1 Number

11 Calculations

Purposeful practice 1

<table>
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</tr>
<tr>
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<td>0</td>
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<tr>
<td>9</td>
<td>16</td>
<td>10</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

Purposeful practice 2

| 1 | 5 | 2 | 8 | 3 | 5 | 4 | 12.5 | 5 | 5 | 6 | 5 |

Purposeful practice 3

1 \[33 + 3 = 11\]
2 \[\sqrt[3]{1331} = 11\]
3 \[\sqrt[3]{1334 - 3} = 11\]

\[\sqrt[3]{2744 - 3} = 11\]
\[\frac{3393}{3} = 11\]
\[\frac{363 \times 11}{3} = 11\]

Problem-solving practice

1 Students’ own answers, for example, \((1 + 2 + 3) \times 4 + 5\).
2 \[7 + 5 \times (3 + 8) = 62\]
3 Students’ own answers, for example,

<table>
<thead>
<tr>
<th>(-3)</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
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<td>-4</td>
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<tr>
<td>-1</td>
<td>-2</td>
<td>3</td>
</tr>
</tbody>
</table>

4 Pole C is 6 m long.

5 \[\frac{2 \times (11 - 7)}{8} = 1\] or \[2 \times (11 - 7) = 8\]

6 Sarah is incorrect. To find the cost of 80 tins of paint, she needs to calculate \(80 \times 4 = £320\).

7 Students’ own answers, for example,

\[(6 - 5) \times (4 - 3) = 1\]
\[(6 - 5) + (4 - 3) = 1\]
\[(6 - 4) + (5 - 3) = 1\]

Exam practice

1 \[£316 \quad 2 \quad 38\]

1.2 Decimal numbers

Purposeful practice 1

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<tr>
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<td>3</td>
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<td>30</td>
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Purposeful practice 2

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<tr>
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<td>10</td>
<td>9</td>
<td>1</td>
<td>10.6</td>
</tr>
<tr>
<td>11</td>
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Purposeful practice 3

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<td>1.2</td>
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<td>3.3</td>
<td>3.5</td>
<td>4.1</td>
<td></td>
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<tr>
<td>11.0</td>
<td>10.5</td>
<td></td>
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</tr>
</tbody>
</table>

Problem-solving practice

1 a \[£4.67\] b \[£0.47\] (rounded)
2 a \[3.849\] b \[3.75\]
3 Calculations C and D
4 Students’ own answers, for example, \(10 \times 0.5 = 5\)
5 \[£30.375\] 6 No, he only has 15 kg of flour.
7 20 packs \[£6.40\]

Exam practice

1 4.2 \[2 \quad 212.5\]

1.3 Place value

Purposeful practice 1

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<td>3</td>
<td>1000</td>
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<tr>
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<td>1000</td>
<td>5</td>
<td>1</td>
<td>6.1</td>
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<td>7</td>
<td>0.001</td>
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Purposeful practice 2

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<th>2</th>
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<th>1</th>
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<tr>
<td>4</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>7</td>
<td>4000</td>
<td>8</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>300</td>
<td></td>
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Purposeful practice 3

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<tbody>
<tr>
<td>8640</td>
<td>b</td>
<td>270</td>
<td>c</td>
<td>86.4</td>
</tr>
<tr>
<td>d</td>
<td>2.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>270</td>
<td>f</td>
<td>27</td>
<td>g</td>
<td>27</td>
</tr>
<tr>
<td>h</td>
<td>2.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>295</td>
<td>b</td>
<td>354</td>
<td>c</td>
</tr>
<tr>
<td>d</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a £500 a month
b Yes, he will save £6000 which is greater than £5775.
2 a No, an estimate of five times their yearly earnings is £180 000.
b It is an underestimate, because Carrie and Arjun’s earnings were rounded down.
3 a 12 ounces
b It is an underestimate, because both values were rounded down.
c The estimated weight will increase to 15 because 4.7 rounds up to 5.
4 Students’ own answers, for example, 0.54 \times 8.7
5 Sam should have found 400 \times 60 and then divided by 0.5 or multiplied by 2.
6 Approximately 20 minutes

Exam practice

1 \[\frac{200}{4^2 + 4} = \frac{200}{16} = \frac{200}{20} = 10\]

Billy’s answer is correct.

2 90

1.4 Factors and multiples

Purposeful practice 1

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>20, 22, 24, 26, 28, 30</td>
<td>b</td>
<td>21, 24, 27, 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>20, 25, 30</td>
<td>d</td>
<td>21, 28</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>22</td>
<td>f</td>
<td>23, 29</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>31, 37</td>
<td>3</td>
<td>41, 43, 47</td>
<td></td>
</tr>
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Purposeful practice 2

<table>
<thead>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>1, 2, 3, 6</td>
<td>1, 5</td>
<td>c</td>
<td>1, 2, 3, 5, 6, 10, 15, 30</td>
</tr>
<tr>
<td>d</td>
<td>1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>1, 3, 5, 9, 15, 45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>6, 12, 18, 24, 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>5, 10, 15, 20, 25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>30, 60, 90, 120, 150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>60, 120, 180, 240, 300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>45, 90, 135, 180, 225</td>
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Purposeful practice 3

<table>
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<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>a</td>
<td>15</td>
<td>b</td>
<td>6</td>
<td>c</td>
</tr>
<tr>
<td>d</td>
<td>1</td>
<td>e</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>90</td>
<td>b</td>
<td>30</td>
</tr>
<tr>
<td>d</td>
<td>30</td>
<td>e</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

Problem-solving practice

1 Students’ own answers, for example, 6 and 12.

There is more than one possible answer.

2 30 and 40, or 10 and 120.

3 Students’ own answers, for example, 45 + 6 = 75. This is not an integer, therefore 6 is not a factor of 45.

4 Tom is wrong because 2 is a prime number and 2\(^2\) = 4, which is not odd.

5 Students’ own answers, for example, 254 + 8 = 317.5. This is not an integer, therefore 8 is not a factor of 254.

6 678 + 3 = 226. This is an integer, therefore 678 is a multiple of 3.

7 9.00 am | 8 | £13 | 9 | Paul is 30; Luca is 45. |

| 10 | boxes |

Exam practice

1 a 24 | b | 2, 17 |
2 Students’ own answers, for example, 5 and 7.

1.5 Squares, cubes and roots

Purposeful practice 1

<table>
<thead>
<tr>
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<th>4</th>
<th>5</th>
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<td>16</td>
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<td>5</td>
<td>9</td>
<td>6</td>
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<tr>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
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</table>
2 Algebra

2.1 Algebraic expressions

Purposeful practice 1
1 9x  2 3x  3 x  4 4x  5 x  6 x  7 2b  8 −3b  9 −b  10 +6b  11 +6b  12 −3b

Purposeful practice 2
1 10y + 3  2 4y + 9  3 10 + 5y  4 7t − 7  5 −2t + 2
6 8 − 5t  7 rs  8 5rs  9 10rs  10 10rs
11 10rt  12 6rt  13 12rt  14 3rst  15 12rst
16 \( \frac{a}{b} \)  17 b  18 \( \frac{a}{2} \)  19 b  20 2 \( \frac{a}{2} \)

Problem-solving practice
1 2x + 5 cm  2 2x − 1 − 4x + 1 (all the rest simplify to 6x)
3 7x + 8 + 2x − 5 + 3x = 8x + 3
4 10q cm²  5 4h
6 Students’ own answers, for example, \( \frac{36x}{3} \), 4x × 3, 5x + 7x
7 Every row and column adds to 2x + 3y:

<table>
<thead>
<tr>
<th></th>
<th>3y</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>–y</td>
<td>2x − y</td>
<td>5y</td>
</tr>
<tr>
<td>4y + x</td>
<td>y</td>
<td>x − 2y</td>
</tr>
</tbody>
</table>

Exam practice
1 a 15p  2 b 2b

2.2 Simplifying expressions

Purposeful practice 1
1 6u  2 −6u  3 6u
4 −6uv  5 −6uv  6 −6uv
7 −6uv  8 −5xy  9 5xy
10 10xy  11 −10xy  12 10xy
13 \( \frac{p}{6} \)  14 6p  15 3p
16 \( \frac{3p}{3} \)  17 \( \frac{p}{3} \) or \( \frac{p}{3} \)  18 \( \frac{1}{3}p \) or \( \frac{p}{3} \)
19 \( \frac{2}{3} \)  20 −3p²  21 3p²
22 3p²  23 −3p²  24 3p
Problem-solving practice

1

\[2x\]

\[-6xy\]

\[10x^2\]

\[5x\]

\[−3y\]

\[−15xy\]

2. Students’ own answers, for example, \(15 \times −c \times d\) or \(3c \times −5d\)

3. a \(t^2 \times t^3 = t^5\)  b \(\frac{b^5}{x^3} = x^7\)  c \(\frac{n^5}{n} = n^4\)

4. a \(4x^3\)  b \(8x^4\)

5. Students’ own answers, for example, \(\frac{8x^3}{2}\) or \(\frac{4x^4}{x}\)

6

\[\frac{6c^6}{2x^2} = \frac{3c^3}{z} \times \frac{2c^4}{2z}\]

7. \(4n\)

Exam practice

1 a \(n^0\)  b \(2x^2\)  c \(14ac\)

2.3 Substitution

Purposeful practice 1

<table>
<thead>
<tr>
<th>1</th>
<th>9</th>
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<th>1</th>
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<th>4</th>
<th>3</th>
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<td>2</td>
<td>6</td>
<td>6</td>
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<td>8</td>
<td>7</td>
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Purposeful practice 2

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<th>2</th>
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<tbody>
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<td>5</td>
<td>1</td>
<td>6</td>
<td>-1</td>
<td>7</td>
<td>2</td>
<td>8</td>
<td>(\frac{3}{2})</td>
</tr>
<tr>
<td>9</td>
<td>-6</td>
<td>10</td>
<td>3</td>
<td>11</td>
<td>-(\frac{1}{2})</td>
<td>12</td>
<td>(\frac{1}{2})</td>
</tr>
<tr>
<td>13</td>
<td>-6</td>
<td>14</td>
<td>18</td>
<td>15</td>
<td>-3</td>
<td>16</td>
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Purposeful practice 3

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<th>18</th>
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<td>0</td>
<td>7</td>
<td>24</td>
<td>8</td>
<td>1</td>
<td>9</td>
<td>-2</td>
</tr>
<tr>
<td>11</td>
<td>-6</td>
<td>12</td>
<td>6</td>
<td>13</td>
<td>4</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>15</td>
<td>-16</td>
<td>16</td>
<td>20</td>
<td>17</td>
<td>14</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>19</td>
<td>-10</td>
<td>20</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>-4</td>
<td>22</td>
<td>25</td>
<td>23</td>
<td>(\frac{4}{10}) or 0.4</td>
<td>24</td>
<td>16</td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a Students’ own answers, for example, \(m = 1\) and \(n = 6\)

b Students’ own answers, for example, \(m = 10\) and \(n = -3\)

2 Alex has forgotten that the expression \(xt\) means \(x \times t\).

The answer should be \(8 \times \frac{1}{2} = 4\)

3 Students’ own answers, for example, \(2 \times 3 \times 4 = 3 \times 4 \times 2 = 4 \times 3 \times 2\).

Three numbers multiplied together in any order give the same answer.

4 1, 3, 5, 7, 9. The odd numbers.

5 a 21  b 22

6 Yes, Dilip is correct. Any negative number squared is positive, zero squared is zero and any positive number squared is positive.

7 \(x = 2\)

8 Many possible answers, for example \(p = 1\), \(q = 10\)

Exam practice

1 14 2 c = 27

2.4 Formulae

Purposeful practice 1

1 20 pence, 30 pence \(n \times 10\) or 10\(n\) pence. \(C = 10n\) pence

2 \(2b\) pence, \(3b\) pence \(\frac{m \times b}{2}\) or \(mb\) pence. \(C = bm\) pence

Purposeful practice 2

1 a \(C = 5p\)  b \(C = 5n\)  c \(C = 4t\)

2 a \(N = y\)  b \(N = y - 20\)  c \(N = xy\)

Problem-solving practice

1 C = 3\(n\) the cost of \(n\) items at £3 each

C = 1\(0n\) the cost of \(n\) items at £10 each

C = 3\(n + 10\) the cost of \(n\) items at £3 each plus £10 delivery charge

C = 1\(0n + 3\) the cost of \(n\) items at £10 each plus £3 delivery charge

Exam practice

1 \(L = 4x + 1\)

2.5 Expanding brackets

Purposeful practice 1

<table>
<thead>
<tr>
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<th>3x + 3</th>
<th>2</th>
<th>3x + 6</th>
<th>3</th>
<th>3x + 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3x - 3</td>
<td>5</td>
<td>3x - 6</td>
<td>6</td>
<td>3x - 15</td>
</tr>
</tbody>
</table>

Purposeful practice 2

<table>
<thead>
<tr>
<th>1</th>
<th>2m + 2</th>
<th>2</th>
<th>2m - 2</th>
<th>3</th>
<th>-2m - 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-2m + 2</td>
<td>5</td>
<td>-m - 7</td>
<td>6</td>
<td>-m + 7</td>
</tr>
</tbody>
</table>

Purposeful practice 3

<table>
<thead>
<tr>
<th>1</th>
<th>4n + 12</th>
<th>2</th>
<th>12 + 4n</th>
<th>3</th>
<th>-15 - 5n</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-5n - 15</td>
<td>5</td>
<td>-5n + 15</td>
<td>6</td>
<td>3r - 18</td>
</tr>
<tr>
<td>7</td>
<td>3r + 18</td>
<td>8</td>
<td>6r + 18</td>
<td>9</td>
<td>12r + 18</td>
</tr>
<tr>
<td>10</td>
<td>-6r - 18</td>
<td>11</td>
<td>-6r + 18</td>
<td>12</td>
<td>-18 - 6r</td>
</tr>
<tr>
<td>13</td>
<td>(r + 3t)</td>
<td>14</td>
<td>2t + 3t</td>
<td>15</td>
<td>2t - 3t</td>
</tr>
<tr>
<td>16</td>
<td>(k \times k)</td>
<td>17</td>
<td>2k (\times) 2k</td>
<td>18</td>
<td>(2k \times -2k)</td>
</tr>
<tr>
<td>19</td>
<td>(2k \times 8k)</td>
<td>20</td>
<td>-2k (\times) -8k</td>
<td>21</td>
<td>-2k (\times) -8k</td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a \(2(a + 4) = 2a + 8\)  b \(2(y - 7) = 2y - 14\)

| c | \(n(n + 5) = n^2 + 5n\) | d | -3(3 + c) = -9 - 3c |

| e | \(6(6t - 2) = 6t^2 - 2t\) | f | \(5p(p - 3) = 5p^2 - 15p\) |

2 The expansion is correct, but 12\(d\) - 8 cannot be simplified as the two terms are not alike.

3 Students’ own examples, for example, 3\(5(x + 2) = 15x + 6\) and 2\(x(x + 1) = 2x^2 + x\)

4

\[12x - 4\]

\[4x + 20\]

\[-x + 2\]

\[-2x + 10\]

\[-2\]

\[5a + 17\]

\[b + 20 + 3n\]

Exam practice

1 a \(2c^2 + 10c\)  b \(8d - 4d^3\)  c \(14t - 3\)

2.6 Factorising

Purposeful practice 1

<table>
<thead>
<tr>
<th>1</th>
<th>2(x + 3)</th>
<th>2</th>
<th>2(x + 2)</th>
<th>3</th>
<th>2(x + 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2(x - 5)</td>
<td>5</td>
<td>2(x - 4)</td>
<td>6</td>
<td>2(x - 1)</td>
</tr>
<tr>
<td>7</td>
<td>3(y + 1)</td>
<td>8</td>
<td>3(y + 2)</td>
<td>9</td>
<td>3(y - 2)</td>
</tr>
</tbody>
</table>

Purposeful practice 2

<table>
<thead>
<tr>
<th>1</th>
<th>4(a + 2)</th>
<th>2</th>
<th>4(a - 3)</th>
<th>3</th>
<th>6(a + 2)</th>
<th>4</th>
<th>6(a - 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6(2t - 3)</td>
<td>6</td>
<td>4(3t + 5)</td>
<td>7</td>
<td>6(2t + 1)</td>
<td>8</td>
<td>3(4t - 3)</td>
</tr>
<tr>
<td>9</td>
<td>3(7t - 3)</td>
<td>10</td>
<td>7(3t + 5)</td>
<td>11</td>
<td>5(4m + 7)</td>
<td>12</td>
<td>20(m - 2)</td>
</tr>
<tr>
<td>13</td>
<td>(m)((m + 1))</td>
<td>14</td>
<td>(m)((m + 2))</td>
<td>15</td>
<td>(m)((m - 3))</td>
<td>16</td>
<td>(m(5 + m))</td>
</tr>
</tbody>
</table>
Problem-solving practice

1 \( n^2 - n \) \( n(n - 1) \)
2 \( 2n^2 - n^2 \) \( 2n^2 - n \)
3 \( n - 2n^2 \) \( n(1 - 2n) \)
4 \( -n^2 + 2n \) \( n(-n + 2) \)
5 \( 2n^2 - n \) \( n(2n - 1) \)
6 \( 2n^2 - 2n \) \( 2n(n - 1) \)

2.7 Using expressions and formulae

Exam practice

1 a \( 4(n - 3) \) b \( x(x + 1) \)

Problem-solving practice 1

1 \( T = 8 \) 2 \( R = -4 \) 3 \( S = 4 \)
4 \( V = -8 \) 5 \( L = 10 \) 6 \( B = 24 \)
7 \( C = 3 \) 8 \( M = 12 \) 9 \( K = -12 \)
10 \( P = \frac{2}{3} \) or \( \frac{1}{3} \) 11 \( N = 3 \) 12 \( Z = -3 \)
13 \( D = 3 \) 14 \( F = \frac{2}{6} \) or \( \frac{1}{3} \) 15 \( H = -\frac{2}{6} \) or \( -\frac{1}{3} \)

Problem-solving practice 2

1 a \( A = 11 \) 2 b \( B = 5 \) 3 c \( C = 0 \)
4 a \( D = 13 \) 5 b \( D = 61 \) 6 c \( E = 25 \)
7 a \( F = 31 \) 8 b \( G = 29 \) 9 c \( H = 26 \)
10 a \( J = 8 \) 11 b \( J = 16 \) 12 c \( K = 11 \)
13 a \( L = 24 \) 14 b \( M = 52 \) 15 c \( P = 13 \)
16 a \( Q = -8 \) 17 b \( R = 9 \) 18 c \( S = -1 \)
19 a \( W = -\frac{2}{3} \) or \( -\frac{4}{2} \) 20 c \( X = \frac{3}{4} \) or \( \frac{3}{4} \)

Problem-solving practice

1 Charlie’s answer is wrong, because she has forgotten that \( st \) means \( s \times t \).
2 Students’ own answers, for example, \( k = na - 10 \)
3 C. All the others give the value \( T = -12 \), whereas C gives the value \( T = 6 \).
4 a \( v = 58.8 \) b \( v = 3 \)

Exam practice

1 a \( x = 16 \) b \( m = 5 \)
2 \( p = -12 \)

3 Graphs, tables and charts

3.1 Frequency tables

Problem-solving practice 1

1 a If students’ own answers, for example,
   a number of matches in a box, shoe size
   b heights or weights of people

<table>
<thead>
<tr>
<th>Dice result</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exam practice

1 a 213 km b 24 km c 105 km d 3532 km e 3745 km

Problem-solving practice 2

1 a 23 1b 15 1c 10 1d 35 1e 70

Problem-solving practice

1 a 213 km b 24 km c 105 km d 3532 km e 3745 km

Exam practice

1 a 23 1b 15 1c 10 1d 35 1e 70

3.2 Two-way tables

Problem-solving practice 1

<table>
<thead>
<tr>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>French</td>
<td>20</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>German</td>
<td>15</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Spanish</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>50</td>
<td>75</td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a Phil 105 b Mike 207 c Tony
2 a Car, train and history, geography
b
<table>
<thead>
<tr>
<th>Car</th>
<th>Train</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Geography</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>12</td>
</tr>
</tbody>
</table>

c 18  d 4

3 Male music and total number of males.

Exam practice

1 | Children | Adults | Total |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Theatre</td>
<td>12</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Cinema</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>18</td>
<td>40</td>
</tr>
</tbody>
</table>

3.3 Representing data

Purposeful practice 1

1 Example answers (students’ answers may vary).

a Number of driving test passes at centre A and centre B over 4 days

b Number of driving test passes at centre A and centre B over 4 days

c Number of driving test passes at centre A and centre B over 4 days

Purposeful practice 2

1 | Time taken, \( t \) (minutes) | Frequency |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; ( t ) \leq 15</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>15 &lt; ( t ) \leq 30</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>30 &lt; ( t ) \leq 45</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>45 &lt; ( t ) \leq 60</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a The data is not grouped.
The data is not continuous.
b Shreya’s homework hours on Monday,
c 

<table>
<thead>
<tr>
<th>Day of the week</th>
<th>Aum</th>
<th>Shreya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sat</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sun</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Mon</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

d Number of hours spent on homework

<table>
<thead>
<tr>
<th>Day of the week</th>
<th>Aum</th>
<th>Shreya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sat</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sun</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Mon</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

e \( 3 + 4 = 7 \) hours

Exam practice

1 a Tuesday

b

<table>
<thead>
<tr>
<th>Day of the week</th>
<th>Jasmine</th>
<th>Fred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tue</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Wed</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Thu</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Fri</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

c 2  d 66

3.4 Time series

Purposeful practice 1

1 a Temperature of a town during one day

Temperature (°C)

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>0</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 am</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

Time taken to travel to school for 32 students

Number of students

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>0</th>
<th>15</th>
<th>30</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 am</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>

| Time | 0 | 5 | 10 | 15 |
|-----|-----|-----|-----|
| 2 am | 10 | 20 | 30 | 40 |

| Time | 0 | 5 | 10 | 15 |
|-----|-----|-----|-----|
| 2 am | 10 | 20 | 30 | 40 |

Answers
b Higher
c Accept answers between –2°C and 2°C.
d Accept answers between 13°C and 16°C.

**Purposeful practice 2**

1 a Temperature of two towns during one day

![Temperature graph](image)

- Town A
- Town B

b 5 am
c Accept answers between 13°C and 15°C.

**Purposeful practice 3**

1 a 24 m  b 4 seconds

**Problem-solving practice**

1 a

<table>
<thead>
<tr>
<th>Month</th>
<th>Earned (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>2200</td>
</tr>
<tr>
<td>Nov</td>
<td>2550</td>
</tr>
<tr>
<td>Dec</td>
<td>2680</td>
</tr>
</tbody>
</table>

b

![Graph](image)

- Amount earned by Sam over three months
- Key: boys’ marks 0 | 2 = 20 marks
- girls’ marks 2 | 5 = 25 marks

- 54
  - c 2 – 1 = 1

**Exam practice**

1 No vertical axis label, no title, July appears twice/no August

3.5 Stem and leaf diagrams

**Purposeful practice 1**

<table>
<thead>
<tr>
<th>茎</th>
<th>叶</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 9</td>
</tr>
<tr>
<td></td>
<td>2 5 5</td>
</tr>
<tr>
<td></td>
<td>3 1 7</td>
</tr>
<tr>
<td></td>
<td>4 0 4 7 8</td>
</tr>
<tr>
<td></td>
<td>Key 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>茎</th>
<th>叶</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5 6 7</td>
</tr>
<tr>
<td></td>
<td>3 0 1 2</td>
</tr>
<tr>
<td></td>
<td>4 2 3 3 5 6 7</td>
</tr>
<tr>
<td></td>
<td>5 0 1 5 5 6</td>
</tr>
<tr>
<td></td>
<td>6 2 2</td>
</tr>
<tr>
<td></td>
<td>7 3</td>
</tr>
<tr>
<td></td>
<td>Key 2</td>
</tr>
</tbody>
</table>

b 73
c 25
d 48

**Purposeful practice 2**

1 a Boys’ marks | Girls’ marks
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>5 4</td>
</tr>
<tr>
<td>9</td>
<td>8 5 3</td>
</tr>
<tr>
<td>9</td>
<td>6 6 5 0 5</td>
</tr>
<tr>
<td>7</td>
<td>7 4 4</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Key: boys’ marks 0 | 2 = 20 marks
- girls’ marks 2 | 5 = 25 marks

b 54
c 2 – 1 = 1

**Exam practice**

1 1 5 8 8 8 9
2 3 5 6 7 7 9
3 0 1 6 6 8 9
4 2 4 5

Key: 115 = 15 years old

**3.6 Pie charts**

**Purposeful practice 1**

![Pie chart](image)

- Milk
- Tea
- Coffee
- Hot chocolate

c 25

d 48

e Final angle should measure 155°

**Purposeful practice 2**

<table>
<thead>
<tr>
<th>Year</th>
<th>Tennis</th>
<th>Snooker</th>
<th>Cricket</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>2005</td>
<td>500</td>
<td>250</td>
<td>250</td>
<td>1000</td>
</tr>
<tr>
<td>2010</td>
<td>1400</td>
<td>700</td>
<td>700</td>
<td>2800</td>
</tr>
<tr>
<td>2015</td>
<td>1750</td>
<td>875</td>
<td>875</td>
<td>3500</td>
</tr>
</tbody>
</table>

Key: 2000 | Tennis = 200
- Snooker = 100
- Cricket = 100
- Total = 400

Answers 290
Problem-solving practice

1 a Positive correlation. More cars on the road will tend to lead to more accidents.
   b Positive correlation. People will tend to drink more when it is hotter.
   c Negative correlation. Car value will tend to decrease with age as people prefer to buy newer cars.
   d Negative correlation. As temperature increases, people will tend to spend less on heating.
   e Positive correlation. People will tend to buy more of an item that is advertised.
   f Negative correlation. Most people want a property that is close to public transport, so they will tend to pay more for it.
   g No correlation. Unlikely to be related.
   h No correlation. Unlikely to be related.

2 a Positive correlation. More cars on the road will tend to lead to more accidents.
   b Positive correlation. People will tend to drink more when it is hotter.
   c Negative correlation. Car value will tend to decrease with age as people prefer to buy newer cars.
   d Negative correlation. As temperature increases, people will tend to spend less on heating.
   e Positive correlation. People will tend to buy more of an item that is advertised.
   f Negative correlation. Most people want a property that is close to public transport, so they will tend to pay more for it.
   g No correlation. Unlikely to be related.
   h No correlation. Unlikely to be related.

Exam practice

1 a (68, 45)  b Negative correlation  c Positive correlation
### 4 Fractions and percentages

#### 4.1 Working with fractions

**Purposeful practice 1**

- 1. \(\frac{2}{4}, \frac{2}{2}, \frac{1}{2}, \frac{1}{2}\)
- 2. \(\frac{5}{8}, \frac{6}{3}, \frac{7}{3}, \frac{8}{7}\)

**Purposeful practice 2**

- 1. \(\frac{3}{4}, \frac{3}{4}, \frac{5}{8}, \frac{7}{8}\)
- 2. \(\frac{9}{8}, \frac{1}{8}, \frac{7}{24}, \frac{1}{24}, \frac{7}{24}, \frac{19}{15}, \frac{1}{15}, \frac{8}{67}, \frac{1}{27}\)

**Purposeful practice 3**

- 1. \(\frac{1}{15}, \frac{2}{15}, \frac{8}{15}, \frac{17}{40}, \frac{4}{5}, \frac{5}{8}\)
- 2. \(\frac{5}{8}, \frac{7}{5}, \frac{7}{24}, \frac{7}{12}, \frac{9}{15}, \frac{15}{20}\)

#### 4.2 Operations with fractions

**Purposeful practice 1**

- 1. 4, 2, 5, 3, 10, 4, 10
- 2. 5, 15, 6, 7.5, 7, 6, 8, 12
- 3. 9, 24, 10, 48, 11, 50, 12, 25
- 4. 15, 14, 5, 15, 27, 16, 12

**Purposeful practice 2**

- 1. \(\frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}, \frac{6}{7}, \frac{7}{7}\)
- 2. \(\frac{5}{7}, \frac{6}{7}, \frac{7}{7}, \frac{8}{7}, \frac{9}{7}\)
- 3. \(\frac{3}{14}, \frac{10}{14}, \frac{11}{14}, \frac{1}{14}, \frac{3}{14}\)

**Purposeful practice 3**

- 1. \(\frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{1}{7}, \frac{4}{7}\)
- 2. \(\frac{5}{7}, \frac{6}{7}, \frac{7}{7}, \frac{8}{7}, \frac{9}{7}\)
- 3. \(\frac{1}{14}, \frac{14}{14}, \frac{1}{14}, \frac{3}{14}\)

---

**Exam practice**

1. **b** Positive correlation
   **c** No, the data point for the bird would lie a long way from the line of best fit so it is unlikely to be from the same family.

2. **a** (8, 25)
   **b** Between 80 and 90
   **c** Yes, as the temperature increases, fewer cartons of soup are sold.

---

**Problem-solving practice**

1. \(\frac{1}{15}, \frac{2}{15}, \frac{8}{15}, \frac{17}{40}, \frac{4}{5}, \frac{24}{45}\)

2. \(\frac{8}{120}, \frac{8}{60}, \frac{8}{15}\)

3. \(\frac{3}{8}, \frac{1}{2}, \frac{4}{8}, \frac{1}{2}, \frac{3}{8}, \frac{4}{8}\)

4. **Students’ answers will vary, for example**
   - \(\frac{1}{15}, \frac{2}{15}, \frac{8}{15}, \frac{17}{40}, \frac{4}{5}, \frac{24}{45}\)
   - \(\frac{8}{120}, \frac{8}{60}, \frac{8}{15}\)
   - \(\frac{3}{8}, \frac{1}{2}, \frac{4}{8}, \frac{1}{2}, \frac{3}{8}, \frac{4}{8}\)

5. **Students’ answers will vary, for example**
   - 4, 10
   - 5, 15
   - 6, 15
   - 10, 48
   - 11, 50
   - 12, 25
   - 13, 27
   - 16, 12

6. **Students’ answers will vary, for example**
   - \(\frac{1}{3}, \frac{2}{9}\)
   - \(\frac{2}{6}, \frac{4}{12}, \frac{4}{27}, \frac{5}{15}, \frac{8}{36}\)
   - \(\frac{7}{24}\)

---

**Exam practice**

1. \(\frac{21}{10}, \frac{23}{10}, \frac{25}{10}, \frac{27}{10}\)

2. \(\frac{15}{48}\)

---

**Answers**
Problem-solving practice
1 1/10 of his yearly pay is the better option.

Students’ reasoning may vary, for example, 3/4 of £1300 is £975 whereas 1/15 of (12 × £1300) is £1040.

2 Tessa has switched the 7 and 2 so worked out 3 × 1/5 and not the other way around.

3 120 4 47 cm 5 7/4 hours
6 22/7 7 195 8 5 5/24
9 Students’ own answers, for example,

2 1/2 + 7 1/2 = 10, 5 1/2 + 4 1/2 = 10, 3 4/11 + 6 5/11 = 10

Exam practice
1 4 8/15

4.3 Multiplying fractions

Purposeful practice 1
1 18 2 18 3 18 4 18

Purposeful practice 2
1 Yes, simplify to 2 × 1/2 = 1/2 2 Yes, simplify to 1/5 × 1/2 = 1/10
3 No 4 No 5 No 6 Yes, simplify to 2 × 2/3 = 4/3

Purposeful practice 3
1 1/10 2 1/10 3 1/10 4 1/10
5 1/2 6 1/2 7 1/2 8 1/2
9 3/4 10 5/4 11 5/4 12 3/4
13 2/3 14 7/3 15 7/3 16 7/3
17 1/3 18 2/3 19 3/3 20 3/3

Problem-solving practice
1 4 8 2 0
3 Students’ own answers, for example, 1 and 4 or 2 and 8
4 12/35 5 2/15 6 1/30 7 69
8 Jo spends longest. Tim spends 1/2 hours. Sam spends 1/2 hours = 3/4 hours. Jo spends 3 × 1/4 = 9/4 = 2 1/4.

Exam practice
1 21 40

4.4 Dividing fractions

Purposeful practice 1
1 4 2 4 3 6 4 6
5 8 6 10 7 15 8 7 1
9 7 1/2 10 5 11 6 2/3 12 2 3/3
13 2 1/2 14 2 1/2 15 2 1/4 16 1 1/5

Purposeful practice 2
1 1/4 2 1/4 3 1/6 4 1/9
5 1/6 6 5/12 7 5/12 8 5/9

Purposeful practice 3
1 1 2 1 3 2 1/2 4 2 3
5 1 3 6 2 3 7 3 5 8 1 5

Problem-solving practice
1 12
2 Several possible answers, for example, 4 8 12 5 10 15
3 1/2 4 7/8 5 a 9/10 b 54 minutes
6 a 96
b Yes, as he can now answer 60 × 3/8 = 60 × 8/3 = 160 questions.

Exam practice
1 6 7 2 63

4.5 Fractions and decimals

Purposeful practice 1
1 5 2 2 5 1 25 5 7 50
6 1/1000 7 1 1 500 8 7 50 9 18 10 125

Purposeful practice 2
1 0.5 2 0.25 3 0.125 4 0.1 5 0.3
6 0.9 7 0.01 8 0.27 9 0.61 10 0.061
11 0.2 12 0.6 13 0.05 14 0.85 15 0.04
16 0.36 17 1.5 18 2.5 19 1.75 20 2.25
21 0.3 22 0.6 23 0.16 24 0.83 25 0.083

Purposeful practice 3
1 0.03, 0.3, 0.25, 4 0.125 2 0.03, 0.25, 4 0.125
3 0.2, 0.23, 0.3, 4 0.23, 0.3 2 0.3
5 0.2, 0.23, 0.3, 4 0.3, 0.33, 1 3
7 2 5, 0.33, 3 0.34 8 1 4, 0.33, 1 0.34
9 3.38, 3.4, 7 17 4 10 0.7 3.38, 3.4, 17 4
11 –1, 4 5, –0.27, 0 12 –1, 4 5, 0.27

Problem-solving practice
1 Any decimal that is greater than 0.4 but less than 0.5, for example, 0.45
2 £8
3 Students’ reasoning may vary, for example, 1/6 = 0.16. This is very close to 0.16 but is not exactly equal to it. Therefore, multiplying by 0.16 is not the same as multiplying by 1/6
4 Naz worked out 125 ÷ 8 instead of 8 = 125
5 a Harry has not divided 3 by 2 to give 1.5, he’s just written the 3 and 2 around a decimal point.
b Harry has not divided 1 by 5 to give 0.2, he’s just written the 5 after a decimal point.
c 0.25, 0.45, 3 2.3
6 9 20
7 Any decimal in between 0.65 and 0.72
8 43.2 g

Exam practice
1 0.03 2 0.4
4.6 Fractions and percentages

Purposeful practice 1

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{100}$</td>
<td>1%</td>
</tr>
<tr>
<td>$\frac{1}{10}$</td>
<td>10%</td>
</tr>
<tr>
<td>$\frac{1}{5}$</td>
<td>20%</td>
</tr>
<tr>
<td>$\frac{1}{4}$</td>
<td>25%</td>
</tr>
<tr>
<td>$\frac{1}{2}$</td>
<td>50%</td>
</tr>
<tr>
<td>$\frac{1}{3}$</td>
<td>33.3%</td>
</tr>
<tr>
<td>$\frac{2}{5}$</td>
<td>40%</td>
</tr>
<tr>
<td>$\frac{3}{7}$</td>
<td>42.8%</td>
</tr>
<tr>
<td>$\frac{4}{7}$</td>
<td>57.1%</td>
</tr>
<tr>
<td>$\frac{5}{9}$</td>
<td>55.6%</td>
</tr>
<tr>
<td>$\frac{6}{10}$</td>
<td>60%</td>
</tr>
</tbody>
</table>

Purposeful practice 2

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{2}$</td>
<td>50%</td>
</tr>
<tr>
<td>$\frac{1}{3}$</td>
<td>33.3%</td>
</tr>
<tr>
<td>$\frac{1}{4}$</td>
<td>25%</td>
</tr>
<tr>
<td>$\frac{1}{5}$</td>
<td>20%</td>
</tr>
<tr>
<td>$\frac{1}{6}$</td>
<td>16.7%</td>
</tr>
<tr>
<td>$\frac{1}{7}$</td>
<td>14.3%</td>
</tr>
<tr>
<td>$\frac{1}{8}$</td>
<td>12.5%</td>
</tr>
<tr>
<td>$\frac{1}{9}$</td>
<td>11.1%</td>
</tr>
</tbody>
</table>

Purposeful practice 3

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{5}$</td>
<td>20%</td>
</tr>
<tr>
<td>$\frac{1}{2}$</td>
<td>50%</td>
</tr>
<tr>
<td>$\frac{1}{3}$</td>
<td>33.3%</td>
</tr>
<tr>
<td>$\frac{1}{4}$</td>
<td>25%</td>
</tr>
<tr>
<td>$\frac{1}{6}$</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

Purposeful practice 4

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{5}$</td>
<td>20%</td>
</tr>
<tr>
<td>$\frac{1}{3}$</td>
<td>33.3%</td>
</tr>
<tr>
<td>$\frac{1}{4}$</td>
<td>25%</td>
</tr>
<tr>
<td>$\frac{1}{6}$</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

Problem-solving practice

1. No, it is 75%.
2. Yes, as the majority of the points for high science scores appear when $x = 5$. Tia has not multiplied $x$ by 5 to give 25.
3. Yes, as the majority of the points for high science scores appear when $x = 5$. Tia has not multiplied $x$ by 5 to give 20.
4. Both the values Kamil has used are larger than the actual values, so the actual cost will be lower than his estimate.
5. No, it is 75%.

Exam practice

1. £3780

Mixed exercises A

Mixed problem-solving practice A

1. $x = 8$
2. $y = 2$
3. Yes, because she scored 38 marks. Finn scored 36 marks.
4. Yes, because she scored 38 marks. Finn scored 36 marks.
5. No, as the majority of the points for high science scores appear when $x = 5$. Tia has not multiplied $x$ by 5 to give 20.
6. The HCF of 8x + 4x is 4x, not 2x.

Exam practice

1. 36
5 Equations, inequalities and sequences

5.1 Solving equations 1

Purposeful practice 1

1 \( a + 3 = 12 \) a) \( a = 12 - 3, a = 9 \)  
 b) \( a = 12 - 12 + 3, a = 15 \)
2 \( 3a = 12, a = \frac{12}{3}, a = 4 \)
3 \( b = 1000, b = 5600 \)
4 Electric, because the bars get proportionally longer over time.
5 No, because we do not know the cost, prices or profit of the different cars.
6 £1836
7 Claire is wrong, a 25% decrease would give a force of 2.25 N/cm² but the force is 2.2 N/cm² which is lower, and therefore is a larger percentage decrease.

5.2 Solving equations 2

Purposeful practice 1

1 \( a = 3 \) b) \( x = 6 \) c) \( x = 2 \) d) \( x = 4 \)
2 \( a = 3 \) b) \( x = 6 \) c) \( x = 2 \) d) \( x = 4 \)
3 \( e = 3 \) f) \( x = 6 \) g) \( x = 2 \) h) \( x = 4 \)

Purposeful practice 2

1 \( x = 11 \) a) \( x + 14 = 36 \) b) \( x = 22 \)
2 \( a = x - 9 = 15 \) b) \( x = 24 \) 4 \( 7x = 42, x = 6 \)

Problem-solving practice

1 35
2 Abi has 9 cards, Bashar has 27 and Chan has 18.
3 135° 4 81 cm²
5 A rectangle with height 3 cm and width 10 cm.
6 128 cm²

Exam practice

1 \( x = 30° \)

5.3 Solving equations with brackets

Purposeful practice 1

1 a) \( x = 3 \) b) \( x = 1.5 \) c) \( x = 4 \) d) \( x = 4.5 \)
2 a) \( x = 3 \) b) \( x = 1.5 \) c) \( x = 4 \) d) \( x = 4.5 \)

Purposeful practice 2

1 \( x = 10 \) 2 \( x = \frac{8}{3} \) 3 \( x = \frac{8}{3} \) 4 \( x = \frac{2}{3} \) 5 \( x = -3 \)
6 \( x = -1 \) 7 \( x = 0 \) 8 \( x = 2 \) 9 \( x = 4 \)

Purposeful practice 3

1 \( x = 3 \) 2 \( x = 1.5 \) 3 \( x = 4 \) 4 \( x = 4.5 \)
5 \( x = 2 \) 6 \( x = 3 \) 7 \( x = 2 \) 8 \( x = -2 \)
9 \( x = 2 \) 10 \( x = -8 \) 11 \( x = -4 \) 12 \( x = 6 \)
13 \( x = 5 \) 14 \( x = 2 \) 15 \( x = 9 \) 16 \( x = 7 \)
17 \( x = -3 \) 18 \( x = -1 \)

Problem-solving practice

1 \( p = 7 \)

5.4 Introducing inequalities

Purposeful practice 1

\[ x = 3 \]

Purposeful practice 2

\[ x < 3 \] 1 \( 3, 2, 1 \) 2 \( 2, 1, 0 \) 3 \( 4, 5, 6 \)
4 \( 3, 4, 5 \) 5 \( 3, 4, 1 \) 6 \( -3, -2, -1 \)
7 \( -2, -1, 0 \) 8 \( -2, -1, 0 \) 9 \( -3, -2, -1 \)

Purposeful practice 3

\[ x < 3 \] 1 \( x < 3 \) 2 \( x < 3 \) 3 \( x > 3 \) 4 \( x > 1 \)
5 \( x > 2 \) 6 \( x > 0 \) 7 \( x > 12 \) 8 \( x < 12 \)
9 \( x < 9 \) 10 \( x < 12 \) 11 \( x > 12 \) 12 \( x > 12 \)
13 \( x > 3 \) 14 \( x > 3 \) 15 \( x > 9 \) 16 \( x < 9 \)
17 \( x < 1 \) 18 \( x > 4 \)

Problem-solving practice

1 4 
2 \( a = x + 2x + 2x - 7 = 58, 5x - 7 = 58 \)
3 73°, 33.7°, 73.3° 4 20 cm 5 \( g = 11.25 \)

Exam practice

1 \( f = 4 \)
Problem-solving practice
1 $x < 3$, so the smallest integer value $x$ can take is 2.
2 $2y > 5 < 20$
3 $3d < 19$, so the oldest David can be is 6.
4 $5r + 6 > 46$
   \( r > 8 \)
   Therefore the smallest number Tumay could have started with is 9.
5 $m + 40 \geq 90$  $6b < 34$  $c > 7.5$

Exam practice
1 $-6, -5, -4, -3$  $2 \ x > \frac{4}{3}$

5.5 More inequalities

Purposeful practice 1
1 $x = 2$ or 3  $2 \ x = 2$  $3 \ x = 2$ or 3  $4 \ x = 2$

Purposeful practice 2
1 $2 < x < 3$  $2 \ x < 3$  $3 \ 2 < x < 3$
4 $2 < x < 3$  $5 \ -1 < x < 3$  $6 \ -2 < x < 2$
7 $-1 < x < 3$  $8 \ -1 < x < 3$  $9 \ 1.5 < x < 3$

Purposeful practice 3
1 $-3 < x < -2$ and $-3$  $2 \ -3 < x < -2$ and $-3, -2$
3 $-2.5 < x < -1.5$ and $-2$  $4 \ -3.5 < x < -2.5$ and $-3$
5 $-3.5 < x < 1.5$ and $-3, -2, -1, 0, 1, 2$
6 $-2.5 < x < 2.5$ and $-2, -1, 0, 1, 2$

Purposeful practice 4
1 4  $2 \ 2$ (other answers possible)  $3 \ 2$
4 4 (other answers possible)  $5 \ 3$ or 4  $6 \ 2$

Problem-solving practice
1 $220 < 20x + 80 < 340$ or $220 < y < 340$
2 $90 < m < 150$
3 a Yes, $x > 3$ (the must be greater than 3) for the rectangle to have an area greater than 44 cm$^2$; $x < 8$ for the triangle to have an area less than or equal to 38 cm$^2$.
   b $6x + 12 < 12x + 8 \rightarrow x > \frac{4}{6}$
4 Toby has not reversed the inequality or the signs when dividing by a negative number. It should be $-5 < x < 4$.
5 $2.5 < p < 3.5$  $6 \ 12.5 < d < 55$  $7 \ 2 < n < 6$

Exam practice
1 4 $a < x < 7$

5.6 Using formulae

Purposeful practice 1
1 1  $2 \ 1$  $3 \ -1$  $4 \ -3$  $5 \ -9$

Purposeful practice 2
1 1  $2 \ 2.5$  $3 \ 2$  $4 \ 1.5$  $5 \ 0$

Purposeful practice 3
1 $x = \frac{y + 3}{2}$  $2 \ 3$

Purposeful practice 4
1 $x = \frac{y}{4}$  $2 \ \frac{I}{V} = \frac{V}{R}$  $3 \ s = ut$
4 $x = y - 3$  $5 \ c = f - d$  $6 \ a = \frac{f}{m}$

Problem-solving practice
1 14 cm
2 a Student A has substituted the value of 48 for $x$ instead of $y$.
   b Student B has subtracted 4 instead of adding 4.
3 a $P = FI$  $b \ 144N$
4 a $180\text{ km}$  $b \ 48\text{ mph}$
5 $12\text{ m/s}$

Exam practice
1 $a \ G = 17$  $b \ T = \frac{G - 2}{5}$

5.7 Generating sequences

Purposeful practice 1
1 Add 2
2 Add the two previous terms
3 Double the previous term
4 Add 3
5 Add the two previous terms
6 Multiply by 2

Purposeful practice 2
1 9, 11  $2 \ 7, 9$  $3 \ -1, 1$
4 1, -1  $5 \ -10, -12$  $6 \ 9, 11$
7 $\frac{3}{2}, \frac{4}{2}, \frac{4}{2}$  $8 \ 3, -2$  $9 \ 3, 3, 5$

Purposeful practice 3
1 5, 10, 15, 20, 25  $2 \ 6, 11, 16, 21, 26$
3 7, 12, 17, 22, 27  $4 \ 8, 13, 18, 23, 28$
5 4, 9, 14, 19, 24  $6 \ 3, 8, 13, 18, 23$
7 $-1, 1, 3, 5, 7$  $8 \ -1, 0, 1, 2, 3$
9 $-1, -1, -1, -1, -1$  $10 \ -1, -2, -3, -4, -5$
11 $-1, -2, -3, -4, -5$  $12 \ -1, -3, -5, -7, -9$

Problem-solving practice
1 14 more chairs and 4 more tables
2 5 of each
3 a Yes, it will alternate between -2 and 1
   b Start at 3
4 a No, 26 will not appear in the sequence. All of the terms, apart from the starting term, will be odd.
   b No, because doubling any integer and subtracting 1 will give an odd number. Therefore, whatever integer is chosen to start the sequence, the rest of the terms will be odd.
5 2 more terms – using 9 and 11 matchsticks

Exam practice
1 $a \ i 17$
   ii Add on to the third of the previous term
   b 23

5.8 Using the $n$th term of a sequence

Purposeful practice 1
1 $1, 4, 8, 12, 16, 20$  $2 \ 5, 9, 13, 17, 21$
3 $6, 10, 14, 18, 22$  $4 \ 6, 8, 10, 12, 14$
5 $-2, 0, 2, 4, 6$  $6 \ 2, 0, -2, -4, -6$

Purposeful practice 2
1 $2n$  $2 \ 2n - 1$  $3 \ n$  $4 \ n + 1$
5 $2n + 2$  $6 \ 4n$  $7 \ -2n + 17$  $8 \ -2n + 22$
9 $-n + 10$  $10 \ -5n + 41$  $11 \ -3n + 23$  $12 \ -4n + 23$

Purposeful practice 3
1 $a \ 50$  $b \ 100$  $c \ 101$  $d \ 150$
   e 149  $f \ 24$  $g \ -151$  $h \ -101$
2 a Yes, 50th term
   b Yes, 25th term
   c No  $d$  No
   e Yes, 17th term
   f Yes, 102nd term
   g No
   h No

Problem-solving practice
1 The fourth terms of sequence A and B are the same (13). The numbers 23, 33, 43... appear in both sequences but in different positions.
2 a No, the pattern would need 60 tiles, which would cost £21.
   b Multiple possible student answers that sum to < 50, for example, 3n gives 3, 6, 9, 12, which costs $3 \times £3.50$ or £10.50 for the first four terms
3 23, 27 or 31
6.1 Properties of shapes

**Purposeful practice 1**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Equal sides</th>
<th>Pairs of equal opposite sides</th>
<th>Pairs of parallel sides</th>
<th>Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Triangle" /></td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4 equal angles of 90°</td>
</tr>
<tr>
<td><img src="image2.png" alt="Rectangle" /></td>
<td>2 pairs, opposite</td>
<td>2</td>
<td>2</td>
<td>4 equal angles of 90°</td>
</tr>
<tr>
<td><img src="image3.png" alt="Parallelogram" /></td>
<td>2 pairs, opposite</td>
<td>2</td>
<td>2</td>
<td>2 pairs equal, opposite</td>
</tr>
<tr>
<td><img src="image4.png" alt="Square" /></td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2 pairs equal, opposite</td>
</tr>
<tr>
<td><img src="image5.png" alt="Rhombus" /></td>
<td>2 pairs, adjacent</td>
<td>0</td>
<td>0</td>
<td>1 pair equal, opposite</td>
</tr>
<tr>
<td><img src="image6.png" alt="Parallelogram" /></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2 equal angles of 90°, adjacent</td>
</tr>
<tr>
<td><img src="image7.png" alt="Parallelogram" /></td>
<td>2 pairs, opposite</td>
<td>1</td>
<td>1</td>
<td>2 pairs equal, adjacent</td>
</tr>
</tbody>
</table>

**Purposeful practice 2**

1. a) $x = 5$ cm  
   b) $n = 8$ cm, $t = 3$ cm  
   c) $p = 80^\circ$, $q = 100^\circ$, $r = 7$ mm  
   d) $j = 80^\circ$, $k = 120^\circ$, $l = 20$ mm, $m = 15$ mm  
   e) $u = 110^\circ$, $v = 70^\circ$, $w = 2$ cm

**Problem-solving practice**

1. Students' own answers, for example,
   a) ![Answer](image8.png)

2. a) Square, rhombus  
   b) Square – or four right angles  
   Rhombus – no right angles

3. Yes, a rhombus has the same properties as a parallelogram, such as two pairs of equal sides, two pairs of opposite parallel sides, opposite angles equal. In addition, a rhombus has an extra property because all of its sides are equal. So, a rhombus is a special type of parallelogram.

4. D = (6, 3)

**Exam practice**

1. Parallelogram

6.2 Angles in parallel lines

**Purposeful practice 1**

1. a) $a = 110^\circ$ (corresponding angles are equal)  
   b) $b = 80^\circ$ (alternate angles are equal)  
   c) $c = 50^\circ$ (angles on a straight line add to 180°)  
   d) $d = 120^\circ$ (alternate angles are equal)  
   e) $e = 60^\circ$ (angles on a straight line add to 180°)  
   f) $f = 70^\circ$ (corresponding angles are equal)  
   g) $g = 110^\circ$ (angles on a straight line add to 180°)  
   h) $h = 130^\circ$ (alternate angles are equal)  
   i) $i = 130^\circ$ (corresponding angles are equal OR vertically opposite angles are equal)  
   j) $j = 130^\circ$ (angles on a straight line add to 180°)  
   k) $k = 130^\circ$ (angles on a straight line add to 180° OR vertically opposite angles are equal)  
   l) $l = 130^\circ$ (alternate angles are equal OR corresponding angles are equal)

**Purposeful practice 2**

1. Students’ reasoning may vary, for example,  
   a) $a = 60^\circ$ (alternate angles are equal)  
   b) $n = 55^\circ$ (alternate angles are equal)  
   c) $m = 60^\circ$ (angles on a straight line add to 180°)  
   d) $p = 65^\circ$ (angles in a triangle add to 180°)  
   e) $s = 50^\circ$ (alternate angles are equal)  
   f) $t = 45^\circ$ (vertically opposite angles are equal)  
   g) $u = 85^\circ$ (angles in a triangle add to 180°)  
   h) $v = 100^\circ$ (corresponding angles are equal)  
   i) $w = 100^\circ$ (corresponding angles are equal)  
   j) $x = 70^\circ$ (alternate angles are equal)  
   k) $y = 70^\circ$ (corresponding angles are equal)  
   l) $z = 110^\circ$ (angles on a straight line add to 180°)  
   m) $a + 33 = 125^\circ$ (corresponding angles are equal, so $a = 92^\circ$)  
   n) $b = 180 - 125 = 55^\circ$ (corresponding angles are equal; angles on a straight line add to 180°)

**Problem-solving practice**

1. Students’ reasoning may vary, for example,  
   a) $a = 60^\circ$ (alternate angles are equal)  
   b) $b = 120^\circ$ (angles on a straight line)  
   c) $c = 50^\circ$ (angles in a triangle)  
   d) $d = 70^\circ$ (corresponding angles are equal)  
   e) $e = 110^\circ$ (angles on a straight line add to 180°)  
   f) $f = 45^\circ$ (vertically opposite angles are equal)  
   g) $g = 130^\circ$ (corresponding angles are equal OR vertically opposite angles are equal)  
   h) $h = 130^\circ$ (angles on a straight line add to 180°)

**Exam practice**

1. Jamal should have written angle DEB = 119° because alternate angles are equal.

6.3 Angles in triangles

**Purposeful practice 1**

1. a) $a$ and $c$  
   b) $e$ and $f$  
   c) $g$ and $h$  
   d) $j$ and $k$  
   e) $m$ and $n$  
   f) $q$ and $r$  

**Purposeful practice 2**

1. a) Scalene  
   b) Scalene  
   c) Isosceles  
   d) Equilateral  
   e) Right-angled, scalene  
   f) Isosceles  

2. a) $d = 30^\circ$, $e = 60^\circ$  
   b) $x = 55^\circ$, $t = 55^\circ$, isosceles  
   c) $f = 60^\circ$, $g = 50^\circ$  
   d) $x = 30^\circ$, $y = 75^\circ$, $z = 75^\circ$, isosceles
Problem-solving practice
1 Angles in a triangle add to 180°. Therefore, triangles can have a maximum of one obtuse angle, so must have at least two acute angles.
2 Angle ACB = 50° (vertically opposite angles are equal)
   Angle CAB = 180° − 65° − 50° = 65° (angles in a triangle add to 180°)
   Two angles in triangle ABC are equal, so it is isosceles.
3 Angle ZXY = 180° − 110° = 70° (angles on a straight line add to 180°)
   Angle XYZ = angle ZXY = 180° − 70° = 110° (angles in a triangle add to 180°)
   Angle XYZ = 110° ÷ 2 = 55° (base angles of an isosceles triangle are equal)
4 Angle PRO = 38° (vertically opposite angles are equal)
   Angle PRQ = 180° − 76° − 104° (angles on a straight line add to 180°)
   Two angles in triangle PQR are equal, so it is isosceles.
5 Students’ own answers, for example,
   Angle STR = 36° (base angles of an isosceles triangle are equal)
   Angle RSU = angle RUS = \( \frac{1}{2} (180° − 36°) \) = 72° (angles in a triangle add to 180°)
   Angle UST = 180° − 36° − 108° = 36° (angles in a triangle add to 180°)
   Triangle UST has two equal angles, so it is isosceles.

Exam practice
1 Angle DBC = 180° − 96° = 84° (angles on a straight line add to 180°)
   Angle BDC = 180° − 84° − 48° = 48° (angles in a triangle add to 180°)
   Two angles in triangle BCD are equal, so it is isosceles.

6.4 Exterior and interior angles

Purposeful practice 1
1 Angles can be drawn in the ‘opposite’ direction from that shown, but all sides must be extended in the same way (i.e. clockwise or anticlockwise).

Purposeful practice 2
1 a \( \alpha = 65° \)
   b \( \omega = x = 90° \), \( y = 110° \)
   c \( p = r = s = u = 50° \), t = 80°

Purposeful practice 3
1 a Exterior angle = 120°
   Interior angle = 60°
   c Exterior angle = 45°
   Interior angle = 135°
   d Exterior angle = 40°
   Interior angle = 140°

Purposeful practice 4
1 36 2 24 3 18 4 12 5 5

Problem-solving practice
1 \( \alpha = 360° ÷ 72° \) (exterior angle of regular pentagon = \( \frac{360°}{5} \))
   \( \alpha = 180° − 72° = 108° \) (interior angle and exterior angle add to 180°,
   all angles in a regular pentagon are equal)
   Angle ABF = angle \( z \) (symmetry)
   \( z = \frac{1}{2} (180° − 108°) \) = 36° (angles on a straight line add to 180°)
   \( \square \)
2 c \( a = 45° \)
   b \( h = 135° \)
3 a \( a = 45° \)
   b \( h = 135° \)
4 For a regular polygon, \( \frac{360°}{h} \) = number of sides
   \( \frac{360°}{50°} \) is not a whole number, so Kelly must be wrong.

5 For a regular polygon, \( \frac{360°}{n} \) = exterior angle
   Exterior angle of a regular 9-sided polygon = \( \frac{360°}{9} \) = 40°
   Exterior angle of a regular 18-sided polygon = \( \frac{360°}{18} \) = 20°
   40° is double 20°, so the exterior angle of a regular 9-sided polygon is double the exterior angle of a regular 18-sided polygon.
   Exterior angle of a regular 9-sided polygon = \( \frac{360°}{9} \) = 40°
   Exterior angle of an equilateral triangle = \( \frac{360°}{3} \) = 120°
   So the exterior angle of an equilateral triangle is 3 times the exterior angle of a regular 9-sided polygon.
6 \( x = 120° \), with students’ own reasoning, for example,
   Exterior angle of regular hexagon is \( 360° ÷ 6 = 60° \) (exterior angle of a regular polygon = \( \frac{360°}{n} \) number of sides).
   The interior angle of a regular hexagon is \( 180° − 60° = 120° \) (angles on a straight line add to 180°).
   Angle HEF = 60° (PEH is a line of symmetry that bisects angle DEF, which is an interior angle).
   \( x = 120° \) (angles on a straight line add to 180°)

Exam practice
1 Interior angle at C is 60° (angles on a straight line add to 180°)
   Interior angle at A is 65° (angles in a triangle add to 180°)
   \( x = 115° \) (angles on a straight line add to 180°)

6.5 More exterior and interior angles

Purposeful practice 1

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Number of sides</th>
<th>Number of triangles</th>
<th>Angle sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td>180°</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2 × 180° = 360°</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3 × 180° = 540°</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>4 × 180° = 720°</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>5 × 180° = 900°</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>6 × 180° = 1080°</td>
<td></td>
</tr>
</tbody>
</table>

Purposeful practice 2

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Number of sides</th>
<th>Angle sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>a 1260°</td>
<td>b 1440°</td>
<td>c 1620°</td>
</tr>
<tr>
<td>a i 360°</td>
<td>ii ( x = 150° )</td>
<td>b i 540°</td>
</tr>
<tr>
<td>c i 720°</td>
<td>ii ( z = 50° )</td>
<td></td>
</tr>
<tr>
<td>a 108°</td>
<td>b 120°</td>
<td>c 135°</td>
</tr>
<tr>
<td>d 140°</td>
<td>e 144°</td>
<td>f 150°</td>
</tr>
</tbody>
</table>

Problem-solving practice
1 11
2 \( n = 60° \), with students’ own working, for example,
   Angle sum of polygon is (number of sides − 2) × 180°
   So angle sum of hexagon is (6 − 2) × 180° = 720°
   Hexagon is regular, so each interior angle is 720° ÷ 6 = 120°
   Horizontal line is line of symmetry, so it bisects an interior 120° angle, therefore \( n = 120° ÷ 2 = 60° \)
7.1 Mean and range

Purposeful practice 1
1 \(10\)

Purposeful practice 2
1 Route 1 range: 16 mins, Route 2 range: 7 mins
2 Route 1 mean: 9 mins, Route 2 mean: 13 mins

7.2 Mode, median and range

Purposeful practice 1
1 a Median 12, range 20
b Median 12, range 15
c Median 13, range 23

Purposeful practice 2
1 a 0.6 kg is an outlier.
b Range, excluding the outlier, is 1.8 kg.
c Median, excluding the outlier, is 3.6 kg.
2 a Median 23.45, mode 24.6, range 5.5
b Median 234.5, mode 246, range 55

Exam practice
1 \(189.5\) s (2 d.p.)
2 3 hours 45 minutes

7.3 Types of average

Purposeful practice 1
Day 1 median: 3 kg, mode: 3 kg
Day 2 median: 4 kg, mode: 4 kg
Day 3 median: 4 kg, mode: 5 kg
Day 4 median: 4 kg, mode: 5 kg

Problem-solving practice
1 Total frequency = 3 + 7 + 8 + 1 = 19
So median = 10th Value.
This lies in the 35 < \(x\) < 40 height range and so the median height is between 35 and 40 cm.
2 a 1st week: mean = 5.5 minutes, median = 5 minutes
2nd week: mean = 10.5 minutes, median = 6 minutes
b Students’ own answers, for example, the mean is least useful because it gives a distorted average for week 2 because of the outlier.

Exam practice
1 a The mean is 15.6 but there is no dress size of 15.6.
b Students’ reasoning may vary, for example, the mode will be the most useful average because it shows Sam that the most frequently bought size is 14.

7.4 Estimating the mean
Purposeful practice 1
1 25.0  2 30.0  3 25.0  4 25.0  5 31.7  6 1317
Purposeful practice 2
1 11.875  2 a 13.125  b 12.1875

Problem-solving practice
1 a Estimated range is 19.
b Estimated range is 10 to 14 complaints.
c Estimated mean is 10.1 complaints.
2 The missing frequency is 3.

Exam practice
1 a £305
b Students’ own answers, for example, Terry is correct. The mean may not be the best average to use as there are outliers.

7.5 Sampling
Purposeful practice 1
1 All Year 7 students who are 12 in Julie’s school
2 All Year 7 students who are in that class
3 All Year 7 students who are in a Cardiff school
4 All Year 7 students who live in Cardiff
5 All Year 7 students who are in a Lancashire school
6 All Year 7 students who are in a Scottish school

Purposeful practice 2
1 Students’ own answers, for example, make a numbered list of all the students in the year group and select numbers using a random number generator.
2 Students’ own answers, for example, carrying out a national census is very costly and time-consuming.
3 a Students’ own answers, for example, a sample taken at midday may largely involve people who are not working that day so may not be representative. The sample size is too small.
b Students’ own answers, for example, take the survey across a wider range of times. Increase the sample size.
4 Students’ own answers, for example, the diet of people at the gym may not be representative of the diet of the rest of the population.

Problem-solving practice
1 a Students’ own answers, for example, a sample of 5 is not big enough to be representative. It is not possible to see, from a sample of 5 customers, whether all the different sandwiches need to be ordered.
b The owner should increase the number of customers in the sample to increase accuracy.
2 Students’ own answers, for example, the last 10 beams may be very similar. They should randomly sample from the 100 beams.
3 a Students’ own answers, for example, 10 am is early, so people won’t have been on many rides. 20 is too small a sample.
b Students’ own answers, for example, take the survey at the park exit. Take a larger sample.
4 Diesel 20, Petrol 25

Exam practice
1 The survey suggests that about 400 people will like rock music.
Assumptions made: The sample is representative of the group of people who will be attending the festival. People have one main type of music they like.

8 Perimeter, Area and Volume 1

8.1 Rectangles, parallelograms and triangles
Purposeful practice 1
1 60 cm²  2 60 cm²  3 60 cm²
Purposeful practice 2
1 30 cm²  2 30 cm²  3 30 cm²
Purposeful practice 3
1 18 cm²  2 9 cm²  3 36 cm²
4 36 cm²  5 24 cm²  6 60 cm²

Problem-solving practice
1 5 cm  2 12 cm
3 Students’ answers will vary. Length × perpendicular height should be 60 cm².
4 10 cm  5 609 cm²

Exam practice
1 8 cm
2 Sketch of a parallelogram with base = 6 cm and height = 3 cm

8.2 Trapezia and changing units
Purposeful practice
1 a 13 cm  b 104 cm²  c 52 cm²
2 a 60 cm²  b 30 cm²
3 42 cm²
4 a 42 cm²  b 52.5 cm²  c 54.6 cm²

Problem-solving practice
1 7 mm  2 3.375 m²  3 14 cm  4 23.4 cm²

Exam practice
1 Students’ answers will vary. Measurements should be clearly labelled with base length and perpendicular height such that $\frac{1}{2}$ base × height = 21 cm².

Example answer:

![Diagram](image)

8.3 Area of compound shapes
Purposeful practice
1 a 6 cm  b 72 cm²  c 5 cm by 4 cm  d 20 cm²  e 92 cm²
2 a Rectangle C is 7 cm by 5 cm and rectangle D is 10 cm by 3 cm.
b Area of rectangle C = 35 cm² and area of rectangle D = 30 cm².
c 65 cm²
3 a Area of rectangle E = 36 cm² and area of rectangle F = 45 cm².
b 81 cm²
4 a 42 cm²  b 330 cm²  c 70 cm²

Problem-solving practice
1 Shape B has the bigger area, by 4 cm².
2 237 cm²
3 Area = (7.5 m × 5.5 m) + (3 m × 4 m) = 53.25 m²
53.25 m² + 1.75 m² = 54.9, so Cally needs 51 packs.

Exam practice
1 304 cm²
8.4 Surface area of 3D solids

**Purposeful practice**

1. **a** and **b**

   - $A = 4 \times 9 = 36 \text{ cm}^2$
   - $A = 4 \times 7 = 28 \text{ cm}^2$
   - $A = 4 \times 7 = 28 \text{ cm}^2$
   - $A = 7 \times 9 = 63 \text{ cm}^2$
   - $A = 7 \times 9 = 63 \text{ cm}^2$
   - $A = 7 \times 9 = 63 \text{ cm}^2$

2. **a** 292 cm$^2$
   - 54 cm$^2$
   - 12 cm$^3$
   - 96 cm$^3$
   - 2,160 cm$^3$
   - 180 cm$^2$
   - 216 cm$^2$

3. **a** 432 cm$^2$
   - 83 cm$^3$
   - 1,250 cm$^3$
   - 95 cm$^3$

4. **Problem-solving practice**

   - 2 cans

5. **Exam practice**

   - 7 cm

8.5 Volumes of prisms

**Purposeful practice 1**

1. **a** 12
   - 12 cm$^3$
   - 96 cm$^3$
   - 90 cm$^3$
   - 315 cm$^3$

2. **a** 12 cm$^3$
   - 12 cm$^3$
   - 90 cm$^3$
   - 252 cm$^3$

**Purposeful practice 2**

1. **a** 96 cm$^3$
   - 90 cm$^3$
   - 315 cm$^3$

2. **a** 160 cm$^3$
   - 54 cm$^3$
   - 252 cm$^3$

**Problem-solving practice**

1. **a** 96 cm$^3$
   - 90 cm$^3$
   - 315 cm$^3$

2. **a** 1,800
   - 1,800
   - 2,160

3. **a** 254 cm$^2$
   - 216 cm$^2$
   - 216 cm$^2$

8.6 More volume and surface area

**Purposeful practice 1**

1. **a** 30 cm$^3$
   - 28 cm$^3$
   - 0.03 m$^3$
   - 0.028 m$^3$

2. **a** 36 000 mm$^3$
   - 360 000 mm$^3$
   - 105 000 000 cm$^3$
   - 378 000 000 cm$^3$

**Problem-solving practice**

1. **a** 9 cm
   - 7 cm
   - 11 cm

2. **a** 225 mm
   - 225 mm

3. **a** No.
   - 22 cm

4. **a** 5 cm
   - 2.5
   - 10
   - 5

**Exam practice**

1. **a** 512 cm$^3$
   - 512 cm$^3$
   - 512 cm$^3$

8.7 Mixed exercises B

**Mixed problem-solving practice B**

1. No, the nth term is $4n - 3$ and when $4n - 3 = 35$, $n = 9.5$
   - 8 cm
   - 3
   - 12

2. **a** 1 40
   - ii The term-to-term rule is ‘add 9’
   - 112
   - 12 cm

3. **a** 9 cm
   - 7 cm
   - 11 cm
   - 225 mm

4. **a** 5 cm
   - 2.5
   - 10

5. **a** Possible answers are 0, 1, 2 or 4
   - 1, 2, or 4

6. **a** Yes, one cube has a volume of 125 cm$^3$, $8 \times 125 = 1000$
   - 125 cm$^3$
   - 125 cm$^3$
   - 125 cm$^3$

7. **a** 96 cm$^3$
   - 90 cm$^3$
   - 315 cm$^3$

8. **a** 5 cm
   - 5 cm

9. **a** Possible answers are 0, 1, 2 or 4
   - 1, 2, or 4

10. Angle $BEF = 35^\circ$. Students’ reasoning may vary, for example, AD and CE are parallel and angle $ADF$ and angle $BEF$ are alternate angles. So, angle $BEF = angle ADF = 35^\circ$ because alternate angles are equal.
   - 360 mm$^2$

11. 260
   - 260

12. **a** $x = 7 m$
   - 159.29
   - 159.29

13. Jakub, because the range for his scores, 3, is less than Kate’s, 7.
   - 91°

14. $91^\circ < x < 124^\circ$

15. **a** 729 cm$^3$
   - 729 cm$^3$
   - 729 cm$^3$

16. **a** $15 \times 2 = 150$. The internal angles of a hexagon total 720°.
   - $Angle DEF = 720^\circ - 138^\circ - 42^\circ - 210^\circ - 95^\circ - 90^\circ = 145^\circ$.
   - $Angle DEF = 145^\circ$.
18  a  30.6  
   b  Yes, because the mean is affected by outliers.

19  $x + 5x + 5x - 29 = 180^\circ$, giving $11x - 29 = 180^\circ$. So, $x = 19^\circ$.
   Angles are $19^\circ$, $5 \times 19^\circ$ and $(5 \times 19^\circ) - 29^\circ$ i.e. $19^\circ$, $95^\circ$ and $66^\circ$.

20  Opposite sides of a rectangle are equal, so $2x + 5 = 4x - 9$.
   Solving these equations gives $x = 7$ cm.
   The length of the rectangle is 19 cm and its area is $95\text{cm}^2$,
   so $19^\circ = 95^\circ$, $y = 5$ cm.

# 9 Graphs

## 9.1 Coordinates

### Purposeful practice 1

1 Student’s own answers, for example, $(1, 3)$, $(2, 4)$, $(3, 5)$
2 a $(-4, -3)$, $(-3, -3)$, $(-2, -3)$, $(-1, -3)$, $(0, -3)$, $(1, -3)$, $(2, -3)$,
   $(3, -3)$, $(4, -3)$
   b $(-4, 0)$, $(-3, 0)$, $(-2, 0)$, $(-1, 0)$, $(0, 0)$, $(1, 0)$, $(2, 0)$, $(3, 0)$, $(4, 0)$
   c $(-4, 3)$, $(-3, 3)$, $(-2, 3)$, $(-1, 3)$, $(0, 3)$, $(1, 3)$, $(2, 3)$, $(3, 3)$, $(4, 3)$
   d $(-4, -4)$, $(-3, -4)$, $(-2, -4)$, $(-1, -4)$, $(0, -4)$, $(1, -4)$, $(2, -4)$, $(3, -4)$, $(4, 4)$
   e $(-4, -6)$, $(-3, -6)$, $(-2, -6)$, $(-1, -6)$, $(0, -6)$, $(1, -6)$, $(2, -6)$, $(3, -6)$, $(4, 8)$
   f $(-4, -8)$, $(-3, -8)$, $(-2, -8)$, $(-1, -8)$, $(0, -8)$, $(1, -8)$, $(2, -8)$, $(3, -8)$, $(4, -8)$
3 a $(-3, -3)$, $(-3, -3)$, $(-2, -3)$, $(-1, -3)$, $(0, -3)$, $(1, -3)$, $(2, -3)$,
   $(-3, 3)$, $(-3, 3)$
   b $(0, -4)$, $(0, -3)$, $(0, -2)$, $(0, -1)$, $(0, 0)$, $(0, 1)$, $(0, 2)$, $(0, 3)$, $(0, 4)$
   c $(3, -4)$, $(3, -3)$, $(3, -2)$, $(3, -1)$, $(3, 0)$, $(3, 1)$, $(3, 2)$, $(3, 3)$, $(3, 4)$
   d $(4, -4)$, $(4, -3)$, $(4, -2)$, $(4, -1)$, $(4, 0)$, $(4, 1)$, $(4, 2)$, $(4, 3)$, $(4, 4)$
   e $(-2, -4)$, $(-1, -4)$, $(0, -4)$, $(0, -5)$, $(0, 0)$, $(0, 0)$, $(0, 1)$, $(0, 2)$,
   $(1, 5, 3)$, $(2, 4)$
   f $(2, -4$, $(1, -3)$, $(1, -2)$, $(0, 0)$, $(0, -0.5)$, $(1, -1)$, $(1, -1)$,
   $(1, -1)$, $(1, -1)$

### Purposeful practice 2

1 $y = -2x$
2 $y = 2x$
3 $y = 3x$
4 $y = 6x$
5 $y = 8x$

### Problem-solving practice

1 $(1, -3)$
2 $x = 5$ (or $x = -3$)
3 Right-angled triangle
4 a
   b $(0, 0)$
5 a and b i $(1, 1)$
   ii $(-2, 3)$

## 9.2 Linear graphs

### Purposeful practice 1

1

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 2x$</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$(2, -2)$</td>
<td>$(2, -1)$</td>
<td>$(0, 0)$</td>
<td>$(1, 1)$</td>
<td>$(1, 2)$</td>
<td>$(2, 2)$</td>
</tr>
</tbody>
</table>

2

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 2x$</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>$-2$</td>
<td>$-4$</td>
</tr>
<tr>
<td>$(2, -2)$</td>
<td>$(2, -1)$</td>
<td>$(0, 0)$</td>
<td>$(1, 1)$</td>
<td>$(1, 2)$</td>
<td>$(2, 2)$</td>
</tr>
</tbody>
</table>

3

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 4x$</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>$-2$</td>
<td>$-4$</td>
</tr>
<tr>
<td>$(2, -2)$</td>
<td>$(2, -1)$</td>
<td>$(0, 0)$</td>
<td>$(1, 1)$</td>
<td>$(1, 2)$</td>
<td>$(2, 2)$</td>
</tr>
</tbody>
</table>

4

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 6x + 1$</td>
<td>3</td>
<td>1</td>
<td>$-1$</td>
<td>$-3$</td>
<td></td>
</tr>
<tr>
<td>$(2, -2)$</td>
<td>$(2, -1)$</td>
<td>$(0, 0)$</td>
<td>$(1, 1)$</td>
<td>$(1, 2)$</td>
<td>$(2, 2)$</td>
</tr>
</tbody>
</table>

5

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 8x - 1$</td>
<td>3</td>
<td>1</td>
<td>$-1$</td>
<td>$-3$</td>
<td>$-5$</td>
</tr>
<tr>
<td>$(2, -2)$</td>
<td>$(2, -1)$</td>
<td>$(0, 0)$</td>
<td>$(1, 1)$</td>
<td>$(1, 2)$</td>
<td>$(2, 2)$</td>
</tr>
</tbody>
</table>
Problem-solving practice

1 a (2, −4) b (2, 0) c (2, 8) d (2, −8)

2 a \[ y = \frac{1}{2}x \]

\[ y = -1 \] \[ y = -0.5 \] \[ y = 0 \] \[ y = 0.5 \] \[ y = 1 \]

3 A (2, −6); B (2, 8); C (2, 0); D (2, −4)

Exam practice

1 a C b A c D

9.3 Gradient

Purposeful practice 1
1 A, B, C, D, E, and F have positive gradients.
2 G, H, and I have negative gradients.
3 Students’ own answers, for example, I and H are parallel.
4 B: 2; C: 1; D: 3; E: 2; F: 1; G: −2; H: −4; I: −4

Purposeful practice 2
1 A \[ \frac{1}{3} \] B: \[ \frac{1}{2} \] C: \[ \frac{1}{2} \] D: 3

2 D: \[ y = 3x - 21 \]
A: \[ y = \frac{1}{3}x + 4 \]
B: \[ y = 2x \]
C: \[ y = \frac{1}{2}x - 1 \]

Problem-solving practice
1 Line B is steeper because it has a greater gradient (gradient of 4, compared to gradient of 3).
2 Students’ own answers, for example,

\[ y = -x \]

\[ y = -x + 3 \]

\[ y = -2 \]

\[ y = 2x + 1 \]

\[ y = -3x \]

\[ y = -3x + 2 \]

\[ y = 2x + 18 \]

\[ y = x + 9 \]

\[ y = 2x + 4 \]

\[ y = x - 3 \]

\[ y = -4x + 20 \]

\[ y = x - 3 \]

\[ y = -x - 4 \]

\[ y = -2x + 4 \]

\[ y = 2x - 1 \]

\[ y = 3x + 3 \]

\[ y = 3x + 2 \]

\[ y = 2x + 5 \]

\[ y = 5 \]

\[ y = 3x + 1 \]

\[ y = -4x + 5 \]

\[ y = -2x + 4 \]

Exam practice
1 \[ y = -2x + 4 \]

9.5 Real-life graphs

Purposeful practice 1
1 Brand A = Line 3, Brand B = Line 2, Brand C = Line 1
2 Brand A = £8/kg, Brand B = £4/kg, Brand C = £2/kg
3 £30
4 No, Brand A and Brand B will cost the same.

Purposeful practice 2
1 a

<table>
<thead>
<tr>
<th>Strawberries bought (kg)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (£)</td>
<td>2.88</td>
<td>3.76</td>
<td>5.64</td>
<td>7.52</td>
<td>9.40</td>
<td>11.28</td>
</tr>
</tbody>
</table>

\[ d = 27 \]
Strawberries bought (kg)

<table>
<thead>
<tr>
<th>Cost of strawberries (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 21 43 65 89 12</td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a Electric used (kWh)

<table>
<thead>
<tr>
<th>Brian pays (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 30.00 60.00 90.00 120.00 150.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tom pays (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.00 39.00 63.00 87.00 111.00 135.00</td>
</tr>
</tbody>
</table>

2 a She has not taken into account the time that Sally was at the service station, stuck in roadworks and buying flowers.

b 48 mph

Exam practice

1 Dalva, with students' own working, for example, from the graph, Dalva ran 80 metres in 11 seconds.

This is equivalent to \( \frac{80}{11} \times 60 \times 60 \) metres per hour = 26200 metres per hour.

(to the nearest 100 m) 26200 metres per hour = 26.2 km/h.

Dalva's speed is about 26.2 km/h whereas Seb's speed is 22.3 km/h, so Dalva ran faster.

9.6 Distance–time graphs

Purposeful practice

1 Red line 2 40 km 3 Kyle for 2 hours
4 2.30 pm and she stays for 1.5 hours 5 1.30 pm
6 Approximately 5.30 pm and they are 27.5 km from Bedford
7 Going back to Bedford 8 9.00 pm
9 a 16 km/hr b 8 km/hr c 16 km/hr (to 1d.p.)

Problem-solving practice

1 a

b Bill's speed is increasing, as the gradient of the distance–time graph becomes steeper.

2 a She has not taken into account the time that Sally was at the service station, stuck in roadworks and buying flowers.

b 48 mph

Exam practice

1 Dalva, with students' own working, for example, from the graph, Dalva ran 80 metres in 11 seconds.

This is equivalent to \( \frac{80}{11} \times 60 \times 60 \) metres per hour = 26200 metres per hour.

(to the nearest 100 m) 26200 metres per hour = 26.2 km/h.

Dalva's speed is about 26.2 km/h whereas Seb's speed is 22.3 km/h, so Dalva ran faster.

9.7 More real-life graphs

Purposeful practice 1

1 a 6.0 cm b 3.8 minutes (or 3 minutes and 48 seconds)

b 3.0 cm b 7.6 minutes (or 7 minutes and 36 seconds)

Problem-solving practice

1 a 2002–2012: either by working out the change in each 10-year period, or by noticing that this is the steepest section.

b £1.10 (accept answers between £1.08 and £1.12)

c Students' answers may vary, for example, the price has started to go down and we cannot be sure if it will continue going down, or if it will go up again.

2 a 29

b This is not very reliable because few results lie on the line of best fit.

However, most results lie within 10 marks to either side of the line of best fit, so David’s score is likely to lie within the range 19–39.

No other students on the graph scored close to 80 in the history test, so it is not possible to directly predict Sakina's maths score from the graph. However, there is a fairly strong positive correlation between maths and history marks, so it is likely that Sakina scored very highly on the maths test.

Exam practice

1 £80 per hour

Exam practice

1 £0.60
10 Transforms

10.1 Translation

**Purposeful practice 1**

1 a C b H c E d G e B f F g D

2 a i \( \begin{pmatrix} 4 \\ 2 \end{pmatrix} \) ii \( \begin{pmatrix} 2 \\ -2 \end{pmatrix} \) iii \( \begin{pmatrix} 6 \\ 0 \end{pmatrix} \)

b i \( \begin{pmatrix} 2 \\ -2 \end{pmatrix} \) ii \( \begin{pmatrix} 8 \\ 0 \end{pmatrix} \) iii \( \begin{pmatrix} 10 \\ 2 \end{pmatrix} \)

c i \( \begin{pmatrix} 8 \\ -4 \end{pmatrix} \) ii \( \begin{pmatrix} 0 \\ 8 \end{pmatrix} \) iii \( \begin{pmatrix} 4 \\ 8 \end{pmatrix} \)

**Problem-solving practice**

1 \( y = -2 \) 2 C 3 (56, 26)

4 Q \( \begin{pmatrix} 4 \\ 0 \end{pmatrix} \) R \( \begin{pmatrix} 4 \\ 3 \end{pmatrix} \) S \( \begin{pmatrix} 0 \\ 3 \end{pmatrix} \)

**Exam practice**

1 Translation of 2 units to the left and 4 units down, so \( \begin{pmatrix} -2 \\ -4 \end{pmatrix} \).

10.2 Reflection

**Purposeful practice 1**

1 a \( x = 2 \) b \( y = 0 \) c \( x = -1 \)

d \( x = 3 \) e \( y = 4 \) f \( y = -2 \)

**Purposeful practice 2**

1 a Reflections are labelled A', B', C' and, D' on the diagram below.

10.3 Rotation

**Purposeful practice 1**

1 a 1 b 2 RC 3 D C B A

2 a (5, 4) b (2, 0) c (4, 5) d (3, 1) e (1, 5)

3 a 180° b 90° anticlockwise (or 270° clockwise)

**Purposeful practice 2**

1 180° 2 90° anticlockwise (or 270° clockwise)

3 180° 4 90° clockwise (or 270° anticlockwise)

**Purposeful practice 3**

1 a H b D c G d E e F

2 a P b S c Q d P

**Exam practice**

1 Reflection in the \( x \)-axis (or the line \( y = 0 \))

2 Reflection in the \( y \)-axis (or the line \( x = 0 \))

10.4 Enlargement

**Purposeful practice 1**

1 Shape C 2 Shape E 3 Shape B

**Purposeful practice 2**

1 a \( P \) b \( Q \) c \( S \) d \( R \)

2 a \( P \) b \( Q \) c \( S \) d \( R \)

**Exam practice**

1 A to C is a rotation 180° around (4, 2).

2 C to E is a rotation 90° anticlockwise around (5, 5).

3 E to A is a rotation 90° anticlockwise around (7, 1).

This is a rotation of 180°. The centre of rotation is the point (1, 0).

1 a The mirror line is \( y = 2 \).

b The shape is reflected in the \( y \)-axis.

c The mirror line is \( x = 4 \).

d \( y = 4 \) e \( y = 2 \)
Problem-solving practice

1 a Scale factor needs to be larger than 1. Check centre of enlargement to ensure the enlarged shape will be in quadrant 1.
b Scale factor needs to be between 0 and 1. Check centre of enlargement to ensure the enlarged shape will be in quadrant 1.
c Scale factor needs to be larger than 1. Check centre of enlargement to ensure the enlarged shape will be in quadrant 2.
d Scale factor needs to be between 0 and 1. Check centre of enlargement to ensure the enlarged shape will be in the same quadrant.

2 Anna: The perimeter should be 36 cm (she has doubled when she should have tripled).
Paul: The difference will triple if the side length triples (i.e. it will become 6 cm not 2 cm).
Charlie: The new area will be 32 times larger (54 cm), not 3 times larger.

Exam practice

1 Correct enlargement shown from any centre of enlargement. For example,

10.5 Describing enlargements

**Purposeful practice 1**

1 a Scale factor 2
   b Scale factor 4
   c Scale factor ½
   d Scale factor 1/2

2 a 1/4
   b 8
   c ½
   d 2

**Purposeful practice 2**

1 Centre (1, –1), scale factor 2
2 Centre (1, –1), scale factor 1/2
3 Centre (0, 8), scale factor 2
4 Centre (0, 8), scale factor 1/2

**Purposeful practice 3**

1 Scale factor 2
2 Scale factor 3

**Problem-solving practice**

1 Centre of enlargement (0, 3), scale factor 2
2 Centre of enlargement (9, 4), scale factor 1/2
3 An enlargement by scale factor 1/3, centre (3, 2)

**Exam practice**

1 Enlargement, scale factor 2, centre of enlargement P

10.6 Combining transformations

**Purposeful practice 1**

1 a P  b P  c T  d R  e S  f S

2 a Translation of \( \begin{pmatrix} 4 \\ 0 \end{pmatrix} \)
   b Translation of \( \begin{pmatrix} 0 \\ -8 \end{pmatrix} \)
   c Rotation of 180° about (2, 3)
   d Rotation of 180° about (4, –1)

**Problem-solving practice**

1 a The reflection in the line \( y = x \) is labelled (a) on the following diagram; the second reflection in the x-axis is labelled ‘End result’
b The translation is labelled (b) on the following diagram; the final position is the same as (a).

3 After rotation, shape T becomes shape B. This reflects to make shape Q.

11 Ratio and proportion

**11.1 Writing ratios**

**Purposeful practice 1**

1 \( \square \square \square \)
   2 \( \square \square \square \)
   3 \( \square \square \square \square \)
   4 \( \square \square \square \square \square \)
   5 \( \square \square \square \square \square \)
   6 \( \square \square \square \)
   7 \( \square \square \)

**Purposeful practice 2**

1 Yes  2 No  3 No  4 No  5 No  6 Yes  7 No  8 Yes
**11.2 Using ratios 1**

**Purposeful practice 1**

1. 16 : 24 : 36
   - 2 : 3 : 4
   - 3 : 8 : 4
   - 4

2. 0.5 : 6 : 1
   - 7 : 10
   - 8 : 40

**Purposeful practice 2**

1. 3 : 4
   - 2 : 3 : 4
   - 3 : 15 : 2
   - 4 : 75 : 1

2. 15 : 2 : 6 : 3 : 4
   - 7 : 3 : 40
   - 8 : 3 : 400

**Purposeful practice 3**

1. 24
   - 24 : 36
   - 42

**Problem-solving practice**

1. 300 ml
   - 2 a 1056
   - b 1200

2. 3 a 24 km
   - b 6 hours

3. 4 a 0.6 m
   - b No, the ratio 9 : 2 is equivalent to 1.8 : 0.4 so it should be 0.4 m

4. Daniel is wrong because there are still decimal points in his ratio.
   - It should be 1 : 4.

5. 3 : 7
   - 5 : 3
   - 8 : 2 : 1 : 9 : 5

**Exam practice**

1. 54

**11.3 Ratio and measures**

**Purposeful practice 1**

1. a 120 minutes
   - b 30 minutes
   - c 150 minutes

2. a 4.8 km
   - b 8 km
   - c 1.875 miles
   - d 3.125 miles

3. a 6.6 pounds
   - b 11 pounds
   - c 1.36 kg (to 2 d.p.)
   - d 2.27 kg (to 2 d.p.)

**Purposeful practice 2**

1. £224
   - 2 £256
   - 3 £178.57
   - 4 £156.25

**Purposeful practice 3**

1. a 1 : 2
   - b 1 : 4
   - c 1 : 8

2. a 1 : 3
   - b 1 : 9
   - c 1 : 27

3. a 1 : 4
   - b 1 : 16
   - c 1 : 64

**Problem-solving practice**

1. 792 pounds
   - 2 48 km/h
   - 3 6.6 pounds or 3 kg

2. 2.5 x 6 = 4, therefore Nana walks 4 km. Charlie walks 3.5 km, so Nana walks further.

3. America, as $425 = £332.03

4. Ollie gains money, because £300 = ¥42 300, ¥42 300 = £306.52

5. 0.5 m

6. 100 ml : 100 ml : 40 ml

7. 200 ml : 100 ml : 40 ml

8. 600 ml : 1000 ml : 400 ml

9. 150 ml : 250 ml : 100 ml

10. 0.15 litres : 0.25 litres : 0.1 litres

11. 1.5 litres : 2.5 litres : 1 litre

12. 1.8 litres : 3 litres : 1.2 litres

13. 6 hours

**Exam practice**

1. 1 204 m
11.6 Using proportion

Purposeful practice 1
1 30 g 2 60 g 3 180 g 4 270 g

Purposeful practice 2
1 7.5 kg 2 15 kg 3 45 kg 4 67.5 kg

Purposeful practice 3
1 £1 : 175 ml 2 £1 : 180 ml 3 £1 : 191.49 ml
4 £1 : 200 ml 5 £1 : 200 ml 6 £1 : 190.22 ml

Purposeful practice 4
1 £0.0057 : 1 ml 2 £0.0055 : 1 ml 3 £0.0052 : 1 ml
4 £0.0050 : 1 ml 5 £0.0050 : 1 ml 6 £0.0053 : 1 ml

Problem-solving practice
1 330 ÷ 75 = 4.4, so 4.4 ml per pence.
500 ÷ 125 = 4, so 4 ml per pence.
Therefore, the can is better value for money.

2 The 25 kg bag is better value. 11 kg bag is 32p per kg.

3 300 ÷ 80 = 3.75, so 3.75p per tea bag.
450 ÷ 160 = 2.8125, so 2.81p per tea bag.
575 ÷ 240 = 2.3958333, so 2.4p per tea bag.
Therefore, the large box at £5.75 is the best value for money.

4 Shop A: 30 ÷ 3 × 1 = £10.
Shop B: 30 ÷ 5 × £1.50 = £9, so shop B is cheaper.

Exam practice
1 For one biscuit: 17.5 g of flour, 5 g butter, 8.75 g brown sugar, 3 g syrup, 0.05 eggs. Matt has only 100 g of syrup so he can make a maximum of 33 biscuits.

11.7 Proportion and graphs

Purposeful practice 1
1 A and D show direct proportion

2 a

b Yes, the values are in direct proportion as the graph is a straight line passing through the origin.

Purposeful practice 2
1 Amount of sugar in teaspoons

2 2.5 teaspoons 3 25 teaspoons 4 0 g
5 24 g 6 240 g

Purposeful practice 3

b The plumber’s charges are in direct proportion to the hours she works because the graph is a straight line which goes through the origin.

2 a

b This graph does not show direct proportion because the line does not go through the origin.

c They make £560 instead of £500, so they are £60 better off.

3 No, because the graph of the fare compared to the distance travelled would not go through the origin.

Exam practice
1 Approximately 10.5 miles

11.8 Proportion problems

Purposeful practice 1
1 £23.60 2 16 chairs 3 £1

Purposeful practice 2
1 £25 2 4 hours 3 300 ml

Purposeful practice 3
1 28 hours 2 a 1.5 days b 40 bananas c 28 monkeys

Problem-solving practice
1 a No, 4 people would take half as long as 2 people to make the table so the cost would be the same (£115.50).

b 12 hours

2 It has doubled.

3 a 20 hours b 10 hours

4 No, because the temperature has halved, but the number of ice creams sold has not doubled.

5 a 3 surgeons b 3 hours c 30 patients

6 a £111 b £111 c 3 people

Exam practice
1 a 7.5 days

b i The rate at which each decorator paints is the same, all the time.

ii If the rate is slower, it will take longer. If the rate is faster, it will take less time.
12 Right-angled triangles

12.1 Pythagoras' theorem 1

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a c, b, a</td>
</tr>
<tr>
<td>3</td>
<td>i b, g, h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 cm</td>
</tr>
<tr>
<td>3</td>
<td>20 cm</td>
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<tr>
<td>5</td>
<td>26 cm</td>
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<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.5 cm</td>
</tr>
<tr>
<td>3</td>
<td>24.5 cm</td>
</tr>
</tbody>
</table>

Problem-solving practice

1.4 m

3. It is quicker to travel directly from A to C, by 14.6 minutes
   (or 14 minutes and 36 seconds).
4. a 60.2 cm  b Wall is vertical, shelf is horizontal.

Exam practice

1. 216 cm²

12.2 Pythagoras' theorem 2

<table>
<thead>
<tr>
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<th>Purposeful practice 1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Coordinates</td>
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<tr>
<td>(0, 0), (3, 4)</td>
<td>3</td>
</tr>
<tr>
<td>(0, 0), (4, 3)</td>
<td>4</td>
</tr>
<tr>
<td>(1, 1), (5, 4)</td>
<td>4</td>
</tr>
<tr>
<td>(1, 2), (5, 5)</td>
<td>4</td>
</tr>
<tr>
<td>(−1, −2), (−5, −5)</td>
<td>4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a x² + 4y² = 5²</td>
</tr>
<tr>
<td>3</td>
<td>a x² + 4y² = 6²</td>
</tr>
</tbody>
</table>

Problem-solving practice

1. a Ladder B

   b Using Pythagoras' theorem
   Length of ladder A = 11.4 m (1 d.p.)
   Length of ladder B = 13.6 m (1 d.p.)
   Height ladder A reaches = 12.4 m (1 d.p.)
   Height ladder B reaches = 14.5 m (1 d.p.).
   So ladder B reaches 2.04 m further up the wall.

2. 6.6 m (1 d.p.)

4. 9² + 40² = 1681 = 41²

5. The hypotenuse of the right-angled triangle is \(\sqrt{(7^2 + 3^2)} = 7.6\) cm, so its perimeter is 7 cm + 3 cm + 7.6 cm = 17.6 cm.
   Perimeter of the equilateral triangle = 3 x 6 cm = 18 cm. So the statement is incorrect.
6. 120.7 cm

Exam practice

1. No, it is not true, because Pythagoras' theorem does not hold true.
   AC = 9 cm, but \(\sqrt{7^2 + 4^2} = 8.06\) cm.
2. 44 cm²

12.3 Trigonometry: the sine ratio 1

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(\sin \theta = \frac{a}{c})</td>
</tr>
<tr>
<td></td>
<td>(\sin \theta = \frac{c}{a})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 2</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>5.0 cm</td>
</tr>
<tr>
<td>3</td>
<td>0.9 cm</td>
</tr>
<tr>
<td>6</td>
<td>0.7 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Problem-solving practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.83 cm</td>
</tr>
<tr>
<td>3</td>
<td>2.74 cm</td>
</tr>
</tbody>
</table>

Exam practice

1. 9 cm

12.4 Trigonometry: the sine ratio 2

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30°</td>
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<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.5°</td>
</tr>
<tr>
<td>4</td>
<td>14.5°</td>
</tr>
</tbody>
</table>

Problem-solving practice

1. 28.1°  2 14.5°  3 9.5°  4 10.5°  5 11.5°  6 511°

Exam practice

1. 43.9°

12.5 Trigonometry: the cosine ratio

<table>
<thead>
<tr>
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<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(\cos \theta = \frac{b}{c})</td>
</tr>
<tr>
<td>3</td>
<td>(\cos \theta = \frac{s}{c})</td>
</tr>
</tbody>
</table>

<table>
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<tr>
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<th>Purposeful practice 2</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>8.7 cm</td>
</tr>
<tr>
<td>3</td>
<td>7.1 cm</td>
</tr>
<tr>
<td>5</td>
<td>20.0 cm</td>
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</table>

<table>
<thead>
<tr>
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<th>Purposeful practice 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.4°</td>
</tr>
<tr>
<td>4</td>
<td>70.5°</td>
</tr>
</tbody>
</table>

Problem-solving practice

1. 3.46 m  2 0.67 m  3 36.9°  4 41 m

Exam practice

1. 33.9°

12.6 Trigonometry: the tangent ratio

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(\tan \theta = \frac{a}{b})</td>
</tr>
<tr>
<td>3</td>
<td>(\tan \theta = \frac{r}{s})</td>
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</tbody>
</table>

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<tr>
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<tbody>
<tr>
<td>1</td>
<td>5.8 cm</td>
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<tr>
<td>3</td>
<td>10 cm</td>
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<tr>
<td>5</td>
<td>5.8 cm</td>
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<tr>
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<th>Purposeful practice 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63.4°</td>
</tr>
<tr>
<td>4</td>
<td>38.7°</td>
</tr>
</tbody>
</table>

Problem-solving practice

1. 26.6°  2 6.7 m  3 8.4 m  4 14.6 m

Exam practice

1. 30.7°

12.7 Finding lengths and angles using trigonometry

<table>
<thead>
<tr>
<th></th>
<th>Purposeful practice 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(\tan 48° = \frac{x}{6})</td>
</tr>
<tr>
<td>2</td>
<td>(\cos \theta = \frac{6}{10})</td>
</tr>
<tr>
<td>3</td>
<td>(\sin \theta = \frac{6}{10})</td>
</tr>
<tr>
<td>4</td>
<td>(\tan \theta = \frac{6}{10})</td>
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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>(\sin 48° = \frac{6}{y}, \cos 48° = \frac{x}{y}, \tan 48° = \frac{6}{x})</td>
</tr>
<tr>
<td>6</td>
<td>(\sin 48° = \frac{x}{y}, \cos 48° = \frac{6}{y}, \tan 48° = \frac{x}{6})</td>
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<thead>
<tr>
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<th>Problem-solving practice</th>
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<tbody>
<tr>
<td>1</td>
<td>45°</td>
</tr>
<tr>
<td>4</td>
<td>2 cm</td>
</tr>
</tbody>
</table>

Exam practice

1. 2

2. \(\sin 30°, \tan 30°, \sin 45°, \cos 30°, \tan 45°\)
3 17.0 cm  
4 11.7 cm  
5 No, it makes an angle of 50.3°.

Exam practice
1 29.4°

Mixed exercises C

Mixed problem-solving practice C

1. a and b

c A reflection in the line $y = -x$

2. Charlie, because Akram saves 60%, Beth 58% and Charlie 65%

3. £80

4. $325 + 100 = 3.25$ so Caitlin has enough flour to make $3.25 \times 8 = 26$ pancakes.

5. Frozen burgers (12 burgers will cost £6.25 compared to £6.39)

6. $y = 2x - 4$

7. a 0820 b 8 km

8. 24.2 kg

9. 34.6 cm

10. a

b 12 squares

Exam practice
11 £42

13 Probability

13.1 Calculating probability

Purposeful practice 1

1. $P(R) = \frac{2}{3}$, $P(W) = \frac{1}{3}$

2. $P(R) = \frac{2}{4}$ or $\frac{1}{2}$, $P(W) = \frac{3}{5}$ or $\frac{1}{2}$

3. $P(R) = \frac{2}{5}$, $P(W) = \frac{3}{5}$ or $\frac{1}{2}$

4. $P(R) = \frac{2}{6}$ or $\frac{1}{3}$, $P(W) = \frac{4}{6}$ or $\frac{2}{3}$

5. $P(R) = \frac{2}{7}$, $P(W) = \frac{4}{7}$ or $\frac{1}{2}$, $P(B) = \frac{1}{7}$

6. $P(R) = \frac{2}{8}$ or $\frac{1}{4}$, $P(W) = \frac{4}{8}$ or $\frac{1}{2}$, $P(B) = \frac{2}{8}$ or $\frac{1}{4}$

Purposeful practice 2

1. $P(B) = \frac{1}{6}$, $P(Y) = \frac{5}{6}$

2. $P(B) = \frac{2}{6}$ or $\frac{1}{3}$, $P(Y) = \frac{4}{6}$ or $\frac{2}{3}$

3. $P(B) = \frac{3}{6}$ or $\frac{1}{2}$, $P(Y) = \frac{3}{6}$ or $\frac{1}{2}$

4. $P(B) = \frac{4}{6}$ or $\frac{2}{3}$, $P(Y) = \frac{2}{6}$ or $\frac{1}{3}$

5. $P(B) = \frac{5}{6}$, $P(Y) = \frac{1}{6}$

6. $P(B) = \frac{6}{6}$ or $\frac{1}{6}$, $P(Y) = 0$

Purposeful practice 3

1. $\frac{1}{10}$

2. $\frac{3}{10}$

3. $\frac{2}{10}$ or $\frac{1}{5}$

4. $\frac{4}{10}$ or $\frac{2}{5}$

5. $\frac{5}{10}$ or $\frac{2}{5}$

6. $\frac{3}{10}$

7. $\frac{5}{10}$ or $\frac{1}{2}$

8. $\frac{6}{10}$ or $\frac{3}{5}$

9. $\frac{8}{10}$ or $\frac{4}{5}$

10. $\frac{9}{10}$

11. $\frac{7}{10}$

12. $\frac{7}{10}$
Problem-solving practice
1 Students' own answers, for example, 4 black and 1 white, or 8 black and 2 white
2 2 \[ \frac{3}{8} \] 3 5% 4 \[ \frac{2}{3} \] 5 \[ \frac{3}{10} \] 6 \( P(1) = P(4) = 0.25 \)

Exam practice
1 3 \[ \frac{1}{14} \]

13.2 Two events

Purposeful practice 1
1 a 2 b 3 c HR, HB, HY, TR, TB, TY d 6
2 a 2 b 4 c HR, HB, HY, HG, TR, TB, TY, TG d 8
3 a 2 b 4 c H1, H2, H3, H4, T1, T2, T3, T4 d 8
4 a 2 b 3 c HR, HB, HY, TR, TB, TY d 6

Purposeful practice 2
1

<table>
<thead>
<tr>
<th>4-sided spinner</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 a 2 \[ \frac{1}{12} \] 3 12 b 3 \[ \frac{1}{12} \] 4 c 7 \[ \frac{1}{12} \] d 9 \[ \frac{3}{12} \] e 5 \[ \frac{1}{12} \]

Problem-solving practice
1 a 6 b 1 \[ \frac{1}{18} \]
2 a 4 \[ \frac{3}{12} \] 3 12 b 3 \[ \frac{1}{4} \] c 7 \[ \frac{1}{12} \] d 9 \[ \frac{1}{2} \]
5 No, it is not fair.
\( P(\text{more than} \ 6) = \frac{21}{36} \) and \( P(\text{6 or less}) = \frac{15}{36} \)

Exam practice
1 4 \[ \frac{1}{9} \]

13.3 Experimental probability

Purposeful practice 1
1 Dice A \[ \frac{18}{100} \] Dice B \[ \frac{17}{100} \]

No, if the dice were fair the probability of rolling a 6 would be \[ \frac{1}{6} \]
2 Dice A a 2 b 9 c 36 Dice B a 2 b 9 c 34

3

<table>
<thead>
<tr>
<th>Number of rolls</th>
<th>Money paid to arcade</th>
<th>Estimated prize money paid</th>
<th>Estimated profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dice A</td>
<td>200</td>
<td>£200</td>
<td>£3 x 10 = £108</td>
</tr>
<tr>
<td>Dice B</td>
<td>200</td>
<td>£200</td>
<td>£3 x 10 = £102</td>
</tr>
</tbody>
</table>

Purposeful practice 2
1 37 2 19 3 19 \[ \frac{37}{3} \] 4 7 5 \[ \frac{7}{37} \] 6 \[ \frac{1}{19} \] 7 \[ \frac{5}{17} \]

Problem-solving practice
1 a 5 b £60 - £30 = £30
c Students' own answers, for example probability is not certainty.
2 a 1 person b 280

Exam practice
1 68

13.4 Venn diagrams

Purposeful practice 1
1 a 1, 8, 10 b 1, 8, 10 c 1, 8, 10 d 1, 8, 10
2 a 1, 8, 10 b 1, 8, 10 c 1, 8, 10 d 1, 8, 10

Purposeful practice 2
1 a 2, 19 b 5, 11 c 1, 12 d 4, 11

Problem-solving practice
1 a 2 \[ \frac{1}{9} \] b 4 \[ \frac{1}{8} \] or \[ \frac{1}{2} \]

<p>|
|----------|----------|----------|</p>
<table>
<thead>
<tr>
<th>Milk</th>
<th>Plain</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mint</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>Orange</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>20</td>
</tr>
</tbody>
</table>

Explain the importance of understanding probability in real-life situations.
Exam practice

1 a

b \( \frac{6}{9} \) or \( \frac{2}{3} \)

13.5 Tree diagrams

**Purposeful practice 1**

\[
\begin{align*}
P(R,R) &= \frac{9}{25} \\
P(R,Y) &= \frac{6}{25} \\
P(Y,R) &= \frac{6}{25} \\
P(Y,Y) &= \frac{4}{25}
\end{align*}
\]

**Purposeful practice 2**

\[
\begin{align*}
P(B,B) &= \frac{25}{36} \\
P(B,W) &= \frac{5}{36} \\
P(W,B) &= \frac{5}{36} \\
P(W,W) &= \frac{1}{36}
\end{align*}
\]

**Problem-solving practice**

1 a

b \( \frac{4}{53} \)

13.6 More tree diagrams

**Purposeful practice 1**

\[
\begin{align*}
P(R,R) &= \frac{6}{30} \\
P(R,B) &= \frac{9}{30} \\
P(B,R) &= \frac{9}{30} \\
P(B,B) &= \frac{6}{30}
\end{align*}
\]

**Purposeful practice 2**

\[
\begin{align*}
P(R,R) &= \frac{11}{10} \\
P(R,Y) &= \frac{7}{10} \\
P(Y,R) &= \frac{4}{10} \\
P(Y,Y) &= \frac{6}{10}
\end{align*}
\]

**Problem-solving practice**

1 a

b \( \frac{26}{50} \) or \( \frac{13}{28} \)

3 a

b \( 0.06 \)

4 \( 0.54 \)
Exam practice

1 The probabilities for the first game do not sum to 1.
On the second game, the first branch is incorrect as the probabilities are on the wrong branches.

14 Multiplicative reasoning

14.1 Percentages

Purposeful practice 1

1  a £125  b £110  c £105  d £102.50
2  a £90  b £89.01  c £95.24  d £97.56
3  a £75  b £79.00  c £85  d £97.50
4  a £133.33  b £111.11  c £105.26  d £102.56

Purposeful practice 2

1  a 10%  b 10%  c –0.1%  d –10%  e 11.1%
   f 11.1%  g 11.1%  h –10%  i –99.1%
2  a 11.1%  b –10%  c 11.1%  d –10%

Problem-solving practice

1  £111.11
2  It is better to buy the small bottle because you get 750 ml for £1.75 instead of £2.50.
3  £266.67
4  a 6923 words  b 16.7% (1 d.p.)
5  With the dessert because it costs £27.12.

Exam practice

1  £219.60
2  111%

14.2 Growth and decay

Purposeful practice 1

1  £1050  2  £1102.50  3  £1157.63  4  £1340.10

Purposeful practice 2

1  £950  2  £902.50  3  £857.38  4  £735.09

Purposeful practice 3

1  £55.75  2  £1677.14  3  £55.17  4  £1712.06

Purposeful practice 4

1  21%  2  4.5%  3  15.5%  4  –1%

Problem-solving practice

1 Increase of 2% every year for 23 years would give expected price of $12p \times 1.0223$, which is 18.9p (to 1 d.p.). The price has increased to 20p, so the increase in price is more than expected.
2 The first loan (0.2% per day) will involve Chelsea paying back £1586.31 in total. The second loan (2.5% per annum) will involve paying back £1575.94 in total. The 2-year loan is cheaper.
3 2019
4 2008
5 No, Adib will lose £1148.40. After the first increase, Adib’s shares are worth £968.50. After the second increase, they are worth £1491.49. After the decrease, they are worth £596.60.
6 12.5%

Exam practice

1  £753.91
2  £753.91

14.3 Compound measures

Purposeful practice 1

1  3 kg/m²  2  6 kg/m²  3  3 kg/m²
4  1.5 kg/m²  5  0.67 kg/m²  6  0.33 kg/m²

Purposeful practice 2

1  a 3 N/m²  b 6 N/m²  c 4 N/m²  d 3 N/m²
2  a 3 litres per minute  b 1.5 litres per minute
   c 0.75 litres per minute  d 0.2 litres per minute
   e 0.1 litres per minute  f 720 litres per minute

Purposeful practice 3

1  20 kg  2  18 N  3  5 m³  4  2 m³

Problem-solving practice

1 Yes, she is right. The pressure exerted will be 2.45 times greater on Earth.
2  a  The second bowl  b  2.9167 litres
3  a £774  b £729  c Sandra (she is paid £1695).
4  a 246  b 123 sentences and 41 quotes
5 330 kg
6  a 20.98 g  b 3.86 g  c 11.3 g/cm³ (1 d.p.)

Exam practice

1 1.01 g/cm³

14.4 Distance, speed and time

Purposeful practice 1

1  a 2 m/s  b 0.5 m/s  2  a 18 m  b 18 m
3  a 0.5 hours (or 30 minutes)  b 2 hrs

Purposeful practice 2

1  a 23 m/s  b 17 m/s  2  a 65 m  b 44 m
3  a 7 m/s  b 7 m/s

Problem-solving practice

1 54.7 mph (1 d.p.)
2  a 2.04 seconds (2 d.p.)  b 20.41 m (2 d.p.)
3  a 1 hour  b 85 km/hr
4 690 m  5  6.56 m/s
6 No, the car is going faster at 5.6 m/s.

Exam practice

1 70.2 km/h

14.5 Direct and inverse proportion

Purposeful practice 1

1 4x = y  2  x = 4y  3  2x = 3y
4 3x = 2y  5  3x = y  6 3x = y

Purposeful practice 2

1  a  f = 2.5t (or equivalent equation)
   b i  g = 0.4t (or equivalent equation)
   ii 30  iii 3.6
2  a  i  f = \frac{10}{t} (or equivalent equation)
   b i  w = \frac{10}{t} (or equivalent equation)
   ii 0.83 (2 d.p.) iii 1.11 (2 d.p.)

Problem-solving practice

1  a  c = \frac{k}{h}  b  c = \frac{24}{h} (or equivalent equation)
   c 6 hours
2  a  w = 6t  b 60 litres
   c Yes, there will be 90 litres of water.
3 14 books
4 a Inversely proportional  b Neither
   c Directly proportional
5  a 6.7 hours (or 6 hours and 40 minutes)
   b Yes, because the total number of hours of work is fixed; if there are more workers, they will each work fewer hours so the total cost will be the same.
Exam practice
1 a 12 days
b i It is assumed they paint at the same rate.
ii If they paint slower, they will take longer.
If they paint faster, they will take a shorter amount of time.

15 Constructions, loci and bearings

15.1 3D solids

Purposeful practice 1
1 a 6 b 12 c 8 2 a 6 b 12 c 8
3 a 6 b 12 c 8 4 a 6 b 12 c 8

Purposeful practice 2
1 a cone b cylinder c sphere

Purposeful practice 3
1 a Triangle and square b 5
2 a i 8 ii 12 iii 18 b i 5 ii 7 iii 10

Problem-solving practice
1 An octagon
2 Each edge of a cube joins two squares together, so two edges from the squares produce only one edge of the cube. The answer is half of 24.
3 Evan is not correct. He has confused edges and vertices. There are 14 faces, 36 edges and 24 vertices.

Exam practice
1 a

Exam practice
1 a

Problem-solving practice
1 a Triangular prism Cuboid
b Side elevation of triangular prism Side elevation of cuboid

Exam practice
1 a

Exam practice
1 a

Purposeful practice 1
1

Purposeful practice 2
1 Students’ answers may vary, for example
a A cuboid, a rectangular pyramid
b A triangular prism, a pentagonal prism
2 a
15.3 Accurate drawings 1

Purposeful practice 1

(These diagrams are not to scale.)

a

\[
\begin{array}{c}
7.7 \text{ cm} \\
60° \\
8.5 \text{ cm} \\
65° \\
55° \\
8.1 \text{ cm}
\end{array}
\]

b

\[
\begin{array}{c}
8.1 \text{ cm} \\
60° \\
8.5 \text{ cm} \\
65° \\
55° \\
7.7 \text{ cm}
\end{array}
\]

c

\[
\begin{array}{c}
8.1 \text{ cm} \\
65° \\
8.5 \text{ cm} \\
60° \\
55° \\
7.7 \text{ cm}
\end{array}
\]

Purposeful practice 2

(These diagrams are not drawn to scale.)

\[
\begin{array}{c}
5 \text{ cm} \\
60° \\
4 \text{ cm} \\
60° \\
4 \text{ cm} \\
5 \text{ cm}
\end{array}
\]

\[
\begin{array}{c}
6 \text{ cm} \\
36° \\
8 \text{ cm}
\end{array}
\]

Purposeful practice 3

1 A and C are congruent (ASA); B and E are congruent (SAS).

Problem-solving practice

1 a Jamie is incorrect. A and B are congruent because of the ASA of 50°, 8 cm, 70°. C is not congruent to A and B because its sides are of different lengths.

2 a RHS b i 12 cm c 5 cm d 67.4°

Exam practice

a

\[
\begin{array}{c}
5.5 \text{ cm} \\
30° \\
85° \\
6 \text{ cm}
\end{array}
\]

15.4 Scale drawings and maps

Purposeful practice 1

1 a Accurate drawing of a rectangle measuring 18 cm by 12 cm
b Accurate drawing of a rectangle measuring 9 cm by 6 cm
c Accurate drawing of a rectangle measuring 6 cm by 4 cm
d Accurate drawing of a rectangle measuring 4.5 cm by 3 cm
e Accurate drawing of a rectangle measuring 3 cm by 2 cm
f Accurate drawing of a rectangle measuring 3.6 cm by 2.4 cm

c i 2.5 ii 1.25 iii 0.5 iv 2
d i 40 cm ii 24 cm iii 7 cm

Purposeful practice 2

1 a 1 cm × 2 cm b 2 cm × 6 cm c 1.5 cm × 3 cm d 2 cm × 2.5 cm e 1.5 cm × 1 cm

Problem-solving practice

1 a Town A to town B is 20 km; town C to town B is 25 km. So the total distance you travel is 45 km.
b James is correct. 40 km would be represented by 12 cm on the map. You can quickly try the points that look furthest from town C and discover they are less than 12 cm away.
2 a 150 km = 600 cm; far too large for a printed map
b 150 km = 150 cm; still too large for a printed map
c 150 km = 30 cm; a good size for a printed map
d 150 km = 1.5 cm; too small to be a useful map
3 a

b i 5.4 km ii 4.5 km

Exam practice

1 7 cm
2 a 8 km

15.5 Accurate drawings 2

Purposeful practice 1

a Diagram C shows the net of a cube.
b Students’ answers may vary. There are 11 possible nets of a cube.
2 Students’ own answers, with examples shown below. Measurements should be accurate with sides of length 3.5 cm and 5 cm.

3 Students’ own answers, with examples shown below. Measurements should be accurate with sides of length 3.5 cm and 5 cm.

Purposeful practice 2
(These diagrams are not drawn to scale.)

1  

2

3

Problem-solving practice
1 It is not possible to form a triangle with these side lengths. The third side of a triangle must be smaller than the total of the other two sides. If AB = 8.2 cm and BC = 7.2 cm then AC would have to be smaller than 15.4 cm.

2 30°

3 A scale of 1 cm to 1 m would be appropriate. (This diagram is not drawn to scale.)

4 a The 8 cm rectangles should alternate between 2 cm and 4 cm tall. The squares on the sides should be rectangles 2 cm wide by 4 cm tall.

b (This diagram is not drawn to scale.)

Exam practice
1 Students’ diagrams will vary but should show accurate net, for example (diagram not drawn to scale):

Purposeful practice 1
(These diagrams are not drawn to scale.)

1 a

b

c and d

e and f

Purposeful practice 2
(This diagram is not drawn to scale.)

1 a and b

Purposeful practice 3
1 a and b Accurate scalene triangle with three acute angles and angle bisectors accurately constructed

2 a and b Accurate scalene triangle with one obtuse angle and angle bisectors accurately constructed

3 a and b Accurate scalene triangle with three acute angles and perpendicular bisectors accurately constructed

4 a and b Accurate scalene triangle with one obtuse angle and perpendicular bisectors accurately constructed

Problem-solving practice
1 Angle constructed correctly: extend the original line; draw a circle centred on the end of the line; use the diameter of the circle as a new line and construct the perpendicular bisector of this line.

2 Jenna is nearest to the bottom edge of the field. The distance is 75 m.

3 (This diagram is not drawn to scale.)

4 Angle constructed correctly (by constructing equilateral triangle, then bisecting one of the angles).

5 Circle with two chords marked. Accurate construction of perpendicular bisector for each chord. Centre of circle is point where perpendicular bisectors intersect.
Exam practice
1 Perpendicular bisector accurately constructed
2 (This diagram is not drawn to scale.)

15.7 Loci and regions
Purposeful practice 1
(These diagrams are not drawn to scale.)

1

2

3

4

5

Purposeful practice 2
(These diagrams are not drawn to scale.)

1

2

3

4

5

Problem-solving practice
(These diagrams are not drawn to scale.)

1

2

3

4

5

15.8 Bearings
Purposeful practice 1

1 B 025° C 070° D 115° E 160°
F 205° G 250° H 295° I 340°
2 a 220° b 285° c 330° d 195°

Problem-solving practice
1 a and b (diagram not drawn to scale)
X 10 km

2 a Accurate scale diagram
b 12.8 miles
c 333°
3 a Accurate scale diagram
b Any answer between 252 and 253 km, at a bearing of 206°

Exam practice
1 a 0.6 km b 110° c 235°
2 1 The angle is 50° not 60°.
2 Bearings are always given using three figures, so even if the angle was 60°, the bearing would be written 060°.
16 Quadratic equations and graphs

16.1 Expanding double brackets

Purposeful practice 1
1 \(x^2 + 8x + 7\) 2 \(x^2 + 8x + 7\) 3 \(z^2 - 5z + 6\) 4 \(z^2 - 5z + 6\) 5 \(y^2 + 3y - 4\) 6 \(y^2 + 3y - 4\)

Purposeful practice 2
2 a 18 3 a 12 2 b \(x^2 + 9x + 18\) 4 b \(x^2 + 8x + 12\) 4 a 2 5 a 20 6 a -20 7 b \(x^2 + 8x - 20\) 8 a -6 9 a -10 6 a 4 10 a 11 a 9 12 a 9 13 a 16 10 a 4 11 a 9 12 a 9 13 a 16

Purposeful practice 3
1 \(x^2 - 1\) 2 \(x^2 - 4\) 3 \(x^2 - 9\) 4 \(x^2 - 16\)

Problem-solving practice
1 a A width must be positive, so for \(x - 5\) to be more than 0, \(x\) must be greater than 5.
2 \(x^2 + 8x + 15\)
3 a 2 4 b 2 5 a 6 6 a -6 7 a -10 8 a 4 9 a 9 10 a 4 11 a 9 12 a 9 13 a 16

Exam practice
1 \(n^2 + 9n + 14\)

16.2 Plotting quadratic graphs

Purposeful practice 1
1 a

\[
\begin{array}{c|cccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 \hline
 y= x^2 & 9 & 4 & 1 & 0 & 1 & 4 & 9 \\
 y= x^2 + 1 & 10 & 5 & 2 & 1 & 2 & 5 & 10 \\
 y= x^2 - 2 & 7 & 2 & -1 & -2 & -1 & 2 & 7 \\
 y= 2 + x^2 & 11 & 6 & 3 & 2 & 3 & 6 & 11 \\
\end{array}
\]

Purposeful practice 2
1 a

\[
\begin{array}{c|cccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 \hline
 y= x^2 & 9 & 4 & 1 & 0 & 1 & 4 & 9 \\
 y= x^2 + x & 6 & 2 & 0 & 0 & 2 & 6 \\
\end{array}
\]
Problem-solving practice
1 a

b

3

16.3 Using quadratic graphs
Purposeful practice 1
1 a $x = -2, x = -3$  b $x = 1$

Purposeful practice 2
1 a $x = 0.37, y = -5.37$ (accept answers between $x = 0.35$ and $x = 0.4, y = -5.35$ and $y = -5.4$)

b $x = -6, x = 1$

c $x = -4.56, y = -0.44$ (accept answers between $x = -4.5$ and $x = -4.6$, and between $x = -0.3$ and $x = -0.5$)

Problem-solving practice 1

1

b $x = -0.7, x = 6.7$ (approximately)

c Line at $y = 14$ only touches the graph at one point. Solution is $x = 3$

d $x = 0, x = 6$

16.4 Factorising quadratic expressions
Purposeful practice 1
1 a $(x + 1)(x + 7)$  b $(x - 1)(x + 7)$  c $(x + 1)(x - 7)$

Purposeful practice 2
1 a $(x + 1)(x + 4)$  b $(x - 1)(x - 4)$  c $(x + 2)(x + 2)$

d $(x - 2)(x - 2)$  e $(x - 1)(x + 4)$  f $(x + 1)(x - 4)$

2 a $(x + 1)(x - 6)$  b $(x + 1)(x + 6)$  c $(x + 2)(x + 3)$

d $(x - 2)(x + 3)$  e $(x - 1)(x + 6)$  f $(x + 2)(x + 3)$

3 a $(x + 3)(x - 6)$  b $(x - 2)(x + 9)$  c $(x - 3)(x - 6)$

d $(x + 1)(x + 18)$  e $(x + 2)(x + 9)$  f $(x + 2)(x - 9)$

g $(x - 1)(x - 18)$  h $(x + 3)(x + 6)$  i $(x - 2)(x - 9)$

j $(x + 1)(x - 18)$  k $(x - 3)(x + 6)$  l $(x - 1)(x - 18)$

Problem-solving practice
1 The two answers are equivalent, as the order of two brackets multiplied together is not important. Alternatively, students may give working to show both Ben and Jill’s answers expand to the original quadratic expression.
2 a \((x - 3)(x + 5)\)
b Desi has taken the \(x\) out of the first two terms as a common factor, but
has not factorised all three terms in the expression.
3 a \((x - 3)\) and \((x - 5)\)
b \((x - 7)\) and \((x - 5)\)
c \((x - 7)\) and \((x - 4)\)
4 Students’ answers may vary,
a of form \(x^2 + \alpha\) b of form \(x^2 - \alpha^2\)
5 a \((x + 2)(x - 6) = x^2 - 4x - 12\)
b \((x - 3)(x + 7) = x^2 + 4x - 21\)
c \((x - 5)(x - 1) = x^2 - 6x + 5\)

Exam practice
1 \((x - 3)(x - 3)\)
2 \((x + 3)(x + 2)\)

16.5 Solving quadratic equations algebraically

Problem-solving practice
1 a \(x = 7, x = -7\) bc \(x = 7, x = -7\) d \(x = 7, x = -7\)
2 a \(x = 8, x = -8\) bc \(x = 8, x = -8\) d \(x = 8, x = -8\)

Problem-solving practice 1
1 a 0 b 0 c 0 d 0
e 0 f 0 g 0 h 0
2 a One of \(a\) or \(b\) or both are zero.
b One of \(a\) or \((x - 3)\) or both are zero.
c One of \((x + 4)\) or \((x - 3)\) is zero.
3 a \(x = 0\)  b \(x = 5\)  c \(x = -3\)
d \(x = 5\)  e \(x = 0, x = 5\)  f \(x = 0, x = -3\)
g \(x = -3, x = 5\)  h \(x = -3, x = 3\)

Problem-solving practice 2
1 a \(x = -4, x = -3\)
b \(x = 4, x = -3\)
c \(x = 4, x = 3\)
d \(x = 4, x = 3\)
e \(x = 6, x = -6\)
f \(x = 4, x = -6\)
g \(x = 6, x = 6\)
h \(x = -4, x = -6\)

Problem-solving practice 3
1 a \(x = -4, x = -3\)
b \(x = 4, x = -3\)
c \(x = 4, x = 3\)
d \(x = 4, x = 3\)
e \(x = 6, x = -6\)
f \(x = 4, x = -6\)
g \(x = 6, x = 6\)
h \(x = -4, x = -6\)

Problem-solving practice
1 Every quadratic equation has two solutions. The square root of any number
has a positive and negative value, as the product of two negative numbers
is positive.
2 a \(x^2 + 3\) b \(x = 0, x = -3\) c \(x = -1, x = -2\)
3 a \(x^2 - 16 = 0\) or \(x^2 = 16\)
b \(x^2 + 17x + 72 = 0\)
c \(x^2 + 10x + 25 = 0\)
d \(x^2 + 7x = 0\) or \(x^2 + 7x = 0\)
4 a Either substitute \(x = -2\) into \(x^2 - 3x - 10\) to show it gives zero or
factorise to find both solutions and show that one is \(x = -2\)
b \(x = 5\)
5 a \(x = -13, x = 13\)
b \(x = -19, x = 19\)
c \(x = -25, x = 25\)
6 \(x = -15, x = -15\)
7 Solutions are \(x = -2\) and \(x = 4\). Positive solution is \(x = 4\)
8 \(x = 10\)

The \(x\)-coordinates are 2 and -4.
17 Perimeter, area and volume 2

17.1 Circumference of a circle 1

**Purposeful practice 1**

<table>
<thead>
<tr>
<th>a</th>
<th>37.68 cm</th>
<th>b</th>
<th>37.68 m</th>
<th>c</th>
<th>75.36 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>75.36 cm</td>
<td>e</td>
<td>15.70 m</td>
<td>f</td>
<td>15.70 m</td>
</tr>
<tr>
<td>g</td>
<td>1.57 m</td>
<td>h</td>
<td>157.00 cm</td>
<td>i</td>
<td>157.08 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>a</th>
<th>37.70 cm</th>
<th>b</th>
<th>37.70 m</th>
<th>c</th>
<th>75.40 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>75.40 cm</td>
<td>e</td>
<td>15.71 m</td>
<td>f</td>
<td>15.71 m</td>
</tr>
<tr>
<td>g</td>
<td>1.57 m</td>
<td>h</td>
<td>157.06 cm</td>
<td>i</td>
<td>157.08 cm</td>
</tr>
</tbody>
</table>

**Purposeful practice 2**

<table>
<thead>
<tr>
<th>1</th>
<th>6.28 cm</th>
<th>2</th>
<th>12.57 cm</th>
<th>3</th>
<th>25.13 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>125.66 cm</td>
<td>5</td>
<td>29.53 m</td>
<td>6</td>
<td>20.14 km</td>
</tr>
</tbody>
</table>

**Problem-solving practice**

1. Kasia needs to type 2π × 6; she has missed out the multiplication sign.
2. Jenny has joined the points with straight lines instead of a smooth curve.
3. Hoorain should have worked out the area of each circle separately, then subtracted the smaller area from the larger area. This would give 36π cm².

**Exam practice**

1. a £17500
2. £18499.99

17.3 Area of a circle

**Purposeful practice**

1. a 28.27 cm²  b 113.10 cm²  c 113.10 cm²
2. d 0.09 km²  e 2.54 m²  f 0.64 m²
3. a 256π cm²  b 0.64π m²  c 0.589 m²  d 0.35 m²
4. a 3.99 cm²  b 5.64 cm²  c 7.98 cm²  d 0.89 m
5. a 3 cm  b 9 cm  c 2.5 m  d 1 km

**Exam practice**

1. Area = 36π m² = 113 m², 113 ÷ 23 = 4.9, so Jo must buy 5 boxes.

17.4 Semicircles and sectors

**Purposeful practice 1**

<table>
<thead>
<tr>
<th>1</th>
<th>1/8</th>
<th>2</th>
<th>3/8</th>
<th>3</th>
<th>5/8</th>
<th>4</th>
<th>8/9</th>
<th>5</th>
<th>7/9</th>
<th>6</th>
<th>5/9</th>
</tr>
</thead>
</table>

**Purposeful practice 2**

1. 4.36 cm²  b 1.75 cm²
2. 8.73 cm²  b 3.49 cm²
3. 34.9 cm²  b 6.98 cm²
4. 56.5 m²  b 18.8 m²
5. 339 mm²  b 56.5 mm²
6. 0.885 m²  b 1.36 m²
7. 3.54 m²  b 2.72 m²
8. 1.77 m²  b 2.72 m²

**Problem-solving practice**

1. 3.65 cm²  b 8.02 m²
2. 3.180 cm²  b 411 cm²
3. Work out the area of the whole circle and divide by 2.
4. a 110 cm  b 6.54 cm
5. 0.691 m²

**Exam practice**

1. 8.02 cm²

17.5 Composite 2D shapes and cylinders

**Purposeful practice 1**

<table>
<thead>
<tr>
<th>1</th>
<th>2260 cm²</th>
<th>2</th>
<th>9050 cm²</th>
<th>3</th>
<th>18100 cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.339 m³</td>
<td>5</td>
<td>1.36 m³</td>
<td>6</td>
<td>2.71 m³</td>
</tr>
</tbody>
</table>

**Purposeful practice 2**

<table>
<thead>
<tr>
<th>1</th>
<th>4.08 m²</th>
<th>2</th>
<th>0.589 m²</th>
<th>3</th>
<th>4.52 m³</th>
</tr>
</thead>
</table>

**Purposeful practice 3**

<table>
<thead>
<tr>
<th>1</th>
<th>942 cm²</th>
<th>2</th>
<th>4360 cm²</th>
<th>3</th>
<th>12700 cm² or 1.27 m²</th>
<th>4</th>
<th>175 m²</th>
</tr>
</thead>
</table>

**Problem-solving practice**

<table>
<thead>
<tr>
<th>1</th>
<th>11 300 m²</th>
<th>2</th>
<th>6706 cm²</th>
<th>3</th>
<th>392 cm²</th>
<th>4</th>
<th>7540 m²</th>
<th>5</th>
<th>5 tins</th>
</tr>
</thead>
</table>

**Exam practice**

1. 339 cm³ (to nearest whole cm³)
17.6 Pyramids and cones

**Purposeful practice 1**
1. 18,000 cm$^3$ or 0.018 m$^3$
2. 128,000 cm$^3$ or 0.128 m$^3$
3. 1.5 m$^2$
4. 120,000 cm$^2$ or 0.12 m$^2$

**Purposeful practice 2**
1. 20,000 cm$^3$
2. 83,800 cm$^3$
3. 41,900 cm$^3$
4. 168,000 cm$^3$

**Purposeful practice 3**
1. 0.146π m$^2$
2. 0.159π m$^2$
3. 65π m$^2$

**Problem-solving practice**
1. 260 cm$^3$
2. 2 a 1395 cm$^3$
3. 209.92
4. $\frac{2}{3}$ cm$^3$

**Exam practice**
1. A has the greater volume. Volume of A = 30.8 cm$^3$.
   Volume of B = 29.3 cm$^3$.

17.7 Spheres and composite solids

**Purposeful practice 1**
1. a 36π cm$^3$
   b 36π cm$^3$
2. a 288π cm$^3$
   b 144π cm$^3$
3. a 972π cm$^3$
   b 324π cm$^3$
4. a 2304π cm$^3$
   b 576π cm$^3$

**Purposeful practice 2**
1. a 1436.76 cm$^3$
   b 615.75 cm$^3$
2. a 7696.90 cm$^3$
   b 2507.00 cm$^3$
3. a 9133.66 cm$^3$
   b 2814.87 cm$^3$
4. a 2565.63 cm$^3$
   b 1264.22 cm$^3$

**Problem-solving practice**
1. a 24200 cm$^3$
   b 5660 cm$^3$
2. 3811 cm$^3$
   3 1767 cm$^3$
4. a 244 cm$^3$
   b 214 cm$^3$

**Exam practice**
1. 603.2 cm$^3$

18 Fractions, indices and standard form

18.1 Multiplying and dividing fractions

**Purposeful practice 1**
1. $\frac{21}{4}$
   b $\frac{16}{3}$
   c $\frac{10}{3}$
   d $\frac{11}{3}$
2. $\frac{3}{2}$
   $\frac{121}{9} = 13\frac{4}{9}$
   $\frac{231}{12} = 19\frac{1}{4}$
   $\frac{5}{4}$
   $\frac{231}{12} = 19\frac{1}{4}$
   $\frac{441}{16} = 27\frac{9}{16}$

**Purposeful practice 2**
1. $\frac{1}{4}$
   b $\frac{1}{4}$
   c 4
   d 4
2. 9
   b 6
   c 16
   d 10
3. $\frac{3}{4}$
   $\frac{7}{9}$
   $\frac{9}{35}$
   d $\frac{11}{24}$

4. $\frac{3}{2}$
   $\frac{1}{3}$
   $\frac{5}{4}$
   $\frac{1}{4}$
   $\frac{19}{44}$
   $\frac{1}{4}$

**Problem-solving practice**
1. $\frac{18}{10}$
2. a 3
   b 5
   c 7
   d 11
3. $\frac{3}{5}$
   4
   a $\frac{2}{7}$
   b $\frac{2}{7}$
   c $\frac{2}{13}$
5. a 40 Egyptian pounds
   b $\frac{27}{4} = 6\frac{3}{4}$ pounds

**Exam practice**
1. Students’ reasoning may vary. For example, Tim has calculated $2 \times 6$ and $\frac{3}{7} \times \frac{1}{2}$ but has forgotten to calculate $\frac{3}{7} \times 6$ and $2 \times \frac{1}{2}$.

18.2 The laws of indices

**Purposeful practice 1**
1. a $a^{2}$
   b $a^{2}$
   c $a^{2}$
   d $a^{2}$
   e $a^{2}$
   f $a^{2}$
2. a $a^{2}$
   b $a^{2}$
   c $a^{2}$
   d $a^{2}$
   e $a^{2}$
   f $a^{2}$
3. $\frac{1}{3}$
   2 $\frac{1}{5}$
   3 3
   4 5
   5 $\frac{5}{2}$
   6 $\frac{1}{9}$
7 $\frac{7}{16}$
8 $\frac{1}{25}$
9 9
10 25
11 $\frac{25}{4}$
12 $\frac{125}{8}$

**Purposeful practice 2**
1. a $a^{2}$
   b $a^{2}$
   c $a^{2}$
   d $a^{2}$
   e $a^{2}$
   f $a^{2}$
3. $\frac{1}{3}$
   2 $\frac{1}{5}$
   3 3
   4 5
   5 $\frac{5}{2}$
   6 $\frac{1}{9}$

**Purposeful practice 3**
1. a 1
   b 1
   2 a $\frac{1}{8}$
   b $\frac{3}{8}$
   3 a $\frac{1}{9}$
   b $\frac{1}{9}$

**Purposeful practice 4**
1. $m^{3}$
   2 $m^{4}$
   3 $m^{5}$
   4 $m^{5}$
   5 $m^{5}$
   6 $m^{4}$
   7 $m^{4}$
   8 $m^{5}$
   9 $m^{5}$

**Problem-solving practice**
1. a $a^{2}$
   b $a^{2}$
   c $a^{2}$
   d $a^{2}$
   e $a^{2}$
   f $a^{2}$
3 $a^{2}$
4 a $-3$
   b 2
   c 9
   d 0
5 a $y=6$
   b $y=-1$
   c $y=10$
   d $y=4$

**Exam practice**
1 a $\frac{1}{9}$
   b 1

18.3 Writing large numbers in standard form

**Purposeful practice 1**
1. a $5.2 \times 10^{7}$
   b $5.2 \times 10^{7}$
   c $5.2 \times 10^{7}$
2. a $5.2 \times 10^{8}$
   b $5.2 \times 10^{8}$
   c $5.2 \times 10^{8}$
3. $1.01 \times 10^{2}$
4. a $1.01 \times 10^{2}$
   b $1.01 \times 10^{2}$
   c $1.01 \times 10^{2}$
   d $1.01 \times 10^{2}$
   e $1.01 \times 10^{2}$
   f $1.01 \times 10^{2}$

**Purposeful practice 2**
1. a 3010
   b 3010000
   c 301
   d 30100
   e 30.1
2. a 2050
   b 2500
   c 2005
3. 5210000
   e 5020100
   f 5021000

**Purposeful practice 3**
1. 507, 570, 5007, 5070, 5700
   2. $5.07 \times 10^{2}, 5.7 \times 10^{2}, 5.007 \times 10^{2}, 5.07 \times 10^{2}, 5.7 \times 10^{2}$

**Problem-solving practice**
1. Country | Population
--- | ---
Canada | 3.62864 × 10^{7}
India | 1.339 × 10^{8}
Thailand | 6.7959 × 10^{7}
Monaco | 3.84 × 10^{4}
Exam practice

1 a 25 630 b 8 093
d 4.3 × 10⁷ b 4 050 6 × 10⁶

18.4 Writing small numbers in standard form

Purposeful practice 1

1 a 5.2 × 10⁻¹  b 5.2 × 10⁻²  c 5.2 × 10⁻⁴  d 5.2 × 10⁻⁷
2 a 1.025 × 10⁻³  b 1.025 × 10⁻⁴  c 9.52 × 10⁻⁵  d 9.52 × 10⁻⁶
3 a 4.04 × 10⁻³  b 4.4 × 10⁻⁴  c 4.04 × 10⁻⁵  d 4.4 × 10⁻⁶

Purposeful practice 2

1 a 0.0035 b 0.35 c 0.000 000 35 d 0.035
2 a 0.0190 f 0.109 g 0.000 000 250 8 h 0.02508
3 a 0.0103 j 0.13 k 0.000 000 000 3 I 0.01003

2 As an ordinary number: 0.000 031, 0.003 011, 0.003 011, 0.003 012

3 As an ordinary number: 0.065 1, 0.065 1, 0.065 1, 0.065 14

4 In standard form: 10² × 10⁻¹, 1.2 × 10⁻³, 1002 × 10⁻⁴, 1.2 × 10⁻⁴

4 In order (smallest first): 1.2 × 10⁻⁴, 10² × 10⁻¹, 1002 × 10⁻⁴, 1.2 × 10⁻⁴

5 In standard form: 7.008 × 10⁻³, 78.10 × 10⁻⁴, 708.10 × 10⁻⁴, 7.810 × 10⁻⁶

In order (largest first): 78.10 × 10⁻⁴, 708.10 × 10⁻⁴, 7.008 × 10⁻³, 7.810 × 10⁻⁶

Problem-solving practice

1 a 2.5 × 10¹ litres  b 5.0 × 10⁻¹ litres  c 1.2 × 10¹ litres
2 a 3.5 × 10⁻¹ litres  b 1.5 × 10⁻¹ litres

2 Students could correct either side of the equals sign.

a 500 = 5 × 10⁰ 
0.005 = 5 × 10⁻²

b 0.0021 = 21 × 10⁻⁴ 
0.0021 > 21 × 10⁻⁴

3 a 0.000 02 = 2 × 10⁻⁴ 
0.000 02 > 5 × 10⁻⁵

3 Robyn is already correct.

4 a 4.1 × 10⁻¹ 
1.5 × 10⁻¹

4 b 6.5 × 10⁻⁵
4.1 × 10⁻¹

4 c 2.3 × 10⁻⁴
6.5 × 10⁻⁵

4 a James: The power should be –4 not 4.

Hannah: The initial number should be 4.06 not 4.6.

Katy: The initial number 40.6 in standard form should be between 1 and 10 so should be 4.06 and so the power needs to be –4.

b 4.06 × 10⁻⁴

Exam practice

1 a 0.017 b 0.007 34
d 2.5 × 10⁻²

18.5 Calculating with standard form

Purposeful practice 1

1 a and b are both 7 × 10⁵ c and d are both 7 × 10⁵
2 All answers are 9.8 × 10⁵

Purposeful practice 2

Answers to Q1–3 are the same:
1 1.6 × 10⁻² 2 1.6 × 10⁻³ 3 1.6 × 10⁻⁵

Purposeful practice 3

1 a 3 × 10⁻²  b 3 × 10⁻⁵  c 3 × 10⁻²
2 a 3 × 10²  b 3 × 10⁵  c 3 × 10²
2 a 3 × 10⁵  e 1.2 × 10³
2 a 4 × 10¹  b 4 × 10⁰  c 4 × 10⁻²  d 4 × 10⁻⁵
2 a 4 × 10⁻²  f 4 × 10⁻²
e a 1600 b 16 000 c 160

Problem-solving practice

1 a Alpha Centauri is 3.78 × 10¹³ km away
b Procyon is 1.026 × 10¹⁰ km away
2 a 2.3 × 10⁻⁶ kg  b 1.15 × 10⁻⁶ kg
3 3.01 × 10⁻⁷

1 b 3 × 10⁻³ m³  b 400 = 4 × 10²

5 Students’ working may vary, for example.
a Time for light to reach Earth from the Sun = (1.496 × 10¹³) ÷ (3 × 10⁸)
= 0.5 × 10³ = 500 seconds

500 seconds = (500 ÷ 60) minutes = 8.3 minutes.
So, light takes about 8 minutes to reach Earth from the Sun.

b The distance from the Moon to Earth is about 1/400 of the distance from the Sun to Earth, so the time light takes to travel from the Moon to Earth = 500 + 400 seconds = 125 seconds

Exam practice

1 8 × 10⁻³  2 7.452 × 10⁻³  3 3.7 × 10⁴

19 Congruence, similarity and vectors

19.1 Similarity and enlargement

Purposeful practice 1

1 Set 1 a 1 : 2, 2  b 1 : 4, 4  c 2 : 1  d 4 : 1
2 Set 1 a 1 : 2, 2  b 1 : 4, 4  c 2 : 1  d 4 : 1

Purposeful practice 2

1 Corresponding angles: angle BAC and angle EFD, angle ABC and angle FDE, angle ACB and angle FED
Coexisting sides: AB and FD, AC and FE, BC and DE

2 Corresponding angles: angle PMN and angle OTR, angle MNP and angle TRQ, angle MPN and angle TQR
Coexisting sides: MP and TO, NP and RQ, MN and TR

3 Corresponding angles: angle UVW and angle XZY, angle UWV and angle YXZ, angle UVW and angle XZY
Coexisting sides: UV and XZ, UW and YZ, WV and XY

Problem-solving practice

1 A and C are similar rectangles because they have corresponding sides in a ratio of 2 : 3

2 B and D are similar triangles because they have corresponding angles and sides in a ratio of 1 : 3

3 Q1 ratio of corresponding sides is 2 : 3

Q2 ratio of corresponding sides is 1 : 3

Exam practice

1 All sides correspond in a ratio of 9 : 2

19.2 More similarity

Purposeful practice 1

1 Scale factor = 2, a = 6 cm
2 Scale factor = 2, b = 4 cm
3 Scale factor = 1.5, c = 7.5 cm
4 Scale factor = 0.5, d = 4.5 cm
5 Scale factor = 0.4, e = 1.6 cm

Purposeful practice 2

1 angle CED 2 angle CDE 3 angle ECD
4 CE 5 CD 6 DE
7 a 2 b 2 c 2

Problem-solving practice

1 6 cm 2 1 cm

Exam practice

1 a 2.86 cm b 9.5 cm
19.3 Using similarity
Purposeful practice 1
1 Yes 2 No 3 No 4 Yes
5 No 6 Yes 7 Yes

Purposeful practice 2
1 1 : 3 \(\frac{1}{3}\) 2 48 mm 3 144 mm 4 1 : 3 \(\frac{1}{3}\)

Problem-solving practice
1 a 24 cm b 24 cm c 40.5 cm
2 33 cm 3 48 cm 4 80 cm

Exam practice
1 a 15.5 cm b 4.6 cm

19.4 Congruence 1
Purposeful practice
1 a SAS b RHS c ASA
2 Yes, BC = DE, AC = FE, AB = FD
3 A and C

Problem-solving practice
1 Yes, by RHS. XY = XZ. Angle XMY = angle XMZ = 90°, XM shared.
2 \(x = 30°, y = 55°\)
3 \(x = 40°\). Students’ working may vary, for example, the two triangles are congruent (SSS), so the two unmarked angles in the bottom triangle are 120° and 20°. Angles in a triangle add up to 180°, so \(x = 180° - 120° - 20° = 40°\)

Exam practice
1 a 3 cm b i 30° ii 80°

19.5 Congruence 2
Purposeful practice
1 a

i Angles are 90°, 35° and 55°.
ii AB = EF, AC = ED, BC = FD

b

i Angle MNO = 91°, angle QPO = 52°
ii MN = PQ, NO = QO, MO = PO
2 a AB = ZY, BC = YX, angle ABC = angle ZXY, congruent by SAS
b PR = MN, PQ = MO, angle PQR = angle MON = 90°, congruent by RHS
c GI = LK, angle HGI = angle JKL, angle GHJ = angle LKJ, congruent by ASA

Problem-solving practice
1 Students’ own answers, for example, BD is a common side, AD = CB (opposite sides in a rectangle are equal), angle BAD = angle BCD = 90° (angles in a rectangle are 90° degrees), so triangles are congruent by RHS.
2 Students’ own answers, for example, FH is a common side, EF = GH (opposite sides in a parallelogram are equal), FG = HE (opposite sides in a parallelogram are equal), so triangles are congruent by SSS.
3 Students’ own answers, for example, \(xW = ZY\) (given), angle WXV = angle YZV (alternate angles are equal), angle XWV = angle ZYV (alternate angles are equal), so triangles are congruent by ASA.

Exam practice
1 a 6 cm b c 5 cm

19.6 Vectors 1
Purposeful practice 1
1 a \(\frac{3}{2}\) b \(\frac{-2}{3}\) c \(\frac{-2}{3}\) d \(\frac{2}{-3}\) e \(\frac{2}{-3}\)

Purposeful practice 2
1 a \(\frac{3}{8}\) b \(\frac{-1}{2}\) c \(\frac{1}{2}\) d \(\frac{3}{-8}\) e \(-3\) f \(-8\)
2 a AC b AB c BD d OE e XZ f OY

Problem-solving practice
1 a \(\frac{4}{1}\) b \(-\frac{1}{6}\) c \(\frac{3}{2}\) d \(\frac{4}{4}\)
2 a \(x = 5\) b \(x = 2, y = 7\) c \(x = 4, y = -9\) d \(x = 5, y = 14\)
3 a \(\frac{2m + 1}{3m + 8}\) b \(\frac{4}{-9}\) c \(\frac{6}{-9}\) d \(\frac{-2}{8}\)

Exam practice
1 \(\frac{9}{5}\)

19.7 Vectors 2
Purposeful practice 1
1 a \(\frac{1}{5}\) b \(\frac{2}{4}\) c \(-\frac{1}{5}\) d \(-\frac{4}{1}\)
6 \(\frac{-4}{-2}\) 7 \(-\frac{1}{-4}\) 8 \(-\frac{1}{4}\) 9 \(-\frac{1}{4}\)

Purposeful practice 2
1 a \(-\frac{6}{10}\) b \(-\frac{9}{15}\) c \(\frac{3}{-5}\) d \(-\frac{4}{1}\)
2 a \(-\frac{8}{2}\) b \(-\frac{16}{4}\)
3 a \(\frac{5}{0}\) b \(\frac{11}{-14}\)
3 a \(\frac{8}{12}\) b \(\frac{16}{24}\) c \(-\frac{12}{-18}\) d \(-\frac{1}{3}\)

Problem-solving practice
1 a b c d e

2 a \(x = 3, y = 2\) b \(y = 4\)
3 x = 8, y = 5
4 x = -2, y = 2
5 p = 4, q = 1

Exam practice
1 \(\frac{9}{-2}\)
20.1 Graphs of cubic and reciprocal functions

Purposeful practice 1

1 a \( y = x^3 + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 x^3 + 1 & -26 & -7 & 0 & 1 & 2 & 9 & 28 \\
\end{array}
\]

b \( y = x^3 - x + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 x^3 - x + 1 & -23 & -5 & 1 & 1 & 1 & 7 & 25 \\
\end{array}
\]

c \( y = x^3 + x^2 - x + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 x^3 + x^2 - x + 1 & -14 & -1 & 2 & 1 & 2 & 11 & 34 \\
\end{array}
\]

d \( y = x^3 + x^2 - x - 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 x^3 + x^2 - x - 1 & -16 & -3 & 0 & -1 & 0 & 9 & 32 \\
\end{array}
\]

e \( y = -x^2 + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 -x^2 + 1 & 28 & 9 & 2 & 1 & 0 & -7 & -26 \\
\end{array}
\]

f \( y = -x^2 + 2x + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 -x^2 + 2x + 1 & 22 & 5 & 0 & 1 & 2 & -3 & -20 \\
\end{array}
\]

g \( y = -x^3 - x^2 + 2x + 1 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 -x^3 - x^2 + 2x + 1 & 13 & 1 & -1 & 1 & 1 & -7 & -29 \\
\end{array}
\]

h \( y = -x^3 - x^2 + 2x - 3 \)

\[
\begin{array}{c|ccccccc}
 x & -3 & -2 & -1 & 0 & 1 & 2 & 3 \\
 -x^3 - x^2 + 2x - 3 & 9 & -3 & -5 & -3 & -3 & -11 & -33 \\
\end{array}
\]
Purposeful practice 2

1 a \( y = \frac{2}{x} \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>0.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

1 b \( y = \frac{3}{x} \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
<td>3</td>
<td>1.5</td>
<td>1</td>
<td>0.75</td>
<td>0.6</td>
<td>0.3</td>
</tr>
</tbody>
</table>

1 c \( y = \frac{4}{x} \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>5</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.8</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Problem-solving practice

1 a Graph ii shows \( y = \frac{5}{x} \) b Graph i shows \( y = \frac{8}{x} \)

2 a Graph iii b Graph iv c Graph i d Graph ii

Exam practice

1 a \( \frac{13 m/s}{s} \) b \( 20 m/s \) c \( 7 \text{ seconds and 15 seconds} \)

20.2 Non-linear graphs

Purposeful practice 1

1 a 100 ants b 200 ants c Month 5
2 a 100°C b 22°C c 3 minutes and 48 seconds d 56°C
3 a Initial/starting height is 40 cm. b Initial distance is 40 km.
   c Initial balance/amount saved is £40. d Initial temperature is 40°C.

Problem-solving practice

1 a Approximately 3\(1\frac{1}{4} \) hours b 60
2 a 3.6 kg b Week 6 and week 7
3 31 m

Exam practice

1 a \( 13 m/s \) b \( 20 m/s \) c \( 7 \text{ seconds and 15 seconds} \)

20.3 Solving simultaneous equations graphically

Purposeful practice 1

1 a

<table>
<thead>
<tr>
<th>( x )</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>2</th>
<th>3.5</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>11</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>-1</td>
</tr>
</tbody>
</table>

b Students’ own answers, for example, \( x = 1, y = 5 \) and \( x = 5, y = -3 \)

c \( x = 2 \) and \( y = 3 \)

e \( x = 2 \) and \( y = 3 \). This is the same as the answer to Q1c. The point at
   which the two lines intersect is the only point where both equations are
   satisfied.

f Students’ own answers, for example, I found eight pairs of values but
   the line extends beyond the graph I have drawn so there are infinite
   possible pairs.

g There are infinite possible solutions to \( 2x + y = 7 \) but only one that also
   satisfies \( x + y = 5 \).

Purposeful practice 2

1 a

<table>
<thead>
<tr>
<th>( x )</th>
<th>0.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
<td>0.75</td>
<td>0.6</td>
<td>0.5</td>
</tr>
</tbody>
</table>

\( x = 4, y = 2 \)
Problem-solving practice
1 Students’ own answers – any two graphs that intersect at (4, 1), for example, graphs to show equations: \(x + y = 5\) and \(x - y = 3\)
2 \(x = -3, y = 4\). Students may or may not draw a graph.
3 \(-0.5\) and \(9.5\). Students may or may not draw graphs of \(x + y = 9\) and \(x - y = 10\)
4 \(x = 7, y = 5\). Students may or may not draw a graph showing \(2x - 3y = -1\) and \(3x - 2y = 11\)

Exam practice
1 a

Problem-solving practice
1 \(x = 4, y = 3\)
2 a Danny has not multiplied the total of \((2)\) by 3
   b Correct working to give \(x = 7\) and \(y = 2\)
3 Students’ own answers, for example, \(2x - y = 8\) and \(x + 3y = 11\).
4 Solution from graph is \( x = -1, y = 5 \)

Students’ own working to show solution algebraically is \( x = -1, y = 5 \).

The answers should be the same.

5 317 and 586

6 Using simultaneous equations, adult ticket is £12 and child ticket is £6.

So, adult ticket costs twice as much as child ticket. Students may use another method.

**Exam practice**

1 \( x = -0.5, y = -3 \)

20.5 Rearranging formulae

**Purposeful practice**

\[
\begin{align*}
1 \quad & a = \frac{m}{3} \\
& b = 2p + \frac{n}{9} \\
& c = \frac{p}{4} \\
& d = \frac{r}{4m} \\
& e = \frac{v}{x} \\
& f = \frac{w}{x} \\
& g = \frac{x}{n} \\
& h = \frac{2y}{x} \\
& i = \frac{2y}{n} \\
2 \quad & a = 3c \\
& b = 10d \\
& c = as \\
& d = abf \\
& e = \frac{1}{s} \\
& f = \frac{r}{m} \\
& g = \frac{r}{n} \\
& h = \frac{4s}{p} \\
& i = \frac{4r}{a} \\
3 \quad & a = x + a - b \\
& b = ax - b \\
& c = x + b \\
& d = x - a \\
& e = \frac{x + a}{3} \\
& f = \frac{x - a}{3} \\
& g = \frac{a + c}{3} \\
& h = \frac{k + b}{3} \\
& i = \frac{2r}{a} \\
& j = \frac{x}{y} \\
4 \quad & a = \frac{C}{3} \\
& b = \frac{\sqrt{x}}{3} \\
5 \quad & a = \frac{D}{3} \\
\end{align*}
\]

**Exam practice**

1 \( n = \frac{D - 5}{3} \)

2 \( x = 2(y + 3z) \)

2.6 Proof

**Purposeful practice 1**

1 Ensure students have expanded and simplified correctly.

2 \( a = x^2 + 3x + 2 - x^2 - x = 2x + 2 = 2(x + 1) \)

**Purposeful practice 2**

1 Even number: \( 2n \)

Odd number: \( 2n + 1 \)

Multiple of 3: \( 3n \)

3 consecutive integers: \( n + n + 1 + n + 2 \)

2 \( a = n + n + 1 = 2n + 1 \). 2n is even, so \( 2n + 1 \) is odd.

b \( 2m + 2n = 2(m - n) \) which is a multiple of 2, so even.

c \( 2n + 1 = (2m + 1) - 2m - 1 = 2n - 2m = 2(n - m) \) which is a multiple of 2, so even.

d \( 2n + 1 = 2m = 2n - 2m + 1 = 2(n - m) + 1 \) which is a multiple of 2, plus 1, so odd.

**Problem-solving practice**

1 a Students’ answers will vary, for example, \( 1 + 2 + 3 = 6 \), which is a multiple of 3.

b Three consecutive integers are \( a, a + 1, a + 2 \)

\( a + a + 1 + a + 2 = 3a + 3 = 3(a + 1) \), which is a multiple of 3.