

Junior Maths - Numbers & Statistics

Number Classification, Integers and Mental Number Skills and full-series practice

Student workbook edition

Near-A4 print layout with ruled working space

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Name: _____

Class: _____

Start date: _____

Worked Solutions Online

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Chapter 1: Number Classification, Integers and Mental Number Skills

Chapter Goal

Recognise important number types quickly, calculate accurately without a calculator, and use factors, multiples and integer rules in problems.

Calculator Policy

Mostly non-calculator. This chapter builds mental mathematics, written arithmetic and number sense.

Quick Notes - Number Classification

- Natural numbers: $1, 2, 3, \dots$
- Whole numbers: $0, 1, 2, 3, \dots$
- Integers: $\dots, -2, -1, 0, 1, 2, \dots$
- Even numbers are divisible by 2.
- Odd numbers are not divisible by 2.
- Prime numbers have exactly two positive factors.
- Composite numbers have more than two positive factors.
- Square numbers are $1, 4, 9, 16, \dots$
- Cube numbers are $1, 8, 27, 64, \dots$
- Triangular numbers are $1, 3, 6, 10, 15, \dots$

Worked Examples

Example 1 - Classifying a Number

Classify 36.

Solution: 36 is natural, whole, integer, even, composite, square and triangular.

Example 2 - Prime or Composite

29 is prime because its only positive factors are 1 and 29.

Example 3 - HCF and LCM

For 24 and 36, $\text{HCF} = 12$ and $\text{LCM} = 72$.

Common Mistake

Do not call 1 a prime number. It has only one positive factor.

Basic Understanding - Number Classification

1. Classify -8 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

2. Classify -3 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

3. Classify 0 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

4. Classify 1 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

5. Classify 2 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

6. Classify 3 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

7. Classify 4 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

8. Classify 5 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

9. Classify 6 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

10. Classify 8 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

11. Classify 9 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

12. Classify 10 . Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

13. Classify 12. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

14. Classify 15. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

15. Classify 16. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

16. Classify 17. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

17. Classify 18. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

18. Classify 20. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

19. Classify 21. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

20. Classify 25. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

21. Classify 27. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

22. Classify 28. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

23. Classify 29. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

24. Classify 36. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

25. Classify 49. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

26. Classify 64. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

27. Classify 81. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

28. Classify 100. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

29. Classify 121. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

30. Classify 125. Use as many words as possible from: natural, whole, integer, even, odd, prime, composite, square, cube, triangular.

31. Explain why 1 is neither prime nor composite.

32. Explain the difference between natural numbers and whole numbers.

33. Write the first eight square numbers.

34. Write the first six cube numbers.

35. Write the first eight triangular numbers.

Mental Mathematics and Number Sense

36. Work out mentally: $48 + 37$.

37. Work out mentally: $126 - 58$.

38. Work out mentally: 25×16 .

39. Work out mentally: $360 \div 9$.

40. Work out mentally: 7×18 .

41. Work out mentally: $84 \div 7$.

42. Work out mentally: 125×8 .

43. Work out mentally: $960 \div 12$.

44. Work out mentally: 15^2 .

45. Work out mentally: $19 + 28 + 31$.

46. Work out mentally: $600 - 275$.

47. Work out mentally: 45×12 .

48. Work out mentally: $72 \div 0.9$.

49. Work out mentally: 3.6×1000 .

50. Work out mentally: 0.48×100 .

51. Work out mentally: 15% of 80.

52. Work out mentally: 1.2×50 .

53. Work out mentally: $240 \div 0.6$.

54. Work out mentally: $99 + 101 + 103$.

55. Work out mentally: 2^6 .

56. Work out mentally: $144 \div 12 + 7$.

57. Work out mentally: $18 \times 5 - 14$.

58. Work out mentally: $4000 \div 25$.

59. Work out mentally: 37×11 .

60. Work out mentally: 3×4^2 .

61. Work out mentally: 250% of 40.

62. Work out mentally: 0.75×200 .

63. Work out mentally: $64 \div 0.8$.

64. Work out mentally: $7^2 + 8^2$.

65. Work out mentally: $1000 - 38 \times 20$.

Place Value, Rounding and Estimation

66. Write 4, 708, 302 in words.

67. Write 6 million 42 thousand and 19 in figures.

68. Round 48, 736 to the nearest thousand.

69. Round 8.746 to 2 decimal places.

70. Round 0.08374 to 2 significant figures.

71. Write 703, 000 as 7.03×10^n . Find n .

72. Estimate 398×51 by rounding to 1 significant figure.

73. Estimate $612 \div 19$ by rounding to 1 significant figure.

74. Find the value of the digit 7 in 5, 274, 109.

75. Order $-3, 8, 0, -11, 5$ from smallest to largest.

Factors, Multiples, HCF and LCM

76. List all factors of 36.

77. Write 36 as a product of prime factors.

78. List all factors of 48.

79. Write 48 as a product of prime factors.

80. List all factors of 60.

81. Write 60 as a product of prime factors.

82. List all factors of 72.

83. Write 72 as a product of prime factors.

84. List all factors of 84.

85. Write 84 as a product of prime factors.

86. List all factors of 96.

87. Write 96 as a product of prime factors.

88. List all factors of 108.

89. Write 108 as a product of prime factors.

90. List all factors of 120.

91. Write 120 as a product of prime factors.

92. List all factors of 144.

93. Write 144 as a product of prime factors.

94. List all factors of 180.

95. Write 180 as a product of prime factors.

96. List all factors of 210.

97. Write 210 as a product of prime factors.

98. List all factors of 225.

99. Write 225 as a product of prime factors.

100. Find the HCF and LCM of 24 and 36.

101. Find the HCF and LCM of 42 and 70.

102. Find the HCF and LCM of 56 and 84.

103. Find the HCF and LCM of 72 and 96.

104. Find the HCF and LCM of 90 and 126.

105. Find the HCF and LCM of 96 and 180.

106. Find the HCF and LCM of 120 and 168.

107. Find the HCF and LCM of 144 and 216.

108. Find the HCF and LCM of 180 and 240.

109. Find the HCF and LCM of 210 and 315.

Integers and Order of Operations

110. Evaluate $-7 + 12$.

111. Evaluate $-15 - 8$.

112. Evaluate $18 - (-6)$.

113. Evaluate -9×7 .

114. Evaluate $(-8) \times (-5)$.

115. Evaluate $72 \div (-9)$.

116. Evaluate $(-84) \div (-7)$.

117. Evaluate $-4 + 3 \times 8$.

118. Evaluate $6 - 2(9 - 13)$.

119. Evaluate -5^2 .

120. Evaluate $(-5)^2$.

121. Evaluate -3^3 .

122. Evaluate $(-3)^3$.

123. Evaluate $40 + (-12) - (-19)$.

124. Evaluate $(-6)(4) - 18 \div (-3)$.

125. Evaluate $5(2 - 9) + 11$.

126. Evaluate $-48 \div 6 + 15$.

127. Evaluate $7 - 3(-4) + 2^3$.

128. Evaluate $(-2)^4 - 3^2$.

129. Evaluate $100 - 6(14 + 3)$.

Mixed Practice - Number Fluency and Reasoning

130. Find the 9th triangular number.

131. Find the 10th triangular number.

132. Find the 11th triangular number.

133. Find the 12th triangular number.

134. Find the 13th triangular number.

135. Find the 14th triangular number.

136. Find the 15th triangular number.

137. Find the 16th triangular number.

138. Find the 17th triangular number.

139. Find the 18th triangular number.

140. State whether 42 is prime or composite. Then state whether it is square, cube or triangular where possible.

141. State whether 45 is prime or composite. Then state whether it is square, cube or triangular where possible.

142. State whether 54 is prime or composite. Then state whether it is square, cube or triangular where possible.

143. State whether 56 is prime or composite. Then state whether it is square, cube or triangular where possible.

144. State whether 63 is prime or composite. Then state whether it is square, cube or triangular where possible.

145. State whether 75 is prime or composite. Then state whether it is square, cube or triangular where possible.

146. State whether 88 is prime or composite. Then state whether it is square, cube or triangular where possible.

147. State whether 99 is prime or composite. Then state whether it is square, cube or triangular where possible.

148. State whether 112 is prime or composite. Then state whether it is square, cube or triangular where possible.

149. State whether 135 is prime or composite. Then state whether it is square, cube or triangular where possible.

150. State whether 169 is prime or composite. Then state whether it is square, cube or triangular where possible.

151. State whether 216 is prime or composite. Then state whether it is square, cube or triangular where possible.

152. Find the HCF and LCM of 126 and 210.

153. Find the HCF and LCM of 132 and 198.

154. Find the HCF and LCM of 150 and 225.

155. Find the HCF and LCM of 168 and 252.

156. Find the HCF and LCM of 180 and 270.

157. Find the HCF and LCM of 216 and 288.

158. Find the HCF and LCM of 240 and 360.

159. Find the HCF and LCM of 252 and 420.

160. Find the HCF and LCM of 315 and 525.

161. Find the HCF and LCM of 384 and 576.

162. Work out mentally or with short written working: $325 + 475 - 190$.

163. Work out mentally or with short written working: 18×25 .

164. Work out mentally or with short written working: 2.5×48 .

165. Work out mentally or with short written working: $720 \div 0.8$.

166. Work out mentally or with short written working: 35% of 240.

167. Work out mentally or with short written working: $999 - 37 \times 9$.

168. Work out mentally or with short written working: $16^2 - 12^2$.

169. Work out mentally or with short written working: 64×125 .

170. Work out mentally or with short written working: $7(18 - 5) + 3^3$.

171. Work out mentally or with short written working: $1200 \div 15 + 44$.

172. Work out mentally or with short written working: $(-11)(-12) - 35$.

173. Work out mentally or with short written working: $5^3 + 4^3$.

Exam-Style Number Reasoning

174. A number is greater than 50, less than 90, odd, triangular and composite. Find one possible number.

175. A bus leaves every 18 minutes and a train leaves every 24 minutes. They leave together at 8:00 am. When will they next leave together?

176. A code number has prime factorisation $2^3 \times 3 \times 5$. Find the code number and list all its prime factors.

177. The temperature is -6 degrees at midnight. It rises by 13 degrees, then falls by 9 degrees. Find the final temperature.

178. A student says every odd number is prime. Give a counterexample and explain.

179. Find the smallest positive integer that is a multiple of both 12 and 18, and also a square number.

180. Three bells ring every 8, 12 and 15 minutes. They ring together at noon. How many minutes later do they next ring together?

181. A number has exactly three positive factors. What type of number must it be? Give an example.

Chapter 2: Fractions and Core Number Skills

Chapter Goal

Understand fractions as numbers, compare them confidently, convert between forms, and solve fraction problems without relying on a calculator.

Calculator Policy

Mostly non-calculator. Show common denominators, simplification and fraction reasoning.

Quick Notes - Fractions

A fraction compares a part with a whole. Equivalent fractions have the same value.

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$$

To simplify a fraction, divide the numerator and denominator by the same common factor.

Quick Notes - Mixed and Improper Fractions

$$2\frac{1}{3} = \frac{7}{3}$$

Multiply the whole number by the denominator, then add the numerator.

Worked Examples

Example 1 - Simplifying

$$\frac{18}{24} = \frac{3}{4}$$

Divide by 6.

Example 2 - Comparing

To compare $\frac{2}{3}$ and $\frac{5}{8}$, cross-multiply: $2 \times 8 = 16$, $5 \times 3 = 15$. So $\frac{2}{3} > \frac{5}{8}$.

Common Mistake

When adding fractions, do not add the denominators. Use a common denominator.

Basic Understanding - Fractions and Equivalence

1. Write $\frac{1}{2}$ of 24.

2. Write $\frac{1}{3}$ of 36.

3. Write $\frac{1}{4}$ of 48.

4. Write $\frac{2}{3}$ of 36.

5. Write $\frac{3}{4}$ of 48.

6. Write $\frac{2}{5}$ of 60.

7. Write $\frac{3}{5}$ of 60.

8. Write $\frac{4}{5}$ of 60.

9. Write $\frac{5}{8}$ of 96.

10. Write $\frac{7}{10}$ of 120.

11. Simplify $\frac{1}{2}$.

12. Simplify $\frac{1}{2}$.

13. Simplify $\frac{1}{2}$.

14. Simplify $\frac{1}{2}$.

15. Simplify $\frac{2}{3}$.

16. Simplify $\frac{2}{3}$.

17. Simplify $\frac{3}{5}$.

18. Simplify $\frac{2}{3}$.

19. Simplify $\frac{2}{3}$.

20. Simplify $\frac{2}{3}$.

21. Simplify $\frac{3}{5}$.

22. Simplify $\frac{3}{5}$.

23. Simplify $\frac{2}{3}$.

24. Simplify $\frac{3}{5}$.

25. Simplify $\frac{5}{8}$.

26. Complete the equivalent fraction: $\frac{1}{2} = \frac{\square}{8}$.

27. Complete the equivalent fraction: $\frac{2}{3} = \frac{\square}{12}$.

28. Complete the equivalent fraction: $\frac{3}{4} = \frac{\square}{20}$.

29. Complete the equivalent fraction: $\frac{5}{6} = \frac{\square}{18}$.

30. Complete the equivalent fraction: $\frac{4}{5} = \frac{\square}{35}$.

31. Complete the equivalent fraction: $\frac{7}{8} = \frac{\square}{32}$.

32. Complete the equivalent fraction: $\frac{3}{10} = \frac{\square}{70}$.

33. Complete the equivalent fraction: $\frac{5}{12} = \frac{\square}{48}$.

34. Complete the equivalent fraction: $\frac{7}{9} = \frac{\square}{45}$.

35. Complete the equivalent fraction: $\frac{11}{15} = \frac{\square}{60}$.

Skill Building - Comparing and Ordering Fractions

36. Compare $\frac{2}{3}$ and $\frac{3}{5}$ using $<$ or $>$.

37. Compare $\frac{5}{8}$ and $\frac{2}{3}$ using $<$ or $>$.

38. Compare $\frac{7}{12}$ and $\frac{3}{4}$ using $<$ or $>$.

39. Compare $\frac{4}{9}$ and $\frac{5}{12}$ using $<$ or $>$.

40. Compare $\frac{11}{15}$ and $\frac{7}{10}$ using $<$ or $>$.

41. Compare $\frac{9}{14}$ and $\frac{5}{7}$ using $<$ or $>$.

42. Compare $\frac{13}{20}$ and $\frac{2}{3}$ using $<$ or $>$.

43. Compare $\frac{5}{6}$ and $\frac{7}{9}$ using $<$ or $>$.

44. Compare $\frac{3}{8}$ and $\frac{4}{11}$ using $<$ or $>$.

45. Compare $\frac{8}{15}$ and $\frac{5}{9}$ using $<$ or $>$.

46. Order these fractions from smallest to largest: $\frac{1}{3}$, $\frac{3}{8}$, $\frac{2}{5}$.

47. Order these fractions from smallest to largest: $\frac{5}{6}$, $\frac{7}{12}$, $\frac{2}{3}$.

48. Order these fractions from smallest to largest: $\frac{4}{9}$, $\frac{1}{2}$, $\frac{5}{12}$.

49. Order these fractions from smallest to largest: $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{10}$.

50. Order these fractions from smallest to largest: $\frac{2}{7}$, $\frac{3}{10}$, $\frac{1}{3}$.

51. Order these fractions from smallest to largest: $\frac{11}{20}$, $\frac{3}{5}$, $\frac{7}{12}$.

Skill Building - Mixed Numbers and Improper Fractions

52. Write $\frac{7}{3}$ as a mixed number.

53. Write $\frac{11}{4}$ as a mixed number.

54. Write $\frac{17}{5}$ as a mixed number.

55. Write $\frac{22}{7}$ as a mixed number.

56. Write $\frac{31}{8}$ as a mixed number.

57. Write $\frac{19}{6}$ as a mixed number.

58. Write $\frac{43}{9}$ as a mixed number.

59. Write $\frac{58}{11}$ as a mixed number.

60. Write $\frac{29}{12}$ as a mixed number.

61. Write $\frac{75}{16}$ as a mixed number.

62. Write $2\frac{1}{3}$ as an improper fraction.

63. Write $3\frac{2}{5}$ as an improper fraction.

64. Write $4\frac{3}{7}$ as an improper fraction.

65. Write $5\frac{5}{8}$ as an improper fraction.

66. Write $6\frac{1}{4}$ as an improper fraction.

67. Write $7\frac{3}{10}$ as an improper fraction.

68. Write $8\frac{7}{12}$ as an improper fraction.

69. Write $9\frac{2}{9}$ as an improper fraction.

70. Write $10\frac{5}{6}$ as an improper fraction.

71. Write $12\frac{3}{11}$ as an improper fraction.

Mixed Practice - Fraction Calculations

72. Work out $\frac{1}{3} + \frac{1}{6}$. Give your answer in its simplest form.

73. Work out $\frac{2}{5} + \frac{1}{10}$. Give your answer in its simplest form.

74. Work out $\frac{3}{4} - \frac{1}{8}$. Give your answer in its simplest form.

75. Work out $\frac{5}{6} - \frac{1}{3}$. Give your answer in its simplest form.

76. Work out $\frac{2}{3} \times \frac{3}{5}$. Give your answer in its simplest form.

77. Work out $\frac{4}{7} \times \frac{7}{8}$. Give your answer in its simplest form.

78. Work out $\frac{3}{5} \div \frac{9}{10}$. Give your answer in its simplest form.

79. Work out $\frac{5}{8} \div \frac{15}{16}$. Give your answer in its simplest form.

80. Work out $\frac{7}{12} + \frac{5}{18}$. Give your answer in its simplest form.

81. Work out $\frac{11}{15} - \frac{2}{9}$. Give your answer in its simplest form.

82. Work out $\frac{5}{6} \times \frac{3}{10}$. Give your answer in its simplest form.

83. Work out $\frac{8}{9} \div \frac{4}{15}$. Give your answer in its simplest form.

84. Work out $\frac{13}{20} + \frac{7}{30}$. Give your answer in its simplest form.

85. Work out $\frac{9}{14} - \frac{2}{7}$. Give your answer in its simplest form.

86. Work out $\frac{15}{16} \times \frac{8}{25}$. Give your answer in its simplest form.

87. Work out $\frac{7}{11} \div \frac{14}{33}$. Give your answer in its simplest form.

88. Work out $\frac{5}{12} + \frac{7}{18}$. Give your answer in its simplest form.

89. Work out $\frac{19}{24} - \frac{5}{16}$. Give your answer in its simplest form.

90. Work out $\frac{11}{12} \times \frac{9}{22}$. Give your answer in its simplest form.

91. Work out $\frac{6}{13} \div \frac{9}{26}$. Give your answer in its simplest form.

Mixed Practice - Extended Fraction Fluency

92. Work out $\frac{7}{15} + \frac{2}{5}$. Give your answer in its simplest form.

93. Work out $\frac{5}{9} + \frac{7}{18}$. Give your answer in its simplest form.

94. Work out $\frac{11}{16} - \frac{3}{8}$. Give your answer in its simplest form.

95. Work out $\frac{13}{21} - \frac{2}{7}$. Give your answer in its simplest form.

96. Work out $\frac{9}{10} \times \frac{5}{12}$. Give your answer in its simplest form.

97. Work out $\frac{14}{15} \times \frac{25}{28}$. Give your answer in its simplest form.

98. Work out $\frac{12}{17} \div \frac{6}{17}$. Give your answer in its simplest form.

99. Work out $\frac{10}{21} \div \frac{5}{14}$. Give your answer in its simplest form.

100. Work out $\frac{17}{24} + \frac{5}{36}$. Give your answer in its simplest form.

101. Work out $\frac{23}{30} - \frac{7}{20}$. Give your answer in its simplest form.

102. Work out $\frac{8}{15} \times \frac{45}{64}$. Give your answer in its simplest form.

103. Work out $\frac{9}{22} \div \frac{27}{44}$. Give your answer in its simplest form.

104. Work out $\frac{3}{14} + \frac{5}{21}$. Give your answer in its simplest form.

105. Work out $\frac{31}{40} - \frac{9}{25}$. Give your answer in its simplest form.

106. Work out $\frac{16}{27} \times \frac{9}{32}$. Give your answer in its simplest form.

107. Work out $\frac{25}{36} \div \frac{5}{12}$. Give your answer in its simplest form.

108. Work out $\frac{7}{18} + \frac{11}{27}$. Give your answer in its simplest form.

109. Work out $\frac{29}{42} - \frac{5}{14}$. Give your answer in its simplest form.

110. Work out $\frac{21}{25} \times \frac{15}{28}$. Give your answer in its simplest form.

111. Work out $\frac{13}{16} \div \frac{39}{64}$. Give your answer in its simplest form.

112. Find $\frac{3}{8}$ of 96.

113. Find $\frac{5}{12}$ of 144.

114. Find $\frac{7}{15}$ of 180.

115. Find $\frac{11}{20}$ of 260.

116. Find $\frac{4}{9}$ of 225.

117. Find $\frac{13}{25}$ of 500.

118. Find $\frac{7}{16}$ of 192.

119. Find $\frac{9}{14}$ of 280.

120. Find $\frac{5}{18}$ of 324.

121. Find $\frac{17}{30}$ of 450.

122. Order these fractions from smallest to largest: $\frac{4}{7}$, $\frac{5}{8}$, $\frac{9}{14}$.

123. Order these fractions from smallest to largest: $\frac{7}{12}$, $\frac{3}{5}$, $\frac{11}{18}$.

124. Order these fractions from smallest to largest: $\frac{5}{9}$, $\frac{8}{15}$, $\frac{7}{10}$.

125. Order these fractions from smallest to largest: $\frac{13}{24}$, $\frac{5}{8}$, $\frac{11}{16}$.

126. Order these fractions from smallest to largest: $\frac{9}{20}$, $\frac{4}{9}$, $\frac{7}{15}$.

127. Order these fractions from smallest to largest: $\frac{17}{30}$, $\frac{3}{5}$, $\frac{11}{20}$.

128. A bag is $\frac{5}{6}$ full. After 18 kg is removed, it is $\frac{1}{2}$ full. Find the full capacity.

129. A student completes $\frac{3}{8}$ of a project on Monday and $\frac{2}{5}$ of the remainder on Tuesday. What fraction is left?

130. A number is increased by $\frac{1}{5}$ of itself and becomes 72. Find the original number.

131. Two fractions have product $\frac{3}{10}$. One fraction is $\frac{5}{8}$. Find the other fraction.

Problem Solving - Fractions in Context

132. A ribbon is $\frac{3}{4}$ m long. Another ribbon is $\frac{5}{8}$ m long. Find the total length.

133. Maya reads $\frac{2}{5}$ of a book on Monday and $\frac{1}{4}$ on Tuesday. What fraction of the book is left?

134. A tank is $\frac{5}{6}$ full. $\frac{1}{3}$ of a tank is used. What fraction remains?

135. A recipe uses $\frac{2}{3}$ cup of sugar for one cake. How much sugar is needed for $\frac{3}{2}$ cakes?

136. A runner completes $\frac{7}{10}$ of a race. The race is 5 km. How far has the runner completed?

137. A class has 28 students. $\frac{3}{7}$ are in the choir. How many are not in the choir?

138. A packet contains 36 counters. $\frac{5}{9}$ are red. How many counters are red?

139. A garden is $\frac{2}{3}$ grass. $\frac{1}{4}$ of the grass area is shaded. What fraction of the whole garden is shaded grass?

Examination-Style Fraction Questions

140. Three fractions are $\frac{5}{8}$, $\frac{7}{12}$ and $\frac{3}{5}$. Put them in descending order.

141. A student says $\frac{2}{3} + \frac{3}{4} = \frac{5}{7}$. Explain the mistake and find the correct answer.

142. A bottle is $\frac{4}{5}$ full. After 300 ml is poured out, it is $\frac{1}{2}$ full. Find the capacity of the bottle.

143. A number is multiplied by $\frac{3}{4}$, then divided by $\frac{2}{5}$. The result is 30. Find the original number.

144. Create two different fractions between $\frac{2}{5}$ and $\frac{1}{2}$.

Chapter 3: Ratio, Proportion and Rates

Chapter Goal

Use ratio fluently in sharing, scale, recipes, currency exchange, best-buy comparisons, rates and multi-step word problems.

Calculator Policy

Mostly non-calculator. Show ratio parts, unit rates and proportional reasoning.

Quick Notes - Ratio

A ratio compares parts. Simplify a ratio by dividing every part by the same common factor.

$$18 : 24 = 3 : 4$$

To share in a ratio, add the parts first.

Worked Examples

Example 1 - Sharing

Share 72 in the ratio 5 : 7.

Total parts = 12. One part = $72 \div 12 = 6$. Shares are 30 and 42.

Example 2 - Scale

Scale 1 : 50,000 means 1 cm on the map represents 50,000 cm in real life.

Common Mistake

Do not reverse the order of a ratio. If red:blue is 2 : 5, red is the first part.

Basic Understanding - Ratio Notation and Simplifying

1. Simplify the ratio 6 : 9.

2. Simplify the ratio 14 : 21.

3. Simplify the ratio 18 : 24.

4. Simplify the ratio 20 : 35.

5. Simplify the ratio 28 : 42.

6. Simplify the ratio 32 : 56.

7. Simplify the ratio 45 : 75.

8. Simplify the ratio 54 : 81.

9. Simplify the ratio 64 : 80.

10. Simplify the ratio 72 : 96.

11. Simplify the ratio 84 : 126.

12. Simplify the ratio 96 : 144.

13. Simplify the ratio 120 : 180.

14. Simplify the ratio 150 : 210.

15. Simplify the ratio 18 : 27 : 45.

16. Simplify the ratio 24 : 36 : 60.

17. Simplify the ratio 28 : 42 : 70.

18. Simplify the ratio 35 : 49 : 77.

19. Simplify the ratio 45 : 60 : 105.

20. Simplify the ratio 64 : 80 : 112.

21. Complete the equivalent ratio: $2 : 3 = \square : 15$.

22. Complete the equivalent ratio: $3 : 5 = \square : 35$.

23. Complete the equivalent ratio: $4 : 7 = \square : 28$.

24. Complete the equivalent ratio: $5 : 8 = \square : 40$.

25. Complete the equivalent ratio: $7 : 9 = \square : 63$.

26. Complete the equivalent ratio: $3 : 4 = \square : 48$.

27. Complete the equivalent ratio: $6 : 11 = \square : 66$.

28. Complete the equivalent ratio: $5 : 12 = \square : 60$.

29. Complete the equivalent ratio: $8 : 13 = \square : 104$.

30. Complete the equivalent ratio: $9 : 14 = \square : 126$.

31. Complete the equivalent ratio: $11 : 18 = \square : 72$.

32. Complete the equivalent ratio: $13 : 20 = \square : 100$.

33. Complete the equivalent ratio: $7 : 15 = \square : 90$.

34. Complete the equivalent ratio: $12 : 17 = \square : 102$.

35. Complete the equivalent ratio: $14 : 25 = \square : 150$.

Skill Building - Sharing in a Ratio

36. Share 60 in the ratio 2 : 3.

37. Share 84 in the ratio 2 : 5.

38. Share 96 in the ratio 3 : 5.

39. Share 120 in the ratio 1 : 2.

40. Share 135 in the ratio 4 : 5.

41. Share 144 in the ratio 5 : 7.

42. Share 180 in the ratio 7 : 8.

43. Share 216 in the ratio 4 : 5 : 9.

44. Share 150 in the ratio 2 : 3 : 5.

45. Share 132 in the ratio 3 : 4 : 4.

46. Share 240 in the ratio 5 : 7 : 8.

47. Share 360 in the ratio 2 : 3 : 4.

48. Share 420 in the ratio 3 : 5 : 6.

49. Share 525 in the ratio 4 : 5 : 6.

50. Share 840 in the ratio 2 : 5 : 7.

51. Share 288 in the ratio 7 : 9.

52. Share 336 in the ratio 5 : 11.

53. Share 420 in the ratio 8 : 13.

54. Share 504 in the ratio 3 : 4 : 7.

55. Share 630 in the ratio 4 : 5 : 12.

56. Share 756 in the ratio 5 : 7 : 9.

57. Share 960 in the ratio 3 : 5 : 8.

58. Share 1152 in the ratio 7 : 11 : 14.

59. Share 1260 in the ratio 4 : 6 : 11.

60. Share 1440 in the ratio 5 : 7 : 12.

Problem Solving - Real-Life Ratio Applications

61. A recipe uses flour:sugar:butter in the ratio 5 : 2 : 3. If 450 g of flour is used, find the amounts of sugar and butter.

62. A map scale is 1 : 50,000. A distance on the map is 6 cm. Find the real distance in km.

63. On a map, 4 cm represents 10 km. Find the map distance for 27.5 km.

64. A currency exchange rate is NZD 1 = CNY 4.4. Convert NZD 75 to CNY.

65. A currency exchange rate is GBP 1 = NZD 2.05. Convert NZD 246 to GBP.

66. Shop A sells 6 notebooks for \$9.60. Shop B sells 10 notebooks for \$15.50. Which is better value?

67. A car travels 180 km using 12 L of petrol. Find the rate in km per litre.

68. Paint is mixed red:blue:white in the ratio 2 : 3 : 5. A batch has 40 L. Find the amount of each colour.

69. The ratio of boys to girls in a club is 5 : 7. There are 48 students. Find the number of boys.

70. A drink is syrup:water = 1 : 4. How much water is needed for 750 ml of drink?

71. A model car has scale 1 : 24. The real car is 4.8 m long. Find the model length in cm.

72. A school buys pencils and pens in the ratio 4 : 9. There are 156 items. Find the number of pens.

73. A cyclist travels 18 km in 45 minutes. Find the speed in km/h.

74. A bag has red, blue and green beads in the ratio 3 : 4 : 5. There are 18 red beads. Find the total number of beads.

75. A best-buy comparison: 400 g costs \$5.20, 650 g costs \$8.45. Which is better value per gram?

76. A recipe uses oats:honey:nuts in the ratio 6 : 1 : 3. A batch uses 900 g oats. Find the mass of honey and nuts.

77. A map scale is 1 : 80,000. A route is 12.5 cm on the map. Find the real distance in km.

78. A drink is mixed concentrate:water = 2 : 7. There is 630 ml of water. Find the total amount of drink.

79. A train travels 156 km in 1 hour 18 minutes. Find its average speed in km/h.

80. A scale model is built using scale 1 : 75. The model height is 18 cm. Find the real height in metres.

81. A currency rate is EUR 1 = NZD 1.80. Convert NZD 450 to EUR.

82. Shop A sells 3 kg rice for \$8.40. Shop B sells 5 kg rice for \$13.50. Which is better value?

83. A charity receives online:cash donations in the ratio 11 : 4. Cash donations are \$260. Find the total donations.

84. A car uses 6.4 L of petrol for 80 km. Find the fuel use in L per 100 km.

85. A photograph has width:height = 4 : 3. The height is 21 cm. Find the width.

Mixed Practice - Ratio Reasoning

86. The ratio $a : b = 3 : 7$. The larger amount is 32 more than the smaller amount. Find a and b .

87. Red and blue counters are in the ratio $2 : 3$. Ten red counters are added and the ratio becomes $4 : 5$. Find the original numbers.

88. Two amounts are in the ratio $5 : 8$. Their sum is 169. Find their difference.

89. A recipe for 4 people uses 300 g rice. How much rice is needed for 7 people?

90. A printer prints 180 pages in 12 minutes. How many pages can it print in 35 minutes at the same rate?

91. A journey has two equal distances. The first half is travelled at 30 km/h and the second half at 60 km/h. Find the average speed.

92. A map has scale $1 : 25,000$. A walking route is 14 cm on the map. Find the real distance in km.

93. A shop changes the price from \$24 to \$30. Write the old:new price as a simplified ratio.

Mixed Practice - Expanded Ratio Applications

94. Share 264 in the ratio 5 : 6 : 11.

95. Share 330 in the ratio 2 : 3 : 6.

96. Share 468 in the ratio 4 : 5 : 9.

97. Share 540 in the ratio 7 : 8 : 12.

98. Share 720 in the ratio 3 : 5 : 7 : 9.

99. Share 960 in the ratio 5 : 7 : 8.

100. Share 1080 in the ratio 2 : 4 : 5 : 7.

101. Share 1250 in the ratio 3 : 4 : 8 : 10.

102. Share 1540 in the ratio 4 : 7 : 11.

103. Share 1890 in the ratio 5 : 9 : 13.

104. Share 1760 in the ratio 6 : 7 : 9.

105. Share 2040 in the ratio 8 : 11 : 15.

106. Share 2250 in the ratio 5 : 9 : 11.

107. Share 2520 in the ratio 3 : 8 : 10.

108. Share 2880 in the ratio 7 : 8 : 17.

109. The ratio of red beads to blue beads is 3 : 8. There are 275 in total. Find both amounts.

110. The ratio of adults to children is 4 : 9. There are 390 in total. Find both amounts.

111. The ratio of small boxes to large boxes is 5 : 12. There are 238 in total. Find both amounts.

112. The ratio of online sales to shop sales is 7 : 11. There are 324 in total. Find both amounts.

113. The ratio of morning visitors to afternoon visitors is 9 : 16. There are 625 in total. Find both amounts.

114. A map has scale 1 : 20,000. A route is 9 cm on the map. Find the real distance in km.

115. A map has scale 1 : 25,000. A route is 18 cm on the map. Find the real distance in km.

116. A map has scale 1 : 40,000. A route is 7.5 cm on the map. Find the real distance in km.

117. A map has scale 1 : 75,000. A route is 12 cm on the map. Find the real distance in km.

118. A map has scale 1 : 100,000. A route is 6.4 cm on the map. Find the real distance in km.

119. Exchange rate: NZD 1 = CNY 4.5. Convert NZD 86 to CNY.

120. Exchange rate: NZD 1 = USD 0.62. Convert NZD 140 to USD.

121. Exchange rate: GBP 1 = NZD 2.1. Convert GBP 95 to NZD.

122. Exchange rate: AUD 1 = NZD 1.08. Convert AUD 250 to NZD.

123. Exchange rate: NZD 1 = JPY 92. Convert NZD 35 to JPY.

124. Best-buy question: 12 apples cost \$5.40. 20 apples cost \$8.60. Which option is better value?

125. Best-buy question: 500 g costs \$6.25. 800 g costs \$9.20. Which option is better value?

126. Best-buy question: 3 pens cost \$4.80. 8 pens cost \$12.40. Which option is better value?

127. Best-buy question: 2 L costs \$3.90. 3 L costs \$5.70. Which option is better value?

128. Best-buy question: 250 ml costs \$2.20. 600 ml costs \$4.80. Which option is better value?

129. A mixture has acid:water = 2 : 7. Water is 250 ml more than acid. Find the total mixture.

130. The ratio of old price:new price is 5 : 6. The new price is \$18 more. Find the old price.

131. A recipe has rice:water = 2 : 5. A cook uses 420 ml water. How much rice is needed?

132. A photo is enlarged in the ratio 3 : 5. The original width is 18 cm. Find the enlarged width.

133. A car travels at 72 km/h for 25 minutes. Find the distance travelled.

Examination-Style Ratio Questions

134. A smoothie uses banana:milk:yoghurt in the ratio 2 : 5 : 3. A cafe makes 4.5 L of smoothie. Find the amount of milk.

135. A scale drawing has scale 1 : 80. A rectangular room is 5.6 m by 3.2 m. Find the drawing dimensions in cm.

136. A and B share money in the ratio 7 : 5. A receives \$36 more than B. Find the total amount shared.

137. A price in NZD is converted to USD using $\text{NZD } 1 = \text{USD } 0.62$. The USD price is \$155. Find the NZD price.

138. Flour and sugar are in the ratio $7 : 3$. After 120 g of sugar is added, the ratio becomes $7 : 5$. Find the original amount of flour.

139. Blue and yellow paint are mixed in the ratio $5 : 2$. Some yellow paint is added and the ratio becomes $5 : 3$. If 90 ml of yellow paint is added, find the original amount of blue paint.

140. A map uses scale $1 : 60,000$. Two villages are 7.5 cm apart on the map. A cyclist travels between them in 18 minutes. Find the cyclist's average speed in km/h.

141. Two packets of cereal are sold. Packet A is 750 g for \$6.90. Packet B is 1.2 kg for \$10.68. Which is better value and by how many cents per 100 g?

142. A journey of 96 km is completed at an average speed of 64 km/h. For another journey, the distance is in the ratio 5 : 8 compared with the first journey and the time is in the ratio 3 : 4. Find the second average speed.

143. Correct the previous student's method: a student says the answer to a ratio sharing problem can be found by dividing by the largest ratio part. Explain why this is not reliable.

Chapter 4: Indices, Surds, Standard Form and Bounds

Chapter Goal

Use numerical indices confidently, simplify surds, rationalise simple denominators, estimate calculations and work with upper and lower bounds.

Calculator Policy

Mostly non-calculator. Use index laws, exact surd form and rounding logic before checking with a calculator.

Quick Notes - Indices

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$$

$$a^m \times a^n = a^{m+n}, \quad a^m \div a^n = a^{m-n}, \quad (a^m)^n = a^{mn}$$

Quick Notes - Surds

A surd is an exact square root that cannot be simplified to a whole number.

$$\sqrt{18} = 3\sqrt{2}$$

To rationalise $\frac{1}{\sqrt{2}}$, multiply top and bottom by $\sqrt{2}$.

Quick Notes - Bounds

If $x = 7.4$ to the nearest 0.1, then:

$$7.35 \leq x < 7.45$$

Worked Examples

Example 1 - Surd Simplification

$$\sqrt{48} = \sqrt{16 \times 3} = 4\sqrt{3}$$

Example 2 - Bounds

A mass is 460 g to the nearest 10 g, so $455 \leq m < 465$.

Common Mistake

For upper bound speed, use upper distance divided by lower time.

Skill Building - Numerical Indices

1. Evaluate 2^5 .

2. Evaluate 3^4 .

3. Evaluate 5^3 .

4. Evaluate 10^4 .

5. Evaluate -2^4 .

6. Evaluate -3^3 .

7. Evaluate 7^2 .

8. Evaluate 4^3 .

9. Evaluate 1^9 .

10. Evaluate 6^2 .

11. Evaluate 8^2 .

12. Evaluate 9^3 .

13. Evaluate 12^2 .

14. Evaluate 2^8 .

15. Evaluate 11^2 .

16. Evaluate 5^4 .

17. Evaluate -4^2 .

18. Evaluate -5^3 .

19. Evaluate 15^2 .

20. Evaluate 20^2 .

21. Simplify or evaluate $2^3 \times 2^5$.

22. Simplify or evaluate $3^4 \times 3^2$.

23. Simplify or evaluate $5^7 \div 5^3$.

24. Simplify or evaluate $10^6 \div 10^2$.

25. Simplify or evaluate $(2^3)^4$.

26. Simplify or evaluate $(7^2)^3$.

27. Simplify or evaluate 4^0 .

28. Simplify or evaluate 9^1 .

29. Simplify or evaluate 2^{-3} .

30. Simplify or evaluate 10^{-2} .

Mixed Practice - Standard Form and Estimation

31. Write 45000 in standard form.

32. Write 7300000 in standard form.

33. Write 0.0062 in standard form.

34. Write 0.00084 in standard form.

35. Write 120000000 in standard form.

36. Write 0.035 in standard form.

37. Write 9800 in standard form.

38. Write $4.7e - 7$ in standard form.

39. Write 3.2×10^5 as an ordinary number.

40. Write 7.5×10^3 as an ordinary number.

41. Write 1.08×10^6 as an ordinary number.

42. Write 4.6×10^{-3} as an ordinary number.

43. Write 9.01×10^{-2} as an ordinary number.

44. Write 2.35×10^4 as an ordinary number.

45. Write 6.72×10^{-5} as an ordinary number.

46. Write 8.4×10^2 as an ordinary number.

47. Estimate 61×19 by rounding each number to 1 significant figure.

48. Estimate 398×51 by rounding each number to 1 significant figure.

49. Estimate $612 \div 19$ by rounding each number to 1 significant figure.

50. Estimate 48.7×0.21 by rounding each number to 1 significant figure.

51. Estimate $799 \div 39$ by rounding each number to 1 significant figure.

52. Estimate 0.049×302 by rounding each number to 1 significant figure.

53. Estimate $5100 \div 98$ by rounding each number to 1 significant figure.

54. Estimate 2.93×19.8 by rounding each number to 1 significant figure.

Skill Building - Surds

55. Simplify $\sqrt{8}$.

56. Simplify $\sqrt{12}$.

57. Simplify $\sqrt{18}$.

58. Simplify $\sqrt{20}$.

59. Simplify $\sqrt{24}$.

60. Simplify $\sqrt{27}$.

61. Simplify $\sqrt{28}$.

62. Simplify $\sqrt{32}$.

63. Simplify $\sqrt{45}$.

64. Simplify $\sqrt{48}$.

65. Simplify $\sqrt{50}$.

66. Simplify $\sqrt{63}$.

67. Simplify $\sqrt{72}$.

68. Simplify $\sqrt{75}$.

69. Simplify $\sqrt{80}$.

70. Simplify $\sqrt{98}$.

71. Simplify $\sqrt{108}$.

72. Simplify $\sqrt{125}$.

73. Simplify $\sqrt{147}$.

74. Simplify $\sqrt{192}$.

75. Simplify $\sqrt{2} \times \sqrt{8}$.

76. Simplify $\sqrt{3} \times \sqrt{12}$.

77. Simplify $\sqrt{5} \times \sqrt{20}$.

78. Simplify $\sqrt{6} \times \sqrt{24}$.

79. Simplify $\sqrt{7} \times \sqrt{28}$.

80. Simplify $\sqrt{2} \times \sqrt{50}$.

81. Simplify $\sqrt{3} \times \sqrt{75}$.

82. Simplify $\sqrt{5} \times \sqrt{45}$.

83. Simplify $\sqrt{4} \times \sqrt{80}$.

84. Simplify $\sqrt{6} \times \sqrt{108}$.

85. Rationalise the denominator: $\frac{1}{\sqrt{2}}$.

86. Rationalise the denominator: $\frac{1}{\sqrt{3}}$.

87. Rationalise the denominator: $\frac{2}{\sqrt{5}}$.

88. Rationalise the denominator: $\frac{3}{\sqrt{7}}$.

89. Rationalise the denominator: $\frac{4}{\sqrt{2}}$.

90. Rationalise the denominator: $\frac{5}{\sqrt{6}}$.

91. Rationalise the denominator: $\frac{6}{\sqrt{10}}$.

92. Rationalise the denominator: $\frac{7}{\sqrt{11}}$.

93. Rationalise the denominator: $\frac{8}{\sqrt{3}}$.

94. Rationalise the denominator: $\frac{9}{\sqrt{5}}$.

Skill Building - Rounding, Bounds and Error Intervals

95. A measurement is given as 8.4 cm, rounded to the nearest 0.1 cm. State the error interval.

96. A measurement is given as 36 kg, rounded to the nearest 1 kg. State the error interval.

97. A measurement is given as 125 m, rounded to the nearest 10 m. State the error interval.

98. A measurement is given as 4.72 s, rounded to the nearest 0.01 s. State the error interval.

99. A measurement is given as 0.86 L, rounded to the nearest 0.01 L. State the error interval.

100. A measurement is given as 12.4 cm, rounded to the nearest 0.1 cm. State the error interval.

101. A measurement is given as 460 g, rounded to the nearest 10 g. State the error interval.

102. A measurement is given as 0.057 m, rounded to the nearest 0.001 m. State the error interval.

103. A measurement is given as 7.35 kg, rounded to the nearest 0.01 kg. State the error interval.

104. A measurement is given as 2800 people, rounded to the nearest 100 people. State the error interval.

105. A measurement is given as 15 km, rounded to the nearest 0.1 km. State the error interval.

106. A measurement is given as 3.6 m, rounded to the nearest 0.2 m. State the error interval.

107. A rectangle has length 12.4 cm and width 5.8 cm, both rounded to the nearest 0.1 cm. Find the upper bound for its area.

108. A journey distance is 84 km to the nearest km and time is 2.5 h to the nearest 0.1 h. Find the upper bound for speed.

109. A mass is 350 g to the nearest 10 g. A packet contains 8 such items. Find the upper bound for total mass.

110. A side length is 6.0 cm to the nearest 0.1 cm. Find lower and upper bounds for the perimeter of a square.

111. A number rounds to 3500 to the nearest 100. Find the smallest and largest possible whole numbers.

Mixed Practice - Extended Indices, Surds and Bounds

112. Simplify or evaluate $3^2 \times 3^5 \div 3^4$.

113. Simplify or evaluate $(5^2)^3 \div 5^4$.

114. Simplify or evaluate 2^{-4} .

115. Simplify or evaluate $4^3 \times 4^0$.

116. Simplify or evaluate $10^{-3} \times 10^5$.

117. Simplify or evaluate $(8^2)^0$.

118. Simplify or evaluate $6^5 \div 6^2$.

119. Simplify or evaluate $9^1 \times 9^2$.

120. Simplify or evaluate $(2^4)^2$.

121. Simplify or evaluate $7^3 \div 7^3$.

122. Simplify $\sqrt{200}$.

123. Simplify $\sqrt{242}$.

124. Simplify $\sqrt{245}$.

125. Simplify $\sqrt{288}$.

126. Simplify $\sqrt{300}$.

127. Simplify $\sqrt{320}$.

128. Simplify $\sqrt{363}$.

129. Simplify $\sqrt{405}$.

130. Simplify $\sqrt{432}$.

131. Simplify $\sqrt{500}$.

132. Simplify $\sqrt{567}$.

133. Simplify $\sqrt{675}$.

134. Simplify $\sqrt{768}$.

135. Simplify $\sqrt{800}$.

136. Simplify $\sqrt{875}$.

137. Simplify $\sqrt{972}$.

138. Simplify $\sqrt{1125}$.

139. Simplify $\sqrt{1215}$.

140. Simplify $\sqrt{1323}$.

141. Simplify $\sqrt{1452}$.

142. Rationalise the denominator: $\frac{10}{\sqrt{2}}$.

143. Rationalise the denominator: $\frac{12}{\sqrt{3}}$.

144. Rationalise the denominator: $\frac{14}{\sqrt{5}}$.

145. Rationalise the denominator: $\frac{15}{\sqrt{6}}$.

146. Rationalise the denominator: $\frac{16}{\sqrt{7}}$.

147. Rationalise the denominator: $\frac{18}{\sqrt{10}}$.

148. Rationalise the denominator: $\frac{20}{\sqrt{11}}$.

149. Rationalise the denominator: $\frac{21}{\sqrt{13}}$.

150. Rationalise the denominator: $\frac{22}{\sqrt{17}}$.

151. Rationalise the denominator: $\frac{24}{\sqrt{19}}$.

152. A value is 18.7 m, rounded to the nearest 0.1 m. Write the error interval.

153. A value is 1250 kg, rounded to the nearest 10 kg. Write the error interval.

154. A value is 0.034 L, rounded to the nearest 0.001 L. Write the error interval.

155. A value is 92.5 km, rounded to the nearest 0.1 km. Write the error interval.

156. A value is 6.25 s, rounded to the nearest 0.01 s. Write the error interval.

157. A value is 4500 people, rounded to the nearest 100 people. Write the error interval.

158. A value is 0.8 cm, rounded to the nearest 0.1 cm. Write the error interval.

159. A value is 13.5 dollars, rounded to the nearest 0.01 dollars. Write the error interval.

160. A value is 240 g, rounded to the nearest 5 g. Write the error interval.

161. A value is 3.75 m, rounded to the nearest 0.05 m. Write the error interval.

162. A rectangle has length 9.8 cm and width 4.6 cm, each to the nearest 0.1 cm. Find the lower bound for the area.

163. A distance is 120 km to the nearest 10 km and time is 2.0 h to the nearest 0.1 h. Find the lower bound for speed.

164. Simplify $3\sqrt{20} + 2\sqrt{45}$.

165. Simplify $\sqrt{27} \times \sqrt{75}$.

166. A student writes $\sqrt{a+b} = \sqrt{a} + \sqrt{b}$. Use $a = 9$, $b = 16$ to show this is false.

Examination-Style Indices, Surds and Bounds

167. Simplify $\sqrt{72} + \sqrt{50}$.

168. Rationalise $\frac{5}{\sqrt{3}}$.

169. A length is 8.6 cm to the nearest 0.1 cm. A width is 3.2 cm to the nearest 0.1 cm. Find the lower bound for the area.

170. Write 0.000072 in standard form and then multiply it by 3×10^5 .

171. Estimate $\frac{397 \times 51}{0.201}$ using 1 significant figure.

172. Simplify $\sqrt{12} \times \sqrt{75}$.

173. A cube has side length 4.8 cm to the nearest 0.1 cm. Find the upper bound for its volume.

174. A student says $\sqrt{20} = \sqrt{16} + \sqrt{4} = 6$. Explain the mistake.

Chapter 5: Sequences and Number Patterns

Chapter Goal

Generate, describe, and extend arithmetic, geometric, quadratic, and visual number patterns.

Calculator Policy

Mostly non-calculator. Show differences, ratios, or substitution into the rule.

Quick Notes - Page 1

An arithmetic sequence has a constant difference.

$$5, 8, 11, 14, \dots$$

The common difference is 3, and the n th term is $3n + 2$.

Quick Notes - Page 2

A geometric sequence has a constant multiplier.

$$3, 6, 12, 24, \dots$$

The common ratio is 2.

For a rule such as $4n - 1$, substitute $n = 1, 2, 3, \dots$ to generate terms.

Worked Examples

Example 1

Find the next term in 7, 12, 17, 22, ...

Solution: Add 5 each time, so the next term is 27.

Example 2

Find the n th term of 4, 9, 14, 19, ...

Solution: The common difference is 5, so start with $5n$. Since $5(1) - 1 = 4$, the rule is $5n - 1$.

Example 3

The n th term is $3n + 4$. Find the 12th term.

Solution: $3(12) + 4 = 40$.

Example 4

Find the next term in 2, 6, 18, 54, ...

Solution: Multiply by 3 each time, so the next term is 162.

Example 5

The sequence 6, 10, 14, 18, ... contains 70. Find its position.

Solution: The n th term is $4n + 2$. Solve $4n + 2 = 70$, so $n = 17$.

Example 6

The pattern 1, 4, 9, 16, ... is the square numbers. Find the 8th term.

Solution: The 8th term is $8^2 = 64$.

Skill Practice

1. Find the next term in the sequence 3, 8, 13, 18, ...

2. Find the next term in the sequence 8, 12, 16, 20, ...

3. Find the next term in the sequence 21, 18, 15, 12, ...

4. Find the next term in the sequence 50, 43, 36, 29, ...

5. Find the next term in the sequence $-4, 2, 8, 14, \dots$

6. Find the next term in the sequence 0, 9, 18, 27, ...

7. Find the next term in the sequence 12, 24, 36, 48, ...

8. Find the next term in the sequence $-15, -10, -5, 0, \dots$

9. Find the next term in the sequence 100, 80, 60, 40, ...

10. Find the next term in the sequence 7, 18, 29, 40, ...

11. Find the next term in the sequence 2, 6, 18, 54, ...

12. Find the next term in the sequence 5, 10, 20, 40, ...

13. Find the next term in the sequence 81, 27, 9, 3, ...

14. Find the next term in the sequence 4, 20, 100, 500, ...

15. Find the next term in the sequence 96, 48, 24, 12, ...

16. Find the next term in the sequence 7, 28, 112, 448, ...

17. Find the n th term rule for 4, 7, 10, 13, ...

18. Find the n th term rule for 7, 12, 17, 22, ...

19. Find the n th term rule for 10, 8, 6, 4, ...

20. Find the n th term rule for -1 , 5, 11, 17, ...

21. Find the n th term rule for 20, 16, 12, 8, ...

22. Find the n th term rule for 2, 10, 18, 26, ...

23. Find the n th term rule for 15, 25, 35, 45, ...

24. Find the n th term rule for 9, 8, 7, 6, ...

25. The n th term of a sequence is $3n + 2$. Find the 8th term.

26. The n th term of a sequence is $5n - 1$. Find the 10th term.

27. The n th term of a sequence is $2n^2$. Find the 6th term.

28. The n th term of a sequence is $n^2 + 4$. Find the 7th term.

29. The n th term of a sequence is $4n + 7$. Find the 12th term.

30. The n th term of a sequence is $50 - 3n$. Find the 9th term.

31. The n th term of a sequence is $n(n + 1)$. Find the 8th term.

32. The n th term of a sequence is 2^n . Find the 7th term.

33. Find the next term in the pattern 1, 3, 6, 10, ...

34. Find the next term in the pattern 1, 4, 9, 16, ...

35. Find the next term in the pattern 1, 8, 27, 64, ...

36. Find the next term in the pattern 2, 5, 11, 23, ...

37. Find the next term in the pattern 40, 39, 36, 31, ...

38. Find the next term in the pattern 3, 6, 5, 10, ...

39. An arithmetic sequence has first term 1 and common difference 4. Find term 10.

40. An arithmetic sequence has first term 2 and common difference 5. Find term 14.

41. An arithmetic sequence has first term 5 and common difference 7. Find term 12.

42. An arithmetic sequence has first term 20 and common difference -2 . Find term 3.

43. An arithmetic sequence has first term 6 and common difference 6. Find term 18.

44. An arithmetic sequence has first term 100 and common difference -5 . Find term 12.

45. An arithmetic sequence has first term -8 and common difference 4. Find term 15.

46. An arithmetic sequence has first term 3 and common difference 9. Find term 20.

47. An arithmetic sequence has first term -12 and 9th term 28. Find the common difference.

48. The n th term is $4n - 7$. Which term has value 89?

49. The sequence 5, 9, 15, 23, ... has increasing differences. Find the next two terms.

50. A geometric sequence has first term 3 and common ratio 2. Find the 8th term.

51. A sequence has n th term $n^2 - 3n + 4$. Find the 1st, 2nd, 3rd and 10th terms.

52. An arithmetic sequence has 5th term 17 and 12th term 45. Find the n th term.

53. A pattern starts at 200 and subtracts 7 each time. Find the first term number below 120.

54. A growing pattern has $4n + 1$ tiles in pattern n . Can it have exactly 82 tiles? Explain briefly.

55. A sequence starts at 5. Each new term is double the previous term, then subtract 3. Find the next three terms.

Exam-Style Structured Practice

1. The first four terms of a sequence are 6, 10, 14, 18.

(a) Find the next two terms. [2]

(b) Find the n th term rule. [3]

2. The n th term of a sequence is $7n - 3$.

(a) Find the first three terms. [3]

(b) Find the 20th term. [2]

3. A sequence begins 81, 27, 9, 3.

(a) Describe the term-to-term rule. [2]

(b) Find the next two terms. [2]

4. A pattern uses matchsticks. Shape 1 uses 4 matchsticks, shape 2 uses 7, shape 3 uses 10.

(a) Find the number for shape 5. [2]

(b) Write a rule for shape n . [3]

5. The n th term is $2n^2 + 1$.

(a) Find the 4th term. [2]

(b) Find the 10th term. [2]

6. The sequence 5, 9, 13, 17, ... contains the number 101. Find its position in the sequence. [5]

7. A sequence has n th term $60 - 4n$.

(a) Find the first term. [1]

(b) Find the first term that is negative. [4]

8. The first term of an arithmetic sequence is 12 and the 8th term is 47. Find the common difference and the 12th term. [6]

9. A table has x -values 1, 2, 3, 4 and y -values 8, 13, 18, 23.

- (a) Find the rule connecting x and y . [3]
 - (b) Find y when $x = 20$. [2]
-

10. The sequence of square numbers begins 1, 4, 9, 16, 25.

- (a) Find the 9th square number. [2]
 - (b) Explain why 70 is not a square number. [3]
-

11. A sequence follows the rule: multiply by 2, then subtract 3. It starts at 5.

- (a) Find the next three terms. [3]
 - (b) Find the fifth term. [2]
-

12. The n th term of a sequence is $an + 4$. The 6th term is 34. Find a , then find the 15th term. [5]

13. The first five terms of a sequence are 2, 6, 12, 20, 30.

- (a) Find the next term. [2]
 - (b) Describe the differences between consecutive terms. [3]
-

14. A decreasing arithmetic sequence has first term 90 and common difference -6 .

- (a) Find the 10th term. [2]
 - (b) Find the first term less than 20. [4]
-

15. A geometric sequence starts 3, 12, 48, ...

- (a) Find the common ratio. [1]
 - (b) Find the 6th term. [4]
-

16. A sequence has rule $n^2 + n + 1$.

- (a) Find the first four terms. [4]
 - (b) Find term 12. [2]
-

17. The sequence 11, 18, 25, 32, ... is arithmetic.

(a) Write the n th term. [3]

(b) Is 201 a term in the sequence? Explain. [3]

18. A sequence has first term 9 and common difference 6.

(a) Find the n th term. [3]

(b) Find the first term greater than 100. [4]

Mixed Review

1. Evaluate 4^3 .

2. Share 72 in the ratio 5 : 7.

3. Find 25% of 168.

4. Write 0.625 as a fraction.

5. Simplify 36 : 48.

6. Round 0.00847 to 2 significant figures.

7. A car travels 180 km in 4 hours. Find the average speed.

8. Write 5.2×10^3 as an ordinary number.

9. Find the next term: 7, 12, 17, 22, ...

10. Find the HCF of 48 and 72.

Challenge Questions

1. An arithmetic sequence has first term 7. The 10th term is 52. Find the n th term.

2. A sequence starts 4, 9, 19, 39, ... Find the next two terms and describe the rule.

3. The n th term of a sequence is $3n + c$. The 12th term is 41. Find c , then find the first term.

4. The sequence 2, 5, 10, 17, 26, ... has rule $n^2 + 1$. Find the first term greater than 100.

5. A geometric sequence has first term 5 and third term 80. The common ratio is positive. Find the second and fourth terms.

6. An arithmetic sequence contains 14 and 62. The common difference is 6. How many terms are from 14 to 62 inclusive?

Common Mistakes

- Finding a difference once and assuming the sequence is arithmetic without checking.
- Forgetting that the first term is found when $n = 1$, not $n = 0$.
- Confusing the term number with the term value.
- Writing dn as the rule but forgetting the constant adjustment.
- Treating geometric growth as repeated addition.

Progress Tracker

Section	Questions	Target
Skill practice	55	Build pattern recognition and n th-term fluency
Exam-style structured practice	18	Apply rules and reverse reasoning
Mixed review	10	Maintain earlier number skills
Challenge	6	Extend sequence reasoning

Chapter 6: Data Collection and Representation

Chapter Goal

Collect reliable data, organise raw data, and choose diagrams that reveal patterns clearly.

Calculator Policy

Mostly non-calculator. Calculators may be used to check percentages or totals.

Quick Notes - Data Thinking

Statistics starts before calculation. Ask:

- What question are we trying to answer?
- Is the data qualitative or quantitative?
- Is the sample fair?
- Which representation shows the pattern most clearly?

Qualitative data are categories. Quantitative data are numbers. Discrete data are counted. Continuous data are measured.

Quick Notes - Representation Choices

- Bar chart: categories or discrete counts.
- Stem-and-leaf diagram: numerical data where the original values should stay visible.
- Back-to-back stem-and-leaf diagram: compare two numerical data sets.
- Grouped frequency table: larger numerical data sets placed into intervals.
- Histogram: grouped continuous data. If class widths are unequal, use frequency density.
- Line graph: values changing over time.
- Pie chart: parts of one whole.

Worked Examples

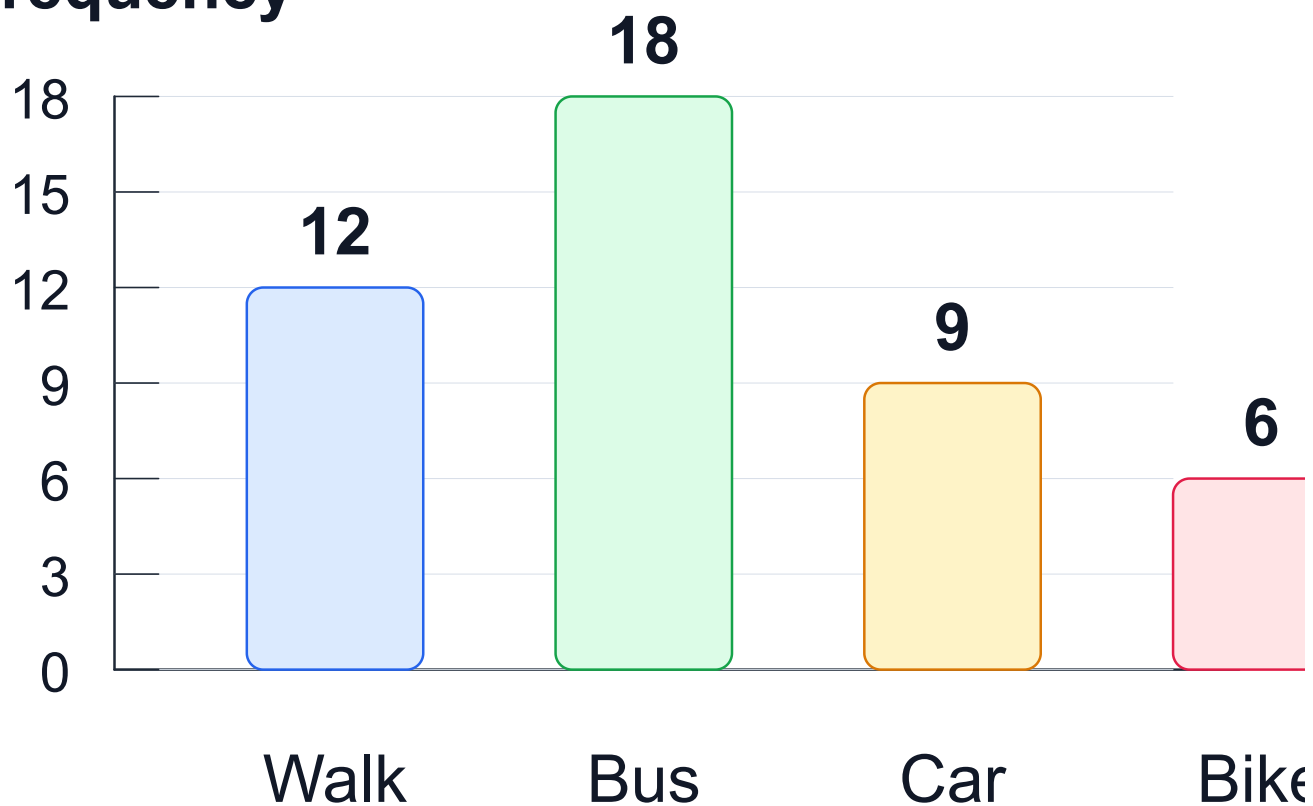
Example 1 - Classifying Data

The time taken to run 100 m is quantitative continuous because it is measured.

Example 2 - Reading a Bar Chart

If the bar heights are Walk 12, Bus 18, Car 9 and Bike 6, the total is $12 + 18 + 9 + 6 = 45$. The modal category is Bus.

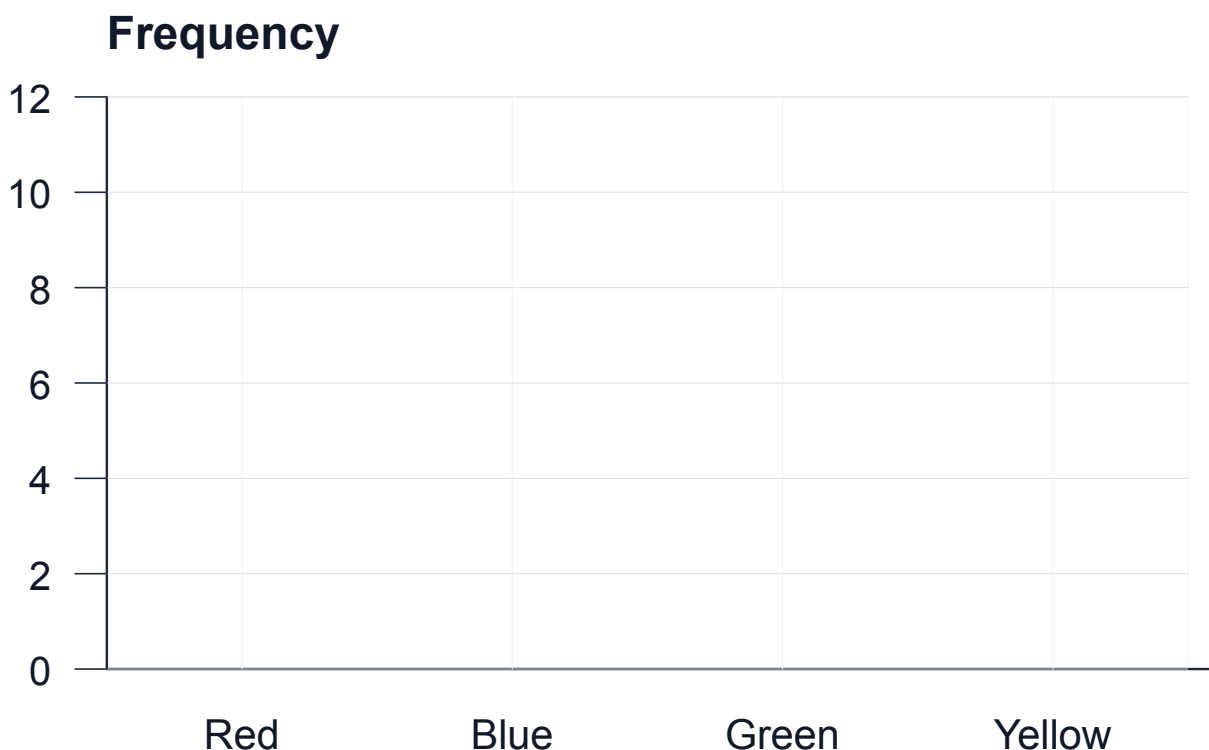
Frequency



Example 3 - Drawing a Bar Chart

Use equal-width bars, equal gaps, a labelled vertical axis and a sensible scale.

Category	Red	Blue	Green	Yellow
Frequency	8	12	5	9



Example 4 - Stem-and-Leaf Diagram

For scores 21, 24, 28, 32, 35, 39:

``` 2 | 1 4 8 3 | 2 5 9 Key: 2 | 1 means 21 ```

### Example 5 - Grouped Data

For intervals 0-10, 10-20 and 20-30, count how many values fall in each class. Use clear boundaries so every value belongs to exactly one class.

### Example 6 - Common Mistake

Do not use a bar chart with a misleading vertical scale. If the frequency axis starts at a number above 0, differences can look much larger than they really are.

## Basic Understanding - Data Types and Good Surveys

1. Classify this data as qualitative, quantitative discrete, or quantitative continuous: favourite breakfast food.

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2. Classify this data as qualitative, quantitative discrete, or quantitative continuous: number of pages read in a week.

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3. Classify this data as qualitative, quantitative discrete, or quantitative continuous: time taken to swim 50 m.

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4. Classify this data as qualitative, quantitative discrete, or quantitative continuous: type of phone used by students.

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5. Classify this data as qualitative, quantitative discrete, or quantitative continuous: temperature in a classroom.

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6. Classify this data as qualitative, quantitative discrete, or quantitative continuous: number of text messages sent in a day.

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7. Classify this data as qualitative, quantitative discrete, or quantitative continuous: shoe size.

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8. Classify this data as qualitative, quantitative discrete, or quantitative continuous: mass of a school bag.

---

9. Classify this data as qualitative, quantitative discrete, or quantitative continuous: bus route used to get home.

---

10. Classify this data as qualitative, quantitative discrete, or quantitative continuous: height of a sunflower.

---

11. Choose a suitable representation for this data: favourite sports of Year 8 students.

---

12. Choose a suitable representation for this data: how a school day is split into subjects.

---

13. Choose a suitable representation for this data: temperature recorded every hour.

---

14. Choose a suitable representation for this data: test scores from 12 students where every score should stay visible.

---

15. Choose a suitable representation for this data: journey times grouped into intervals.

---

16. Choose a suitable representation for this data: two classes compared by test score distribution.

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17. A survey asks only the basketball team which sport is most popular in the school. Explain one problem and improve the data collection method.

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18. A question asks: Do you agree that homework is too long and boring? Explain one problem and improve the data collection method.

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19. A student records plant heights but does not write the unit. Explain one problem and improve the data collection method.

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20. A class wants to know how students travel to school and lets students choose more than one method. Explain one problem and improve the data collection method.

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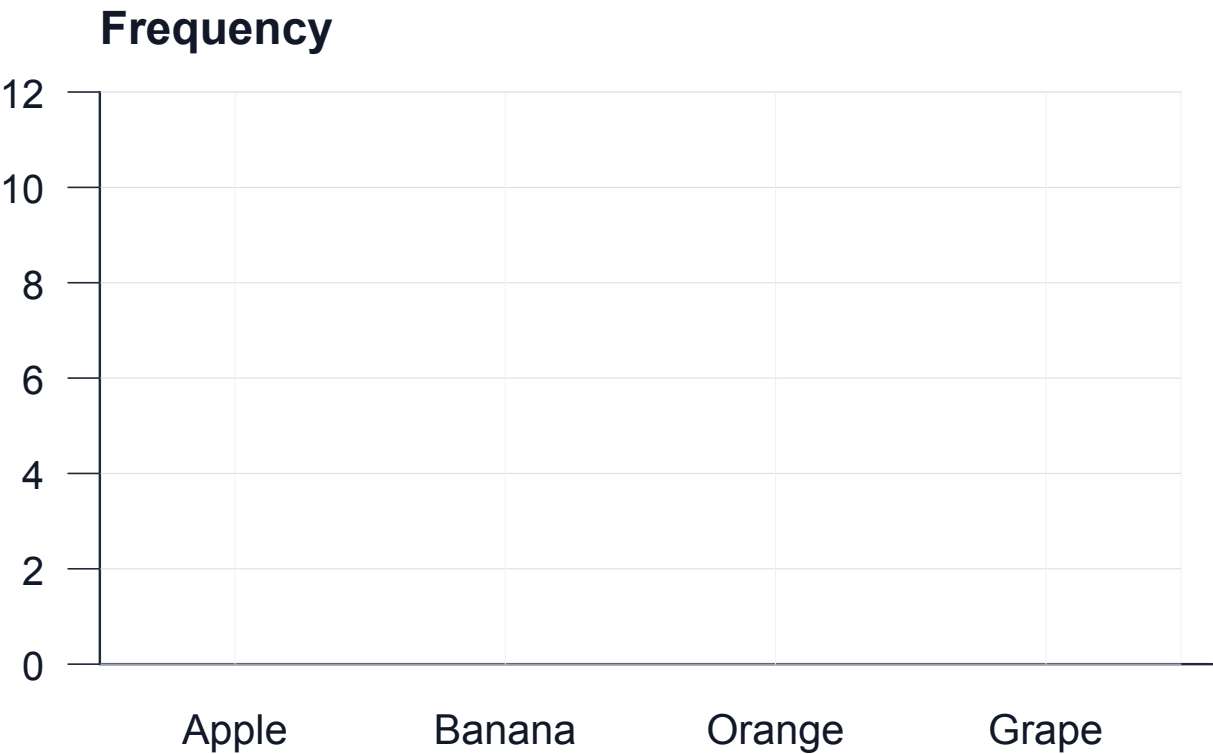
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Frequency Tables and Bar Charts

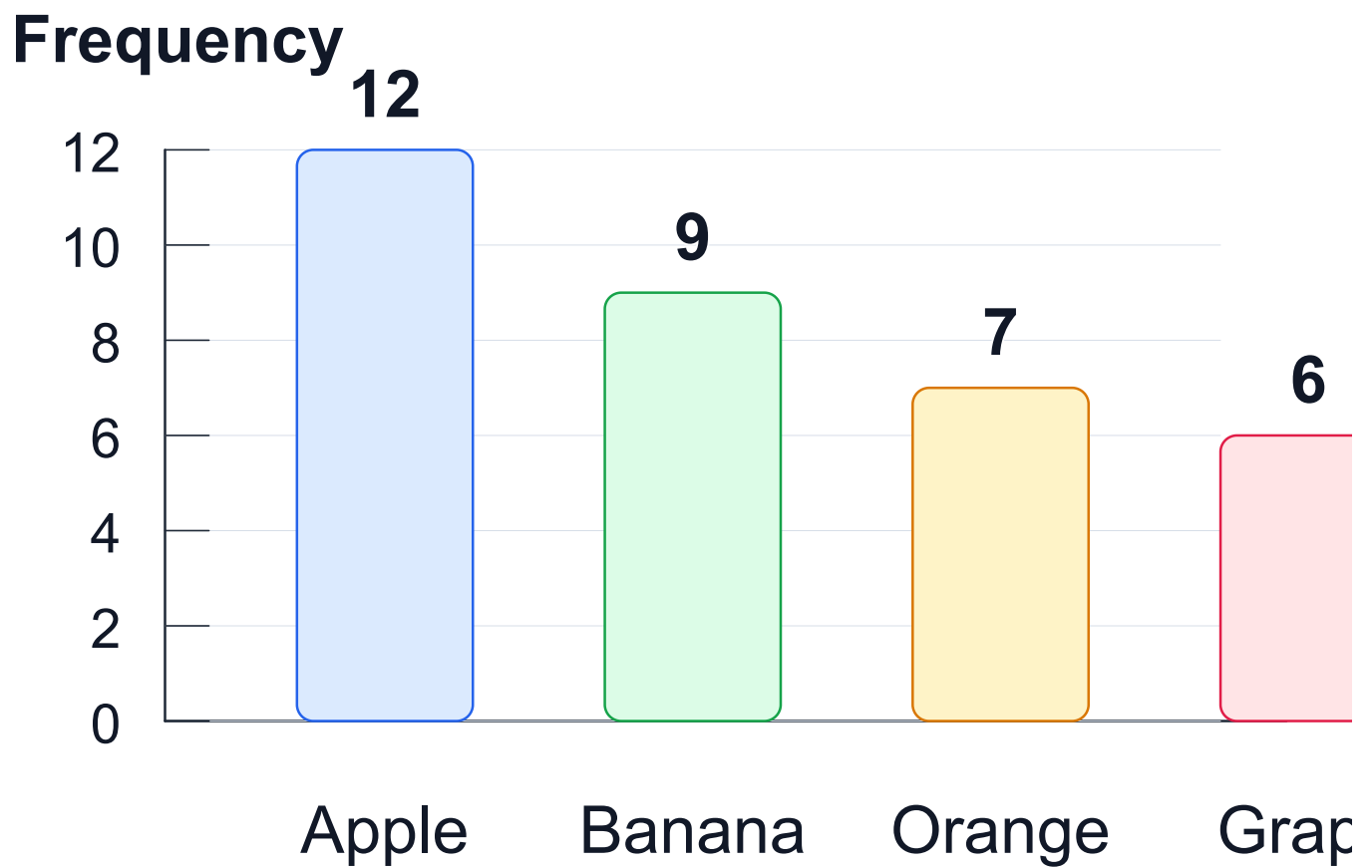
21. Students' favourite fruit are shown below. Draw a bar chart on the grid.

Category	Apple	Banana	Orange	Grape
Frequency	12	9	7	6

Category	Apple	Banana	Orange	Grape
Frequency	12	9	7	6



22. Students' favourite fruit are represented by this bar chart.



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Apple than Grape?

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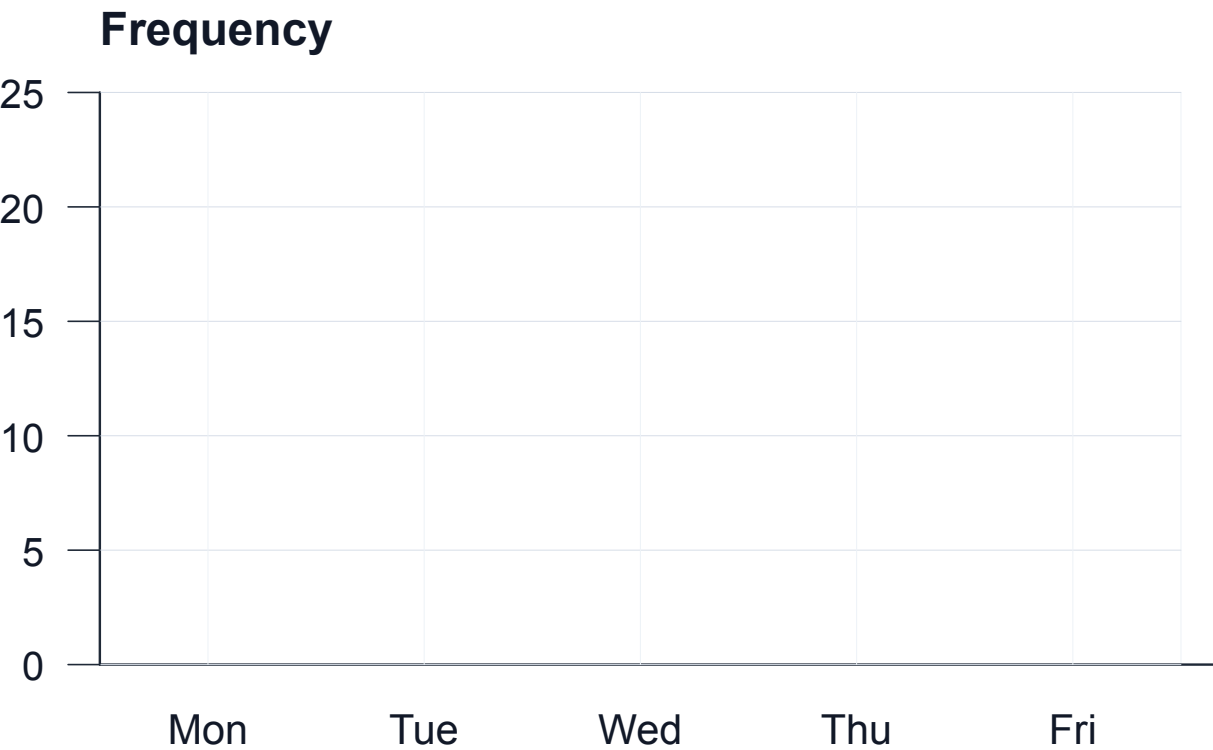
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23. Books borrowed in one week are shown below. Draw a bar chart on the grid.

Category	Mon	Tue	Wed	Thu	Fri
Frequency	18	21	15	24	20

Category	Mon	Tue	Wed	Thu	Fri
Frequency	18	21	15	24	20



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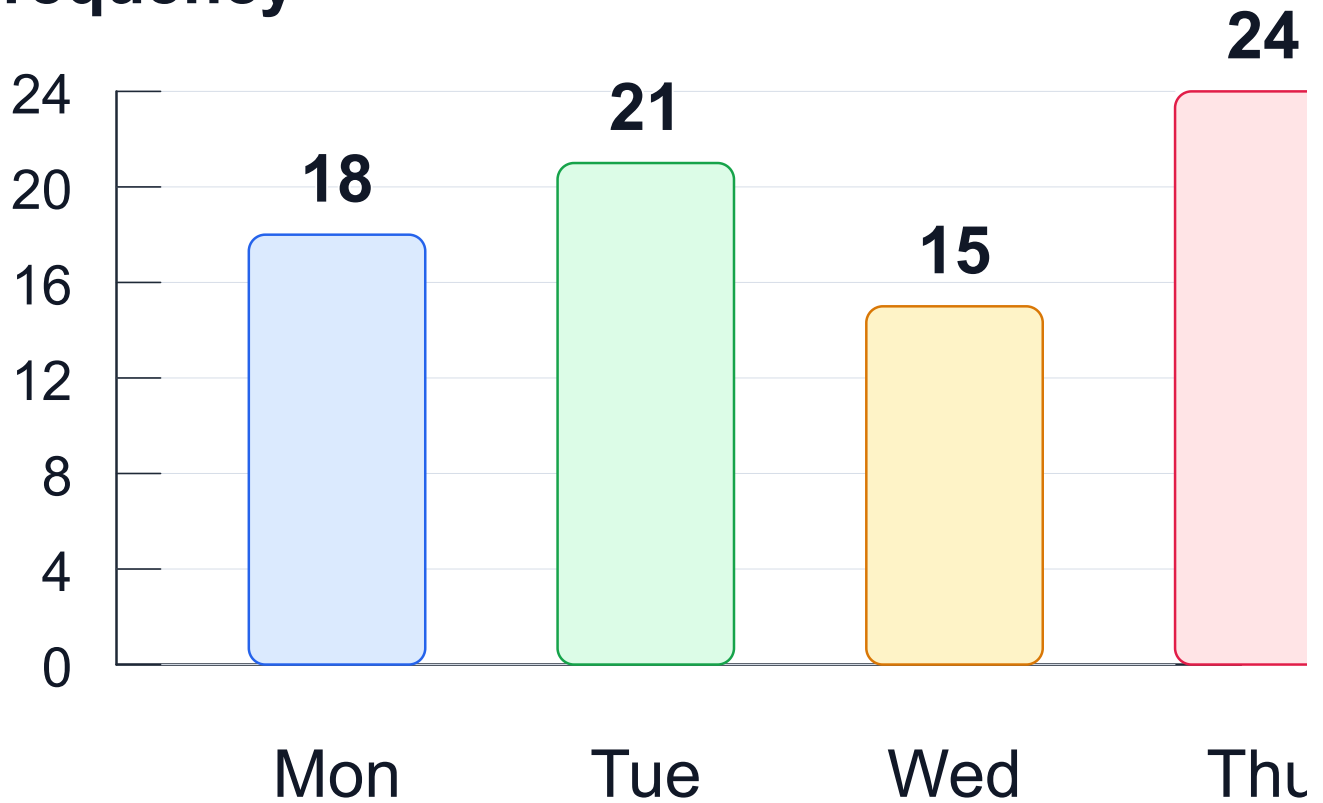
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24. Books borrowed in one week are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Thu than Wed?

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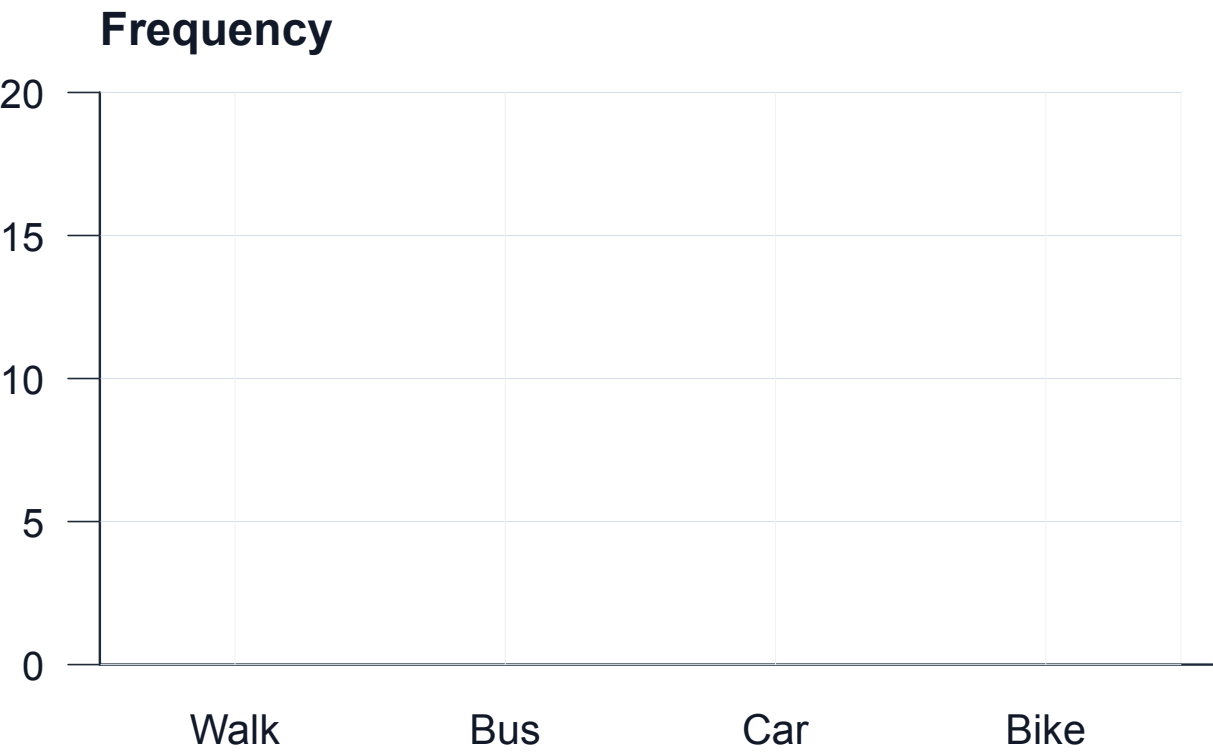
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25. Transport to school are shown below. Draw a bar chart on the grid.

Category	Walk	Bus	Car	Bike
Frequency	14	19	11	6

Category	Walk	Bus	Car	Bike
Frequency	14	19	11	6



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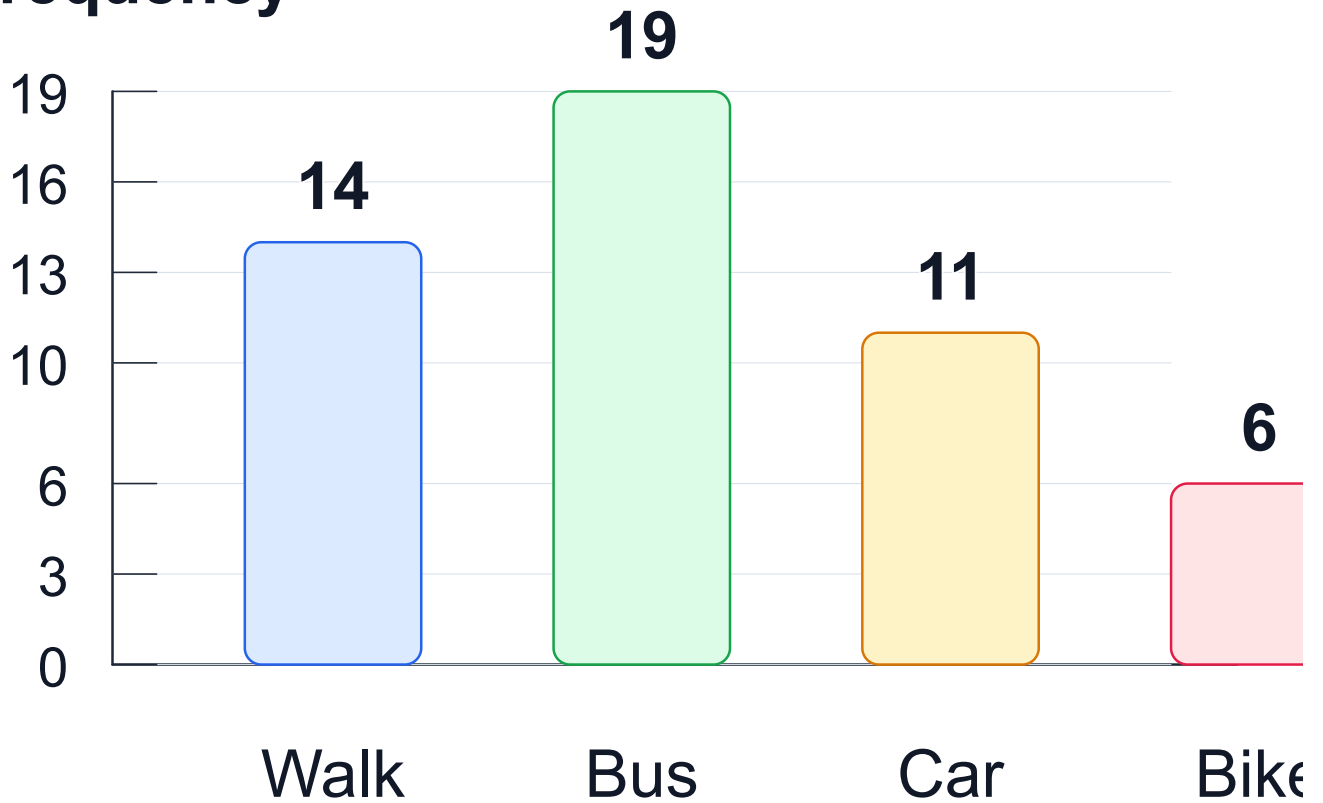
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26. Transport to school are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Bus than Bike?

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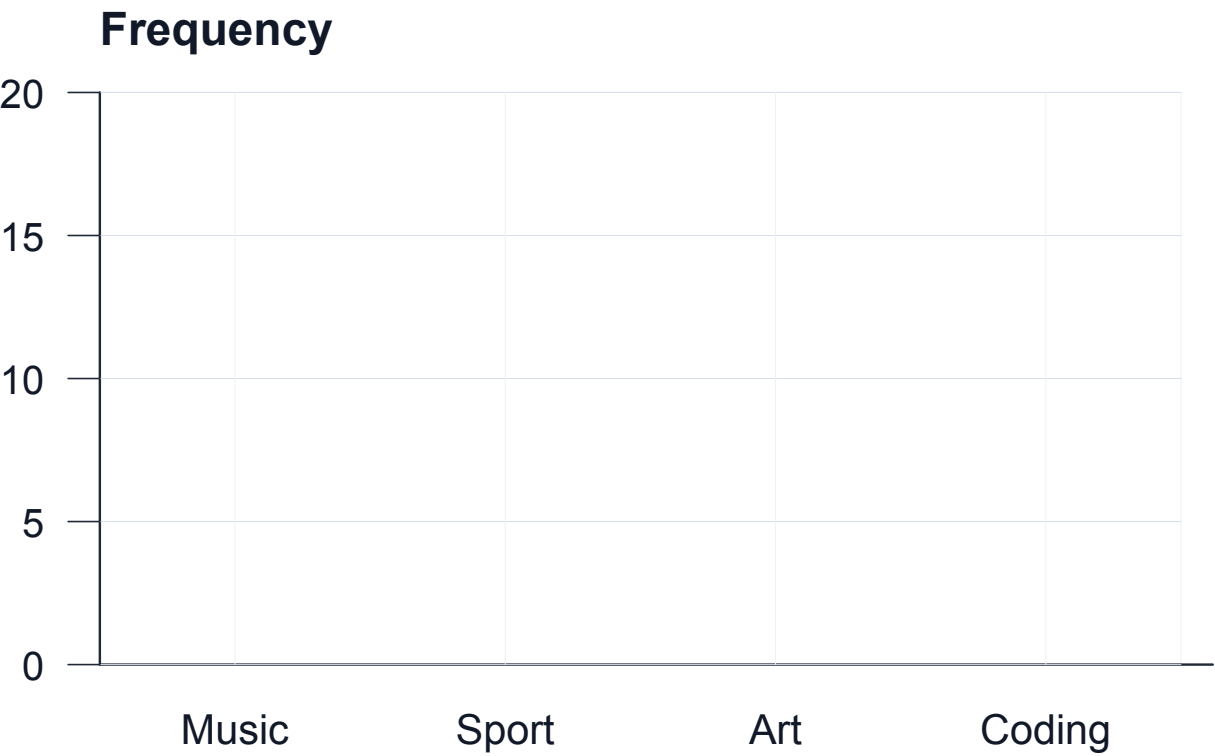
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27. After-school club choices are shown below. Draw a bar chart on the grid.

Category	Music	Sport	Art	Coding
Frequency	8	17	10	13

Category	Music	Sport	Art	Coding
Frequency	8	17	10	13



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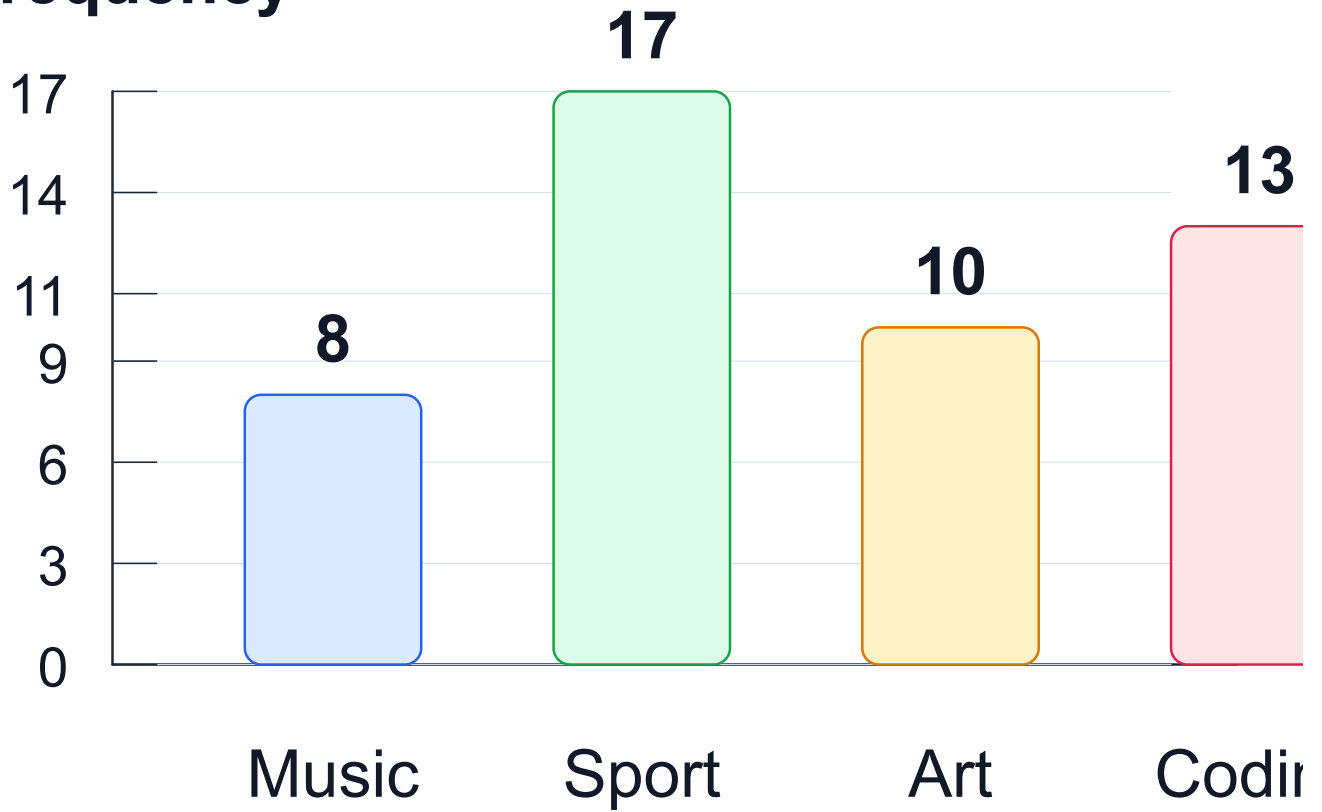
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28. After-school club choices are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Sport than Music?

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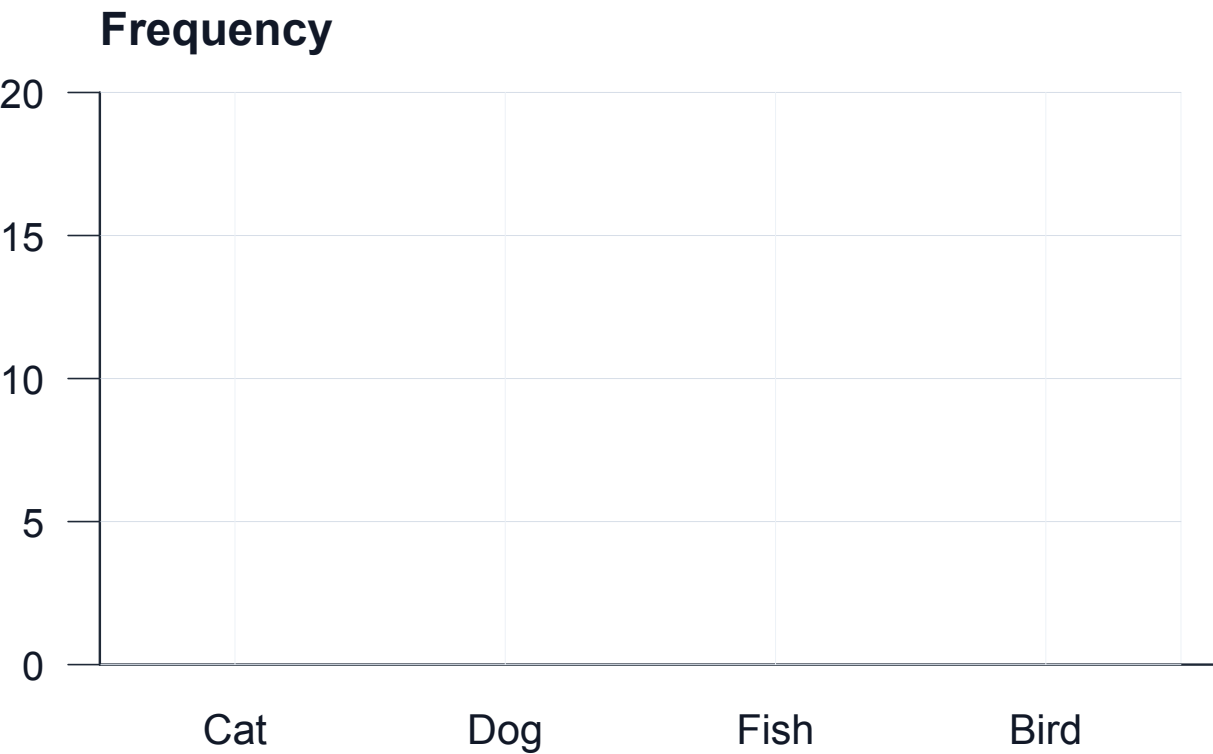
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29. Pets owned by students are shown below. Draw a bar chart on the grid.

Category	Cat	Dog	Fish	Bird
Frequency	15	18	7	4

Category	Cat	Dog	Fish	Bird
Frequency	15	18	7	4



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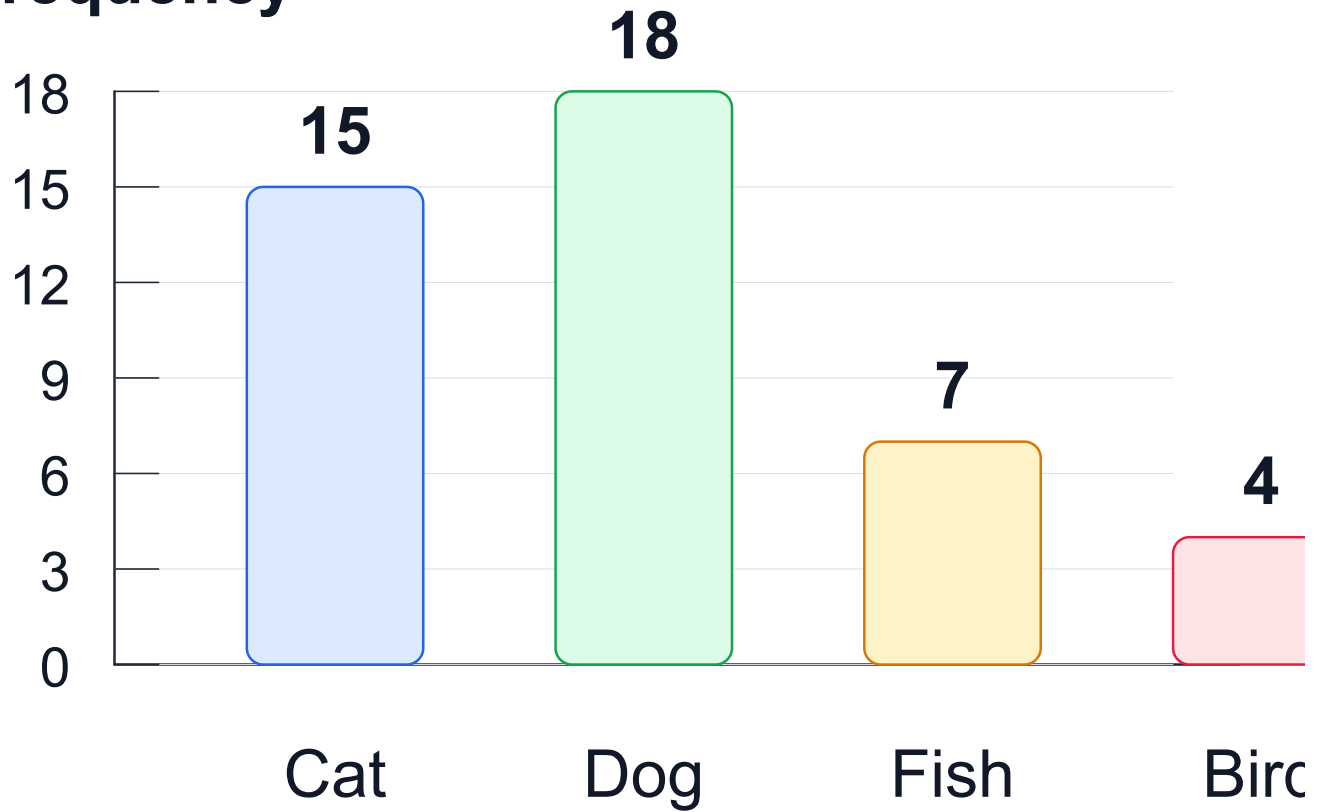
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30. Pets owned by students are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Dog than Bird?

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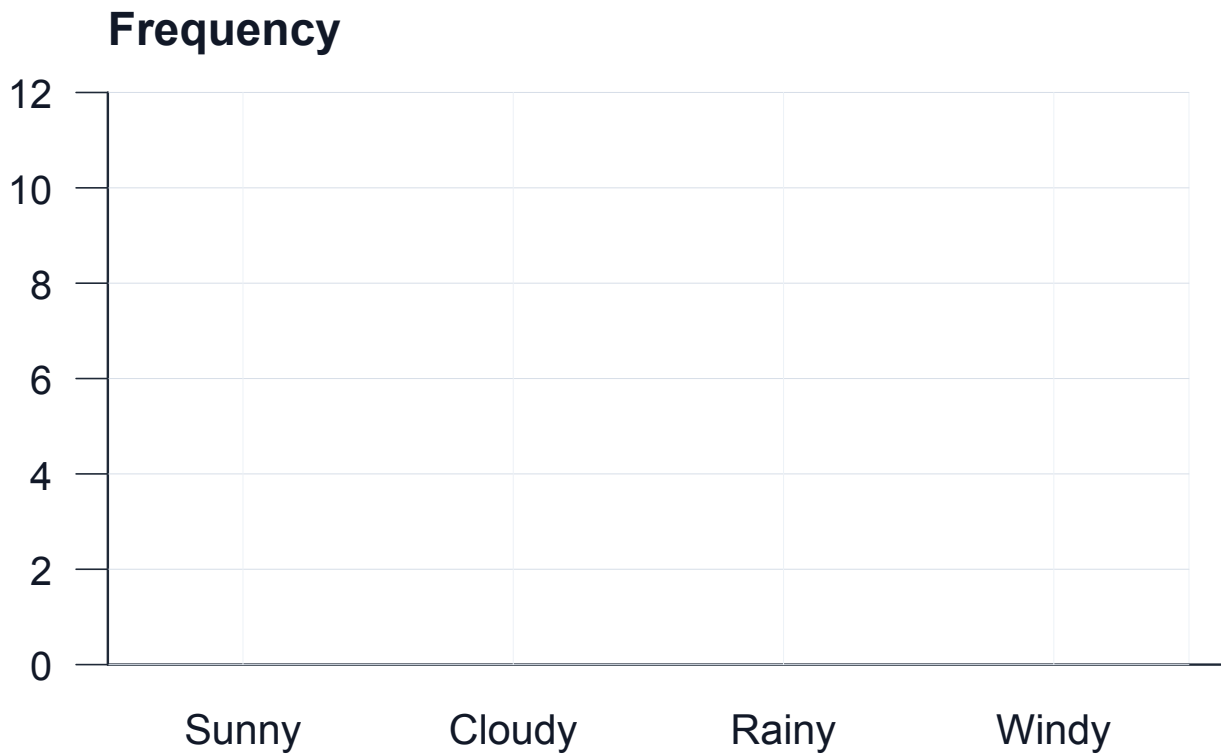
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31. Weather over 30 days are shown below. Draw a bar chart on the grid.

Category	Sunny	Cloudy	Rainy	Windy
Frequency	11	8	7	4

Category	Sunny	Cloudy	Rainy	Windy
Frequency	11	8	7	4



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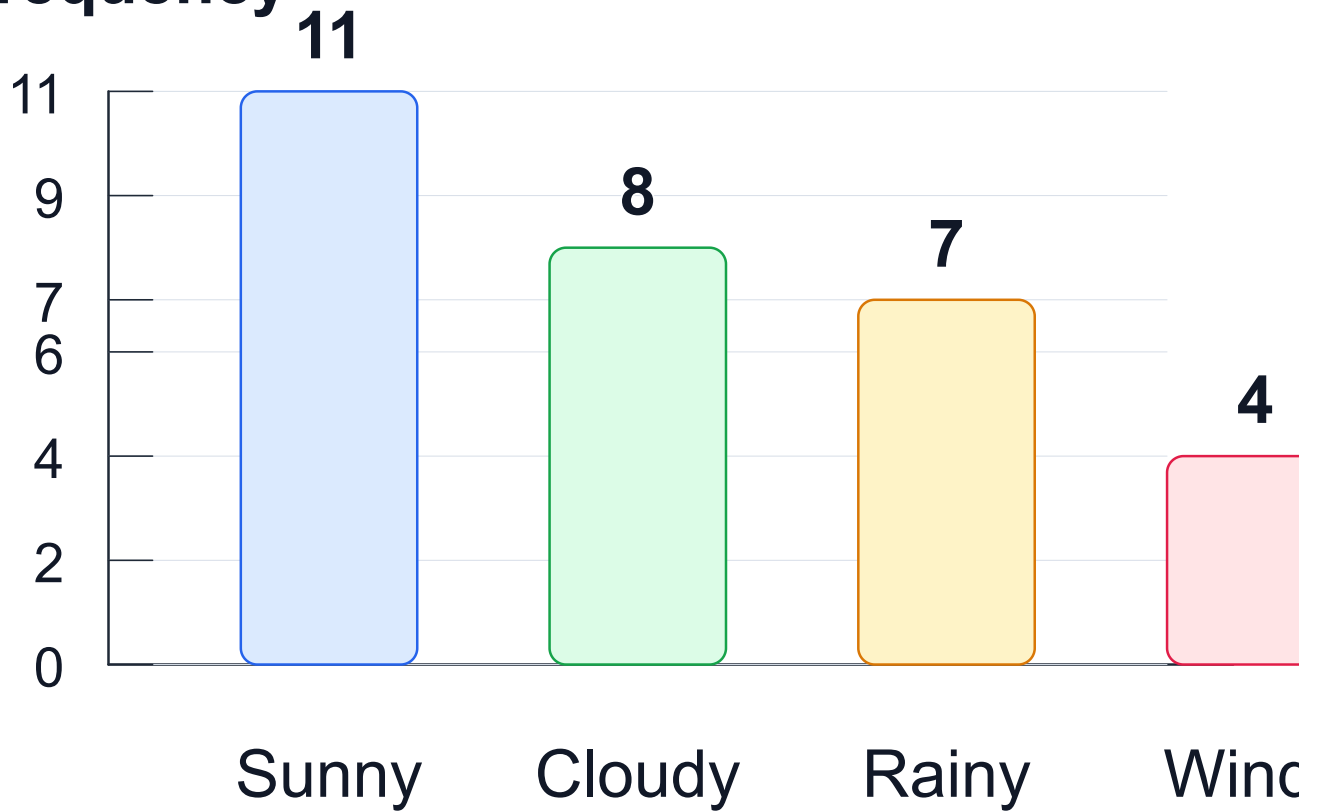
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32. Weather over 30 days are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Sunny than Windy?

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33. Favourite school lunch are shown below. Draw a bar chart on the grid.

Category	Sandwich	Sushi	Pasta	Salad	Noodles
Frequency	16	12	9	5	8

Category	Sandwich	Sushi	Pasta	Salad	Noodles
Frequency	16	12	9	5	8



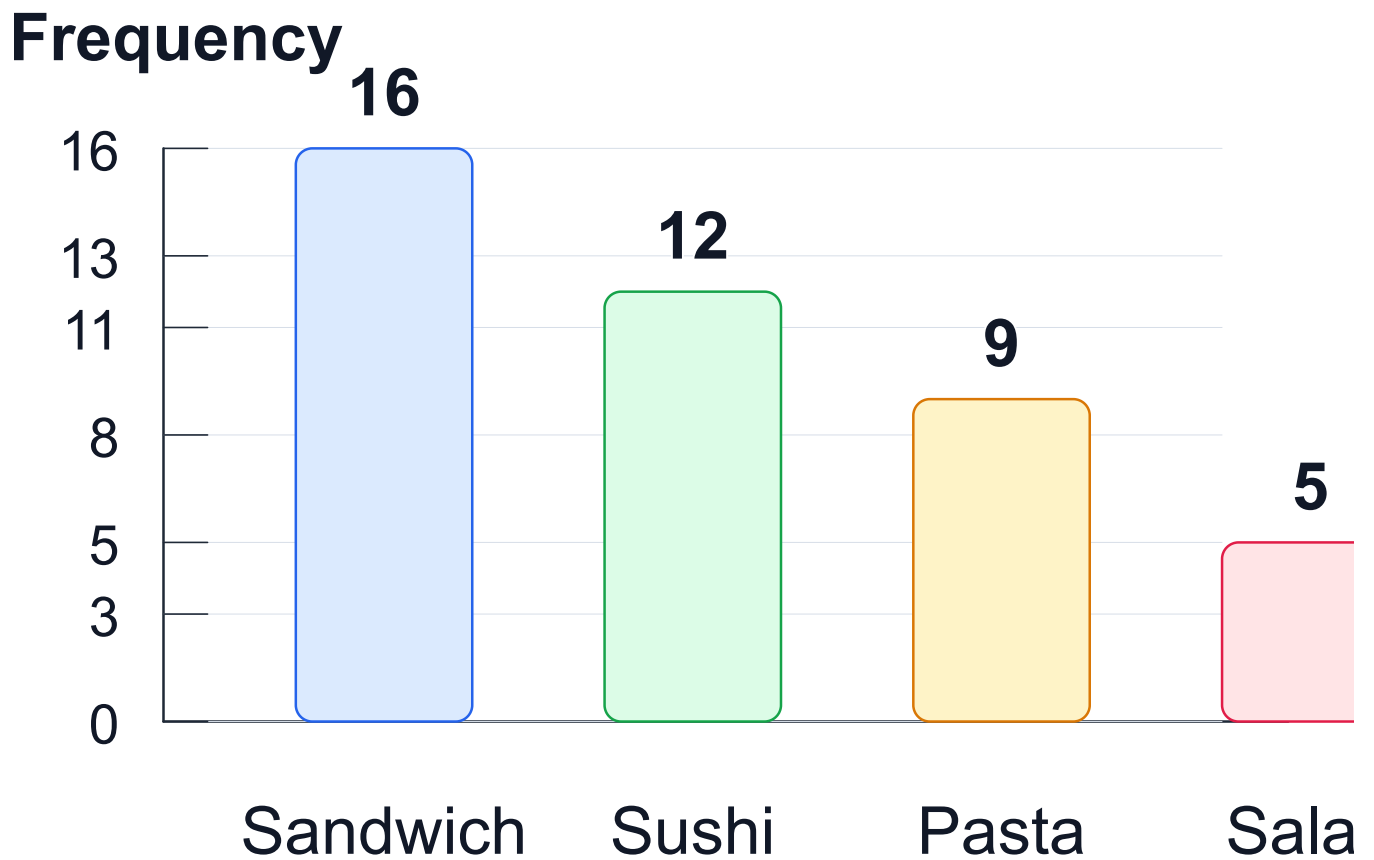
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34. Favourite school lunch are represented by this bar chart.



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Sandwich than Salad?

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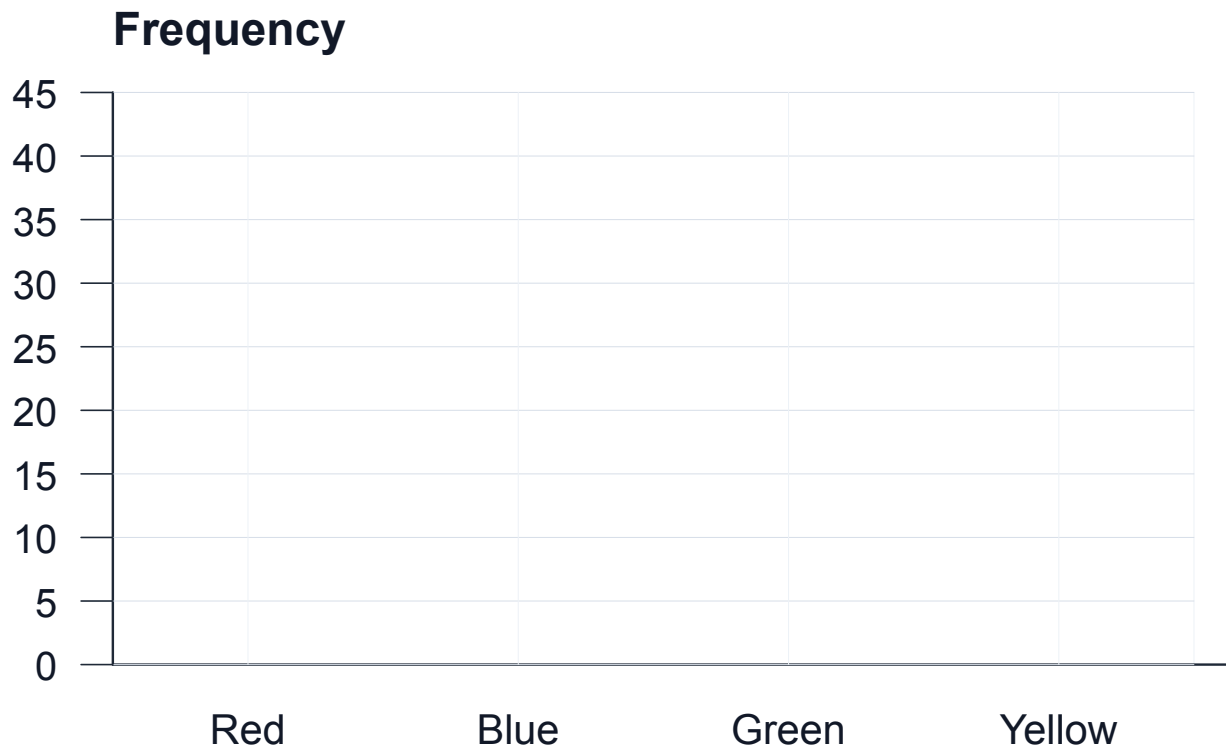
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35. House points this week are shown below. Draw a bar chart on the grid.

Category	Red	Blue	Green	Yellow
Frequency	34	41	28	37

Category	Red	Blue	Green	Yellow
Frequency	34	41	28	37



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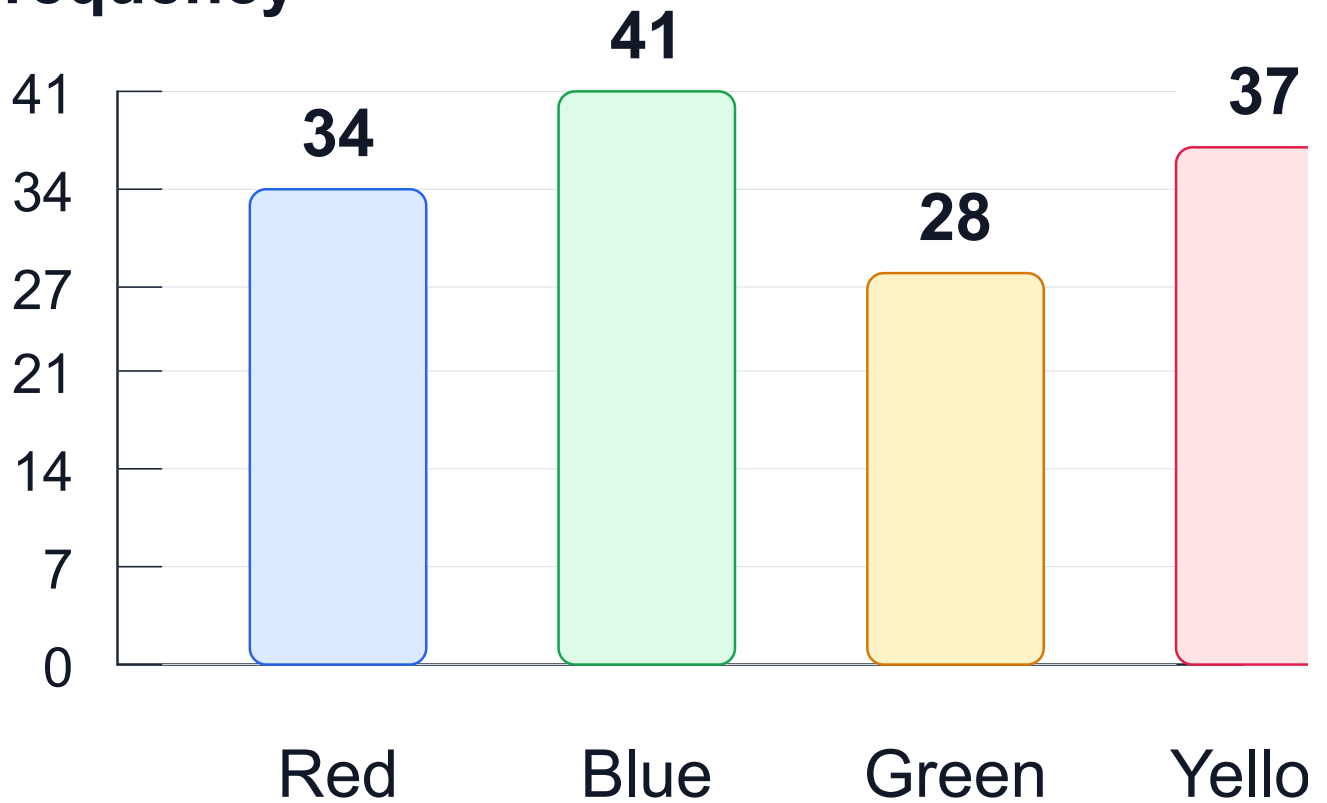
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36. House points this week are represented by this bar chart.

## Frequency



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Blue than Green?

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37. Weekend activities are shown below. Draw a bar chart on the grid.

Category	Sport	Reading	Gaming	Music	Family
Frequency	22	13	18	9	16

Category	Sport	Reading	Gaming	Music	Family
Frequency	22	13	18	9	16



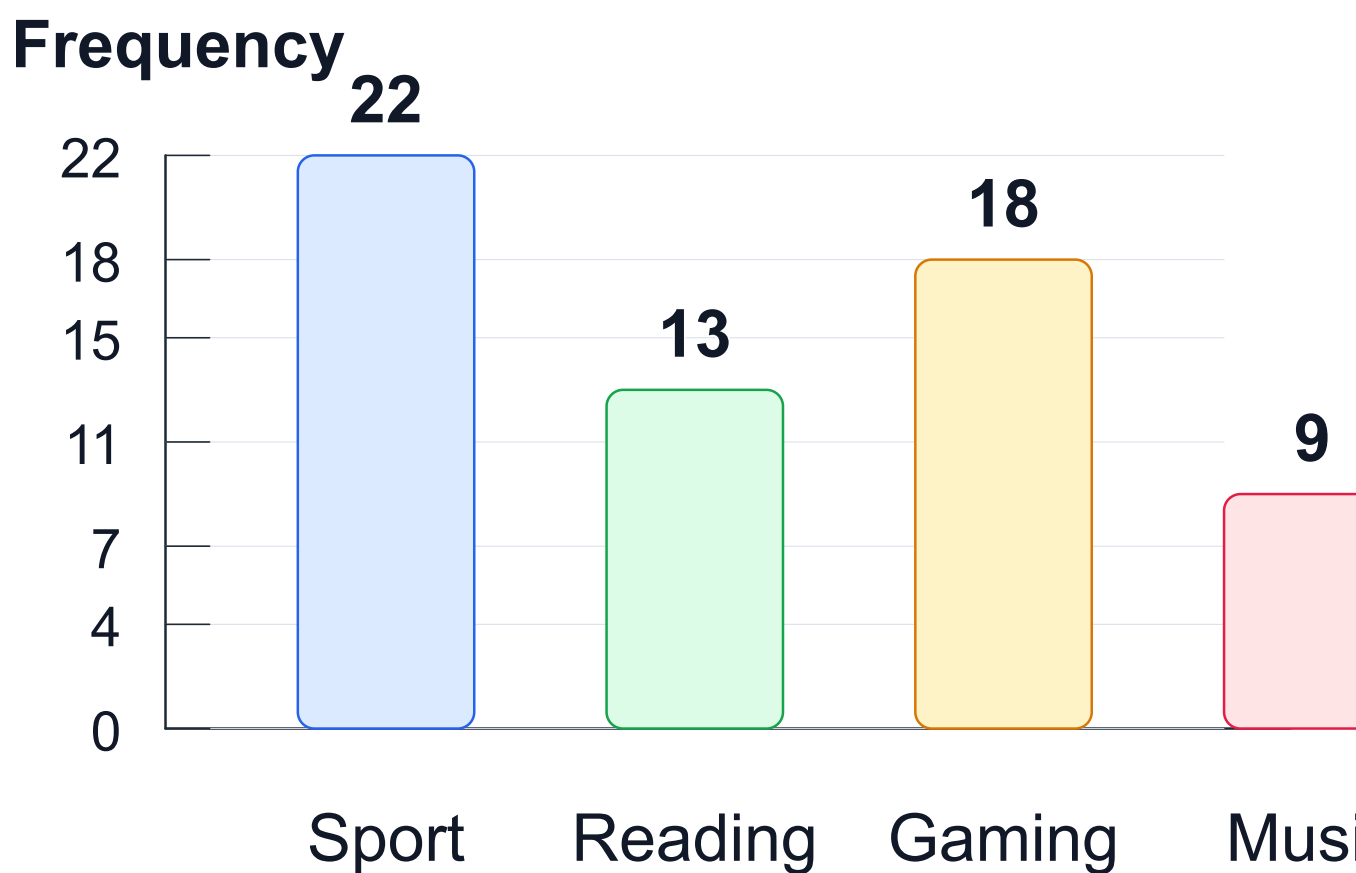
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38. Weekend activities are represented by this bar chart.



(a) Find the total frequency. (b) Find the modal category. (c) How many more chose Sport than Music?

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39. Number of siblings: 1, 0, 2, 1, 3, 1, 0, 2, 1, 4, 2, 1, 0, 3, 2. Construct a frequency table and state the modal value.

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40. Goals scored in PE games: 0, 1, 2, 1, 3, 2, 4, 1, 0, 2, 3, 1, 2, 5, 1, 0. Construct a frequency table and state the modal value.

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41. Library visits in a month: 2, 4, 3, 5, 2, 1, 4, 3, 3, 2, 6, 5, 4, 2, 3. Construct a frequency table and state the modal value.

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42. Packets sold at a school fair: 7, 9, 8, 10, 6, 7, 8, 12, 9, 8, 7, 10, 11, 8. Construct a frequency table and state the modal value.

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43. Quiz scores out of 10: 6, 7, 8, 7, 9, 5, 6, 8, 10, 7, 8, 6, 9, 8, 7, 6. Construct a frequency table and state the modal value.

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44. Number of apps used yesterday: 3, 4, 5, 2, 6, 4, 3, 5, 7, 4, 6, 5, 3, 4, 8. Construct a frequency table and state the modal value.

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45. Books read last term: 2, 4, 3, 5, 6, 2, 4, 7, 3, 5, 4, 6, 8, 3, 5, 4, 7, 6. Construct a frequency table and state the modal value.

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46. Daily spelling practice minutes: 5, 10, 15, 10, 20, 5, 15, 25, 10, 15, 20, 15, 10, 30, 20, 15. Construct a frequency table and state the modal value.

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47. Correct answers in a mental quiz: 12, 15, 14, 16, 18, 15, 13, 17, 16, 15, 19, 14, 18, 16, 17, 15, 20. Construct a frequency table and state the modal value.

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48. Steps in hundreds before school: 3, 5, 4, 6, 8, 5, 7, 4, 6, 9, 5, 7, 6, 8, 4, 10. Construct a frequency table and state the modal value.

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## Stem-and-Leaf Diagrams

49. Maths test scores: 34, 41, 38, 55, 47, 62, 59, 44, 51, 68, 73, 49, 57, 63, 46. Construct a stem-and-leaf diagram. Include a key.

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50. Heights in centimetres: 128, 135, 132, 141, 138, 145, 130, 136, 139, 142, 147, 133. Construct a stem-and-leaf diagram. Include a key.

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51. Race times in seconds: 21, 24, 28, 25, 31, 29, 34, 27, 26, 32, 36, 30, 23. Construct a stem-and-leaf diagram. Include a key.

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52. Weekly reading minutes: 45, 52, 38, 61, 55, 49, 73, 66, 57, 80, 69, 58, 62, 54. Construct a stem-and-leaf diagram. Include a key.

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53. Science quiz marks: 18, 22, 24, 19, 31, 27, 25, 28, 34, 29, 21, 23, 32, 26. Construct a stem-and-leaf diagram. Include a key.

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54. Bus waiting times: 4, 7, 12, 9, 15, 6, 11, 13, 18, 5, 8, 14, 10, 16, 6. Construct a stem-and-leaf diagram. Include a key.

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55. Temperatures over a month: 17, 19, 21, 18, 22, 24, 20, 23, 25, 18, 19, 21, 26, 24, 22. Construct a stem-and-leaf diagram. Include a key.

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56. Practice scores: 52, 64, 58, 71, 69, 73, 55, 62, 67, 76, 80, 74, 61, 65. Construct a stem-and-leaf diagram. Include a key.

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57. Cycling distances in kilometres: 12, 14, 18, 21, 25, 28, 30, 32, 35, 39, 41, 44, 48. Construct a stem-and-leaf diagram. Include a key.

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58. Homework times in minutes: 15, 18, 22, 26, 31, 34, 38, 42, 45, 49, 53, 58, 61, 64. Construct a stem-and-leaf diagram. Include a key.

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59. Charity donations in dollars: 5, 8, 12, 15, 18, 20, 22, 25, 28, 31, 35, 40, 42, 45. Construct a stem-and-leaf diagram. Include a key.

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60. Puzzle completion times in seconds: 31, 34, 37, 39, 42, 45, 48, 52, 55, 57, 60, 64, 68, 71. Construct a stem-and-leaf diagram. Include a key.

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61. Two classes completed the same mental maths test. Group A: 42, 48, 51, 53, 57, 60, 62, 65, 67, 71. Group B: 38, 44, 46, 50, 54, 58, 59, 63, 69, 74. Draw a back-to-back stem-and-leaf diagram and compare the medians.


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62. Two teams recorded training times. Group A: 12, 15, 18, 21, 24, 28, 30, 32, 35. Group B: 10, 14, 17, 19, 20, 23, 27, 31, 34. Draw a back-to-back stem-and-leaf diagram and compare the medians.



63. Two Year 8 groups recorded project scores. Group A: 65, 69, 72, 74, 78, 80, 83, 85, 88. Group B: 58, 63, 67, 70, 73, 77, 81, 84, 90. Draw a back-to-back stem-and-leaf diagram and compare the medians.



64. Two running clubs recorded weekly training distances. Group A: 18, 21, 23, 25, 28, 30, 32, 36, 39, 41. Group B: 14, 17, 19, 22, 26, 29, 31, 33, 35, 38. Draw a back-to-back stem-and-leaf diagram and compare the medians.



65. Two groups recorded problem-solving scores. Group A: 52, 55, 58, 63, 66, 69, 72, 78, 81, 84. Group B: 48, 51, 54, 59, 62, 68, 75, 79, 83, 88. Draw a back-to-back stem-and-leaf diagram and compare the medians.


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### Grouped Data and Class Intervals

66. Journey times to school in minutes: 6, 8, 12, 14, 15, 18, 21, 23, 24, 27, 29, 31, 33, 35, 38, 42, 44, 46. Complete a grouped frequency table using these classes: 0-10, 10-20, 20-30, 30-40, 40-50.

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67. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
0-10	2
10-20	4
20-30	5
30-40	4
40-50	3

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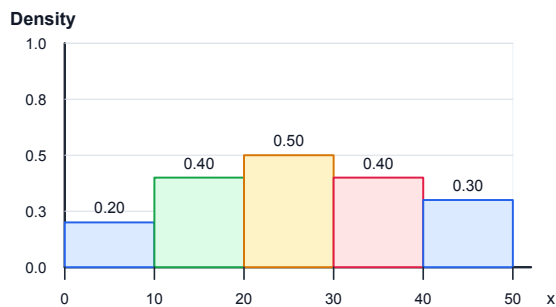
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68. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
0-10	2
10-20	4
20-30	5
30-40	4
40-50	3

Class	0-10	10-20	20-30	30-40	40-50
Frequency	2	4	5	4	3



69. Heights of seedlings in cm: 12, 15, 17, 19, 22, 24, 28, 31, 34, 35, 39, 41, 42, 45, 47, 49, 52, 55, 58. Complete a grouped frequency table using these classes: 10-20, 20-30, 30-40, 40-50, 50-60.

70. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
10-20	4
20-30	3
30-40	4
40-50	5
50-60	3

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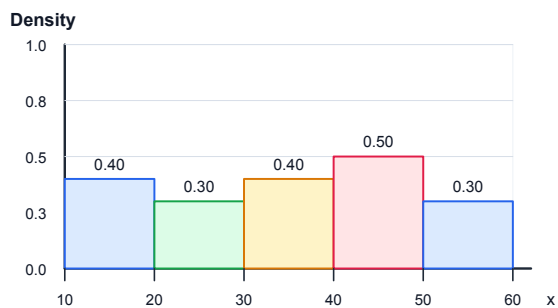


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71. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
10-20	4
20-30	3
30-40	4
40-50	5
50-60	3

Class	10-20	20-30	30-40	40-50	50-60
Frequency	4	3	4	5	3




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72. Scores in a spelling test: 18, 22, 24, 27, 31, 33, 35, 38, 42, 44, 47, 50, 52, 55, 58, 61, 63, 67, 70. Complete a grouped frequency table using these classes: 10-30, 30-50, 50-70, 70-90.

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73. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
10-30	4
30-50	7
50-70	7
70-90	1

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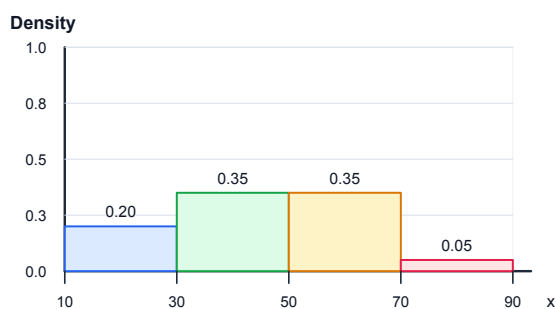


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74. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
10-30	4
30-50	7
50-70	7
70-90	1

Class	10-30	30-50	50-70	70-90
Frequency	4	7	7	1




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75. Masses of parcels in grams: 120, 135, 148, 151, 162, 175, 188, 194, 205, 218, 229, 241, 255, 267, 276. Complete a grouped frequency table using these classes: 100-150, 150-200, 200-250, 250-300.

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76. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
100-150	3
150-200	5
200-250	4
250-300	3

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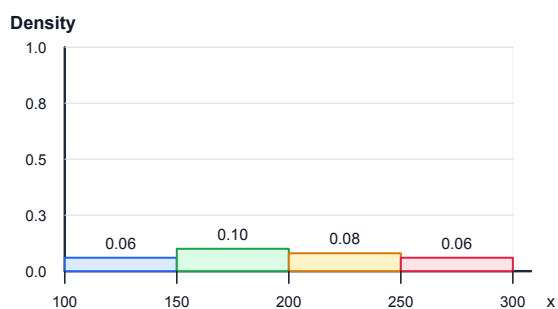
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77. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
100-150	3
150-200	5
200-250	4
250-300	3

Class	100-150	150-200	200-250	250-300
Frequency	3	5	4	3




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78. Daily screen time in minutes: 24, 35, 41, 45, 58, 62, 67, 74, 88, 93, 104, 116, 121, 132, 145, 154, 168. Complete a grouped frequency table using these classes: 0-60, 60-120, 120-180.

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79. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
0-60	5
60-120	7
120-180	5

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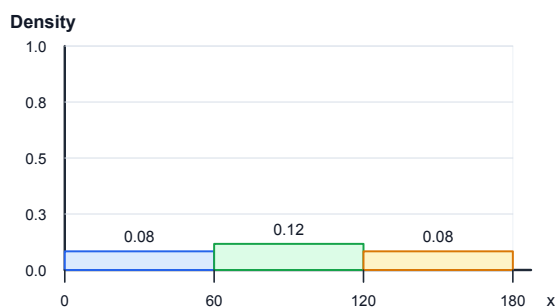


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80. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
0-60	5
60-120	7
120-180	5

Class	0-60	60-120	120-180
Frequency	5	7	5




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81. Lengths of leaves in millimetres: 22, 24, 28, 31, 33, 35, 39, 42, 45, 48, 51, 54, 58, 63, 66. Complete a grouped frequency table using these classes: 20-30, 30-40, 40-50, 50-60, 60-70.

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82. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
20-30	3
30-40	4
40-50	3
50-60	3
60-70	2

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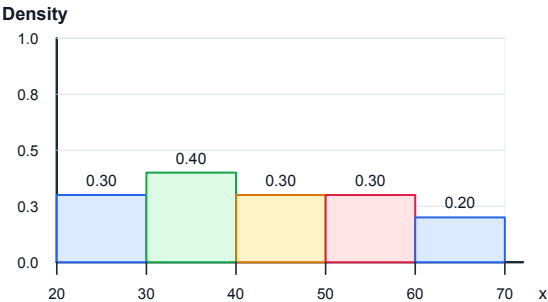


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83. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
20-30	3
30-40	4
40-50	3
50-60	3
60-70	2

Class	20-30	30-40	40-50	50-60	60-70
Frequency	3	4	3	3	2



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84. Time spent on maths homework in minutes: 5, 8, 12, 16, 18, 21, 25, 28, 32, 35, 39, 43, 46, 52, 57. Complete a grouped frequency table using these classes: 0-15, 15-30, 30-45, 45-60.

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85. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
0-15	3
15-30	5
30-45	4
45-60	3

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86. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
0-15	3
15-30	5
30-45	4
45-60	3

Class	0-15	15-30	30-45	45-60
Frequency	3	5	4	3




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87. Distances walked in metres: 80, 95, 110, 125, 148, 160, 185, 205, 220, 245, 260, 285, 310, 340, 365. Complete a grouped frequency table using these classes: 0-100, 100-200, 200-300, 300-400.

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88. For this grouped table, state the modal class and explain what it means.

Class interval	Frequency
0-100	2
100-200	5
200-300	5
300-400	3

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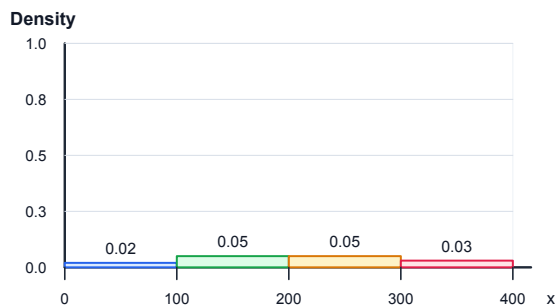


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89. Draw a histogram or grouped frequency diagram for this grouped data.

Class interval	Frequency
0-100	2
100-200	5
200-300	5
300-400	3

Class	0-100	100-200	200-300	300-400
Frequency	2	5	5	3




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90. The grouped classes are 3-5, 6-10, 11-15. Write the continuous class boundaries.

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91. The grouped classes are 0-9, 10-19, 20-29. Write the continuous class boundaries.

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92. The grouped classes are 21-25, 26-30, 31-35. Write the continuous class boundaries.

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93. The grouped classes are 100-149, 150-199, 200-249. Write the continuous class boundaries.

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94. The grouped classes are 50-54, 55-59, 60-64. Write the continuous class boundaries.

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95. The grouped classes are 7-12, 13-18, 19-24. Write the continuous class boundaries.

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96. The grouped classes are 200-249, 250-299, 300-349. Write the continuous class boundaries.

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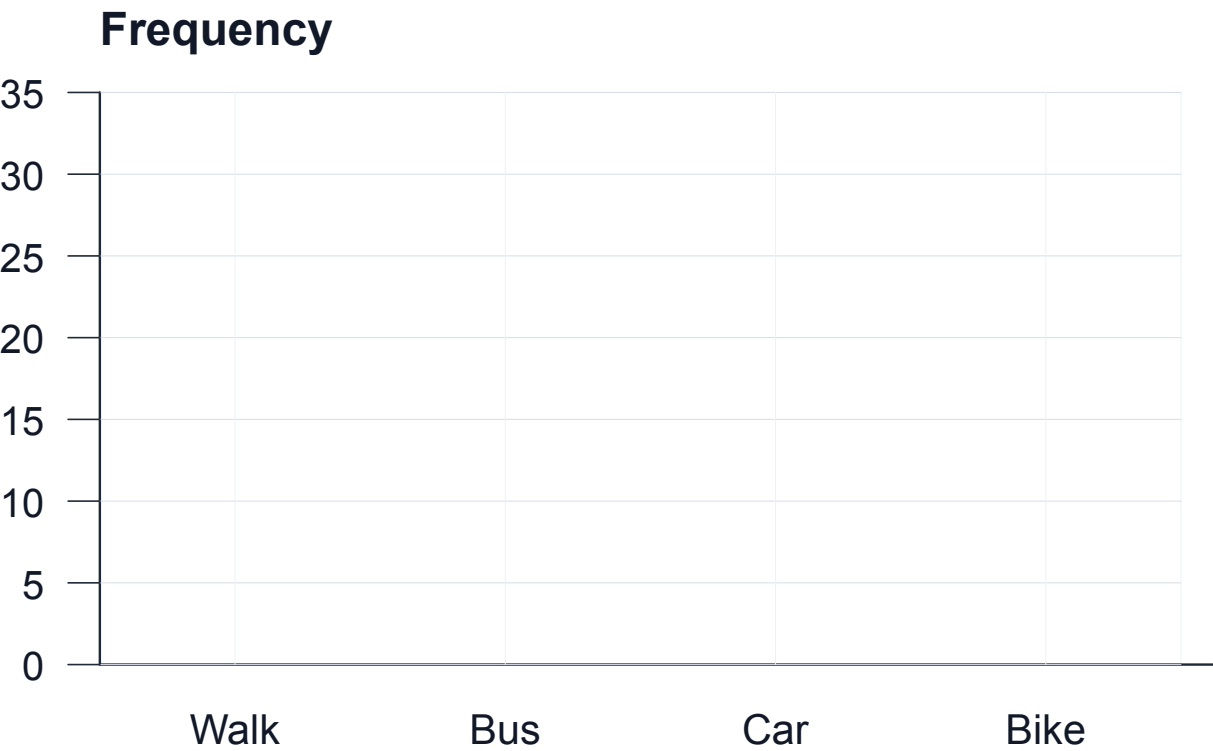
Exam-Style Structured Practice

97. A school records how 80 students travel to school.

Method	Walk	Bus	Car	Bike
Frequency	22	31	17	10

(a) Draw a bar chart. (b) Find the percentage who travel by bus. (c) Give one reason why a pie chart would also be suitable.

Category	Walk	Bus	Car	Bike
Frequency	22	31	17	10



98. A survey asks only students in the chess club whether the school should buy more chess boards. Explain why the data may be unreliable and describe a better sample.

99. A newspaper shows a bar chart where the vertical axis starts at 40 instead of 0. Explain how this could mislead readers.

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100. The grouped table shows daily exercise time for 50 students.

Time t minutes	0-20	20-40	40-60	60-80
Frequency	6	18	17	9

(a) State the modal class. (b) Estimate how many students exercised for at least 40 minutes. (c) Explain why the exact median cannot be found from this table.

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101. Two classes record reading times. Class A has most data in 20-40 minutes. Class B has most data in 40-60 minutes. Write one comparative statement about the two classes.

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102. A data set has 24 values. Explain why a stem-and-leaf diagram may be more useful than a bar chart for this data.

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103. A student writes class intervals 0-10, 10-20 and 20-30 for ages in whole years. Explain one possible problem with these classes.

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104. A shop records the number of customers each hour: 12, 15, 18, 25, 31, 28, 24, 20, 16, 14. Choose a suitable diagram and justify your choice.

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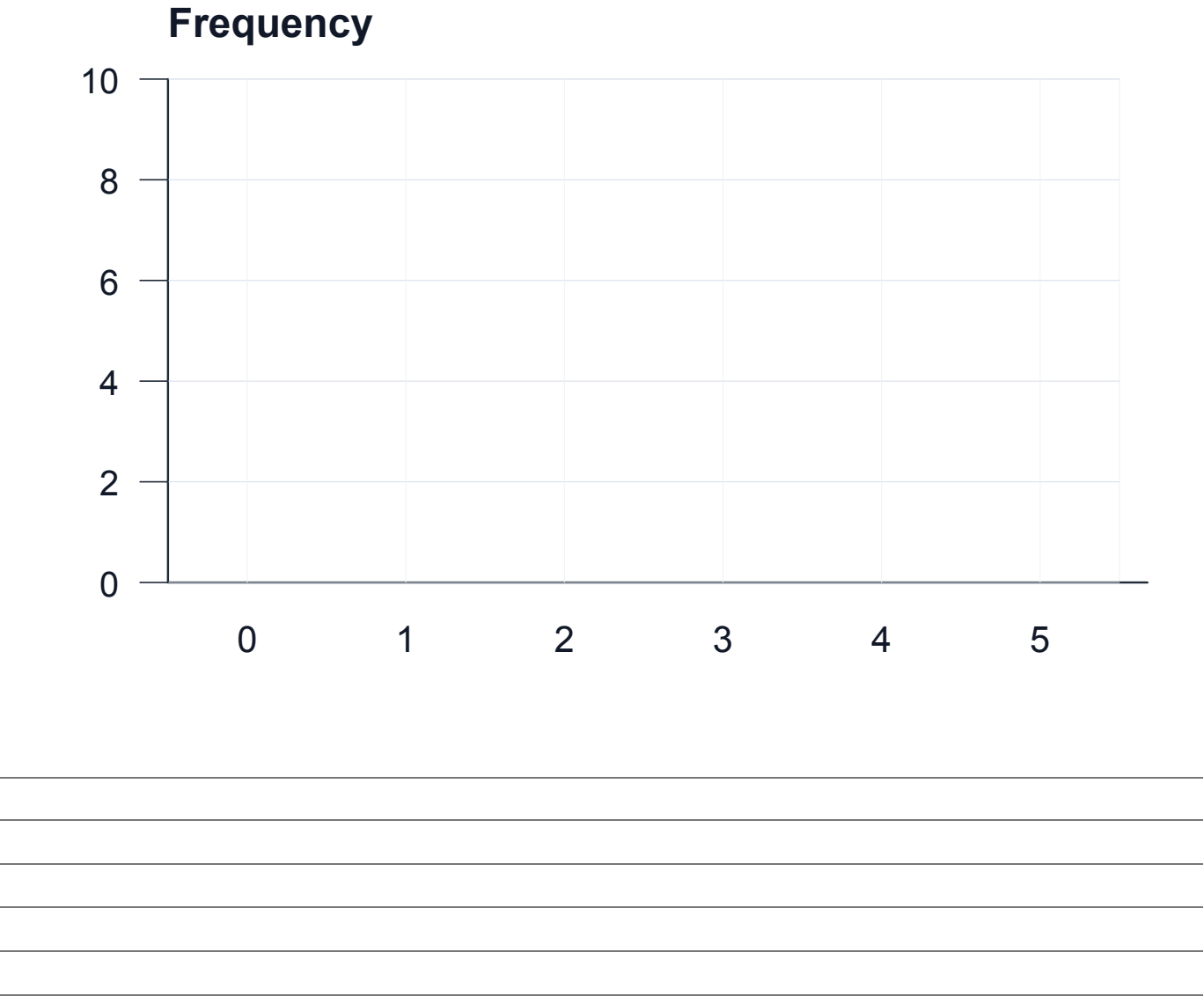
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105. A coach records the number of goals scored by 30 players.

Goals	0	1	2	3	4	5
Frequency	4	7	9	6	3	1

(a) Draw a bar chart. (b) Find the total number of goals scored. (c) Explain why goals are discrete data.

Category	0	1	2	3	4	5
Frequency	4	7	9	6	3	1



106. The temperatures at midday for 18 days were 18, 20, 21, 19, 24, 26, 22, 21, 23, 25, 20, 19, 27, 28, 24, 22, 26, 23. Choose either a stem-and-leaf diagram or grouped table. Explain your choice and draw it.


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107. A grouped frequency table uses classes 0-10, 10-20 and 20-40 with frequencies 5, 12 and 9. Explain why the last class needs special care on a histogram.

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108. A teacher wants to compare revision time for boys and girls in Year 8. Write two survey questions: one good question and one question that would give biased or unclear data.

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109. A stem-and-leaf diagram has key  $4 \mid 7$  means 47. The stems are 3, 4, 5 and 6. Explain what the stems and leaves represent.

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110. A class records times to complete a puzzle.

Time $t$ minutes	0-5	5-10	10-15	15-20
Frequency	3	11	9	2

(a) State the total frequency. (b) State the modal class. (c) Explain why a bar chart of individual times cannot be drawn from this table.

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111. A sports club records member ages in whole years using classes 8-10, 11-13 and 14-16. Write the continuous boundaries and explain why boundaries help when drawing a histogram.

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112. Two students draw charts for the same categorical data. One uses a bar chart and one joins the tops of the bars with a line. Explain which display is better and why.


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## DeepMaths Challenge Questions

113. Create a data collection plan to compare homework time for Year 7 and Year 8 students. Include the sample, question wording, and one suitable diagram.

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114. A grouped table has intervals 0-5, 5-15 and 15-30 with frequencies 6, 12 and 9. Explain why a histogram should not use the raw frequencies as bar heights.

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115. A bar chart shows A: 18, B: 20, C: 19 and D: 21. A student says D is twice as popular as A because its bar looks twice as tall. What likely design error caused this?

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116. Design a small data set of 12 whole-number scores between 10 and 40 that would produce stems 1, 2, 3 and 4 in a stem-and-leaf diagram.

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117. A student wants to compare two distributions but only has bar charts for category totals. Explain why this is not enough to compare medians or spreads.

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118. Write two different questions that could be answered from a grouped frequency table, and one question that could not be answered exactly.

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119. Design a realistic data set of at least 20 values that would be better shown in a grouped table than in a list. State your classes and explain your choice.

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120. A report says, "Most students are excellent because the tallest bar is Excellent." The survey allowed only Excellent, Good or Poor as choices. Give two reasons why this conclusion may be weak.

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# Chapter 7: Averages, Quartiles and Spread

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## Chapter Goal

Calculate, interpret and compare statistical summaries using realistic data sets.

## Calculator Policy

Mostly non-calculator. Show totals, ordering and frequency working.

## Quick Notes - Descriptive Statistics

The mean is the total divided by the number of values.

$$\text{mean} = \frac{\text{total}}{\text{number of values}}$$

The median is the middle value after ordering the data. The mode is the most common value. The range is largest value minus smallest value.

## Quick Notes - Quartiles and IQR

Quartiles split ordered data into quarters.

- $Q_1$ : lower quartile.
- $Q_2$ : median.
- $Q_3$ : upper quartile.
- $\text{IQR} = Q_3 - Q_1$ .

The IQR measures the spread of the middle 50% of the data.

## Quick Notes - Combined Mean

For two groups:

$$\text{combined mean} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

Do not average the two means unless the groups have the same size.

## Quick Notes - Grouped Data

Grouped data hide the exact values, so the mean is estimated using class midpoints.

$$\text{estimated mean} = \frac{\sum(\text{midpoint} \times \text{frequency})}{\sum \text{frequency}}$$

## Worked Examples

### Example 1 - Mean

For 6, 8, 10, 12, the mean is  $(6 + 8 + 10 + 12) \div 4 = 9$ .

### Example 2 - Median and Mode

For 4, 7, 7, 9, 12, the median is 7 and the mode is 7.

### Example 3 - Quartiles

For 3, 5, 8, 10, 12, 15, 17, the median is 10. The lower half is 3, 5, 8, so  $Q_1 = 5$ . The upper half is 12, 15, 17, so  $Q_3 = 15$ . IQR = 10.

### Example 4 - Box Plot

A box plot uses the five-number summary: minimum,  $Q_1$ , median,  $Q_3$ , maximum.



### Example 5 - Combined Mean

Group A has 10 students with mean 62. Group B has 20 students with mean 71.

Combined mean =  $(10 \times 62 + 20 \times 71) \div 30 = 68$ .

### Example 6 - Grouped Mean

For classes 0-10, 10-20, 20-30 with frequencies 4, 8, 6, use midpoints 5, 15, 25.

Estimated mean =  $(5 \times 4 + 15 \times 8 + 25 \times 6) \div 18 = 16.1$  to 1 decimal place.

### Common Mistake

Do not calculate a combined mean by averaging the means unless the groups are the same size.

## Descriptive Statistics - Mean, Median, Mode and Range

1. For the data set 6, 8, 10, 12, 14, 16, find the mean.

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2. For the data set 6, 8, 10, 12, 14, 16, find the median.

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3. For the data set 6, 8, 10, 12, 14, 16, find the mode.

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4. For the data set 6, 8, 10, 12, 14, 16, find the range.

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5. For the data set 9, 11, 13, 15, 17, 19, 21, find the mean.

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6. For the data set 9, 11, 13, 15, 17, 19, 21, find the median.

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7. For the data set 9, 11, 13, 15, 17, 19, 21, find the mode.

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8. For the data set 9, 11, 13, 15, 17, 19, 21, find the range.

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9. For the data set 4, 7, 7, 9, 11, 13, 13, 15, find the mean.

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10. For the data set 4, 7, 7, 9, 11, 13, 13, 15, find the median.

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11. For the data set 4, 7, 7, 9, 11, 13, 13, 15, find the mode.

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12. For the data set 4, 7, 7, 9, 11, 13, 13, 15, find the range.

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13. For the data set 22, 25, 28, 31, 35, 39, 42, 45, 48, find the mean.

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14. For the data set 22, 25, 28, 31, 35, 39, 42, 45, 48, find the median.

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15. For the data set 22, 25, 28, 31, 35, 39, 42, 45, 48, find the mode.

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16. For the data set 22, 25, 28, 31, 35, 39, 42, 45, 48, find the range.

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17. For the data set 3, 5, 8, 8, 10, 12, 14, 17, 20, find the mean.

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18. For the data set 3, 5, 8, 8, 10, 12, 14, 17, 20, find the median.

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19. For the data set 3, 5, 8, 8, 10, 12, 14, 17, 20, find the mode.

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20. For the data set 3, 5, 8, 8, 10, 12, 14, 17, 20, find the range.

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21. For the data set 18, 19, 21, 24, 25, 27, 30, 35, find the mean.

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22. For the data set 18, 19, 21, 24, 25, 27, 30, 35, find the median.

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23. For the data set 18, 19, 21, 24, 25, 27, 30, 35, find the mode.

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24. For the data set 18, 19, 21, 24, 25, 27, 30, 35, find the range.

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25. For the data set 40, 42, 45, 48, 50, 53, 57, 60, 65, 72, find the mean.

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26. For the data set 40, 42, 45, 48, 50, 53, 57, 60, 65, 72, find the median.

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27. For the data set 40, 42, 45, 48, 50, 53, 57, 60, 65, 72, find the mode.

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28. For the data set 40, 42, 45, 48, 50, 53, 57, 60, 65, 72, find the range.

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29. For the data set 5, 6, 6, 7, 8, 9, 9, 9, 10, 12, 14, find the mean.

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30. For the data set 5, 6, 6, 7, 8, 9, 9, 9, 10, 12, 14, find the median.

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31. For the data set 5, 6, 6, 7, 8, 9, 9, 9, 10, 12, 14, find the mode.

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32. For the data set 5, 6, 6, 7, 8, 9, 9, 9, 10, 12, 14, find the range.

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33. For the data set 28, 30, 33, 37, 41, 45, 49, 52, 56, find the mean.

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34. For the data set 28, 30, 33, 37, 41, 45, 49, 52, 56, find the median.

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35. For the data set 28, 30, 33, 37, 41, 45, 49, 52, 56, find the mode.

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36. For the data set 28, 30, 33, 37, 41, 45, 49, 52, 56, find the range.

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37. For the data set 11, 14, 16, 17, 19, 22, 25, 29, find the mean.

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38. For the data set 11, 14, 16, 17, 19, 22, 25, 29, find the median.

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39. For the data set 11, 14, 16, 17, 19, 22, 25, 29, find the mode.

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40. For the data set 11, 14, 16, 17, 19, 22, 25, 29, find the range.

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## Quartiles, IQR and Five-Number Summary

41. For the ordered data 12, 15, 18, 19, 22, 25, 28, 30, 34, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

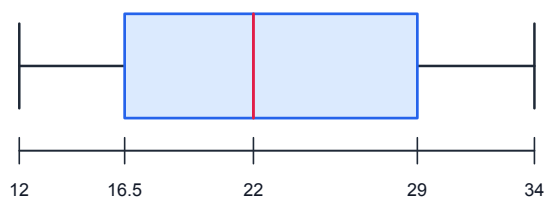
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42. For the data 12, 15, 18, 19, 22, 25, 28, 30, 34, write the five-number summary and sketch the box-and-whisker plot.

Box-and-whisker plot



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43. For the ordered data 5, 7, 9, 11, 14, 18, 21, 24, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

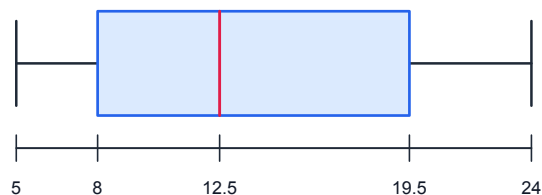
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44. For the data 5, 7, 9, 11, 14, 18, 21, 24, write the five-number summary and sketch the box-and-whisker plot.

Box-and-whisker plot



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45. For the ordered data 31, 34, 36, 38, 40, 43, 46, 50, 55, 61, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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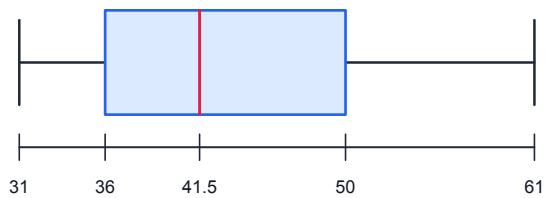
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46. For the data 31, 34, 36, 38, 40, 43, 46, 50, 55, 61, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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47. For the ordered data 8, 10, 13, 17, 18, 22, 26, 29, 33, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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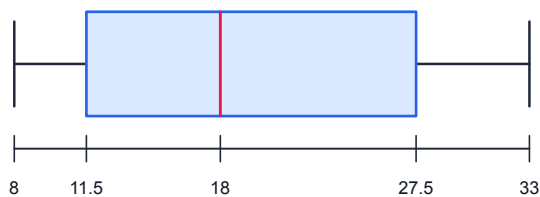
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48. For the data 8, 10, 13, 17, 18, 22, 26, 29, 33, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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49. For the ordered data 44, 47, 49, 52, 56, 59, 63, 68, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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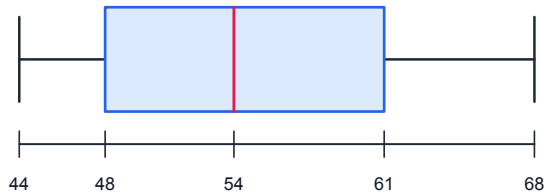
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50. For the data 44, 47, 49, 52, 56, 59, 63, 68, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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51. For the ordered data 2, 4, 5, 7, 9, 12, 15, 18, 21, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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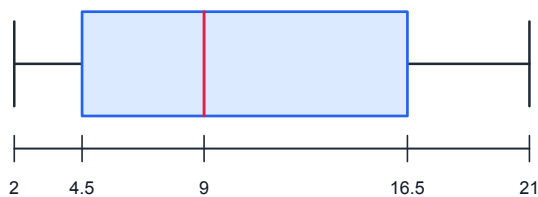
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52. For the data 2, 4, 5, 7, 9, 12, 15, 18, 21, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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53. For the ordered data 71, 73, 76, 79, 82, 86, 90, 95, 101, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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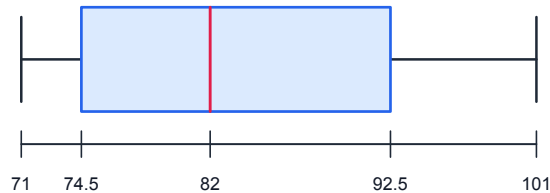
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54. For the data 71, 73, 76, 79, 82, 86, 90, 95, 101, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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55. For the ordered data 16, 18, 20, 23, 27, 31, 35, 38, 42, 45, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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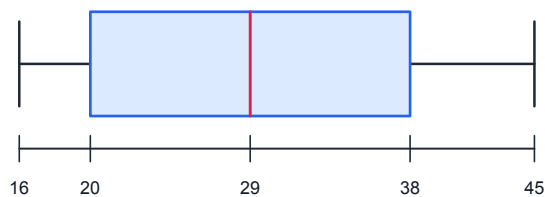
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56. For the data 16, 18, 20, 23, 27, 31, 35, 38, 42, 45, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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57. For the ordered data 6, 9, 12, 12, 15, 17, 19, 23, 26, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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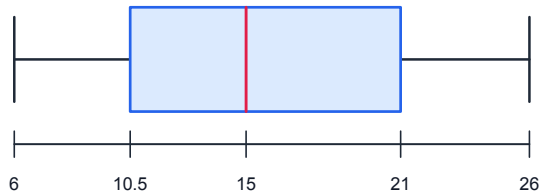
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58. For the data 6, 9, 12, 12, 15, 17, 19, 23, 26, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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59. For the ordered data 100, 108, 115, 120, 126, 133, 140, 148, find ( $Q_1$ ), the median, ( $Q_3$ ) and the interquartile range.

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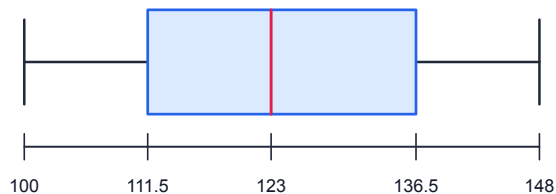
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60. For the data 100, 108, 115, 120, 126, 133, 140, 148, write the five-number summary and sketch the box-and-whisker plot.

**Box-and-whisker plot**



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## Combined Mean

61. There are 12 students in two revision groups with mean 18, and 8 more with mean 21. Find the combined mean.

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62. There are 15 test scores in two classes with mean 64, and 20 more with mean 70. Find the combined mean.

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63. There are 9 minutes of reading in two groups with mean 32, and 11 more with mean 38. Find the combined mean.

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64. There are 24 goals scored by two teams with mean 7, and 16 more with mean 10. Find the combined mean.

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65. There are 18 heights in two sports squads with mean 145, and 12 more with mean 152. Find the combined mean.

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66. There are 30 books read by two year groups with mean 22, and 25 more with mean 18. Find the combined mean.

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67. There are 14 quiz marks in two clubs with mean 56, and 21 more with mean 62. Find the combined mean.

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68. There are 16 house points in two groups with mean 11, and 14 more with mean 15. Find the combined mean.

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69. There are 40 hours of sleep in two surveys with mean 6.5, and 35 more with mean 7.2. Find the combined mean.

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70. There are 22 practice scores in two classes with mean 48, and 18 more with mean 52. Find the combined mean.

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71. There are 13 journey times in two bus groups with mean 25, and 17 more with mean 29. Find the combined mean.

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72. There are 28 exam marks in two sets with mean 74, and 32 more with mean 71. Find the combined mean.

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73. Class A has 18 students with mean score 62. Class B has 12 students. The combined mean is 66. Find the mean score of Class B.

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74. A cricket team has 10 players with mean age 14.2 years. A new player joins and the mean becomes 14.5 years. Find the new player's age.

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## Box-and-Whisker Plots and Comparisons

75. Two groups record homework times. Group A: 12, 15, 18, 21, 24, 27, 31, 35, 40. Group B: 10, 14, 16, 20, 25, 30, 38, 45, 55. Find the IQR for each group and compare the spread.

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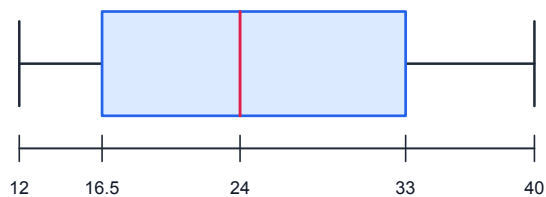
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76. The box plot for Group A is shown. Interpret the median and IQR.

Box-and-whisker plot



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77. Two groups record test marks. Group A: 42, 45, 48, 51, 54, 57, 60, 64. Group B: 38, 44, 49, 50, 58, 63, 70, 76. Find the IQR for each group and compare the spread.

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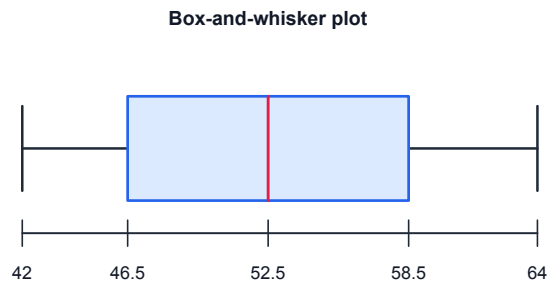
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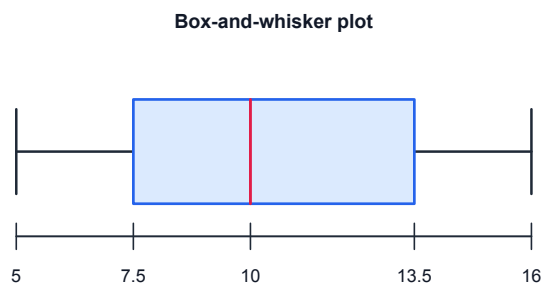
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78. The box plot for Group A is shown. Interpret the median and IQR.



79. Two groups record practice scores. Group A: 5, 7, 8, 9, 11, 13, 14, 16. Group B: 4, 6, 8, 10, 12, 15, 18, 22. Find the IQR for each group and compare the spread.

80. The box plot for Group A is shown. Interpret the median and IQR.



81. Two groups record running distances. Group A: 100, 105, 112, 118, 120, 125, 130, 136, 140. Group B: 92, 100, 110, 116, 121, 132, 145, 160, 175. Find the IQR for each group and compare the spread.

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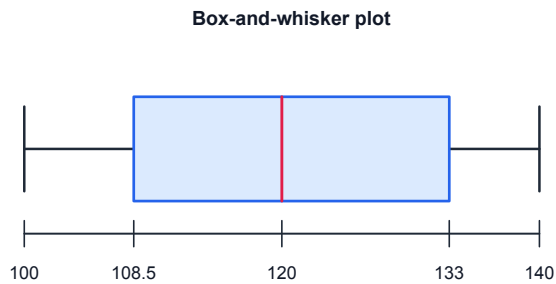
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82. The box plot for Group A is shown. Interpret the median and IQR.



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83. Two groups record reading minutes. Group A: 18, 21, 25, 29, 32, 35, 39, 42. Group B: 16, 20, 23, 30, 36, 41, 47, 55. Find the IQR for each group and compare the spread.

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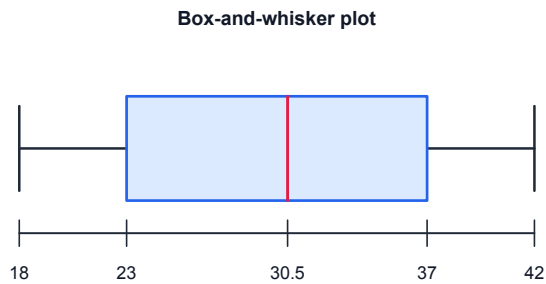
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84. The box plot for Group A is shown. Interpret the median and IQR.



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**Grouped Data and Estimated Mean**

85. Estimate the mean from this grouped frequency table.

Class interval	Frequency
0-10	4
10-20	8
20-30	6
30-40	2

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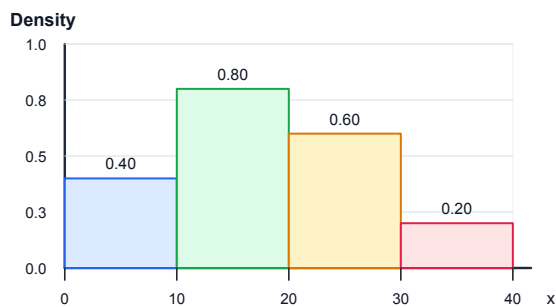
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86. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
0-10	4
10-20	8
20-30	6
30-40	2

Class	0-10	10-20	20-30	30-40
Frequency	4	8	6	2



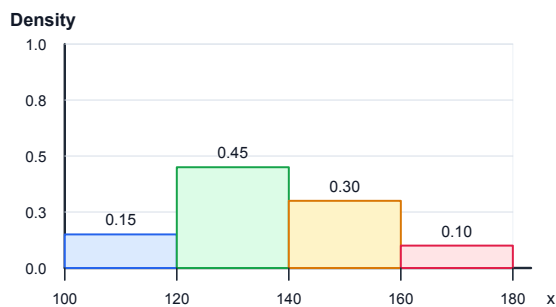
87. Estimate the mean from this grouped frequency table.

Class interval	Frequency
100-120	3
120-140	9
140-160	6
160-180	2

88. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
100-120	3
120-140	9
140-160	6
160-180	2

Class	100-120	120-140	140-160	160-180
Frequency	3	9	6	2



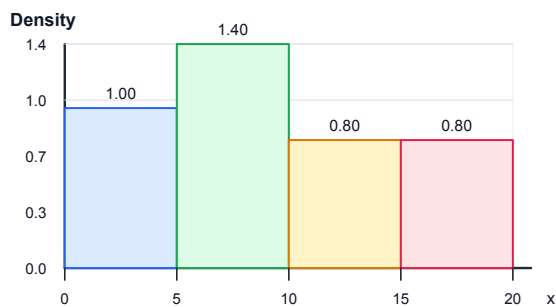
89. Estimate the mean from this grouped frequency table.

Class interval	Frequency
0-5	5
5-10	7
10-15	4
15-20	4

90. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
0-5	5
5-10	7
10-15	4
15-20	4

Class	0-5	5-10	10-15	15-20
Frequency	5	7	4	4



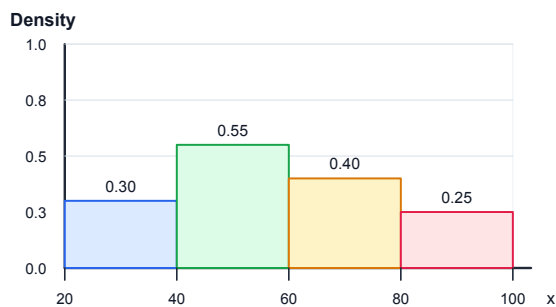
91. Estimate the mean from this grouped frequency table.

Class interval	Frequency
20-40	6
40-60	11
60-80	8
80-100	5

92. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
20-40	6
40-60	11
60-80	8
80-100	5

Class	20-40	40-60	60-80	80-100
Frequency	6	11	8	5



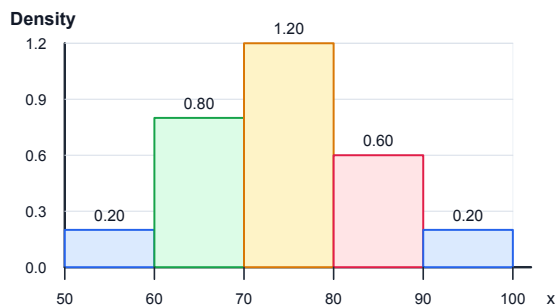
93. Estimate the mean from this grouped frequency table.

Class interval	Frequency
50-60	2
60-70	8
70-80	12
80-90	6
90-100	2

94. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
50-60	2
60-70	8
70-80	12
80-90	6
90-100	2

Class	50-60	60-70	70-80	80-90	90-100
Frequency	2	8	12	6	2



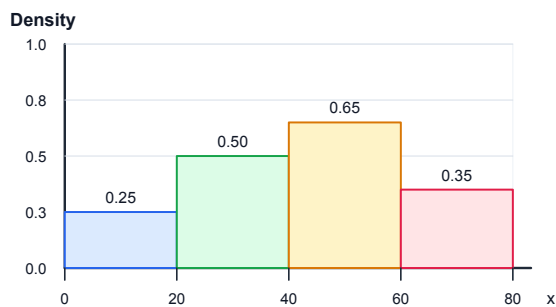
95. Estimate the mean from this grouped frequency table.

Class interval	Frequency
0-20	5
20-40	10
40-60	13
60-80	7

96. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
0-20	5
20-40	10
40-60	13
60-80	7

Class	0-20	20-40	40-60	60-80
Frequency	5	10	13	7



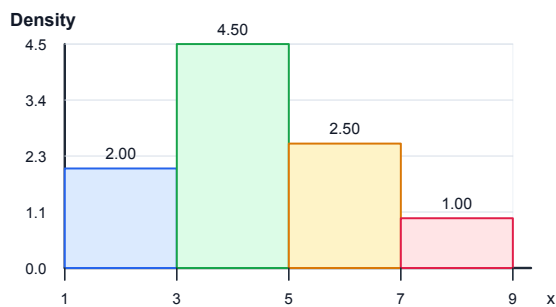
97. Estimate the mean from this grouped frequency table.

Class interval	Frequency
1-3	4
3-5	9
5-7	5
7-9	2

98. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
1-3	4
3-5	9
5-7	5
7-9	2

Class	1-3	3-5	5-7	7-9
Frequency	4	9	5	2



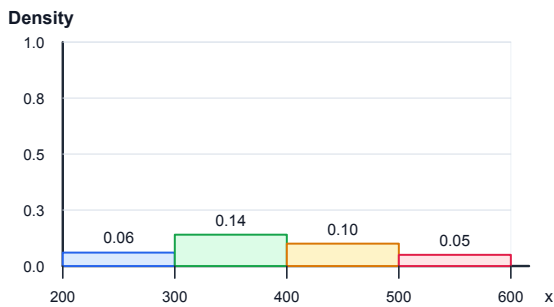
99. Estimate the mean from this grouped frequency table.

Class interval	Frequency
200-300	6
300-400	14
400-500	10
500-600	5

100. For this grouped data, state the modal class and explain why the mean is only an estimate.

Class interval	Frequency
200-300	6
300-400	14
400-500	10
500-600	5

Class	200-300	300-400	400-500	500-600
Frequency	6	14	10	5




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## Exam-Style Statistical Reasoning

101. The number of pages read by 15 students is 8, 12, 15, 16, 18, 21, 23, 24, 25, 28, 31, 35, 38, 44, 52. (a) Find the median. (b) Find ( $Q_1$ ) and ( $Q_3$ ). (c) Find the IQR. (d) Explain why the IQR is useful.

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102. A class has 16 students with mean score 68. Another class has 24 students with mean score 73. Find the combined mean score.

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103. A data set has mean 14. There are six values. Five values are 9, 12, 15, 16 and 18. Find the missing value.

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104. A box plot has minimum 12, ( $Q_1=18$ ), median 25, ( $Q_3=31$ ), maximum 52. Describe the skewness or unusual feature.

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105. A grouped table has classes 0-10, 10-20, 20-30 and frequencies 3, 9, 8. Estimate the mean and state one limitation of your answer.

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106. Two groups have the same median but Group B has a larger IQR. What does this tell you?

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107. A student says, "The mode is always the best average because it is easy to find." Explain why this is not always true.

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108. A data set has minimum 3, maximum 23 and range 20. Give one possible set of five numbers with median 12.

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## DeepMaths Challenge Questions

109. Create a data set of seven values with median 20, range 18 and mode 16.

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110. A class mean is 72. One score of 27 was entered incorrectly as 72. There are 20 students. Find the correct mean.

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111. The combined mean of two groups is 30. Group A has 10 values with mean 24. Group B has 15 values. Find Group B's mean.

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112. A data set has ( $Q_1=12$ ), median 18 and ( $Q_3=24$ ). Explain why many different data sets can have this same five-number middle summary.

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113. A grouped table estimates the mean as 42. Another student claims the exact mean is 42. Explain the problem with this claim.

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114. Design two data sets with the same mean but different spreads.

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# Chapter 8: Probability Basics

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## Chapter Goal

Use probability language, probability scales, sample spaces, complements, and simple combined events.

## Calculator Policy

Mostly non-calculator. Count outcomes clearly and simplify fractions.

## Quick Notes - Page 1

Probability is measured from 0 to 1.

$$0 = \text{impossible}, \quad 1 = \text{certain}$$

If all outcomes are equally likely:

$$P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$$

## Quick Notes - Page 2

Complements add to 1:

$$P(\text{not } A) = 1 - P(A)$$

For two independent events, multiply probabilities.

For mutually exclusive alternatives, add probabilities.

When unsure, list the sample space.

## Worked Examples

### Example 1

Find the probability of rolling an even number on a fair die.

Solution: Even outcomes are 2, 4 and 6. Probability =  $3/6 = 1/2$ .

### Example 2

A bag has 3 red and 5 blue counters. Find the probability of red.

Solution: There are 8 counters, so  $P(\text{red}) = 3/8$ .

### Example 3

An event has probability  $\frac{2}{7}$ . Find the probability it does not happen.

Solution:  $1 - \frac{2}{7} = \frac{5}{7}$ .

### Example 4

List the sample space for tossing a fair coin twice.

Solution: HH, HT, TH, TT.

### Example 5

A fair coin is tossed and a fair die is rolled. Find the probability of heads and a 6.

Solution:  $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$ .

### Example 6

In 40 trials, red occurs 12 times. Estimate the probability of red.

Solution:  $12/40 = 3/10$ .

## Skill Practice

1. Classify the event as impossible, unlikely, even chance, likely, or certain: rolling a 7 on an ordinary six-sided die.

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2. Classify the event as impossible, unlikely, even chance, likely, or certain: rolling an even number on an ordinary six-sided die.

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3. Classify the event as impossible, unlikely, even chance, likely, or certain: the sun rising tomorrow.

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4. Classify the event as impossible, unlikely, even chance, likely, or certain: choosing a red counter from a bag with only blue counters.

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5. Classify the event as impossible, unlikely, even chance, likely, or certain: getting heads when tossing a fair coin.

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6. Classify the event as impossible, unlikely, even chance, likely, or certain: choosing a vowel from the letters A, E, I, O, U.

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7. Classify the event as impossible, unlikely, even chance, likely, or certain: rolling a number greater than 2 on a fair die.

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8. Classify the event as impossible, unlikely, even chance, likely, or certain: rolling a 1 on a fair die.

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9. On the probability scale from 0 to 1, describe probability 0.

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10. On the probability scale from 0 to 1, describe probability 1.

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11. On the probability scale from 0 to 1, describe probability 0.5.

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12. On the probability scale from 0 to 1, describe probability 0.25.

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13. On the probability scale from 0 to 1, describe probability 0.75.

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14. On the probability scale from 0 to 1, describe probability 0.1.

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15. List the sample space for: fair coin.

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16. List the sample space for: ordinary six-sided die.

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17. List the sample space for: spinner labelled A, B, C, D.

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18. List the sample space for: bag with counters numbered 1, 2, 3, 4.

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19. List the sample space for: fair coin tossed twice.

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20. Find the probability of rolling an even number on a fair die.

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21. Find the probability of rolling a prime number on a fair die.

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22. Find the probability of rolling a number greater than 4 on a fair die.

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23. Find the probability of choosing a vowel from the letters A, B, C, D, E.

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24. Find the probability of choosing a red counter from 4 red and 6 blue counters.

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25. Find the probability of choosing a blue counter from 3 red, 5 blue and 2 green counters.

---

26. Find the probability of getting tails on a fair coin.

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27. Find the probability of choosing a multiple of 3 from 1, 2, 3, 4, 5, 6.

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28. Find the probability of choosing a card labelled 1, 2, 3, 4, 5 and getting an odd number.

---

29. Find the probability of spinning a sector labelled C on a fair spinner labelled A, B, C, D.

---

30. An event has probability  $\frac{1}{5}$ . Find the probability that it does not happen.

---

31. An event has probability  $\frac{2}{7}$ . Find the probability that it does not happen.

---

32. An event has probability  $\frac{3}{8}$ . Find the probability that it does not happen.

---

33. An event has probability  $\frac{5}{12}$ . Find the probability that it does not happen.

---

34. An event has probability  $\frac{7}{10}$ . Find the probability that it does not happen.

---

35. An event has probability  $\frac{9}{20}$ . Find the probability that it does not happen.

---

36. An event has probability  $\frac{4}{9}$ . Find the probability that it does not happen.

---

37. In 20 trials, red occurred 6 times. Estimate the probability of red.

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38. In 20 trials, blue occurred 8 times. Estimate the probability of blue.

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39. In 25 trials, green occurred 5 times. Estimate the probability of green.

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40. In 30 trials, yellow occurred 9 times. Estimate the probability of yellow.

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41. In 28 trials, purple occurred 7 times. Estimate the probability of purple.

---

42. A bag has 4 red, 5 blue and 3 green counters. One counter is chosen at random. Find the probability of red or blue.

---

43. A spinner is numbered 1 to 5. Find the probability of 1 or 2.

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44. A spinner has 3 green sectors, 7 yellow sectors and 10 purple sectors. Find the probability of green or yellow.

---

45. A fair die is rolled. Find the probability of even or greater than 4.

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46. A card is chosen from a set with 13 hearts, 13 clubs, 13 diamonds and 13 spades. Find the probability of heart or club.

---

47. Find the probability of two fair coin tosses and getting two heads.

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48. Find the probability of rolling a 6 then heads on a coin.

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49. Find the probability of choosing red then blue with replacement from 3 red and 2 blue counters.

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## Exam-Style Structured Practice

1. A fair die is rolled.

- (a) List the sample space. [1]
  - (b) Find the probability of rolling an even number. [2]
  - (c) Find the probability of not rolling an even number. [2]
- 

2. A bag contains 5 red, 3 blue and 2 green counters. One counter is chosen at random.

- (a) Find the probability of red. [2]
  - (b) Find the probability of not green. [3]
- 

3. A spinner has 8 equal sectors numbered 1 to 8.

- (a) Find the probability of spinning a prime number. [2]
  - (b) Find the probability of spinning a number greater than 5. [2]
  - (c) Find the probability of spinning a number that is prime or greater than 5. [3]
- 

4. A fair coin is tossed twice.

- (a) List all outcomes. [2]
  - (b) Find the probability of exactly one head. [2]
  - (c) Find the probability of at least one head. [2]
- 

5. In 50 trials, a drawing pin lands point-up 18 times.

- (a) Estimate the probability of point-up. [2]
  - (b) Estimate how many point-up results there would be in 200 similar trials. [3]
- 

6. A card is chosen at random from cards labelled 1 to 10.

- (a) Find the probability of an odd number. [2]
  - (b) Find the probability of a multiple of 3. [2]
  - (c) Find the probability of an odd multiple of 3. [2]
- 

7. Two fair six-sided dice are rolled.

- (a) How many equally likely outcomes are there? [1]
  - (b) Find the probability of getting a total of 7. [3]
  - (c) Find the probability of getting a double. [2]
-

8. A bag contains 4 red and 6 blue counters. Two counters are chosen with replacement.

- (a) Find the probability of two red counters. [3]
  - (b) Find the probability of one red and one blue in that order. [3]
- 

9. A bag contains 4 red and 6 blue counters. Two counters are chosen without replacement.

- (a) Find the probability of two red counters. [3]
  - (b) Find the probability of red then blue. [3]
- 

10. The probability that a bus is late is  $\frac{3}{20}$ .

- (a) Find the probability that it is not late. [2]
  - (b) In 100 school days, estimate how many days the bus is late. [3]
- 

11. A school survey asks 80 students. 32 choose football, 20 choose netball, 12 choose tennis and 16 choose swimming.

- (a) Find the probability that a student chosen at random chose football. [2]
  - (b) Find the probability that a student chose tennis or swimming. [3]
- 

12. A probability scale has marks 0,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1.

- (a) Place 'impossible' and 'certain' on the scale. [2]
  - (b) Which mark represents an even chance? [1]
  - (c) Which mark is closest to 0.8? [2]
- 

13. In a class, 14 students play chess, 18 play football and 8 play both. There are 30 students.

- (a) How many play chess or football? [3]
  - (b) Find the probability that a randomly chosen student plays neither. [3]
- 

14. A fair spinner has sectors A, B, C and D. A student spins it 40 times and gets A 8 times.

- (a) What is the theoretical probability of A? [2]
  - (b) What is the experimental probability of A? [2]
  - (c) Explain why the two probabilities may be different. [2]
-

15. A password is made by choosing one letter from A, B, C and one digit from 1, 2, 3.

- (a) List the sample space. [3]
  - (b) Find the probability that the password contains B. [2]
- 

16. The probability of rain is 0.35.

- (a) Write this as a fraction. [2]
  - (b) Find the probability of no rain. [2]
  - (c) Describe whether rain is more likely or less likely than no rain. [2]
- 

17. A bag has red, blue and green counters. The probability of red is  $\frac{2}{5}$ , and the probability of blue is  $\frac{3}{10}$ .

- (a) Find the probability of green. [3]
  - (b) If there are 30 counters, how many are green? [3]
- 

18. A game uses a fair coin and a fair spinner numbered 1 to 4.

- (a) How many outcomes are in the sample space? [1]
  - (b) Find the probability of heads and an even number. [3]
  - (c) Find the probability of tails or number 4. [4]
- 

19. A student says that if  $P(A) = \frac{2}{3}$ , then  $P(\text{not } A) = \frac{1}{3}$ . Explain why this is correct. [4]

---

## Mixed Review

1. Find the mean of 4, 8, 12.

---

2. Find the next term: 5, 9, 13, 17, ...

---

3. Write 0.6 as a fraction.

---

4. Find the probability of heads on a fair coin.

---

5. Share 60 in the ratio 2 : 3.

---

6. Find the range of 7, 11, 15, 20.

---

7. Find 25% of 96.

---

8. Write  $3.5 \times 10^2$  as an ordinary number.

---

9. Find the pie-chart angle for 10 out of 40.

---

10. Find the median of 3, 9, 5, 7, 1.

---

## Challenge Questions

1. A bag contains red, blue and green counters. The probability of red is  $\frac{1}{3}$ , and the probability of blue is twice the probability of green. Find the probability of green.

---
2. Two fair coins are tossed. Given that at least one coin shows heads, find the probability that both coins show heads.

---
3. A fair die is rolled twice. Find the probability that the two numbers have a sum of 5.

---
4. In a class,  $P(\text{walk}) = \frac{2}{5}$ ,  $P(\text{bus}) = \frac{1}{4}$ , and the rest travel by car. Find the probability of car.

---
5. A spinner has three colours. Red has probability  $\frac{1}{2}$ , blue has probability  $\frac{1}{3}$ , and green has probability  $x$ . Find  $x$ , then find the probability of not red.

---
6. A game chooses one letter from A, B and one number from 1, 2, 3, 4. Find the probability of choosing B and an even number.

---
7. A biased spinner is spun 120 times and lands on red 45 times. It is then spun 200 more times. Estimate the number of reds in the next 200 spins.

---

## Common Mistakes

- Writing the favourable outcomes without dividing by the total outcomes.
- Forgetting to simplify probability fractions.
- Treating overlapping events as if they do not overlap.
- Multiplying probabilities for events that are alternatives.
- Forgetting that complementary probabilities add to 1.
- Confusing theoretical probability with experimental probability.

## Progress Tracker

Section	Questions	Target
Skill practice	49	Build basic probability fluency
Exam-style structured practice	19	Apply probability in contexts
Mixed review	10	Maintain earlier number and statistics skills
Challenge	7	Extend probability reasoning

# Chapter 9: Mixed Number and Statistics Review

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## Chapter Goal

Blend number, ratio, data handling and probability skills in cumulative review sets.

## Calculator Policy

Mostly non-calculator. Show written methods first; a calculator may only be used afterwards to check arithmetic.

## Quick Notes - Page 1

Read every question for its topic before calculating. Mixed review questions often combine two familiar skills.

- For fractions, use common denominators or unit fractions.
- For percentages, decide whether the question asks for the change, the new value, or the original value.
- For ratio, add the parts before sharing a total.
- For rates, use  $\text{speed} = \text{distance} \div \text{time}$ .

## Quick Notes - Page 2

For data questions:

- Mean = total divided by number of values.
- Median = middle value after ordering.
- Mode = most frequent value.
- Range = largest value minus smallest value.

For probability:

$$P(\text{event}) = \frac{\text{favourable outcomes}}{\text{total outcomes}}$$

Complements add to 1. For combined outcomes, list the sample space if needed.

## Worked Examples

### Example 1

Calculate  $-6 + 14 - 3$ .

Solution:  $-6 + 14 = 8$ , then  $8 - 3 = 5$ .

### Example 2

Share 72 in the ratio 5 : 4.

Solution: There are 9 parts. Each part is  $72 \div 9 = 8$ , so the shares are 40 and 32.

### Example 3

Find 35% of 80.

Solution: 10% is 8, 30% is 24 and 5% is 4, so 35% is 28.

### Example 4

Find the mean of 4, 6, 9 and 13.

Solution: The total is 32. Divide by 4 to get a mean of 8.

### Example 5

A bag has 3 red counters and 7 blue counters. Find the probability of red.

Solution: There are 10 counters, so  $P(\text{red}) = 3/10$ .

### Example 6

A spinner lands on yellow 18 times in 60 spins. Estimate yellow in 200 spins.

Solution: Experimental probability  $= 18/60 = 3/10$ . Estimate  $(3/10) \times 200 = 60$ .

## Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	60	[ ]	___ / 60	[ ]
Exam-Style Structured Practice	18	[ ]	___ / 18	[ ]
Mixed Review	10	[ ]	___ / 10	[ ]
Challenge Questions	6	[ ]	___ / 6	[ ]

## Skill Practice

1. Use the number line to write these numbers in increasing order:  $-7, 3, -2, 0, -5$ .

---

2. Calculate  $-8 + 15 - 6$ .

---

3. Calculate  $4^2 + 3^2$ .

---

4. Find the highest common factor of 24 and 36.

---

5. Find the lowest common multiple of 8 and 12.

---

6. A fraction bar is divided into 24 equal parts and 18 parts are shaded. Write the shaded fraction in simplest form.

---

7. Calculate  $\frac{2}{3} + \frac{1}{6}$ .

---

8. Calculate  $\frac{5}{8} - \frac{1}{4}$ .

---

9. Find  $\frac{3}{5}$  of 40.

---

10. Convert 0.375 to a fraction in simplest form.

---

11. Convert  $\frac{7}{20}$  to a percentage.

---

12. Increase 60 by 15%.

---

13. Decrease 80 by 25%.

---

14. 20% of a number is 14. Find the number.

---

15. A quantity is split in the ratio 3 : 5. The total is 64. Find the smaller share.

---

16. Share £45 in the ratio 2 : 3.

---

17. Four pencils cost £3.20. How much do seven pencils cost at the same rate?

---

18. A train travels 150 km in 3 hours. Find its average speed.

---

19. Write  $3.4 \times 10^5$  as an ordinary number.

---

20. Write 0.0062 in standard form.

---

21. Calculate  $2^3 \times 2^4$ .

---

22. Calculate  $10^6 \div 10^2$ .

---

23. The sequence is 7, 11, 15, 19, ... Write the next two terms.

---

24. The sequence is 2, 6, 18, 54, ... Write the next term.

---

25. Bar chart data: apples 8, pears 5, bananas 7. How many pieces of fruit are shown altogether?

---

26. For the bar chart data apples 8, pears 5, bananas 7, name the modal fruit.

---

27. Find the range of 4, 9, 6, 12, 5.

---

28. Find the mean of 6, 8, 10, 12.

---

29. Find the median of 3, 7, 8, 10, 12.

---

30. Find the mode of 5, 6, 5, 7, 8, 5.

---

31. Frequency table: score 1 has frequency 2, score 2 has frequency 5, score 3 has frequency 3. Find the total frequency.

---

32. Frequency table: score 1 has frequency 2, score 2 has frequency 3, score 4 has frequency 5. Find the mean score.

---

33. Pie chart data: red 10 and blue 15. Find the angle for the red sector.

---

34. Find the probability of rolling a prime number on a fair six-sided die.

---

35. A bag contains 4 red counters and 6 blue counters. Find the probability of choosing a red counter.

---

36. The probability of rain is 0.35. Find the probability of no rain.

---

37. A fair coin and a spinner labelled 1 and 2 are used together. List the sample space.

---

38. A fair coin is tossed twice. Find the probability of getting two heads.

---

39. A spinner lands on red 18 times in 60 spins. Estimate how many reds would occur in 200 spins.

---

40. Round 387 to the nearest ten.

---

41. Estimate  $49 \times 21$  by rounding each number to one significant figure.

---

42. A length is 13 cm to the nearest centimetre. Write the smallest possible actual length.

---

43. Ratio table: 5 kg of rice costs £12. Find the cost of 3 kg at the same rate.

---

44. In a class, 12 students walk, 8 take the bus and 10 travel by car. What fraction of the class takes the bus? Give your answer in simplest form.

---

45. A grouped frequency diagram has frequencies 3, 5 and 7 for three intervals. Find the total frequency.

---

46. On a probability scale from 0 to 1, classify a probability of 0.2.

---

47. A value is increased by 12.5% to become 90. Find the original value.

---

48. An arithmetic sequence has first term 11 and 15th term 67. Find the  $n$ th term.

---

49. A box has red, blue and green counters in the ratio 2 : 3 : 5. There are 80 counters altogether. Find the probability of not choosing a green counter.

---

50. A mass is 3.6 kg to the nearest 0.1 kg. Find the least possible total mass of 4 such objects.

---

51. The mean of 6 numbers is 18. Five of the numbers have total 91. Find the sixth number.

---

52. A spinner has three outcomes with probabilities 0.35,  $\frac{1}{4}$ , and  $p$ . Find  $p$ .

---

53. A train travels 45 km in 36 minutes. Find its average speed in km/h.

---

54. Simplify the ratio 0.6 : 1.5 : 2.4.

---

55. A grouped frequency table has frequencies 4,  $x$ , 9. The total frequency is 28. Find  $x$ .

---

56. A value decreases by 20%, then increases by 20%. If the starting value is 150, find the final value.

---

57. A bag has 5 red, 4 blue and 3 green counters. Two counters are chosen without replacement. Find the probability that both are red.

---

58. The sequence 2, 6, 12, 20, ... has  $n$ th term  $n(n + 1)$ . Find the 12th term.

---

59. A test has 56 marks. A student scores 42 marks. How many more marks are needed to reach at least 80%?

---

60. The mean of 5 values is 18. Four values are 9, 15, 20 and 24. Find the missing value and the range.

---

## Exam-Style Structured Practice

- 
1. (a) Write  $-4, -9, 2, 0$  in increasing order. (b) Find the difference between the smallest and largest numbers. (c) Find the highest common factor of 18 and 24.
- 
2. A tank holds 36 litres when full. It is  $\frac{5}{6}$  full. Then 12 litres are poured out. (a) How many litres are in the tank at first? (b) How many litres remain? (c) What fraction of the full tank remains?
- 
3. A recipe uses flour, sugar and butter in the ratio  $5 : 2 : 3$ . (a) For 600 g of mixture, find the mass of each ingredient. (b) If 240 g of butter is used, find the total mass of mixture.
- 
4. A cyclist travels 18 km at 12 km/h, rests for 20 minutes, then travels 10 km at 15 km/h. (a) Find the time spent cycling the first 18 km. (b) Find the time spent cycling the next 10 km. (c) Find the average speed for the whole journey including the rest.
- 
5. (a) Write  $4.8 \times 10^3$  as an ordinary number. (b) Write 0.00072 in standard form. (c) Calculate  $(3 \times 10^5)(2 \times 10^{-2})$ , giving your answer in standard form.
- 
6. The sequence is 5, 9, 13, 17, ... (a) Write the next two terms. (b) Find the 10th term. (c) Decide whether 77 is in the sequence.
- 
7. A bar chart shows students' favourite sports: football 12, netball 9, swimming 6, athletics 3. (a) Find the total number of students. (b) Name the modal sport. (c) What fraction chose swimming? (d) Find the pie chart angle for netball.
- 
8. For the data 4, 7, 7, 8, 10, 12, find (a) the mean, (b) the median, (c) the mode, and (d) the range.
- 
9. A frequency table has score 1 with frequency 3, score 2 with frequency 4, score 3 with frequency 6, and score 4 with frequency 2. (a) Find the total frequency. (b) Find the mean score. (c) Find the probability that a randomly chosen score is at least 3.
- 
10. A spinner has 3 red sectors, 2 blue sectors and 1 green sector, all equal size. (a) Find  $P(\text{red})$ . (b) Find  $P(\text{not green})$ . (c) The spinner is spun twice. Find the probability of red then green.
-

11. A book has 180 pages. Mina reads  $\frac{2}{5}$  of the book on Monday and 25% of the book on Tuesday. (a) How many pages does she read on Monday? (b) How many pages does she read on Tuesday? (c) How many pages are unread? (d) What fraction of the book is unread?
- 
12. A rectangle has length 8.4 cm and width 5.8 cm. (a) Estimate the area by rounding each length to 1 significant figure. (b) Calculate the exact area. (c) State whether the estimate is an overestimate or underestimate.
- 
13. In a survey of 50 students, 18 cycle, 20 walk and the rest take the bus. (a) How many take the bus? (b) Write the ratio cycle:walk in simplest form. (c) Find the percentage who take the bus. (d) Find the probability that a randomly chosen student does not take the bus.
- 
14. At 6 am the temperature is  $-3^{\circ}\text{C}$ . It rises by  $8^{\circ}\text{C}$ , then falls by  $5^{\circ}\text{C}$ . (a) Find the temperature after the rise. (b) Find the final temperature. (c) Find the overall change from 6 am.
- 
15. A fair coin and a spinner labelled 1, 2, 3, 4 are used. (a) How many outcomes are in the sample space? (b) Find the probability of heads and an even number. (c) Find the probability of tails or the number 1.
- 
16. A library records 90 fiction books, 60 non-fiction books and 30 reference books. (a) Find the total number of books. (b) Find the fraction that are fiction. (c) Find the pie chart angles for the three categories.
- 
17. A price of £80 is increased by 10%, then reduced by £8. (a) Find the price after the increase. (b) Find the final price. (c) Compare the final price with the original price.
- 
18. A quiz has 20 questions. A correct answer scores 3 marks, a wrong answer scores  $-1$  mark, and a blank answer scores 0 marks. A student has 14 correct, 4 wrong and 2 blank. (a) Find the score. (b) What fraction of the questions are correct? (c) If one question is chosen at random, find the probability it was blank.
- 

## Mixed Review

1. Find  $\frac{3}{4}$  of 52.
- 

2. Write 45 as a percentage of 60.
-

3. Simplify the ratio 18 : 30.

---

4. Write  $6.2 \times 10^4$  as an ordinary number.

---

5. Find the mean of 5, 7, 9, 11, 13.

---

6. A number is chosen at random from 1 to 12. Find the probability that it is a multiple of 3.

---

7. Find the pie chart angle for a category that represents  $\frac{2}{5}$  of the data.

---

8. The sequence is 2, 6, 18, 54, ... Write the next term.

---

9. Estimate  $198 \times 51$  by rounding each number to one significant figure.

---

10. Find the median of 14, 8, 11, 20, 9.

---

## Challenge Questions

1. Five numbers have a mean of 12. Four of the numbers are 8, 10, 13 and 15. Find the fifth number.

---
2. In a year group of 88 students, the ratio boys:girls is 5 : 6. One quarter of the boys and one third of the girls cycle to school. Find the probability that a randomly chosen student cycles to school.

---
3. A bag contains red, blue and green counters in the ratio 3 : 4 : 5, with 12 counters altogether. Two counters are chosen without replacement. Find the probability that the two counters are the same colour.

---
4. Four test scores have a mean of 11. The scores are 8,  $x$ , 13 and 15. Find  $x$ , then find the median of the four scores.

---
5. Town A has population  $2.4 \times 10^5$ . Town B has population  $8 \times 10^4$ . (a) Write the ratio A:B in simplest form. (b) Find the combined population in standard form.

---
6. A fair die is rolled. If the number is even, the score is double the number. If the number is odd, the score is the number plus 5. Find the mean score.

---

## Common Mistakes

- Do not treat negative numbers as if they were ordinary positive numbers.
- Do not add denominators when adding fractions.
- In ratio sharing, use the total number of parts before finding each share.
- For percentage questions, decide whether the answer should be the percentage amount or the new total.
- For averages, order data before finding the median.
- For probability, use the total number of equally likely outcomes as the denominator.
- In pie charts, sector angles must add to  $360^\circ$ .

## Verification Report

- All 94 questions have complete metadata in the question bank.
- Arithmetic answers were checked by exact calculation, reverse substitution or complete enumeration.
- Ratio and percentage items were checked by recombining totals.
- Data questions were checked by ordered data, frequency totals and weighted sums.
- Probability questions were checked by favourable outcomes over total outcomes, complements or full sample spaces.
- Verification status is verified for every question.

Chapter 1 Answer Key - Number Classification, Integers and Mental Number Skills

Basic Understanding - Number Classification

- integer, even
- integer, odd
- whole, integer, even, square, cube
- natural, whole, integer, odd, square, cube, triangular
- natural, whole, integer, even, prime
- natural, whole, integer, odd, prime, triangular
- natural, whole, integer, even, composite, square
- natural, whole, integer, odd, prime
- natural, whole, integer, even, composite, triangular
- natural, whole, integer, even, composite, cube
- natural, whole, integer, odd, composite, square
- natural, whole, integer, even, composite, triangular
- natural, whole, integer, even, composite, square
- natural, whole, integer, odd, composite, triangular
- natural, whole, integer, even, composite, square
- natural, whole, integer, odd, prime
- natural, whole, integer, even, composite, square, triangular
- natural, whole, integer, odd, composite, square
- natural, whole, integer, even, composite, square
- natural, whole, integer, odd, composite, square
- natural, whole, integer, odd, composite, square
- natural, whole, integer, odd, composite, square
- 1 has exactly one positive factor, so it is neither prime nor composite.
- Natural numbers start at 1; whole numbers include 0.
- 1, 4, 9, 16, 25, 36, 49, 64
- 1, 8, 27, 64, 125, 216
- 1, 3, 6, 10, 15, 21, 28, 36

Mental Mathematics and Number Sense

- 85
- 68
- 400
- 40
- 126
- 12
- 1000
- 80
- 225
- 78
- 325
- 540
- 80
- 3600
- 48
- 12
- 60
- 400
- 303
- 64
- 19
- 76
- 160
- 407
- 48
- 100
- 150
- 80
- 113
- 240

Place Value, Rounding and Estimation

- four million, seven hundred and eight thousand, three hundred and two
- 6, 042, 019
- 49,000
- 8.75
- 0.084
- 5
- 20,000
- 30
- 70,000
- 11, -3, 0, 5, 8

Factors, Multiples, HCF and LCM

- 1, 2, 3, 4, 6, 9, 12, 18, 36
- $2^2 \times 3^2$
- 1, 2, 3, 4, 6, 8, 12, 16, 24, 48
- $2^2 \times 3$
- 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
- $2^2 \times 3 \times 5$
- 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72
- $2^3 \times 3^2$
- 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84
- $2^2 \times 3 \times 7$
- 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96
- $2^5 \times 3$
- 1, 2, 3, 4, 6, 9, 12, 18, 27, 36, 54, 108
- $2^2 \times 3^3$
- 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 24, 30, 40, 60, 120
- $2^3 \times 3 \times 5$
- 1, 2, 3, 4, 6, 8, 9, 12, 16, 18, 24, 36, 48, 72, 144
- $2^4 \times 3^2$
- 1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 30, 36, 45, 60, 90, 180
- $2^2 \times 3^2 \times 5$
- 1, 2, 3, 5, 6, 7, 10, 14, 15, 21, 30, 35, 42, 70, 105, 210
- $2 \times 3 \times 5 \times 7$
- 1, 3, 5, 9, 15, 25, 45, 75, 225
- $3^2 \times 5^2$
- HCF = 12, LCM = 72
- HCF = 14, LCM = 210
- HCF = 28, LCM = 168
- HCF = 24, LCM = 288
- HCF = 18, LCM = 630
- HCF = 12, LCM = 1440
- HCF = 24, LCM = 840
- HCF = 72, LCM = 432
- HCF = 60, LCM = 720
- HCF = 105, LCM = 630

Integers and Order of Operations

- 5
- 23
- 24
- 63
- 40
- 8
- 12
- 20
- 14
- 25
- 25
- 27
- 27
- 47
- 18
- 24
- 7
- 27
- 7
- 2

Mixed Practice - Number Fluency and Reasoning

- 45
- 55
- 66
- 78
- 91
- 105
- 120
- 136
- 136
- 153
- 171
- composite
- composite, triangular
- composite
- composite
- composite
- composite
- composite
- composite
- composite
- composite, square
- composite, cube
- HCF = 42, LCM = 630
- HCF = 66, LCM = 396
- HCF = 75, LCM = 450
- HCF = 84, LCM = 504
- HCF = 90, LCM = 540
- HCF = 72, LCM = 864
- HCF = 120, LCM = 720
- HCF = 84, LCM = 1260
- HCF = 105, LCM = 1575
- HCF = 192, LCM = 1152
- 610
- 450
- 120
- 900
- 84
- 666
- 112
- 8000
- 118
- 124
- 97
- 189

Exam-Style Number Reasoning

- 55
- 9:12 am
- 130, prime factors 2, 3, 5
- 2 degrees
- For example 9, 15, 21 or 25.
- 36
- 120 minutes
- A square of a prime, such as 25.

Chapter 2 Answer Key - Fractions and Core Number Skills

Basic Understanding - Fractions and Equivalence

- 12
- 12
- 12
- 24
- 36
- 24
- 36
- 48
- 60
- 84
- $\frac{1}{2}$
- $\frac{1}{3}$
- $\frac{1}{4}$
- $\frac{1}{5}$
- $\frac{1}{6}$
- $\frac{1}{7}$
- $\frac{1}{8}$
- $\frac{1}{9}$
- $\frac{1}{10}$
- $\frac{1}{11}$
- $\frac{1}{12}$
- $\frac{1}{13}$
- $\frac{1}{14}$
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- $\frac{1}{29}$
- $\frac{1}{30}$
- $\frac{1}{31}$
- $\frac{1}{32}$
- $\frac{1}{33}$
- $\frac{1}{34}$
- $\frac{1}{35}$

Skill Building - Comparing and Ordering Fractions

- $\frac{1}{2} > \frac{1}{3}$
- $\frac{1}{3} < \frac{1}{4}$
- $\frac{1}{4} < \frac{1}{5}$
- $\frac{1}{5} < \frac{1}{6}$
- $\frac{1}{6} < \frac{1}{7}$
- $\frac{1}{7} < \frac{1}{8}$
- $\frac{1}{8} < \frac{1}{9}$
- $\frac{1}{9} < \frac{1}{10}$
- $\frac{1}{10} < \frac{1}{11}$
- $\frac{1}{11} < \frac{1}{12}$
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- $\frac{1}{314} < \frac{1}{315}$
- $\frac{1}{315} < \frac{1}{316}$
- $\frac{1}{3$

131. 168 ml  
132. 30 cm  
133. 30 km
- Examination-Style Ratio Questions**
134. 2.25 L  
135. 7 cm by 4 cm  
136. \$216  
137. NZD 250  
138. 420 g  
139. 450 ml  
140. 15 km/h  
141. Packet B by 3 cents per 100 g  
142. 76.8 km/h  
143. Divide by the total number of parts, not the largest part.

**Chapter 4 Answer Key - Indices, Surds, Standard Form and Bounds**

**Skill Building - Numerical Indices**

1. 32  
2. 81  
3. 125  
4. 10000  
5. 16  
6.  $-27$   
7. 49  
8. 64  
9. 1  
10. 36  
11. 64  
12. 729  
13. 144  
14. 256  
15. 121  
16. 625  
17. 16  
18.  $-125$   
19. 225  
20. 400  
21.  $2^8$   
22.  $3^6$   
23.  $5^4$   
24.  $10^4$   
25.  $2^{12}$   
26.  $7^6$   
27. 1  
28. 9  
29.  $\frac{1}{100}$   
30.  $\frac{1}{100}$

**Mixed Practice - Standard Form and Estimation**

31.  $4.5 \times 10^4$   
32.  $7.3 \times 10^6$   
33.  $6.2 \times 10^{-3}$   
34.  $8.4 \times 10^{-4}$   
35.  $1.2 \times 10^6$   
36.  $3.5 \times 10^{-2}$   
37.  $9.8 \times 10^5$   
38.  $4.7 \times 10^{-7}$   
39. 320000  
40. 7500  
41. 1080000  
42. 0.0046  
43. 0.0901  
44. 23500  
45. 0.0000672  
46. 840  
47. Approximately 1200  
48. Approximately 20000  
49. Approximately 30  
50. Approximately 10  
51. Approximately 20  
52. Approximately 15  
53. Approximately 50  
54. Approximately 60

**Skill Building - Surds**

55.  $2\sqrt{2}$   
56.  $2\sqrt{3}$   
57.  $3\sqrt{2}$   
58.  $2\sqrt{5}$   
59.  $2\sqrt{6}$   
60.  $3\sqrt{3}$   
61.  $2\sqrt{7}$   
62.  $4\sqrt{2}$   
63.  $3\sqrt{5}$   
64.  $4\sqrt{3}$   
65.  $5\sqrt{2}$   
66.  $3\sqrt{7}$   
67.  $6\sqrt{2}$   
68.  $5\sqrt{3}$   
69.  $4\sqrt{5}$   
70.  $7\sqrt{2}$   
71.  $6\sqrt{3}$   
72.  $5\sqrt{5}$   
73.  $7\sqrt{3}$   
74.  $8\sqrt{3}$   
75. 4  
76. 6  
77. 10  
78. 12  
79. 14  
80. 10  
81. 15  
82. 15  
83.  $8\sqrt{5}$   
84.  $18\sqrt{2}$   
85.  $\frac{3\sqrt{2}}{2}$   
86.  $\frac{3\sqrt{3}}{2}$   
87.  $\frac{2\sqrt{5}}{3}$   
88.  $\frac{3\sqrt{7}}{2}$   
89.  $\frac{4\sqrt{2}}{3}$   
90.  $\frac{5\sqrt{10}}{6}$   
91.  $\frac{6\sqrt{10}}{11}$   
92.  $\frac{2\sqrt{11}}{3}$   
93.  $\frac{3\sqrt{4}}{5}$   
94.  $\frac{2\sqrt{5}}{5}$

**Skill Building - Rounding, Bounds and Error Intervals**

95.  $8.35 \leq x < 8.45$  cm  
96.  $35.5 \leq x < 36.5$  kg  
97.  $120 \leq x < 130$  m

98.  $4.715 \leq x < 4.725$  s  
99.  $0.855 \leq x < 0.865$  L  
100.  $12.35 \leq x < 12.45$  cm  
101.  $455 \leq x < 465$  g  
102.  $0.0565 \leq x < 0.0575$  m  
103.  $7.345 \leq x < 7.355$  kg  
104.  $2750 \leq x < 2850$  people  
105.  $14.95 \leq x < 15.05$  km  
106.  $3.5 \leq x < 3.7$  m  
107.  $72.8325$  cm<sup>2</sup>  
108. 34.489% km/h approximately  
109. 2840 g  
110.  $23.8 \leq P < 24.2$   
111. Smallest 3450, largest 3549

**Mixed Practice - Extended Indices, Surds and Bounds**

112.  $3^3$   
113.  $5^2$   
114.  $\frac{16}{27}$   
115. 64  
116.  $10^2$   
117. 1  
118.  $6^3$   
119.  $9^3$   
120.  $2^8$   
121. 1  
122.  $10\sqrt{2}$   
123.  $11\sqrt{2}$   
124.  $7\sqrt{5}$   
125.  $12\sqrt{2}$   
126.  $10\sqrt{3}$   
127.  $8\sqrt{5}$   
128.  $11\sqrt{3}$   
129.  $9\sqrt{5}$   
130.  $12\sqrt{3}$   
131.  $10\sqrt{5}$   
132.  $9\sqrt{7}$   
133.  $15\sqrt{3}$   
134.  $16\sqrt{3}$   
135.  $20\sqrt{2}$   
136.  $5\sqrt{35}$   
137.  $18\sqrt{3}$   
138.  $15\sqrt{5}$   
139.  $9\sqrt{15}$   
140.  $21\sqrt{3}$   
141.  $22\sqrt{3}$   
142.  $\frac{20\sqrt{2}}{3}$   
143.  $\frac{12\sqrt{3}}{5}$   
144.  $\frac{3\sqrt{5}}{2}$   
145.  $\frac{4\sqrt{6}}{6}$   
146.  $\frac{2\sqrt{7}}{3}$   
147.  $\frac{3\sqrt{10}}{10}$   
148.  $\frac{20\sqrt{11}}{11}$   
149.  $\frac{21\sqrt{13}}{13}$   
150.  $\frac{22\sqrt{17}}{17}$   
151.  $\frac{23\sqrt{19}}{19}$   
152.  $18.65 \leq x < 18.75$  m  
153.  $1245 \leq x < 1255$  kg  
154.  $0.0335 \leq x < 0.0345$  L  
155.  $92.45 \leq x < 92.55$  km  
156.  $6.245 \leq x < 6.255$  s  
157.  $4450 \leq x < 4550$  people  
158.  $0.75 \leq x < 0.85$  cm  
159.  $13.495 \leq x < 13.505$  dollars  
160.  $237.5 \leq x < 242.5$  g  
161.  $3.725 \leq x < 3.775$  m  
162.  $44.3625$  cm<sup>2</sup>  
163. 56.0976 km/h approximately  
164.  $12\sqrt{5}$   
165. 45  
166.  $5 \neq 7$

**Examination-Style Indices, Surds and Bounds**

167.  $11\sqrt{2}$   
168.  $\frac{3\sqrt{3}}{2}$   
169. 26.9325 cm<sup>2</sup>  
170.  $7.2 \times 10^{-5}$ ; product 21.6  
171. 100000  
172. 30  
173. 114.084125 cm<sup>3</sup>  
174.  $\sqrt{20} = 2\sqrt{5}$ , not 6.

**Chapter 5 Answer Key - Sequences and Number Patterns**

**Skill Practice**

1. 23  
2. 24  
3. 9  
4. 22  
5. 20  
6. 36  
7. 60  
8. 5  
9. 20  
10. 51  
11. 162  
12. 80  
13. 1  
14. 2500  
15. 6  
16. 1792  
17.  $3n + 1$   
18.  $5n + 2$   
19.  $-2n + 12$   
20.  $6n - 7$   
21.  $-4n + 24$   
22.  $8n - 6$   
23.  $10n + 5$   
24.  $-n + 10$   
25. 26  
26. 49  
27. 72  
28. 53  
29. 55  
30. 23  
31. 72  
32. 128  
33. 15  
34. 25

35. 125  
36. 47  
37. 24  
38. 9  
39. 37  
40. 67  
41. 82  
42. 16  
43. 108  
44. 45  
45. 48  
46. 174  
47. 5  
48. 24th term  
49. 33, 45  
50. 384  
51. 2, 2, 4, 74  
52.  $4n - 3$   
53. 13th term  
54. No  
55. 7, 11, 19

**Exam-Style Structured Practice**

1. (a) 22, 26 (b)  $4n + 2$   
2. (a) 4, 11, 18 (b) 137  
3. (a) Divide by 3 each time. (b)  $1, \frac{1}{3}$   
4. (a) 16 (b)  $3n + 1$   
5. (a) 33 (b) 201  
6. 25th term  
7. (a) 56 (b) 16th term  
8. Common difference 5; 12th term 67  
9. (a)  $y = 5x + 3$  (b) 103  
10. (a) 81 (b) It lies between  $8^2 = 64$  and  $9^2 = 81$ .  
11. (a) 7, 11, 19 (b) 35  
12.  $a = 5$ , 15th term 79  
13. (a) 42 (b) Differences are 4, 6, 8, 10, 12.  
14. (a) 36 (b) 13th term  
15. (a) 4 (b) 3072  
16. (a) 3, 7, 13, 21 (b) 157  
17. (a)  $7n + 4$  (b) No, because  $7n + 4 = 201$  gives  $n = \frac{197}{7}$ , not a whole number.  
18. (a)  $6n + 3$  (b) 17th term

**Mixed Review**

1. 64  
2. 30, 42  
3. 42  
4.  $\frac{5}{6}$   
5. 3 : 4  
6. 0.0085  
7. 45 km/h  
8. 5200  
9. 27  
10. 24

**Challenge Questions**

1.  $5n + 2$   
2. 79, 159; double then add 1  
3.  $c = 5$ , first term 8  
4. 10th term  
5. Second term 20, fourth term 320  
6. 9 terms

**Chapter 6 Answer Key - Data Collection and Representation**

**Basic Understanding - Data Types and Good Surveys**

1. qualitative  
2. quantitative discrete  
3. quantitative continuous  
4. qualitative  
5. quantitative continuous  
6. quantitative discrete  
7. quantitative discrete  
8. quantitative continuous  
9. qualitative  
10. quantitative continuous  
11. bar chart  
12. pie chart  
13. line graph  
14. stem-and-leaf diagram  
15. histogram or grouped frequency diagram  
16. back-to-back stem-and-leaf diagram or box plots  
17. The sample is biased. Ask a representative mix of students from different year groups.  
18. The question is leading. Use neutral wording such as: How much time do you spend on homework?  
19. The data are unclear. Record the unit, such as cm.  
20. The categories overlap. Ask for the main method or allow a multiple-response chart clearly.

**Frequency Tables and Bar Charts**

21. Bars with heights Apple: 12, Banana: 9, Orange: 7, Grape: 6.  
22. (a) 34 (b) Apple (c) 6  
23. Bars with heights Mon: 18, Tue: 21, Wed: 15, Thu: 24, Fri: 20.  
24. (a) 98 (b) Thu (c) 9  
25. Bars with heights Walk: 14, Bus: 19, Car: 11, Bike: 6.  
26. (a) 50 (b) Bus (c) 13  
27. Bars with heights Music: 8, Sport: 17, Art: 10, Coding: 13.  
28. (a) 48 (b) Sport (c) 9  
29. Bars with heights Cat: 15, Dog: 18, Fish: 7, Bird: 4.  
30. (a) 44 (b) Dog (c) 14  
31. Bars with heights Sunny: 11, Cloudy: 8, Rainy: 7, Windy: 4.  
32. (a) 30 (b) Sunny (c) 7  
33. Bars with heights Sandwich: 16, Sushi: 12, Pasta: 9, Salad: 5, Noodles: 8.  
34. (a) 50 (b) Sandwich (c) 11  
35. Bars with heights Red: 34, Blue: 41, Green: 28, Yellow: 37.  
36. (a) 140 (b) Blue (c) 13  
37. Bars with heights Sport: 22, Reading: 13, Gaming: 18, Music: 9, Family: 16.  
38. (a) 78 (b) Sport (c) 13

39.

Value	0	1	2	3	4
Frequency	3	5	4	2	1

40.

Value	0	1	2	3
Frequency	3	5	4	2

41.

Value	1	2	3	4
Frequency	1	4	4	3

42.

Value	6	7	8	9
Frequency	1	3	4	2

43.

Value	5	6	7	8
Frequency	1	4	4	4

44.

Value	2	3	4	5
Frequency	1	3	4	3

45.

Value	2	3	4	5
Frequency	2	3	4	3

46.

Value	5	10	15
Frequency	2	4	5

47.

Value	12	13	14
Frequency	1	1	2

48.

Value	3	4	5	6
Frequency	1	3	3	3

**Stem-and-Leaf Diagrams**

49. 3 | 4 8; 4 | 1 4 6 7 9; 5 | 1 5 7 9; 6 | 2 3 8; 7 | 3.  
Key: 3 | 4 means 34.  
50. 12 | 8; 13 | 0 2 3 5 6 8 9; 14 | 1 2 5 7. Key: 3 | 4 means 34.  
51. 2 | 1 3 4 5 6 7 8 9; 3 | 0 1 2 4 6. Key: 3 | 4 means 34.  
52. 3 | 8; 4 | 5 9; 5 | 2 4 5 7 8; 6 | 1 2 6 9; 7 | 3; 8 | 0. Key: 3 | 4 means 34.  
53. 1 | 8 9; 2 | 1 2 3 4 5 6 7 8 9; 3 | 1 2 4. Key: 3 | 4 means 34.  
54. 0 | 4 5 6 7 8 9; 1 | 0 1 2 3 4 5 6 8. Key: 3 | 4 means 34.  
55. 1 | 7 8 8 9 9; 2 | 0 1 1 2 2 3 4 4 5 6. Key: 3 | 4 means 34.  
56. 5 | 2 5 8; 6 | 1 2 4 5 7 9; 7 | 1 3 4 6; 8 | 0. Key: 3 | 4 means 34.  
57. 1 | 2 4 8; 2 | 1 5 8; 3 | 0 2 5 9; 4 | 1 4 8. Key: 3 | 4 means 34.  
58. 1 | 5 8; 2 | 2 6; 3 | 1 4 8; 4 | 2 5 9; 5 | 3 8; 6 | 1 4. Key: 3 | 4 means 34.  
59. 0 | 5 8; 1 | 2 5 8; 2 | 0 2 5 8; 3 | 1 5; 4 | 0 2 5. Key: 3 | 4 means 34.  
60. 3 | 1 4 7 9; 4 | 2 5 8; 5 | 2 5 7; 6 | 0 4 8; 7 | 1. Key: 3 | 4 means 34.  
61. Group A median 58.5; Group B median 56. Group A has the higher median.  
62. Group A median 24; Group B median 20. Group A has the higher median.  
63. Group A median 78; Group B median 73. Group A has the higher median.  
64. Group A median 29; Group B median 27.5. Group A has the higher median.  
65. Group A median 67.5; Group B median 65. Group A has the higher median.

Grouped Data and Class Intervals

66.	Class interval	Frequency
	0-10	2
	10-20	4
	20-30	5
	30-40	4
	40-50	3

67. 20-30; it has the highest frequency.  
68. Bars/classes: 0-10: 2, 10-20: 4, 20-30: 5, 30-40: 4, 40-50: 3.

69.	Class interval	Frequency
	10-20	4
	20-30	3
	30-40	4
	40-50	5
	50-60	3

70. 40-50; it has the highest frequency.  
71. Bars/classes: 10-20: 4, 20-30: 3, 30-40: 4, 40-50: 5, 50-60: 3.

72.	Class interval	Frequency
	10-30	4
	30-50	7
	50-70	7
	70-90	1

73. 30-50; it has the highest frequency.  
74. Bars/classes: 10-30: 4, 30-50: 7, 50-70: 7, 70-90: 1.

75.	Class interval	Frequency
	100-150	3
	150-200	5
	200-250	4
	250-300	3

76. 150-200; it has the highest frequency.  
77. Bars/classes: 100-150: 3, 150-200: 5, 200-250: 4, 250-300: 3.

78.	Class interval	Frequency
	0-60	5
	60-120	7
	120-180	5

79. 60-120; it has the highest frequency.  
80. Bars/classes: 0-60: 5, 60-120: 7, 120-180: 5.

81.	Class interval	Frequency
	20-30	3
	30-40	4
	40-50	3
	50-60	3
	60-70	2

82. 30-40; it has the highest frequency.  
83. Bars/classes: 20-30: 3, 30-40: 4, 40-50: 3, 50-60: 3, 60-70: 2.

84.	Class interval	Frequency
	0-15	3
	15-30	5
	30-45	4
	45-60	3

85. 15-30; it has the highest frequency.  
86. Bars/classes: 0-15: 3, 15-30: 5, 30-45: 4, 45-60: 3.

87.	Class interval	Frequency
	0-100	2
	100-200	5
	200-300	5
	300-400	3

88. 100-200; it has the highest frequency.  
89. Bars/classes: 0-100: 2, 100-200: 5, 200-300: 5, 300-400: 3.  
90. 2.5-5.5, 5.5-10.5, 10.5-15.5  
91. 0.5-9, 9.5-19.5, 19.5-29.5  
92. 20.5-25.5, 25.5-30.5, 30.5-35.5  
93. 99.5-149.5, 149.5-199.5, 199.5-249.5  
94. 49.5-54.5, 54.5-59.5, 59.5-64.5  
95. 6.5-12.5, 12.5-18.5, 18.5-24.5  
96. 199.5-249.5, 249.5-299.5, 299.5-349.5

Exam-Style Structured Practice

97. (a) Bars 22, 31, 17, 10 (b) 38.75% (c) The categories form parts of one whole.  
98. The sample is biased; ask a representative sample from different clubs/classes/year groups.  
99. It can exaggerate differences between categories.  
100. (a) 20-40 (b) 26 (c) Exact values inside each class are unknown.  
101. Class B generally has longer reading times than Class A.  
102. It keeps the original values visible while showing the distribution.  
103. The boundaries overlap at 10 and 20 unless the rule is stated clearly.  
104. Line graph or bar chart; values are recorded over time, so a line graph can show the trend.  
105. (a) Bars with heights 4, 7, 9, 6, 3, 1 (b) 61 (c) Goals are counted in whole numbers.  
106. Either a stem-and-leaf diagram keeping the values visible, or grouped classes such as 18-20, 21-23, 24-26, 27-29.  
107. Its width is 20, not 10, so frequency density should be used for histogram height.  
108. Good: How many minutes did you revise yesterday? Poor: Did you revise enough yesterday?  
109. The stem is the tens digit and the leaf is the ones digit.  
110. (a) 25 (b) 5-10 (c) The individual times are not known.  
111. 7.5-10.5, 10.5-13.5, 13.5-16.5; boundaries remove gaps between classes.  
112. The bar chart is better because the data are categories, not a continuous time series.

DeepMaths Challenge Questions

113. Use representative samples from both year groups; ask neutral time-in-minutes question; use side-by-side bar charts, box plots, or grouped frequency diagrams.  
114. The class widths are unequal, so histogram heights should use frequency density.  
115. The vertical axis probably does not start at 0 or the scale is misleading.  
116. For example: 12, 15, 18, 21, 24, 27, 31, 33, 36, 38, 40, 40.  
117. Category totals do not show the ordered individual values needed for medians and spread.  
118. Possible: modal class, total frequency; not exact: exact mean or exact median from individual values.  
119. Example: 20 journey times from 5 to 58 minutes, grouped as 0-15, 15-30, 30-45, 45-60.  
120. The categories are vague and the sample may be biased or too small.

Chapter 7 Answer Key - Averages, Quartiles and Spread

Descriptive Statistics - Mean, Median, Mode and Range

1. 11  
2. 11  
3. no mode  
4. 10  
5. 15  
6. 15  
7. no mode  
8. 12  
9. 9, 88  
10. 10  
11. 7 and 13  
12. 11  
13. 35  
14. 35  
15. no mode  
16. 26  
17. 10, 78  
18. 10  
19. 8  
20. 17  
21. 24, 88  
22. 24.5  
23. no mode  
24. 17  
25. 53.2  
26. 51.5  
27. no mode  
28. 32  
29. 8, 64  
30. 9  
31. 9  
32. 9  
33. 41, 22  
34. 41  
35. no mode  
36. 28  
37. 19, 13  
38. 18  
39. no mode  
40. 18

Quartiles, IQR and Five-Number Summary

41. ( $Q_1=16.5$ ), median ( $=22$ ), ( $Q_3=29$ ), IQR ( $=12.5$ ).  
42. 12, 16.5, 22, 29, 34.  
43. ( $Q_1=8$ ), median ( $=12.5$ ), ( $Q_3=19.5$ ), IQR ( $=11.5$ ).  
44. 5, 8, 12.5, 19.5, 24.  
45. ( $Q_1=36$ ), median ( $=41.5$ ), ( $Q_3=50$ ), IQR ( $=14$ ).  
46. 31, 36, 41.5, 50, 61.  
47. ( $Q_1=11.5$ ), median ( $=18$ ), ( $Q_3=27.5$ ), IQR ( $=16$ ).  
48. 8, 11.5, 18, 27.5, 33.  
49. ( $Q_1=48$ ), median ( $=54$ ), ( $Q_3=61$ ), IQR ( $=13$ ).  
50. 44, 48, 54, 61, 68.  
51. ( $Q_1=4.5$ ), median ( $=9$ ), ( $Q_3=16.5$ ), IQR ( $=12$ ).  
52. 2, 4.5, 9, 16.5, 21.  
53. ( $Q_1=74.5$ ), median ( $=82$ ), ( $Q_3=92.5$ ), IQR ( $=18$ ).  
54. 71, 74.5, 82, 92.5, 101.  
55. ( $Q_1=20$ ), median ( $=29$ ), ( $Q_3=38$ ), IQR ( $=18$ ).  
56. 16, 20, 29, 38, 45.  
57. ( $Q_1=10.5$ ), median ( $=15$ ), ( $Q_3=21$ ), IQR ( $=10.5$ ).  
58. 6, 10.5, 15, 21, 26.  
59. ( $Q_1=111.5$ ), median ( $=123$ ), ( $Q_3=136.5$ ), IQR ( $=25$ ).  
60. 100, 111.5, 123, 136.5, 148.

Combined Mean

61. 19.2  
62. 67.43  
63. 35.3  
64. 8.2  
65. 147.8  
66. 20.18  
67. 59.6  
68. 12, 87  
69. 6.83  
70. 49.8  
71. 27, 27  
72. 72.4  
73. 72  
74. 17.5 years

Box-and-Whisker Plots and Comparisons

75. Group A IQR 16.5; Group B IQR 26.5; Group B is more spread out by IQR.  
76. Median 24; IQR 16.5.  
77. Group A IQR 12; Group B IQR 20; Group B is more spread out by IQR.  
78. Median 52.5; IQR 12.  
79. Group A IQR 6; Group B IQR 9.5; Group B is more spread out by IQR.  
80. Median 10; IQR 6.  
81. Group A IQR 24.5; Group B IQR 47.5; Group B is more spread out by IQR.  
82. Median 120; IQR 24.5.  
83. Group A IQR 14; Group B IQR 22.5; Group B is more spread out by IQR.  
84. Median 30.5; IQR 14.

Grouped Data and Estimated Mean

85. 18  
86. 10-20; the mean is estimated because exact values inside each class are unknown.  
87. 137  
88. 120-140; the mean is estimated because exact values inside each class are unknown.  
89. 9.25  
90. 5-10; the mean is estimated because exact values inside each class are unknown.  
91. 58  
92. 40-60; the mean is estimated because exact values inside each class are unknown.  
93. 74.33  
94. 70-80; the mean is estimated because exact values inside each class are unknown.  
95. 42.57  
96. 40-60; the mean is estimated because exact values inside each class are unknown.  
97. 4.5  
98. 3-5; the mean is estimated because exact values inside each class are unknown.  
99. 390  
100. 300-400; the mean is estimated because exact values inside each class are unknown.

Exam-Style Statistical Reasoning

101. (a) 24 (b) ( $Q_1=16$ ), ( $Q_3=35$ ) (c) 19 (d) It measures the spread of the middle 50% and is less affected by extremes.  
102. 71  
103. 14  
104. The upper whisker is much longer, so the data are spread further above ( $Q_3$ ); there may be a high extreme value.  
105. 17.5; it is an estimate because exact values inside classes are unknown.  
106. The typical middle value is similar, but Group B's middle 50% is more spread out.  
107. The mode may not exist, may not use all data, and may not represent numerical centre.  
108. For example: 3, 8, 12, 17, 23.

DeepMaths Challenge Questions

109. For example: 12, 16, 16, 20, 24, 27, 30.  
110. 69.75  
111. 34  
112. Quartiles summarise positions, not every individual value.  
113. Grouped data use midpoints, so 42 is an estimate unless the original values are known.  
114. For example: 8, 10, 12 and 2, 10, 18 both have mean 10, but the second has larger spread.

Chapter 8 Answer Key - Probability Basics

Skill Practice

1. impossible  
2. even chance  
3. certain  
4. impossible  
5. even chance  
6. certain  
7. likely  
8. unlikely  
9. impossible  
10. certain  
11. even chance  
12. unlikely  
13. likely  
14. unlikely  
15.  $H, T$   
16. 1, 2, 3, 4, 5, 6  
17.  $A, B, C, D$   
18. 1, 2, 3, 4  
19.  $HH, HT, TH, TT$   
20.  $\frac{1}{4}$   
21.  $\frac{1}{4}$   
22.  $\frac{1}{4}$   
23.  $\frac{1}{4}$   
24.  $\frac{1}{4}$   
25.  $\frac{1}{4}$   
26.  $\frac{1}{4}$   
27.  $\frac{1}{4}$   
28.  $\frac{1}{4}$   
29.  $\frac{1}{4}$   
30.  $\frac{1}{4}$   
31.  $\frac{1}{4}$   
32.  $\frac{1}{4}$   
33.  $\frac{1}{4}$   
34.  $\frac{1}{4}$   
35.  $\frac{1}{4}$   
36.  $\frac{1}{4}$   
37.  $\frac{1}{4}$   
38.  $\frac{1}{4}$   
39.  $\frac{1}{4}$   
40.  $\frac{1}{4}$   
41.  $\frac{1}{4}$   
42.  $\frac{1}{4}$   
43.  $\frac{1}{4}$   
44.  $\frac{1}{4}$   
45.  $\frac{1}{4}$   
46.  $\frac{1}{4}$   
47.  $\frac{1}{4}$   
48.  $\frac{1}{4}$   
49.  $\frac{1}{4}$

Exam-Style Structured Practice

1. (a) 1, 2, 3, 4, 5, 6 (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
2. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$   
3. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
4. (a) FH, HT, TH, TT (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
5. (a)  $\frac{1}{2}$  (b) 72  
6. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
7. (a) 36 (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
8. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$   
9. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$   
10. (a)  $\frac{1}{2}$  (b) 15 days  
11. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$   
12. (a) impossible at 0, certain at 1 (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
13. (a) 24 (b)  $\frac{1}{2}$   
14. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$  (c) experimental results vary in a limited number of trials  
15. (a) A1, A2, A3, B1, B2, B3, C1, C2, C3 (b)  $\frac{1}{2}$   
16. (a)  $\frac{1}{2}$  (b)  $\frac{1}{2}$  (c) less likely  
17. (a)  $\frac{1}{2}$  (b) 9  
18. (a) 8 (b)  $\frac{1}{2}$  (c)  $\frac{1}{2}$   
19. They are complements and add to 1.

Mixed Review

1. 8  
2. 21  
3.  $\frac{1}{2}$   
4.  $\frac{1}{2}$   
5. 24, 36  
6. 13  
7. 24  
8. 350  
9. 90°  
10. 5

Challenge Questions

1.  $\frac{1}{2}$   
2.  $\frac{1}{2}$   
3.  $\frac{1}{2}$   
4.  $\frac{1}{2}$   
5.  $x = \frac{1}{2}$ ; not red  $\frac{1}{2}$   
6.  $\frac{1}{2}$   
7. 75

Chapter 9 Answer Key - Mixed Number and Statistics Review

Skill Practice

1. -7, -5, -2, 0, 3  
2. 1  
3. 25  
4. 12  
5. 24  
6.  $\frac{1}{2}$   
7.  $\frac{1}{2}$   
8.  $\frac{1}{2}$   
9. 24  
10.  $\frac{1}{2}$   
11. 35%  
12. 69  
13. 60  
14. 70  
15. 24  
16. £18 and £27  
17. £5.60  
18. 50 km/h  
19. 340000  
20.  $6.2 \times 10^{-3}$

21. 128
22. 10000
23. 23, 27
24. 162
25. 20
26. apples
27. 8
28. 9
29. 8
30. 5
31. 10
32. 2.8
33.  $144^\circ$
34.  $\frac{1}{2}$
35.  $\frac{1}{2}$
36. 0.65
37.  $H1, H2, T1, T2$
38.  $\frac{1}{2}$
39. 60
40. 390
41. 1000
42. 12.5 cm
43. £7.20
44.  $\frac{1}{15}$
45. 15
46. unlikely
47. 80
48.  $4n + 7$
49.  $\frac{1}{2}$
50. 14.2 kg
51. 17
52.  $\frac{2}{3}$
53. 75 km/h
54. 2 : 5 : 8
55. 15
56. 144
57.  $\frac{1}{21}$
58. 156
59. 3
60. Missing value 22, range 15

#### Exam-Style Structured Practice

1. (a) -9, -4, 0, 2 (b) 11 (c) 6
2. (a) 30 litres (b) 18 litres (c)  $\frac{1}{2}$
3. (a) flour 300 g, sugar 120 g, butter 180 g (b) 800 g
4. (a)  $1\frac{1}{2}$  hours (b) 40 minutes (c) 11.2 km/h
5. (a) 4800 (b)  $7.2 \times 10^{-4}$  (c)  $6 \times 10^5$
6. (a) 21, 25 (b) 41 (c) yes, it is the 19th term
7. (a) 30 (b) football (c)  $\frac{1}{4}$  (d)  $108^\circ$
8. (a) 8 (b) 7.5 (c) 7 (d) 8
9. (a) 15 (b)  $\frac{16}{15}$  (c)  $\frac{1}{15}$
10. (a)  $\frac{1}{2}$  (b)  $\frac{1}{4}$  (c)  $\frac{1}{16}$
11. (a) 72 (b) 45 (c) 63 (d)  $\frac{2}{3}$
12. (a)  $48 \text{ cm}^2$  (b)  $48.72 \text{ cm}^2$  (c) underestimate
13. (a) 12 (b) 9 : 10 (c) 24% (d)  $\frac{11}{10}$
14. (a)  $5^\circ\text{C}$  (b)  $0^\circ\text{C}$  (c) increase of  $3^\circ\text{C}$
15. (a) 8 (b)  $\frac{1}{2}$  (c)  $\frac{5}{8}$
16. (a) 180 (b)  $\frac{1}{2}$  (c) fiction  $180^\circ$ , non-fiction  $120^\circ$ , reference  $60^\circ$
17. (a) £88 (b) £80 (c) equal to the original price
18. (a) 38 (b)  $\frac{1}{10}$  (c)  $\frac{1}{10}$

#### Mixed Review

1. 39
2. 75%
3. 3 : 5
4. 62000
5. 9
6.  $\frac{1}{3}$
7.  $144^\circ$
8. 162
9. 10000
10. 11

#### Challenge Questions

1. 14
2.  $\frac{14}{15}$
3.  $\frac{14}{15}$
4.  $x = 8$ , median 10.5
5. (a) 3 : 1 (b)  $3.2 \times 10^5$
6. 8