Mathematics Companion

WORKBOOK 1

Marilyn Buchanan, Andrew Lewis, *et al.*

GRADE
8
CAPS

Terms 1 & 2

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Mathematics Companion

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THIS STUDY GUIDE INCLUDES

1. Exercises
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WORKBOOK 1

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EXERCISE 1.1.3

1. Evaluate each of the following expressions.

1.1 $7 \times (5 - 4)$

= ....

= ....

1.2 $(6 - 5) \times 3$

= ....

= ....

1.3 $4 \div (12 - 11)$

= ....

= ....

1.4 $8 + 4 + 0$

= ....

= ....

1.5 $7 - (5 - 5)$

= ....

= ....

1.6 $54 \times (76 - 76)$

= ....

= ....

1.7 $(12 - 12) \times 8$

= ....

= ....

= ....

1.8 $(12 - 12) \div 8$

= ....

= ....

= ....

1.9 $(25 - 15) \div 0$

= ....

= ....

1.10 $(7 - 6) \div (5 - 5)$

= ....

= ....

2. Take note of the number of terms in each of the following expressions. Then evaluate each (if possible).

2.1 $3 + 2 \times 5$

= ....

= ....

2.2 $16 - 6 + 2 \times 4$

= ....

= ....

2.3 $4 + 2 \times (7 - 5)$

= ....

= ....

= ....

2.4 $10 - 6 + 12 \div 3$

= ....

= ....

2.5 $18 - 6 \times 2 - 1$

= ....

= ....

= ....

2.6 $(18 - 6) \times 2 - 1$

= ....

= ....

= ....

2.7 $6 + 3 \times (2 - 2)$

= ....

= ....

= ....

2.8 $6 + 3 \div (5 - 4)$

= ....

= ....

= ....

2.9 $(5 - 3) \times (4 - 4)$

= ....

= ....

2.10 $(6 - 2) \div (7 - 3)$

= ....

= ....

Example 1

We are going to find the HCF of 840 and 630, given the following information.

$840 = 2 \times 2 \times 2 \times 3 \times 5 \times 7$ $\quad$ $630 = 2 \times 3 \times 3 \times 5 \times 7$

In order to determine the HCF, we look for all the prime factors that are common to both numbers.

$840 = \mathbf{2} \times 2 \times 2 \times \mathbf{3} \times \mathbf{5} \times \mathbf{7}$ $\quad$ $630 = \mathbf{2} \times 3 \times \mathbf{3} \times \mathbf{5} \times \mathbf{7}$

The common prime factors are 2, 3, 5 and 7.
So the highest common factor (HCF) will be $\mathbf{2 \times 3 \times 5 \times 7 = 210}$.

HCF of 840 and 630: **210**

Example 2

Determine the highest common factor (HCF) of 1260, 1500 and 840.

÷ 2	1260
÷ 2	630
÷ 3	315
÷ 3	105
÷ 5	35
÷ 7	7
	1

÷ 2	1500
÷ 2	750
÷ 3	375
÷ 5	125
÷ 5	25
÷ 5	5
	1

÷ 2	840
÷ 2	420
÷ 2	210
÷ 3	105
÷ 5	35
÷ 7	7
	1

$1\,260 = \mathbf{2} \times \mathbf{2} \times \mathbf{3} \times 3 \times \mathbf{5} \times 7$

$1\,500 = \mathbf{2} \times \mathbf{2} \times \mathbf{3} \times \mathbf{5} \times 5 \times 5$

$840 = \mathbf{2} \times \mathbf{2} \times 2 \times \mathbf{3} \times \mathbf{5} \times 7$

The common prime factors are 2, 2, 3 and 5.
So the highest common factor (HCF) will be $\mathbf{2 \times 2 \times 3 \times 5 = 60}$.

HCF of 1 260, 1 500 and 840: **60**

Note that we look for ***all the prime factors that are common to all three numbers***. Also note that the ***same prime factor*** may appear ***more than once*** on the list of common factors.

EXERCISE 1.2.4

1. Consider 36 and 60.
   - 1.1 Write down the factors of 36. ....
   - 1.2 Write down the factors of 60. ....
   - 1.3 Determine the HCF (highest common factor) of 36 and 60. ....

2. Consider 32, 48 and 56.
   - 2.1 Write down the factors of 32. ....
   - 2.2 Write down the factors of 48. ....
   - 2.3 Write down the factors of 56. ....
   - 2.4 Determine the HCF of 32 and 48. ....
   - 2.5 Determine the HCF of 32 and 56. ....
   - 2.6 Determine the HCF of 48 and 56. ....
   - 2.7 Determine the HCF of 32, 48 and 56. ....

3.1 Below you are given 210 and 300, each written as the product of its prime factors.

$210 = 2 \times 3 \times 5 \times 7$ $\quad$ $300 = 2 \times 2 \times 3 \times 5 \times 5$

Use the given information to determine the highest common factor (HCF) of 210 and 300.

....

SQUARES, CUBES AND ROOTS OF COMMON FRACTIONS

Attempt this exercise without using a calculator.
Where applicable, leave your answer as an improper fraction.

EXERCISE 1.4.3

1. Evaluate:

1.1 $11\frac{1}{9} \times \left(\frac{3}{10}\right)^2$

= ....

= ....

1.2 $\left(\frac{2}{3}\right)^2 \div 4\frac{1}{2}$

= ....

= ....

= ....

1.3 $\left(1\frac{2}{3}\right)^2 \div 5\frac{5}{9}$

= ....

= ....

= ....

1.4 $\left(1\frac{2}{3}\right)^2 \div 2\left(1\frac{2}{3}\right)^2$

= ....

= ....

= ....

= ....

= ....

2. Evaluate:

2.1 $\frac{\sqrt{4}}{3} \times \frac{\sqrt{9}}{2}$

= ....

= ....

2.2 $\frac{\sqrt{16}}{\sqrt{9}} \times \frac{\sqrt{81}}{\sqrt{36}}$

= ....

= ....

2.3 $\sqrt{\frac{9}{16}} \div \sqrt{\frac{1}{4}}$

= ....

= ....

= ....

2.4 $\sqrt{2\frac{1}{4}} \div 3$

= ....

= ....

= ....

2.5 $\sqrt{2\frac{1}{12} \times 3}$

= ....

= ....

= ....

2.6 $\sqrt{1\frac{1}{8} \div \frac{1}{2}}$

= ....

= ....

= ....

2.7 $\sqrt{\frac{4}{81}} + \frac{\sqrt{16}}{9}$

= ....

= ....

= ....

= ....

2.8 $\frac{2}{\sqrt{25}} - \sqrt{\frac{90}{1000}}$

= ....

= ....

= ....

= ....

2.9 $\sqrt[3]{\frac{27}{8}} - \frac{\sqrt{9}}{4}$

= ....

= ....

= ....

2.10 $\sqrt{2\frac{7}{9}} - \sqrt[3]{2\frac{10}{27}}$

= ....

= ....

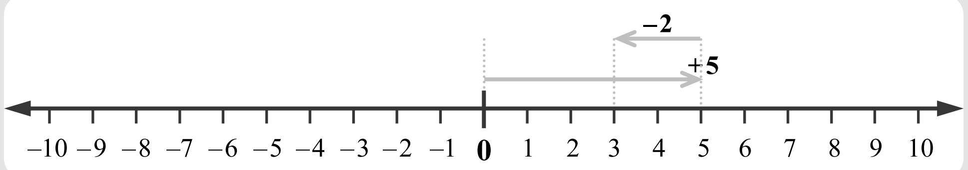
= ....

Stop and take note!

Finding the Difference (Subtracting)

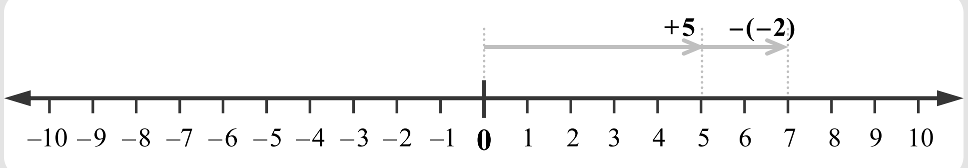
Again we start at zero on the number line, but move in the opposite direction for the value that is subtracted.

Example 1 Find the difference between 5 and 2 [+5 – (+2)]
i.e. Subtract 2 from 5



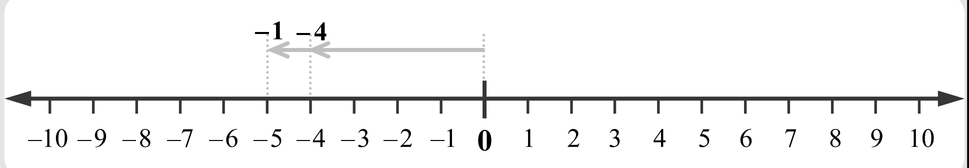
Final answer: 3

Example 2 Subtract –2 from 5 [+5 – (–2)]



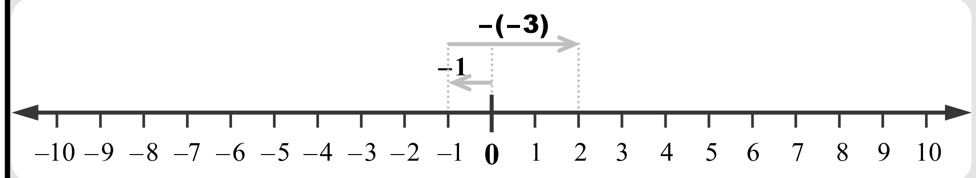
Final answer: 7

Example 3 Subtract 1 from –4 [–4 – (+1)]



Final answer: –5

Example 4 Subtract –3 from –1 [–1 – (–3)]

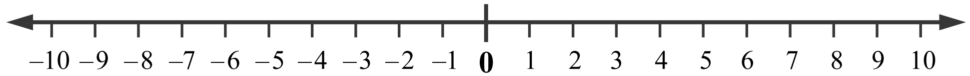


Final answer: 2

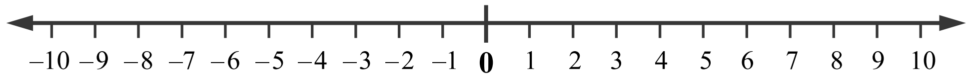
EXERCISE 1.6.3

Use the given number lines to illustrate the following differences:

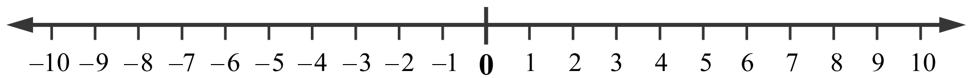
1. Find the difference between 8 and 3 Final answer: ....
   i.e. Subtract 3 from 8



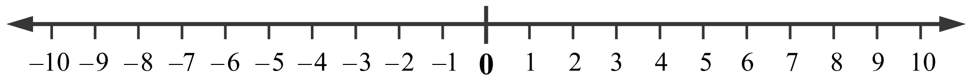
2. Subtract 8 from 3 Final answer: ....



3. Subtract 3 from –2 Final answer: ....



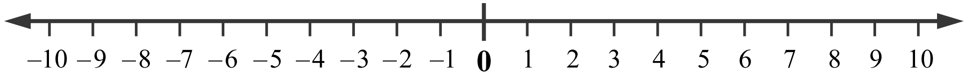
4 Subtract –2 from 3 Final answer: ....



END-OF-UNIT 1.6 TEST

40 marks
40 minutes

Attempt this test without using a calculator.



QUESTION 1

1.1 Arrange the following numbers in ascending order.

3 –5 9 –7 1 –4 Answer: .... (3)

1.2 Place the correct inequality sign (either '<' or '>') in the space between each of the following pairs of numbers.

1.2.1 2 7

1.2.2 –2 ...... –7

1.2.3 –2 7

1.2.4 2 ...... –7 (4)

[7]

QUESTION 2

2.1 What is the difference between 8 and 3? .... (1)

2.2 What is the difference between 8 and –3? .... (1)

2.3 What is the difference between –8 and –3? .... (1)

2.4 What is the difference between –8 and 3? .... (1)

[4]

QUESTION 3

Simplify each of the following expressions as far as possible.

3.1 $2 + (-5)$

= ....

= .... (1)

3.2 $2 - (-5)$

= ....

= .... (1)

3.3 $-2 - (-5)$

= ....

= .... (2)

3.4 $-2 \times 3 + 8 - 1$

= ....

= .... (2)

3.5 $(2 - 5)(1 - 3) + 2(-3)$

= ....

= ....

= .... (3)

3.6 $-2 \times 5 + 9 - 3 \times 1 + 4$

= ....

= ....

= .... (3)

3.7 $\dfrac{-2 + 3 \times (-4)}{-5 - 2}$

= ....

= ....

= .... (3)

3.8 $\dfrac{5 - (-7)}{-5 - (-7)}$

= ....

= ....

= .... (4)

3.9 $\dfrac{-6 - 2(-3)}{4 - 2(-2)}$

= ....

= ....

= .... (3)

3.10 $\dfrac{6 - 1}{3 - 3}$

= ....

= .... (4)

3.11 $-\dfrac{2}{3} - \left(\dfrac{-5}{6}\right) + \dfrac{1}{2} - \left(\dfrac{-1}{-6}\right)$

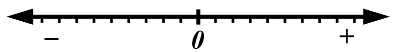
= ....

= ....

= ....

= .... (5)

It is always useful to remember the number line when you are dealing with negative numbers.



[29]

TOTAL: [40]

MULTIPLYING INTO A BRACKET (THE DISTRIBUTIVE LAW)

What is the distributive law?

In mathematics, multiplication is ***distributive***. We may say that multiplication of numbers is ***distributive*** over addition of numbers.

Note and compare the following calculations:

$2 \times (3+4+5)$	and	$2\times 3 + 2\times 4 + 2\times 5$
$= 2 \times 12$		$= 6 + 8 + 10$
$= \mathbf{24}$		$= \mathbf{24}$

$$2 \times (3+4+5) = 2\times 3 + 2\times 4 + 2\times 5$$

EXERCISE 2.2.4

1. If $a = 2$, $b = 3$, $c = 5$ and $d = 7$, determine the value of each of the following expressions. Note which pairs are equivalent.

1.1 $7 \times (a + b)$ ***Compared to…*** 1.2 $7 \times a + 7 \times b$

= .... = ...

= .... = ...

= .... = ...

1.3 $4(a + b + c)$ ***Compared to…*** 1.4 $4a + 4b + 4c$

= .... = ...

= .... = ...

= .... = ...

1.5 $a \times (b + c)$ ***Compared to…*** 1.6 $a \times b + a \times c$

= .... = ...

= .... = ...

= .... = ...

1.7 $a(b + c + d)$ ***Compared to…*** 1.8 $ab + ac + ad$

= .... = ...

= .... = ...

= .... = ...

2. Simplify each of the following expressions, giving your final answers without brackets.

2.1 $2 \times (a + 1) + 3 \times a - 2$

= ....

= ....

= ....

2.2 $3(b + 1) + 2b - 3$

= ....

= ....

= ....

2.3 $3\times x + 2\times(x + 3) - 3\times(x + 3)$

= ....

= ....

= ....

2.4 $4y + 3(y+2) - 2(y+3)$

= ....

= ....

= ....

2. Consider the set of figures below. The figures represent the start of a pattern, created with matches.

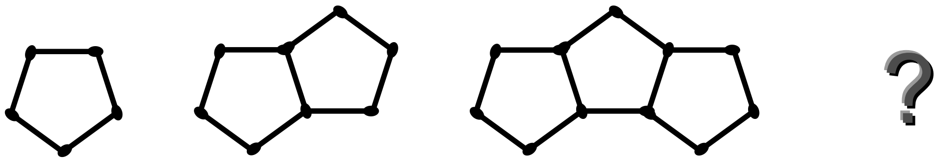
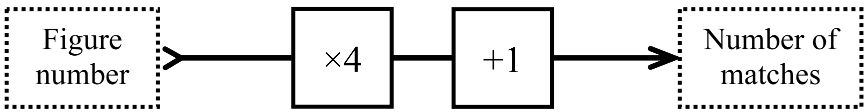


Figure 1 **Figure 2** **Figure 3** **Figure 4**

2.1 Complete the following table, with reference to the pattern above.

Figure number	1	2	3	4	6	9	15	25
No. of matches	5	9						

2.2 The following flow diagram represents the relationship between the figure number and the number of matches.



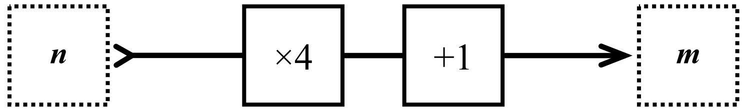
Complete the following statements.

2.2.1 If we know the figure number, then to find the number of matches in the figure, we can multiply the figure number by ..... and then add ..... to the product.

2.2.2 Figure number × ..... + ... = Number of matches

2.2.3 Number of matches = Figure number × ..... + ...

2.3 Let ***n*** represent the figure number, and let ***m*** represent the number of matches. Then the flow diagram can be represented as follows.



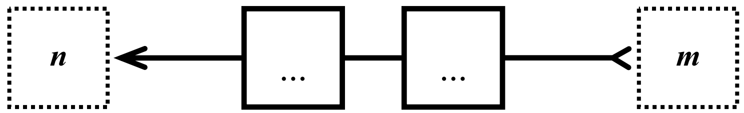
We can translate this flow diagram into a mathematical statement, a formula:

$$n \times 4 + 1 = m$$

We can also write this as $m = n \times 4 + 1$. Complete the following table, with reference to this matchstick pattern.

n	10	7	15			
m				61	45	201

2.4 Complete the following flow diagram.



2.5 Complete the following statements.

2.5.1 If we know exactly how many matches were used to create a figure, then to find the figure number, we can subtract ..... from the number of matches, and then divide the result (the difference) by .....

2.5.2 Figure number = (Number of matches − .....) ÷ .....

2.5.3 (Number of matches − .....) ÷ ..... = Figure number

Why do we need the brackets?

Checking a solution

If you wish to determine whether or not a given ***value*** is, in fact, a ***solution*** of an ***equation***, you work with the left-hand side (LHS) of the equation ***separately*** from the right-hand side (RHS) of the equation.

You ***substitute*** the given value into each side of the ***equation*** and then you compare the value of the LHS with the value of the RHS.

If they are ***equal*** (i.e. LHS = RHS), then the substituted value is a ***solution of the equation***. We may refer to such a value as a ***root of the equation***, and we say that the value ***satisfies the equation***. If the value of the LHS ***differs*** from that of the RHS (i.e. LHS ≠ RHS), then the substituted value is ***not a solution*** of the equation.

Example 1

Without solving for x, determine by calculation whether or not 5 is a solution (a root) of the following equation.

$$2x+3-x=\frac{x}{2}+5$$

Solution

If $x = 5$,

$$\text{LHS} = 2(5)+3-5 = 10+3-5 = 8$$

$$\text{RHS} = \frac{5}{2}+5 = \frac{5}{2}+\frac{10}{2} = \frac{15}{2} = 7\frac{1}{2}$$

∴ LHS ≠ RHS and thus 5 is not a root of the equation.

The value 5 does not balance this equation.

Example 2

Without solving for x, determine by calculation whether or not 5 is a solution of the following equation.

$$\frac{x+3}{4}+\frac{x-1}{2}=\frac{2x-4}{3}+\frac{x-3}{2}$$

Solution

Note that you have not yet learnt how to solve such an equation. But that does not mean that you cannot ***check*** the given root (solution).

If $x = 5$,

$$\text{LHS} = \frac{5+3}{4}+\frac{5-1}{2} = \frac{8}{4}+\frac{4}{2} = 2+2 = 4$$

$$\text{RHS} = \frac{2(5)-4}{3}+\frac{5-3}{2} = \frac{6}{3}+\frac{2}{2} = 2+1 = 3$$

∴ LHS ≠ RHS and thus 5 is not a root of the equation.

The value 5 does not balance this equation.

Example 3

Without solving for x, determine by calculation whether or not 5 is a root of the following equation.

$$\frac{x+3}{2}-\frac{x-1}{4}=\frac{2x-4}{3}+\frac{x-3}{2}$$

Solution

Note that you have not yet learnt how to solve such an equation. But that does not mean that you cannot ***check*** the given root (solution).

If $x = 5$,

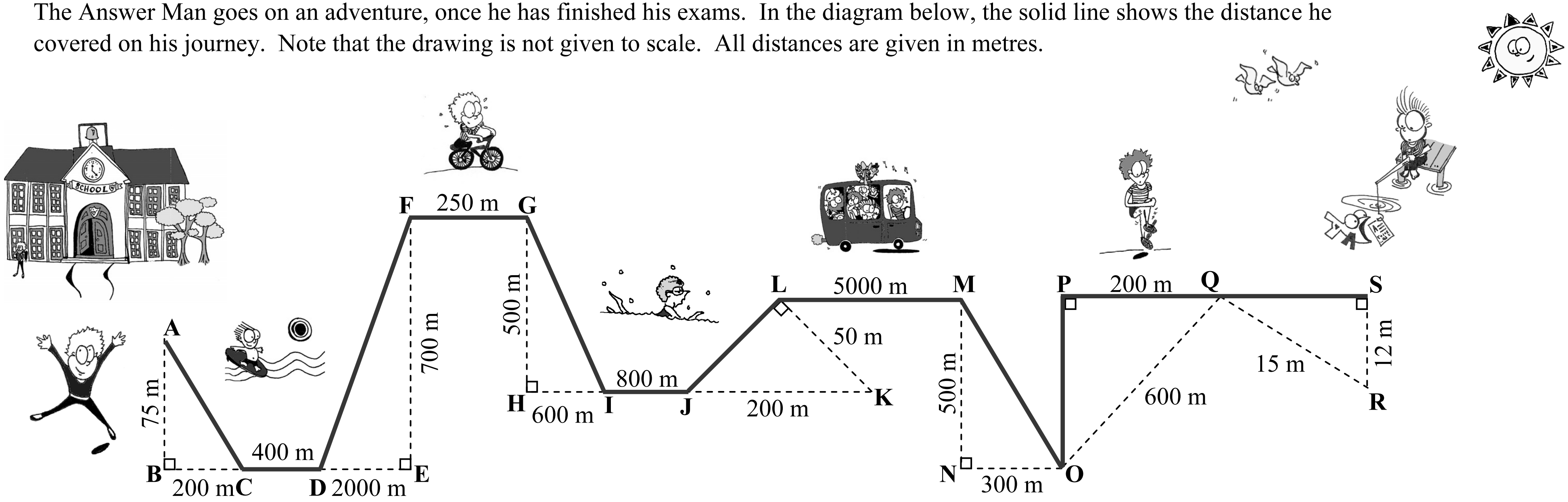
$$\text{LHS} = \frac{5+3}{2}-\frac{5-1}{4} = \frac{8}{2}-\frac{4}{4} = 4-1 = 3$$

$$\text{RHS} = \frac{2(5)-4}{3}+\frac{5-3}{2} = \frac{6}{3}+\frac{2}{2} = 2+1 = 3$$

∴ LHS = RHS and thus 5 is a root of the equation.

The value 5 does balance this equation.

6. The Answer Man goes on an adventure, once he has finished his exams. In the diagram below, the solid line shows the distance he covered on his journey. Note that the drawing is not given to scale. All distances are given in metres.



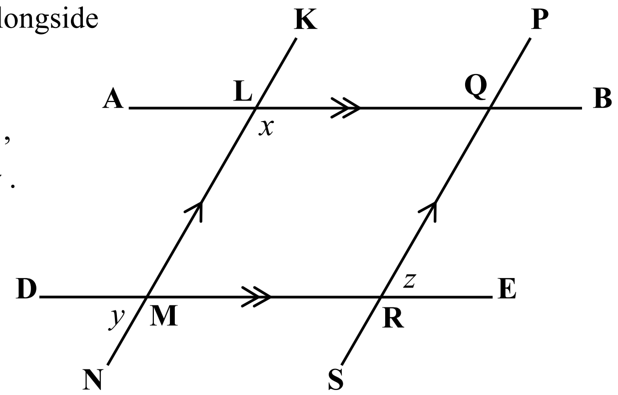
6.1 Find the distance that the Answer Man travels on his adventure (from A to S). Round off your intermediate answers to the nearest metre and give your final answer in metres.

Section of Journey		**Distance**		**Section of Journey**		**Distance**	
AC:	AC^2 = ... + ...	∴ AC =		JL:	JL^2 = ... –	∴ JL =	
CD:		CD =	400 m	LM:		LM =	5000 m
DF:	DF^2 = ... + ...	∴ DF =		MO:	MO^2 = ... + ...	∴ MO =	
FG:		FG =	250 m	OP:	OP^2 = ... –	∴ OP =	
GI:	GI^2 = ... + ...	∴ GI =		PQ:		PQ =	200 m
IJ:		IJ =	800 m	QS:	QS^2 = ... –	∴ QS =	
				Total distance (A to S):			

6.2 Convert your final answer to kilometres and then round it off to the nearest kilometre. .... metres = ... km ≈ .... km

4.1 In the diagram given alongside AB || DE and KN || PS.

Furthermore, $B\hat{L}N = x$, $D\hat{M}N = y$ and $P\hat{R}E = z$.



In this question, you are not required to give reasons for your answers.

4.1.1 If $x = 100°$, determine the magnitude (size) of y. $y =$ ....

4.1.2 If $x = 120°$, determine the magnitude of z. $z =$ ....

4.1.3 If $y = 70°$, determine the magnitude of x. $x =$ ....

4.1.4 If $y = 60°$, determine the magnitude of z. $z =$ ....

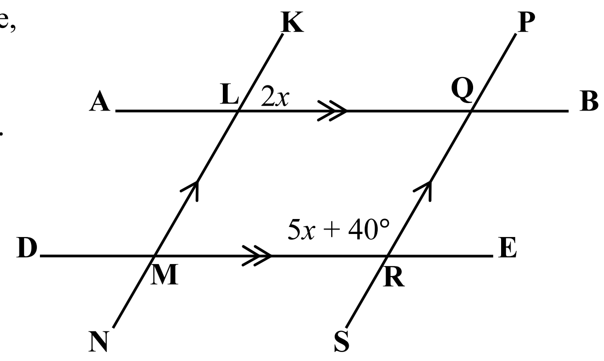
4.1.5 If $z = 45°$, determine the magnitude of x. $x =$ ....

4.1.6 If $z = 50°$, determine the magnitude of y. $y =$ ....

4.2 In the diagram alongside, AB || DE and KN || PS.

Determine the value of x.

Give reasons for all your statements.



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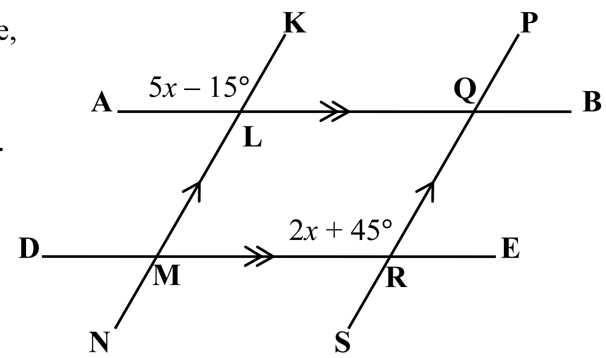
4.3 In the diagram alongside, AB || DE and KN || PS.

Determine the value of x.

Give reasons for all your statements.



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Practical Ratios Part 4: Problem solving

Read the question carefully and determine what you are actually being asked to do, because there is a limited number of options...

- Simplify a given ratio
- Complete a ratio
- Divide a quantity (in a given ratio)
- Increase a given quantity (in a given ratio)
- Decrease a given quantity (in a given ratio)

Example 1

A gardener plants red rose bushes and white rose bushes along the edge of a lawn. For every three red rose bushes he plants, he plants five white rose bushes.

1.1 If he plants a total of 56 rose bushes, how many of each colour rose bush will he plant?

1.2 If he plants 45 red rose bushes, how many white rose bushes will he plant?

1.3 If he plants 125 white rose bushes, how many red rose bushes will he plant?

Given ratio: 3 : 5 (three red rose bushes : five white rose bushes)

1.1 Plants a total of 56 rose bushes

No. of Red $= \frac{3}{8}$ of 56

$= 21$

No. of White $= \frac{5}{8}$ of 56

$= 35$ [Note: 21 + 35 = 56]

Answer: 21 red rose bushes and 35 white rose bushes

Example 1 continued…

1.2 Plants 45 red rose bushes

Red : White = 3 : 5 = 45 : x

$$\frac{45}{x} = \frac{3}{5}$$

$$\frac{x}{45} = \frac{5}{3}$$

$$x = \frac{5 \times 45}{3}$$

$$= 75$$

Answer: 75 white rose bushes [Note: 3 : 5 = 45 : 75]

1.3 Plants 125 white rose bushes

Red : White = 3 : 5 = x : 125

$$\frac{x}{125} = \frac{3}{5}$$

$$x = \frac{3 \times 125}{5}$$

$$= 75$$

Answer: 75 red rose bushes [Note: 5 : 2 = 125 : 75]