## Answers

### 1 Angles

#### Practise... 1.1 Angles

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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>90°</td>
<td>b</td>
<td>120°</td>
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<tr>
<td></td>
<td>c</td>
<td>60°</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>a</td>
<td>1/12</td>
<td>b</td>
<td>1/8</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>1/4</td>
<td>d</td>
<td>1/2</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>South</td>
<td>b</td>
<td>South</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>South</td>
<td>d</td>
<td>East</td>
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<tbody>
<tr>
<td>4</td>
<td>a</td>
<td>obtuse (between 90° and 180°)</td>
<td>b</td>
<td>acute (less than 90°)</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>acute (less than 90°)</td>
<td>d</td>
<td>reflex (between 180° and 360°)</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>obtuse (between 90° and 180°)</td>
<td>f</td>
<td>acute (less than 90°)</td>
</tr>
<tr>
<td></td>
<td>g</td>
<td>reflex (between 180° and 360°)</td>
<td>h</td>
<td>acute (less than 90°)</td>
</tr>
<tr>
<td></td>
<td>i</td>
<td>obtuse (between 90° and 180°)</td>
<td>j</td>
<td>reflex (between 180° and 360°)</td>
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#### Practise... 1.2 Angles and lines

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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>28°</td>
<td>c</td>
<td>65°</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>95°</td>
<td>d</td>
<td>26°</td>
</tr>
<tr>
<td></td>
<td>f</td>
<td>15°</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>a</td>
<td>210°</td>
<td>d</td>
<td>116°</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>100°</td>
<td>e</td>
<td>64°</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>100°</td>
<td>f</td>
<td>145°</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>45°</td>
<td>d</td>
<td>58°</td>
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<tr>
<td></td>
<td>b</td>
<td>135°</td>
<td>e</td>
<td>116°</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>45°</td>
<td>f</td>
<td>64°</td>
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<tr>
<td>4</td>
<td>e</td>
<td>67°</td>
<td>h</td>
<td>55°</td>
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<tr>
<td></td>
<td>f</td>
<td>60°</td>
<td>k</td>
<td>70°</td>
</tr>
<tr>
<td></td>
<td>g</td>
<td>72°</td>
<td>l</td>
<td>32°</td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>108°</td>
<td>b</td>
<td>72°</td>
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<tr>
<td></td>
<td>c</td>
<td>110°</td>
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<tbody>
<tr>
<td>6</td>
<td>a</td>
<td>p</td>
<td>85°</td>
<td>q</td>
</tr>
<tr>
<td></td>
<td>r</td>
<td>85°</td>
<td>s</td>
<td>95°</td>
</tr>
<tr>
<td></td>
<td>w</td>
<td>135°</td>
<td>x</td>
<td>45°</td>
</tr>
<tr>
<td></td>
<td>y</td>
<td>142°</td>
<td>z</td>
<td>55°</td>
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#### Practise... 1.3 Angles and parallel lines

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<tbody>
<tr>
<td>1</td>
<td>x = 135°</td>
<td>y = 52°</td>
<td>z = 140°</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>p = 110° (corresponding angles)</td>
<td>q = 95° (corresponding angles)</td>
<td></td>
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<tr>
<td></td>
<td>r = 80° (corresponding angles or angles on a straight line)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>s = 100° (corresponding angles)</td>
<td></td>
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<tr>
<td>3</td>
<td>x = 105° (allied angles)</td>
<td>y = 83° (alternate angles)</td>
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<td></td>
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<tr>
<td></td>
<td>z = 142° (allied angles)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>a = 72° (alternate angles)</td>
<td>b = 72°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(corresponding or vertically opposite)</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>c = 115° (corresponding angles)</td>
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<tbody>
<tr>
<td></td>
<td>d</td>
<td>65° (angles on a straight line)</td>
<td>e</td>
<td>115° (alternate or vertically opposite angles)</td>
</tr>
<tr>
<td></td>
<td>iii</td>
<td>f = 88° (corresponding angles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>g = 88° (vertically opposite angles)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>h = 60° (allied angles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i = 60° (vertically opposite angles)</td>
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<tbody>
<tr>
<td>5</td>
<td>a</td>
<td>Yes, corresponding angles are equal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Yes. Allied angles add up to 180°</td>
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<tbody>
<tr>
<td>6</td>
<td>a</td>
<td>a = 105°</td>
<td>b</td>
<td>68°</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>112°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>137°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>p = 85°</td>
<td>q = 85°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>r = 85°</td>
<td>s = 95°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>w = 135°</td>
<td>x</td>
<td>45°</td>
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<tr>
<td></td>
<td>y</td>
<td>142°</td>
<td>z</td>
<td>55°</td>
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Practise... 1.4 Bearings

1

\[ \begin{array}{ccc}
\text{a} & 115^\circ & \text{c} & 270^\circ & \text{e} & 228^\circ \\
\text{b} & 029^\circ & \text{d} & 286^\circ & \text{f} & 009^\circ \\
\end{array} \]

2 angles drawn within 2°

3 \[ 258^\circ \]

4 \[ 70^\circ \]

5 \[ \begin{array}{ccc}
\text{a} & H_1 & \text{b} & 080^\circ & \text{c} & 205^\circ \\
\end{array} \]

Practise... 1.5 Angles and triangles

1

\[ \begin{array}{ccc}
\text{a} & A, E & \text{b} & B, C, F & \text{c} & D \\
\text{d} & B & \text{e} & 50^\circ & \text{f} & 20^\circ \\
\end{array} \]

2 \[ \begin{array}{ccc}
\text{a} & 50^\circ & \text{c} & 20^\circ & \text{e} & 9^\circ \\
\text{b} & 78^\circ & \text{d} & 125^\circ & \text{f} & 40^\circ \\
\end{array} \]

3 \[ 56^\circ \text{ and } 68^\circ \]

4 \[ a = 104^\circ, \quad c = 139^\circ, \quad e = 108^\circ \\
b = 66^\circ, \quad d = 41^\circ, \quad f = 113^\circ \]

5 \[ a = 116^\circ \text{ (sum of opposite interior angles)} \\
b = 90^\circ \text{ (angles on a straight line)} \\
c = 137^\circ \text{ (sum of opposite interior angles)} \]

Assess 1

1

\[ \begin{array}{ccc}
\text{a} & \frac{1}{4} & \text{b} & \frac{3}{8} & \text{c} & \frac{1}{6} \\
\end{array} \]

2 \[ \begin{array}{ccc}
\text{a} & \text{two of } 17^\circ, 39^\circ, 82^\circ & \text{b} & 122^\circ \text{ and } 97^\circ \\
\text{c} & \text{two of } 242^\circ, 305^\circ, 196^\circ \\
\end{array} \]

3 \[ a = 146^\circ, \quad b = 34^\circ, \quad c = 155^\circ, \quad d = 28^\circ \]

4 \[ 180^\circ \text{ on a straight line } 35 + 75 + 80 = 190 \text{ so } ABC \text{ is not a straight line.} \]

5 \[ a = 41^\circ \text{ acute}, \quad b = 89^\circ \text{ acute}, \quad c = 99^\circ \text{ obtuse} \]

6 \[ x = 40^\circ \]

7 Angle \( \angle A = 180^\circ - 65^\circ - 50^\circ = 65^\circ \)

Two angles are equal so the triangles is isosceles.

8 \[ B = 51^\circ, \quad C = 39^\circ \]

9 \[ a = 72^\circ \text{ (corresponding)} \\
b = 108^\circ \text{ (angles on a straight line)} \\
c = 105^\circ \text{ (vertically opposite angles)} \\
d = 68^\circ \text{ (angles on a straight line and corresponding or alternate angles)} \\
e = 18^\circ \text{ (alternate angles)} \]

10 \[ a = 064^\circ, \quad b = 192^\circ, \quad c = 314^\circ \]

11 \[ a = 39^\circ, \quad b = 309^\circ \]

12 Angle \( \angle B = \frac{1}{2} (180^\circ - 30^\circ) = 75^\circ \)

The two angles of \( 75^\circ \) are alternate angles so \( \overline{XA} \) is parallel to \( \overline{BC} \).

13 \[ a = 224^\circ, \quad b = 012^\circ, \quad c = 134^\circ \]

AQA Examination-style questions

1

\[ \begin{array}{ccc}
\text{a} & \text{isosceles} & \text{b} & 65^\circ & \text{c} & 50^\circ \\
\end{array} \]

2 \[ \begin{array}{ccc}
\text{a} & 110^\circ & \text{b} & 130^\circ & \text{c} & 28^\circ \\
\end{array} \]

3 \[ a = x = 128^\circ \text{ corresponding angles} \quad b = y = 95^\circ \]

4 \[ a = E, \quad b = C, \quad c = 65^\circ \]
Types of numbers

Practise... 2.1 Place value

1  a  i  300  ii  30  iii  3000
   b  i  70 000  ii  70 000  iii  70 000 000

2  a  two thousand seven hundred and forty-six
   b  i  70 000  ii  700 000  iii  7 000 000

3  a  80 000 000  e  2067  i  6074 905
   b  80 000  f  15 907  j  20 400 000
   c  18 000  g  345 000
   d  5429  h  130 500

4  170 000, 782 000, 7 000 000, 17 000 000

5  a  two hundred and forty-seven
   b  two hundred thousand and forty-seven
   c  2047

6  a  i  and ii 852, 825, 582, 528, 285, 258
   b  i  and ii 1367, 1376, 1637, 1673, 1736, 1763, 3167, 3176, 3617, 3671, 3716, 3761, 6137, 6173, 6317, 6371, 6713, 6731, 7136, 7163, 7316, 7361, 7613, 7631

7  a  3000  b  30

8  a  Mont Blanc, Monte Rosa, Dom, Matterhorn
   b  four thousand, eight hundred and seven metres

9  a  98 514  c  49 851
   b  14 589  d  14 985

10  a  i  425 000 000  iv  1 500 000
    ii  500 000  v  35 600 000
    iii  250 000  vi  7 000 000 000
    b  i  42 500 000  iv  15 000 000
       ii  50 000  v  3 560 000
       iii  25 000  vi  7 000 000 000
    c  i  42 500 000 000  lv  15 000 000
       ii  5 000 000  v  3 560 000
       iii  25 000  vi  7 000 000 000

11  a  and b

City Population Left-handed
--- --- --- ---
London  7 500 000  750 000
Newcastle  250 000  25 000
Leeds  75 000  75 000
Portsmouth  20 000  20 000

Practise... 2.2 Working with whole numbers

1  a  81  c  919  e  605  g  6726
   b  156  d  442  f  860  h  421

2  a  27  c  56  e  286  g  3119
   b  18  d  122  f  552  h  4126

3  a  54, 46  b  86, 46  c  86 + 63 + 54 = 203

4  a  Six different pairs of numbers that have a sum of 100
   b  Six different pairs of numbers that have a difference of 25

5  a  80  f  1224  k  27  p  78 r8
   b  324  g  1156  l  292  q  25
   c  280  h  4396  m  117 r1  r  31
   d  126  i  14  n  94  s  45
   e  735  j  16  o  118 r5  t  17

6  a  1170  c  2656  e  2028  g  6045
   b  918  d  3198  f  4042  h  6794

7  a  Two of the following: 16 × 2, 2 × 16, 1 × 32, 32 × 1
   b  i  3200  ii  32 000  iii  80

8  a  1620 from 45 × 36
   b  280 from 5 × 7 × 8

9  a  Six of these: 1 × 120, 2 × 60, 3 × 40, 4 × 30, 5 × 24, 6 × 20, 8 × 15, 10 × 12, 12 × 10, 15 × 8, 20 × 6, 24 × 5, 30 × 4, 40 × 3, 60 × 2, 120 × 1
   b  Six different divisions with an answer of 12, for example, 12 ÷ 1, 24 ÷ 2, 36 ÷ 3, 48 ÷ 4, 60 ÷ 5, 72 ÷ 6
10 a Carol has worked out 9 - 6 instead of 6 - 9 and 4 - 0 instead of 0 - 4. In each column, she has just taken the low digit from the high digit. Imran has not taken 1 from the tens column to use with the units.
   b 457

11 a Sally has carried the wrong digits (3 instead of 6 in 63 and 9 instead of 5 in 59). Mike has lost a zero at the end of 560 (in 7 ÷ 80).
   b 623

### Practise... 2.3 Order of operations

1 a 24 c 28 e 17 g 0 i 13 k 6
   b 10 d 2 f 10 h 21 j 29 l 10
2 a false (30) d false (28) g false (7)
   b true e false (7) h true
c true f false (2)
3 a 4 b 2 c 2 d 2

No. 8 - (3 - 2) = 8 - 1 = 7 and 8 - 3 - 2 = 5 - 2 = 3

5 a (2 + 3) × 4 = 20
   b 15 ÷ (3 + 2) = 3
   c 12 - (9 - 2) = 5
d (15 + 7 - 2) ÷ 5 = 4
e 15 + (7 - 2) + 5 = 16
   f (8 - 3) × (6 - 2) = 20

6 a 4 × 3 + 8 = 20
   b 4 × (3 + 5) = 32
c (12 - 6) ÷ 3 = 2
d 12 - 6 + 2 = 9
e (12 + 8) ÷ 4 - 2 = 3
   f 12 + 8 + 4 - 11 = 3

### Practise... 2.4 Positive and negative integers

1 a 2°C, 1°C, 0°C, 1°C, -1°C, -2°C
   b 8°C, 6°C, 3°C, 0°C, -7°C, -9°C
   c 26°C, 23°C, 14°C, 5°C, -8°C, -10°C, -15°C
2 a 17°C, 20°C
   b -4°C, -23°C, -5°C, -12°C
c -23°C, -12°C
d 9°C, -4°C, 17°C, 20°C
3 a -8, -4, -3, +1, +5, +6, +9
   b -27, -19, -16, -10, 0, 11, 18
c -145, -103, -98, 47, 84, 134, 260

4 a +5, +9
c -8
   b -8, -1, -4, -3
d +2, +5, -1, +9

5 No. -16 is less than 0 and so less than the positive number 15.

6 a -5 > -8
c -5 < 2
e -9 < 9
   b -4 < -3
d 7 > -7
7 a -2, -1, 0, +1, +2, +3, +4, +5 b 10
Practise... 2.5 Adding and subtracting positive and negative integers

1 a 1°C b −5°C c −3°C d −5°C
2 a 3 b −3 c −8 d −5
3 Sunday 6°C Monday 9°C Tuesday 10°C Wednesday 8°C Thursday 6°C Friday 4°C Saturday 5°C
4 a −4 b −6 c 2 d −11
5 a i 7 ii 6 iii 5 iv 4 v 3 vi 2 vii 1
6 a 3 b 5 c −5 d −3 e 5 f −1 g −4 h 5
7 Yes. Both give −6
8 a −2, −4, −6 b 1, 4, 7
9 a 8 b −6 c −5

Practise... 2.6 Multiplying and dividing positive and negative integers

1 a 15 b −12 c 40 d 14 e 35 f −32 g −42 h 72
2 a 4 b −8 c 6 d 8 e −9 f 4
3 a, c, f, h, j, n, o and p are correct.
   b −16 e 28 i 27 l 5
   d 12 g −63 k −3 m 6
4 a −5 b −7 c 0 d 8 e −9 f 4 g −1 h 4
5 Yes. Both give −35
6 a +1 × −16 +2 × −8 +4 × −4 +8 × −2 +16 × −1
   b −1 × −20 −2 × −10 −4 × −5 −5 × −4 −10 × −2 −20 × −1
   1 × 20 2 × 10 4 × 5 5 × 4 10 × 2
   20 × 1
7 a −10 b 12 c −6 d −2
8 a −100 b −282 c 2560 d −390 e −47 f 24 g −55 h 48
9 a Rory 12 points
   Ann 16 points
   Neil 8 points
   Kath −10 points
   Peter −3 points
   Moira −5 points
   b i 24 points ii −12 points
   c i 5 correct (7 incorrect)
   ii 1 correct (11 incorrect)
   iii 10 correct (2 incorrect)
   iv 3 correct (9 incorrect)
10 a −2 and −6 b 2 and −9 c −3 and −8

Practise... 2.7 Factors and multiples

1 a 2, 4 b 2, 3, 4, 6 c 2, 4, 5 d 2, 4, 7 e 2, 3, 4, 6, 7 f all of them
2 a 1, 2, 4 c 1, 2, 5, 10 b 1, 3, 9 d 1, 2, 3, 6, 9, 18 e 1, 5, 25 f 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
3 a 4, 8, 12, 16, 20 c 7, 14, 21, 28, 35 b 6, 12, 18, 24, 30 d 8, 16, 24, 32, 40
4 a i 10, 20, 30, 40, 50, 60 ii All end in 0
   b i 5, 10, 15, 20, 25, 30
5 a 9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99, 108
   Digit sum is 9
   b 153, 207, 378, 3789
   c Students’ own working
d The digit sum is 9
6 a 1, 3 c 1, 7 e 1, 5
   b 1, 2, 4 d 1, 2, 3, 4, 6, 12 f 1, 2, 3, 6
7 a −11 b −34 c 63 d 13 e −77 f 75 g −26
   b −34 d 13 f 75 h −8
8 a Athens b Moscow c i 3°C d −8°C e 3°C f 5°C g 7°C h 12°C
9 a 32m b 31m c i 1011m ii 1057m
10 a −11 b −34 c 63 d 13 e −77 f 75 g −26
   b −34 d 13 f 75 h −8
11 a Athens b Moscow c i 3°C d −8°C e 3°C f 5°C g 7°C h 12°C
12 a 32m b 31m c i 1011m ii 1057m
13 a

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7 1, 2, 7, 14 HCF = 14
8 a 3 b 6 c 8 d 12
e 25 f 14
9 7 and any other multiple of 7, 14 and 21, 21 and 35, 14 and 35, and so on
10 a 12 b 35 c 24 d 60 e 30 f 60

Practise... 2.8 Prime numbers and prime factors

1 23, 29
2 33 (4 factors – 1, 3, 11, 33)
 35 (4 factors – 1, 5, 7, 35)
 39 (4 factors – 1, 3, 13, 39)
3 a 2 × 7 b 2 × 3 × 5 c 3 × 11 d 2 × 3 × 7 e 5 × 13 f 7 × 13
4 a 2³ × 3 b 2² × 3² c 3³ × 5 d 2² × 3 e 2² × 3² × 7 f 2⁵ × 3
5 1 is not a prime factor. The answer is 2³ × 5
6 a 2² × 5² b 2² × 3 × 11 c 2⁴ × 3² d 3² × 17 e 2³ × 3³ f 2¹ × 5 × 13

Assess 2

1 a eighteen thousand four hundred and ninety.
b i ninety ii eight thousand
c eight hundred
2 a 643 b 462 c 602 d 1334 e 49 f 112 r4
3 1, 2, 4, 5, 8, 20, 40
4 a 8 + 23 b 23 − 16
c 27 d 3 e 5 × 6 × 8 f 3, 5, 23
5 a i Newcastle ii Bristol
   b Leeds, Manchester and Newcastle
6
<table>
<thead>
<tr>
<th>Temperature</th>
<th>Change</th>
<th>New temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>3°C</td>
<td>+ 4°C</td>
<td>7°C</td>
</tr>
<tr>
<td>2°C</td>
<td>− 5°C</td>
<td>−3°C</td>
</tr>
<tr>
<td>−4°C</td>
<td>+ 9°C</td>
<td>5°C</td>
</tr>
<tr>
<td>−1°C</td>
<td>− 5°C</td>
<td>−6°C</td>
</tr>
<tr>
<td>7°C</td>
<td>+ 4°C</td>
<td>11°C</td>
</tr>
</tbody>
</table>
7 10, −5, 2.5, −1.25
8 a 15 b 225
9 2³ × 7²
10 7 minutes

AQA Examination-style questions

1 a 4 + 6 + 8 + 12 b 6 or 12 or 18 c 3, 6, 9, 18 d 5
2 Any multiple of 4 and multiple of 5 that add to make a multiple of 6 (e.g. 8 + 10 = 18)
3 a 2² × 3² b 36
### 3 Collecting data

#### Practise... 3.1 Types of data

1. | Person | Qualitative | Quantitative | Discrete | Continuous | Primary | Secondary |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nat</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prita</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niles</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. a, b, c, f, i quantitative; d, e, g, h qualitative

3. a, b, d, f, i discrete; c, e, g, h continuous

4. Lengths of fish caught in a competition
   Number of goals scored by a football team
   Ages of teachers at a school
   Favourite colours in the tutor group
   Number of sweets in a bag
   Favourite type of music
   Person’s foot length
   Person’s shoe size
   Cost of stamps
   Best player on the Wales rugby team

Note: it can be argued that this is a categorising of the shoe and could therefore be considered qualitative but do not trouble students with this possible interpretation.

5. | Age (years) |    | Quantitative and continuous |
   | Gender (M/F) |    | Quantitative and discrete |
   | Height (cm) |    | Qualitative |
   | Hand span (cm) |    |                |
   | Arm span (cm) |    |                |
   | Foot length (cm) | |                |
   | Eye colour | |                |
   | No. of brothers | |                |
   | No. of sisters | |                |
   | House number | |                |
   | Favourite pet | |                |

6. a A sample is a part of the population, which it is hoped has the same features as the population.
   b to save time and money
   c Items may be ‘used up’ when sampled so the sample does not want to be too large a scale otherwise items are wasted. Also, it is time consuming and possibly expensive to take a particularly large sample.

7. many possible answers
   a the colour/style/type of pattern
   b number of goals scored/league position/match attendance
   c speed/time to leave Earth’s atmosphere/age of astronauts
   d your mark/your answers/your feelings when doing it
   e life expectancy/types of rat food/average length it might grow to
8 This will definitely be a sample, as the
population is very difficult to define (in theory
it is the whole population of the country) before
the problem of asking the whole population is
even considered.

9 How: a sample from the production line needs
to be taken across several time periods – it is not
sufficient to simply test, say, the first 20 bulbs
produced one morning.

Why: testing will use up the light bulbs so
testing the whole population would mean there
were no light bulbs left (which would leave
everyone in the dark).

**Practise... 3.2 Data collection methods**

1 When rewriting the questions there are many
possible options.

a There are too few groups and no box for an
answer of 1 hour.

Rewrite response boxes with more groups.

Less than 1 hour/1 or more but less than 2/
2 or more but less than 3/3 or more

b Only 2 of many choices are given.

Probably best to rewrite as an open question
asking for their own answer as there are so
many possible options.

c Most people will do more than one thing so
the question should probably ask which they
do most.

Which of these do you do most of in your
leisure time? (tick one box)

Then offer the same choices plus the choice
of 'other'.

d This is a biased question, leading people into
saying 'yes'. Options could also be better.

Do you like football?

Yes I love it/Yes I quite like it/No, I am not
keen/No, I hate it!

e This is a personal question, which should
be avoided unless essential. If it had to be
asked, additional options should be offered.

Less than £10 000/£10 000 to
£19 999/£20 000 to £29 999/£30 000 to
£39 999/£40 000 or more

f The question needs a timescale so that
everyone is not left to judge what 'often'
‘rarely’ and ‘sometimes’ mean. Also, anyone
who never goes cannot answer.

How often do you go to the cinema in a
typical month?

Never/Once/Twice/Three times/More than
three times

g Too black and white; it would be more useful
to find out how much/often.

How often do you travel by taxi?

Every day/More than once a week/More than
once a month/Less than once a month/Never
(In some ways, some of these options overlap
but this is a frequently used type of scale.)

h The opinion of the question writer is in the
question!

What do you think of dogs?

Love them/Like them a little/Do not
particularly like them/Totally dislike them/
Don't know

2 Opinion is given in the question. No option to
give a negative opinion.

3 a data logging

b online questionnaire (email questionnaire)

c controlled experiment

d face-to-face (or personal) interview

e observation

4 to check that the questions in a questionnaire
give the type of response desired
to check that questions are understood

5 a i Are you married? Yes □ No □

ii How much is it to get the train to
Glasgow? (Note that the scenario is
difficult, not mentioning when or who for.)

Under £20 □ £20–£39 □ £40–£59 □ £60–£79 □ £80+ □

b i Are you married?

Answer __________

ii How much is it to get the train to
Glasgow?

Answer £ _________

c i The answer can only be 'Yes' or 'No'. There
seems little point in not having a closed
question such as the first option here.
It is very difficult giving options for the closed questions. You may have little idea what the possible answer could be. It may therefore be better to use the open question; you could still group the answers together for analysis afterwards if you wanted to.

6 Note: This is not easy – focus carefully on exactly what was to be found out.

a In the last two years, have you been on a holiday?

Yes ☐ No ☐ Don’t know ☐

If ‘Yes’ tick which of these places you have been to.

UK ☐ France ☐ Spain ☐

USA ☐ Greece ☐

Other ☐

(please state where) _____________________

b What is your gender?

Male ☐ Female ☐

How old are you?

Under 10 ☐ 10–14 ☐ 15–19 ☐

20–29 ☐ 30–39 ☐ 40+ ☐

Do you like Wayne Rooney?

Yes ☐ No ☐ Don’t know ☐

c Does someone in your family buy a newspaper?

Yes ☐ No ☐ Don’t know ☐

If ‘Yes’, how much does it cost?

Under 30p ☐ 30p–39p ☐

40p–49p ☐ 50p or more ☐

Don’t know ☐

Practise... 3.3 Organising data

1

<table>
<thead>
<tr>
<th>Number</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>☐</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>☐ ☐</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>☐ ☐ ☐ ☐</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>☐ ☐ ☐</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>☐ ☐ ☐</td>
<td>3</td>
</tr>
</tbody>
</table>

2 a 36

b 8

3

<table>
<thead>
<tr>
<th>Number</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–13</td>
<td>☐ ☐</td>
<td>5</td>
</tr>
<tr>
<td>14–17</td>
<td>☐ ☐ ☐ ☐</td>
<td>9</td>
</tr>
<tr>
<td>18–21</td>
<td>☐ ☐ ☐</td>
<td>8</td>
</tr>
<tr>
<td>22–25</td>
<td>☐ ☐ ☐</td>
<td>6</td>
</tr>
</tbody>
</table>

4

<table>
<thead>
<tr>
<th>Number</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 &lt; h ≤ 10</td>
<td>☐ ☐ ☐</td>
<td>8</td>
</tr>
<tr>
<td>10 &lt; h ≤ 15</td>
<td>☐ ☐ ☐ ☐</td>
<td>10</td>
</tr>
<tr>
<td>15 &lt; h ≤ 20</td>
<td>☐ ☐ ☐ ☐</td>
<td>7</td>
</tr>
<tr>
<td>20 &lt; h ≤ 25</td>
<td>☐ ☐ ☐ ☐</td>
<td>5</td>
</tr>
</tbody>
</table>

a 30 b 10 c 12

5 a 25 b 41 c 15 d observation

6

<table>
<thead>
<tr>
<th>Sheep</th>
<th>Cattle</th>
<th>Pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>80</td>
<td>170</td>
</tr>
<tr>
<td>Female</td>
<td>50</td>
<td>70</td>
</tr>
</tbody>
</table>

7

<table>
<thead>
<tr>
<th>Weather</th>
<th>Morning</th>
<th>Afternoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunshine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloudy (dry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow/sleet/hail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8

<table>
<thead>
<tr>
<th>Play football</th>
<th>Do not play football</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>52 15</td>
</tr>
<tr>
<td>Girls</td>
<td>18 15</td>
</tr>
</tbody>
</table>

9 a They could go between 7 April and 21 July.

b Yes, but they must go between 7 April and 5 June.
Assess 3

1

<table>
<thead>
<tr>
<th>Number</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>II II</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>II I</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>II II</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>IIII</td>
<td>4</td>
</tr>
</tbody>
</table>

2

<table>
<thead>
<tr>
<th>Number</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–13</td>
<td>III</td>
<td>4</td>
</tr>
<tr>
<td>14–17</td>
<td>III</td>
<td>7</td>
</tr>
<tr>
<td>18–21</td>
<td>III</td>
<td>8</td>
</tr>
<tr>
<td>22–25</td>
<td>IIII</td>
<td>9</td>
</tr>
</tbody>
</table>

3 a 24 b 27 c \( \frac{19}{40} \) d 50%

4 a

<table>
<thead>
<tr>
<th>Chocolate</th>
<th>Sweets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>24</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
</tr>
</tbody>
</table>

b 20 c 70 d \( \frac{16}{40} = \frac{2}{5} \)

5 a i This would be very difficult to remember accurately.
ii It needs to offer choices regarding how often they are watched.

b i This is biased with the words ‘our’ and ‘improved’.

Rate the fruit juice you have just tried.
Excellent/Good/Average/Poor/Terrible

ii A personal question. What is your monthly salary? (with choices)
iii A leading question. Give your opinion on the new bypass. (with choices)

iv A leading question. Do you prefer smoking or non-smoking areas?
v No time period is specified. How many showers do you have in a typical week? (options possible again)

6 a Take a sample of 20–40 sheep from throughout the farm and weigh them, finding the average.

b Ask random people from the town, using a phone, postal or face-to-face interview.

c Question a sample of students from across the school in different classes.

d Measure the hand spans of a sample of students from your school, including all ages and genders.

e Take a sample of villagers and ask them. Perhaps go from door to door to ensure a variety of the homes within the village.

f Phone, postal or email survey with a carefully chosen and unbiased sample.

g Use a data-logging machine to keep a full record. This should enable an accurate result for this data.

7 Write a hypothesis such as ‘this shop is the cheapest in town for fruit and vegetables’.

Collect data by finding a sample of fruit and vegetables from this shop and from other fruit and vegetable sellers in the town.

For each selected item, calculate measures of average and spread, and show prices in simple diagrams such as bar charts and pictograms.

Interpret the data, the measures and the diagrams, and decide whether they support the hypothesis or not.

8 £109 cheaper (£544 in May, £653 in June)

AQA Examination-style questions

1 a i

<table>
<thead>
<tr>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk (W)</td>
<td>II II</td>
</tr>
<tr>
<td>Bus (B)</td>
<td>IIII</td>
</tr>
<tr>
<td>Car (C)</td>
<td>IIII</td>
</tr>
<tr>
<td>Total: 30</td>
<td></td>
</tr>
</tbody>
</table>

ii walk
iii \( \frac{3}{10} \)

b i More come by bus, or fewer come by car.
ii The same number walk.
## Fractions

### Practise... 4.1 Fractions

1. **a**
   - i. 0, 0.5, 1, 1.5, 3.5, 4, 4.5
   - ii. 0.5, 0.8, 1.6, 3.2, 4.1, 5.0
   - iii. \( \frac{1}{2}, 1.5, 2\frac{1}{2}, 3.0, 3\frac{1}{4}, 3\frac{1}{2}, 4.5 \)

   **b**
   - i. and ii. both have a range of 4.5

2. \( \frac{1}{4} = 25\% \), \( \frac{3}{4} = 75\% \)

3. **a**
   - i. \( 2\frac{3}{4} \)
   - iii. \( 1\frac{3}{4} \)
   - v. \( 3\frac{3}{4} + 2\frac{1}{2} = 3\frac{1}{2} + 1\frac{3}{4} \)

   **b**
   - i. \( 2\frac{3}{5} \)
   - iii. \( 2\frac{4}{5} \)
   - v. \( 3\frac{7}{10} + 2\frac{1}{2} + \frac{6}{10} + 2\frac{1}{2} + \frac{7}{10} \)

4. **b**
   - i. \( 2\frac{7}{10} \)
   - iv. \( 2\frac{9}{10} \)

5. **a**
   - i. \( 1\frac{1}{2} \)
   - ii. \( 4\frac{1}{2} \)
   - iii. \( 7\frac{1}{2} \)
   - iv. \( 10\frac{1}{2} \)

   **b**
   - i. \( \frac{3}{4} \)
   - iii. \( 2\frac{1}{4} \)
   - v. \( 3\frac{3}{4} \)

6. **b**
   - i. \( 2\frac{5}{6} \)
   - iii. \( 2\frac{4}{5} \)
   - v. \( 7\frac{1}{2} \)

7. **b**
   - i. \( 1\frac{1}{10} \)
   - iv. \( 2\frac{1}{2} \)
   - vii. \( 7\frac{1}{2} \)

8. **b**
   - i. \( 1\frac{1}{6} \)
   - iv. \( 4\frac{1}{2} \)

9. an hour and a half

10. a, c, d

   **b**
   - i. \( 1\frac{1}{6} \)
   - iii. \( 1\frac{3}{4} \)
   - v. \( 2\frac{1}{3} \)

### Practise... 4.2 Equivalent fractions

1. **a**
   - i. \( \frac{1}{6} \)
   - iii. \( \frac{1}{3} \)
   - v. \( \frac{2}{3} \)
   - vii. \( \frac{5}{6} \)

   **b**
   - i. \( \frac{1}{4} \)
   - iv. \( \frac{1}{2} \)
   - vi. \( \frac{3}{4} \)
   - viii. \( 1 \)

2. \( \frac{6}{8} \)

   0.8, 0.75, 0.8, 0.8

   Odd one out in decimal form is 0.75, which is \( \frac{6}{8} \)

3. No, \( \frac{3}{5} = \frac{24}{40} \) and \( \frac{5}{8} = \frac{30}{40} \)

4. e.g. \( \frac{4}{6}, \frac{5}{12}, \frac{10}{15}, \text{etc.} \)

5. **a**
   - i. \( \frac{3}{10} \)
   - ii. \( \frac{2}{5} \)
   - iii. \( 1 \)

   **b**
   - i. \( \frac{1}{10} \)
   - iv. \( \frac{2}{5} \)
   - vii. \( \frac{7}{10} \)

   **c**
   - i. \( \frac{1}{9} \)
   - iv. \( \frac{1}{3} \)
   - vii. \( \frac{5}{9} \)

6. **a**
   - i. \( \frac{1}{5} = \frac{10}{18} \)
   - iii. \( \frac{2}{9} = \frac{4}{18} \)

   **b**
   - i. \( \frac{1}{6} = \frac{4}{20} \)
   - iii. \( \frac{1}{6} = \frac{4}{14} \)

7. **a**
   - e.g. \( \frac{12}{24}, \frac{20}{24} \)

   **b**
   - e.g. \( \frac{7}{24}, \frac{11}{24} \)

8. **a**
   - i. \( \frac{5}{9} = \frac{10}{18} \)
   - iii. \( \frac{2}{9} = \frac{4}{18} \)

   **b**
   - i. \( \frac{1}{6} = \frac{24}{24} \)
   - iii. \( \frac{1}{6} = \frac{4}{14} \)

   **c**
   - i. \( \frac{6}{12} = \frac{2}{4} = \frac{1}{2} \)
   - ii. \( \frac{1}{4} = \frac{2}{8} = \frac{4}{16} = \frac{10}{20} = \frac{50}{100} \)

9. **a**
   - \( \frac{3}{5} = \frac{6}{10} \)
   - **b**
   - \( \frac{5}{10} = \frac{2}{2} \)

10. **a**
    - e.g. \( \frac{1}{8} = \frac{2}{16} = \frac{3}{32} \)
    - **b**
    - e.g. \( \frac{1}{10} = \frac{2}{20} = \frac{3}{60} = \frac{4}{120} = \frac{6}{180} = \frac{9}{270} \)

11. **b**
    - All the fractions equivalent to \( \frac{1}{2} \) are on a straight line through \((0, 0)\) and at an angle of \(45^\circ\).
c Each set of equivalent fractions is on a straight line through (0, 0) but the angle of the line varies. The bigger the fraction, the steeper the line.

d Top-heavy fractions are in the bottom left-hand half of the grid.

e You can arrange fractions in order by starting with a horizontal line through (0, 0) and rotating it clockwise. It will reach the smallest fraction first.

f You can simplify fractions by looking on the equivalent fraction line and finding the fraction nearest (0, 0).

### Practise... 4.3 Arranging fractions in order

#### 1

<table>
<thead>
<tr>
<th>a</th>
<th>Ordered: 12, 12, 12, 12, 6, 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Ordered: 15, 15, 15, 15, 4, 15</td>
</tr>
<tr>
<td>c</td>
<td>Ordered: 5, 5, 5, 5, 2, 1, 4, 4</td>
</tr>
</tbody>
</table>

#### 2

<table>
<thead>
<tr>
<th>a</th>
<th>2, 1, 2, 3, 7, 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>2, 3, 3, 8, 7, 1, 5, 4</td>
</tr>
</tbody>
</table>

### Practise... 4.4 Adding and subtracting fractions

#### 1

<table>
<thead>
<tr>
<th>a</th>
<th>11/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>1/20</td>
</tr>
<tr>
<td>c</td>
<td>23/44</td>
</tr>
<tr>
<td>d</td>
<td>7/24</td>
</tr>
<tr>
<td>e</td>
<td>7/18</td>
</tr>
<tr>
<td>f</td>
<td>1</td>
</tr>
</tbody>
</table>

#### 2

Fran has added the numerators and the denominators instead of just adding the numerators.

#### 3

1/20 of a litre

#### 4

3/4 + 1/8 + 1/16 = 15/16

All the other calculations have an answer of 1.

### Practise... 4.5 Multiplying and dividing fractions

#### 1

<table>
<thead>
<tr>
<th>a</th>
<th>i 1/5</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Each answer is the reciprocal of the other.</td>
</tr>
<tr>
<td>d</td>
<td>Yes.</td>
</tr>
<tr>
<td>2</td>
<td>8/31</td>
</tr>
<tr>
<td>3</td>
<td>a One number is divided by itself so answer is 1</td>
</tr>
<tr>
<td>b</td>
<td>Multiplying by 2/3 then dividing by 2/3 has no effect so the answer is 1 1/2</td>
</tr>
<tr>
<td>c</td>
<td>Multiplying by a fraction then by its reciprocal has no effect so the answer is 1 1/2</td>
</tr>
</tbody>
</table>

#### 4

<table>
<thead>
<tr>
<th>a</th>
<th>3/5</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>25/4</td>
</tr>
<tr>
<td>e</td>
<td>15</td>
</tr>
<tr>
<td>g</td>
<td>26</td>
</tr>
<tr>
<td>i</td>
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</tr>
<tr>
<td>k</td>
<td>9/8</td>
</tr>
<tr>
<td>5</td>
<td>a 6</td>
</tr>
<tr>
<td>b</td>
<td>1/6</td>
</tr>
<tr>
<td>6</td>
<td>a 5/16</td>
</tr>
<tr>
<td>b</td>
<td>4/1</td>
</tr>
<tr>
<td>c</td>
<td>47/8</td>
</tr>
<tr>
<td>7</td>
<td>a 5/6 + 2/9</td>
</tr>
</tbody>
</table>

Multiplying by 2/9 makes 5 smaller but adding 2/9 makes it bigger.

b Both answers will be bigger than 2 1/2

2 1/2 x 1 1/4 = 3 1/8; 2 1/2 + 1 1/4 = 3 3/4, so 2 1/2 + 1 1/4 is bigger.
8 3½ tins
9 2 cups
10 15 yards

11 10, 160
12 a 2  b ½  c 1⅔  d 4⅓

Practise… 4.6 Fractions of quantities

1 a 4  b 4  c 34  d 15p
2 a i 8  ii 10  iii 12  iv 14
The number is increased by 5 and $\frac{3}{5}$ of 5 is 2
Answers would increase by 4
3 a £75  b 500 kg  c £80  d 18 km
4 a 75 m  c 7.5 km  e 15 cm²
   b 600 g  d 75 cm
5 $\frac{3}{4}$ of 1.2 kg
6 £20

Practise… 4.7 One quantity as a fraction of another

1 a $\frac{3}{5}$  b $\frac{1}{9}$  c $\frac{2}{5}$  d $\frac{5}{8}$
2 $\frac{7}{10}$
3 $\frac{7}{10}$
4 $\frac{3}{5}$

Assess 4

1 a $\frac{3}{5}$  b $\frac{13}{25}$
2 a $\frac{1}{4}$  c $\frac{3}{4}$  e $\frac{1}{3}$  g $\frac{2}{9}$
   b $\frac{1}{2}$  d 1  f $\frac{7}{9}$  h $\frac{1}{5}$
3 a £2.25  c 1.35 kg  e 0.375 metres
   b $73.50  d £768
4 a, b, d, e, f
5 110
6 $\frac{7}{10}$

AQA Examination-style questions

1 10
2 a 70
   b correct explanation, e.g. 175 is not exactly divisible by 2, 175 is odd, you cannot have half a boy
   c 175 × 8 = 1400
5 Coordinates

Practise...  5.1 Coordinates in four quadrants

1  
\[ A = (3, 3) \]
\[ B = (-3, 1) \]
\[ C = (-4, -2) \]
\[ D = (0, -4) \]
\[ E = (4, -3) \]

2  
\[ \text{a and b} \]

\[ \text{c a square} \]

3  
No. You must read along the x-axis, then the y-axis. The correct coordinates are \[ E (-2, 2) \] and \[ F (-2, -4) \].

4  
\[ \text{a } (-1, 3) \]  \[ \text{b } (1, -1) \]  \[ \text{c } (0, 1) \]

5  

Judi is correct

6  
\[ \text{a and b} \]

\[ \text{c } S = (4, -2) \]

7  
\[ \text{a Either } (6, 0) \text{ and } (6, 4) \text{ or } (-2, 0) \text{ and } (-2, -4) \]
\[ \text{b } P (0, 2) \ Q (4, 2) \]

8  
\[ \text{a Ben} \]
\[ \text{b They are all on straight lines from each other.} \]

9  
\[ \text{a, b and c} \]

\[ \text{d Pollyanna} \]
Practise...  5.2  Introduction to straight-line graphs

1  Any two of the following: (2, −5) (2, −4) (2, −3) (2, −2) (2, −1) (2, 0) (2, 1) (2, 2) (2, 3) (2, 4) (2, 5)

2  Any two of the following: (−5, −4) (−4, −4) (−3, −4) (−2, −4) (−1, −4) (0, −4) (1, −4) (2, −4) (3, −4) (4, −4) (5, −4)

3  Any three of the following: (−3, −5) (−3, −4) (−3, −2) (−3, −1) (−3, 0) (−3, 1) (−3, 2) (−3, 3) (−3, 4) (−3, 5)

4  Any three of the following: (−5, 2) (−4, 2) (−3, 2) (−2, 2) (−1, 2) (0, 2) (1, 2) (2, 2) (3, 2) (4, 2) (5, 2)

5  Any three of the following: (−5, −1) (−4, −1) (−3, −1) (−2, −1) (−1, −1) (0, −1) (1, −1) (2, −1) (3, −1) (4, −1) (5, −1)

6  a  Any three of the following: (−5, 0) (−4, 0) (−3, 0) (−2, 0) (−1, 0) (0, 0) (1, 0) (2, 0) (3, 0) (4, 0) (5, 0)
   b  The $x$-axis coordinate moves as it moves along the line. The $y$-coordinate is always 0 on the $x$-axis line.
   c  $y = 0$

7  (7, 3)

8  (−5, −4)

9  (0, −2)

10  (4, 0)

11  They are parallel.

12  a  $x = −1$  b  $y = 4$  c  $y = −2$

13  a  Any two of the following: (−3, −3) (0, 0) (1, 1)
   b  No. That point is not on the straight line.
   c  Geeta, $x = y$. This is demonstrated by the points on the line, that the $x$-coordinate is the same value as the $y$-coordinate.

14  a

   ![Graph](image1)
   b  i  It is a mirror image/reflection in the $y$-axis.
   ii  It is a mirror image/reflection in the $x$-axis of the second flag.
   c  i  It is a mirror image/reflection in the $x$-axis of the second flag.

1 a and b

![Graph with points labeled A, B, C, D]

c $CD$

d $CD$

2 a and b

![Graph with points labeled P, Q, R, O]

c $PR$ and $PQ$

3 a $A (0, 8)$ $B (1, 8)$ $C (4, 9)$ $D (11, 13)$ $E (2, 5)$ $F (3, 5)$ $G (6, 6)$ $H (9, 5)$ $I (8, 2)$ $J (12, 0)$
b $J$
c $D$
d He has confused the two axes. $E$, $F$ and $H$ lie on the line $y = 5$
e $G$

4 (4, $-1$)

5 a Any set of coordinates with 0 as the first coordinate
b Any set of coordinates in which the coordinates for $x$ are the minus version of the $y$-coordinate

c $S = (-2, -3)$
b $(1, 3)$

d $M = (0, -3)$
Angle between $AM$ and $BC$ is 90°

8 (2, 0.5)

9 (5, 4)

Examiner’s tip
Examination-style questions

1 a (5, 3)
b $(-3, 1)$
c i Midpoint marked

d ii (1, 2)

d $M$ is the midpoint of the line $BD$ because $ABCD$ is a square.
6 Working with symbols

Practise... 6.1 Collecting like terms

1 a 7p  c 12C  e -2q  g -d
  b 4a  d -5x  f 0  h f

2 a 11y  c 13y  e 13f + 3
  b 22g  d 12p + 1  f 16d + 4

3 a 30p + 40p + 50p = 120p
  b 10k + 30k + 40k + 10k = 90k
  c 90° + 2x + 2x + 2x = 90° + 6x

4 a 18n  b 90° + 30x  c 32j

5 a 7d  f 2 - 3g - fg
  b 4x  g 3a
  c 10y - 8w + 3  h 22x - 15y - 5
  d 13c - 3  i 34 - 10m - 3n
  e 2f - 2g - 4

6 a student’s own method showing collecting like terms to show that 5x² - 4x² + x² = 2x²
  b student’s own method showing collecting like terms to show that a³ - a + 3a² - 5a = 4a³ - 6a
  c i Shannon added terms in f and f
  ii 7f - 5f

7 Simplify:
  a 0  d 11v - 5v²
  b -4y³ - 3y  e 3p³ + 4t²
  c h³ + h - 5  f -t² - 2m²

Practise... 6.2 Substitution

1 a 7  c 2  e 60  g 82  i 7
  b -3  d 1  f 42  h 9  j 14

2 a 45°  c 135°  e 36°
  b 65°  d 200°  f 6°

3

4 Tracey  Debbie
  3p - 2q = -8  4p + q = 3  different
  4x -3y/2 = 9.5  7x - 2y = 4.5  different
  cd = -2  4/ cd = -2  same
  4a/b = -10  2a - b = -10  same

5 a 1 cm, 9 cm  area = 9 cm²
  b 2 cm, 8 cm  area = 16 cm²
  c 3 cm, 7 cm  area = 21 cm²
  d 4 cm, 6 cm  area = 24 cm² greatest area
  e You cannot have negative lengths or areas.

6 a i 5 x 2f = 14f  ii 28 cm
  b i 4f + 3, 4f + 3, 3f + 3, f + 3, 2f + 3
  ii 14f + 15
  iii 43 cm

7 a 5a/2 or 2.5a  d 33d/2 or 16.5d
  b 10b + 2  e 25.2e
  c 17d/2 or 8.5d  f 22.8g

8 y = 4
**Practise... 6.3 Expanding brackets and collecting terms**

1. a. \(3x + 12\)
   b. \(5y - 10\)
   c. \(16 - 8c\)
   d. \(6p + 15\)
   e. \(25d^2 - 5\)
   f. \(14 - 14f\)
   g. \(30v + 21\)
   h. \(77 + 33m\)

2. a. \(3(5a + 1) = 15a + 3\)
   b. \(2(b - 5) = 2b - 10\)
   c. \(6(4c + 3) = 24c + 18\)
   d. \(1.5d(d - 2) = 1.5d^2 - 3d\)
   e. \(2.5e(10 + e) = 25e + 2.5e^2\)
   f. \(5.5f(3 - f) = 16.5f - 5.5f^2\)

3. a. \(n\) is multiplied by 5 as well as 2
   b. i. \(5(n - 8) = 5n - 40\)
   ii. \(3(10 - n) + 3n = 30\)
   c. i. \(5(n + 2) - 10 = 5n + 10 - 10 = 5n\)
   ii. \(3n - 2(n - 1) = 3n - 2n + 2 = n + 2\)
   iii. \(5(n + 1) + 2(3 - n) = 5n + 5 + 6 - 2n = 3n + 11\)
   iv. \(7(3 - 2n) + 10n = 21 - 14n + 10n = 21 - 4n\)
   v. \(3(2 + 3n) - 2(3 + 4n) = 6 + 9n - 6 - 8n = n\)
   vi. \(2(n + 1) + 5(n - 2) - 4n = 2n + 2 + 5n - 10 - 4n = 3n - 8\)

**Practise... 6.4 Factorising expressions**

1. a. \(4(2c + 1)\)
   g. \(3y(4x - 3y)\)
   b. \(3(4d - 5)\)
   h. \(b(b + 9a)\)
   c. \(10(2 - p)\)
   i. \(2n(2 + 9nm)\)
   d. \(6(4 + 3k)\)
   j. \(3k(5l + 9k)\)
   e. \(x(20 + x)\)
   k. \(13(f - 5g)\)
   f. \(y(y - 5)\)
   l. \(6j(k(6j - 5k)\)

2. a. \(6x - 21 = 3(2x - 7)\)
   b. \(20x^2 - 25x = 5x(4x - 5)\)
   c. \(7p^2 - 5p = p(7p - 5)\)
   d. \(100r^2 + 125t = 25t(4t + 5)\)
   e. \(2kq - 3kr = k(2q - 3r)\)

3. a. \(10p - 8 = 2(5p - 4)\)
   b. \(12x - 15y = 3(4x - 5y)\)
   c. \(11ab + 7bc = b(11a + 7c)\)
   d. \(20pq - 15q = 5q(4p - 3)\)
   e. \(24x^2 + 9x = 3x(8x + 3)\)
   f. \(19fh + 38gh = 19fh(1 + 2g)\)

4. a. sides are 5g and \((1 + 2r)\)
   b. sides are 3x and \((x + 7y)\)
   c. sides are 2pq\(^2\) and \((3p - q)\)
   d. sides are 5abc(ac + 3b)
5 Sue is correct as she factorised fully and Chris did not factorise fully.

6 a $3ap - 9p = 3p(a - 3)$ right
b $12f^2 - 18f = 3f(4f - 6)$ wrong
c $36 - 4t^2 + 12t = 4(9 - t^2 + 3t)$ right
d $15x^3y^2 - 20x^2y = 5xy(3xy - 4x)$ wrong
  $15x^2y (3y - 4)$
e $55k - 44klm^2 = 11k(5 - 4lm^2)$ right

7 a

\[
\begin{align*}
5y & \quad 3 + 3y \\
3 - 2y & \quad 1 - y
\end{align*}
\]

b i

\[
\begin{align*}
7a & \quad 2 \\
a - 2 & \quad 4a + 1
\end{align*}
\]

Assess 6

1 60p

2 a 15p
   b i 30 cm ii 150 cm iii 7.5 cm

3 a 1 b 17 c -7 d -11

4 a $7a - 3$ b $10ab$ c $2d^2 - d - 3$

5 $4(5b + 3) = 20b + 12$

6 a $4x + 4$ b $15 - 11p$

7 a $7(2f + 3)$ b $6x(4 - 3y)$

8 a $x(5 + x)$ b $y(y - 3)$ c $7pq(q - 8)$

9 9x - 10

10 $4(3k - 1) - 3k = 12k - 4 - 3k = 9k - 4$

AQA Examination-style questions

1 a $ab + ac$
   b 270
Decimals

Practise... 7.1 Place value

<table>
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<tr>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>Units</th>
<th>Tenths</th>
<th>Hundredths</th>
<th>Thousandths</th>
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<td>3</td>
<td>1</td>
<td>.</td>
<td>4</td>
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<td>9</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>3</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>.</td>
<td>7</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

2 a 3.4, 3.27, 3.19, 3.16, 3.08
   b 27.68, 25.75, 25.34, 24.2, 24.02
   c 0.64, 0.623, 0.57, 0.426, 0.421

3 a 1.09, 1.138, 1.2, 1.37, 1.4
   b 15.0, 15.46, 15.49, 16.54, 17.3

Practise... 7.2 Rounding

1 a 4 c 35 e 0
   b 8 d 1 f 77

2 a It should be 540. He has missed off the zero.
   b No. It should round down to 4.

3 a i 54.9 iii 4.5 v 12.5
   ii 0.3 iv 6.0
   b i 54.92 iii 4.53 v 12.47
   ii 0.27 iv 6.04
   c i 54.924 iii 4.529 v 12.469
   ii 0.274 iv 6.038

4 a i 780 iii 7090 v 10
   ii 350 iv 2580 vi 650

Practise... 7.3 Adding and subtracting decimals

1 a 16.1 c 15.33 e 39.69
   b 6.71 d 1.24 f 7.07

2 Isaac. Yusef has worked out 3.02 + 1.34

3 a 3 c 3 e 5 and 9
   b 4 d 4 f 7 and 5

4 Tom. He worked out 7.44 – 5.32

5 a 3 + 3 = 6
   b 8 + 2 = 10
   c 70 + 20 = 90
   d 20 + 40 = 60
   e 100 + 100 = 200
   f 70 – 20 = 50
   g 9 – 3 = 6
   h 20 – 9 = 11
   i 5 + 9 – 6 = 8
   j 90 – 30 + 40 = 100
6 a 4.6 and 15.4, 8.6 and 11.4, 12.6 and 17.4, 8.6 and 21.4

b 8.6 and 15.4, 12.6 and 11.4, 4.6 and 21.4, 8.6 and 17.4

Practise... 7.4 Multiplying decimals

1 a 8.4 c 24.6 e 1.2 g 3.2
b 10 d 25.2 f 3.5 h 2.4

2 a C b B c C

3 a 0.09 c 0.24 e 0.005 g 0.03
b 0.46 d 0.045 f 0.93

4 a 119.6 c 0.001196 e 0.1196 g 0.01196
b 11.96 d 11.96 f 1.196

b 10 d 25.2 f 3.5 h 2.4

5 a 28.6 d 4.8 g 0.91
b 3.91 e 2.04 h 62.73
c 21.75 f 14.24

6 a 0.0286 d 0.048 g 0.091
b 0.0391 e 0.00204 h 0.0006273
c 0.002175 f 0.0001424

7 63 tiles so 16 boxes
8 £73.51

Practise... 7.5 Dividing decimals

1 a 60 c 270 e 4 g 60
b 180 d 90 f 140 h 210

2 a 8 c 0.8 e 2.9 g 3.7 i 19
b 177 d 127 f 33 h 140 j 230

3 a 85 c 0.34 e 3.4
b 40 d 0.85 f 0.04

4 Jack is correct.

Practise... 7.6 Fractions and decimals

1 a 0.2 c 0.125 e 0.75 g 0.02
b 0.7 d 0.15 f 0.03 h 0.3

2 b

3 a \(\frac{59}{100}\) c \(\frac{4}{10}\) or \(\frac{2}{5}\) e \(\frac{1}{10}\) g \(\frac{45}{100}\) or \(\frac{9}{20}\)
b \(\frac{7}{100}\) d \(\frac{1}{4}\) f \(\frac{36}{100}\) or \(\frac{9}{25}\) h \(\frac{5}{100}\) or \(\frac{1}{20}\)

4 a 0.1 b 0.6 c 0.16

5 a 0.2 b 0.26 c 0.83 d 0.045

6 a 12 500

7 18 cm or 0.18 m

Assess 7

1 a 37 b 10 c 4 d 4 e 14

2 a 7.02, 7.025, 7.16, 7.2, 7.28
b 83.531, 83.9, 84.709, 84.72, 84.8
c 0.446, 0.46, 0.464, 0.466, 0.64

3 a 8 hundredths b 8 tenths
c 8 units d 8 tens
e 8 thousandths f 8 tenths
g 8 hundreds h 8 thousands

4 a 33 000 b 32 920 c 30 000 d 32 900

5 16.1 miles

6 Yes, both round to 80 to 1 s.f.

7 70

8 800

AQA Examination-style questions

1 a 260 cm b 17 cm

2 79p

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8 Statistical measures

Practise... 8.1 Basic measures

1 a i 5    ii 15    iii 6
   b i no mode    ii 15    iii 5 and 7
   c i \(30 \div 5 = 6\)    ii \(48 \div 8 = 6\)
   d i \(14 - 1 = 13\)    iii \(8 - 4 = 4\)

2 a mode = 1 and 4, median = 3,
      mean = \(\frac{33}{11} = 3\), range = \(6 - 1 = 5\)
   b mode = 1, median = 1.5, mean = \(\frac{23}{12} = 1.92\), range = \(4 - 1 = 3\)
   c mode = 1, median = 1.5, mean = \(\frac{18}{10} = 1.8\), range = \(4 - 0 = 4\)
   d mode = 5, median = 2, mean = \(\frac{21}{8} = 2.625\), range = \(5 - 0 = 5\)

3 a \(180p \div 3 = 60p\)
   b The mean has been calculated here.

4 13

5 any value of 25 or less

6 one 8 and one number that is not 6, 7 or 8

7 \(\frac{20}{10} = 2\)
   Zoë is correct.

8 a mean = \(\frac{50}{10} = 5\)    range = 8
   b mean = \(\frac{50}{10} = 5\)    range = 4
   c They have the same mean but Teddy’s results have a larger range.

9 To compare these two groups, you need to find the range and the mean.
   Teachers’ range = \(131 - 103 = 28\)
   Teachers’ mean = \(\frac{1184}{10} = 118.4\)
   Lawyers’ range = \(129 - 100 = 29\)
   Lawyers’ mean = \(\frac{1119}{100} = 111.9\)
   The lawyers have a slightly larger range, meaning their IQs are slightly more spread out.
   The teachers have a higher mean, indicating their IQ is higher on average.

10 There is an unlimited set of possible answers.

11 There is an unlimited set of possible answers.

12 It suggests that the average weight is about \(700 \div 8 = 87.5\) kg
   If the average weight of the lift occupants is 90 kg, there cannot be more than 7 people in the lift.

Practise... 8.2 Frequency distributions

1 a

<table>
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<th>Frequency (f)</th>
<th>Score (\times) frequency (fx)</th>
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<td>18</td>
</tr>
<tr>
<td>2</td>
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<td>48</td>
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<td>5</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>120</td>
</tr>
</tbody>
</table>

\(\frac{347}{100} = 3.47\)

b 3   c 6   d 5   e \(\frac{20}{100} = \frac{1}{5}\)

2 a 96

b \(\frac{88}{324} \times 100 = 27.16\%\) (2 d.p.)

<table>
<thead>
<tr>
<th>Speed limit (miles per hour)</th>
<th>Number of roads</th>
<th>fx</th>
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<tr>
<td>70</td>
<td>3</td>
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\(15240 \div 324 = 47.037037\ldots\) mph
3

<table>
<thead>
<tr>
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<th>Frequency</th>
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</tr>
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</tr>
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</table>

$1000 \div 40 = 25$

a $25$  
c $30$  
e $50\%$

b $30$  
d $40$

4

a 1

<table>
<thead>
<tr>
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<th>Frequency</th>
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<td>60</td>
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<td>6</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

$150 \div 100 = 1.5$

c The median because it gives a value which is a possible data value.

5

One possible solution:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f$</th>
</tr>
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<tbody>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>

6

a anything bigger than 66 so that 8 has the highest frequency

b Anything less than 81. 100 values occur by the end of the 4s so, by the end of the data for 4 to be the median, there must be fewer than 200 values.

7

Some of the measures that may be calculated are given in the tables below.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Location</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Town centre</td>
<td>Village</td>
</tr>
<tr>
<td>Mode</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Median</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mean (2 d.p.)</td>
<td>2.06</td>
<td>3.09</td>
</tr>
<tr>
<td>IQR</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Percentage of bedrooms of each size:

<table>
<thead>
<tr>
<th>Number of bedrooms</th>
<th>% in town sample</th>
<th>% in village sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.9</td>
<td>8.6</td>
</tr>
<tr>
<td>2</td>
<td>54.3</td>
<td>25.7</td>
</tr>
<tr>
<td>3</td>
<td>17.1</td>
<td>28.6</td>
</tr>
<tr>
<td>4</td>
<td>5.7</td>
<td>22.9</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Averages suggest fewer bedrooms in a town house than in a village house on average.

Percentages show a much greater percentage for the houses with a small number of bedrooms in a town compared to a village. Many similar comments are possible.

8

a Big Bus: mode = 0, median = 5, mean = 5.75 minutes, IQR = 10, range = 35
Super Express: mode = 5, median = 12.5, mean = 10.7 minutes, IQR = 10, range = 20
Super Express is, on average, more minutes late than Big Bus but Big Bus has a larger range of late times indicating that it can be much later than Super Express when it is late.

b A bus that is on average a little late is unlikely to cause a problem. However, if a bus was extremely late (as indicated as a possibility by a larger range) that would be a problem.

Practise...

8.3 Grouped frequency distributions

1

a $2 \leq t < 4$  
b $2 \leq t < 4$

c $\frac{2}{24} \times 100 = 5.88235\% = 6\%$ (1 s.f.)

d $126 \div 34 = 3.71$ minutes (2 d.p.)

<table>
<thead>
<tr>
<th>Time, $t$ (minutes)</th>
<th>Frequency</th>
<th>midpoint, $x$</th>
<th>$fx$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 $\leq t &lt; 2$</td>
<td>8</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2 $\leq t &lt; 4$</td>
<td>14</td>
<td>3</td>
<td>42</td>
</tr>
<tr>
<td>4 $\leq t &lt; 6$</td>
<td>6</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>6 $\leq t &lt; 8$</td>
<td>4</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>8 $\leq t &lt; 10$</td>
<td>2</td>
<td>9</td>
<td>18</td>
</tr>
</tbody>
</table>

e 10 minutes

2

a i $\£100 \leq x < \£150$  
ii $\frac{6600}{48} = \£165$

b Probably the median as there are two quite isolated high values, which will make the mean high.

3

27

4

The frequencies immediately show that some packets are underweight. However, the mean weight is just over 25g ($25.280 \div 1000 = 25.280g$)
5 Machine A = 30.07 ÷ 100 = 0.3007 mm
Machine B = 29.07 ÷ 100 = 0.2907 mm
The mean for Machine A is 0.01 mm higher than the mean for Machine B.
The range of the two machines is similar as far as it is possible to tell from grouped data.
Machine A is producing paper much closer to the desired thickness.
6 Class 7A = 2458 ÷ 29 = 84.76%
Class 7B = 2462 ÷ 30 = 82.07%

Assess 8

1 a mode = 7, median = 4, mean = 4.5, range = 7
b mode = −1, median = − 1/2, mean = − 1/8 (−0.125), range = 3 − −3 = 6
2 a i 26   iii 27, 28, 29
   ii 27.5  iv 32 −17 = 15
b i mean increases to 26.3
ii median unaffected
iii mode unaffected
iv range increases by 3 to 18
3 a range = 2.5 kg
b median = 7.25 kg
c 2 (Sarah and Sam)
d mean = 43.5 / 6 = 7.25 kg
e Yes, though these babies come in slightly lighter at 0.25 kg below the chart mean.
4 Three numbers adding up to 63 with two below 21 and one above.

7 Number of years’ service | Number of teachers (f) | Midpoint (x) | fx
0–4      | 11 | 2 | 2 × 11 = 22
5–9      | 15 | 7 | 7 × 15 = 105
10–14    | 4  | 12| 12 × 4 = 48
15–19    | 10 | 17| 17 × 10 = 170
20–24    | 6  | 22| 22 × 6 = 132
25–29    | 4  | 27| 27 × 4 = 108
Total    | 50 |               | 585

a modal class = 5–9 years
b mean = 585 / 50 = 11.7 years

8 a Length in centimetres | Tally | Total
5 but less than 7       | I    | 6
7 but less than 9        | II   | 7
9 but less than 11       | III  | 6
11 but less than 13      | I    | 6
13 but less than 15      | I    | 4
15 but less than 17      | I    | 1
Total                    |      | 30

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b \( \frac{296}{30} = 9.87 \text{ cm (2 d.p.)} \)

c \( \frac{292.3}{30} = 9.74 \text{ cm (2 d.p.)} \)

d It is only an estimate because the midpoints were used for each group instead of the exact values.

<table>
<thead>
<tr>
<th>Weight of apples, w (grams)</th>
<th>Frequency</th>
<th>Midpoint</th>
<th>( fx )</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 &lt; w \leq 40</td>
<td>25</td>
<td>35</td>
<td>875</td>
</tr>
<tr>
<td>40 &lt; w \leq 50</td>
<td>28</td>
<td>45</td>
<td>1260</td>
</tr>
<tr>
<td>50 &lt; w \leq 60</td>
<td>21</td>
<td>55</td>
<td>1155</td>
</tr>
<tr>
<td>60 &lt; w \leq 70</td>
<td>6</td>
<td>65</td>
<td>390</td>
</tr>
</tbody>
</table>

mean = \( \frac{\Sigma fx}{\Sigma f} \)
= \( \frac{3680}{80} \)
= 46

range estimated as \( 70 - 30 = 40 \)

These results show that the apples in the table are slightly heavier and have a slightly larger weight range than Granny Smith figures, but they are so close that the sample could be Granny Smiths.

1 a 3 is the mean of the two middle numbers, 4 and 2

b \( \frac{3}{2} \)

c Any set of the form \( x, 3, 3, 3, y, z \) where \( x \) is less than 3 and \( y \) and \( z \) are greater or equal to 3, e.g. 1, 3, 3, 3, 7, 9
Sequences

Practise... 9.1 The rules of a sequence

1. a
   
   ![Matchsticks Diagram]

   b
   
   ![Matchsticks Diagram]

   c
   
   ![Matchsticks Diagram]

   2. a 19, 23
      b 20, 24
      c 34, 42
      d 20, 25
      e 32, 64
      f 1 000 000, 10 000 000

3. Pattern (n) | Diagram | Number of matchsticks (m)
---------------|---------|------------------------
4             |         | 9 matchsticks          
5             |         | 11 matchsticks         

   a ‘They are all odd numbers’ or ‘They all go up in twos’.

4. a +4 c ×2 e –4 g ×1.5
   b +5 d +1.5 f ×10 h ×1/3 or ÷3

5. Any sequence in which terms increase by 4 each time, e.g. 4, 8, 12, 16, 20, . . .

6. a 33 and 65
   b (5, 8) and (6, 9). The line plotted from these points is straight and has a positive gradient of 1.

7. a 123 454 321 and 12 345 654 321
   b No, the pattern will break down after 12 345 678 987 654 321

8. a 45, 31, 14, 15, 16, 17, 18, 19, 20, 11, 12, 13, 14, 15, . . . which is a repeating sequence.
   The 10th term is 11, the 20th term is 11, the 30th term is 11 and so the 100th term is 11.

9. a 25 and 36 (sequence of square numbers)
   b 125 and 216 (sequence of cubed numbers)
   c 21 and 28 (sequence of triangle numbers)
   d 13 and 21 (sequence of Fibonacci numbers)
   e 13 and 17 (sequence of prime numbers)

Practise... 9.2 The nth term of a sequence

1. a 6, 7, 8, 9, 10, . . .
   b 3, 6, 9, 12, 15, . . .
   c 6, 11, 16, 21, 26, . . .
   d –5, –3, –1, 1, 3, . . .
   e 3, 6, 11, 18, 27, . . .
   f 2.5, 3, 3.5, 4, 4.5, . . .
   g 8, 6, 4, 2, 0, . . .

2. a 103, 104
   b 290, 293
   c –100, –102
   d 9999, 10 200

3. No, because the first term in the sequence n + 4 would be 5

4. a No, because 31 + 1 = 32 which does not divide by 3
   b No, because the 10th term is (10 × 3) –1 = 29 and the 20th term is (20 × 3) –1 = 59 which is not double 29.

5. a 4n – 1
   b 6n – 6
   c 6n + 3
   d 6n + 2
   e 2n – 3
   f 4n – 9
   g 1.5n + 3.5
   h –2n + 25 or 25 – 2n

6. a 39 and 399
   b 54 and 594
   c 63 and 603
   d 62 and 602
   e 17 and 197
   f 31 and 391
   g 18.5 and 153.5
   h 5 and –175

7. a m = 2n + 1
   b 200 = 2n + 1 so n = 99.5 so the 99th pattern can be made

8. 4n – 3

9. Because the sequence is 1, 4, 7 . . . so the nth term is 3n – 2 and the 100th pattern will have 298 cubes
10 a $n^2$  
   b $n^2 + 1$  
   c $2n^2$  
   d $n^3$  
   e $n^3 - 1$  
   f $10^n$

11 a $n \times (n + 1)$  
   b $\frac{n + 1}{n + 2}$  
   c $n \times (n + 1) \times (n + 4)$  
   d $0.1n$

12 a $3n + 1$  
   b $31$

13 a $\frac{3n}{10}$  
   b i $24m$  
   ii $10.5m$

Assess 9

1 a i

\[ \begin{array}{cccc}
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\end{array} \]

ii

\[ \begin{array}{cccc}
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\end{array} \]

iii

\[ \begin{array}{cccc}
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\bullet \bullet \bullet \bullet \\
\end{array} \]

b i $22, 27$  
   ii $20, 2.2$  
   iii $162, 486$  
   iv $50000, 500000$

2 a i $14, 23$ and $29$  
   ii $21, 36$ and $46$  
   iii $48, 384$ and $1536$

b i $+4$  
   ii $\times 5$  
   iii $\times 3 - 1$

3 a i $8, -1, -7$  
   ii $4, -\frac{3}{1}, -\frac{1}{3}$  
   iii $16, -128, -512$

b i $-3$  
   ii $-3$  
   iii $\times -14$

No, because the 5th term is 23 and the 10th term is 43 which is not double 23.

5 a

\begin{array}{|c|c|c|c|c|c|}
\hline
\text{side of square (cm)} & 1 & 2 & 3 & 4 & n \\
\text{area of square (cm²)} & 1 & 4 & 9 & 16 & n^2 \\
\hline
\end{array}

b i $2n^2$  
   ii $n^2 - 3$

6 a $2n + 4$  
   b $10n - 7$  
   c $10 - 2n$

7 For a term to occur in both sequences, $4n - 5 = 2n + 8$, so $2n = 13$ and $n = 6.5$

As the $n$th term is always a whole number, $n$ could never be 6.5, so Jo is incorrect.

8 2, 4, 6, 8

Yes, because if the first term is $a$ and the difference is $d$, then the sequence is written $a, a + d, a + 2d, a + 3d, \ldots$

If the first term is $d$, then the 2nd term is $d + d = 2d$ and the 4th term is $d + 3d = 4d$ so the 4th term is twice the 2nd term.

1 a $20$

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

\[ \frac{3 - 5}{2} = -1 \]

So, the first term is $-1$
10 Percentages

### 10.1 Percentages, fractions and decimals

#### 1

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>i</td>
<td>30%</td>
<td>ii</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii</td>
<td></td>
<td>$\frac{7}{10}$</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>32%</td>
<td>ii</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii</td>
<td></td>
<td>$\frac{17}{25}$</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>ii</td>
<td>0.06</td>
<td>iii</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>i</td>
<td>0.85</td>
<td>ii</td>
</tr>
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#### 2

<table>
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<tr>
<th></th>
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<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>e</td>
<td>4%</td>
<td>i</td>
<td>12.5%</td>
</tr>
<tr>
<td></td>
<td>f</td>
<td>40%</td>
<td>j</td>
<td>2.6%</td>
</tr>
<tr>
<td></td>
<td>g</td>
<td>103%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>h</td>
<td>90%</td>
<td></td>
<td>250%</td>
</tr>
</tbody>
</table>

#### 3

<table>
<thead>
<tr>
<th></th>
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<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.3</td>
<td>0.08</td>
<td>g</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>0.625</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>0.47</td>
<td>f</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>0.8</td>
<td>i</td>
<td>0.075</td>
</tr>
</tbody>
</table>

#### 4

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>27%</td>
<td>35%</td>
<td>g</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>37.5%</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>3%</td>
<td>h</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>90%</td>
<td>i</td>
<td>45%</td>
</tr>
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</table>

#### 5

<table>
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<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>$\frac{49}{100}$</td>
<td>$\frac{7}{10}$</td>
<td>g</td>
<td>$\frac{1}{50}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>$\frac{6}{25}$</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>$\frac{1}{20}$</td>
<td>h</td>
<td>$\frac{1}{25}$</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>$\frac{2}{25}$</td>
<td>f</td>
<td>$\frac{3}{5}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>i</td>
<td>$\frac{2}{5}$</td>
<td></td>
</tr>
</tbody>
</table>

### 10.2 Finding a percentage of a quantity

#### 1

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>c</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>£35</td>
<td>£38</td>
<td>£196</td>
</tr>
<tr>
<td></td>
<td>£2250</td>
<td>£2520</td>
<td>£76</td>
</tr>
</tbody>
</table>

#### 2

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>c</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>36 m</td>
<td>1440 l</td>
<td>184 g</td>
</tr>
<tr>
<td></td>
<td>280 kg</td>
<td>36 km</td>
<td>185 ml</td>
</tr>
</tbody>
</table>

#### 3

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

|   | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z |
|   | i | 30 | iv | £175 | vii | £26.25 |
|   | ii | 1.6 | v | £1.40 | viii | £0.81 |
|   | iii | 38.4 | vi | £8.80 | ix | £32 |

#### 4

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>£1.85</td>
<td>7.021</td>
<td>g</td>
<td>32.52 t</td>
</tr>
<tr>
<td></td>
<td>101.7 cm</td>
<td>62.44 miles</td>
<td>h</td>
<td>£1.96</td>
</tr>
<tr>
<td></td>
<td>£8.70</td>
<td>f</td>
<td>8.16 km</td>
<td>i</td>
</tr>
</tbody>
</table>

#### 5

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5.4</td>
<td>1050</td>
<td>e</td>
<td>0.315</td>
</tr>
<tr>
<td></td>
<td>15190</td>
<td>d</td>
<td>12.25</td>
<td>f</td>
</tr>
</tbody>
</table>

#### 6

54 male and 66 female zebra

#### 7

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>£80.50</td>
<td>£10.26</td>
<td>c</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 8

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>£10.88</td>
<td>£5.69</td>
</tr>
</tbody>
</table>

#### 9

No – she has misread the calculator display. 40% of £18 = £7.2 = £7.20

#### 11

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>6</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 12

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>$\frac{3}{40}$</td>
<td>$\frac{1}{16}$</td>
<td>e</td>
<td>$\frac{2}{3}$</td>
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#### 13

Emma ($\frac{33}{40} = 82.5\%$, which is less than 83%)
### Practise... 10.3 Increasing or decreasing by a percentage

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<td>11</td>
<td>No, £2.78 is the amount it is reduced by, the sale price is £4.17</td>
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<td>12</td>
<td>No. (Any price chosen is reduced by 0.25% overall.)</td>
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<td>13 a</td>
<td>Tina is correct, 2% would only give them £308 extra.</td>
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<td>b</td>
<td>Factory workers will also prefer the £350 increase because 2% would only give them £338. Warehouse workers will get the same rise in both offers. Delivery drivers will prefer 2%, which will give them £395, £45 more than the £350 increase.</td>
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<td>c</td>
<td>The 2% increase will cost the company less (£14370 instead of £14700 with the £350 rise).</td>
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<td>Balance is £395  7.5% of £395 = £29.625</td>
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<td>Monthly payment = £424.63 ÷ 6 = £70.77</td>
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<td>Month</td>
<td>Balance</td>
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<td>Payment</td>
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Total paid in monthly payments = £445.57 in 9 months

*The amounts in this table have been rounded to the nearest penny. Students may choose to use rounded figures in the calculations or continue calculations on their calculators without rounding. This does not affect the values given above when each is rounded to the nearest penny.

**Conclusions:** On PayLess, Sally would pay £20.94 more (from £445.57 − £424.63) but she would have less to pay each month. It would take her 9 months to pay off her debt, instead of 6 months by EasyPay. If she cannot afford more than £50 per month, then PayLess might be the better option.

If EasyPay charged 8%, it would cost £426.60 and if PayLess charged 1.5% it would cost £423.67.
Practise... 10.4 Writing one quantity as a percentage of another

When answers are not exact, round them to 1 d.p.

1 a 16%  c 8%  e 12.5%
    b 31.3% d 43.3% f 74%

2 a 48%  c 50%  e 112%
    b 2.5% d 170% f 8.7%

3 70%

4 a 65.4%  b 34.6%

5 a 66.7%  c 56.3%
    b 47.1% d 43.7%

6 | Colour | Tally | Frequency |
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<tbody>
<tr>
<td>Blonde</td>
<td>⬄ ⬄ ⬄</td>
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<tr>
<td>Brown</td>
<td>⬄ ⬄ ⬄ ⬄</td>
<td>13</td>
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<tr>
<td>Black</td>
<td>⬄</td>
<td>5</td>
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<tr>
<td>Red</td>
<td>⬄</td>
<td>2</td>
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</table>

No, 10 is the frequency, not the percentage.
Blonde 33.3%, Brown 43.3%, Black 16.7%, Red 6.7%

7 a i 32.1%   iii 28.6%    v 3.6%
    ii 21.4%   iv 14.3%
    b Add the % to see whether they total 100.

8 a 46.3%  b 12.5%

9 a 1.6%  c 496.7%  e 7.3%
    b 3.1% d 3.2%

10 a 29.2%  b 70.8%

11

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<th>Cycled (number of times a week)</th>
<th>Number of people aged</th>
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<td>Once or more</td>
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<td>Less than once</td>
<td>26%</td>
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<tr>
<td>Never</td>
<td>29%</td>
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12 8.6% of girls are left-handed compared to 10.4% of boys.

Practise... 10.5 Percentage increase and decrease

Answers rounded to 1 d.p. when not exact.

1 7.5%

2 16%

3 77.1%

4 12.8%

5 10.5%

6 a i 36.9%  ii 54.9%   b 41.8%
    a i 9.1%  ii 33.7%   b 12.5%

7 a She has divided £30 by £150 instead of by £120
    b 25%

8 a

9 | Drink              | % change |
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<tr>
<td>Fruit juice</td>
<td>+21.4%</td>
</tr>
<tr>
<td>Low calorie soft drinks</td>
<td>+14.9%</td>
</tr>
<tr>
<td>Other soft drinks</td>
<td>−15.1%</td>
</tr>
<tr>
<td>Beverages (e.g. tea, coffee)</td>
<td>No change</td>
</tr>
<tr>
<td>Alcoholic drinks</td>
<td>+1.2%</td>
</tr>
</tbody>
</table>

10 a 2001–2006 (2.5% increase)
    b could be answered in a variety of ways
1  a  75%  
   b  25%  
   c  \( \frac{4}{5} \)

2

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Fraction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>( \frac{7}{10} )</td>
<td>70%</td>
</tr>
<tr>
<td>0.45</td>
<td>( \frac{9}{20} )</td>
<td>45%</td>
</tr>
<tr>
<td>0.625</td>
<td>( \frac{5}{8} )</td>
<td>62.5%</td>
</tr>
<tr>
<td>0.25</td>
<td>( \frac{1}{4} )</td>
<td>25%</td>
</tr>
<tr>
<td>0.4</td>
<td>( \frac{2}{5} )</td>
<td>40%</td>
</tr>
<tr>
<td>0.667</td>
<td>( \frac{2}{3} )</td>
<td>66.7%</td>
</tr>
<tr>
<td>0.05</td>
<td>( \frac{3}{20} )</td>
<td>5%</td>
</tr>
<tr>
<td>0.125</td>
<td>( \frac{3}{8} )</td>
<td>12.5%</td>
</tr>
<tr>
<td>0.333</td>
<td>( \frac{1}{3} )</td>
<td>33%</td>
</tr>
<tr>
<td>1.5</td>
<td>1( \frac{1}{2} )</td>
<td>150%</td>
</tr>
<tr>
<td>2.6</td>
<td>2( \frac{3}{5} )</td>
<td>260%</td>
</tr>
<tr>
<td>3.75</td>
<td>3( \frac{3}{4} )</td>
<td>375%</td>
</tr>
</tbody>
</table>

3  0.64

4  46 \times 0.65 = \£29.90

\( \frac{3}{5} \) = 0.6, 0.6 \times 52 = \£31.20

\( \frac{3}{5} \) of \£52 is greater

5  Test A

<table>
<thead>
<tr>
<th>Test</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>65%</td>
</tr>
<tr>
<td>B</td>
<td>60%</td>
</tr>
</tbody>
</table>

6  26%

7  a  20.1%
   b  i  Some students read more than one of the categories.
   ii  86%  
   iii  30.4%

8  Girls did better.

Boys 68\%, Girls 70\%

9  20%

10  21.4%

11  60% of 135 = 81 marks, so she needs 49 on the second paper.

12  297

13  Increase in English:

\[ 75 - 53 = 22 \]

\[ 22 \div 53 \times 100\% = 41.5\% \]

Increase in maths:

\[ 63 - 41 = 22 \]

\[ 22 \div 41 \times 100\% = 53.7\% \]

Therefore the biggest increase was in maths.
Perimeter and area

11.1 Perimeter and area of rectangle

1

1 i  a  26 cm  
   b  16 cm
   ii  a  30 cm
      b  16 cm
2

approx 25

3

a  B  
   b  D
   c  B
   d  B, A, C, D
4

a  48 cm  
   c  18.4 cm
   b  80 cm
   d  26 cm
5

any rectangles with length + width = 6

6

a i  22 cm  
   ii  22.41 cm²
   b i  19.2 cm
      ii  11.48 cm²
   c i  24 m
      ii  36 m²
   d i  20 cm
      ii  25 cm²
   e i  17 m
      ii  15 m²
   f i  80 cm
      ii  175 cm²
   g i  40 cm
      ii  51 cm²
   h i  48 m
      ii  100 m²
7

a i  10.36 cm² or 1036 mm²
   ii  1.764 m² or 17640 cm²

11.2 Area of parallelograms and triangles

1

a  96 cm²
   b  450 mm²
   c  43.32 cm²
   d  26 mm²
2

a  24 cm²
   b  11.52 m²
   c  21 cm²
   d  45 cm²
3

A = 36 cm²  B = 24 cm²  C = 40 cm²
C has the largest area.
4

13.5 cm
5

a  Leanne
   b  Kieran has not divided by 2, Javed has

11.3 Compound shapes

1

a i  58.8 mm²
   b  16.5 m²
   c  3186 mm²
   d  12.04 cm²
2

a  65 cm²
   b  54.76 m²
   c  363 mm²
   d  28 m²
3

a i  39.8 cm
   b i  46.7 cm
   c i  15.6 cm
   d i  48 cm
   e i  35.2 cm
   ii  63.5 cm²
   ii  80 cm²
   ii  8 m²
   ii  138 cm²
   ii  92 cm²
4

a i  320 cm²
   ii  39.62 m²
   b i  64%
   ii  88.6%
5

Yes, 8.25 cm² is required.
6

a  £1470.72
   b  1134 m²
7

a  No, she needs 19.75 m² and 2 tins cover 19 m²
   b  £55.93
## Practise... 11.4 Circumference and area of a circle

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(A = \text{circumference, } B = \text{radius, } C = \text{chord, } D = \text{segment})</td>
<td>(A)</td>
<td>(B)</td>
</tr>
<tr>
<td>2</td>
<td>(\text{diameter} \quad \text{sector} \quad \text{tangent})</td>
<td>(a)</td>
<td>(b)</td>
</tr>
<tr>
<td>3</td>
<td>(31.4 \text{ cm} \quad 7.5 \text{ cm})</td>
<td>(a)</td>
<td>(c)</td>
</tr>
<tr>
<td>4</td>
<td>(25.1 \text{ m} \quad 109.3 \text{ cm})</td>
<td>(a)</td>
<td>(c)</td>
</tr>
<tr>
<td>5</td>
<td>(20 \text{ cm})</td>
<td>(a)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(50.27 \text{ m}^2 \quad 951.15 \text{ cm}^2)</td>
<td>(a)</td>
<td>(c)</td>
</tr>
<tr>
<td>7</td>
<td>(78.54 \text{ cm}^2 \quad 4.52 \text{ cm}^2)</td>
<td>(a)</td>
<td>(c)</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>(a)</td>
<td>(P = 46.3 \text{ cm} \quad ii \quad A = 127.2 \text{ cm}^2)</td>
<td>(b)</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>(8 \text{ mm})</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(a)</td>
<td>(P = 15 \text{ m} \quad ii \quad A = 13.9 \text{ m}^2)</td>
<td>(b)</td>
</tr>
<tr>
<td>11</td>
<td>(25 \times 397.0796 = 9927 \text{ m})</td>
<td>She is not correct.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>72.2 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>70.7 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Assess 11

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(P = 56 \text{ cm, } A = 192 \text{ cm}^2)</td>
<td>(b)</td>
<td>(C = 91.7 \text{ mm, } A = 669.7 \text{ mm}^2)</td>
</tr>
<tr>
<td>2</td>
<td>(P = 21 \text{ m, } A = 22.94 \text{ m}^2)</td>
<td>(c)</td>
<td>(C = 270.2 \text{ cm, } A = 5808.8 \text{ cm}^2)</td>
</tr>
<tr>
<td>3</td>
<td>(P = 104.4 \text{ mm, } A = 562.4 \text{ mm}^2)</td>
<td>(d)</td>
<td>(C = 207.3 \text{ mm, } A = 3421.2 \text{ mm}^2)</td>
</tr>
<tr>
<td>4</td>
<td>(24 \text{ cm}^2)</td>
<td>(b)</td>
<td>(144 \text{ m}^2)</td>
</tr>
<tr>
<td>5</td>
<td>(60 \text{ cm}^2)</td>
<td>(c)</td>
<td>(24 \text{ cm}^2)</td>
</tr>
<tr>
<td>6</td>
<td>(24 \text{ cm}^2)</td>
<td>(d)</td>
<td>(13 \text{ cm}^2)</td>
</tr>
<tr>
<td>7</td>
<td>(24 \text{ cm}^2)</td>
<td>(a)</td>
<td>(24 \text{ cm}^2)</td>
</tr>
<tr>
<td>8</td>
<td>(C = 47.1 \text{ cm, } A = 176.7 \text{ cm}^2)</td>
<td>(b)</td>
<td>(909.6 \text{ cm}^2)</td>
</tr>
<tr>
<td>9</td>
<td>(92.5 \text{ cm}^2)</td>
<td>(c)</td>
<td>(92.5 \text{ cm}^2)</td>
</tr>
</tbody>
</table>

## AQA Examination-style questions

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(50 \quad 50 \times 4 = 200 \text{ m}^2; \quad 200 \times £2.03 = £406)</td>
<td>giving (3x = 15), (x = 5 \text{ cm}) and (x = 10 \text{ cm}); (\text{Area} = 150 \text{ cm}^2)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(\text{Let width of rectangle} = x \text{ cm; let the length of rectangle} = y \text{ cm}; y = 2x \text{ and } x + y = 15;)</td>
<td>(D, C, B, E, A)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12 Real-life graphs

12.1 Conversion graphs and other linear real-life graphs

1  a  i  45 litres  iii  54 litres  
       ii  22.5 litres  iv  9 litres

    b  i  4.5 gallons  iii  10 gallons  
       ii  16 gallons  iv  9 gallons

    c  7.5 gallons

    d  Charlie has mixed up the axes and read the gallons as litres and vice versa.

2  a and b

3  a  Number of litres  
    | Cost  |   0  |  1  |  50 |
    |-------|-----|-----|-----|
    |       | £0  | £1.10 | £55 |

    b and c

    d  i  £27.50  ii  £77  iii  £71.50
    e  i  18 litres  ii  59 litres  iii  14.5 litres
    f  11 gallons

4  a and b

    c  i  $7.60  iii  $16.15  v  $17.48
    ii  $13.30  iv  $0.95
    d  i  £6.32  iii  £1.58  v  £0.26
    ii  £5.26  iv  £3.42
    e  $1.20 is equivalent to about 63p so it is cheaper to send a postcard from home to Australia.
c i 68°F  iii 194°F  v −76°F  
  ii 158°F  iv −4°F

d i 38°C  iii −18°C  v −62°C  
  ii 26°C  iv −29°C

e −128°F  
f −40°C/F

g −17°F

h 101°F

5 a and b

<table>
<thead>
<tr>
<th>Miles</th>
<th>Kilometres</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>50</td>
<td>80</td>
</tr>
</tbody>
</table>

6 a Up to point A because the line is going up steeply.
   
b Perhaps to regulate the temperature of the water, the taps were turned down.
   
c The taps were turned off.
   
d D to E. Ibrahim put the plug back in the drain so that there would still be some water left.

7 a £15  b 150 minutes  c 10p

8 Terence the plumber calculates the cost of a job as £50 call out fee plus £30 per hour
   a \[ P = 30H + 50 \]
   b

<table>
<thead>
<tr>
<th>Time job taken (Hours)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>£80</td>
<td>£110</td>
<td>£140</td>
<td>£170</td>
</tr>
</tbody>
</table>

9 a i \[ C = 30 + 10n \]  ii \[ C = 16n \]
   b i £40  ii £16
   c i £50  ii £32
   d

10 a i £150  ii £130
   b Hire 2 U. You can tell because the line goes right down to (0, 0).
   c i \[ P = £30 \]  ii \[ Q = £20 \]  iii \[ R = £30 \]
   d 3 days

11 a 13 gallons  c £64.35  e A $13.78
   b 72 mpg  d 14.5p
1  a  6 km
   b  15 min
   c  Sam is walking fastest on his way home. His average speed is 6 km/h.

2  a  15 km
   b i  G and H ii 4 km iii 5 min
   c i  F and G ii 0.5 km iii 30 min
   d  A–B average speed = 18 km/h
       B–C average speed = 2 km/h
       C–D average speed = 24 km/h
       D–E average speed = 6 km/h
       E–F average speed = 0 km/h
       F–G average speed = 1 km/h
       G–H average speed = 48 km/h
       H–J average speed = 10 km/h
   e  7.5 km/h

3  a i  10.15 am ii 30 min iii 75 miles
   b  B
   c  10 miles
   d  A–B average speed = 40 mph
       B–C average speed = 65 mph
       C–D average speed = 0 mph
       D–E average speed = 65 mph
       E–F average speed = 20 mph
   e  46.2 mph

4  10\(^\frac{2}{3}\) mph

5  a  Frances walked, because it is the slowest journey.
    Henri cycled because it is the next slowest.
    Fay is likely to have taken the train, as it is the quickest journey.

   John is likely to have taken the bus, as it is quite a short distance but a relatively slow average speed.

   b  Frances average speed = 2 km/h
       Henri average speed = 12 km/h
       Fay average speed = 36 km/h
       John average speed = 16 km/h

6  a  Various answers possible. For example, Hamish could have fallen off at 0.5 hours and then had a break and set off again at a slower pace to recover. Or, he could have fallen off at 3.5 hours and then ridden straight back again.
   b  Between 4 and 5 hours.
   c  Hamish cycles 5 km in half an hour, then stops for half an hour. He then cycles at a slower pace, covering 2 km in 2 hours. Between 3 and 3.5 hours, he picks up speed, covering a distance of 6 km. He stops for 30 minutes. Hamish then turns back and cycles 13 km between 4 and 5 hours.
   d  4.8 km/h
   e  Various possible answers. For example, in five hours he needs to go a total of 25 km so lowering the furthest point to 12.5 would make the average speed 5 km/h.
   f  Various answers. For example, he could have walked back after the fall, which would have taken longer, extending the time axis past the 5 hour point. Or he could have got a lift in a car making the return journey much quicker.

Assess 12

1  a i 19 pints iii 45.6 pints
   ii 11.4 pints iv 34.2 pints
   b i 5.5 litres iii 15.4 litres
      ii 25 litres iv 17.6 litres
   c  Various answers possible. For example, Zachary should buy the milk from the corner shop, as according to the graph, 1 litre is approximately 2 pints so this is the cheaper option.

2  a and b
c  i  4.5 kg   ii  16 kg   iii  2.5 kg   iv  19 kg

<table>
<thead>
<tr>
<th>d</th>
<th>i  18 lb</th>
<th>ii  33 lb</th>
<th>iii  16.5 lb</th>
<th>iv  27 lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>64 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f  Sal has been undercharged. £8 would buy 3.80 kg, which is equivalent to about 9 lb. Alternatively, 20 lb is equivalent to about 9 kg, which would cost £18.90.

d  i  18 lb   | ii  33 lb   | iii  16.5 lb  | iv  27 lb  |
| e  | 64 kg     |

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| e  | 64 kg     |

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| e  | 64 kg     |

f  Sal has been undercharged. £8 would buy 3.80 kg, which is equivalent to about 9 lb. Alternatively, 20 lb is equivalent to about 9 kg, which would cost £18.90.

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| e  | 64 kg     |

f  Sal has been undercharged. £8 would buy 3.80 kg, which is equivalent to about 9 lb. Alternatively, 20 lb is equivalent to about 9 kg, which would cost £18.90.

AQA Examination-style questions

1  a  Journey A has two stops, as the graph shows two periods where the distance does not change.

b

![Graph of Journey A](image)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastest</td>
<td></td>
</tr>
</tbody>
</table>

2  a  14 m

b  Tim should increase the gap because the minimum safe distance at 40 mph on the Wet road line is greater than the 60 mph on a dry road by $36 - 27 = 9$ metres.

c  Jill is correct, as the distance covered and time taken are the same, so the average speed must also be the same.

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13 Ratio and proportion

13.1 Finding and simplifying ratios

1 a 1 : 2  c 1 : 4  e 1 : 6  g 1 : 3
   b 1 : 3  d 1 : 5  f 1 : 7  h 3 : 4
   i 2 : 3  k 3 : 2  m 3 : 8  o 1 : 4
   j 1 : 4  l 3 : 5  n 1 : 3  p 1 : 8

2 a e.g. 2 : 4, 3 : 6, 10 : 20
   b The second number is twice the first.

3 1 : 2.5, 0.2 : 0.5, 2 : 5

4 She is adding the same number to both numbers in the ratio instead of multiplying them both by the same number.

5 a 6  b 7

6 1 : 10

13.2 Using ratios to find quantities

1 a 50, 100  d 2 litres, 4 litres
   b 100, 200  e £0.50, £1
   c £1.50, £3  f 0.5 litres, 1 litre

2 a 30, 120; 60, 240; £0.90, £3.60; 1.2 litres, 4.8 litres; £0.30, £1.20; 0.3 litres, 1.2 litres
   b 60, 90; 120, 180; £1.80, £2.70; 2.4 litres, 3.6 litres; 60p, 90p;
   c 45, 105; 90, 210; £1.35, £3.15; 1.8 litres, 4.2 litres; 45p, 105p; 0.45 litres, 1.05 litres
   d 15, 30, 105; 30, 60, 210; 60p, £1.20, £3.15; 0.6 litres, 1.2 litres, 4.2 litres; 15p, 30p, £1.05; 0.15 litres, 0.3 litres, 1.05 litres

3 £210

4 162 degrees

5 a 50 g, 75 g, 75 g, 40 g, 30 g, 65 g

b chicken sandwich, grilled salmon, yoghurt (whole milk), milk
   c 400 g
   d taco chips, bread

6 a copper 950 g, tin 40 g, zinc 10 g
   b copper 9.5 kg, tin 400 g, zinc 100 g
   c copper 475 g, tin 20 g, zinc 5 g
   d 0.06 g

7 Leena £51851.85, Kate £18148.15

8 a boys : girls for each school is:
   School A 375, 375; School B 400, 500;
   School C 800, 1000; School D 612, 714;
   School E 602, 582. Therefore, School C has the greatest number of boys.
   b School E
**Practise... 13.3 Ratio and proportion: the unitary method**

1. a 317 miles  
   b 32 miles  
   c 3 hours 57 minutes

2. a 41.3 litres  
   b 97 miles  
   c The assumption is that the rate of consumption of diesel is constant.

3. large (small $50 \div 99 = 0.51\text{ ml}$; standard $75 \div 110 = 0.68\text{ ml}$; large $100 \div 128 = 0.78\text{ ml}$)

4. a 5.50 kg £2.85; 12.75 kg £2.20; 25.50 kg £2.08  
   b 25.50 kg  
   c £72.68  
   d It is cheaper per kilogram. It is heavy to carry, difficult to store, not easy to use, etc.

5. a 900 newtons  
   b 60 newtons

6. a £37.50  
   b Number of hours worked  
   c Money earned (£)  
   
<table>
<thead>
<tr>
<th>Number of hours worked</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money earned (£)</td>
<td>7.50</td>
<td>15</td>
<td>22.50</td>
<td>30</td>
<td>37.50</td>
<td></td>
</tr>
</tbody>
</table>

   c The amount earned is directly proportional to the hours worked.  
   d Read $y$-coordinate of point where line though (5, 0) parallel to $y$-axis meets graph.

7. a 20  
   b 300

8. a 30  
   b £30

**Practise... 13.4 Dividing quantities in given ratios**

1. a £10, £20  
   b £8, £16  
   c £20, £40  
   d £200, £400  
   e £1000, £2000

2. 1:4 answers: a £6, £24  
   b £4.80, £19.20  
   c £12, £48  
   d £120, £480  
   e £600, £2400  
   2:3 answers: a £12, £18  
   b £9.60, £14.40  
   c £24, £36  
   d £240, £360  
   e £1200, £1800  
   3:7 answers: a £9, £21  
   b £7.20, £16.80  
   c £18, £42  
   d £180, £420  
   e £900, £2100  
   1:2:7 answers: a £3, £6, £21  
   b £2.40, £4.80, £16.80  
   c £5, £12, £42  
   d £50, £120, £420  
   e £300, £600, £2100

3. a 6  
   b 7

4. a i 40  
   ii 32  
   b 42

5. A 422, 422  
   B 384, 576  
   C 330, 440  
   D 360, 450  
   E 500, 450

6. a i 90°  
   ii right-angled  
   b obtuse-angled

7. For example:  
   Add 2 and 3 to find the number of parts, 5  
   Divide the total amount by 5  
   Multiply this result by 2 to find the first share and by 3 to find the second share.  
   Check that both shares add up to the original amount.

8. a 100 g  
   b 120 g

9. a £17500  
   b £24000

10. a 18  
    b 5  
    c 9 (or 10)
Assess 13

1 a i 3:4 iii 100:1 v 5:7
  ii 1:3 iv 1:8
b i 2:3 ii 7:10

2 1 : 18

3 3:7

4 a 400 g
  b 375 ml

5 a the same in each
  b 24

6 a 3.33 litres
  b straight line graph through origin with gradient 15

7 £2, £10

8 15

9 ‘Lowerpay’

10 a 7 seconds
  b 16 seconds

11 a Cuba
  b Cuba 20 468, Israel 10 140, Italy 107 413, Nigeria 203 558, Tanzania 55 772, Thailand 109 666, UK 109 478, USA 494 999

12 They both have £9.

AQA Examination-style questions

1 $\frac{84}{4} \times 5 = 105$
  $\frac{150}{5} \times 3 = 90$
  $105 + 90 = 195$
# 14 Properties of polygons

## Practise... 14.1 Angle properties of quadrilaterals

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<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>a</strong></td>
<td>square</td>
<td><strong>d</strong></td>
<td>parallelogram</td>
<td><strong>13</strong></td>
<td></td>
<td></td>
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<td></td>
<td><strong>b</strong></td>
<td>trapezium</td>
<td><strong>e</strong></td>
<td>rhombus</td>
<td><strong>i</strong></td>
<td>or</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>c</strong></td>
<td>rectangle</td>
<td><strong>f</strong></td>
<td>kite</td>
<td><strong>ii</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>2</strong></td>
<td></td>
<td>square, rhombus</td>
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<tr>
<td><strong>3</strong></td>
<td><strong>a</strong></td>
<td>42°</td>
<td><strong>c</strong></td>
<td>87°</td>
<td><strong>e</strong></td>
<td>114°</td>
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<td></td>
<td><strong>b</strong></td>
<td>115°</td>
<td><strong>d</strong></td>
<td>66°</td>
<td><strong>f</strong></td>
<td>42°</td>
<td></td>
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<tr>
<td><strong>4</strong></td>
<td><strong>a</strong></td>
<td>122°</td>
<td><strong>c</strong></td>
<td>i 90° ii square or rectangle</td>
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<td></td>
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<tr>
<td></td>
<td><strong>b</strong></td>
<td>85°</td>
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<tr>
<td><strong>5</strong></td>
<td><strong>a</strong></td>
<td>61°</td>
<td><strong>b</strong></td>
<td>79°</td>
<td><strong>c</strong></td>
<td>26°</td>
<td><strong>d</strong></td>
<td>279°</td>
<td><strong>e</strong></td>
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<td><strong>6</strong></td>
<td><strong>a</strong></td>
<td>square, rhombus</td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>b</strong></td>
<td>square, rectangle, parallelogram, rhombus, trapezium</td>
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<td></td>
<td><strong>c</strong></td>
<td>square, kite, rhombus</td>
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<td></td>
<td><strong>d</strong></td>
<td>trapezium</td>
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<tr>
<td><strong>7</strong></td>
<td></td>
<td>He is wrong. These angles add up to 370° and not 360°</td>
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<td><strong>8</strong></td>
<td></td>
<td>He could be right. 72 + 108 = 180 and 66 + 114 = 180</td>
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<td>These would make the adjacent angles required for parallel lines.</td>
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<tr>
<td><strong>9</strong></td>
<td></td>
<td>square, rectangle, kite (if it has two right angles)</td>
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<td><strong>10</strong></td>
<td></td>
<td>Yes, but only if it is an isosceles trapezium.</td>
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<tr>
<td><strong>11</strong></td>
<td></td>
<td>3x + 150 = 360°; x = 70°</td>
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<tr>
<td><strong>12</strong></td>
<td></td>
<td>55°</td>
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## Practise... 14.2 Diagonal properties of quadrilaterals

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<td>b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d</td>
<td></td>
</tr>
<tr>
<td><strong>13</strong></td>
<td></td>
<td>i 90° ii 30°, 30°, 150°, 150° iii 60°, 60°, 120°, 120°</td>
</tr>
</tbody>
</table>

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### 14.3 Angle properties of polygons

**1** 101°

**2**
\[ a = (4 \times 180°) - 610° = 110° \]
\[ b = 180° - 135° = 45° \]

**3** 6

**4** 144° – 140° = 4°

**5** No, it should be \((n - 2) \times 180° = 4 \times 180°\)

**6** \((8 - 2) \times 180° = 6 \times 180° = 3 \times 360°\)

**7** Regular hexagon: draw six lines radiating from the centre of the circle, each 60° apart. Join the points at which the lines touch the circle. Regular nonagon: draw nine lines radiating from the centre of the circle, each 40° apart as above.

**8**

- a 108°
- b 120°
- c 132°
- d 36°
- e 72°
- f 30°
- g 90°

**9** 36°

**10**

- a 135°
- b No, a square is left between them.
Assess 14

1  a parallelogram  d isosceles triangle
   b isosceles trapezium  e regular pentagon
   c regular octagon  f rhombus

2  a, b, d  f c, d, e, f
   b, e, c  g b, c, e
   a, b, d, f  h c, f
   a, b, c, e, f  i f, a
   a, b, c, d, e, f  j b, c, d, e

3  a = 80°  b = 80°  c = 100°

4  possible polygons = a, b, c, e, g, h, i

5  a  a = 112°
   b  b = 50°; c = 40°

   c  d = 69°; e = 41°; f = 35°
   d  g = 47°; h = 90°; i = 43°; j = 47°
   e  k = 110°; l = 50°
   f  m = 129°; n = 100°
   g  p = 128°
   h  q = 60°; r = 150°
   i  s = 88°; t = 92°
   j  u = 135°; v = 45°

6  Sophie is correct. 40° divides into 360° to give 9, so it is a nonagon.

7  a  90
   b  176°
   c  15840°

8  36°

AQA Examination-style questions

1  a  A = parallelogram, B = rhombus  b  i  ii trapezium
## 15.1 Simple equations

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<td>1</td>
<td>a</td>
<td>7</td>
<td>c</td>
<td>11</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>0.6</td>
<td>d</td>
<td>14</td>
<td>f</td>
</tr>
<tr>
<td>2</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>40</td>
<td>b</td>
<td>28</td>
<td></td>
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<tr>
<td>4</td>
<td>20</td>
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<td>5</td>
<td>57p</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>$2x - 3 = 7$</td>
<td>b</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>$2x + 110 = 180$</td>
<td>b</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>a</td>
<td>$z - 6 = 8$</td>
<td>b</td>
<td>14</td>
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## 15.2 Harder equations

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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>6</td>
<td>c</td>
<td>$-2.25$</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>$-4$</td>
<td>d</td>
<td>$\frac{1}{4}$</td>
<td>f</td>
</tr>
<tr>
<td>2</td>
<td>She has subtracted 4 from the right-hand side instead of adding. $10x + 7 = 9$</td>
<td></td>
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<tr>
<td>3</td>
<td>She has subtracted 2 from the right-hand side instead of adding. $3y = 10 + 2y$</td>
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<tr>
<td>4</td>
<td>a</td>
<td>$7x - 2 = 108 - 4x$</td>
<td>b</td>
<td>$x = 10$</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>$6y = 3y + 6$</td>
<td>b</td>
<td>$y = 2$</td>
<td>c</td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>$6x - 10 = 4x - 2$</td>
<td>b</td>
<td>$x = 4$</td>
<td>c</td>
</tr>
<tr>
<td>8</td>
<td>a</td>
<td>$3x = x + 4.6$</td>
<td>b</td>
<td>2.2</td>
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<tbody>
<tr>
<td>9</td>
<td>a</td>
<td>$2x = 5x - 9, 2y = 13 - 2y$</td>
<td>b</td>
<td>$x = 3, y = 3\frac{1}{4}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>3 metres by $3\frac{1}{4}$ metres</td>
<td>d</td>
<td>6 metres by $6\frac{1}{2}$ metres</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>$2x + 20 + 3x + 10 = 180$</td>
<td>$5x + 30 = 180$</td>
<td>$5x = 150$</td>
<td>$x = 30$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If the lines were to be parallel, then $2x + 20$ would equal $7x - 100$</td>
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<tr>
<td></td>
<td>$2x + 20 = 80$</td>
<td>$7x - 100 = 110$</td>
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<td></td>
<td>Therefore, the lines are not parallel.</td>
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## 15.3 Equations with brackets

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<td>5</td>
<td>c</td>
<td>2</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>19</td>
<td>d</td>
<td>$-1\frac{1}{2}$</td>
<td>f</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>10</td>
<td>c</td>
<td>3.1</td>
<td>e</td>
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<td></td>
<td>b</td>
<td>4</td>
<td>d</td>
<td>$-3$</td>
<td>f</td>
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<td>3</td>
<td>15</td>
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<td>4</td>
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<tbody>
<tr>
<td>6</td>
<td>a</td>
<td>$7(2x + 3) - 4(x + 1) = 35$</td>
<td>b</td>
<td>$x = 1.8$ metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>The pond is 4 metres by 2.8 metres.</td>
<td>d</td>
<td>The whole garden is 7 metres by 6.6 metres.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>area of lawn = $(7 \times 6.6) - (4 \times 2.8)\text{ m}^2$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>= $46.2 - 11.2 = 35\text{ m}^2$</td>
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</tr>
<tr>
<td>7</td>
<td>a</td>
<td>$\frac{1}{2} \times 4(x + 5) = 64$</td>
<td>b</td>
<td>27 cm</td>
<td>c</td>
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<tr>
<td>8</td>
<td>7.25</td>
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## 15.4 Equations with fractions

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<td>1</td>
<td>a</td>
<td>18</td>
<td>d</td>
<td>7</td>
<td>g</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>45</td>
<td>e</td>
<td>$13\frac{1}{2}$</td>
<td>h</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>$-\frac{1}{16}$</td>
<td>f</td>
<td>$-24$</td>
<td>i</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>$\frac{1}{3}x = 25$</td>
<td>b</td>
<td>75⁵</td>
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<tr>
<td>3</td>
<td>$\frac{3}{4}(x + 12) = 207; x = 264$</td>
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<tr>
<td>4</td>
<td>a</td>
<td>$2(x + 1)$</td>
<td>b</td>
<td>$\frac{3}{4}(x + 1) \times 2$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>$\frac{3}{4}(x + 1) \times 2 = 13.5, x = 8$</td>
<td>d</td>
<td>$18\text{ m}^2$</td>
<td></td>
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<tr>
<td>5</td>
<td>43.6 cm</td>
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<tr>
<td>6</td>
<td>a</td>
<td>$2x^2 = 450$</td>
<td>b</td>
<td>30 cm by 45 cm</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>7</td>
<td>b</td>
<td>6 and 18 sweets</td>
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### Assess 15

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<th>c</th>
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<td>1</td>
<td>8</td>
<td>11</td>
<td>(2\frac{1}{2})</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>-30</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-2</td>
<td>1</td>
</tr>
</tbody>
</table>
| 4 | 3x + 20 = 6x - 130  
   | \(x = 50\)           |

\[\begin{align*}
\angle 1 &= 170^\circ \\
\angle 2 &= 170^\circ
\end{align*}\]
**16**

## Indices

### Practise... 16.1 Powers and roots

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>36</td>
<td>c</td>
<td>169</td>
<td>e</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>81</td>
<td>d</td>
<td>5</td>
<td>f</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>25</td>
<td>b</td>
<td>8</td>
<td>c</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>8</td>
<td>c</td>
<td>1000</td>
<td>e</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>64</td>
<td>d</td>
<td>6</td>
<td>f</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>17</td>
<td>b</td>
<td>2</td>
<td>c</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>1</td>
<td>g</td>
<td>0</td>
<td>f</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Neil is correct as (-5^2 = -(5 \times 5) = -25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>3^2</td>
<td>b</td>
<td>(\sqrt{64})</td>
<td>c</td>
<td>(3\sqrt{-8})</td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>25</td>
<td>b</td>
<td>7</td>
<td>c</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Vivek is incorrect as (-11^2 = -(11 \times 11) = -121)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0.1 and (-0.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(-0.3)</td>
<td></td>
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### Practise... 16.2 Rules of indices

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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>5^4</td>
<td>c</td>
<td>6^{12}</td>
<td>e</td>
<td>2^{18}</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>10^7</td>
<td>d</td>
<td>13^2</td>
<td>f</td>
<td>12^4</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>49</td>
<td>d</td>
<td>9</td>
<td>g</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>16</td>
<td>e</td>
<td>8</td>
<td>h</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>121</td>
<td>f</td>
<td>10000</td>
<td>i</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>5^8</td>
<td>d</td>
<td>4^{11}</td>
<td>g</td>
<td>6^2</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>12^{11}</td>
<td>e</td>
<td>10^{18}</td>
<td>h</td>
<td>4^t</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>3^5</td>
<td>f</td>
<td>7^5</td>
<td>i</td>
<td>9^i</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>False (6^2 = 6 \times 6 = 36)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>True (1^3 = 1 \times 1 \times 1 = 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>True (\frac{2^{10}}{4^5} = \frac{2^{10}}{(2^2)^5} = \frac{2^{10}}{2^{10}} = 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>False (3^2 + 3^3 \neq 3^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>(x^6)</td>
<td>c</td>
<td>(a^4)</td>
<td>e</td>
<td>(q^9 = 1)</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>(e^{11})</td>
<td>d</td>
<td>(p^5)</td>
<td>f</td>
<td>(b^{10})</td>
</tr>
</tbody>
</table>

<p>| | | | | | | |</p>
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</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Many possible answers; some of them are: (5^2 + 5^2 + 5^2 + 5^2 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1^2 + 7^2 + 1^2 + 7^2 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6^2 + 8^2 = 100)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(8^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4^2 + 4^2 + 4^2 + 4^2 + 4^2 + 4^2 + 2^2 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9^2 + 1^2 + 1^2 + 1^2 + 4^2 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One possible solution is (1^3 + 2^3 + 3^3 + 4^3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It may be helpful to consider . . .</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cube numbers are 1, 8, 27, 64, 125, 216, . . . (using negative integers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Adnan is correct. (a^2 \div a^2 = a^{2-2} = a^0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Many possible answers, for example: ((-8)^2, 4^3, 2^6, (-2)^6)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
| 9 | Ravi is correct. 
   The sum of the squares of two odd numbers is always even. 
   The reason is that: 
   An odd \(\times\) odd = odd, so all odd numbers squared are odd. 
   An odd + odd = even, so when you add two odd numbers you get an even number. |
### Assess 16

<p>| | | | | | | | | | | |</p>
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<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>16</td>
<td>b</td>
<td>121</td>
<td>c</td>
<td>6</td>
<td>d</td>
<td>14</td>
<td>e</td>
<td>0</td>
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<tr>
<td>2</td>
<td>a</td>
<td>125</td>
<td>b</td>
<td>1000</td>
<td>c</td>
<td>3</td>
<td>d</td>
<td>4</td>
<td>e</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>100</td>
<td>b</td>
<td>10</td>
<td>c</td>
<td>−5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>Gareth is right. Negative numbers have no square roots.</td>
<td>b</td>
<td>No. Numbers only have one cube root.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>$4^8$</td>
<td>c</td>
<td>$5^6$</td>
<td>e</td>
<td>$6^9$</td>
<td>g</td>
<td>$21^2$</td>
<td>i</td>
<td>$5^1$</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>$11^8$</td>
<td>d</td>
<td>$7^6$</td>
<td>f</td>
<td>$10^2$</td>
<td>h</td>
<td>$16^1$</td>
<td>j</td>
<td>$2^9$</td>
</tr>
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### Examination-style questions

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>t⁹</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p⁴</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>ii</td>
<td>$3^5$</td>
</tr>
</tbody>
</table>

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17 Graphs of linear functions

Practise... 17.1 Drawing straight-line graphs

1 a

\[ y = x + 2 \]

b (0, 2)

2 a

\[ y = 3x - 1 \]

b \((-\frac{2}{3}, -3)\)

3 a

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

c (0, 1)

4 a and b

No, because if you substitute these numbers into the equation of the line, it does not work: \(4 \neq \frac{1}{2} \times 7\)

5 a and b

The origin, coordinates (0, 0)
6 a

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>9</th>
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</thead>
<tbody>
<tr>
<td>y</td>
<td>4.5</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>


b

\[ x + 2y = 9 \]


7 a

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-(\frac{1}{2})</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>


b

\[ x - 2y = 1 \]


8 a, B and D

9 B, D and E

Putting A (0, 4) into the equation gives an answer of \((3 \times 0) + (2 \times 4) = 8\)

Putting B (2, 3) into the equation gives an answer of \((3 \times 2) + (2 \times 3) = 12\)

Putting C (3, 2) into the equation gives an answer of \((3 \times 3) + (2 \times 2) = 13\)

Putting D \((1, 4\frac{1}{2})\) into the equation gives an answer of \((3 \times 1) + (2 \times 4\frac{1}{2}) = 12\)

Putting E \((6, -3)\) into the equation gives an answer of \((3 \times 6) + (2 \times -3) = 12\)

Putting F \((-2, 8)\) into the equation gives an answer of \((3 \times -2) + (2 \times 8) = 10\)

10 Putting P into equation A gives an answer of \((3 \times 0) + (2 \times 9) + 1\)

Putting P into equation B gives an answer of \((3 \times 2) + (2 \times 3) + 1\)

Putting P into equation C gives an answer of \((3 \times 3) + (2 \times 2) + 1\)

Putting P into equation D \((1, 4\frac{1}{2})\) gives an answer of \((3 \times 1) + (2 \times 4\frac{1}{2}) + 1\)

Putting P into equation E \((6, -3)\) gives an answer of \((3 \times 6) + (2 \times -3) + 1\)

Putting P into equation F \((-2, 8)\) gives an answer of \((3 \times -2) + (2 \times 8) + 1\)

11 Point A lies on line \(x + y = 5\)

Point B lies on line \(y = 4x\)

Point C lies on line \(x + y = 5\) and \(y = 4x\)

Point D lies on line \(2x + y = 9\) and \(y = 6x - 7\)

Point E lies on line \(2x + y = 9\)

Point F lies on line \(2x + y = 9\) and \(x + y = 5\)

Practise... 17.2 Gradients of straight-line graphs

1 a 1
b 3
c \(\frac{1}{2}\)
d -1

2 a 5
b 1
c -2
d 3
e 3
f -4

3 The gradient of the line \(y = 5 - 2x\) is -2 and the gradient of the line \(y = 5 - 4x\) is -4 so Jo is wrong to say they are the same. One is double the other.

4 a Line A because the increase in \(y\) is double the increase in \(x\)
b Line C because the increase in \(y\) is equal to the increase in \(x\)
c Line D because the \(y\) values decrease as the \(x\) values increase

5 The equation of the line is \(y = 3x - 5\) so the gradient is 3

The gradient \(\frac{PQ}{RQ}\) so \(3 = \frac{PQ}{RQ}\) so \(PQ = 9\) so the length of \(PQ = 9\) units.
They are all parallel. The equations all have the same number in front of the \( x \) terms, which means they have the same gradient so they must be parallel.

7  
\( a \) This is  \( y = 4 - x \)  
\( b \) This is  \( y = 3x \)  
\( c \) This is  \( y = 3x + 8 \)  
\( d \) This is  \( y = -2x \)
c Yes, because if you put the coordinates (6, 6) into the line equation $6 = 3 + \frac{1}{2}(6)$ which is correct.

5 B, D and E lie on the line $4x - 3y = 4$
Putting (0, 1) into the equation gives an answer of $(4 \times 0) - (3 \times 1) = -3$
Putting (1, 0) into the equation gives an answer of $(4 \times 1) - (3 \times 0) = 4$
Putting (3, 4) into the equation gives an answer of $(4 \times 3) - (3 \times 4) = 0$
Putting (4, 4) into the equation gives an answer of $(4 \times 4) - (3 \times 4) = 4$
Putting (7, 8) into the equation gives an answer of $(4 \times 7) - (3 \times 8) = 4$
Putting (8, 7) into the equation gives an answer of $(4 \times 8) - (3 \times 7) = 11$

6 a 5 b -2 c -3 d 1

7 B

8 \[
\frac{AB}{BC} = \text{gradient} = -2
\]
\[
\frac{AB}{4} = -2 \text{ so } AB = -8 \text{ so the length of } AB \text{ is 8 units.}
\]

9 The equation tells us that the point at which the line crosses the y-axis is +4
The line in the graph passes through the origin, so Jacqui must be wrong.

10 Rasheed is wrong because the gradient of the line is negative, which is not the case in his equation. Also the line crosses the y-axis at +5 not -5 so his equation is actually the inverse of the line shown.
18 Reflections, rotations and translation

Practise... 18.1 Reflection

1 a i 1 iii 2 v 4
   ii 1 iv 1 vi 1
b any six from F G J L P Q R S

2 a

b

c

d

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3 a

i 2

ii 2

iii 2

iv 1

v 1 line of symmetry

b Equilateral triangles always have 3 lines of symmetry and isosceles triangles always have 1. All other triangles have no lines of symmetry.

4 a i 4 iii 4 v 0

ii 2 iv 0 vi 4

b student’s own diagram with 4 lines of symmetry

5 There is more than one answer to each question. Students complete correctly.

a 4 lines of symmetry

b 2 lines of symmetry

c 0 lines of symmetry
The $y$-coordinate has changed from negative to positive or from positive to negative.

**b i–iv**

The $x$-coordinate has changed from negative to positive or from positive to negative.

**7 a i–ii, iv, v**

iii a kite
b i–ii, iv, v

![Diagram](image)

iii a parallelogram

8 a \( y = 0 \) b \( x = 0 \) c \( x = 2 \) d \( y = -2.5 \)

9 a–b

![Diagram](image)

c square

d \((-1, 1) (-1, 3) (-3, 1) (-3, 3)\)

e \((1, -1) (1, -3) (3, -1) (3, -3)\)

f The square does not change.

10 a reflection in \( y = x \), the coordinates are reversed

b \((1, 3) (-1, 7) (-4, -2)\)

\((3, 1) (7, -1) (-2, -4)\)

c The coordinates are reversed.

d \((3, 2) (-2, -1) (-4, 0) (-2, 2)\)

e i The \(x\)-coordinates change from negative to positive or from positive to negative.

ii The \(x\)-coordinates remain the same.

iii The \(y\)-coordinates remain the same.

11 a square, rectangle, rhombus, kite, arrowhead, isosceles trapezium

b

![Diagram](image)

c They do not all have the same number of lines of symmetry. Note that only the isosceles trapezium is symmetrical, all other trapeziums are not symmetrical.

12 a \( y = 0 \) \( x = 0 \) \( y = x \) \( y = -x \)

b

![Diagram](image)

c student's own pattern

### Practise... 18.2 Rotation

1 a i 2 iii 2 v 4

ii 1 iv 2 vi 2

b The rotation symmetry of \( O \) depends upon the font used. If it is a perfect circle then the order is infinite.

2 a i 3 iv 1 vii 6

ii 5 v 2 viii 2

iii 2 vi 1

b Equilateral triangles have rotation symmetry order 3. All others are order 1.

c A regular pentagon has rotation symmetry order 5. All others are order 1.

3 a 4 b 4 c 2 d 2 e 2 f 4

4 There is more than one answer to each section. Students' answers should have:

a order 2 c order 1

b order 2 d order 4

5 a 90° b 330° c 270° d 120° e 240°
6 a i order 3 120°
   ii order 2 180°
   iii order 4 90°

b order 6

7 Shape R:
   a

   b Shape S:

   c Shape T:

   d Shape U:

   e Shape V:
8 a
i  Shape A:

f  Shape W:

ii  Shape B:

iii  Shape C:
iv Shape D:

vi Shape F:

v Shape E:

8b Shape A:
ii Shape B:

![Diagram of Shape B]

iii Shape C:

![Diagram of Shape C]

iv Shape D:

![Diagram of Shape D]

v Shape E:

![Diagram of Shape E]
9 a i Shape G:

ii Shape H:

iii Shape I:
iv Shape J:

v Shape K:

iv Shape L:

b i Shape G:
ii Shape $H$:

![Diagram of Shape $H$]

iii Shape $I$:

![Diagram of Shape $I$]

iv Shape $J$:

![Diagram of Shape $J$]

v Shape $K$:

![Diagram of Shape $K$]
11 a–c

12 a (3, 2)  c (3, -1)  e (1, 1)
b (-2, 4)  d (-2.5, -2.5)  f (0.5, 1.5)

13 Vertices of triangle are: (2, 4), (2, 6), (4, 6)

14 a The arrows have rotational symmetry but the house in the logo does not.
b i order 3  ii 120°
c i student’s own design
   ii order of rotational symmetry of student’s design

15 students’ own diagrams
a order 2  b order 4  c order 1

16 a i–iii

   b order 8  d because 38 is not a factor of 360
   c order 12  e Yes. Order 5 as 72° × 5 = 360°

Practise... 18.3 Translation

1 a

   b
2. a. \( \begin{pmatrix} 4 \\ -2 \end{pmatrix} \)  
   b. \( \begin{pmatrix} 4 \\ 3 \end{pmatrix} \)

3. a. i. \( \begin{pmatrix} 6 \\ 3 \end{pmatrix} \) ii. \( \begin{pmatrix} -1 \\ -6 \end{pmatrix} \) iii. \( \begin{pmatrix} -7 \\ -9 \end{pmatrix} \) iv. \( \begin{pmatrix} 7 \\ 9 \end{pmatrix} \)
   b. They are opposites.

4. a. \( \begin{pmatrix} 2 \\ 5 \end{pmatrix} \) b. \( \begin{pmatrix} -5 \\ -11 \end{pmatrix} \) c. \( \begin{pmatrix} -3 \\ 7 \end{pmatrix} \) d. \( \begin{pmatrix} 12 \\ -7 \end{pmatrix} \)

5. a–d

6. a–d

7. a–b student’s own designs

8. a. C E B D F A X b. \( \begin{pmatrix} -1 \\ 8 \\ -5 \\ -4 \\ 11 \\ -6 \end{pmatrix} \) c. student’s own vector route
1. a 1  
   b 0  
   c 1  
   d 1  
   e 0

2. a

3. a

4. a order 5  
   b 72°

5. a

b kite  
   c student’s own drawing  
   d (−1, −3) (−1, −5) (−3, −3) (−4, −6)
**6**

- **a**
  - Rotation 90 degrees clockwise
  - Centre the origin.

- **b**
  - (1, 2) (2, 5) (3, 4)

**7**

- \( \begin{pmatrix} 5 \\ -4 \end{pmatrix} \)

**8**

- \( x = 2 \)

**9 a and c**

- **b**
  - (−2, 2) (−5, −1) (0, −4)

- **d**
  - (−2, 2) (1, 5) (4, 0)
## 19. Measures

### 19.1 Measurements and reading scales

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>10 cm</td>
<td>c</td>
<td>4 cm</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>8 cm</td>
<td>d</td>
<td>8 cm</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>14 cm</td>
<td>b</td>
<td>143 mm</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>metres</td>
<td>f</td>
<td>centimetres</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>millimetres</td>
<td>g</td>
<td>millimetres</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>metres</td>
<td>h</td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>millimetres</td>
<td>i</td>
<td>kilometres</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>kilometres</td>
<td>j</td>
<td>metres</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>tonnes (kg for a small car!)</td>
<td>b</td>
<td>kilograms</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>grams</td>
<td>f</td>
<td>grams</td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>millilitres</td>
<td>d</td>
<td>litres</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>litres</td>
<td>e</td>
<td>litres</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>litres</td>
<td>f</td>
<td>millilitres</td>
</tr>
</tbody>
</table>

### 19.2 Conversion between metric units

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>50 mm</td>
<td>b</td>
<td>30 mm</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>5 cm</td>
<td>b</td>
<td>3 cm</td>
</tr>
<tr>
<td>3</td>
<td>3000 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>450 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.25 km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>1200 kg</td>
<td>c</td>
<td>900 kg</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>3100 kg</td>
<td>d</td>
<td>2 kg</td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>700 ml</td>
<td>b</td>
<td>0.7 litres</td>
</tr>
<tr>
<td>8</td>
<td>a</td>
<td>m</td>
<td>c</td>
<td>cm</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>mm</td>
<td>d</td>
<td>km</td>
</tr>
<tr>
<td>9</td>
<td>1850 g (or 1.85 kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>9.5 km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>a</td>
<td>750 ml orange juice, 1000 ml apple juice, 500 ml water, 1250 ml lemonade</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>2 glasses each</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 12
No. She needs 207 cm for the presents and 2 m is only 200 cm.

### 13

#### a 

![Diagram](image)

- 6 cm
- 3 cm
- 2 cm

#### b 

- The following can all be measured using these four pieces: 1 cm, 2 cm, 3 cm, 4 cm, 5 cm, 6 cm, 7 cm, 8 cm, 9 cm, 10 cm, 11 cm, 12 cm, 13 cm, 14 cm, 15 cm, 16 cm, 17 cm, 18 cm, 19 cm, 20 cm, 21 cm, 22 cm.

#### b 

- Student’s own suggestions
### 19.3 Conversion between metric and imperial units

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>13.5 litres</td>
<td><strong>10</strong></td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>1.36 (2p)</td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>
| **3** | 15 cm | **12** | a Iqbal has used 8 miles as 5 km (rather than 8 km as 5 miles).  
   |   |   | b 64 km  
   |   |   | c 15.625 miles  
| **4** | 4.5 kg | **13** | Liz needs to raise £3.34 for each mile (£3.33 is not enough to get £1000). |
| **5** | £3.86 | **14** | The minimarket is cheapest. (85.33p per litre at the corner shop) (or 95.625p for 2 pints at minimarket) |
| **6** | £5.04 |   |   |
| **7** | 2.73 kg (2 d.p.) |   |   |
| **8** | 32 km |   |   |
| **9** | 26 miles (to the nearest mile) |   |   |

### 19.4 Compound measures

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **1** | a 25 m/s | **6** | a 48 minutes  
   |   | b 7.14 m/s (2 d.p.)  
   |   | c 115 mph  
   |   |   | **c** 1 hour 48 minutes  
   |   | b 40 minutes  
| **2** | a 0.5 h | **7** | a 5 km  
   |   | b 0.25 h  
   |   | c 4.75 h  
| **3** | a 2 hours 30 minutes | **8** | a 42.5 mpg  
   |   | b 3 hours 15 minutes  
   |   | c 1 hour 45 minutes  
   |   |   | c Yes, she can travel 637.5 miles if she manages 42.5 mpg all the time.  
| **4** | a 68 mph | **9** | 7.29 km/h (2 d.p.)  
   |   | b 50 mph  
| **5** | a 300 | **10** | No, he needs to use 15.8 gallons of fuel.  
   |   | b 20 minutes  

### 19.5 Accuracy in measurements

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **1** | a 13 cm | **7** | No, the van may be anything up to 2.5 tonnes.  
   |   | c 50 m  
   |   | e 44 kg  
   | b 81 m  
   |   | d 7 g  
   |   | f 47 l  
| **2** | a for example 14.77, 15.023 | **8** | b, c and e  
   | b 14.5  
   | c 15.5  
| **3** | 2.5 metres and 3.5 metres | **9** | 5 kg (the most each type of book could be is 3.5 kg and 1.5 kg)  
| **4** | No, some could be 7.6 cm and others could be 8.3 cm, or any other lengths that round to 8 cm to the nearest cm. | **10** | 5 kg (0.5 kg + 4.5 kg)  
| **5** | a 17.5 km | **11** | It appears safe as their total weight is 249 kg. Yes, it does make a difference if the weights are rounded, if they are to the nearest kg then they could total 250.5 kg, which is above the maximum weight.  
   | b 18.5 km  
| **6** | 42.5 g, 43.5 g |   |   |
Answers

Assess 19

1 a 4 cm  b 3 cm  c 6 cm  d 6 cm
2 a tonnes  b metres  c kg  d grams
3 A 5, B 13, C 17.5
4 2000 ml
5 2 km
6 8.8 pounds
7 2.25 l
8 68.75 mph
9 32.9 mph
10 22.67 mph (2 d.p.)
11 18.5 °C and 17.5 °C

AQA Examination-style questions

1 Dipak travels $\frac{6}{5} \times 30 = 48$ km, which is further than Wendy’s 40 km
Wendy travels $\frac{5}{8} \times 40 = 25$ m, which is less far
So, Dipak travels further.
### Coordinates and graphs

#### Practise...

#### 20.1 Coordinates and equations of a straight line

1. | A (3, 1) | C (3, 4) | E (−1, 1) | G (5, −1) |
   | B (5.3) | D (−1, 3) | F (−1, −2) |

2. ![Graph](image)

3. (5, 1)

4. **a** (6, 4); (9, 4); (6, 6); (9, 6)
   **b** (9, 6); (12, 6); (9, 8); (12, 8)

5. **a** A: $x = 4$, B: $y = 4$, C: $x = 1$, D: $y = 1$,
   E: $y = 0$, F: $x = −2$
   **b** Line A crosses line D at (4, 1). Declan has written the x- and y-coordinates the wrong way around.
   **c** i (4, 4) iii (4, 0) v (−2, 1)
   ii (1, 4) iv (−2, 4)

6. **a** i−vi

   ![Graph](image)

   **b** The lines cross at (2, 3), (2, −2), (−1, 3), (−1, −2), $x = 2$ meets $y = 3$ at (2, 3). The equations give the coordinates of the point of intersection.

7. **a** Any two points with equal x- and y-coordinates, for example (1, 1) (2, 2).
   **b** ![Graph](image)
   **c** (0, 0)

8. **a** for example, (1, −1), (−3, 3)
   **b** ![Graph](image)
   **c** There are several things that can be noticed: both lines go through (0, 0); the lines are perpendicular to each other; they meet the axes at 45°

9. (5, 3)

10. (1, 1), (5, 5), (−3, 1)
Practise... 20.2 Real-life graphs

1 a

<table>
<thead>
<tr>
<th>Children</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (£)</td>
<td>105</td>
<td>160</td>
<td>215</td>
<td>270</td>
</tr>
</tbody>
</table>

b

![Graph showing cost against children number]

<table>
<thead>
<tr>
<th>Children</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (£)</td>
<td>105</td>
<td>160</td>
<td>215</td>
<td>270</td>
</tr>
</tbody>
</table>

c i £132.50  ii £171  iii £220.50
d 27

2 a

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (ml)</td>
<td>0</td>
<td>125</td>
<td>250</td>
<td>375</td>
<td>500</td>
<td>625</td>
</tr>
</tbody>
</table>

b

![Graph showing water against time]

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (ml)</td>
<td>0</td>
<td>125</td>
<td>250</td>
<td>375</td>
<td>500</td>
<td>625</td>
</tr>
</tbody>
</table>

c 400 ml
d 1.6 seconds
e 13.6 seconds

3 a i 3 l  ii 1.75 l
b i 80 km  ii 50 km
c Gradient = 20 km/l
The gradient tells you the number of km travelled for each litre of petrol used.

4 a

<table>
<thead>
<tr>
<th>Units</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (£)</td>
<td>8.5</td>
<td>61</td>
<td>113.5</td>
<td>166</td>
<td>218.5</td>
</tr>
</tbody>
</table>

b

![Graph showing cost against units used]

<table>
<thead>
<tr>
<th>Units</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (£)</td>
<td>8.5</td>
<td>61</td>
<td>113.5</td>
<td>166</td>
<td>218.5</td>
</tr>
</tbody>
</table>

d For anyone using more than about 600 units, Betta-supplies is cheaper.

5 a £9.60
b 12p
c £21.60
d 101 pens. Any more than 100 starts getting a discount.
e

<table>
<thead>
<tr>
<th>Pens</th>
<th>100</th>
<th>200</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheapo</td>
<td>9</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>Budget</td>
<td>12</td>
<td>19</td>
<td>25</td>
</tr>
</tbody>
</table>

f

![Graph showing cost against number of pens]

<table>
<thead>
<tr>
<th>Pens</th>
<th>100</th>
<th>200</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheapo</td>
<td>9</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>Budget</td>
<td>12</td>
<td>19</td>
<td>25</td>
</tr>
</tbody>
</table>
g  For 150 pens, ‘Cheapo’ pens are cheaper by £2.
h  220 pens for £19.80
i  158 is the first number of pens to make a profit (assuming they sell all the ones they buy!)
j  9p

6 a i  AB   ii  CD
    b  2.75 km/h
    c  3.3 km/h

7 a  5 calories per minute
    b  9 calories per minute – cross trainer.

c

Practise... 20.3 Drawing 2-D representations of 3-D objects

1 a

2

3

4 A, D, H, J
   B, G, K
   E, F, I
   C

5

6

7
Practise... 20.4 Plans and elevations

1. a F S
   ![Diagram](image)

2. ![Diagram](image)

3. a Jane's view:
   ![Diagram](image)

   b Chim's view:
   ![Diagram](image)

   c Charlie's view:
   ![Diagram](image)

4. d Plan view:
   ![Diagram](image)

5. a The line across the top of the bureau should not be in the middle. The lines across the desk should be dotted.

   b
   ![Diagram](image)

6. a A3, C2, B1, D4

   b
   ![Diagram](image)
Practise... 20.5 Nets

1  A, B, D, E, I

2

Handle

Keep upright

Top

Fragile

Computer

Open other end

3

4

5  B, E, F

6  a  The triangles are the same ‘height’ as half the length of the base so fold flat.

7  a

b  area = 84 cm²

c  volume = 36 cm³

8

9  D

10  Net of pyramid, with at least 4 cm square base and triangular faces with perpendicular height of at least 3 cm
11  

a  student’s own drawing

b  Pentominoes

---

Hexominoes
Assess 20

1. a (6, 7)  
   b (1, 4)  
   c (4.5, −3.5)  
   d (−3, 3) and (−6, 1)  
   e (−5.5, −5)

2. 

3. 

4. triangular prism

5. 

6. a £1200  
   b i £1800 ii £1700  
   c £100  
   d 16  
   e £3400

7. a A: x = 4, B: y = 2, C: x = 1.5

8. (−3, 3), (−1, 7), (5, 3)

9. a

AQA Examination-style questions

1. a 3  
   b 2

2. 

3. 

4. triangular prism

5. 

6. a £1200  
   b i £1800 ii £1700  
   c £100  
   d 16  
   e £3400

7. a A: x = 4, B: y = 2, C: x = 1.5

8. (−3, 3), (−1, 7), (5, 3)

9. a

AQA Examination-style questions

1. a 3  
   b 2