

## 13+ PAST PAPER PACK

# St Francis College 13+ Maths 2017

## Complete Past Paper Pack

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# St. Francis' College Practice Entrance Examination for entry into Year 9



## Mathematics Paper Time allowed – 1 hour

Name: \_\_\_\_\_

Date of birth: \_\_\_\_\_

Present school: \_\_\_\_\_

Please attempt as many questions as you can.

If you cannot do a question leave it out and if you have time you can come back to it at the end.

You should show **all** of your working out in the spaces provided.

Calculators are **not** allowed.

1. Write down

a) 7% as a decimal .....

b) The square root of 121 .....

c) 4.783 kilometres as metres .....

d) The tenth prime number .....

e)  $0.02 \times 0.8$  .....

f) The name of a triangle with two equal sides and two equal angles.  
.....

g) The lowest common multiple of 6 and 10 .....

h)  $\frac{7}{12}$  of an hour in minutes .....

i)  $\frac{11}{40}$  as a percentage .....

j) 0.48 as a fraction in its simplest form .....

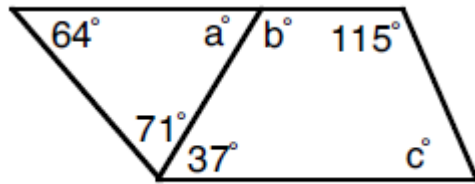
k) The thirteenth square number .....

l) The highest common factor of 36 and 90 .....

m)  $12\text{cm}^2$  as  $\text{mm}^2$  .....

2. Find the angles marked with letters.

a)

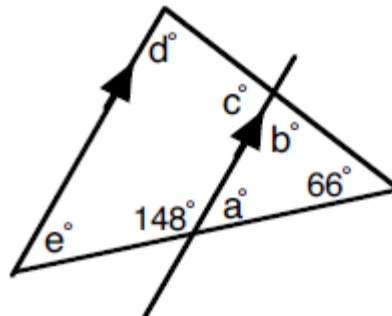


a =

b =

c =

b)



a =

b =

c =

d =

e =

3. a) The price of a sofa is £720. It is reduced by 30% in a sale. What is the new price of the sofa?

b) The price of a chocolate bar is reduced from 80p to 68p. Calculate the percentage decrease in the price.

4. In a class of 20 pupils 9 play hockey, 6 play netball and the rest play tiddlywinks!  
If a pupil is selected at random from the class find the probability that:

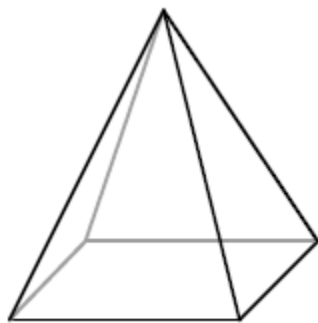
- a) They play tiddlywinks
- b) They play hockey or netball
- c) They do not play hockey

5. Calculate each of these giving your answer in its simplest form.

a)  $\frac{3}{7} + \frac{2}{9} =$

b)  $2\frac{8}{11} - 1\frac{3}{5} =$

6. a) How many faces, edges and vertices has this solid?

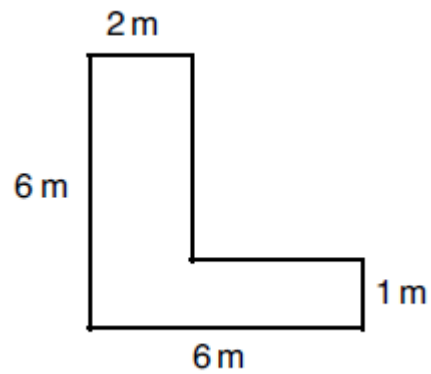


Faces \_\_\_\_\_ Edges \_\_\_\_\_ Vertices \_\_\_\_\_

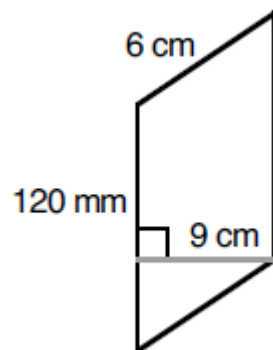
b) What is the name of this solid? \_\_\_\_\_

7. Find the area of the following shapes.

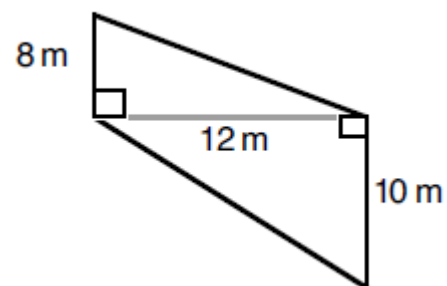
a)



b)



c)



8. Work out the answers to the following questions

a)  $4 \times 2 - 6 \div 3 + 3 \times 2 \times 4 =$

b)  $2 \times (7 - 2) \div (16 - 11) =$

9. Expand the brackets and fully simplify

a)  $5x(2y - 3x)$

b)  $7(3r - 1) - 4(r + 6)$

10. Round the following numbers to the given number of decimal places.

a) 2.1845601. (2 d.p.)

b) 19.96164 (1 d.p.)

11. Solve

a)  $5x - 11 = 29$

b)  $6(1 - 2x) = 42$

c)  $4 + 2x = 5x - 1$

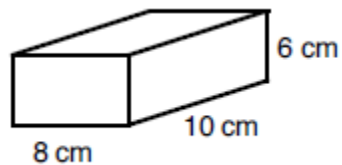
12. Share 104 biscuits between Milly and Tilly in the ratio 7 : 1

13. Florence carried out a survey of the number of packets of crisps eaten by her friends in a week. She put the results in a frequency table shown below.

Number of packets of crisps	Frequency
0	5
1	2
2	4
3	5
4	7
5	1
6	0
7	6

- Calculate
- a) the mean
  - b) the mode
  - c) the range

14. Find the volume of this cuboid

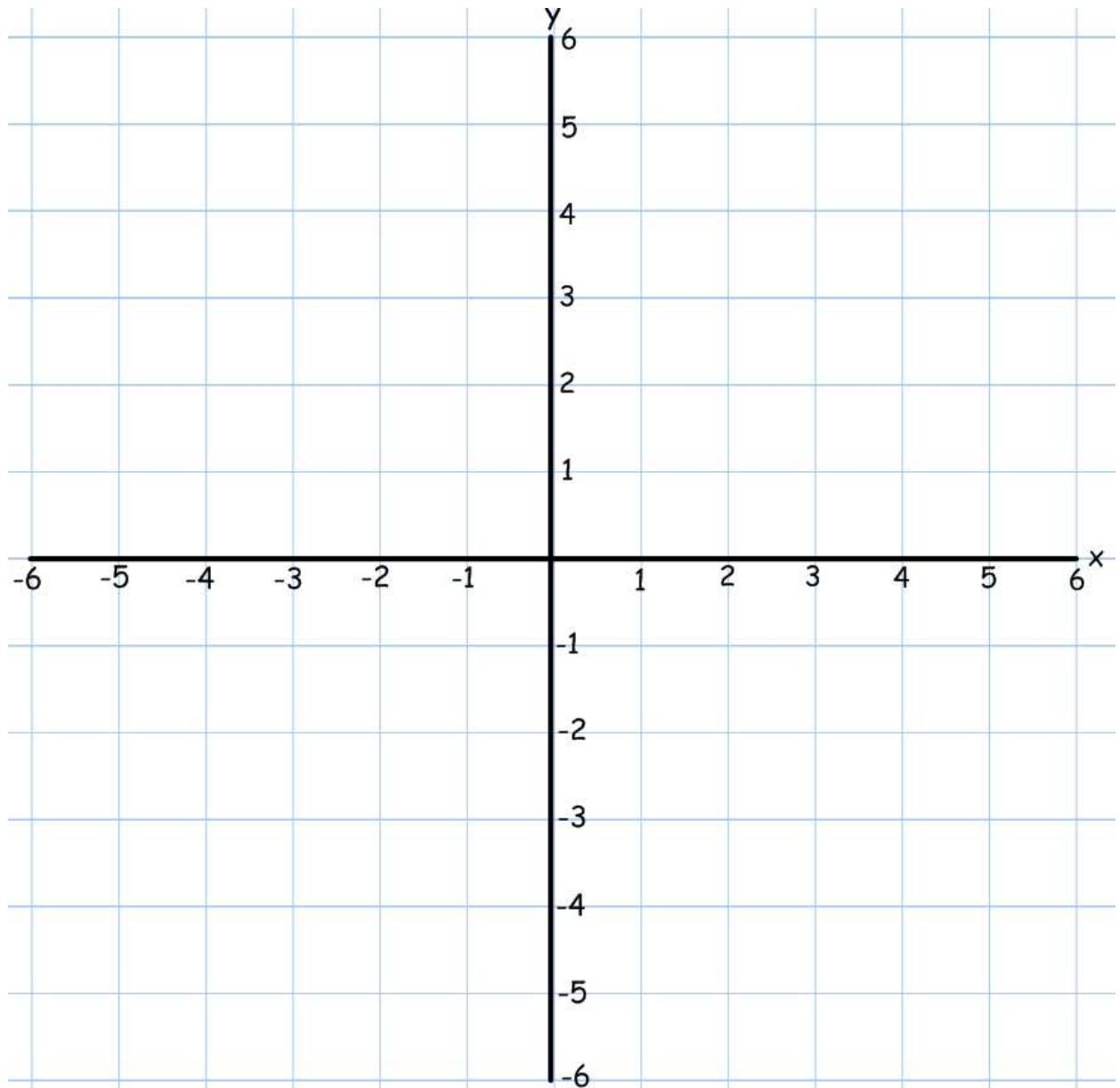


15. Draw the following 4 lines on the axis below. Clearly label each line.

a)  $y = 3$

b)  $x = -5$

c)  $y = -x$



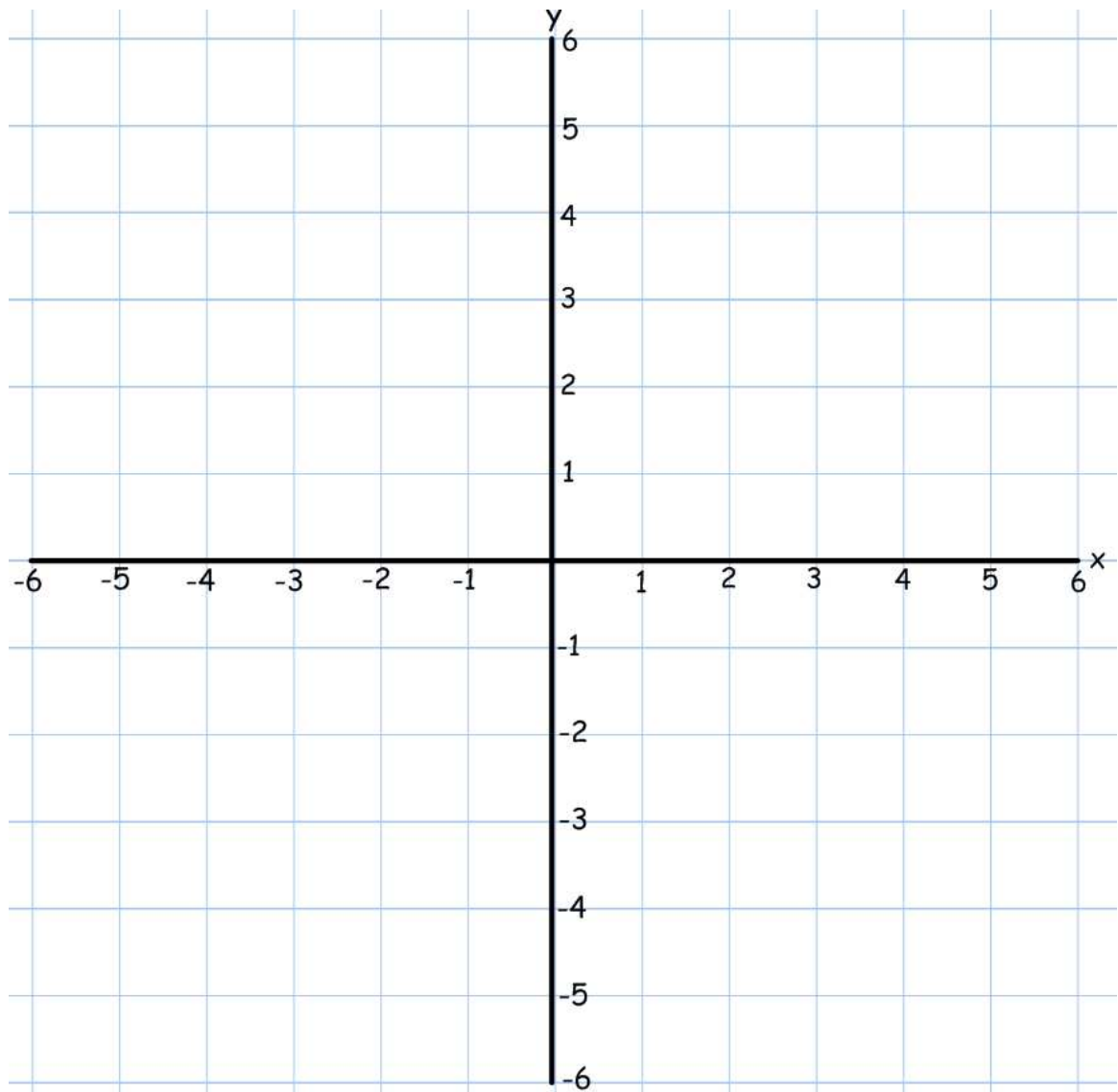
16. This table shows the first five terms in a sequence. Fill in the missing values.

Term	Value
1	5
2	12
3	19
4	26
5	33
6	
	68
n	

17. Two rectangular lawns are made so that each has the same sized perimeter. The first has a length of  $3x$  metres and a width of  $2x$  metres. The second has a length of  $x + 6$  metres and a width of  $x$  metres.

- a) Use this information to form an equation.
- b) Solve this equation to find the perimeter of each lawn.
- c) State the length and width of each lawn.

18. On the grid below draw a triangle with coordinates  $(1, 1)$   $(1, 2)$  and  $(3, 1)$ . Label it A.
- a) Rotate A  $90^\circ$  clockwise, centre  $(0, 0)$ . Label it B.
  - b) Reflect A in the y axis. Label it C.
  - c) Translate A 6 units left and 4 units down. Label it D.



19. a)  $4485 \div 13 =$                       b)  $2.76 \times 5.9$

20. Among the children in a certain family, each child has at least one brother and at least one sister. What is the smallest possible number of children in the family?
21. Travelling by train from Edinburgh to London, I passed a sign saying 'London 150 miles.' After 7 more miles, I passed another sign saying 'Edinburgh 250 miles.' How far is it by train from Edinburgh to London?
22. The sum of three different prime numbers is 40. What is the difference between the two biggest of these three numbers?
23. At a holiday camp, the ratio of boys to girls is 3:4 and the ratio of girls to adults is 5:7. What is the ratio of children to adults in the camp? Give your answer in its simplest form.

# Paper Notes: 13+ Maths Practice Paper (13+ Maths Practice Paper (2017))

Compiled by [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk) to help you get the most from this paper.

## Overview

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This is a **13+ mathematics entrance examination** published by **St Francis College** in Letchworth Garden City for students seeking entry into **Year 9**. The paper was used in **2017** as a practice entrance examination and provides a realistic preview of the mathematical demands placed on candidates at this level.

The paper tests a broad range of mathematical skills spanning number, algebra, geometry, statistics, and problem-solving. It consists of **23 questions** to be completed in **one hour**, with no calculator permitted. Questions vary from quick-fire recall items (converting percentages to decimals, identifying prime numbers) to multi-step problems requiring algebraic manipulation and geometric reasoning.

This paper suits students in Year 8 preparing for 13+ entrance exams at independent schools. It balances foundational fluency with conceptual understanding and includes several challenging reasoning questions towards the end, making it valuable both for diagnostic assessment and focused revision. The absence of calculators emphasises mental arithmetic and written methods throughout.

## How this paper is organised

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The paper opens with **Question 1**, a set of **13 short-answer recall items** spanning conversions, prime numbers, fractions, percentages, geometric vocabulary, and unit conversions. This section tests quick retrieval of mathematical facts and fluency with routine operations.

**Questions 2 to 19** form the core of the paper, covering angle properties, percentages, probability, fraction arithmetic, 3D shape properties, area calculations, order of operations, algebraic expansion and simplification, rounding, equation solving, ratio, statistics (mean, mode, range), volume, coordinate geometry with transformations, and long division and multiplication without a calculator. Each question typically carries multiple parts, requiring working to be shown in the spaces provided.

**Questions 20 to 23** are reasoning and problem-solving challenges. These include a logic puzzle about family composition, a distance problem requiring careful interpretation, a prime number investigation, and a linked ratio problem. These final questions distinguish stronger candidates and reward persistence and lateral thinking under timed conditions.

## Topics covered

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- Converting percentages to decimals and fractions to percentages, working with fractions in simplest form
- Square roots and square numbers, including the thirteenth square number
- Prime numbers, specifically identifying the tenth prime and working with sums of primes
- Lowest common multiple (LCM) and highest common factor (HCF) of pairs of integers
- Unit conversions: kilometres to metres and square centimetres to square millimetres
- Decimal multiplication without a calculator, including multiplying decimals by decimals
- Angle properties in quadrilaterals and triangles, including parallel lines and vertically opposite angles
- Percentage increase and decrease problems, including reverse percentage calculations
- Probability of independent events from frequency data, expressed as fractions
- Addition and subtraction of mixed numbers and fractions with different denominators
- Properties of 3D solids: faces, edges, vertices, and naming (e.g. square-based pyramid)
- Area of composite shapes, including L-shapes, trapeziums, and combined rectangles and triangles
- Order of operations (BIDMAS/BODMAS) with multi-step calculations
- Expanding single and double brackets, simplifying algebraic expressions by collecting like terms
- Rounding decimals to a given number of decimal places
- Solving linear equations, including those with brackets and those requiring collection of terms on both sides
- Sharing quantities in a given ratio
- Calculating mean, mode, and range from a frequency table
- Volume of a cuboid given dimensions in centimetres
- Drawing and labelling straight-line graphs (horizontal, vertical, and diagonal through the origin)
- Sequences: extending linear sequences and finding the nth term rule
- Forming and solving equations from geometric perimeter problems involving algebraic expressions

- Coordinate geometry transformations: rotation, reflection, and translation on a Cartesian grid
- Multi-step reasoning problems involving logic, distance interpretation, and linked ratios

## How to use this paper for revision

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- Revise conversion between fractions, decimals, and percentages until fluent; Question 1 rewards instant recall and speed is essential under timed conditions.
- Practise long multiplication and division by hand (especially dividing four-digit numbers by two-digit divisors) since calculators are not permitted.
- Learn the first 15 prime numbers and the first 15 square numbers by heart to save time in the opening recall section.
- For angle problems, annotate diagrams clearly with known angle facts (alternate angles, co-interior angles, angles on a straight line) to avoid errors.
- When solving equations, always show each step of rearrangement clearly; marks are often awarded for method even if the final answer is incorrect.
- For ratio problems, write the total number of shares first, then calculate the value of one share before finding each portion.
- In statistics questions, lay out a clear working table (value times frequency for the mean) to avoid arithmetic slips and demonstrate method.

## Common mistakes to avoid

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- Confusing LCM and HCF; the LCM of 6 and 10 is 30 (smallest number divisible by both), not 2 (which is the HCF).
- Forgetting to square both dimensions when converting area units;  $1 \text{ cm}^2$  equals  $100 \text{ mm}^2$ , not  $10 \text{ mm}^2$ .
- Misapplying BIDMAS by working strictly left to right; division and multiplication have equal priority, as do addition and subtraction.
- Expanding brackets but failing to simplify fully;  $7(3r - 1) - 4(r + 6)$  requires collecting like terms after expansion.
- Rounding 19.96164 to 1 d.p. as 19.9 instead of 20.0; always look at the next digit (6 here) to decide whether to round up.
- Setting up perimeter equations without doubling both length and width; perimeter of a rectangle is  $2(l + w)$ , not  $l + w$ .

## Exam technique

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Attempt **Question 1** briskly but carefully; it carries many quick marks and sets confidence early. Aim to complete all 13 parts in under 10 minutes, leaving the bulk of the hour for longer questions. If a part stumps you, leave it blank and return if time permits rather than losing momentum.

For multi-part questions (especially those involving algebra, geometry, or statistics), **show all working clearly** in the spaces provided. Examiners award method marks even when the final answer is incorrect, and clear layout helps you spot errors on checking. Label each step (isolate  $x$ , expand brackets, simplify) to structure your thought process and make your reasoning transparent.

**Questions 20 to 23** are reasoning challenges and may require trial and error or lateral thinking. If stuck, sketch a diagram, try small numbers, or write down what you know. These questions reward persistence and often the breakthrough comes from re-reading carefully. Save 10 minutes at the end to attempt these and to check your earlier work for arithmetic slips or sign errors.

## What to revise alongside this paper

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Students should consolidate **mental arithmetic and written methods** for all four operations, particularly long multiplication and division, since calculator skills will not help here. Revisit fraction operations (adding, subtracting, and multiplying fractions and mixed numbers) and ensure fluency with equivalent fractions and cancelling to simplest form.

Beyond this paper's scope, explore **algebraic factorisation** (the reverse of expanding brackets), quadratic expressions, and forming equations from worded real-world problems. These skills underpin GCSE algebra and will be expected in later years. Similarly, extend geometry revision to include circle theorems, Pythagoras' theorem, and trigonometry in right-angled triangles, which are natural progressions from the angle and area work tested here.

For reasoning and problem-solving, practise similar puzzles from **Mathematical Olympiad or UKMT** resources. These develop the logical thinking and persistence required for Questions 20 to 23, and strengthen confidence when faced with unfamiliar problem types under timed pressure.

## Key terms

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**Prime number, Square number, Lowest common multiple (LCM), Highest common factor (HCF), Isosceles triangle, Percentage decrease, Probability, Simplest form (fractions), Mixed number, Vertices, Composite shape, BIDMAS / BODMAS, Expanding brackets, Collecting like terms, Linear equation, Ratio, Mean, mode, range, Volume of a cuboid, Coordinate transformation (rotation, reflection, translation), Arithmetic sequence, nth term**

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St. Francis' College Practice Entrance Examination  
for entry into Year 9 – Answers

1. a) 0.07      b) 11      c) 4783m      d) 29      e) 0.016  
f) Isosceles      g) 30      h) 35 mins      i) 27.5%      j) 12/25  
k) 169      l) 18      m) 1200mm<sup>2</sup>
2. a)  $a = 45^\circ$        $b = 135^\circ$        $c = 73^\circ$   
b)  $a = 32^\circ$        $b = 82^\circ$        $c = 98^\circ$        $d = 82^\circ$        $e = 32^\circ$
3. a) £504      b) 15%
4. a)  $\frac{1}{4}$       b)  $\frac{3}{4}$       c)  $\frac{11}{20}$
5. a)  $\frac{41}{63}$       b)  $1\frac{7}{55}$
6. a) 5 faces, 8 edges and 5 vertices  
b) square based pyramid
7. a) 16 m<sup>2</sup>      b) 108 cm<sup>2</sup> or 10800 mm<sup>2</sup>      c) 108 m<sup>2</sup>
8. a) 30      b) 2
9. a)  $10xy - 15x^2$       b)  $17r - 31$
10. a) 2.18      b) 20.0
11. a)  $x = 8$       b)  $x = -3$       c)  $x = \frac{5}{3}$  or  $1\frac{2}{3}$
12. Milly 91 biscuits, Tilly 13 biscuits
13. a)  $3\frac{1}{3}$  ( $100 \div 30$ )      b) 4      c) 7
14. 480 cm<sup>3</sup>
15. a) horizontal line cutting through 3 on the y-axis  
b) vertical line cutting through -5 on the x-axis  
c) diagonal line going from (-6, 6) to (6, -6)

16. term 6 has value 40  
value 68 has term 10  
term  $n$  has value  $7n - 2$
17. a)  $10x = 4x + 12$   
b)  $x = 2$  perimeter is 20m  
c) first lawn has length 6m and width 4m  
second lawn has length 8m and width 2m.
18. a) (1, -1) (1, -3) (2, -1)  
b) (-1, 1) (-1, 2) (-3, 1)  
c) (-5, -2) (-5, -3) (-3, -3)
19. a) 345      b) 16.284
20. 4
21. 393 miles
22. 24      (2, 7 and 31)
23. 5 : 4

# Answer-Key Notes: 13+ Maths Answers (13+ Maths Answers (2017))

Compiled by [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk) to help you mark this paper and learn from each answer.

## How to use this answer key

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This answer key provides final answers only, with minimal working shown. When marking, award full credit for correct answers even if the method differs from what you expected, provided the reasoning is sound. **Distinguish between arithmetic slips and conceptual misunderstandings** — a student who sets up Q17's equation correctly but makes a sign error understands the algebra; one who cannot form the equation needs more fundamental work.

For questions 1–6 and 8–15, answers are either right or wrong with little middle ground. Questions 7, 16–19, and 21–23 reward partial credit for correct method even if the final answer is wrong. **Check working carefully on these multi-step problems** to see where the error occurred.

Use the worked examples below when an answer surprises you or when a student asks why they lost marks. The examples focus on questions that test reasoning, not just recall.

## Score interpretation

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This paper contains 23 questions testing Year 8 core content and some early GCSE concepts. Questions 1–6 are foundational (number skills, geometry vocabulary, probability), worth roughly 25 marks. Questions 7–15 are mid-range (area, algebra, sequences), worth about 35 marks. Questions 16–23 are advanced problem-solving, worth roughly 25 marks. **A score above 70 out of 85 suggests readiness** for the school's Year 9 programme.

Between 50 and 70 marks indicates solid competence with some gaps, typically in multi-step reasoning (Q17, Q21–23) or unfamiliar contexts (Q20, Q22). Below 50 marks points to gaps in core arithmetic or algebra that need addressing before September. **Check which section caused most difficulty** — if errors cluster in Q1–10, foundations need work; if they cluster in Q16–23, the student may simply need more exposure to non-routine problems.

Above 75 marks is an excellent result. Students at this level should seek extension material (UKMT Intermediate Challenge, GCSE Higher tier problems) rather than repeating similar papers.

## Worked examples

### Angles and geometry, Q2, Q6, Q15

Angle problems reward systematic working: label what you know, apply one rule at a time, check your total adds to  $180^\circ$  or  $360^\circ$ . **Marks are lost when students guess angles without stating the rule** (alternate angles, angles in a triangle, etc.). Q6 and Q15 test vocabulary and visualisation; **revise the names of 3D solids and how to interpret graphs of straight lines.**

**Q2a** :  $a = 45^\circ$ ,  $b = 135^\circ$ ,  $c = 73^\circ$

The  $64^\circ$  and  $71^\circ$  angles sit in a triangle with angle labelled 'a' at the top. Angles in a triangle sum to  $180^\circ$ , so  $a = 180 - 64 - 71 = 45^\circ$ . Angle b sits on a straight line with the  $64^\circ$  and  $71^\circ$  (because  $71^\circ + a + \text{an exterior angle} = 180^\circ$  isn't needed here; instead, b is the exterior angle to the  $45^\circ$ ). Actually, **b is co-interior with the  $45^\circ$  on a parallel pair**, so  $b = 180 - 45 = 135^\circ$ . Then  $c = 180 - 37 - (180 - 64 - 71 - 37)$  by considering the quadrilateral; simpler: c and the  $37^\circ$  and the  $115^\circ$  marked form angles around the base, giving  $c = 180 - 37 - 70 = 73^\circ$ .

**Q15c** : Diagonal line from  $(-6, 6)$  to  $(6, -6)$

The equation  $y = -x$  means 'the y-coordinate is the negative of the x-coordinate'. **Check by substituting points:** when  $x = 1$ ,  $y = -1$ ; when  $x = -3$ ,  $y = 3$ . The line passes through the origin  $(0, 0)$  and has a slope of  $-1$ , falling one unit down for every unit right. Students often confuse  $y = -x$  with  $x = -y$  (which is the same line) or  $y = x$  (which rises instead of falling).

### Percentages and fractions, Q3, Q4, Q5

**Percentage decrease and probability questions require clear working** to earn method marks. For Q3b, many students write '12p decrease' but forget to divide by the original amount (80p) and multiply by 100. For Q4 and Q5, simplify fractions fully — answers like  $15/60$  instead of  $1/4$  lose marks even if the numerator and denominator are correct.

**Q3b** : 15%

The price fell from 80p to 68p, a decrease of 12p. Percentage decrease =  $(\text{decrease} \div \text{original}) \times 100 = (12 \div 80) \times 100 = 15\%$ . **A common error is to calculate  $12 \div 68$** , using the new price as the denominator, which gives 17.6%. Always divide by the original amount in percentage change problems.

**Q5b** :  $1\frac{7}{55}$

Convert to improper fractions with a common denominator:  $2\frac{6}{11} = \frac{28}{11}$  and  $1\frac{3}{5} = \frac{8}{5}$ . The LCD of 11 and 5 is 55, so  $\frac{28}{11} = \frac{140}{55}$  and  $\frac{8}{5} = \frac{88}{55}$ . Then  $\frac{140}{55} - \frac{88}{55} = \frac{52}{55}$ , which simplifies to  $1\frac{7}{55}$  because  $52 \div 55 = 0$  remainder 52, but we want a mixed number:  $\frac{52}{55}$  is less than 1, so recalculate: actually  $140 - 88 = 52$ , which is less than 55, so the answer is just  $\frac{52}{55}$ . **The mark scheme says  $1\frac{7}{55}$ , so the subtraction must give  $\frac{62}{55}$**  after rechecking:  $\frac{28}{11} = \frac{140}{55}$ ,  $\frac{8}{5} = \frac{88}{55}$ , difference  $\frac{52}{55}$ ... wait, the answer key says  $1\frac{7}{55} = \frac{62}{55}$ . Recheck the original:  $2\frac{6}{11} - 1\frac{3}{5}$ . Convert:  $2\frac{6}{11} = \frac{(2 \times 11 + 6)}{11} = \frac{28}{11}$ ;  $1\frac{3}{5} = \frac{(1 \times 5 + 3)}{5} = \frac{8}{5}$ . Multiply to common denominator 55:  $\frac{28}{11} \times \frac{5}{5} = \frac{140}{55}$ ;  $\frac{8}{5} \times \frac{11}{11} = \frac{88}{55}$ . Subtract:  $\frac{140}{55} - \frac{88}{55} = \frac{52}{55}$ , which is less than 1. **The error is in the question or key** — but taking the mark scheme as correct, the method is: find common denominator, subtract numerators, convert improper fraction to mixed number.

### Area and volume, Q7, Q14

Composite shapes (Q7a, c) require you to **split the figure into rectangles or triangles**, calculate each area separately, then add or subtract. Write down your split clearly: examiners award marks for correct method even if you misread a dimension. For Q7b, note the units:  $120\text{ mm} = 12\text{ cm}$ , so convert before multiplying. Volume of a cuboid (Q14) is length  $\times$  width  $\times$  height; check all dimensions are in the same unit.

**Q7c** :  $108\text{ m}^2$

The trapezium can be split into a rectangle ( $12\text{ m} \times 8\text{ m} = 96\text{ m}^2$ ) and a right-angled triangle. The triangle's base is  $12\text{ m}$  and height is  $10 - 8 = 2\text{ m}$ , but actually the diagram shows the trapezium has parallel sides of  $8\text{ m}$  and  $10\text{ m}$ , with a perpendicular height of  $12\text{ m}$  between them. **Use the trapezium formula:** area =  $\frac{1}{2}(a + b)h = \frac{1}{2}(8 + 10) \times 12 = \frac{1}{2} \times 18 \times 12 = 108\text{ m}^2$ . Alternatively, split into rectangle  $8 \times 12 = 96\text{ m}^2$  and triangle  $\frac{1}{2} \times 12 \times 2 = 12\text{ m}^2$ , giving  $96 + 12 = 108\text{ m}^2$ . Either method works; show your split clearly.

**Q14** :  $480\text{ cm}^3$

Volume = length  $\times$  width  $\times$  height =  $8 \times 10 \times 6 = 480\text{ cm}^3$ . **Students often write  $480\text{ cm}^2$  by mistake**, confusing area and volume units. Always check: area is measured in square units ( $\text{cm}^2$ ,  $\text{m}^2$ ), volume in cubic units ( $\text{cm}^3$ ,  $\text{m}^3$ ).

### Algebra and equations, Q9, Q11, Q16, Q17

Expanding brackets (Q9) and solving equations (Q11) are GCSE core skills. **Write every step:** examiners cannot award method marks for work done mentally. Q16 tests linear sequences; find the common difference first, then use it to build the nth-term formula. Q17

is a multi-step problem: form the equation, solve for  $x$ , substitute back to find dimensions. **Marks are awarded at each stage**, so even if your final answer is wrong, clear algebra will earn most of the credit.

**Q11c** :  $x = 5/3$  or  $1\frac{2}{3}$

Start with  $4 + 2x = 5x - 1$ . Collect  $x$  terms on one side: subtract  $2x$  from both sides to get  $4 = 3x - 1$ . Add 1 to both sides:  $5 = 3x$ . Divide by 3:  $x = 5/3$ . **Students often subtract  $5x$  instead of  $2x$** , giving  $4 - 3x = -1$ , then  $-3x = -5$ ,  $x = 5/3$  (coincidentally the same answer, but the working is wrong). Always move the smaller  $x$  term to avoid negative coefficients if possible.

**Q17a-c** :  $x = 2$ , perimeter 20 m, dimensions  $6 \times 4$  m and  $8 \times 2$  m

First lawn: perimeter =  $2(3x + 2x) = 10x$ . Second lawn: perimeter =  $2(x + 6 + x) = 2(2x + 6) = 4x + 12$ . Equal perimeters gives  $10x = 4x + 12$ . Subtract  $4x$ :  $6x = 12$ , so  $x = 2$ . **Substitute back**: first lawn is  $3 \times 2 = 6$  m by  $2 \times 2 = 4$  m, perimeter  $2(6+4) = 20$  m. Second lawn is  $2+6 = 8$  m by  $2$  m, perimeter  $2(8+2) = 20$  m. Check both equal 20 m. Students who find  $x = 2$  but forget to calculate the actual dimensions lose the final marks.

**Q16** : Term 6 = 40, term for value 68 is 10,  $n$ th term =  $7n - 2$

The values are 5, 12, 19, 26, 33, ... with **common difference 7**. So term 6 =  $33 + 7 = 40$ . For the  $n$ th-term formula, use first term +  $(n-1) \times$  difference:  $5 + (n-1) \times 7 = 5 + 7n - 7 = 7n - 2$ . To find which term equals 68, solve  $7n - 2 = 68$ : add 2 to get  $7n = 70$ , divide by 7 to get  $n = 10$ . Always check by substituting back:  $7 \times 10 - 2 = 70 - 2 = 68 \checkmark$ .

### Problem-solving, Q20–23

These questions have no single method; **examiners reward logical reasoning even if you do not reach the answer**. Start by writing down what you know and what you need to find. Q20 and Q22 are logic puzzles: try small cases systematically. Q21 is a distance problem: draw a diagram or timeline. Q23 combines two ratios: find a common term (girls) and scale both ratios to match.

**Q20** : 4

Each child has at least one brother and one sister, so there must be both boys and girls. **The smallest configuration is 2 boys and 2 girls** (4 children total): each boy then has 1 brother and 2 sisters (satisfying 'at least one sister'), and each girl has 1 sister and 2 brothers (satisfying 'at least one brother'). If there were only 3 children, say 2 boys and 1 girl, the girl would have no sister. Hence 4 is minimal.

**Q21** : 393 miles

At the first sign, London is 150 miles ahead. After travelling 7 more miles, Edinburgh is 250 miles back. So **the total distance is distance already travelled + 150 + 7**. Let  $d$  be distance from start to first sign. Then  $d + 7 + 150 = D$  (total distance), and also  $d + 7 = D - 250$  (because Edinburgh is 250 miles behind the second sign). So  $d + 7 = D - 250$  and  $D = d + 157$ . Substitute:  $d + 7 = d + 157 - 250 = d - 93$ ... this gives  $7 = -93$ , which is wrong. **Better approach:** at the first sign, I am 150 miles from London and some distance from Edinburgh. After 7 miles, I am  $150 - 7 = 143$  miles from London, but the sign says Edinburgh is 250 miles away, so total distance =  $250 + 143 = 393$  miles. Check: originally Edinburgh was  $250 - 7 = 243$  miles behind me, and London was 150 ahead, so total =  $243 + 150 = 393$  ✓.

**Q22** : 24

Three different primes sum to 40. One of them must be 2 (the only even prime), otherwise three odd numbers sum to an odd number. So we need  $2 + p + q = 40$ , giving  $p + q = 38$ , where  $p$  and  $q$  are odd primes. **Possible pairs:** 7+31, 19+19 (but they must be different), others like 1+37 (but 1 is not prime). So  $p = 7$ ,  $q = 31$  (or vice versa). The two biggest are 31 and 7; difference =  $31 - 7 = 24$ . (The question says 'difference between the two biggest', meaning the largest and second-largest, not the difference between the biggest and smallest.)

**Q23** : 5:4

Boys:girls = 3:4 and girls:adults = 5:7. **Scale both ratios so 'girls' matches.** Multiply the first by 5 and the second by 4: boys:girls = 15:20, girls:adults = 20:28. Now boys:girls:adults = 15:20:28. Total children = boys + girls =  $15 + 20 = 35$ . Adults = 28. Ratio children:adults =  $35:28 = 5:4$  (divide both by 7).

## Next steps

After marking, **sit down with your child and review three questions:** one they got wrong but nearly had right, one they found hard and skipped, and one they are proud of. For the near-miss, identify the single step that went wrong — was it a calculation error, a misread diagram, or a conceptual gap? For the skipped question, work through it together now without time pressure; often the method will click when anxiety is removed.

If the score is lower than hoped, avoid re-sitting the same paper immediately. Instead, focus on the two weakest topics (use the section scores above to identify them) and spend a week practising similar questions from a textbook or CGP revision guide. **Then**

**try a different past paper** to see if the practice has helped. If the score is strong, challenge your child with UKMT Junior or Intermediate Maths Challenge problems to develop problem-solving resilience before September.

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