$

(Reason: The largest number that divides both 8 and 10 is 2, so 2 goes outside the bracket and what is left of each term goes inside.)

Step 3: substitute the two given values into the formula

$$m = 5a + 7b$$
$$48 = 5a + 7 \times 3$$
$$48 = 5a + 21$$

(Reason: Replacing m with 48 and b with 3 turns the formula into an equation with only a unknown, and $7 \times 3 = 21$.)

Step 4: undo the $+21$ to leave $5a$ on its own

$$5a = 48 - 21 = 27$$

(Reason: The opposite of adding is subtracting, so doing that to both sides removes the constant term and leaves $5a$ by itself.)

Step 5: undo the $\times 5$ to find a

$$a = \frac{27}{5}$$

$$a = 5.4$$

(Reason: Dividing both sides by 5 leaves a on its own, and $\frac{27}{5} = 5.4$ exactly, so no rounding is needed.)

(a) $x^2 - 7x$

(b) $2(4y - 5)$

(c) $a = 5.4$

Verification

- ✓ **Check 1:** Put $x = 3$ into the bracketed form and into the expanded form of part (a). Two forms of the same expression must give the same value for every x. $3(3 - 7) = -12$ and $3^2 - 7 \times 3 = -12$
- ✓ **Check 2:** Multiply out the answer to part (b) and see whether the original expression comes back. $2(4y - 5) = 8y - 10$
- ✓ **Check 3:** Put $a = 5.4$ and $b = 3$ into $m = 5a + 7b$ and check that m comes back out as 48. $5 \times 5.4 + 7 \times 3 = 27 + 21 = 48$
- ✓ **Check 4:** Work part (c) the other way round: rearrange the formula first, and substitute afterwards. $a = \frac{48 - 7 \times 3}{5} = \frac{27}{5} = 5.4$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) $x^2 - 7x$	**B1**	Correct answer only. Allow the terms the other way round, $-7x + x^2$.	✓
(b) $2(4y - 5)$	**B1**	Correct answer only. Allow the terms inside the bracket the other way round, $2(-5 + 4y)$.	✓

Step	Mark	Description	Got it?
(c) Substituting into the formula, eg $48 = 5a + 7 \times 3$ or $48 = 5a + 21$ or $(5a =)48 - 7 \times 3\ (= 27)$ or $(5a =)48 - 21\ (= 27)$, or making a the subject, $a = \dfrac{m - 7b}{5}$	**M1**	for substituting into the equation, or for making a the subject of the equation. Or equivalent.	✓
(c) $(a =)\dfrac{48 - 7 \times 3}{5}$ or $(a =)\dfrac{48 - 21}{5}$	**M1**	for a complete method. Or equivalent.	✓
(c) $a = 5.4$	**A1**	or equivalent, eg $\dfrac{27}{5}$. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
(c) Special case	**SCB1**	for answer of 261	✓
(c) The special case	**Note**	$5 \times 48 + 7 \times 3 = 261$ is the value of m when $a = 48$, so the two letters have been used the wrong way round: m has been worked out from a instead of a from m.	✓

Full marks: 5/5

Question 15 - Exam Solution

Understanding the Question

Given

The ratio of lavender candles sold to vanilla candles sold is $5 : 7$
40 lavender candles are sold
One lavender candle sells for $\$8.50$ and one vanilla candle sells for $\$12.75$

Find

The total amount of money Marcus gets for selling all of the candles

Plan the Solution

- Read the ratio carefully. The 40 is the LAVENDER part of the ratio, not the total number of candles, so 5 parts are worth 40 candles.
- Divide to find what one part of the ratio is worth, then multiply by 7 to get the number of vanilla candles.
- Work out the money taken on each kind of candle separately, then add the two amounts together.

Worked Solution [4 marks]

> Rule - Sharing in a ratio: divide the known quantity by the number of parts it stands for to get one part, then multiply one part by the other number of parts. The money taken on a kind of candle is price $\times$ number sold.

Step 1: Find what one part of the ratio stands for

$$\frac{40}{5} = 8$$

(Reason: The 40 lavender candles are the 5 parts of the ratio, so one part stands for 8 candles.)

Step 2: Work out how many vanilla candles were sold

$$7 \times 8 = 56$$

(Reason: The vanilla candles are 7 parts of the ratio, and each part stands for 8 candles.)

Step 3: Work out the money taken on the lavender candles

$$40 \times 8.50 = 340$$

(Reason: Every lavender candle brings in $\$8.50$, and 40 of them were sold.)

Step 4: Work out the money taken on the vanilla candles

$$56 \times 12.75 = 714$$

(Reason: Multiply the number of vanilla candles by the price of one vanilla candle.)

Step 5: Add the two amounts

$$340 + 714 = 1\,054$$

(Reason: The total taken is the money from the lavender candles plus the money from the vanilla candles.)

$\$1\,054$

Verification

✓ **Check 1:** The two candle counts must cancel back to the ratio the question gives. Divide each of them by 8. $\frac{40}{56} = \frac{5}{7}$

✓ **Check 2:** Work backwards from the total. Take the lavender money away from it, then divide what is left by the price of one vanilla candle. That must give the number of vanilla candles back. $1\,054 - 340 = 714$, and $\frac{714}{12.75} = 56$

✓ **Check 3:** A size check. Altogether 96 candles were sold, at prices between $\$8.50$ and $\$12.75$, so the total should be near 96 lots of about $\$10$. $96 \times 10 = 960$, which is the right size for the answer.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
$\frac{40}{5} = 8$ or $40 \times 8.50 = 340$	**M1**	for starting to work with the ratio, or for working out the total money taken on the lavender candles	✓
$7 \times 8 = 56$	**M1**	for a method to find the number of vanilla candles	✓
$340 + 56 \times 12.75$ or $340 + 714$	**M1**	for a complete method	✓
$1\,054$	**A1**	cao. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
If no other marks are awarded	**SC B2**	for answer of $439(.166\ldots)$	✓
If no other marks are awarded	**SC B1**	for $141(.66\ldots)$ or $297(.5(0))$	✓
The two special cases	**Note**	Both come from sharing the 40 candles in the ratio $5 : 7$, instead of reading the 40 as the 5 parts. $141(.66\ldots)$ is the lavender half of that wrong share and $297(.5(0))$ the vanilla half, and $439(.166\ldots)$ is the two together. The bracketed digits are optional, so a truncated 141 or 297 or 439 is accepted.	✓

Full marks: 4/4

Question 16 - Exam Solution

Understanding the Question

Given

A Venn diagram for G (plays the guitar) and P (plays the piano)
9 in G only, 6 in the overlap, 8 in P only
2 members inside the box but outside both circles

Find

(a) The number of members who play only the guitar or only the piano (b) The probability that a member chosen at random plays both instruments

Plan the Solution

- Part (a) wants the members inside one circle only, so add the two regions that are not in the overlap.
- Part (b) needs the size of the whole group first, so add all four regions - the members outside both circles were asked too.
- Then put the number in the overlap over that total and see whether the fraction cancels.

Worked Solution [3 marks]

Rule - Probability: $\dfrac{\text{members in the region you want}}{\text{members altogether}}$. The four regions of a Venn diagram do not overlap, so the total is the sum of all four values.

Step 1: add the two regions that lie inside one circle only

$$9 + 8 = 17$$

(Reason: The 9 is inside G but outside the overlap, so those members play the guitar and not the piano, and the 8 is inside P but outside the overlap. The 6 in the middle plays both instruments, so it is not counted here.)

Step 2: work out how many members were asked altogether

$$9 + 6 + 8 + 2 = 25$$

(Reason: Every member who was asked appears in exactly one region of the diagram, and that includes the ones sitting inside the box but outside both circles, so the size of the whole group is the sum of all four values.)

Step 3: write the probability of landing in the overlap

$$\frac{6}{25}$$

$$\frac{6}{25} = 0.24$$

(Reason: Only the 6 in the overlap play both instruments, and there are 25 members to choose from. 6 and 25 share no common factor, so the fraction is already in its simplest form. The decimal is worth writing down too, because the mark scheme accepts it.)

(a) 17 members

(b) $\frac{6}{25}$

Verification

✓ **Check 1:** Add the answer to part (a) to the members it leaves out - the 6 who play both and the 2 who play neither. It must come back to the whole group. $17 + 6 + 2 = 25$

✓ **Check 2:** Read the probability as a decimal and take that fraction of the group. It must come back to the number in the overlap. $0.24 \times 25 = 6$ members

✓ **Check 3:** The four regions cover everyone and share nobody, so the four probabilities must add to 1. $\frac{9}{25} + \frac{6}{25} + \frac{8}{25} + \frac{2}{25} = \frac{25}{25} = 1$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) 17	**B1**	cao - the correct answer only. No working has to be shown for this mark.	✓
(b) $\frac{6}{m}$ where $m > 6$, or $\frac{n}{25}$ where $n < 25$, or $6 : 25$, or 6 out of 25	**M1**	For a probability with the right numerator or the right denominator. Writing 6 over anything bigger than 6 shows the overlap has been picked out; writing anything smaller than 25 over 25 shows the whole group has been counted.	✓
(b) $\frac{6}{25}$	**A1**	oe eg 0.24, 24%	✓
A correct answer scores full marks	**Note**	Printed against part (b) on the official scheme. A ratio such as $6 : 25$ earns the method mark but not	✓

Step	Mark	Description	Got it?
unless it comes from obviously incorrect working.		the accuracy mark, because a ratio is not a probability.	

Full marks: 3/3

Question 17 - Exam Solution

Understanding the Question

Given

The plan is a rectangle 8 m by 6 m with an isosceles triangle joined along one 6 m edge
The triangle stands 3 m out from that edge, so 3 m is its height
One tin of sealer covers $4\ \text{m}^2$

Find

The smallest number of whole tins that will give the deck one coat

Plan the Solution

- Split the plan along the dashed line into the rectangle and the triangle, and work out each area on its own.
- Add the two areas to get the area of the whole deck.
- Divide that total by 4 to see how many tins' worth of sealer the deck takes.
- Round up. Tins are sold whole, so any sealer needed beyond a whole number of tins means buying one more.

Worked Solution [4 marks]

> Rule - Composite area: split the shape into parts whose areas you know, then add. A rectangle has area $\text{length} \times \text{width}$ and a triangle has area $\frac{1}{2} \times \text{base} \times \text{height}$.

Step 1: the area of the rectangle

$8 \times 6 = 48\ \text{m}^2$

(Reason: The rectangle is 8 m along the bottom and 6 m up the side, so its area is length times width.)

Step 2: the area of the triangle

$$\frac{1}{2} \times 6 \times 3 = 9 \text{ m}^2$$

(Reason: The triangle is joined along the 6 m edge, so that edge is its base, and the arrow gives its height as 3 m.)

Step 3: the area of the whole deck

$$48 + 9 = 57 \text{ m}^2$$

(Reason: The rectangle and the triangle meet along the dashed line and do not overlap, so the two areas simply add.)

Step 4: how many tins' worth of sealer that is

$$\frac{57}{4} = 14.25$$

(Reason: Each tin covers 4 m^2, so the total area divided by 4 gives the number of tins the deck takes.)

Step 5: round up to whole tins

$$14 \times 4 = 56 \text{ m}^2$$
$$15 \times 4 = 60 \text{ m}^2$$

(Reason: Sealer is only sold in whole tins. 14 tins cover 56 m^2, which leaves part of the deck bare, so the 14.25 has to be rounded up rather than down.)

15 tins

Verification

✓ **Check 1:** Use the symmetry instead of the split. Cutting along the line through the point leaves a trapezium with parallel sides 8 m and 11 m and width 3 m, and the other half is identical. $\frac{1}{2} \times (8 + 11) \times 3 = 28.5$ and $28.5 \times 2 = 57$, the same total area

✓ **Check 2:** Count the tins part by part rather than from the total: $\frac{48}{4}$ for the rectangle and $\frac{9}{4}$ for the triangle. $12 + 2.25 = 14.25$, which rounds up to the same 15 tins

✓ **Check 3:** Test the answer against the area it has to cover, from both sides. $15 \times 4 = 60$, enough for 57 m^2 with 3 m^2 spare, while $14 \times 4 = 56$ leaves 1 m^2 uncovered

Mark Scheme Breakdown

Step	Mark	Description	Got it?
A correct method for one relevant area	**M1**	Any one correct area method, eg $6 \times 8 = 48$ or $\frac{1}{2} \times 6 \times 3 = 9$ or $\frac{1}{2} \times \frac{6}{2} \times 3 = 4.5$ (half the triangle) or $\frac{1}{2} \times (11 + 8) \times 3 = 28.5$ (half the plan)	✓
A complete method for the total area, or the tins for one part	**M1**	From this mark on, follow either the area route or the tins route. Area route - a complete method for the total area, eg $48 + 9 = 57$ or $48 + 4.5 + 4.5 = 57$ or $28.5 \times 2 = 57$. Tins route - a correct method for the tins needed for part of the deck, eg $\frac{48}{4}$ $(= 12)$ or $\frac{9}{4}$ $(= 2.25$ or $3)$ or $\frac{4.5}{4}$ $(= 1.125)$ or $\frac{28.5}{4}$ $(= 7.125)$. The official scheme prints the 9 in quotation marks, which means the candidate's own earlier area may be used in its place.	✓
A method for the number of tins	**M1 indep**	Area route - independent, and follow through from any area that came from a calculation using at least two of the given dimensions, eg $\frac{57}{4} = 14.25$ or their area divided by 4 or $15 \times 4 = 60$. Tins route - adding the tins found for the parts, eg $12 + 2.25 = 14.25$ or $2 \times 7.125 = 14.25$	✓
The answer	**A1 dep on M2**	15, from correct working. Working is required, so an unsupported answer earns nothing here.	✓

Full marks: 4/4

Question 18 - Exam Solution

Understanding the Question

Given

Find

The distance, d km, travelled to work by each of 100 members of staff, grouped into five classes
The five frequencies 26, 40, 16, 10 and 8
No individual distance is given, only the class that each one falls in

(a) The modal class (b) An estimate for the mean distance, in km

Plan the Solution

- For part (a), read the answer straight off the table: the modal class is the class with the largest frequency, and the answer is that class, not the frequency itself.
- For part (b), the individual distances are unknown, so treat everybody in a class as if they travelled the midpoint of that class.
- Multiply each midpoint by its frequency, add the five products to estimate the total distance travelled, then divide that total by 100.

Worked Solution [5 marks]

> Rule - Estimated mean of grouped data: $\text{estimated mean} = \dfrac{\sum fx}{\sum f}$, where x is the midpoint of a class and f is the frequency of that class.

Step 1: Pick out the largest frequency (part (a))

$26,\ 40,\ 16,\ 10,\ 8$

$5 < d \leq 10$

(Reason: The largest frequency is 40, and those 40 members of staff are the ones whose distance lies in the class $5 < d \leq 10$. The modal class is that class. Writing 40 as the answer names how many, not how far.)

Step 2: Find the midpoint of each class

$$\frac{0+5}{2} = 2.5$$

$$\frac{5+10}{2} = 7.5$$

$$\frac{10+15}{2} = 12.5$$

$$\frac{15+20}{2} = 17.5$$

$$\frac{20+25}{2} = 22.5$$

(Reason: Add the two ends of the class and halve. The midpoint is the single value that best represents everybody in that class, which is why the answer to part (b) can only ever be an estimate.)

Step 3: Multiply each midpoint by its frequency

$2.5 \times 26 = 65$

$7.5 \times 40 = 300$

$12.5 \times 16 = 200$

$17.5 \times 10 = 175$

$22.5 \times 8 = 180$

(Reason: Each product estimates the total distance travelled by the staff in one class: 26 people at about 2.5 km each accounts for about 65 km.)

Step 4: Add the five products

$65 + 300 + 200 + 175 + 180 = 920$

(Reason: This is the estimated total distance, in km, travelled to work by all 100 members of staff.)

Step 5: Divide by the total frequency

$$\frac{920}{100} = 9.2$$

(Reason: Sharing the estimated total distance equally between the 100 members of staff gives the estimated mean. Divide by the total frequency, never by the number of classes.)

(a) $5 < d \leq 10$

(b) 9.2 km

Verification

✓ **Check 1:** Add the frequency column: $26 + 40 + 16 + 10 + 8 = 100$. Every member of staff has been counted exactly once, so 100 is the right number to divide by.

✓ **Check 2:** Work the mean out a second way, from an assumed mean of 7.5. The midpoints differ from 7.5 by -5, 0, 5, 10 and 15, so

$$26 \times (-5) + 40 \times 0 + 16 \times 5 + 10 \times 10 + 8 \times 15 = 170. \; 7.5 + \frac{170}{100} = 9.2,$$

which is the same estimate reached without using the five products.

✓ **Check 3:** Bracket the answer. Replace every distance by the smallest value its class allows, then by the largest: $\frac{670}{100} = 6.7$ and $\frac{1170}{100} = 11.7$. The mean has to sit between 6.7 and 11.7, and 9.2 does. It also sits inside the modal class, which is where most of the staff are.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) Write down the class with the greatest frequency	**B1**	$5 < d \leq 10$. Allow $5 - 10$ or 5 to 10, or $5 < d < 10$, or $5 \leq d \leq 10$, or $5 \leq d < 10$.	✓
(b) At least 4 correct products of midpoint and frequency, added	**M2**	$2.5 \times 26 + 7.5 \times 40 + 12.5 \times 16 + 17.5 \times 10 + 22.5 \times 8 = 920$, or $65 + 300 + 200 + 175 + 180 = 920$. The products need not be evaluated, so the first form on its own earns this.	✓
If M2 is not earned: at least 4 products added, using a value taken consistently from inside each interval (an end point is allowed), or correct midpoints used for at least 4 products but not added	**M1**	For example $5 \times 26 + 10 \times 40 + \ldots$ Again the products need not be evaluated.	✓
Divide their total by their total frequency: $\frac{920}{100}$	**M1**	Dependent on at least M1. Division by their own $\sum f$ is allowed, provided the addition, or a total written under the frequency column, is seen.	✓
(b) The estimate of the mean	**A1**	9.2, or an equivalent value such as $9\frac{1}{5}$ or $\frac{46}{5}$. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
Special case, when no other marks in part (b) are earned: an answer of 6.7, 9.7 or 11.7	**SC B2**	Each one names a particular slip. 6.7 uses the lower end of every class instead of its midpoint, 11.7 uses the upper end, and 9.7 uses 3, 8, 13, 18 and 23, each a half kilometre above the true midpoint.	✓

Full marks: 5/5

Question 19 - Exam Solution

Understanding the Question

Given

Each candle costs 6 Swiss francs to make.
Each box holds 4 candles, and 80 boxes are sold.
The 80 boxes bring in 2160 Swiss francs altogether.
A height of 9 cm, correct to the nearest cm.
A weight of 120 g, correct to the nearest 10 g.

Find

(a) The percentage profit. (b) The lower bound of the height. (c) The upper bound of the weight.

Plan the Solution

- Count the candles first: 4 in each of 80 boxes.
- Cost them all, then take that away from the money taken to leave the profit.
- Percentage profit compares the profit with what the candles COST, not with the money taken.
- For each bound, halve the accuracy the measurement is given to, then step that far below or above the value stated.

Worked Solution [6 marks]

> Rule - Percentage profit: $\text{percentage profit} = \dfrac{\text{profit}}{\text{cost}} \times 100$. Rule - Bounds: a measurement given to the nearest u lies within $\dfrac{u}{2}$ of the value stated, so the bounds sit half a unit either side of it.

Step 1: Count the candles that are sold

$$4 \times 80 = 320$$

(Reason: (Reason: each of the 80 boxes holds 4 candles, so the number of candles is one multiplication.))

Step 2: Work out what those candles cost to make

$$320 \times 6 = 1920$$

(Reason: (Reason: every candle costs the same 6 Swiss francs, so the total cost is the number of candles times the cost of one.))

Step 3: Take the cost away from the money taken

$$2160 - 1920 = 240$$

(Reason: (Reason: profit is what is left of the 2160 Swiss francs once the making cost has been paid for.))

Step 4: Write the profit as a percentage of the cost

$$\frac{240}{1920} \times 100 = 12.5$$

(Reason: (Reason: percentage profit measures the profit against what the candles cost to make, so it is the profit that is divided by the cost.))

Step 5: (b) The lower bound of the height

$$9 - 0.5 = 8.5$$

(Reason: (Reason: to the nearest cm, half a unit is 0.5 cm, so every height from 8.5 cm up to 9.5 cm rounds to 9 cm, and 8.5 cm is the smallest of them.))

Step 6: (c) The upper bound of the weight

$$120 + 5 = 125$$

(Reason: (Reason: to the nearest 10 g, half a unit is 5 g, so the weights that round to 120 g run from 115 g up to 125 g, and 125 g is the upper bound.))

(a) 12.5 %

(b) 8.5 cm

(c) 125 g

Verification

✓ **Check 1:** Work with one box instead of the whole order. One box brings in $\frac{2160}{80} = 27$ Swiss francs and costs $4 \times 6 = 24$ Swiss francs to make. $\frac{27 - 24}{24} \times 100 = 12.5$

✓ **Check 2:** Scale the cost back up. A profit of 12.5 per cent means the money taken should be 1.125 times the making cost. $1920 \times 1.125 = 2160$

✓ **Check 3:** Test the two bounds by looking at the interval each one ends. The heights that round to 9 cm run from 8.5 cm to 9.5 cm; the weights that round to 120 g run from 115 g

to 125 g. Each interval is centred on the measurement given, $\frac{8.5 + 9.5}{2} = 9$ and $\frac{115 + 125}{2} = 120$, so the bounds are the right distance out.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a) A method for the total making cost, or for one box, or for the money taken for one box or for one candle: $4 \times 6 \times 80 = 1920$, or $4 \times 6 = 24$, or $\frac{2160}{80} = 27$, or $\frac{2160}{80 \times 4} = 6.75$	**M1**	Any one of these four starting methods earns the mark.	✓
Work out the profit, or divide the money taken by the cost: $2160 - 1920 = 240$, or $27 - 24 = 3$, or $6.75 - 6 = 0.75$, or $\frac{2160}{1920} = 1.125$	**M1**	The official scheme puts these figures in quotation marks, which means the candidate's own earlier value may be used here.	✓
A method that reaches one step from the answer: $\frac{240}{1920} \times 100$, or 0.125×100, or $\left(\frac{2160}{1920} - 1\right) \times 100$, or $1.125 \times 100 = 112.5$	**M1**	Getting as far as $\frac{1}{8}$ or equivalent, or 0.125, or 112.5. A candidate who stops at 112.5 has not taken off the 100 per cent that is the original cost.	✓
(a) 12.5	**A1**	Working is required, and this mark is not awarded unless a method mark has been earned.	✓
(b) 8.5	**B1**	Correct answer only.	✓
(c) 125	**B1**	Allow $124.\dot{9}$ or $124.99\ldots$.	✓

Full marks: 6/6

Question 20 - Exam Solution

Understanding the Question

Given

AB and BC are two sides of a regular polygon with n sides
At B a third line makes an angle of $50°$ with BC and an angle of $148°$ with BA

Find

The value of n, the number of sides of the polygon

Plan the Solution

- The three angles at B make one full turn, so taking the two marked angles away from $360°$ leaves the interior angle $\angle ABC$ of the polygon.
- An interior angle and its exterior angle sit on a straight line, so the exterior angle is what is left from $180°$.
- Every exterior angle of a regular polygon is the same size and they add up to $360°$, so dividing gives the number of sides.

Worked Solution [4 marks]

> Rule - Exterior angles: angles at a point add up to $360°$; an interior angle and its exterior angle add up to $180°$; and the exterior angles of any polygon add up to $360°$.

Step 1: Add the two marked angles at B

$$148 + 50 = 198$$

(Reason: The two marked angles sit side by side at B, so between them they take up $198°$ of the turn at that point.)

Step 2: Take that away from a full turn

$$360 - 198 = 162$$

(Reason: Angles at a point add up to $360°$, so the angle left over is the polygon's interior angle $\angle ABC$, which is $162°$.)

Step 3: Turn the interior angle into the exterior angle

$$180 - 162 = 18$$

(Reason: The interior angle and the exterior angle at the same corner lie on a straight line, and angles on a straight line add up to $180°$.)

Step 4: Divide a full turn by the exterior angle

$$\frac{360}{18} = 20$$

(Reason: A regular polygon has n equal exterior angles adding up to $360°$, so the number of them of size $18°$ is what n must be.)

$$n = 20$$

Verification

✓ **Check 1:** Work backwards from the answer. The interior angles of a polygon with 20 sides add up to $180 \times 18 = 3240$, shared equally between 20 corners. $\dfrac{3240}{20} = 162$, which is the interior angle the diagram gives.

✓ **Check 2:** Put the interior angle back on the diagram and add all three angles at B. $162 + 148 + 50 = 360$, one complete turn.

✓ **Check 3:** Walk right round the polygon, turning through one exterior angle at each of the 20 corners. $20 \times 18 = 360$, so the walk faces its starting direction again and the shape closes.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Method for the interior angle at B	**M1**	For $360 - (148 + 50)$ $(= 162)$, or for a start on the exterior angle such as $180 - 50$ $(= 130)$ or $180 - 148$ $(= 32)$.	✓
Method for the exterior angle	**M1**	For $180 - 162$ $(= 18)$, or $148 - 130$ $(= 18)$, or $50 - 32$ $(= 18)$; or for setting up the interior angle sum as $180(n - 2) = 162n$ or $\dfrac{180(n - 2)}{n} = 162$. The official scheme prints the 162, the 130 and the 32 in quotation marks, which means the candidate's own interior angle may be used in place of each.	✓
A complete method	**M1**	For $\dfrac{360}{18}$ on their exterior angle, or for $n = \dfrac{360}{180 - 162}$ written in one line.	✓
The value of n	**A1**	For 20. Working is required, so the mark is not given for a bare answer: it depends on a method mark being earned.	✓

Full marks: 4/4

Question 21 - Exam Solution

Understanding the Question

Given

$x^5 \times x^7 = x^m$

$\frac{y^8}{y^3} = y^n$

The expression $(5a^4r^2)^3$, to be written as one simplified term

Find

The value of m The value of n A single term for $(5a^4r^2)^3$ with no bracket left in it

Plan the Solution

- Parts (a) and (b) are the two basic index laws. Powers of the same base multiplied together have their indices added; divided, their indices are taken away.
- Part (c) has a bracket, so the index 3 outside it reaches every factor inside: the 5, the a^4 and the r^2 each get cubed.
- Deal with those three factors one at a time. The number is cubed like everything else, and a power raised to a power has its indices multiplied.

Worked Solution [4 marks]

> Rule - Index laws: $x^a \times x^b = x^{a+b}$, $\frac{x^a}{x^b} = x^{a-b}$ and $(x^a)^b = x^{ab}$. A power written outside a bracket applies to every factor inside it.

Step 1: Part (a) - two powers of the same base multiplied

$x^5 \times x^7 = x^{5+7} = x^{12}$

$m = 12$

(Reason: The base is x on both sides of the multiplication sign, so five x's standing beside seven x's make twelve x's in one product. Comparing that with x^m gives the value of m.)

Step 2: Part (b) - two powers of the same base divided

$\frac{y^8}{y^3} = y^{8-3} = y^5$

$n = 5$

(Reason: Three of the eight y's on the top cancel with the three underneath, and five are left. Comparing with y^n gives the value of n.)

Step 3: Part (c) - give every factor inside the bracket the index 3

$(5a^4r^2)^3 = 5^3 \times (a^4)^3 \times (r^2)^3$

(Reason: Cubing the bracket means writing its contents out three times and multiplying, so each of the three factors inside is cubed. Missing the 5 here is the commonest way marks are lost in this part.)

Step 4: Part (c) - work out the three factors separately

$5^3 = 5 \times 5 \times 5 = 125$

$(a^4)^3 = a^{4\times3} = a^{12}$

$(r^2)^3 = r^{2\times3} = r^6$

(Reason: The number is cubed exactly as the letters are. For a power of a power the indices multiply, because a^4 taken three times over is a taken 4×3 times.)

Step 5: Part (c) - put the three factors back together

$(5a^4r^2)^3 = 125a^{12}r^6$

(Reason: The three factors are multiplied, so the number goes in front and each letter keeps its new index. Nothing can be collected any further, because a and r are different letters.)

(a) $m = 12$

(b) $n = 5$

(c) $125a^{12}r^6$

Verification

- ✓ **Check 1 - part (a):** Put $x = 2$ into the left-hand side, working the two powers out separately: $2^5 = 32$ and $2^7 = 128$. $32 \times 128 = 4096$ and $2^{12} = 4096$, so the two sides agree and $m = 12$.
- ✓ **Check 2 - part (b):** Put $y = 2$ into the fraction: the top is $2^8 = 256$ and the bottom is $2^3 = 8$. $\frac{256}{8} = 32$ and $2^5 = 32$, so the two sides agree and $n = 5$.
- ✓ **Check 3 - part (c):** Put $a = 2$ and $r = 3$ into the bracket first, then cube what comes out: $5 \times 16 \times 9 = 720$. $720^3 = 373\,248\,000$ and the answer gives $125 \times 2^{12} \times 3^6 = 373\,248\,000$, the same number.
- ✓ **Check 4 - part (c) without any index law:** Write the bracket out three times, $(5a^4r^2)(5a^4r^2)(5a^4r^2)$, and collect the numbers and each letter by hand. The numbers give $5 \times 5 \times 5 = 5^3 = 125$, the a's give $4 + 4 + 4 = 12$ and the r's give $2 + 2 + 2 = 6$.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Part (a): the value of m	**B1**	For 12. Accept the answer written as x^{12}.	✓
Part (b): the value of n	**B1**	For 5. Accept the answer written as y^{5}.	✓
Part (c): fully simplified	**B2**	For $125a^{12}r^{6}$, with no bracket left and nothing further to collect.	✓
Part (c): partly simplified	**B1**	Awarded instead of the two marks, for a product in the form $ka^{p}r^{q}$ in which two of k, p and q are correct, for example $5a^{12}r^{6}$ - the candidate who cubes both letters but leaves the 5 alone. Allow $125a^{12}$, $125r^{6}$ or $a^{12}r^{6}$ so long as they are not added to any other terms.	✓

Full marks: 4/4

Question 22 - Exam Solution

Understanding the Question

Given

In the sale, every normal price is reduced by 28%.
The sale price of the rucksack is 198 euros.
The reduction is taken off the normal price, and the normal price is the unknown.

Find

The normal price of the rucksack, in euros, before the reduction.

Plan the Solution

- A reduction of 28% leaves 72% of the normal price, so work out what is left before anything else.
- Write that percentage as a decimal multiplier, so that the sale price is the multiplier times the normal price.
- Divide to undo the multiplication, then check by taking the reduction off the answer.

Worked Solution [3 marks]

> Rule - Reverse percentage: sale price $=$ multiplier $\times$ normal price, so normal price $=\dfrac{\text{sale price}}{\text{multiplier}}$.

Step 1: Work out the percentage that is left

$100\% - 28\% = 72\%$

(Reason: The normal price is the whole thing, 100%. Taking 28% away leaves 72% of it, and that is what the 198 euros on the sale ticket buys.)

Step 2: Turn that percentage into a multiplier

$$\frac{72}{100} = 0.72$$

$$0.72 \times n = 198$$

(Reason: Per cent means out of a hundred, so 72% is the decimal 0.72. Writing n for the normal price in euros, paying 72% of it is the same as multiplying it by 0.72.)

Step 3: Divide to reverse the multiplication

$$n = \frac{198}{0.72}$$

$$n = 275$$

(Reason: Division undoes multiplication, so the normal price is the sale price divided by the multiplier found in Step 2. The answer comes out as a whole number of euros, which is what a price tag should be.)

275 euros

Verification

✓ **Check 1:** Take 28% of the answer and subtract it. The sale price must come back. $\dfrac{28 \times 275}{100} = 77$ and $275 - 77 = 198$

✓ **Check 2:** Use the unitary method instead. Divide the sale price by 72 to get 1% of the normal price, then take 100 of those. $\dfrac{198}{72} = 2.75$ and $2.75 \times 100 = 275$

✓ **Check 3:** Compare the two prices as a fraction. The sale price should be 0.72 of the normal price. $\dfrac{198}{275} = 0.72$

Mark Scheme Breakdown

Step	Mark	Description	Got it?
eg $1 - 0.28 = 0.72$ oe, or $100\% - 28\% = 72\%$, or $0.72x = 198$, or $\frac{198}{72} = 2.75$ oe	M1	for a correct first step: the multiplier, or the percentage that is left, or an equation for the normal price	✓
eg $(x =) \frac{198}{0.72}$ oe, or $\frac{198}{72} \times 100$ oe, or 2.75×100	M1	for a complete method: dividing the sale price by the multiplier, or the equivalent unitary method. The official scheme prints the 0.72, the 72 and the 2.75 in quotation marks, which means the candidate's own value from the first mark may be used in place of each.	✓
275	A1	cao, the normal price in euros	✓
Correct answer scores full marks, unless it comes from obvious incorrect working.	Note	guidance for the marker; this row carries no mark of its own	✓

Full marks: 3/3

Question 23 - Exam Solution

Understanding the Question

Given

The equation $x - 4 = \frac{3 + 2x}{6}$, which has the unknown on both sides and a fraction on the right.
The quadratic expression $y^2 - 11y + 30$, which is in the form $y^2 + by + c$ with $b = -11$ and $c = 30$.

Find

(a) The value of x, with the algebra shown. (b)(i) $y^2 - 11y + 30$ written as a product of two brackets. (b)(ii) The values of y that make that product zero. A quadratic like this one has two of them.

Plan the Solution

- (a) Multiply both sides by 6 so the fraction disappears, expand the bracket, then gather the x terms on one side and the numbers on the other.
- (b)(i) Look for the pair of numbers whose product is 30 and whose sum is -11. A positive product with a negative sum means both numbers are negative.
- (b)(ii) The word hence is an instruction: use the brackets from part (b)(i) rather than starting again. A product of two things is zero only when one of them is zero.

Worked Solution [6 marks]

> Rule - Clearing a fraction: multiply every term on BOTH sides by the denominator, then solve as usual. Rule - Factorising $y^2 + by + c$: find the pair of numbers whose product is c and whose sum is b; each one goes into its own bracket.

(a) Multiply both sides by 6

$$x - 4 = \frac{3 + 2x}{6}$$

$$6(x - 4) = 3 + 2x$$

(Reason: The fraction is the only thing stopping ordinary algebra. Multiplying by 6 cancels the denominator on the right, and the left-hand side must be multiplied by 6 too, which is why it goes inside a bracket.)

(a) Expand the bracket

$$6x - 24 = 3 + 2x$$

(Reason: The 6 outside multiplies BOTH terms inside the bracket, the x and the 4. This line is where the first method mark is earned, and it is the line most often lost.)

(a) Gather the x terms on one side

$$6x - 2x = 3 + 24$$

$$4x = 27$$

(Reason: Take $2x$ from both sides and add 24 to both sides. The four terms then sit where they belong: terms in x on the left, numbers on the right.)

(a) Divide both sides by 4

$$x = \frac{27}{4} = 6.75$$

(Reason: 27 does not divide by 4 exactly, so the fraction is the exact answer. The mark scheme accepts $\frac{27}{4}$, 6.75 and $6\frac{3}{4}$, because they are one value written three ways.)

(b)(i) Find the pair of numbers

$(-6) \times (-5) = 30$

$(-6) + (-5) = -11$

(Reason: The product 30 is positive and the sum -11 is negative, so both numbers must be negative. Of the pairs that multiply to 30, only -6 and -5 also add to -11.)

(b)(i) Write the expression as two brackets

$y^2 - 11y + 30 = (y - 6)(y - 5)$

(Reason: Each number of the pair goes into its own bracket. Multiplying out gives $y^2 - 5y - 6y + 30$, and the two middle terms collect back to $-11y$.)

(b)(ii) Set each bracket equal to zero

$(y - 6)(y - 5) = 0$

$y - 6 = 0$ or $y - 5 = 0$

$y = 6$ or $y = 5$

(Reason: Two things multiply to give zero only when one of them IS zero, so each bracket is tried in turn. Because part (b)(i) has already been done, no further algebra is needed here, which is why this part carries only one mark.)

(a) $x = \dfrac{27}{4} = 6.75$

(b)(i) $(y - 6)(y - 5)$

(b)(ii) $y = 6$ **or** $y = 5$

Verification

- ✓ **Check 1:** Put the answer back into the equation the question printed and work the two sides out separately. Left-hand side: $6.75 - 4$. Right-hand side: $\dfrac{3 + 2 \times 6.75}{6}$. Both sides come to 2.75, so $x = 6.75$ balances the equation.
- ✓ **Check 2:** Multiply the brackets back out, without looking at the original expression: $(y - 6)(y - 5) = y^2 - 5y - 6y + 30$. That collects to $y^2 - 11y + 30$, which is the expression the question gave.
- ✓ **Check 3:** Substitute each solution into the quadratic itself, not into the brackets: $6^2 - 11 \times 6 + 30$ and $5^2 - 11 \times 5 + 30$. The first gives $36 - 66 + 30 = 0$ and the second gives $25 - 55 + 30 = 0$, so both values really are solutions.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
$6x - 24 = 3 + 2x$ or $x - 4 = \frac{3}{6} + \frac{2}{6}x$	M1	for correct removal of the fraction and expansion of the bracket in a correct equation, or for separating the fraction on the right-hand side in an equation	✓
$6x - 2x = 3 + 24$ or $4x = 27$ or $-24 - 3 = 2x - 6x$ or $-27 = -4x$ or $x - \frac{2}{6}x = \frac{3}{6} + 4$ or $-4 - \frac{3}{6} = \frac{2}{6}x - x$	M1ft	Dependent on a 4 term equation. For correctly rearranging their 4 term equation so that the terms in x are on one side of the equation and the number terms on the other.	✓
$x = \frac{27}{4}$	A1	oe, eg 6.75 or $6\frac{3}{4}$, dependent on the first M1. Working is required, so a correct answer written down with no algebra scores nothing here.	✓
$(y \pm 6)(y \pm 5)$ or $(6 \pm y)(5 \pm y)$ or $y(y - 6) - 5(y - 6)$ or $y(y - 5) - 6(y - 5)$	M1	for $(y \pm 6)(y \pm 5)$ or $(6 \pm y)(5 \pm y)$, or for $(y + a)(y + b)$ where $ab = 30$ or $a + b = -11$; or for $y(y + a) + b(y + a)$ or $y(y + b) + a(y + b)$, again where $ab = 30$ or $a + b = -11$	✓
$(y - 6)(y - 5)$	A1	oe, and any letter is allowed in place of y. A correct answer scores full marks unless it comes from obviously incorrect working.	✓
$y = 6, y = 5$	B1	must follow through from their answer to part (b)(i), where their factors are in the form $(y + a)(y + b)$	✓

Full marks: 6/6

Question 24 - Exam Solution

Understanding the Question

Given

A solid candle in the shape of a cylinder
Radius $r = 8$ cm
Height h cm - the unknown
Volume $V = 3892$ cm³

Find

The value of h, correct to one decimal place

Plan the Solution

- The volume of a cylinder is the area of its circular face multiplied by its height.
- Work out the area of the circular face first, from the radius 8 cm.
- Then divide the volume by that area, which leaves h on its own.
- Keep the full calculator value all the way through and round only on the last line.

Worked Solution [3 marks]

> Rule - Volume of a cylinder: $V = \pi r^2 h$, where r is the radius of the circular face and h is the height.

Step 1: put what you know into the formula

$$V = \pi r^2 h$$
$$3892 = \pi \times 8^2 \times h$$

(Reason: The volume and the radius are both given, so h is the only letter left in the equation.)

Step 2: work out the area of the circular face

$$\pi \times 8^2 = \pi \times 64 = 201.0619\ldots$$

(Reason: Square the radius first, then multiply by π - this is the area of the flat circular face of the candle, in square centimetres.)

Step 3: divide to find h

$$h = \frac{3892}{\pi \times 8^2}$$
$$h = \frac{3892}{201.0619\ldots} = 19.3572\ldots$$

(Reason: h is multiplied by the area, so dividing the volume by the area undoes that and leaves the height.)

Step 4: round to one decimal place

$$h = 19.4$$

(Reason: The digit after the first decimal place is 5, so $19.3572\ldots$ rounds up to 19.4.)

$$h = 19.4$$

Verification

✓ **Check 1:** Reverse the division - multiply the area of the circular face by the height and see whether the volume comes back. $201.0619\ldots \times 19.3572\ldots = 3892$

✓ **Check 2:** Work it out again with 3.14 in place of π, and then with $\frac{22}{7}$.
$\frac{3892}{3.14 \times 64} = 19.367\ldots$, still 19.4 to one decimal place, while $\frac{22}{7}$ gives $19.349\ldots$, which rounds to 19.3. That pair is exactly why the mark scheme accepts anything from 19.3 to 19.4.

✓ **Check 3:** Is the size sensible? The smallest box that would hold the candle is 16 cm by 16 cm by the height, and a cylinder fills a little under four fifths of its box.
$16 \times 16 \times 19.4 = 4966.4$, and 3892 is about 78 per cent of that - just what a cylinder inside its box should be.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
Substitute into $V = \pi r^2 h$ to reach $3892 = \pi \times 8^2 \times h$, or work out $\pi \times 8^2$ on its own	**M1**	A method mark for a correct volume statement. Allow 3.14 or $\frac{22}{7}$ in place of π, and allow the area left as 64π or written as $201\ldots$.	✓
Divide: $h = \frac{3892}{\pi \times 8^2}$, or in two stages, $\frac{3892}{64} = 60.8\ldots$ then $\frac{60.8\ldots}{\pi}$	**M1**	A second method mark for the division, in either order. Again allow 3.14 or $\frac{22}{7}$ for π.	✓
Answer: $h = 19.4$	**A1**	Allow anything from 19.3 to 19.4, which covers the approximations for π. A correct answer scores full marks unless it comes from obviously incorrect working.	✓

Full marks: 3/3

Question 25 - Exam Solution

Understanding the Question

Given

The number 520 million.
The number 8.79×10^{-5}, already written in standard form.
The product $(5 \times 10^{42}) \times (7 \times 10^{-180})$.

Find

(a) That number written in standard form. (b) The same number written out in full, with no power of ten in it. (c) The product, written in standard form.

Plan the Solution

- (a) Write 520 million out in full, then put the decimal point just after the first digit and count how many places it moved.
- (b) A negative index means dividing by that power of ten, so move every digit 5 places to the right.
- (c) Multiply the front numbers, add the indices, then bring the front number back into range and lift the index to match.

Worked Solution [4 marks]

> Standard form writes a number as a front number times a power of ten, $A \times 10^n$, where the front number is from 1 up to (but never reaching) 10, and the index is a whole number. To multiply two numbers in standard form, multiply the front numbers and add the indices.

(a) Write the number in full, then count the places

$520\,000\,000 = 5.2 \times 100\,000\,000$

$100\,000\,000 = 10^8$

$520\,000\,000 = 5.2 \times 10^8$

(Reason: One million is $1\,000\,000$, so 520 million is $520\,000\,000$. The front number has to be from 1 up to 10, which makes it 5.2, and the decimal point has travelled 8 places to the left. That count is the index.)

(b) A negative index moves the digits the other way

$$8.79 \times 10^{-5} = \frac{8.79}{10^5}$$

$$\frac{8.79}{100\,000} = 0.0000879$$

(Reason: Multiplying by 10^{-5} is the same as dividing by 10^{5}, so every digit moves 5 places to the right. The 8 lands in the fifth place after the decimal point, with the 7 and the 9 following it.)

(c) Multiply the front numbers, add the indices

$5 \times 7 = 35$

$10^{42} \times 10^{-180} = 10^{42+(-180)} = 10^{-138}$

$(5 \times 10^{42}) \times (7 \times 10^{-180}) = 35 \times 10^{-138}$

(Reason: A product may be taken in any order, so collect the two front numbers together and the two powers of ten together. Adding the indices gives $42 + (-180) = -138$, and adding a negative index is a subtraction, so the index falls well below zero.)

(c) Bring the front number back into range

$35 = 3.5 \times 10$

$35 \times 10^{-138} = 3.5 \times 10^{-137}$

(Reason: The front number must be from 1 up to 10, and 35 is too big for that. Writing 35 as 3.5×10 hands one more power of ten to the index, so the index rises by one: $-138 + 1 = -137$.)

(a) 5.2×10^{8}

(b) 0.0000879

(c) 3.5×10^{-137}

Verification

- ✓ **Check 1:** Multiply the standard-form answer to part (a) back out. It must return the number the question gave. $5.2 \times 10^{8} = 520\,000\,000$
- ✓ **Check 2:** Send part (b) back the other way. Multiplying the ordinary number by 10^{5} must return the front number. $0.0000879 \times 10^{5} = 8.79$
- ✓ **Check 3:** Divide the answer to part (c) by one of the two numbers being multiplied. The other one must come back. $\dfrac{3.5 \times 10^{-137}}{7 \times 10^{-180}} = 5 \times 10^{42}$
- ✓ **Check 4:** Test both standard-form answers against the definition itself: a front number from one up to ten, and a whole-number index. The front numbers are 5.2 and 3.5, both in range, and the indices 8 and -137 are whole numbers, so each answer really is in standard form.

Mark Scheme Breakdown

Step	Mark	Description	Got it?
(a)	**B1**	5.2×10^{8}, and nothing else.	✓
(b)	**B1**	0.0000879, and nothing else. The digits may be written grouped in threes.	✓
(c)	**M1**	For 35×10^{-138}, or $3.5 \times 10 \times 10^{-138}$, or 3.5 times a power of ten whose index is anything other than -137. This is the method mark: the multiplying and the adding of indices have been done, but the answer has not been put back into standard form.	✓
(c)	**A1**	3.5×10^{-137}. A correct answer scores both marks, unless it follows obviously incorrect working.	✓

Full marks: 4/4

Question 26 - Exam Solution

Understanding the Question

Given

Trapezium $ABCD$, with exactly one line of symmetry
angle $ADC = 60°$
$AD = 12$ cm, the sloping side
$DC = 47$ cm, the long parallel side

Find

The area of the trapezium, correct to 3 significant figures

Plan the Solution

- The parallel sides are AB and DC. Only one of them is given, so the area formula needs two missing pieces: the length of AB and the perpendicular height.
- Drop a perpendicular from A onto DC. That makes a right-angled triangle with hypotenuse 12 cm and an angle of $60°$ at D.
- In that triangle the height is opposite the $60°$, so it comes from the sine. The piece it cuts off along the bottom is next to the $60°$, so it comes from the cosine.
- One line of symmetry means an identical triangle sits at the other end, so that same piece comes off DC at both ends.
- Then put AB, DC and the height into the trapezium formula and round at the very end.

Worked Solution [5 marks]

> Rule - Trapezium: $\text{Area} = \frac{1}{2}(a+b)h$, where a and b are the two parallel sides and h is the perpendicular distance between them. In a right-angled triangle the side opposite an angle is $\text{hypotenuse} \times \sin\theta$ and the side next to it is $\text{hypotenuse} \times \cos\theta$.

Step 1: The perpendicular height

$$h = 12 \times \sin 60^\circ$$
$$h = 10.3923\ldots \text{ cm}$$

(Reason: The perpendicular from A to DC makes a right-angled triangle in which $AD = 12$ cm is the hypotenuse and the height is opposite the 60° angle. The exact height is $6\sqrt{3}$ cm, so leave it on the calculator instead of rounding it here.)

Step 2: The piece cut off at each end

$$12 \times \cos 60^\circ = 6 \text{ cm}$$

(Reason: In the same triangle this piece of DC lies next to the 60° angle, so it uses the cosine. Pythagoras agrees: $\sqrt{12^2 - (6\sqrt{3})^2} = 6$.)

Step 3: The short parallel side

$$AB = 47 - 6 - 6 = 35 \text{ cm}$$

(Reason: The one line of symmetry makes the two end triangles identical, so the 6 cm from Step 2 comes off DC at the D end and again at the C end.)

Step 4: Into the trapezium formula

$$\frac{1}{2} \times (47 + 35) \times 10.3923 = 426.0843$$

(Reason: The parallel sides are 47 cm and 35 cm, and 10.3923 is the height to 4 decimal places. Carrying the height unrounded instead gives 426.0845, which rounds to the same answer - one more reason to round only at the end.)

Step 5: Round to 3 significant figures

$$426.0843 \approx 426 \text{ cm}^2$$

(Reason: The first three significant figures are 4, 2 and 6. The next digit is 0, so the 6 is left alone. The units are cm^2 because this is an area.)

$$\boxed{426 \text{ cm}^2}$$

Verification

✓ **Check 1 - cut the shape a different way:** A rectangle 35 cm by 10.3923 cm sits between two triangles, each of base 6 cm and height 10.3923 cm.

$$35 \times 10.3923 + 2 \times \frac{1}{2} \times 6 \times 10.3923 = 426.0843$$

✓ **Check 2 - split along the diagonal:** Triangle ADC has sides 12 cm and 47 cm with 60° between them, and triangle ABC has sides 35 cm and 12 cm with 120° between them, because AB is parallel to DC. Each area is $\frac{1}{2}ab\sin C$, giving 244.2 and 181.9 to 1 decimal place. $244.2 + 181.9 = 426.1$, which is 426 to 3 significant figures

✓ **Check 3 - is the size sensible?** The trapezium contains a rectangle 35 cm by 10.3923 cm and fits inside a rectangle 47 cm by 10.3923 cm, so its area must lie between the areas of those two rectangles. 363.7 and 488.4 are the two bounds, and 426 lies between them

Mark Scheme Breakdown

Step	Mark	Description	Got it?
For example $12\sin 60^\circ$ $(= 6\sqrt{3} = 10.39\ldots)$ or $\sqrt{12^2 - 6^2}$, or the area of triangle ADC as $\frac{1}{2} \times 12 \times 47 \times \sin 60^\circ$ $(= 244.2\ldots)$	**M1**	For a method to find the perpendicular height of the trapezium, or the area of triangle ADC. The first two method marks may be earned in either order.	✓
For example $12\cos 60^\circ = 6$ or $\sqrt{12^2 - (6\sqrt{3})^2} = 6$	**M1**	For a method to find the base of the end triangle. Condone missing brackets around $6\sqrt{3}$. Awarded whatever happened earlier in the question.	✓
$AB = 47 - 6 - 6 = 35$	**M1**	For a method to find the length of AB, taking the end piece off both ends of DC. Taking it off once, giving 41, earns nothing here.	✓
For example $\frac{1}{2} \times (47 + 35) \times 10.39\ldots$ or $35 \times 10.39\ldots + 2 \times \frac{1}{2} \times 6 \times 10.39\ldots$	**M1**	For a complete method that would give the correct area. Other complete methods score this mark.	✓

Step	Mark	Description	Got it?
426	A1	Working must be shown. Accept anything from 420 to 427 from correct working.	✓

Full marks: 5/5

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