WHAT SHOULD YOU DO IF YOU ARE RAPED OR SEXUALLY ASSAULTED?

1. Go to a safe place where you can get help
2. Tell someone you trust what happened as soon as possible
3. Do not throw away your clothes or wash yourself
4. Put the clothes you were wearing in a paper bag or wrap them in newspaper
5. Go to a hospital as soon as possible
6. It is advisable to report the rape to the police
7. Tell the police if you are threatened by the perpetrator at any time
8. Get treatment and medication within 72 hours to prevent HIV, other sexually transmitted infections and pregnancy

REMEMBER, IT'S NEVER THE FAULT OF THE PERSON WHO WAS RAPED, ABUSED, VIOLATED OR HARASSED!

GET HELP AND SUPPORT

If you or someone you know is being sexually harassed or abused, get help to stop the abuse. Speak to someone you trust, tell your school, go to your local police station or phone one of the following national numbers:

SAPS Crime Stop:	**086 0010 111**
SAPS Emergency Number:	**10111**
Childline:	**0800 055 555**
Lifeline:	**011 781 2337/0861 322 322**

Department of Basic Education National Hotline: **0800 20 29 33**

ACT AGAINST ABUSE

Rainbow WORKBOOKS

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MATHEMATICS IN ENGLISH
GRADE 8 – BOOK 1 • TERMS 1 & 2
ISBN 978-1-4315-0222-6
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13th Edition

MATHEMATICS IN ENGLISH – Grade 8 Book 1

ISBN 978-1-4315-0222-6

Revised and CAPS aligned

Grade 8

Name:

Class:

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

MATHEMATICS IN ENGLISH

Book 1
Terms 1 & 2

Contents

Mrs Angie Motshekga,
Minister of
Basic Education

Dr Reginah Mhaule
Deputy Minister of
Basic Education

These workbooks have been developed for the children of South Africa under the leadership of the Minister of Basic Education, Mrs Angie Motshekga, and the Deputy Minister of Basic Education, Dr Reginah Mhaule.

The Rainbow Workbooks form part of the Department of Basic Education's range of interventions aimed at improving the performance of South African learners in the first six grades. As one of the priorities of the Government's Plan of Action, this project has been made possible by the generous funding of the National Treasury. This has enabled the Department to make these workbooks, in all the official languages, available at no cost.

We hope that teachers will find these workbooks useful in their everyday teaching and in ensuring that their learners cover the curriculum. We have taken care to guide the teacher through each of the activities by the inclusion of icons that indicate what it is that the learner should do.

We sincerely hope that children will enjoy working through the book as they grow and learn, and that you, the teacher, will share their pleasure.

We wish you and your learners every success in using these workbooks.

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Rainbow WORKBOOKS

Grade 8

Mathematics

Book 1

1 Revision worksheets: R1 to R16
Key concepts from Grade 7

2 Worksheets: 1 to 64

Book 2

3 Worksheets: 65 to 144

ENGLISH

Name:

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The structure of a worksheet

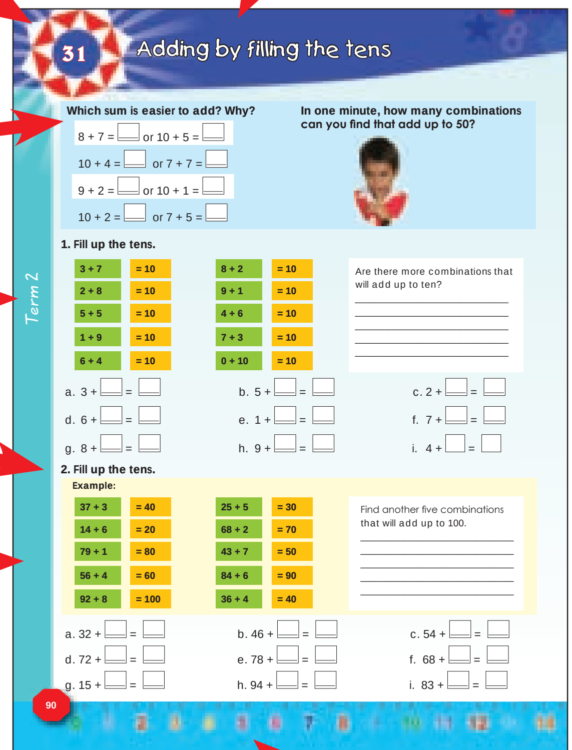
Worksheet number
(Revision R1 to R16, Ordinary 1 to 144)

Worksheet title

Topic introduction
(Text and pictures to help you think about and discuss the topic of the worksheet.)

Term indicator
(There are forty worksheets per term.)

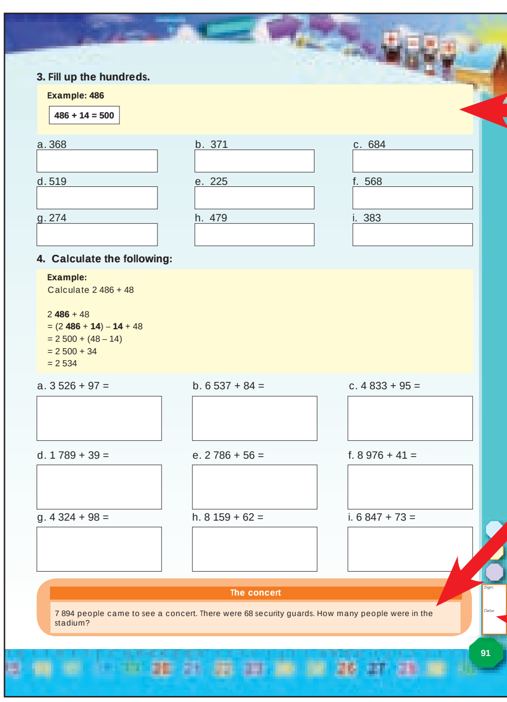
Questions



Colour code for content area

Content	Side bar colour
Revision	Purple
Number	Turquoise
Patterns and functions (algebra)	Electric blue
Space and shape (geometry)	Orange
Measurement	Green
Data handling	Red

Language colour code:
Afrikaans (Red), English (Blue)



Example frame (in yellow)

Fun/challenge/problem solving activity
(This is an end of worksheet activity that may include fun or challenging activities that can also be shared with parents or brothers and sisters at home.)

Teacher assessment rating, signature and date

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Rainbow WORKBOOKS

Grade 8

Mathematics

PART 1

Revision

Key concepts from Grade 7

WORKSHEETS R1 to R16

ENGLISH

Book 1

Name:

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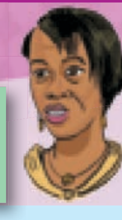
R1 Doing calculations

Revision



Note that the first 16 worksheets are revision activities.

To solve problems we need to know that we can use different words for addition, subtraction, multiplication and division. Think of some of them.

+	−	×	÷

1. Calculate.

a. 27 835 + 32 132

b. 45 371 + 12 625

c. 51 832 + 32 749

2. Calculate.

a. 457 834 − 325 613

b. 788 569 − 123 479

c. 384 789 − 325 894

3. Calculate.

a. 14 815 × 38

b. 29 783 × 24

c. 38 765 × 36

4. Calculate:

a. 22)36842

b. 63)96431

c. 45)76593

What is **arithmetic**?

Arithmetic is the oldest and most basic part of mathematics.

It deals with the properties of numbers and the handling of numbers and quantity.

It is used by almost everyone for both simple and complex tasks, from simple everyday counting tasks to complicated business and scientific calculations.

In common usage, arithmetic refers to the basic rules for the operations of addition, subtraction, multiplication and division with smaller values of numbers.

5. Give an example of each of these properties of number.

Commutative:
Means that you can change or swap the order in which you add or multiply numbers and still get the same answer.

Associative:
Means that you add or multiply regardless of how you group the numbers.

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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6. **Use the commutative property to make the number sentences true.**

Example: $4 + 6 =$
$4 + 6 = 6 + 4$
$10 = 10$

a. $3 + 4 =$

b. $8 + 4 =$

7. **Use the commutative property to make number sentences true.**

Example: $a + b =$ ☐
$a + b = b + a$

a. $c + d =$

b. $f + g =$

8. **Use the commutative property to make number sentences true.**

Example: $2 \times 3 =$ ☐
$2 \times 3 = 3 \times 2$
$6 = 6$

a. $4 \times 5 =$

b. $7 \times 9 =$

9. **Use the commutative property to make number sentences true.**

Example: $a \times b =$ ☐
$a \times b = b \times a$
$ab = ba$

a. $x \times c =$

b. $m \times n =$

10. **Use zero as the identity element for addition, or 1 as the identity element for multiplication to simplify the following:**

a. $a \times 1 =$

b. $b \times \_\_ = b$

c. $e + 0 =$

Problem solving

Either change the question into a number sentence or calculate it.

What should I add to a number so that the answer will be the same as the number?

By which number should I multiply so that the answer will be the same as the number?

If $a \times (b + c) = (a \times b) + (a \times c)$, and $a = -3$, $b = -5$ and $c = -2$, substitute and calculate.

Sign:

Date:

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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R2 Multiples and factors

What did we learn before?

A multiple of a number is that number multiplied by an integer, e.g. 3 × 4 = 12. So 12 is a multiple of 3. The multiples of 3 are: 3, 6, 9, 12, 15, …

LCM stands for lowest common multiple

A factor is a number which divides exactly into another number, e.g. 3 and 4 are factors of 12. All the factors (all the numbers that can divide exactly into) 12 are 1, 2, 3, 4, 6, 12.

HCF stands for highest common factor

1. What are the first 5 multiples of:

Example: Multiples of 3: 3, 6, 9, 12, 15

a. 5 ____________ b. 11 ____________ c. 8 ____________

d. 10 ____________ e. 25 ____________ f. 50 ____________

2. Write down the first 12 multiples for each of the given numbers. Circle all the common multiples of each pair of the given numbers. Identify the lowest common multiple (LCM).

Example: Multiples of 4: {4, 8, 12, 16, (20), 24, 28, 32, 36, (40), 44, 48}
Multiples of 5: {5, 10, 15, (20), 25, 30, 35, (40), 45, 50, 55, 60}
The lowest common multiple is 20.

a. Multiples of 2: {____________}
Multiples of 3: {____________}
LCM: ____________

b. Multiples of 8: {____________}
Multiples of 7: {____________}
LCM: ____________

c. Multiples of 9: {____________}
Multiples of 10: {____________}
LCM: ____________

d. Multiples of 12: {____________}
Multiples of 13: {____________}
LCM: ____________

3. What are the factors of:

Example: Factors of 12: 1, 2, 3, 4, 6 and 12

a. 15 ____________ b. 64 ____________ c. 24 ____________

d. 72 ____________ e. 80 ____________ f. 45 ____________

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4. What are the common factors and the highest common factor (HCF) for these pairs of numbers?

Example: Factors of 12 are (1), (2), (3), 4, (6), 12
Factors of 18 are (1), (2), (3), (6), 9, 18
Common factors: 1, 2, 3, 6 HCF = 6

a. Factors of 8: {____________________}
Factors of 7: {____________________}
HCF: ____________________

b. Factors of 14: {____________________}
Factors of 12: {____________________}
HCF: ____________________

c. Factors of 9: {____________________}
Factors of 18: {____________________}
HCF: ____________________

d. Factors of 11: {____________________}
Factors of 10: {____________________}
HCF: ____________________

e. Factors of 15: {____________________}
Factors of 6: {____________________}
HCF: ____________________

f. Factors of 9: {____________________}
Factors of 8: {____________________}
HCF: ____________________

5. Explain the following in your own words:

a. Multiples ____

b. Factors ____

6. How to use multiples and factors in mathematics is a very important skill. Here are some statements. Explain each statement and give examples of your own.

It is useful to break large numbers into smaller ones when you are asked to simplify a fraction.

Sometimes I want to check if my calculator results make sense. I then use factors and multiples to reduce the numbers to their simplest form and get an approximate answer.

Sign:

Date:

Problem solving

A dog and a cat run around a circular field making 3 and 4 strides per meter respectively. How many strides will each make to reach the first common point?

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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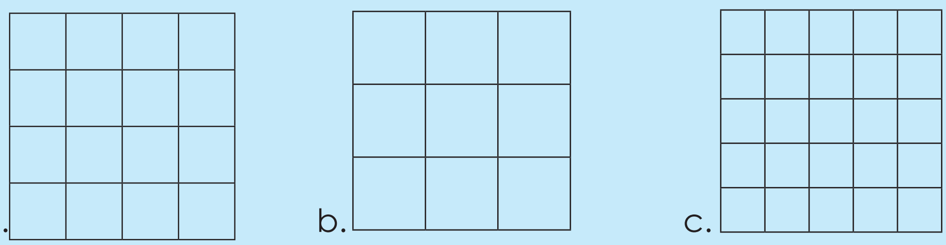
R3a Exponents

Term 1

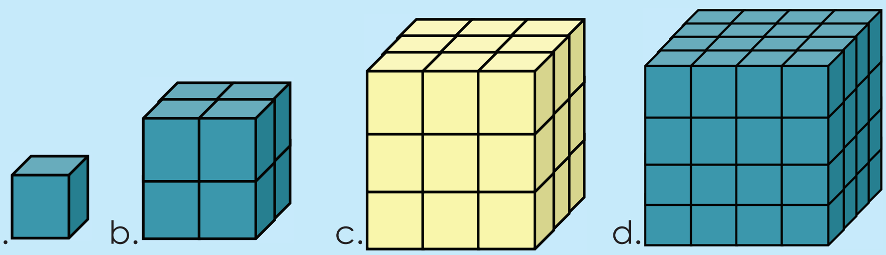
What square number and root does each diagram given below represent?

$3 \times 3 = 9$, so the square root of 9 is 3. We write $\sqrt{9} = 3$



What is a cube root? Which diagram represents this?

$3 \times 3 \times 3 = 27$, so the cube root of 27 is 3. We write $\sqrt[3]{27} = 3$



The concepts of the square root and the cube root are the prerequisite for many other mathematical concepts. Can you think of a few?

In this activity we revise all the basic concepts you need to know in Grade 8.

You can complete this activity at home.

1. Write the following in exponential form:

Example: $13 \times 13 = 13^2$ a. $2 \times 2 =$ ______ b. $7 \times 7 =$ ______

2. Write the following as multiplication sentences:

Example: $15^2 = 15 \times 15$ a. $12^2 =$ ______ b. $7^2 =$ ______

3. Identify the following in 3^2 : a. the base b. the exponent

______

4. Write the following in exponential form:

Example: $6 \times 6 \times 6 = 6^3$ a. $3 \times 3 \times 3 =$ ______ b. $2 \times 2 \times 2 =$ ______

5. Expand the expression as shown in the example.

Example: $6^3 = 6 \times 6 \times 6$ a. $2^3 =$ ______ b. $4^3 =$ ______

6. Calculate.

Example: $5^2 + 3^2 = 25 + 9 = 34$ a. $2^2 + 10^2 =$ ______ b. $6^2 - 3^2 =$ ______

7. Calculate.

Example: $5^2 + 3^3 = 25 + 27 = 52$

a. $6^3 - 5^2 =$

b. $2^2 + 3^3 =$

8. Calculate.

Example: $\sqrt[3]{27}$
$= \sqrt[3]{3 \times 3 \times 3}$
$= 3$

a. $\sqrt[3]{8} =$

b. $\sqrt[3]{64} =$

9. Calculate.

Example: $\sqrt{16} + \sqrt{25}$
$= 4 + 5$
$= 9$

a. $\sqrt{9} + \sqrt{16} =$

b. $\sqrt{100} + \sqrt{81} =$

10. Calculate.

Example: $\sqrt[3]{64} + \sqrt[3]{27}$
$= 4 - 3$
$= 1$

a. $\sqrt[3]{216} + \sqrt[3]{27} =$

b. $\sqrt[3]{27} - \sqrt[3]{8} =$

11. Calculate.

Example: $\sqrt[3]{125} + \sqrt{16}$
$= 5 + 4$
$= 9$

a. $\sqrt{25} + \sqrt[3]{8} =$

b. $\sqrt{25} - \sqrt[3]{27} =$

12. Calculate.

Example: $\sqrt[3]{27} + 3^2 - \sqrt{25}$
$= 3 + 9 - 5$
$= 7$

a. $\sqrt[3]{216} + 4^2 - \sqrt{16} =$

b. $9^2 - \sqrt[3]{27} + \sqrt{4} =$

13. Calculate the following as fast as you can:

Example: $10 \times 10 \times 10 \times 10 = 10\ 000$

a. $10 \times 10 =$ ______________

b. $10 \times 10 \times 10 \times 10 \times 10 =$ ______________

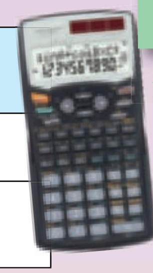
Sign:

Date:

continued ☛

R3b Exponents continued

You can check your answers using a scientific calculator.



14. Complete the table.

Expression	Exponential format	Answer
a. 10×10	10^2	100
b. $10 \times 10 \times 10 \times 10 \times 10 \times 10$		

15. Calculate.

Example: $10^4 + 10^3$
$= 10\ 000 + 1\ 000$
$= 11\ 000$

a. $10^3 + 10^2 =$

b. $10^4 + 10^6 =$

16. Calculate.

Example: $4 + 10^3$
$= 4 + 1\ 000$
$= 1\ 004$

a. $5 + 10^4 =$

b. $10^5 \times 9 =$

17. Calculate.

Example: $2 \times 10^4 + 3 \times 10^5$
$= 2 \times 10\ 000 + 3 \times 100\ 000$
$= (2 \times 10\ 000) + (3 \times 100\ 000)$
$= 20\ 000 + 300\ 000$
$= 320\ 000$

a. $3 \times 10^3 + 4 \times 10^4 =$

b. $8 \times 10^4 + 3 \times 10^2 =$

18. Calculate.

Example: $2 \times 10^4 + 3 \times 10^3 + 4 \times 10^5$
$= 2 \times 10\ 000 + 3 \times 1\ 000 + 4 \times 100\ 000$
$= (2 \times 10\ 000) + (3 \times 1\ 000) + (4 \times 100\ 000)$
$= 20\ 000 + 3\ 000 + 400\ 000$
$= 423\ 000$

a. $1 \times 10^2 + 8 \times 10^5 + 3 \times 10^6 =$

19. Calculate.

Example: $2^2 + 2^3 = 4 + 8 = 12$

a. $2^2 + 12^2 =$

b. $4^2 + 10^2 =$

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20. Calculate.

Example: $2^2 + 3^3 + 4^2 = 4 + 27 + 16 = 47$

a. $2^2 + 4^3 + 3^2 =$

21. Complete.

a. $4^2 =$ ______________

b. 6^2 ______________

22. Calculate.

Example: $(12 - 9)^3$
$= (3)^3$
$= 27$

a. $(8 - 4)^3 =$

b. $(7 + 1)^2 =$

23. Expand the expression as shown in the example. Check your answer with a calculator.

Example: 18^4
$= 18 \times 18 \times 18 \times 18$
$= 104\ 976$

a. 22^3

b. 81^2

24. Expand the expression as shown in the example.

Example: m^4
$= m \times m \times m \times m$

a. x^5

b. 7^7

Problem solving

Add the smallest square number and the largest cube number that is smaller than 100.

Write down all the two-digit square numbers.
Write down all the three-digit cube numbers.

Write one billion in exponential notation.

Sign:

Date:

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R4 Integers

What is an integer?
Integers are the set of positive and negative natural numbers (including zero).
A number line can be used to represent the set of integers.

–5 –4 –3 –2 –1 0 1 2 3 4 5

Positive integers
Whole numbers greater than zero are called positive integers. These numbers are to the right of zero on the number line.

Negative integers
Whole numbers less than zero are called negative integers. These numbers are to the left of zero on the number line.

Zero
The integer zero is neutral. It is neither positive nor negative.

The sign
The sign of an integer is either positive (+) or negative (–), except for zero, which has no sign. Two integers are opposites if they are each the same distance away from zero, but on opposite sides of the number line. One will have a positive sign, the other a negative sign. In the number line below, +2 and –2 are circled as opposites.

–5 –4 –3 (–2) –1 0 1 (2) 3 4 5

1. Complete the number lines.

a. –1 0 1

b. –3 0 3

2. Write an integer to represent each description.

a. 8 units to the right of –3 on a number line. ______________

b. 16 to the right of (above) zero. ______________

c. 14 units to the right of –2 on a number line. ______________

d. The opposite of –108. ______________

e. 15 to the left of zero. ______________

3. Put the integers in order from smallest to greatest.

a. –41; 54; –31; –79; 57 ____________________________

b. 43; –54; 44; –55; –37; 22; 52; –39; –43; –56; 18 ____________________________

4. Calculate the following: Use the number line to guide you.

Example: –4 + 2 = –2

–5 –4 –3 –2 –1 0 1 2 3 4 5

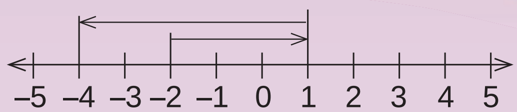
a. –5 + 5 = ______

b. 10 – 12 = ______

Term 1

5. Calculate the following:

Example: –2 + 3 – 5 = –4



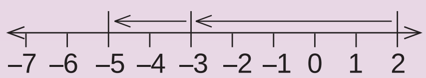
a. –6 + 8 – 7 = ___________ b. 9 – 11 + 2 = ___________

6. Complete the following:

a. Find –8 + (–3) [ ] b. Find 3 + (–16) [ ]

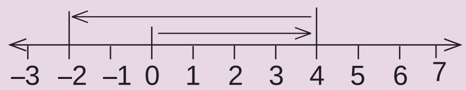
7. Write a sum for:

a.



[ ]

b.



[ ]

8. Calculate the following:

a. 4 + (–5) = [ ] b. 5 + (–7) = [ ] c. –5 + (–7) = [ ]

9. Calculate the following:

a. 2 – (–4) = [ ] b. 3 – (–6) = [ ] c. 5 – (–6) = [ ]

10. Calculate the following:

Example: 11 + (–23)
= 11 – 23
= –12

a. 33 + (–44) = [ ] b. 5 + (–43) = [ ] c. –15 + (–20) = [ ]

11. Calculate the following:

Example: –14 – (–20)
= –14 + 20
= 6

a. –16 – 22 = [ ] b. 49 – (–19) = [ ] c. 47 – (–10) = [ ]

12. Solve the following:

a. _____ + 24 = –11 b. _____ + 10 = 33 c. _____ + 49 = 18

Problem solving

Temperature is a nice way to explain positive and negative integers. Explain integers using the concept of temperature to your family.

Sign:

Date:

Revision

R5a Common fractions

Look at these examples and give five more examples of each.

Proper fraction	Improper fraction	Mixed number
$\frac{3}{4}$	$\frac{8}{3}$	$1\frac{1}{2}$

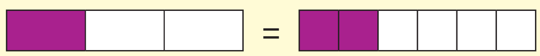
Improper fraction to mixed number

$\frac{8}{3} = 2\frac{2}{3}$

Mixed number to improper fraction

$1\frac{1}{4} = \frac{5}{4}$

1. What other fraction equals: Draw a diagram to show it.

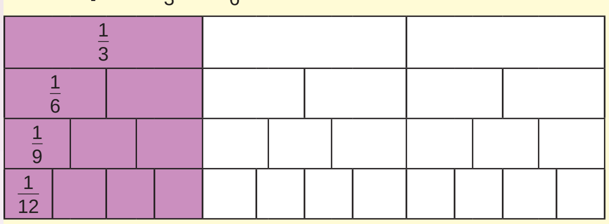
Example: $\frac{1}{3} = \frac{2}{6}$ 

a. $\frac{1}{2}$ =

b. $\frac{1}{7}$ =

2. Write the next or previous equivalent fraction for:

Example: $\frac{1}{3} = \frac{2}{6}$

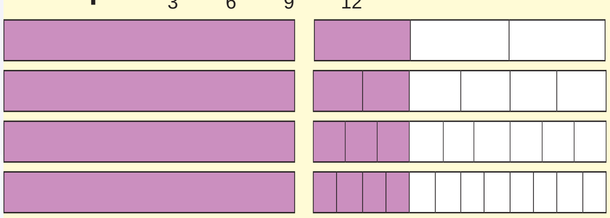


a. $\qquad = \frac{2}{5}$

b. $\qquad = \frac{8}{10}$

3. Write down three equivalent fractions for: Make a drawing.

Example: $1\frac{1}{3} = 1\frac{2}{6} = 1\frac{3}{9} = 1\frac{4}{12}$



a. $1\frac{1}{2}$

b. $3\frac{2}{5}$

What happened to the denominators and numerators? Always start with the given number.

$1 + \left[\frac{1 \times 2}{3 \times 2}\right] = 1\frac{2}{6}$

$1 + \left[\frac{1 \times 3}{3 \times 3}\right] = 1\frac{3}{9}$

$1 + \left[\frac{1 \times 4}{3 \times 4}\right] = 1\frac{4}{12}$

Term 1

4. What is the highest common factor?

Example:

Highest common factor (HCF)

Factors of 4 = {1, 2, 4}

Factors of 6 = {1, 2, 3, 6}

HCF = 2

So 2 is the biggest number that can divide into 4 and 6.

a. Factors of 3:
Factors of 4:

b. Factors of 5:
Factors of 10:

5. Write in the simplest form.

Example: $\frac{12}{16}$

$= \frac{12}{16} \div \frac{4}{4}$

$= \frac{3}{4}$

HCF:
Factors of 12: {1, 2, 3, 4, 6, 12}
Factors of 16: {1, 2, 4, 8, 16}

a. $\frac{6}{18}$

b. $\frac{5}{25}$

6. Add the two fractions, write the sum as a mixed number and simplify if necessary.

Example: $\frac{1}{3} + \frac{4}{3}$

$= \frac{5}{3}$

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

When we add fractions the denominators should be the same.

a. $\frac{2}{5} + \frac{4}{5}$

b. $\frac{5}{9} + \frac{6}{9}$

7. Calculate and simplify if necessary.

Example: $\frac{1 \times 2}{2 \times 2} + \frac{1}{4}$

$= \frac{2}{4} + \frac{1}{4}$

$= \frac{3}{4}$

Remember, when we add fractions the denominators should be the same.

To do that we can find the LCM (Lowest common multiple)

Multiples of 2 = {2, 4, 6, 8, …}
Multiples of 4 = {4, 8, 12, 16, …}

… or in this case the denominators are multiples of each other.

2 is a multiple of 4. **See on the left how we do this.**

a. $\frac{1}{4} + \frac{1}{2} =$

b. $\frac{1}{5} + \frac{1}{10} =$

Sign:

Date:

continued ☛

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R5b Common fractions continued

8. Add the two fractions. Then multiply the two fractions.

Example: $\frac{1}{2}$ and a $\frac{1}{3}$

Addition

$\frac{1}{2} + \frac{1}{3}$

LCM = 6

$\frac{3}{6} + \frac{2}{6}$

$= \frac{5}{6}$

Multiplication

$\frac{1}{2} \times \frac{1}{3}$

$= \frac{1}{6}$

I see that when I multiply by proper fractions the answer gets smaller, but when I multiply positive integers the number gets bigger.

That is true. If you take two six packs of juice, you get 12 juices. But if you take half ($\frac{1}{2}$) of a six pack ($\frac{6}{1}$) you get 3 juices.

a. $\frac{1}{2}$ and a $\frac{1}{12}$ =

b. $\frac{1}{2}$ and a $\frac{1}{11}$ =

9. Calculate.

Example: $\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}$

$= \frac{1}{24}$

a. $\frac{1}{3} \times \frac{1}{5} \times \frac{1}{2} =$

b. $\frac{1}{2} \times \frac{1}{5} \times \frac{1}{9} =$

10. Calculate and simplify.

Example 1: $\frac{6}{7} \times \frac{5}{7}$

$= \frac{30}{49}$

Example 2: $\frac{6}{7} \times \frac{5}{6}$

$= \frac{30}{42} \div \frac{6}{6}$

$= \frac{5}{7}$

a. $\frac{7}{8} \times \frac{2}{4} =$

11. Complete the following statements as shown in the example below.

Example: ____ × ____ = $\frac{12}{18}$

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

$\frac{3}{3} \times \frac{4}{6} = \frac{12}{18}$

A whole number × a proper fraction.

$\frac{2}{6} \times \frac{6}{3} = \frac{12}{18}$

A proper fraction × improper fraction.

a. ____ × ____ = $\frac{2}{4}$

b. ____ × ____ = $\frac{8}{4}$

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

12. Calculate and simplify

Example: $8 \times \frac{1}{4}$

$= \frac{8}{1} \times \frac{1}{4}$

$= \frac{8}{4}$

$= 2$

$= \frac{8}{4}$

$= \frac{8}{4} \div \frac{4}{4}$

$= 2$

a. $2 \times \frac{3}{5} =$

b. $4 \times \frac{5}{6} =$

13. Write each of the following fractions as a product of a whole number and a common fraction.

Example: ____ × ____ $= \frac{2}{3}$

$\frac{2}{1} \times \frac{1}{3}$

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

a. ____ × ____ $= \frac{7}{21}$

b. ____ × ____ $= \frac{13}{15}$

14. Simplify the following:

Example: $\frac{15}{20}$

$= \frac{15}{20} \div \frac{5}{5}$

$= \frac{3}{4}$

a. $\frac{4}{12}$

b. $\frac{8}{16}$

15. Multiply and simplify the answer if possible.

Example: $\frac{1}{3} \times \frac{3}{4}$

$\frac{3}{12} = \frac{3}{12} \div \frac{3}{3}$

$= \frac{1}{4}$

a. $\frac{1}{2} \times \frac{4}{8} =$

b. $\frac{1}{2} \times \frac{2}{7} =$

Problem solving

Name five fractions that are between one fifth and four fifths.

What is $\frac{1}{8} + \frac{3}{8}$ in its simplest form?

What is $\frac{3}{9} \times \frac{3}{4}$ in its simplest form?

Can two proper fractions added together or multiplied together give you a proper fraction as an answer?

If the answer is $\frac{42}{72}$, what are the two fractions that have been multiplied?

If ____ (whole number) × ____ (fraction) = $\frac{24}{36}$, how many possible solutions are there for this sum?

Multiply any 2 improper fractions and explain your observation.

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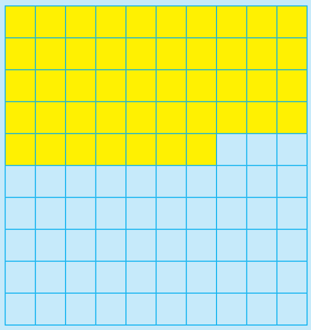
R6a Percentages and decimal fractions

Look at the following. What does it represent?



$$\frac{47}{100} = 0{,}47 = 47\%$$

Where in everyday life do we use:

- Decimal fractions?
- Percentages?

1. Write each of the following percentages as common and decimal fractions.

Example: 18% or $\frac{18}{100}$ or 0,18

a. 37%

b. 83%

2. Calculate.

Example: 40% of R40

$= \frac{40}{100} \times \frac{R40}{1}$

$= \frac{R1600}{100}$

= R16

a. 20% of R24

b. 70% of R15

3. Calculate.

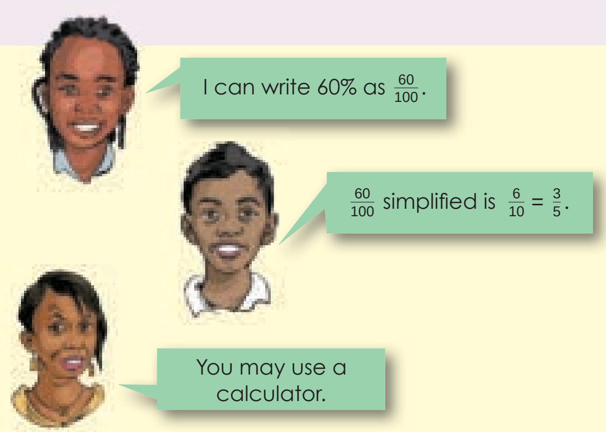
Example:

$\frac{60}{100} \times \frac{R300}{1}$

$= \frac{3}{5} \times \frac{R300}{1}$

$= \frac{R900}{5}$

= R180



a. 80% of R1,60

b. 24% of R72

4. Calculate the percentage *increase.*

Example:
Calculate the percentage increase if the price of a bus ticket of R60 is increased to R84.

$\frac{24}{60} \times \frac{100}{1}$

$= \frac{240}{60}$

= 40

Therefore an increase of 40%

We first need to know by how much did the bus ticket price increase. It was increased by R24 because R84 minus R60 is R24.

The amount of the price increase is R24 and the original price was R60. So the fraction the price increase was of the original price is $\frac{24}{60}$.

Then to work out the **percentage increase** we need to multiply $\frac{24}{60}$ by 100.

R80 to R96

Price increase: ________

5. Calculate the percentage *decrease.*

Example:
Calculate the percentage decrease if the price of petrol goes down from 20 cents a litre to 18 cents. Amount decreased is 2 cents.

$\frac{2}{20} \times \frac{100}{1}$

$= \frac{200}{20}$

= 10

Therefore a decrease of 10%

We first need to say by how much was the price of petrol decreased.

Then to work out the **percentage decrease** we need to multiply $\frac{2}{20}$ by 100 (percentage).

It was decreased by 2c because 18c + 2c gives you 20c.

R50 of R46

Price decrease: ________

6. Write the following in expanded notation:

Example: 6,745
= 6 + 0,7 + 0,04 + 0,005

a. 3,983 ________________________________

b. 8,478 ________________________________

7. Write the following in words:

Example: 5,854
= 5 units + 8 tenths + 5 hundredths + 4 thousandths

What is the difference between 5 units and 5 hundredths?

a. 9,764 ____

b. 7,372 ____

8. Write down the value of the underlined digit.

Example: 9,6<u>9</u>4
= 0,09 or 9 hundredths

a. 8,<u>3</u>78 __________ b. 4,3<u>2</u> __________

9. Write these as decimal fractions:

Example: $\frac{40}{100}$
= 0,4

a. $\frac{6}{10}$ [ ] b. $\frac{7}{10}$ [ ]

Sign:

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continued ☛

Revision

R6b Percentages and decimal fractions continued

Term 1

10. Write as decimal fractions.

Example: $\frac{73}{100}$ = 0,73

a. $\frac{45}{100}$ ______

b. $\frac{76}{100}$ ______

11. Write as decimal fractions.

Example: $\frac{85}{10}$ = 8,5

a. $\frac{36}{10}$ ______

b. $\frac{6\,705}{100}$ ______

12. Write as common fractions.

Example: 4,3 $\frac{43}{10}$

a. 9,5 ______

b. 15,15 ______

13. Write the following as decimal fractions.

Example: $\frac{2}{5} = \frac{4}{10} = 0{,}4$

$\frac{1}{25} = \frac{4}{100} = 0{,}04$

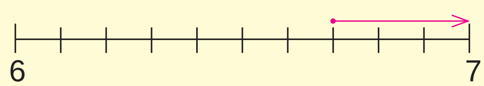
a. $\frac{1}{5}$ ______

b. $\frac{1}{4}$ ______

The sign ≈ means it is approximately equal to.

14. Round off to the nearest unit.

Example: 6,7 ≈ 7

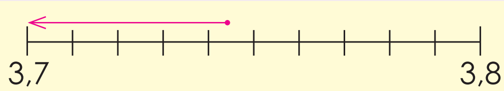


a. 5,1 ______

b. 14,8 ______

15. Round off to the nearest tenth.

Example: 3,745 ≈ 3,7



a. 6,14 ______

b. 3,578 ______

16. Calculate using any one method shown in the example.

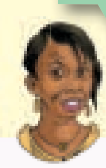
Method 1: 2,37 + 4,53
= (2 + 4) + (0,3 + 0,5) + (0,07 + 0,03)
= 6 + 0,8 + 0,1
= 6,9

Method 2:

$$\begin{array}{r} 2{,}37 \\ +\ 4{,}53 \\ \hline 6{,}90 \end{array}$$

Make sure the decimal commas are under each other.

Note that 6,9 and 6,90 are the same.



a. 6,89 + 3,67 =

b. 4,694 + 3,578 =

You can check your answer using the inverse operation of addition which is subtraction.

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17. **Calculate. Check your answers using a calculator.**

Example:

- 0,2 × 0,3 = 0,06
- 0,02 × 0,3 = 0,006
- 0,002 × 0,3 = 0,0006

Do you notice the pattern?

Describe it.

a. 0,4 × 0,2 = ______________

b. 0,3 × 0,1 = ______________

18. **Calculate. Check your answers using a calculator.**

Example 1: 0,3 × 0,2 × 100
= 0,06 × 100
= 6

Example 2: 0,3 × 0,2 × 10
= 0,06 × 10
= 0,6

a. 0,4 × 0,2 × 100 =

b. 0,5 × 0,02 × 10 =

19. **Calculate. Check your answers using a calculator.**

Example: 5,276 × 30
= (5 × 30) + (0,2 × 30) + (0,07 × 30) + (0,006 × 30)
= 150 + 6 + 2,1 + 0,18
= 150 + 6 + 2 + 0,1 + 0,1 + 0,08
= 158 + 0,2 + 0,08
= 158,28

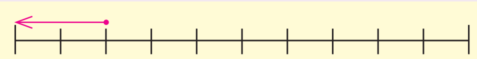
a. 1,123 × 10 =

b. 4,886 × 30 =

20. **Calculate the following. Round off the answer to the nearest whole number:**

Example: 0,4 ÷ 2
= 0,2

0,2 rounded off to the nearest whole number is 0.

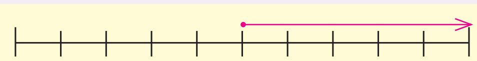


a. 0,8 ÷ 4 = __________ b. 0,6 ÷ 3 = __________

21. **Calculate the following. Round off the answer to the nearest tenth:**

Example: 0,25 ÷ 5
= 0,05

0,05 rounded off to the nearest tenth is 0,1.



a. 0,81 ÷ 9 = __________ b. 0,85 ÷ 5 = __________

Problem solving

Multiply the number that will be exactly between 2,25 and 2,26 by the number that is equal to ten times three.

You need nine equal pieces from 54,9 m of rope. How long will each piece be?

My mother bought 32,4 m of rope. She has to divide it into four pieces. How long will each piece be?

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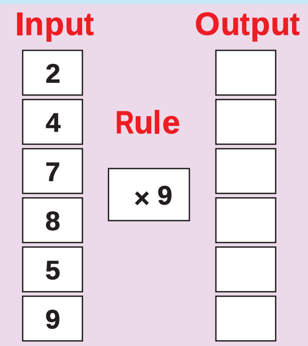
R7 Input and output

Draw the arrows in the flow diagram and fill in the output values.



The rule is <u>× 9</u>.

Use the flow diagram on the left.

What will the output be, if the **rule** is:

- × 5
- × 7
- × 8
- × 4
- × 12

Explain the words:

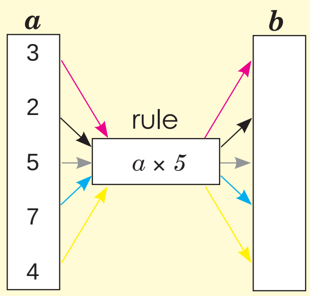
Input

Output

Rule

1. Use the given rule to calculate the value of b.

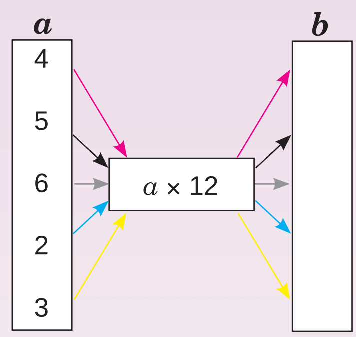
Example:



$b = a \times 5$

so:

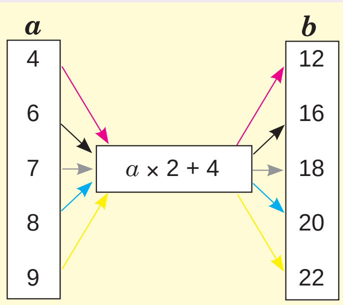
- 3 × 5 = 15
- 2 × 5 = 10
- 5 × 5 = 25
- 7 × 5 = 35
- 4 × 5 = 20



The rule is ________.

2. Complete the flow diagrams. Show all your calculations.

Example:



a is the input,

b is the output,

b* = *a × 2 + 4 is the rule.

b = 4 × 2 + 4 = 12

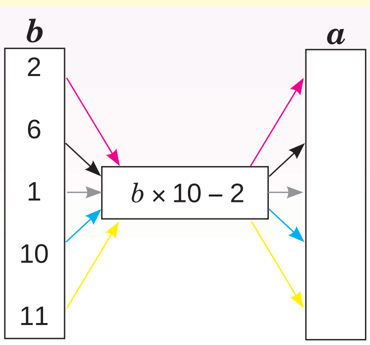
b = 6 × 2 + 4 = 16

b = 7 × 2 + 4 = 18

b = 8 × 2 + 4 = 20

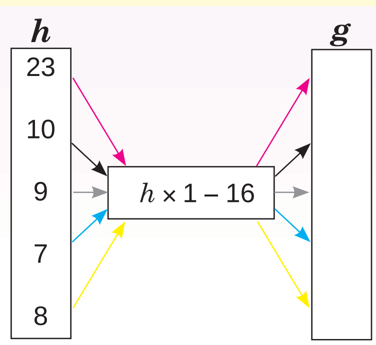
b = 9 × 2 + 4 = 22

a.



The rule is _______.

b.



The rule is _________.

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3. Complete the tables.

Example: $x = y + 2$

y	2	4	6	8	10	20
x	4	6	8	10	12	22

$x = 2 + 2$
$x = 4$

$x = 4 + 2$
$x = 6$

$x = 6 + 2$
$x = 8$

$x = 8 + 2$
$x = 10$

$x = 10 + 2$
$x = 12$

$x = 20 + 2$
$x = 22$

$a = b + 9$

b	1	2	3	4	5	10
a						

4. Solve for m and n.

Example:

x	1	2	3	4		14	m	25
y	6	7	8	9		19	22	n

Determine the rule:
e.g. $y = x + 5$

***n*?**
$y = x + 5$
$y = 25 + 5$
$y = 30$
n is 30

***m*?**
$x = m$ and $y = 22$
$y = x + 5$
$22 = m + 5$
$22 - 5 = m + 5 - 5$
$17 = m$
$m = 17$

x	1	2	3	4		25	m	51
y	10	11	12	13		n	39	60

Rule:

***n*?**

***m*?**

Problem solving

Draw a flow diagram where $x = y + 9$.

Draw your own flow diagram where $x = y \times 4 + 8$.

If $x = 2y + 4$ and $y = 2, 3, 4, 5, 6$, draw a table to show it.

What is the 10th term in this pattern? 2 × 11, 3 × 11, 4 × 11, …

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15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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R8a Algebraic expressions and equations

Revise the following:

variable → $x + 23 = 45$ ← constants

operation → $x + 23 = 45$ ← equal sign

Say if the following is an expression or an equation and why?

$x + 23 = 45$

$x + 23$

1. Say whether it is an expression or an equation.

Example: 8 + 3 (It is an expression.)

8 + 3 = 11 (It is an equation.)

a. 9 + 7 = 16 ______

b. 7 + 6 ______

c. 3 + 5 = 8 ______

d. 11 + 2 ______

2. Describe the following:

Example: 6 + 3 = 9

6 + 3 is an **expression** that is equal to the **value 9** on the right–hand side.

6 + 3 = 9 is called an **equation**. The left–hand side of an equation equals the right–hand side.

a. 12 + 5 = 17

b. 9 + 8 = 17

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3. **Describe the following in words:**

Example: 4, 8, 12, 16, 20, …
Adding 4 to the previous term.

a. 2, 5, 8, 11 …

b. 11, 20, 29, 38 …

4. **Write down an expression for the n^{th} term of each sequence.**

Example: 5, 9, 13, 17, 21 … Expression or rule: $4(n) + 1$

Position in sequence	1	2	3	4	5	n
Term	5	9	13	17	21	$4(n) + 1$

a. 6, 11, 16, 21 ...

b. 7, 13, 19, 25 ...

5. **What does the rule mean?**

Example: What does the rule 2n-1 mean for the following number sequence: 1, 3, 5, 7, 9…?

Position in sequence	1	2	3	4	5	n
Term	1	3	5	7	9	

What does the rule $6n – 2$ mean for the following number sequence 4, 10, 16, 22 …?

Position in sequence						
Term						

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continued ☛

Revision

R8b Algebraic expressions and equations continued

6. Solve for x.

Example 1:

$x + 5 = 9$

$x + 5 - 5 = 9 - 5$

$x = 4$

a. $x + 18 = 26$

b. $x + 6 = 12$

Example 2:

$x - 5 = 2$

$x - 5 + 5 = 2 + 5$

$x = 7$

c. $x - 15 = 12$

d. $x - 28 = 13$

Example 3:

$x + 4 = -7$

$x + 4 - 4 = -7 - 4$

$x = -11$

e. $x + 7 = -12$

f. $x + 24 = -34$

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7. Solve for x.

Example: $5x = 20$

$\frac{5x}{5} = \frac{20}{5}$

$x = 4$

a. $6x = 72$

b. $7x = 84$

8. Solve for x.

Example: $2x - 1 = 8$

$2x - 1 + 1 = 8 + 1$

$2x = 9$

$\frac{2x}{2} = \frac{9}{2}$

$x = 4\frac{1}{2}$

a. $5x - 6 = 18$

b. $3x + 4 = -5$

9. Substitute.

Example: if $y = x^2 + 2$, calculate y when $x = 4$

$y = 4^2 + 2$

$y = 16 + 2$

$y = 18$

Test

$y = x^2 + 1$

$18 = 4^2 + 2$

$18 = 16 + 2$

$18 = 18$

a. $y = p^2 + 7; p = 8$

b. $y = c^2 + 4; c = 8$

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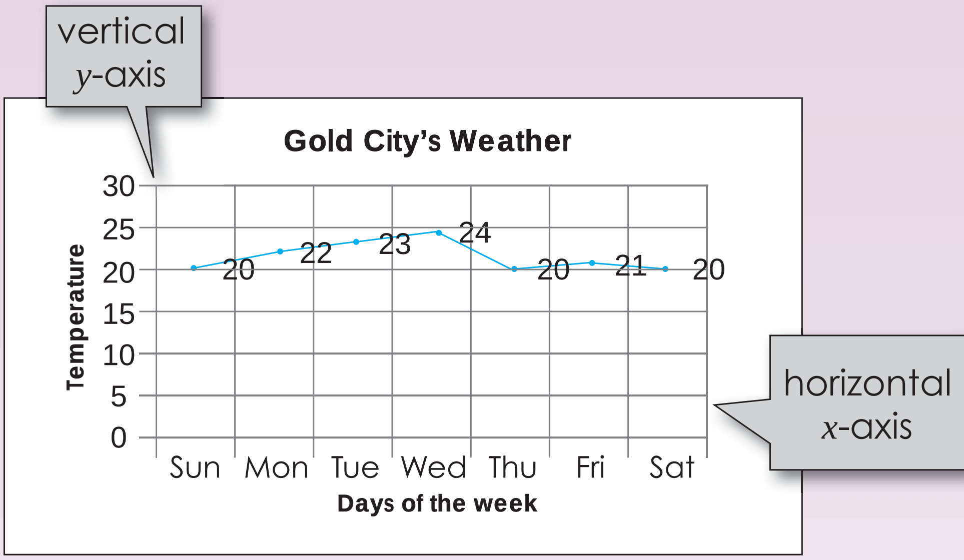
Problem solving

Write down five different equations where x is equal to 5.

R9 Graphs

A line graph uses points connected by lines to show how something changes in value (as time goes by, or as something else happens).



1. Look at the graph and answer the following questions.

a. What is the title of the graph? ____________________

b. What does the x-axis tell us? ____________________

c. What does the y-axis tell us? ____________________

d. What does this graph tell us? ____________________

e. What can you add to the word "temperature" on the y-axis? __________

f. What was the temperature on:

i. Sunday? ________

ii. Monday? ________

iii. Wednesday? ________

g. Identify the grid lines on the graph that helped you to answer the previous question. ____________________

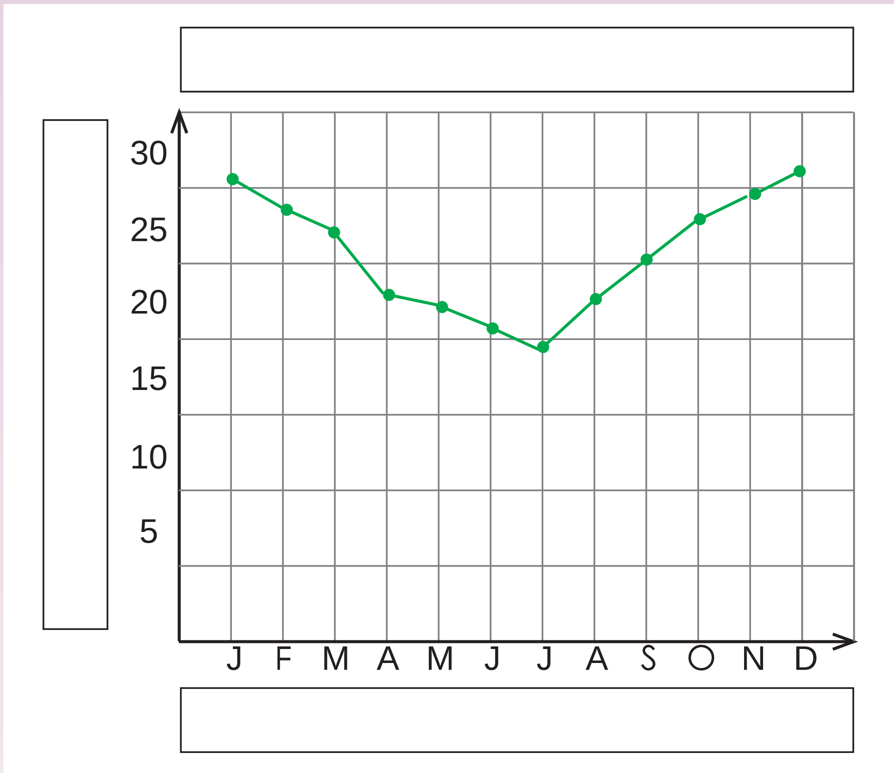
h. Look at the temperature on Sunday and Monday. What do you notice?

____

i. What happened to the temperature from Wednesday to Thursday? __________

2. Look at the graph and label it.

title	x-axis	y-axis	points	grid lines



3. Fill in the missing words (lines, title, label, vertical scale, points or dots, horizontal scale).

a. The __________ of the graph tells us what the graph is about.

b. The horizontal __________ across the bottom and the vertical __________ along the side tell us what kinds of facts are listed.

c. The ____________________ across the bottom and the ____________________ along the side tell us how much or how many, or what.

d. The __________ on the graph show us the facts.

e. The __________ connecting the points give estimates of the values between the points.

Activity

Find a graph in a newspaper. Write down five points about the graph.

Sign:

Date:

R10 Financial mathematics

Can you remember the meaning of the following?

Profit is the surplus left over after total costs are deducted from total revenue.
Loss is the excess of expenditure over income.
Discount is the amount deducted from the selling price before payment.

Budget is the estimate of cost and revenues over a specified period.

A budget is like a scale where you try to balance your income and your expenses.

Important: Your income should always outweigh your expenses.

A **loan** is sum of money that an individual or a company lends to an individual or company with the objective of gaining profits when the money is paid back.

Interest is the fee a lender charges a borrower for the use of borrowed money, usually expressed as an annual percentage of the amount borrowed, also called the interest rate.

1. **Are you making a profit or a loss? How much? Circle the correct answer and calculate the amount.**

a. You are buying ice creams for R4,50 each and selling them for R6,00 each.
You made a profit/loss of ____________ (amount) per ice cream.

b. You bought 150 pencils for R1,00 each and sold them for R1,35 each. You had to give your mother R60 for transport costs.
You made a profit/loss of _____________ (amount).

Profit can be calculated by different methods. Normally when we talk about a 10% profit we calculate it on the cost price. We sometimes also refer to a 10% mark–up.

Example: If my tennis racquet costs me R400 and I want to sell it and make a 10% profit, I need to sell it for R440.

R400 + (R400 × 10%) = R440

2. **Answer the questions on profit.**

a. You are buying sweets for 80c each and you want to sell them and make a 25 % profit. How much must you sell them for? _____________ (amount).

b. You are buying sweets in large packets of 100 for R25,50 per packet. You are selling them to your friends for 50c per sweet. If they buy 10 sweets or more at a time you give them 20% discount. During the first break you sold 40 loose sweets and 20 sweets at the discounted price. What will your profit be on the sweets you sold? ______ (amount).

Spend less than you earn !

Creating a budget is the most important step in controlling your money.
The first rule of budgeting is: **Spend less than you earn!**
Example: If you get R100 allowance per month (pocket money) and another R40 for your birthday, you cannot spend more than R140 for the entire month.

Net income is what remains after all the costs are deducted from total revenue. If the costs or expenses exceed the income we call it a **shortage**.

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3. Track your budget.

Using the example below, draw up a budget in your exercise book.
Make sure you make a net income.

Income	Estimated amount	Actual amount	Difference
Estimated total income			
Expenses			
Estimated total expenses			
Net income			

When someone lends money to someone else, the borrower usually pays a fee to the lender. This fee is called 'interest', '**simple**' interest, or '**flat rate**' interest. The amount of simple interest paid each year is a fixed percentage of the amount borrowed or lent at the start.

The simple interest formula is as follows:
Interest = Principal × Rate × Time
where:
Interest is the total amount of interest paid,
Principal is the amount lent or borrowed,
Rate is the percentage of the principal charged as interest each year.
Time is the time in years that it will take to pay back the loan.

4. I borrowed R10 000 from the bank and they charged me 10% interest per year. The total amount I had to repay was R15 000. For how long was the loan?

Sharing

Make notes of the important financial tips you have learned, and share them with a family member.

Sign:
Date:

R11a Geometric shapes

Symbols you need to revise or learn:

Triangle	Angle	Perpendicular	Parallel	Degrees	Right angle
△	∠	⊥	||	o	∟
Line segments	**Line**	**Ray**	**Congruent**	**Similar**	**Therefore**
$\overline{AB}$	$\overleftrightarrow{AB}$	$\overrightarrow{AB}$	≡	|||	∴

Geometric shapes to remember:

Geometric shapes

Triangles	Quadrilaterals	More polygons
Equilateral triangle	Parallelogram	Pentagon
Isosceles triangle	Rectangle	Hexagon
Scalene triangle	Square	Heptagon
	Rhombus	Octagon
	Trapezium	Nonagon
	Kite	Decagon, etc.

These are also polygons

A ***polygon*** is a plain shape completey enclosed by three or more straight edges.

Angles to remember:

Acute angle: an angle that is less than 90°

Right angle: an angle that is 90°

Obtuse angle: an angle that is greater than 90° but less than 180°

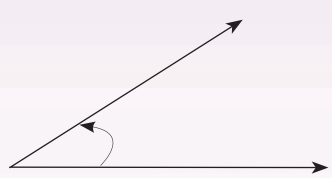
Straight angle: an angle that is exactly 180°

Reflex angle: an angle that is greater than 180°

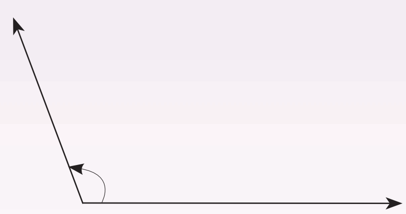
Revolution angle: An angle that is equal to 360°

1. **Measure each angle.** (You might need to extend the lines depending on the size of your protractor.)

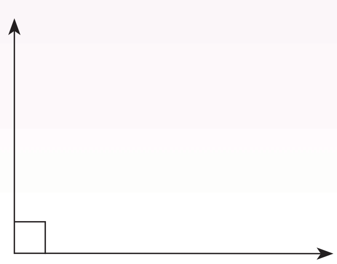
a.



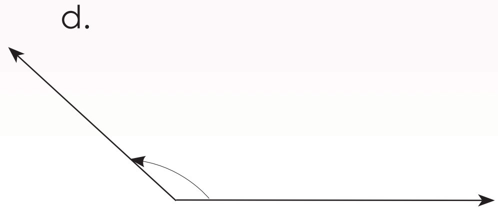
b.



c.



d.



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2. Draw an angle:

a. Smaller than 90 degrees. Estimate the size of your angle, then measure it.

b. Bigger than 90 degrees. Estimate the size of your angle, then measure it.

3. Use a ruler and a protractor to construct a 60° angle and label it as ABC. Write down the steps you followed to construct it.

Sign:

Date:

continued ☛

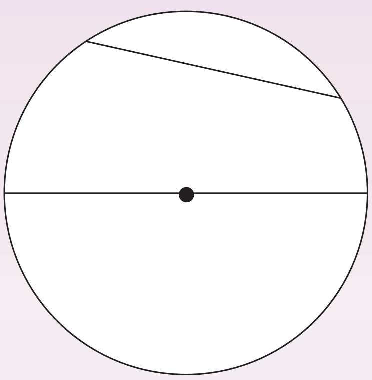
R11b

Geometric shapes continued

4. Using a compass, go through the steps for constructing a line labelled CD perpendicular to both sides of a line labelled AB.

5. Label the circle.

a. Use the following words: chord, diameter, radius and centre.



b. Draw a circle with a diameter of 2,3 cm.

6. Draw an equilateral, isosceles and a scalene triangles. Label each triangle.

a.

b.

c.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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7. **Draw a parallelogram, rectangle, square, rhombus, trapezium and kite. Label each diagram.**

a.

b.

c.

d.

e.

f.

8. **How do I know when triangles are congruent or similar?**

a. Congruent:

b. Similar:

Activity

The most common angle we get in everyday life is a 90° angle. Name at least five everyday examples of angles smaller than 90°. Make drawings to show your answers.

Sign:

Date:

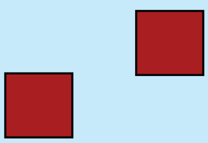
R12 Transformations

Look at the transformations and describe each one.

Transformation: to transform something is to change it in some way.

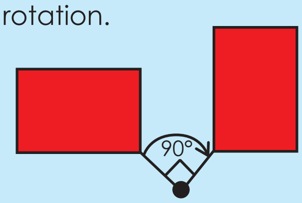
A transformation is what brings about the change. There are many kinds of geometric transformations, ranging from translations, rotations, reflections to enlargements.

Translation: a translation is the movement of an object to a new position without changing its shape, size or orientation.



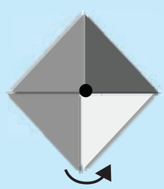
When a shape is transformed by sliding it to a new position, without turning, it is said to have been translated.

Rotation: a rotation is a transformation that moves points so that they stay the same distance from a fixed point, the centre of rotation.

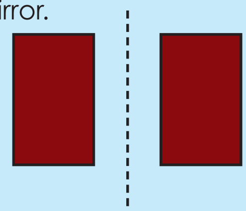


Rotational symmetry
A figure has rotational symmetry if an outline of the turning figure matches its original shape.

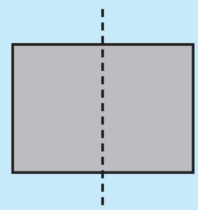
Order of symmetry
This is how many times an outline matches the original in one full rotation.



Reflection: a reflection is a transformation that has the same effect as a mirror.



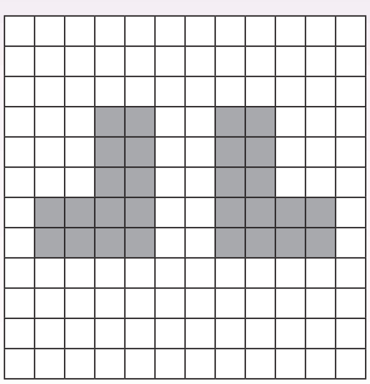
Reflective symmetry
An object is symmetrical when one half is a mirror image of the other half.



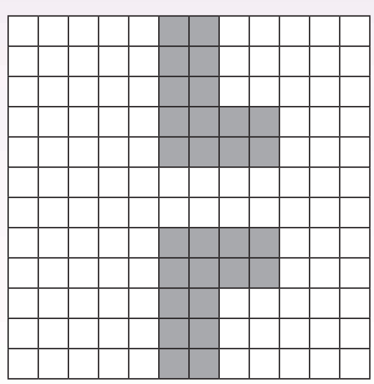
1. **Describe each reflection. The words below may help you.**

Mirror image	Shape	Original shape	Line of reflection	Vertical	Horizontal

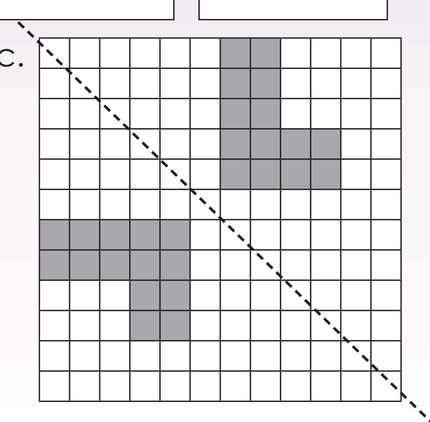
a.



b.



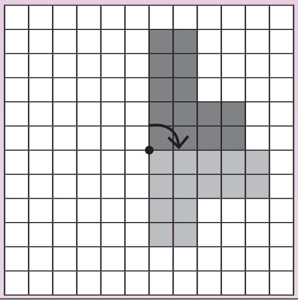
c.



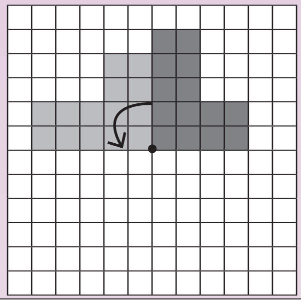
2. Describe each rotation. The words below may help you.

Rotate	Clockwise	Anti–clockwise	Centre of rotation	Degrees	Horizontal

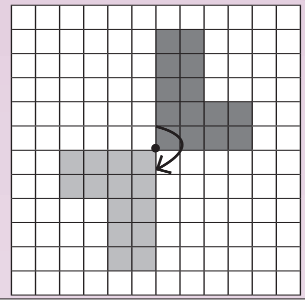
a.



b.



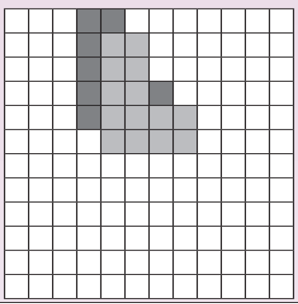
c.



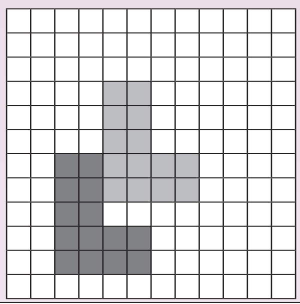
3. Describe each translation. The words below may help you.

Slide	Left	Right	Up	Down	Place

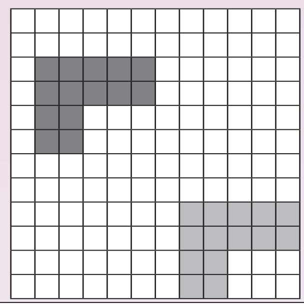
a.



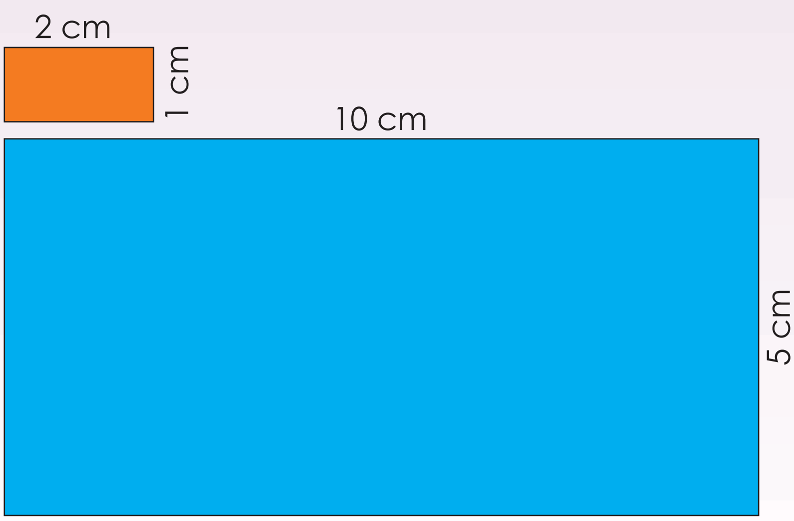
b.



c.



4. Fill in the answers:



Orange rectangle:

a. The length = ____

b. The width = ____

Blue rectangle:

c. The length = ____

d. The width = ____

e. The blue rectangle is the orange rectangle enlarged ____ times.

Activity'

Find a translated, rotated and reflected pattern in nature and explain each one in words.

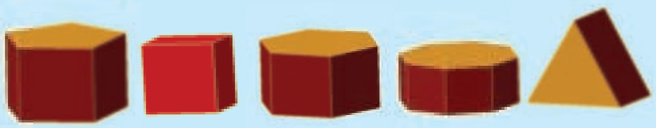
Sign:

Date:

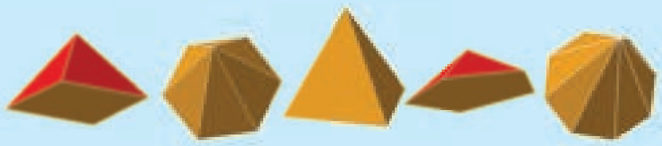
R13 Geometry

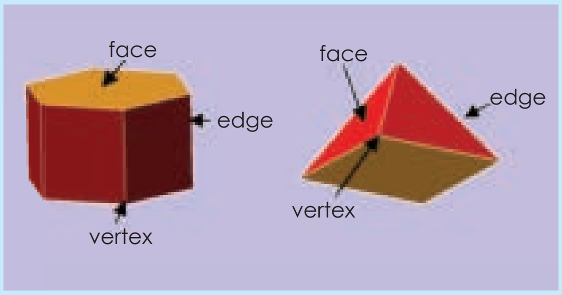
Term 1

Why are these called prisms?



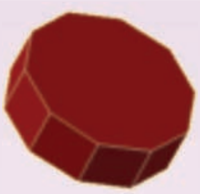
Why are these called pyramids?





1. Label the following using these words: face, edge and vertex.

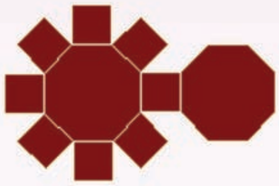
a.



b.

2. Write a comparison of geometric shapes and geometric solids.

3. Describe the net of this geometric solid.



a. Name the geometric solid.

b. Identify and count the faces.

c. Identify and count the vertices and edges.

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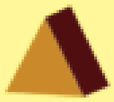
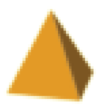
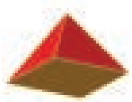
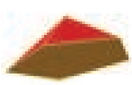
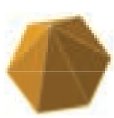
Euler's formula

3. **Complete the table.**

	Solid	Vertices	Edges	Faces	Formula V – E + F
a. Triangular prism		6	9	5	6 – 9 + 5 = 2
b. Rectangular prism					
c. Pentagonal prism					
d. Hexagonal prism					
e. Octagonal prism					
f. Triangular pyramid					
g. Square pyramid					
h. Pentagonal pyramid					
i. Hexagonal pyramid					
j. Octagonal pyramid					

Activity

Which geometric objects do you see most in your everyday life?

Sign:

Date:

R14 Perimeter and area

Revise.

Perimeter of a **rectangle**: 2 l × 2 b

Area of a rectangle: $l \times b$

Perimeter of a **square**: 4 l

Area of a square: $l \times l$

The area of **a triangle** is: $\frac{1}{2}\ b \times h$

1 cm = 10 mm
1 cm^2 (1 cm × 1 cm) = 100 mm^2 (10 mm × 10 mm)

1 m = 1 000 mm
1 m^2 (1 m × 1 m) = 1 000 000 mm^2 (1 000 mm × 1 000 mm)

1 km = 1 000 m
1 km^2 (1 km × 1 km) = 1 000 000 m^2 (1 000 m × 1 000 m)

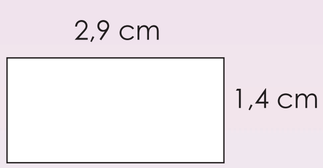
1. Calculate the perimeter and/or the area of the following polygons:

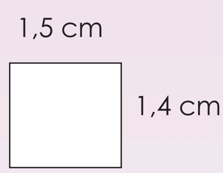
Example: Rectangle

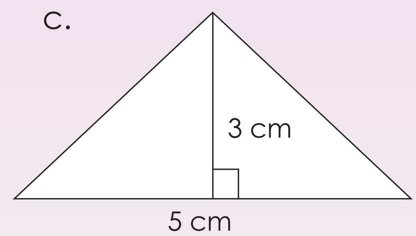
Perimeter
Double 4,5 cm + double 3,2 cm
(2 × 4,5 cm) + (2 × 3,2 cm)
= 9 cm + 6,4 cm
= 15,4 cm

Double 4,5 cm is the same as 2 × 4,5

Area
4,5 cm × 3,2 cm
= 14 cm^2

a.


b.


c.


Area:	Area:	Area:
Perimeter:	Perimeter:	

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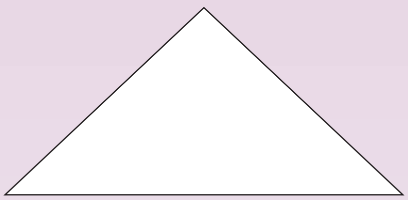
2. **Draw the triangle and then calculate the area.**

Height 3 cm
Base 5 cm

Drawing	Area

3. **Measure the triangle and calculate the area in mm² and cm².**



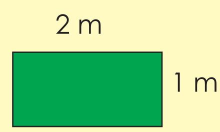
4. **Calculate the area and give your answer in m², cm² and mm².**

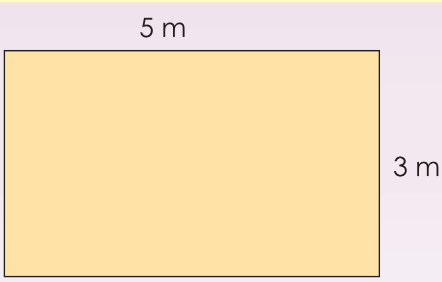
Example: length = 2 m, breadth = 1 m

A = l × b
= 2 m × 1 m
= 2 m²

A = l × b
= 200 cm × 100 cm
= 20 000 cm²

A = l × b
= 2 000 mm × 1000 mm
= 200 000 mm²





a. In m²	b. In cm²	c. In mm²

5. **Calculate the length and the breadth in cm and m if the area of a square is 64 000 000 mm².**

Example: 9 000 000 mm²
= 3 000 mm × 3 000 mm
= 300 cm × 300 cm
= 90 000 cm²
= 3 m × 3 m
= 9 m²

Calculation:

Sign:
Date:

Problem solving

If a square has a perimeter of 10 m, what is the area? Give your answer in mm² and cm². If you change the square to a rectangle with a perimeter of 10 m, will the area change?

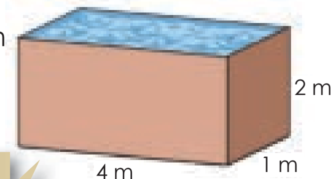
R15a Volume and surface area

What is the difference between volume and capacity?

The volume of a solid is the amount of space it occupies.

Capacity is the amount of liquid a container can hold.

We know that:
10 cm × 10 cm × 10 cm
= 1 000 cm^3
= 1 000 ml
= 1 ℓ

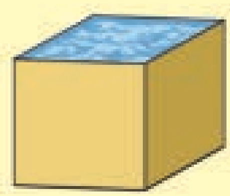


This container will take 8 000 litres.

1. Use a formula to calculate the volumes of the cubes. How much water can each cube hold?

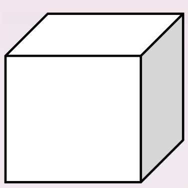
Example:

The formula for the volume of a cube is s^3.



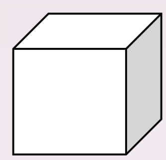
V = 2 cm × 2 cm × 2cm
= 8 cm^3
= 8 ml
= 0,008 ℓ

a.



5 cm

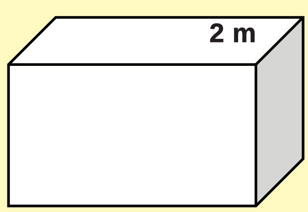
b.



4,5 cm

2. Calculate the volume of this container and give your answer in m^3, cm^3 and mm^3. How much water can this container hold?

Example:



This container will hold 30 000 000 ml or 30 000 ℓ water

m^3	cm^3	mm^3
$V = l \times b \times h$	$V = l \times b \times h$	$V = l \times b \times h$
= 5 m × 2 m × 3 m	= 500 cm × 200 cm × 300 cm	= 5 000 mm × 2 000 mm × 3 000 mm
= 30 m^3	= 30 000 000 cm^3	= 30 000 000 000 mm^3

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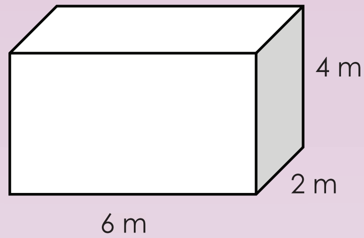
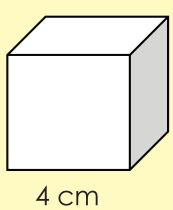


m^3	cm^3	mm^3
Capacity:	Capacity:	Capacity:

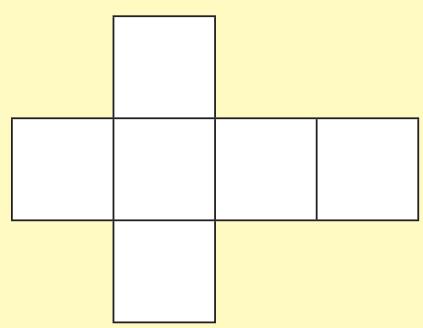
3. Calculate the surface area of the following cubes.

Example:



The surfae area of a cube is $l \times l \times$ total number of faces

= $l^2 \times$ total faces
= $(4\ \text{cm})^2 \times$ total faces
= $16\ \text{cm}^2 \times 6$
= $96\ \text{cm}^2$



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Date:

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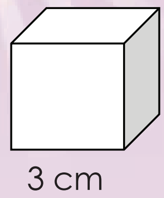
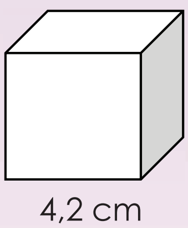
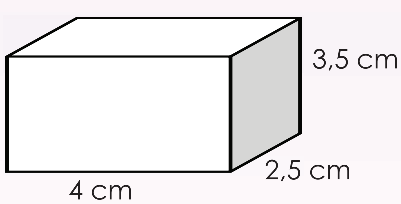
a.

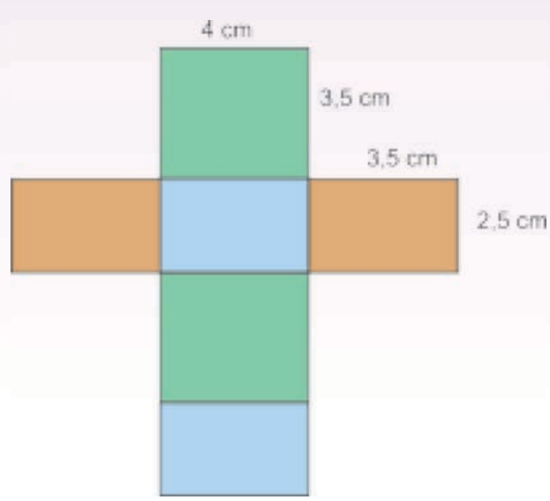


b.

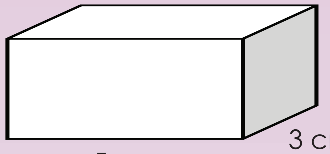


4. Calculate the surface area of the following rectangular prisms:





a.

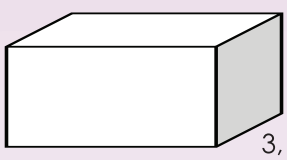


2 cm

3 cm

5 cm

b.



2,1 cm

3,1 cm

4,3 cm

Problem solving

If the volume of a cube is 112 cm³, what is its dimension in mm and m?

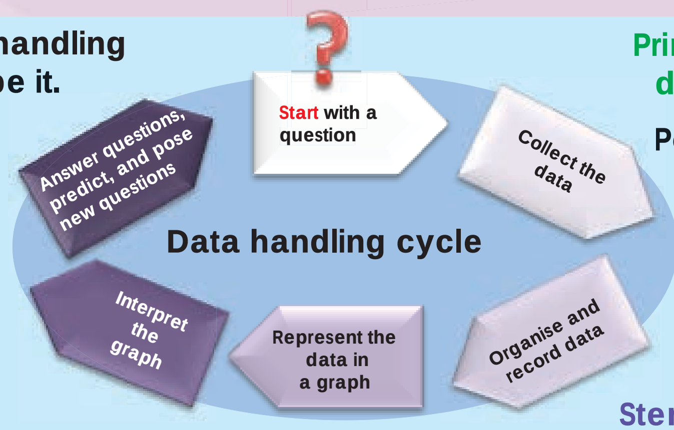
Sign:

Date:

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

R16a Data

Look at the data-handling cycle and describe it.



Primary data
Secondary data
Population
Survey
Questionnaire

Tables
Tallies
Stem and leaf diagram

range
mean
median
mode

Bar graph
Histogram
Pie charts
Pictograph

1. Answer the questions about collecting data.

How much water do we drink at school?

a. How will you find the data?

b. Who should you ask?

c. What will the data tell you?

d. Do you think the data can help you to solve the problem?

e. Why will the data help you to solve any possible problem?

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f. Write five questions you could ask in a questionaire to help you find out how much water is drunk in the school.

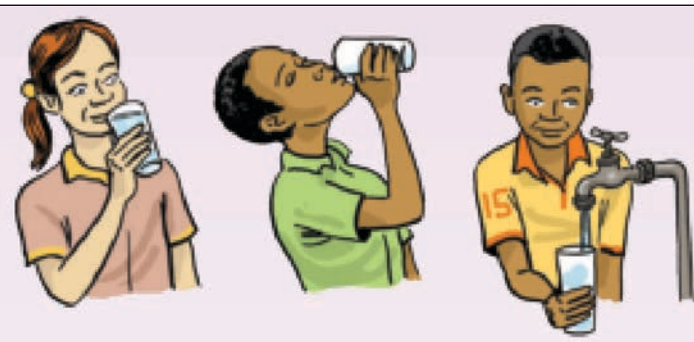
Continue on an extra sheet of paper.

g. Write a hypothesis for your questionnaire.

Continue on an extra sheet of paper.

h. Compile a simple questionnaire which includes yes/no type responses and multiple choice responses.

Continue on an extra sheet of paper.



2. You collected data by interviewing children in your class about their favourite sport. The results are as follows:

Name	Favourite colour	Name	Favourite colour
Denise	Rugby	**Elias**	Soccer
John	Golf	**Simon**	Rugby
Jason	Soccer	**Edward**	Cricket
Mathapelo	Cricket	**Susan**	Soccer
Beatrix	Cricket	**Philip**	Golf
Opelo	Rugby	**Ben**	Rugby
Lisa	Soccer	**Lauren**	Tennis
Gugu	Golf	**Tefo**	Rugby
Sipho	Rugby	**Alicia**	Soccer
Lerato	Rugby	**Masa**	Tennis

a. Compile a table showing tally and frequency.

Sign:

Date:

R16b Data continued

b. Draw a bar graph using your frequency table.

c. Interpret your graph and write at least 5 conclusions.

3. Use the data collected from a survey of the favourite subjects in your class. You will need extra paper to do this activity.

Name	Favourite subject	Name	Favourite subject
Denise	Maths	Elias	History
John	Arts	Simon	Maths
Jason	History	Edward	Sciences
Mathapelo	Sciences	Susan	History
Beatrix	Sciences	Philip	Arts
Opelo	Maths	Ben	Maths
Lisa	History	Lauren	Language
Gugu	Arts	Tefo	Maths
Sipho	Maths	Alicia	History
Lorato	Maths	Masa	Language

Art
Biology
History
Language
Maths
Physical science

a. Compile a frequency table using tallies, splitting the results for boys and girls.

b. Draw a double bar graph using your frequency table, comparing the preferences of the boys and girls.

c. Interpret your graph and write at least 5 conclusions.

d. Compare the graph in 2b with the double bar graph in 3b. Which graph gives the more detailed informaton.

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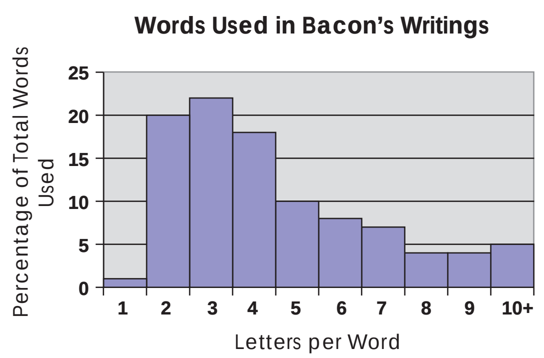
4. Write a short report on your findings.

5. Why is this a histogram? Write two sentences on this histogram that explain the data.



6. Currently every person in South Africa generates about 2 kg of solid waste per day.
Draw a pie chart to display this information.

This table shows the different categories of solid waste and the amount in grams generated per day.

Waste category	Waste generated per person per day (in grams)
Plastic	240
Glass	120
Paper	600
Metal	200
Organic	600
Non-recyclables	240

Activity

Make your own drawing of the data handling cycle. Present it to the class or a family member.

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Notes

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Rainbow WORKBOOKS

Grade 8

Mathematics

PART 2

WORKSHEETS

1 to 64

ENGLISH

Book 1

1 Natural numbers, whole numbers and integers

Explain the difference between:

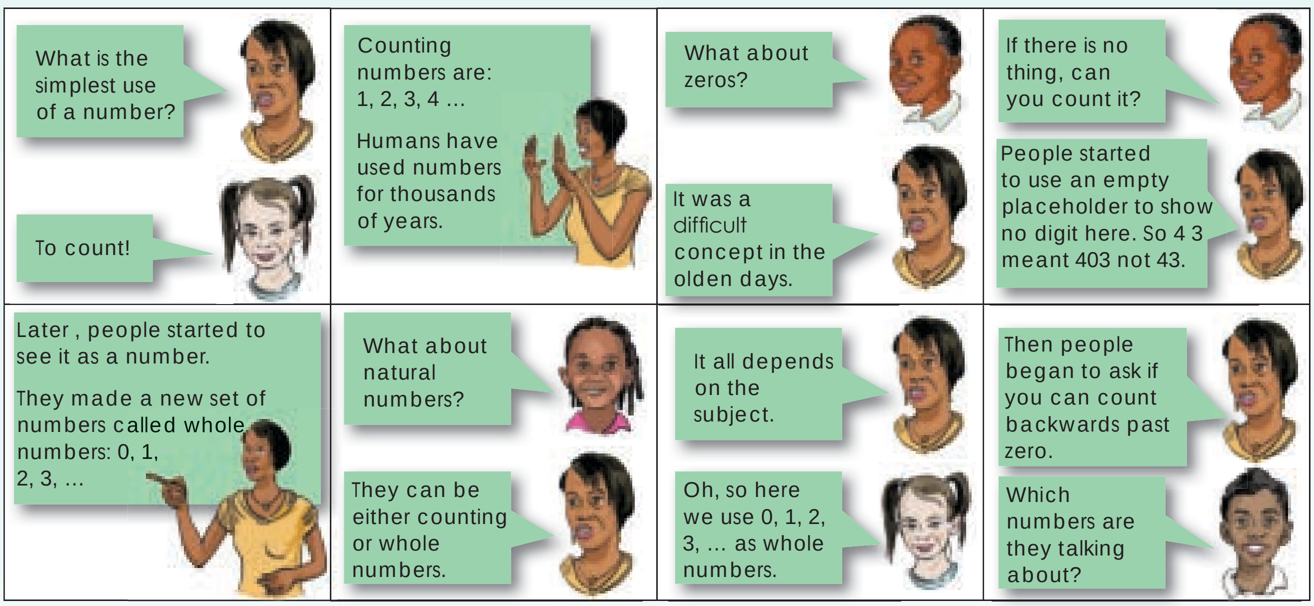
Natural numbers:
{1, 2, 3, 4, ...} No negative numbers and no fractions.

Whole numbers:
{0, 1, 2, 3, ...} No negative numbers and no fractions. Zero included.

Integers:
{... –3, –2, –1, 0, 1, 2, 3, ...} Positive and negative numbers. Includes zero (which is neither positive nor negative). No fractions.

The symbol for each: **N** **No** **Z**

1. Read the cartoon and discuss it.



2. Draw number lines explaining the following:

a. Natural numbers b. Whole numbers c. Integers

Write a set for each group of numbers.

d. Natural numbers ____________________

e. Whole numbers ____________________

f. Integers ____________________

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3. **Say whether the following numbers are natural numbers and/or whole numbers and/or integers.**

a. 15 ______________________

b. – 8 ______________________

c. – 6 ______________________

d. 100 ______________________

e. 200 ______________________

4. **Complete the following:**

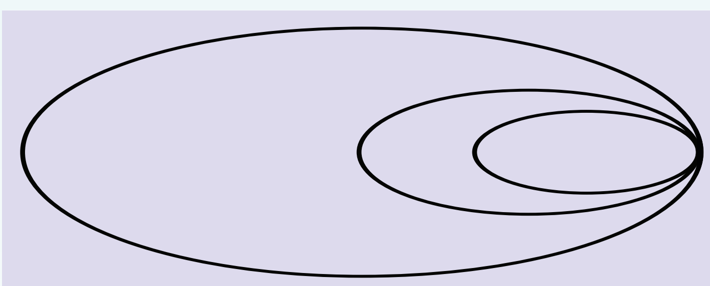
a. A = {1, 2, 3, ...} is the set of ______________ numbers.

b. B = {0, 1, 2, ...} is the set of ______________ numbers.

c. C = {... –3, –2, –1, 0, 1, 2, 3, ...} is the set of ______________ numbers.

d. Sometimes we talk about positive and negative integers. Write a set for each.

5. **Enrichment: Label this Venn diagram using the words: : integers, natural numbers and whole numbers.**



A Venn Diagram is a way of showing the relationship between two or three sets of numbers. The diagram is made up of two or three overlapping oval shapes.

6. **Do you know of any other types of numbers? Write them down.**

Sign:

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Activity

Explain what a Venn diagram is to your family.

2a Commutative, associative and distributive properties

Revise these properties of numbers. Give an example of each.

Commutative property of numbers:	Associative property of numbers: Distributive property of numbers:	Zero as the identity element of addition: One as the identity element of multiplication:

1. Make use of the associative property to show that the expressions are equal.

Example: $(6 + 3) + 4 = 6 + (3 + 4)$
$9 + 4 = 6 + 7$
$13 = 13$

a. $(2 + 5) + 3 =$

b. $(4 + 6) + 2 =$

c. $(7 + 8) + 1 =$

2. Use the associative property to show that the expressions are equal.

Example: $(a + b) + c = a + (b + c)$
$a + b + c = a + b + c$

a. $(m + n) + p =$

b. $(x + y) + z =$

c. $(c + d) + e =$

Term 1

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3. **Use the commutative property to show that the expressions are equal.**

Example: $2 \times 3 = 3 \times 2$
$6 = 6$

a. $5 \times 10 =$

b. $4 \times 5 =$

c. $7 \times 9 =$

4. **Use the commutative property to show that the expressions are equal.**

Example: $a \times b = b \times a$
$ab = ba$

a. $x \times c =$

b. $m \times n =$

c. $p \times q =$

5. **Make use of the associative property to show that the expressions are equal.**

Example: $8 + (7 + 4) = (8 + 7) + 4$
$8 + 11 = 15 + 4$
$19 = 19$

a. $3 + (6 + 7) =$

b. $12 + (4 + 9) =$

c. $5 + (3 + 11) =$

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continued ☛

2b Commutative, associative and distributive properties continued

6. Use the associative property to show the equation is true.

Example: $a + (b + c) = (a + b) + c$

$a + b + c = a + b + c$

a. $x + (y + z) =$

b. $r + (s + t) =$

c. $d + (e + f) =$

7. Use the associative property to show that the equation is true.

Example: $(2 \times 4) \times 3 = 2 \times (4 \times 3)$

$8 \times 3 = 2 \times 12$

$24 = 24$

a. $(3 \times 4) \times 3 = 3 \times (4 \times 3)$

b. $(7 \times 4) \times 2 = 7 \times (4 \times 2)$

8. Use the associative property to show that the equation is true.

Example: $a \times b \times c = (a \times b)c$

$abc = ab \times c$

$abc = abc$

a. $(c \times d \times e) = c(d \times e)$

b. $x \times y \times z = x(y \times z)$

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9. **Show that the following equations are true, by using the distributive property.**

a. 3 × (2 + 6) = (3 × 2) + (3 × 6)

b. 5 × (3 + 3) = (5 × 3) + (5 × 3)

c. 3 × (7 + 4) = (3 × 7) + (3 × 4)

10. **Prove that the following expressions are true, by using the distributive property.**

a. $m \times (n + p) = (m \times n) + (m \times p)$

b. $d \times (g + h) = (d \times g) + (d \times h)$

c. $r \times (s + t) = (r \times s) + (r \times t)$

11. **Use zero as the identity element of addition and one as the identity element of multiplication to write the sum or the product of each of the following:**

		Zero as the identity of addition	One as the identity of multiplication
	$\frac{1}{2}$	$\frac{1}{2} + 0 = \frac{1}{2}$	$\frac{1}{2} \times 1 = \frac{1}{2}$
a.	3,5		
b.	56		
c.	$\frac{1}{5}$		

Problem solving

a. If $a \times (b + c) = (a \times b) + (a \times c)$ and $a = -5$, $b = -2$ and $c = -3$, substitute in the equation to show that the distributive property holds.
b. What should I add to a number so that the answer will be the same as the number?
c. What should I multiply a number by so that the answer will be the same as the number?

Sign:

Date:

3 Factors, prime factors and factorising

Term 1

Definitions

Factor: A factor is a number that divides exactly into another number, e.g. 8 is a factor of 32.

Prime number: A number that has only two factors, 1 and itself.

Prime factor: A factor of a number that is itself a prime number, e.g. the factors of 12 are 1, 2, 3, 4, 6 and 12. Only 2 and 3 are prime factors.

1. What is a factor? Give an example.

2. Write the factors of:

Example: Factors of 16 = {1, 2, 4, 8, 16}

a. Factors of 8 = {...}

b. Factors of 24 = {...}

c. Factors of 21 = {...}

3. What is a prime number? Give five examples.

4. Revision. Complete the table.

	Factors	Common factors	Highest common factor
Example: 4 and 8	1, 2, 4 and 1, 2, 4, 8	1, 2, 4	4
a. 6 and 12			
b. 7 and 28			
c. 9 and 36			
d. 8 and 24			
e. 3 and 21			

5. What does HCF stand for?

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6. What is the HCF of:

Example: Factors of 12: {1, 2, 3, (4), 6, 12} **Factors of 16: {1, 2, (4), 8, 16}**

a. 15 and 45

b. 16 and 64

c. 21 and 63

d. 24 and 88

7. Use the ladder or tree methods of factorisation to find the highest common factors.

Example: Factors of 24 and 36

24	**2**
12	**2**
6	**2**
3	**3**
1	

36	**2**
18	**2**
9	**3**
3	**3**
1	

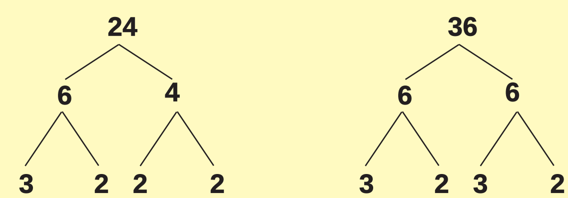
Select the common factors once only.

HCF: 2 × 2 × 3 = 12

Check your answer: 24 ÷ 12 = 2

36 ÷ 12 = 3

Tree factorisation



a. Factors of 24 and 32

b. Factors of 64 and 32

c. Factors of 48 and 36

d. Factors of 72 and 32

Problem solving

a. Factorise 358.
b. What is the sum of the highest common factor of 100 and 150 together with the highest common factor of 200 and 250?

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4 Multiples and the lowest common multiple

Look at the definitions. Give five examples of each.

Multiple:
A multiple of a number is that number multiplied by an integer.

LCM
(Lowest common multiple): The smallest number that is a multiple of two or more numbers.

1. Write the first 12 multiples of:

Example: Multiples of 9: {9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99, 108}

a. Multiples of 2: {…}

b. Multiples of 4: {…}

c. Multiples of 7: {…}

d. Multiples of 3: {…}

2. What does LCM stand for?

3. Determine the lowest common multiple.

Example: Multiples of 4: {4, 8, 12, 16, (20)} LCM is 20 Multiples of 5: {5, 10, 15, (20)}

a. Multiples of 8: {…}
Multiples of 5: {…}

b. Multiples of 5: {…}
Multiples of 12: {…}

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c. Multiples of 7: {…}

Multiples of 4 {…}

d. Multiples of 8: {…}

Multiples of 4: {…}

e. Multiples of 2: {…}

Multiples of 4: {…}

f. Multiples of 6: {…}

Multiples of 8 {…}

4. Determine the LCM using the ladder method (factorising).

Example: Multiples of 12 and 8

12	2
6	2
3	3
1	

8	2
4	2
2	2
1	

$2 \times 2 \times 2 \times 3$

$= 8 \times 3$

$= 24$

The lowest common multiple is 24.

First determine the factors and then select ALL the factors from both numbers, but select the common factors once only.

a. Multiples of 22 and 28

b. Multiples of 38 and 72

c. Multiples of 32 and 36

d. Multiples of 74 and 48

e. Multiples of 27 and 81

f. Multiples of 68 and 88

Sign:

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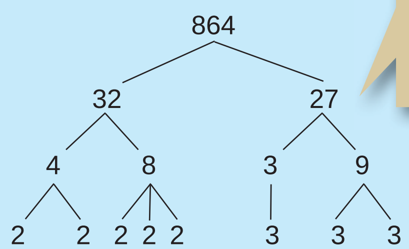
Problem solving

What is the sum of the first 20 numbers that are multiples of both 3 and 5?

5 Highest common factor and lowest common multiple of three-digit numbers

Term 1

Explain the factor tree and ladder method by using the examples below.



Why do you think we call this a factorisation tree?

384	3
128	2
64	2
32	2
16	2
8	2
4	2
2	2
1	

Start by working out whether it is divisible by one of the prime numbers 2, 3, 5, 7, etc.

- If the number ends with an even number it is divisible by 2.
- If the sum of the digits is divisible by 3, the number is divisible by 3.
- If the number ends with 0 or 5 it is divisible by 5.

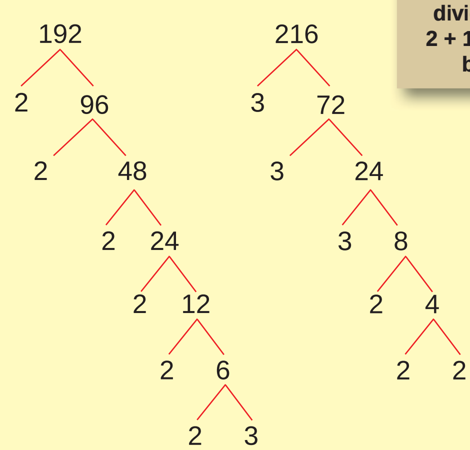
1. Calculate the HCF of two numbers using factorisation or inspection.

Example: Factors of 192 and 216

192	(2)
96	(2)
48	(2)
24	2
12	2
6	2
3	(3)
1	

216	(2)
108	(2)
54	(2)
27	3
9	3
3	(3)
1	

Factor trees



I know that 216 can be divided by 3 because 2 + 1 + 6 = 9, and 9 can be divided by 3.

192 = (2) × (2) × (2) × 2 × 2 × 2 × (3)

216 = (2) × (2) × (2) × (3) × 3 × 3

Common factors are = 2, 2, 2, 3

HCF = 2 × 2 × 2 × 3 = **24**

a. 72 and 188

b. 205 and 315

c. 456 and 572

d. 208 and 234

Learners to use their exercise books for the above activity.

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e. 275 and 350

f. 204 and 252

2. Calculate the LCM using factorisation or inspection.

Example: 123 and 141

123	3
41	41
	1

141	3
47	47
	1

LCM = 3 × 41 × 47 × 1 = 5 781

a. 128 and 256

b. 243 and 729

c. 125 and 625

d. 200 and 1 000

e. 225 and 675

f. 162 and 486

Problem solving

Explain to a member of your family how you calculate the HCF using factorisation.

Sign:

Date:

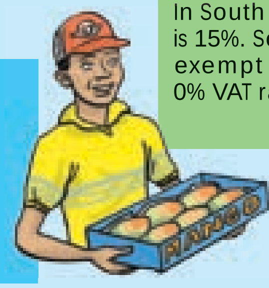
6 Finances – profit, loss and discount

Can you still remember the meaning of profit, loss and discount?Do you know the meaning of VAT?

Profit is the surplus remaining after total costs are deducted from total revenue.

Loss is the excess of expenditure over income.

Discount is the amount deducted from the selling price before payment.VAT (Value Added Tax) is the tax payable on all goods and services in South Africa.



In South Africa the current VAT rate is 15%. Some essential foods are exempt – that means they have a 0% VAT rate.

1. Peter buys 10 apples at R2,50 each. He sells each apple for R4,00. How much profit does he make if he sells 50% of his apples at full price and the rest at a 25% discount?

2. Mandla goes to university for one year. It costs R45 000 for his tuition and residence fees. The university offers him 22% discount based on his good school results. How much does he pay for the year?

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Interesting facts: Value Added Tax (VAT) was introduced by the European Economic Community (now the European Union) in the 1970s as a consumption tax. It is a tax on the purchase price levied each stage in the chain of production and distribution from raw materials to the final sale. For the final buyer, it is a tax on the full purchase price. For the seller, it is tax only on the "value added" by the seller to the product, material or service (as the seller claims back the VAT they paid for the product). Most of the cost of collecting the tax is borne by business, rather than by the state. Value Added Taxes were introduced in part because they give sellers a direct financial stake in collecting the tax.

3. Ann buys a computer game for R650 excluding VAT. How much VAT will she pay? How much will she pay in total?

4. Lebo buys blank writable CDs in bulk. He repackages them and sells them individually. He pays R40,00 cash (including VAT) for 50 CDs. He receives a 5% cash discount. For how much must he sell each CD to make a 40% profit?

5. Musa buys a new radio for R125,00 excluding VAT. He pays cash and gets a 5% cash discount. How much will he pay in total including VAT?

Problem solving

Palesato receives R100 per week pocket money. She goes to the cinema twice (cost R30,00 per film excluding VAT). She has coffee for R5,00 and buys R25,00 airtime, both with VAT included. How much pocket money can she carry over to the next week?

Sign:

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7 Finances – budget

Can you still remember what a budget is?
What is the most important rule of a budget?

Budget is the estimate of revenues and expenditures over a specified period.

Budget isn't a bad word

Budgeting is one of the best keys to good management of your money. Budgeting prevents overspending.

1. You receive R300,00 pocket money every month. You want to go to a movie once a week. The entrance fee is R30,00 and a cold drink is R8,00. The taxi fare is R10,00. Will you be able to go every week? Compile a budget for the month (4 weeks).

2. You had the following expenses last month: Movie R30,00; Taxi R100,00; Ice Cream R9,75; New shirt R45,00; Donation to welfare R50,00; Stationery R65,00; Repairs to your bicycle R175,00. You receive R400 pocket money per month for the chores you do around the house. You have saved R372,00 until now. Complete the budget below to find out if you can save anything or if you will need to use some of your savings?

	Estimated amount	Actual amount	Difference
Income (pocket money)	400,00		
Expenses			
Taxi	75,00		
Movies	60,00		
Sweets	15,00		
Clothes	100,00		
Donations	65,00		
Savings	40,00		
Stationary	50,00		
Estimated total expenses			
Net Income			

3. You plan to start selling flowers to make extra pocket money. A bunch of flowers costs you R65,00 at the market. You need to pay R50 taxi fare for a return trip to the market and your wrapping paper cost you R20,00 for 20 sheets. You only need one sheet per bunch. Use the budget below to calculate what your income for the month must be if you estimate that you can sell 5 bunches per week and you want to make 25% profit. You can only carry 10 bunches at a time in the taxi.

	Estimated amount
Income (sales of flowers)	
Expenses	
Flowers	
Wrapping	
Taxi	
Estimated total expenses	
Net Income (profit)	

4. Previously Sipho spent R160,00 a week of his weekly allowance of R200,00. Now his allowance has been reduced to only R100,00 a week. Work out a new budget so that he can still do the same things.

   Previous expenditure:

   Movies: R25 (×2)

   Airtime: R60 (×1)

   Cold drink: R8 (×4)

   Chips: R3 (×6)

Activity

Make a list of 5 ways you can extend your budget. Share this list with the rest of the class.

Remember: Extending your budget means you have to increase your surplus.
This does not only mean reducing expenditure, but also increasing income.

Sign:

Date:

8 Finances – loans and interest

Can you still remember what a loan is? What is interest?

A **loan** is a sum of money that an individual or a company (lender) lends to an individual or company (borrower) with the objective of gaining profits when the money is paid back.

Interest is the fee charged by a lender to a borrower for the use of borrowed money. The fee is usually expressed as an annual percentage of the amount borrowed, also called interest rate.

Everyone knows the old advice, **"Never a borrower or a lender be,"** but in the modern world loans and credit have just about replaced cash savings as the way that average people finance large purchases. Therefore make sure you know exactly how much interest you pay.

Term 1

1. Calculate the simple interest earned on a amount of R1 400 at an annual interest rate of 6.5% over 3 years.

2. On 1 June Sipho opened a savings account at the Postbank that paid 4.5% interest. He deposited R600. Ten days later on 10 June he deposited R1 000. Five days later on 15 June he deposited R500. No other deposits or withdrawals were made. Fifteen days later, at the end of the month, the bank calculated the daily interest.

   a. How much simple interest (calculated to the nearest cent) did he earn?
   b. What was the balance of the account at the end of the first 30 days?

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3. Suzy borrowed R2 400 from a bank for a period of two years and six months at a simple annual interest rate of 4.7%. How much must she repay at the end of the period?

4. Andile has R1 300 to invest and needs R1 800 in 12 years. What annual rate of return will he need to accomplish his goal?

5. Jabu's investment of R2 200 earned R528 in two years.
   a. Calculate the simple interest rate for this investment.
   b. If she decides to invest the total amount (original principal amount plus interest) for another two years at the same rate, what interest will she earn over the second two years.
   c. What is the difference in interest earned over the first two years, compared with interest earned over the second two years?

Problem solving

The simple interest on an initial amount (P) after 5 years is $\frac{4}{5}$ of P. Calculate the interest rate.

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9 Finances – hire purchase

Do you know what hire purchase means?

Hire purchase is a system by which a buyer pays for an asset in regular instalments, while enjoying the use of it.

During the repayment period, ownership of the item does not pass to the buyer (it is on ‘hire’). Upon the full payment of the loan plus interest, the title passes to the buyer (the ‘purchase’ is now complete).

Many organisations enter into hire purchase or leasing agreements to pay for and use equipment over a period of time rather than paying the full cost up front.

The repayment period is normally the same as the production life of the machine. For example: a farmer buys a tractor and pays it off over 5 years. After 5 years he typically has to replace the tractor.

Hire purchase must not be confused with **instalment sale**.

In North America and the United Kingdom they call hire purchases, instalment sales, but in South Africa an instalment sale refers to the finance of an asset that is similar to a loan. In the case of an instalment sale the buyer borrows the money from an institution (such as a bank) and uses the equipment as surety. Ownership of the item is transferred to the buyer immediately. In the case of a hire purchase the institution buys the equipment and ownership belongs to the institution. The buyer ‘hires’ the equipment from the institution at a agreed instalment. Only at the end of the hire purchase agreement is ownership transferred to the buyer.

1. How to calculate hire purchase payments

a. Determine the total cost of the item you wish to purchase including the VAT (value added tax) and any other charges or fees that may apply. These may include accounting, insurance, and transport charges, among others.

b. Subtract the amount of your down payment (initial deposit towards the expense) from the total cost. Your payments are based on the total cost minus the down payment.

c. Ask what the interest rate is and how it is calculated. Some interest rates are offered at a flat rate (simple interest), while others are calculated periodically on the balance remaining (compound interest).

d. Calculate hire purchase payments based on the amount you owe, the interest rate and payment schedule. This could amount to an equal payment throughout the course of your payment schedule, or it could mean varying amounts.

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2. James buys a gas grill for his restaurant on hire purchase. The grill costs R7 800 and he pays a deposit of R1 000. What will his instalment be if he pays 12 % p.a. simple interest and repays over a period of 18 months?

3. Mandla, a farmer, wants to buy a new tractor. The tractor costs R160 000 excluding VAT. He can pay a deposit of R20 000. He decides to buy the tractor on hire purchase over 60 months at a simple interest rate of 10 %.
   a. What will his instalment be?
   b. How much interest will he pay?
   c. How much will he pay in total for the tractor over 60 months?

Problem solving

David buys a new car on hire purchase. The car costs R65 000 (excluding VAT) and he trades in his old car (that was fully paid for) for R7 500. The car registration, documentation and licence fees were R2 500. What will his instalment be if he pays 7 % p.a. in simple interest and repays over a period of 54 months?

Sign:

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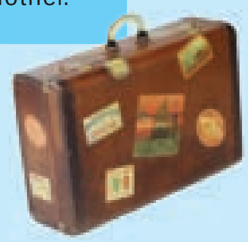
10 Finances – exchange rates

Do you know what exchange rate means?

An **exchange rate** is the current market price for which one currency can be exchanged for another.



The **Rand** (sign: R; code: ZAR) is the currency of South Africa.

The **United States Dollar** (sign: $; code: USD; also abbreviated US$) is the official currency of the United States of America.

The **Euro** (sign: €; code: EUR) is the official currency of the Euro zone.

The **Pound sterling** (symbol: £; code: GBP), commonly called the Pound, is the official currency of the United Kingdom.

Quotes using a country's home currency as the price currency (e.g., EUR 0.735342 = USD 1.00 in the euro zone) are known as direct quotation or price quotation (from that country's perspective) and are used by most countries.

Quotes using a country's home currency as the unit currency (e.g., EUR 1.00 = USD 1.35991 in the euro zone) are known as indirect quotation.

Use the exchange rates in the table to help you solve the word problems. Show your work in the space provided.

	ZAR (R)	USD ($)	GBP (£)	CAD ($)	EUR (€)	AUD ($)
ZAR	1,00	6,76	11,06	6,89	9,88	7,17
USD	0,15	1,00	1,60	0,92	1,46	0,87
GBP	0,09	1,09	1,00	0,58	0,91	0,55
CAD	0,15	1,09	1,74	1,00	1,59	0,95
EUR	0,10	0,69	1,10	0,63	1,00	0,60
AUD	0,14	1,15	1,83	1,05	1,67	1,00

1. Mbali earned R100 from waitressing. The new body board she wants to buy costs $12 AUD. After her purchase, how much money will she have left in ZAR?

2. Jack lives in Ottawa, Ontario, Canada. His uncle lives in London, England. For his birthday, Jack received £20 from his uncle. How many Canadian dollars can he buy with his birthday money?

3. Olivia lives in Sydney, Australia. Her grandmother lives in Paris, France. For Christmas, she received €40 from her grandmother. How many Australian dollars can she buy with her Christmas money?

4. Mandla has $11 USD. The computer game he wants to buy costs $10 AUD. Does he have enough money to buy the game? If not, how much more US money does he need?

Problem solving

Jabu has €35. She wants to purchase jeans for $25 CAD and a T– shirt for $15 CAD. After her purchases, how much ZAR will she have left in ZAR?

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11 Sequences that involve integers

Think about what you know about integers. Look at these integers. Which integers come before and after each number?

–9   10   –1   –12

1   –7   –2   –15

Integers include the natural numbers {1, 2, 3, ...}, zero {0}, and the negatives of the natural numbers {-1, -2, -3, ...}

Place the integers above in ascending and then descending order.

1. Complete these number lines.

a. Number line with labels: –1, 0, 1

b. Number line with labels: –4, –3, –1

c. Number line with labels: 14, 15, 17

d. Number line with labels: –209, –205

2. Complete these number lines. We have given you the integers for the first value and the last value of the intervals you are to show on each number line.

Think carefully what your intervals will be.

a. –5 and 1

b. –2 and 6

c. –10 and –3

d. –100 and 0

3. Complete the following.

a. –8 → –6 → –4 → ☐ → ☐ → ☐ → ☐ → ☐ → ☐

b. –64 → –56 → –48 → ☐ → ☐ → ☐ → ☐ → ☐ → ☐

c. –50 → –45 → –42 → ☐ → –42 → ☐ → ☐ → ☐ → –66

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

4. Identify the last term in each pattern. What is the rule?

Example: –8; –7; –6; –5; –4; –3; –2. The last term (–2) is the 7th term in the pattern. The rule is previous number + 1.

a. –7; –6; –5; –4; –3; –2; –1; 0; 1 ______ th term. ______

b. –20; –18; –16; –14; –12; –10 ______ th term. ______

c. –25; –16; –9; –4; –1 ______ th term. ______

5. Circle the fifth term in each pattern. What is the rule?

a. –8; –6; –4; –2; 0; 2; 4; 6; 8 ______

b. –15; –12; –9; –6; –3; 0; 3; 6 ______

c. –80; –75; –70; –65; –60; –55; –50 ______

6. Determine the 10th term in each pattern. What is the rule?

a. –10; –9; –8; ______

b. –28; –26; –24; ______

c. –31; –28; –25; ______

d. –99; –94; –89; ______

e. –82; –78; –74; ______

f. –84; –77; –70; ______

7. Write the following in ascending order:

a. 6; –4; 4; 2; –2; 0; –6

b. –8; 0; 8; –24; 16; –16; 24

c. –5; 5; 15; 55; 10; –15; –10; –55

d. –100; –50; –200; –150; 0; –300

8. Fill in <, > or =

a. 4 ______ –4

b. –18 ______ –8

c. –2 ______ 2

d. –3 ______ 3

e. –10 ______ 10

f. –26 ______ –62

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Problem solving

The rule for a number sequence is plus five.
Using this rule, make a ten–term sequence including positive and negative integers.

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12 Calculations with multiple operations

BODMAS stands for:

B =

O =

D =

M =

A =

S =

What do you notice?

(–3 – 2) × (7 – 2)	(–3 – 2) × (7 – 2)
= –5 × 5	= –3 – 2 × 7 – 2
= –25	= –3 –14 – 2
	= –19

Which one is correct? Why?

Try it on a normal calculator and then on a scientific calculator. What do you notice?

Term 1

1. Calculate the following:

Example: **(–7) + (5)**
= –7 + 5
= –2

a. (–2) + (–3) =

b. (2) – (–3) =

c. (–6) – (8) =

d. (–8) + (–4) =

e. (4 + 2) + (8 – 3) =

f. (6 – 8) + (3 + 4) =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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2. Solve the following:

Example: **(–5 – 4) × (6 – 2)**
= –9 × 4
= –36

a. (2 + 3) × (4 × 2)

b. (–2 + 3) × (–4 + 2)

c. (2 – 3) ÷ (4 – 2)

d. (–2 – 3) ÷ (–4 – 1)

e. (5 + 6) × (8 + 7)

f. (5 – 6) × (8 – 7)

3. Solve the following:

Example: **(–3 + 2) + (5 – 3) × (8 – 9)**
= (–1) + (2) × (–1)
= –1 + (–2)
= –1 – 2
= –3

a. (–6 + 8) + (–3 – 4) × (7 – 9) =

b. (–9 + 4) – (–6 + 5) × (–3 + 2)=

c. (6 – 5) × (–3 + 9) ÷ (3 + 3) =

d. (–7 + 5) × (–2 – 7) + (–5 + 3)=

e. (–9 + 5) ÷ (–6 +4) – (10 – 11) =

f. Create a number sentence. Solve it.

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Problem solving

If the answer is 20 and the calculation has three operations, give an example of what the calculation could be.

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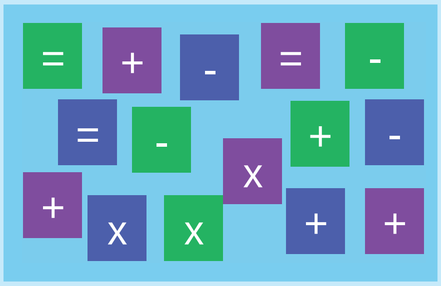
13 Properties of numbers and integers

Make equations using the same coloured symbols. What do you notice.



Commutative property:
$a + b = b + a$
$a \times b = b \times a$

What will happen if you make all the "a" s negative?

Associative property:
$a + (b + c) = (a + b) + c$
$a \times (b \times c) = (a \times b) \times c$

... make all the "a" s and "b"s negative?

Distributive property
$a \times (b + c) = a \times b + a \times c$ or
$a \times (b + c) = (a \times b) + (a \times c)$

... make all the "a" s, "b" s and "c" s negative?

1. Commutative property: use the example to guide you to solve the following:

Example: 8 + (–3) = (–3) + 8 = 5 8 × (–3) = (–3) × 8 = –24

a. 4 + (–2) = ______
= ______

b. 6 + (–4) = ______
= ______

c. 10 + (–2) = ______
= ______

d. 33 + (–14) = ______
= ______

e. 7 × (–6) = ______
= ______

f. Make your own equation.

2. Use subtraction to check addition or vice versa.

Example: 8 + (–3) = 5 then
5 – 8 = –3 or
5 – (–3) = 8

a. 6 + (–2) = ______ then

b. 8 + (–9) = ______ then

c. 3 + (–2) = ______ then

d. 17 + (–8) = ______ then

e. 9 + (–5) = ______ then

f. Make your own equation

Term 1

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3. Associative property: use the example to guide you to calculate the following:

Example: $[(-6) + 4] + (-1) = (-6) + [4 + (-1)] = -3$

a. $[(-3) + 2] + (-4) =$ ______ = ______

b. $[(-6) + 7] + (-8) =$ ______ = ______

c. $[(13) + (-3)] + (-2) =$ ______ = ______

d. $[(-4) + (-10)] + 5 =$ ______ = ______

e. $[(-12) + (-9)] + 18 =$ ______ = ______

4. Use division to check or vice versa.

Example: $5 \times (-6) = -30$ then
$-30 \div 5 = -6$ and
$-30 \div (-6) = 5$

a. $8 \times (-3) =$

b. $(-7) \times (9) =$

c. $5 \times (-7) =$

d. $6 \times (-8) =$

e. $4 \times (-2) =$

5. Complete the pattern.

Example:
$(+5) \times (+5) = 25$
$(-5) \times (-5) = 25$

$(+5) \times (-5) = -25$
$(-5) \times (+5) = -25$

a. $(+2) \times (+2) =$
$(-2) \times (-2) =$
$(+2) \times (-2) =$
$(-2) \times (+2) =$

b. $(+1) \times (+1) =$
$(-1) \times (-1) =$
$(+1) \times (-1) =$
$(-1) \times (+1) =$

c. $(-12) \times (-12) =$
$(-12) \times (-12) =$
$(+12) \times (-12) =$
$(-12) \times (+12) =$

d. $(+7) \times (+7) =$
$(-7) \times (-7) =$
$(+7) \times (-7) =$
$(-7) \times (+7) =$

e. $(+4) \times (+4) =$
$(-4) \times (-4) =$
$(+4) \times (-4) =$
$(-4) \times (+4) =$

f. $(+5) \times (+5) =$
$(-5) \times (-5) =$
$(+5) \times (-5) =$
$(-5) \times (+5) =$

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Problem solving

If the answer is –30 and the calculation has three operations, what could the calculation be?

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14 Square numbers, cube numbers and more exponents

Write your definition of square numbers.

Square numbers:

____

____

____

____

$2 = 2^1 = 2$
$2 \times 2 = 2^2 = 4$
$2 \times 2 \times 2 = 2^3 = 8$
$2 \times 2 \times 2 \times 2 = 2^4 = 16$
What will the 10th term be in the pattern?

1. Revision: calculate the following:

Example: 5^2
$= 5 \times 5$
$= 25$

a. 2^2 ______ b. 7^2 ______ c. 4^2 ______

d. 6^2 ______ e. 10^2 ______ f. 9^2 ______

2. Revision: calculate the following:

Example: 4^3
$= 4 \times 4 \times 4$
$= 64$

a. 2^3 ______ b. 1^3 ______ c. 4^3 ______

d. 3^3 ______ e. 3^3 ______

3. Revision: calculate the following using a calculator:

Example: 11^3
$=11 \times 11 \times 11$
$= 1\ 331$

a. 17^3 ______ b. 14^3 ______ c. 16^3 ______

d. 6^3 ______ e. 7^3 ______ f. 8^3 ______

4. Write these numbers in exponential form:

Example: $144 = 12 \times 12$
$= 12^2$

a. 64 ____ b. 9 ____ c. 25 ____

d. 100 ____ e. 36 ____ f. 4 ____

5. Write these numbers in exponential form:

Example: $81 = 3 \times 3 \times 3 \times 3 = 3^4$

a. 27 ____ b. 8 ____ c. 125 ____

6. Write the following in exponential form:

Example: $64 + 8$
$= 8^2 + 2^3$
$= 2^6 + 2^3$

a. $125 + 25 =$ ____ b. $64 + 125$ ____ c. $1 + 9 =$ ____

d. $1 + 81 =$ ____ e. $25 + 36 =$ ____

7. Write the following in exponential form.

Example: $50 \times 50 \times 50 \times 50 \times 50 \times 50 \times 50 = 50^7$

a. $30 \times 30 \times 30 \times 30 \times 30 =$ ____

b. $40 \times 40 \times 40 \times 40 \times 40 \times 40 \times 40 \times 40 \times 40 \times 40 \times 40 =$ ____

c. $60 \times 60 \times 60 \times 60 =$ ____

d. $70 \times 70 \times 70 \times 70 \times 70 \times 70 \times 70 \times 70 =$ ____

e. $90 \times 90 \times 90 =$ ____

f. $200 \times 200 \times 200 \times 200 =$ ____

8. Look at the examples and calculate:

Example: $3^1 = 3$, $25^1 = 25$, $m^1 = m$, $9^1 = 9$

a. $x^1 =$ ____ b. $a^1 =$ ____ c. $250^1 =$ ____

d. $12^1 =$ ____ e. $7^1 =$ ____ f. $47^1 =$ ____

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Problem solving

Add the first 10 square numbers.

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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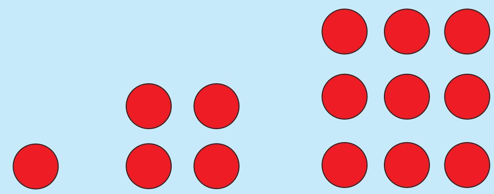
15

Square numbers and square roots

If the first pattern is 1, the second pattern is 4, and the third pattern is 9, what will the tenth pattern be?



It is important to know your times tables. Why?

1. Complete the table:

Number	**Square the number**	**Answer**
a. 6	**6^2 (6×6)**	**36**
b. 8		
c. 9		
d. 10		
e. 11		
f. 16		
g. 21		
h. 34		
i. 48		
j. 57		

2. Without calculating, say whether the answer will be a positive or negative number.

Example: $(-15)^2$ will be positive since $(-15) \times (-15) = 225$

$(15)^2$ will be positive since $(+15) \times (+15) = 225$

a. $(-9)^2$ ☐ b. $(18)^2$ ☐ c. $(19)^2$ ☐ d. $(-21)^2$ ☐

3. Write in exponential form:

Example: $a \times b \times a \times b$
$= a^2 \times b^2$

$b^2 \times c^2 \times c^2 \times b^2$
$= b^4 \times c^4$

a. $g \times g \times g \times g \times g$

b. $a \times a \times b \times b$

c. $z \times z \times c \times c \times c$

d. $d \times s \times s \times d \times s$

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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4. Revision. Calculate the square root.

Example: $\sqrt{9}$

$= \sqrt{3 \times 3}$

$= 3$

Area of the room is $9m^2$

a. $\sqrt{64}$

b. $\sqrt{25}$

c. $\sqrt{1}$

d. $\sqrt{81}$

e. $\sqrt{49}$

f. $\sqrt{121}$

5. Calculate the square root using the example to guide you:

Example: $\sqrt{256}$

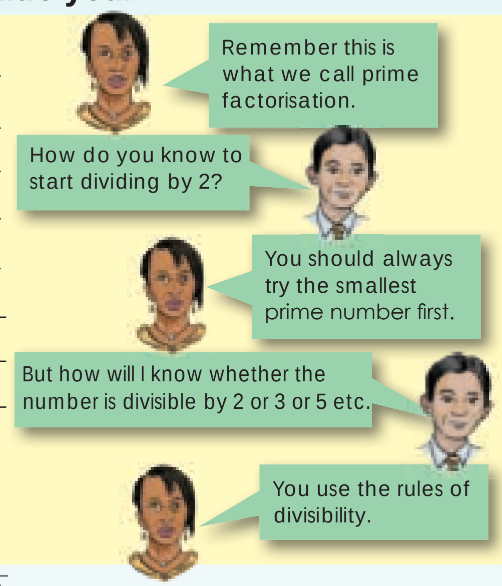
$= \sqrt{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2}$

$= 2 \times 2 \times 2 \times 2$

$= 16$

256	2
128	2
64	2
32	2
16	2
8	2
4	2
2	2
1	

Test your answer: $16 \times 16 = 256$



a. $\sqrt{36}$

b. $\sqrt{144}$

c. $\sqrt{324}$

d. $\sqrt{1296}$

Sign:

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Problem solving

Use any three examples to show that the square of any odd number is always an odd number.

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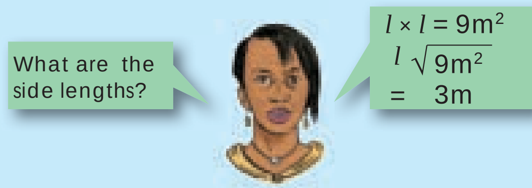
16 Representing square roots

How quickly can you calculate the lengths of the sides of these square rooms? You may use a calculator.

9 m²

144 m²

529 m²



1. Say whether the following are true or false. Make any false statements true.

a. $\sqrt{7^2} = 7$

b. $\sqrt{7^2} = 49$

c. $\sqrt{16 + 9} = 25$

d. $\sqrt{16 + 9} = 5$

e. $\sqrt{6^2} = 36$

f. $\frac{\sqrt{16}}{9} = \frac{4}{3}$

2. Revise: calculate.

Example: $\sqrt{12 \cdot 12}$
$= 12$

Note: We have used the · symbol for multiplication, instead of the usual ×, to save space.

a. $\sqrt{2 \cdot 2}$

b. $\sqrt{3 \cdot 3}$

c. $\sqrt{4 \cdot 4}$

d. $\sqrt{5 \cdot 5}$

e. $\sqrt{6 \cdot 6}$

f. $\sqrt{8 \cdot 8}$

g. $\sqrt{10 \cdot 10}$

h. $\sqrt{7 \cdot 7}$

i. $\sqrt{9 \cdot 9}$

j. $\sqrt{11 \cdot 11}$

3. Represent the square root differently (with numbers that are not square numbers).

Example 1: $\sqrt{2 \cdot 2 \cdot 2}$
$= \sqrt{2 \cdot 2} \times \sqrt{2}$
$= 2 \times \sqrt{2}$
$= 2\sqrt{2}$

Example 2: $\sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}$
$= \sqrt{2 \cdot 2} \times \sqrt{2 \cdot 2} \times \sqrt{2}$
$= 2 \times 2 \times \sqrt{2}$
$= 2^2\sqrt{2}$

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a. $\sqrt{3 \cdot 3 \cdot 3}$ b. $\sqrt{6 \cdot 6 \cdot 6}$ c. $\sqrt{8 \cdot 8 \cdot 8}$

d. $\sqrt{9 \cdot 9 \cdot 9}$ e. $\sqrt{5 \cdot 5 \cdot 5}$ f. $\sqrt{4 \cdot 4 \cdot 4}$

g. $\sqrt{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}$ h. $\sqrt{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}$ i. $\sqrt{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7}$

j. $\sqrt{8 \cdot 8 \cdot 8 \cdot 8 \cdot 8}$

4. Represent the square root differently.

Example: $\sqrt{8} = \sqrt{2 \times 2 \times 2}$
$= \sqrt{2 \cdot 2} \times \sqrt{2}$
$= 2 \times \sqrt{2}$
$= 2\sqrt{2}$

a. $\sqrt{12}$ b. $\sqrt{45}$ c. $\sqrt{28}$

d. $\sqrt{20}$ e. $\sqrt{24}$ f. $\sqrt{18}$

5. Look at the example and complete the following:

Example: $3^2 = 9 \therefore \sqrt{9} = 3$

a. 5^2 b. 9^2 c. 7^2

d. 2^2 e. 100^2 f. $\sqrt{36}$

g. $\sqrt{81}$ h. $\sqrt{625}$ i. $\sqrt{1}$

j. $\sqrt[3]{8}$

Sign:

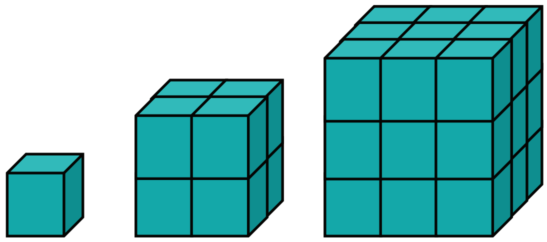
Date:

Problem solving

Represent the square root of any four–digit number using prime factorisation.

17 Cube numbers and roots

If the first step in the pattern is 1, the second step in the pattern is 8 and the third step is 27, what is the tenth step in the pattern?



1. Complete the table.

Number	Cube the number	Answer
a. 2	$2^3 = (2 \times 2 \times 2)$	8
b. 3		
c. 5		
d. 4		
e. 1		
f. 7		
g. 9		
h. 8		
i. 10		
j. 12		

2. Answer positive or negative without calculating.

Example: $(-3)^3$ is negative because $(-3) \times (-3) \times (-3) = -27$
$(3)^3$ is positive because $(+3) \times (+3) \times (+3) = 27$

a. $(4)^3$

b. $(16)^3$

c. $(-9)^3$

d. $(27)^3$

e. $(-13)^3$

f. $(-6)^3$

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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3. Write in exponential form..

Example 1: $a \times a \times a \times b \times b \times b$
$= a^3 \times b^3$

Example 2: $4 \times 4 \times m \times m \times m$
$= 4^2 \times m^3$
$= 16m^3$

a. $b \times b \times b \times m \times m \times m$

b. $3 \times 3 \times 3 \times 3 \times c \times c$

c. $2 \times 2 \times 2 \times n \times n \times n \times n$

d. $m \times m \times m \times n \times n \times n$

e. $4 \times 4 \times 4$

4. Calculate.

Example: $\sqrt[3]{27}$
$= \sqrt[3]{3 \times 3 \times 3}$
$= 3$

a. $\sqrt[3]{125}$

b. $\sqrt[3]{64}$

c. $\sqrt[3]{1}$

d. $\sqrt[3]{8}$

e. $\sqrt[3]{0}$

5. Calculate the cube root using the example to help you.

Example: $\sqrt[3]{729}$
$= \sqrt[3]{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}$
$= 3 \cdot 3$
$= 9$

729	3
243	3
81	3
27	3
9	3
3	3
1	

Is 729 divisible by 3?
Yes ,
7 + 2 + 9 = 18,
18 is divisible by 3

a. 216

b. 19 683

Problem solving

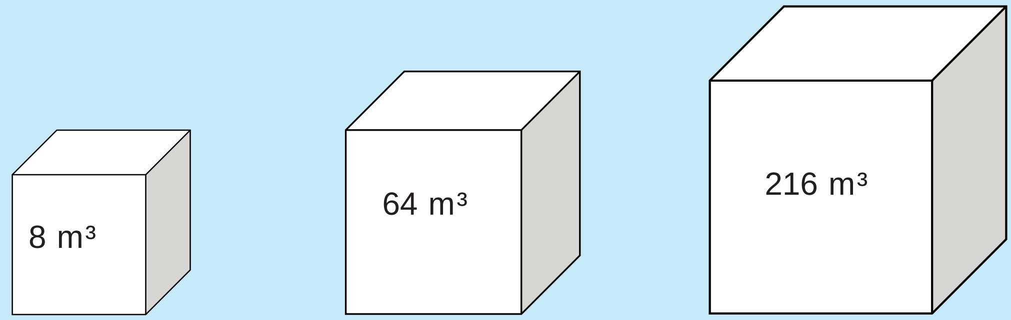
Calculate the cube root of any four digit number using prime factorisation.

Sign:

Date:

Representing cube roots

What is the length, height and width of these cubes?



1. Say whether the following are true or false:

a. $\sqrt[3]{2^3} = 2$

b. $\sqrt[3]{7^3} = 49$

c. $\sqrt[3]{27} = 27$

d. $\sqrt[3]{27} = 3$

e. $\sqrt[3]{9^3} = 3$

2. Revise: calculate.

Example: $\sqrt[3]{12 \cdot 12 \cdot 12}$
$= 12$

a. $\sqrt[3]{10 \cdot 10 \cdot 10}$

b. $\sqrt[3]{5 \cdot 5 \cdot 5}$

c. $\sqrt[3]{3 \cdot 3 \cdot 3}$

d. $\sqrt[3]{11 \cdot 11 \cdot 11}$

e. $\sqrt[3]{7 \cdot 7 \cdot 7}$

f. $\sqrt[3]{4 \cdot 4 \cdot 4}$

3. Calculate.

Example: $\sqrt[3]{8 \cdot 2}$
$= \sqrt[3]{2 \cdot 2 \cdot 2 \cdot 2}$
$= \sqrt[3]{2 \cdot 2 \cdot 2} \times \sqrt[3]{2}$
$= 2 \times \sqrt[3]{2}$
$= 2\sqrt[3]{2}$

a. $\sqrt[3]{9 \cdot 3}$

b. $\sqrt[3]{25 \cdot 5}$

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c. $\sqrt[3]{49 \cdot 7}$

d. $\sqrt[3]{64 \cdot 8}$

e. $\sqrt[3]{4 \cdot 16}$

f. $\sqrt[3]{10 \cdot 100}$

4. Calculate.

Example: $\sqrt[3]{16}$

$= \sqrt[3]{8 \times 2}$

$= \sqrt[3]{2^3 \times 2}$

$= 2\sqrt[3]{2}$

$8 = 2 \times 2 \times 2 = 2^3$

$\sqrt[3]{8} = \sqrt[3]{2^3} = 2$

a. $\sqrt[3]{24}$

b. $\sqrt[3]{54}$

c. $\sqrt[3]{72}$

d. $\sqrt[3]{81}$

e. $\sqrt[3]{80}$

f. $\sqrt[3]{40}$

5. Look at the example and complete the following:

Example: $2^3 = 8$ therefore $\sqrt[3]{8} = 2$

a. 3^3

b. 4^3

c. 7^3

d. 9^3

e. 1^3

f. $\sqrt[3]{64}$

Problem solving

Find a three-digit cube number that is between 500 and 600.

Sign:

Date:

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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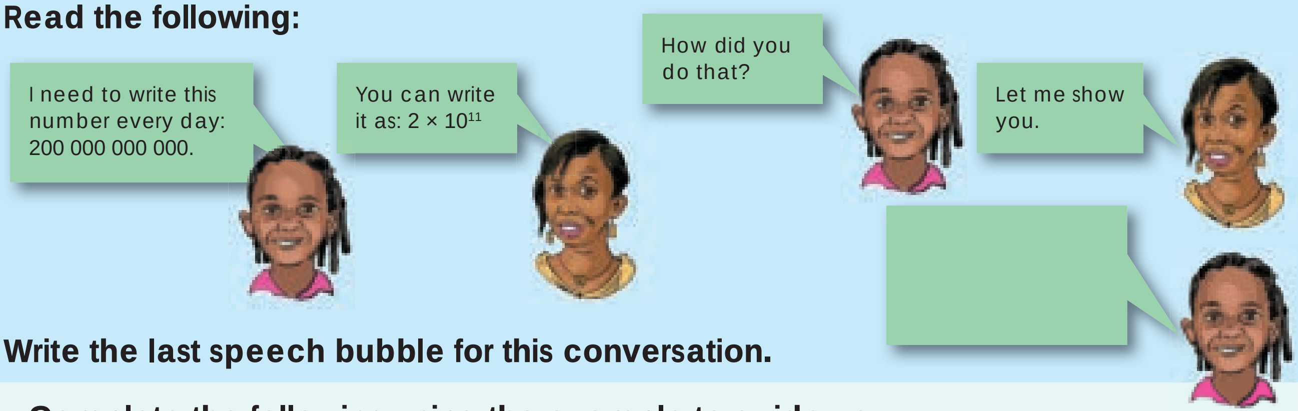
19 Scientific notation

Read the following:



Write the last speech bubble for this conversation.

1. Complete the following using the example to guide you.

Example $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
= 10 000 000
= 10^7

a. $10 \times 10 =$

b. $10 \times 10 \times 10 \times 10 =$

c. $10 \times 10 \times 10 \times 10 \times 10 \times 10 =$

d. $10 \times 10 \times 10 \times 10 \times 10 =$

e. $10 \times 10 \times 10 =$

2. Write the following in standard notation:

a. 10^6 b. 10^4 c. 10^8 d. 10^3 e. 10^5

Term 1

3. **Write the following numbers in scientific notation:**

Example: 76 430 202
$= 7{,}6430202 \times 10^7$

a. 2 567 389

b. 32 876 843

c. 35 784 321

d. 99 999 999

e. 126 589 543

f. 101 101 101

4. **Write the following in standard notation:**

Example: $7{,}6430202 \times 10^7$
= 76 430 202

a. $7{,}834561 \times 10^6 =$

b. $8{,}4762 \times 10^4 =$

c. $8{,}99945671 \times 10^8 =$

d. $9{,}9345678 \times 10^7 =$

e. $5{,}8384567 \times 10^7 =$

f. $11{,}34529 \times 10^5 =$

Problem solving

Write a number sentence, using scientific notation, for one hundred thousand plus one million multiplied by ten to the power of two.

Sign:

Date:

20 Laws of exponents: $x^m \times x^n = x^{m+n}$

The exponent of a number says how many times to use the number in a multiplication.
E.g. $2^3 = 2 \times 2 \times 2$

An exponent is an easy way to write a lot of multiples.

The laws of exponents are also called the laws of powers or indices. What do you think this means? In this worksheet you will learn that $x^m x^n = x^{m+n}$

Term 1

1. Solve.

Example:
$2^3 \times 2^2$
$= 2^{3+2}$
$= 2^5$
$= 32$

Test:
$2^3 \times 2^2$
$= 8 \times 4$
$= 32$

You can use a calculator.

a. $3^3 \times 3^7 =$

b. $9^4 \times 9^2 =$

c. $1^9 \times 1^9 =$

d. $10^2 \times 10^6 =$

e. $7^2 \times 7^3 =$

f. $8^5 \times 8^9 =$

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2. Simplify and test your answer.

Example:	*Test your answer: $x = 2$*	
$x^3 \times x^4$	$2^3 \times 2^4$	2^{3+4}
$= x^{3+4}$	$= 8 \times 16$	$= 2^7$
$= x^7$	$= 128$	$= 128$

a. $c^2 \times c^4 =$
test with $c = 2$

b. $m^4 \times m^5 =$
test with $m = 3$

c. $p^7 \times p^3 =$
test with $p = 2$

d. $q^3 \times q^7 =$
test with $q = 3$

e. $x^5 \times x^8 =$
test with $x = 4$

f. $s^9 \times s^2 =$
test with $s = 5$

3. Why can we say: $a^m \times a^n = a^{m+n}$? Give three examples.

a.

b.

c.

Problem solving

Complete: $\square \times \square = d^{4+2} =$

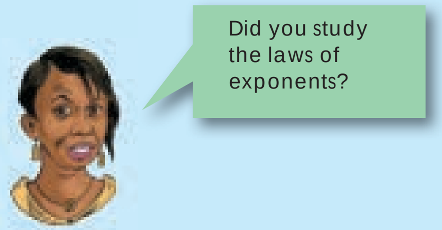
Sign:

Date:

21 Law of exponents: $x^m \div x^n = x^{m-n}$

Can you still remember what the answer for this law of exponents is?

$x^m \times x^n =$ ______



Today we are going to learn that:

$\frac{x^m}{x^n} = x^{m-n}$ or $x^m \div x^n = x^{m-n}$

1. Simplify.

Example:

$3^5 \div 3^2$

$= 3^{5-2}$

$= 3^3$

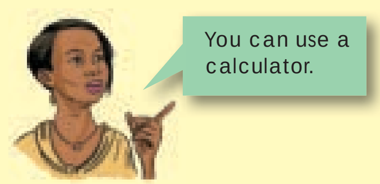
$= 27$

Test:

$3^5 \div 3^2$

$= 243 \div 9$

$= 27$



a. $7^5 \div 7^2 =$

b. $3^{10} \div 3^7 =$

c. $2^9 \div 2^3 =$

d. $8^{12} \div 8^8 =$

e. $1^{10} \div 1^{10} =$

f. $4^{15} \div 4^4 =$

Term 1

2. Solve and test your answer.

Example:

$x^5 \div x^3$
$= x^{5-3}$
$= x^2$

Test your answer:* x *= 2

$2^5 \div 2^3$ and $2^5 \div 2^3$
$= 2^{5-3}$; $= 32 \div 8$
$= 2^2$; $= 4$
$= 4$

$2^5 \div 2^3 = 2^{5-3}$

a. $p^5 \div p^3 =$
Test with $p = 2$

b. $z^7 \div z^4 =$
Test with $z = 3$

c. $e^8 \div e^3 =$
Test with $e = 2$

d. $x^7 \div x^6 =$
Test with $x = 3$

e. $s^9 \div s^5 =$
Test with $s = 2$

f. $g^{20} \div g^{15} =$
Test with $g = 3$

Problem solving

Complete: [ ] ÷ [ ] $= c^{b-d}$

Sign:

Date:

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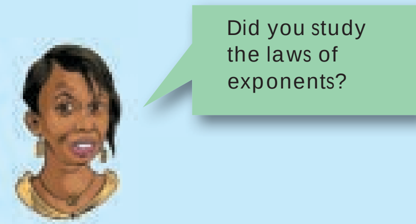
22 More laws of exponents: $(x^m)^n = x^{mn}$

Revise the following:

$x^m \times x^n =$ ______

$x^m \div x^n =$ ______



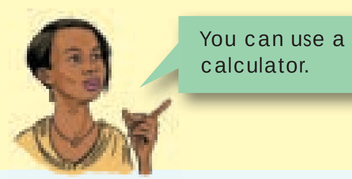
Today we are going to learn that:

$(x^m)^n = x^{mn}$

1. Simplify.

Example:
$(2^3)^2$
$= 2^{3x2}$
$= 2^6$
$= 64$

Test:
$(2^3)^2$
$= (8)^2$
$= 64$



a. $(2^2)^7$

b. $(1^4)^1$

c. $(7^9)^4$

d. $(3^5)^2$

e. $(15^2)^5$

f. $(12^7)^{11}$

2. Simplify.

Example:
$(x^3)^2$
$= x^{3x2}$
$= x^6$

Test your answer: ***x = 2***
$(2^3)^2$ and 2^{3x2}
$= 8^2$ $= 2^6$
$= 64$ $= 64$

$(2^3)^2 = 2^{3x2}$

a. $(x^2)^3$

b. $(p^2)^6$

c. $(p^5)^5$

d. $(a^2)^3$

e. $(x^3)^4$

f. $(v^3)^3$

Term 1

3. Solve.

Example:

$(3x^2)^3$

$= 3^{1\times3} \times x^{2\times3}$

$= 3^3 \times x^6$

$= 27x^6$

a. $(2e^4)^1$

b. $(4g^3)^5$

c. $(9f^6)^6$

d. $(10k^9)^4$

e. $(23e^{10})^2$

f. $(14t^5)^3$

4. Solve.

Example:

$(a \times t)^n$

$= a^n \times t^n$

a. $(r \times s)^4$

b. $(b \times c)^y$

c. $(x \times y)^t$

d. $(a \times d)^n$

e. $(a \times c)^k$

f. $(e \times g)^k$

Problem solving

Complete: $\left(\frac{\square}{\square}\right)^{\square} = (a \div b)^c$

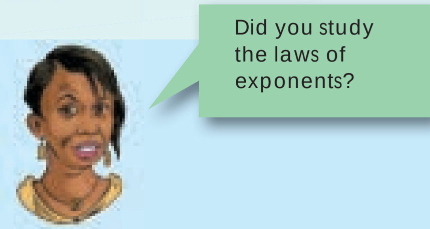
Sign:

Date:

23 Laws of exponents: $(x^0) = 1$

Revise the following:

$x^m x^n$	=	
$x^m \div x^n$	=	
$(x^m)^n$	=	



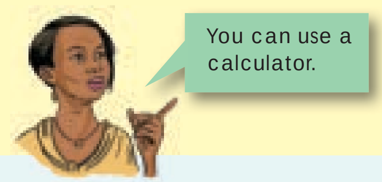
Today we are going to learn that:

$(x^0) = 1$

1. Solve: what will each number to the power of 0, 1, 2 and 3 be?

Example:

3^0	3^1	3^2	3^3
$= 1$	$= 3$	$= 9$	$= 27$



a. 12

b. 8

c. 4

d. 13

e. 9

f. 7

2. Solve: what will each number to the power of 0 and 1 be?

Example:

a^0	a^1
$= 1$	$= a$

a. x

b. q

c. r

d. m

e. p

f. y

Term 1

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3. Simplify

Example:
$(4x^2)^0$
$= 1$

a. $(6x^7)^0$

b. $(4y^3)^0$

c. $(7k^9)^0$

d. $(9t^5)^0$

e. $(8s^{10})^0$

f. $(13p^{10})^0$

4. **Simplify using both methods.**

Example:
$a^4 \div a^4$
$= \frac{a \cdot a \cdot a \cdot a}{a \cdot a \cdot a \cdot a}$
$= 1$

a^4 means
$a \times a \times a \times a$
(which is the same as
$a \cdot a \cdot a \cdot a$).

$= a^{4-4}$
$= a^0$
$= 1$

a. $a^6 \div a^6$

b. $v^3 \div v^3$

c. $m^3 \div m^3$

d. $w^2 \div w^2$

e. $y^7 \div y^7$

f. $z^{10} \div z^{10}$

Sign:

Date:

Problem solving

$(1000 \times 1000)^t = 1$: what is the value of t?

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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24 Calculations with exponents

Write down 3 examples of each of these.

Square number	Square root	Cube number	Cube root

1. Calculate the following:

Example: (-6^2)

$= -(6 \times 6)$

$= -36$

How do we use the BODMAS rule here?
B – Brackets first
O – Orders (powers and roots come before division, multiplication, addition and subtraction)
DM – Division and Multiplication
AS – Addition and Subtraction

a. (-8^2) b. (7^2) c. (-9^2)

d. (-10^2) e. (6^2) f. (-11^2)

2. Calculate the following:

Example: (-6^3)

$= -(6 \times 6 \times 6)$

$= -216$

a. (-3^3) b. (1^3) c. (-9^3)

d. (2^3) e. (-7^3) f. (-10^3)

3. **Calculate the following:**

Example: $-\sqrt{9}$
$= -\sqrt{3 \times 3}$
$= -3$

a. $-\sqrt{36}$

b. $-\sqrt{49}$

c. $-\sqrt{16}$

d. $\sqrt{81}$

e. $\sqrt{4}$

f. $-\sqrt{64}$

4. **Calculate the following:**

Example: $\sqrt[3]{-8}$
$= -2$

a. $\sqrt[3]{8}$

b. $\sqrt[3]{-27}$

c. $\sqrt[3]{-125}$

d. $\sqrt[3]{64}$

e. $\sqrt[3]{125}$

f. $\sqrt[3]{-64}$

Activity

Square negative fifteen.

Sign:

Date:

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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25 Calculations with multiple operations (square and cube numbers, square and cube roots)

Revision: What does BODMAS mean?

B ____________________

O ____________________

D ____________________

M ____________________

A ____________________

S ____________________

Term 1

1. Calculate.

Example: $(7 + 6) + (2^3)$
$= 13 + 8$
$= 21$

a. $(8 + 5) + (2^2) =$

b. $(2^3) – (3 + 2) =$

c. $(7 + 6) + (7^2) =$

d. $(4 + 2) – (5^2) =$

e. $(3^2) – (3 + 2) =$

f. $(5 – 1) + (4^3) =$

2. Calculate.

Example: $(3^2) – (4 – 5)$
$= 9 – (–1)$
$= 10$

a. $(1^3) + (3 – 5) =$

b. $(6^2) – (6 – 8) =$

c. $(4^2) – (5 – 7) =$

d. $(8 – 7) – (4^3) =$

e. $(9 – 10) + (2^3) =$

f. $(5 – 7) + (7^2) =$

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3. Calculate.

Example: $\sqrt{9} + (5 + 1)$
$= 3 + 6$
$= 9$

a. $\sqrt{4} + (2 + 3)$

b. $\sqrt{36} + (5 + 6)$

c. $(8 + 4) + \sqrt[3]{27}$

d. $\sqrt[3]{64} - (2 + 1)$

e. $(6 + 8) + \sqrt{144}$

f. $(4 - 3) + \sqrt{16}$

4. Calculate.

Example: $\sqrt[3]{125} - (3 - 8)$
$= 5 - (-5)$
$= 10$

a. $\sqrt{4} + (5 - 6)$

b. $\sqrt{64} - (5 - 6)$

c. $(8 - 10) + \sqrt{36}$

d. $(9 - 12) + \sqrt[3]{8}$

e. $\sqrt[3]{125} - (6 - 9)$

f. $(-4 - 7) + \sqrt{9}$

5. Calculate.

a. $(\sqrt{25}) + (5 + 4) + (6^2) =$

b. $(9^2) + (\sqrt{36}) - (6 + 2) =$

c. $(\sqrt[3]{125}) + (3) + (5 - 6) =$

d. $(5 + 4) - (5^3) - (\sqrt[3]{8}) =$

e. $(10 - 5) + (\sqrt{81}) - (6^2) =$

f. $(1^3) - (3 - 4) - (\sqrt{144}) =$

Problem solving

If the answer is one hundred and the calculation has three operations, with a cube root and a square number, what could the calculation be?

Sign:

Date:

26 More calculating with exponents

Write down all the rules and definitions you know about exponents and the calculation of exponents.

1. Calculate.

Example: $\frac{2^3}{2^2}$

$= \frac{2 \times 2 \times 2}{2 \times 2}$ or $= 2^{3-2}$

$= \frac{8}{4}$ $= 2^1$

$= 2$ $= 2$

Remember

$\frac{x^m}{x^n} = x^{m-n}$

a. $\frac{4^4}{4^1}$

b. $\frac{7^4}{7^3}$

c. $\frac{11^9}{11^7}$

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

e. $\frac{8^4}{8^2}$

f. $\frac{9^{10}}{9^4}$

2. Calculate and simplify your answer if possible.

Example: $\left(\frac{3}{4}\right)^2$

$= \frac{3^2}{4^2}$

$= \frac{3 \times 3}{4 \times 4}$

$= \frac{9}{16}$

You did it like this.

... and your friend like this.

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

$= \frac{3^2}{(2^2)^2}$

$= \frac{3^2}{2^4}$

$= \frac{9}{16}$

Talk about it.

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a. $\left(\frac{3}{8}\right)^4$

b. $\left(\frac{4}{9}\right)^5$

c. $\left(\frac{7}{10}\right)^3$

d. $\left(\frac{6}{8}\right)^2$

e. $\left(\frac{9}{13}\right)^3$

f. $\left(\frac{2}{14}\right)^4$

3. Calculate.

Example:

$\sqrt{\frac{9}{25}}$

You did it like this.

$= \frac{\sqrt{9}}{\sqrt{25}}$

$= \frac{3}{5}$

... and your friend like this.

$= \frac{\sqrt{3 \cdot 3}}{\sqrt{5 \cdot 5}}$

$= \frac{3}{5}$

Talk about it.

a. $\sqrt{\frac{16}{36}}$

b. $\sqrt{\frac{25}{169}}$

c. $\sqrt{\frac{9}{81}}$

d. $\sqrt{\frac{9}{25}}$

e. $\sqrt{\frac{9}{49}}$

f. $\sqrt{\frac{36}{144}}$

Problem solving

Write an algebraic expression where the numerator and denominator are written in exponential form.

Sign:

Date:

27a Numeric patterns

What does each statement tell you?

Constant difference: e.g. –3; –7; –11; –15 "Add –4" to the previous term or counting in "–4s".

Constant ratio: e.g. –2; –4; –8; –16; –32 "Multiply the previous term by 2."

Not having a constant difference or ratio: e.g. 1; 2; 4; 7; 11; 16 "Increase the difference between consecutive terms by 1 each time".

A numeric pattern is a sequence of numbers. Learners have to identify a pattern or a relationship between consecutive terms in order to describe and extend a pattern.

Term 1

1. What is the constant difference between the consecutive terms?

a. 3, 5, 7, 9

b. 2, 4, 6, 8

c. 9, 6, 3, 0

d. 7, 14, 21, 28

e. 1, 2, 3, 4

f. 6, 12, 18, 24

2. What is the constant ratio between the consecutive terms?

a. 3, 9, 27, 81

b. 9, – 27, 81, –243

c. 5, –25, 125, – 625

d. 8, 16, 32, 64

e. 2, –8, 32, – 128

f. 10, –100, 1 000, –10 000

3. Do these patterns have a constant difference or a constant ratio or neither?

a. 1, 4, 10, 19

b. 2, 5, 7, 11

c. 3, 7, 13, 21

d. 12, 10, 6, 0

e. 2, 6, 13, 23

f. 7, 13, 25, 43

4. What is the constant difference or ratio between the consecutive terms?

a. 5, –15, 45, –135

b. 6, 24, 96, 384

c. 1, 9, 17, 25

d. 4, –20, 100, –500

e. 8, 2, –4, –10

f. 9, 5, 1, –3

5. Complete the table and then state the rule.

Example:

Position	**1**	**2**	**3**	**4**	**5**	***n***
Value of the term	3	6	9	12	15	$n \times 3$

Rule? The term × 3.

i. Complete the table.
ii. State the rule.
iii. Determine term value as asked.

a.

Position	2	4	6	8	n
Value of the term	4	8		16	

Rule? What will the value of the 20th term be?

b.

Position	5	15	25	35	n
Value of the term	12	22			

Rule? What will the value of the 45th term be?

c.

Position	1	2	3	4	5	n
Value of the term				–12	–15	

Rule? What will the value of the 46th term be?

d.

Position	1	2	3	4	5	n
Value of the term		4	9		25	

Rule? What will the value of the nth term be?

e.

Position	0	1		3	4	n
Value of the term		2		6	8	

Rule? What will the value of the nth term be?

Problem solving

If the constant ratio is –8, what could a sequence of numbers be?

Sign:

Date:

continued ☛

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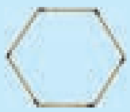
27b Numeric patterns continued

Talk about this.



1st term, 2nd term, 3rd term, 4th term, 5th term

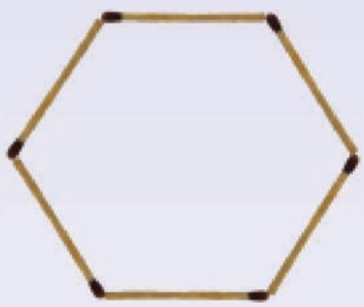
Position of hexagon in pattern	1	2	3	4	5	n
Number of matches	?	12	18	24	30	

1 × ?, 2 × 6, 3 × 6, 4 × 6, 5 × 6

Read the top row.
The positions: 1st term, 2nd term, 3rd term, 4th term, 5th term and nth term
If the 2nd term's position is 2 and its value is 12 the rule is 2 × 6 = 12. Does this rule (n × 6) hold true for the other positions? What is the value of the 1st term?

1. Draw more matchsticks to make the next pattern in a sequence of hexagons.

Hexagon pattern 1:



(1 × 6)

What will the next pattern be?
The rule: add one matchstick to each side.

Hexagon pattern 2:

2. Calculate the number of matchsticks used.

a. 1st hexagon has 1 matchstick per side 1 × 6 = 6

b. 2nd hexagon has 2 matchsticks per side

c. 3rd hexagon has 3 matchsticks per side

d. 4th hexagon has 4 matchsticks per side

3. Record your results in this table.

n is the position of the term.

Position of hexagon in pattern	1	2	3	4	5	6	10	n
Number of matches								

10th hexagon =

nth hexagon =

Term 1

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4. Complete the following:

Example: 8, 15, 22, 29, ...

Term	**1**	**2**	**3**	**4**	**18**	n
Value of the term	8	15	22	29	127	$7(n)$ +1

Add 7 to the previous position.
7 × the position of the term + 1 ___.
$7(n) + 1$, where "n" is the position of the term.
$7(n) + 1$, where "n" is a natural number.

a. 13, 25, 37, 49…

Term	1	2	3	4	17	n
Value of the term						

b. 6, 11 16, 21 …

Term	1	2	3	4	22	n
Value of the term						

c. 3, 5, 7, 9 …

Term	1	2	3	4	41	n
Value of the term						

5. Draw and complete your own tables using the following information:

a. $4(n) + 1$

Term						n
Value of the term						

b. $6(n) + 1$

Term						n
Value of the term						

c. $8(n) + 3$

Term						n
Value of the term						

Problem solving

a. Draw the first three terms of a triangular number pattern (as you did for a hexagon using matches in question 1).
Identify the rule.
Complete the table.

Position of ___ in pattern	1	2	3	4	5	10	n
Number of matches							

b. Then do similar tables, but only for the first three terms, for these patterns.
i. Square number pattern   ii. Pentagonal number pattern
iii. Octagonal number pattern

Sign:

Date:

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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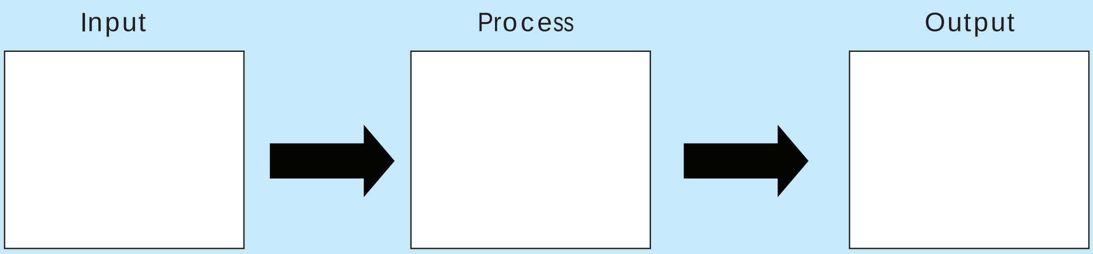
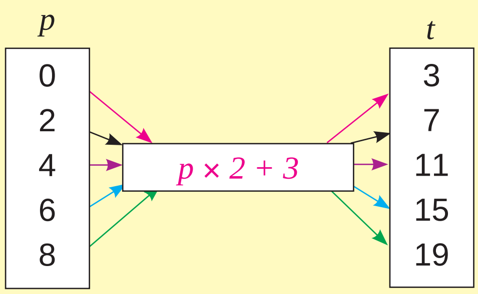
28 Input and output values

In Grade 7 you learned about input and output values. Make a drawing to illustrate input and output values.



1. Complete the following:

Example:



$t = p \times 2 + 3$

$0 \times 2 + 3 = 3$ ($t = 3$)

$2 \times 2 + 3 = 7$ ($t = 7$)

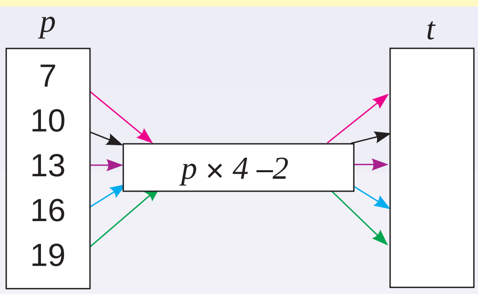
$4 \times 2 + 3 = 11$ ($t = 11$)

$6 \times 2 + 3 = 15$ ($t = 15$)

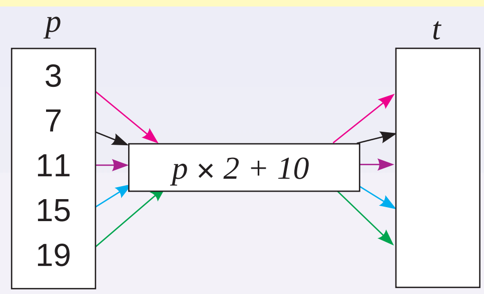
$8 \times 2 + 3 = 19$ ($t = 19$)

This is the rule for this flow diagram.

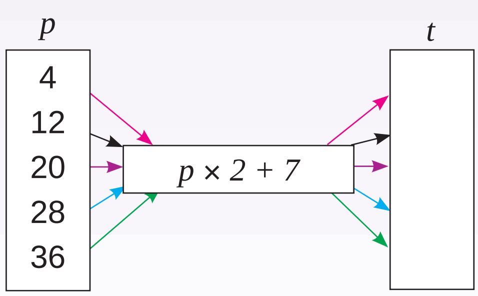
a.



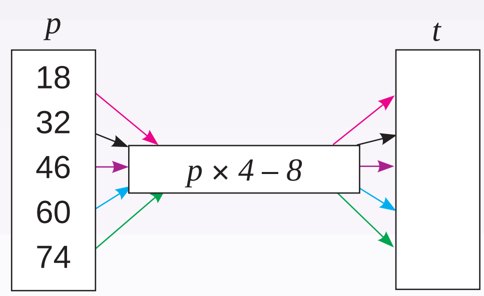
b.



c.



d.



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2. What is the rule?

Example:

p	t
8	31
12	47
20	79
36	143
68	271

$4(8) - 1 = 31$

$4(12) - 1 = 47$

$4(20) - 1 = 79$

$4(36) - 1 = 143$

$4(68) - 1 = 271$

The rule is: $4(p) - 1 = t$

a.

p	t
4	7
13	52
22	97
31	142
40	187

b.

p	t
40	22
18	11
–16	–6
–44	–20
–72	–34

c.

p	t
2	–2
4	6
6	14
8	22
10	30

d.

p	t
8	28
32	172
64	364
512	3052
1024	6124

3. Describe the relationship between the numbers in the top row and those in the bottom row of the table. Then write down the values for m and n.

Example:

x	**–2**	**–1**	**0**	m	**2**	**3**
y	**30**	**27**	n	**21**	**18**	**15**

$m = 1$ $n = 24$

Rule is $y = -3x + 24$

a.

x	–3	–2	m	0	1	2
y	–1	0	1	2	3	n

$m =$ $n =$

Rule is ________________

b.

x	1	2	3	4	m	6
y	4			n		14

$m =$ $n =$

Rule is ________________

Activity

a. If $s = r \times 5 - 9$, where $r = -2$, what is s?

b. $y = -x + (-3)$ is the rule. Show this in a table with $x = \{-3, -2, -1, 0, 1, 2\}$.

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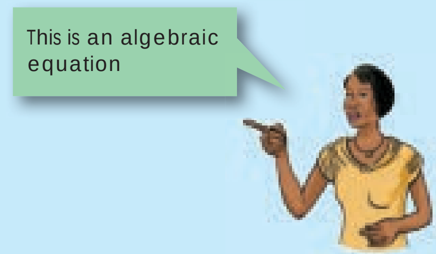
29a Algebraic vocabulary

Match the words with the algebraic equation.



variable — index (exponent) — operator — coefficient — base of the power — constant

$$4a^2 + 5 = 12$$

$4a^2 + 5 = 12$ is an algebraic equation. $4a^2 + 5$ is an algebraic expression.

1. Circle the variable.

a. $x + 7 = 10$ b. $2x + 5 = 9$ c. $8 + x = 10$

2. Circle the constant.

a. $x + 8 = 14$ b. $3x + 10 = 19$ c. $5 + 9 = 20$

3. Circle the coefficient.

a. $8x$ b. $9a$ c. $4x + 2 = 10$

4. Circle the operator.

a. $8 \times x$ b. $9a$ c. $4x + 2 = 10$

5. Circle the index/exponent.

a. 5^2 b. $3^3 + 2^2 = 31$ c. $4^2 + 1^3 = 17$

6. Circle the equations with "like terms".

a. $6a + 7a =$ b. $2a + 3b =$ c. $7b + 19 =$

Like and unlike terms:

We can add "3 apples" and "4 apples", but we cannot add "3 apples" and "4 pears".

7. Circle the equations with "unlike terms".

a. $6a + 3a =$ b. $7x + 2y =$ c. $7x + 2x =$

8. Circle the algebraic expression.

a. $2a + 7$ b. $7a$ c. $3a + 22$

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9. Circle the algebraic equations.

a. $3a + 2 = 10$ b. $10b$ c. $7b + 2 = 16$

10. Revision: Write an algebraic expression for each of the following descriptions:

a. Six more than a certain number.

b. Six less than a certain number.

c. A certain number less than six.

d. A number repeated as a term three times.

e. A certain number times itself.

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29b Algebraic vocabulary continued

11. Explain the following algebraic terms in your own words:

a. What does 3^n mean in 3, 9, 27, 81...3^n?

b. What does $2^n + 1$ mean in 3, 5, 9, ...$2^n + 1$?

b. What does $3^n - 7$ mean in –4, 2, 20, ...$3^n - 7$?

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d. For which values of n will the sequence: 16, 22, 28, 34, 40, …, have the rule $6(n + 1) + 4$?

e. What does n represent in the following sequence: 8, 10, 14, 22, …, with the rule $6 + 2^n$?

f. What is the role of $7(n)+2$ in the sequence 9, 16, 23, 30, …$7(n) + 2$?

Problem solving

a. Create an algebraic expression with three like and three unlike terms.
b. What does n mean in $7(n + 2)$? (n^{th} term)

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30 Like terms: whole numbers

Discuss this:

We can add "3 apples" and "4 apples", but we cannot add "3 apples" and "4 pears".

Give 5 examples of like terms.

Term 1

1. Simplify.

Example: $3a + 4a$
$= 7a$

a. $5a + 3a =$

b. $6m - 2m =$

c. $7x - 2x =$

d. $1n + 5n =$

e. $9z + 7z =$

f. $3t + 5t =$

2. Simplify.

Example: $3a^2 + 5a^2$
$= 8a^2$

Note: $3a^2 + 5a^2$ is not $8a^4$

a. $1a^2 + 2a^2 =$

b. $8r^2 + 5r^2 =$

c. $2x^2 + 4x^2 =$

d. $4t^2 - 3t^2 =$

e. $3m^2 - 2m^2 =$

f. $5b^2 - 2b^2 =$

3. Calculate.

Example 1: $5x^2 + 4x^2 = 9x^2$

Example 2: $5x + 4x^2 = 5x + 4x^2$

a. $4x^2 + 2x^2 =$

b. $5x^2 + 5x =$

c. $8a^2 - 5b^2 =$

d. $8a^3 + 2a =$

e. $3b^3 + 3b =$

f. $8c^3 - 2c^3 =$

4. Simplify.

Example: $3a^2 \times 4a^2$
$= (3a^2)(4a^2)$ $\quad = 3 \times 4 \times a^2 \times a^2 = 12 \times a^4$
$= 12a^4$

a. $2a \times 3a =$

b. $2c^2 \times 5c^2 =$

c. $5b^2 \times 4b^2 =$

d. $7c \times 8c =$

e. $6b \times 2b =$

f. $5a^2 \times 4a^2 =$

5. Simplify.

Example: $3a^2 \div 4a^2$
$= \frac{3a^2}{4a^2} = \frac{3}{4} \times \frac{a^2}{a^2}$
$= \frac{3}{4}$

a. $1a \div 7a =$

b. $3f \div 5f =$

c. $4a^2 \div 2a^2 =$

d. $5b^3 \div 2b^3 =$

e. $9c \div 9c =$

f. $3x \div 6x =$

Problem solving

Create an expression with six like terms. Simplify it.

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31 Like terms: integers

What is an integer? Give some examples.

Revise the following:

- A **positive number** × a **positive number** = a **positive number**
- A **negative number** × a **negative number** = a **positive number**
- A **negative number** × a **positive number** = a **negative number**
- A **positive number** + a **positive number** = a **positive number**
- A **negative number** + a **negative number** = a **negative number**
- A **positive number** + a **negative number** = a **positive** or a **negative number**

1. Simplify.

Example: $-3a - 4a$
$= -7a$

a. $-5a + 3a =$

b. $-6m - 2m =$

c. $-7x - 2x =$

d. $1n - 5n =$

e. $-9z + 7z =$

f. $-3t + 5t =$

2. Simplify.

Example: $-3a^2 - 5a^2$
$= -8a^2$

a. $1a^2 - 2a^2 =$

b. $-8r^2 - 5r^2 =$

c. $2x^2 - x^2 =$

d. $-4t^2 - 3t^2 =$

e. $3m^2 - 2m^2 =$

f. $-5b^2 - 2b^2 =$

3. Simplify.

Example 1: $5x^2 - 4x^2 = x^2$

Example 2: $5x + 4x^2 = 5x + 4x^2$

a. $-4x^2 + 2x^2 =$

b. $-5x^2 + 5x =$

c. $-8a^2 - 5b^2 =$

d. $-8a^3 + 2a =$

e. $-3b^3 + 3b =$

f. $-8c^3 - 2c^3 =$

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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4. Simplify.

Example: $3a^2 \times 4a^2$
$= (3a^2)(4a^2)$
$= 12a^4$

a. $2a \times -3a =$

b. $-2c^2 \times -5c^2 =$

c. $-5b^2 \times 4b^2 =$

d. $-7c \times 8c =$

e. $-6b \times 2b =$

f. $3a^2 \times -4a^2 =$

5. Calculate.

Example: $3a^2 \div 4a^2$
$= -\frac{3a^2}{4a^2}$
$= -\frac{3}{4}$

a. $-1a \div 7a =$

b. $3f \div -5f =$

c. $-4a^2 \div 2a^2 =$

d. $-5b^3 \div -2b^3 =$

e. $-9c \div -9c =$

f. $-3x \div 6x =$

Problem solving

Share with your friend what like terms are.

Sign:

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32 Writing number sentences

Read through this problem and underline the key concepts.

The relationship between a boy's age (x years old) and his mother's age is given as $25 + x$. How can this relationship be used to find the mother's age if the boy is 11 years old?

25 + 11 = 36

Here you must recognise that to find the mother's age, you must substitute the boy's current age into the rule $25 + x$. You should also recognise that this rule means that this boy's mother is 25 years older than he is.

1. **Write a number sentence, algebraic expression or algebraic equation to help you solve the following problems:**

a. If Peter is seven years younger than Jabu and Jabu is two years older than Tshepo, how old are Jabu and Tshepo if Peter is 12 years old?

b. Sandra buys three more apples than Lebo bought. Lebo has seven apples left after he has sold 17 apples. If Sandra only sells eight apples, how many does she have left?

c. Thabo is 10 cm taller than Lebo, and Lebo is 7cm shorter than Mpho. How tall is Mpho if Thabo is 178 cm tall?

Term 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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d. Tshepo gets R5 more than Alwin. Alwin get R2 less than Lebo. How much more does Tshepo get than Lebo if Lebo gets R20?

e. James weighs 80 kg and Jenny weighs x kg less. How much do they weigh altogether?

f. Tea Company A makes 700 more tea–bags than Tea Company B. Tea Company B makes 300 tea–bags less than Tea Company C. How much more must Tea Company A produce to make 5 000 tea–bags per day, if Tea Company C produces 3 600 tea bags per day?

Activity

Create your own word problem and get a friend to try it out.

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33 Set up algebraic equations

Term 1

Talk about this:

Altogether

Sipho has seven marbles and John has five. How many do they have altogether?

What is the keyword in the problem telling you which operation to use?

What does "altogether" tell us?

Addition is probably the operation (that is needed)

What are the quantities?

- Sipho's (7) marbles
- John's (5) marbles

What is the **relationship** and the **number sentence**?

The relationship is Sipho's marbles + John's marbles = total marbles

The **number sentence** is: 7 + 5 = _____

1. Solve the following:

Example:

Sipho has $7n$ marbles and John has $5n$. How many do they have altogether?

Keyword: addition

Relationship: Sipho's marbles + John's marble = total marbles

Number sentence: $7n + 5n = 12n$

a. Mpho, Ryna and Gugu have 15 books altogether. Mpho has two books and Gugu has nine books. How many books does Ryna have?

Keyword: ______________________________

Relationship: ______________________________

Number sentence: ______________________________

b. Belinda is on page 84 of her book. The book has 250 pages. How many pages does she still have to read?

Keyword: ______________________________

Relationship: ______________________________

Number sentence: ______________________________

c. Thomas read 64 pages and Linda read 52. How many more pages did Thomas read than Linda?

Keyword: ________________

Relationship: ________________

Number sentence: ________________

d. Thabo buys x amount of toffees. He has eight left from yesterday. If today he eats half of all the toffees he bought, he will have 3 left for tomorrow. How many did he buy?

Keyword: ________________

Relationship: ________________

Number sentence: ________________

2. Write a different number sentences for each statement.

a. Money earned each month – expenses = money available each month

____

____

____

b. Speed × time = distance

____

____

____

c. Distance from A to B + distance from B to C = distance A to C.

____

____

____

Problem solving

Kabelo has a certain number of computer games. He gets four more for his birthday. How many games did he have before his birthday if he now has 37 games?

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34 Additive inverse and reciprocal

The additive inverse of –4 is 4, and the additive inverse of 4 is –4.

number → –4 + 4 = 0 ← additive inverse

4 + –4 = 0

number ↑ additive inverse ↑

Talk about the reciprocal of a number.

number → 4 $\frac{1}{4}$ ← its reciprocal

What do you notice? To get the reciprocal of a number, just divide 1 by the number.

1. Revision.

a. What is the inverse operation of addition? ______________________________

b. What is the inverse operation of subtraction? ______________________________

c. What is the inverse operation of multiplication? ______________________________

d. What is the inverse operation of division? ______________________________

2. Complete.

Example: –4 ___ = 0
= –4 + 4 = 0

a. –5 ___ = 0

b. –9 ___ = 0

c. 11 ___ = 0

d. 6 ___ = 0

e. –10 ___ = 0

f. –2 ___ = 0

3. What is the additive inverse? Show your calculation to check that the sum of a number and its additive inverse equals zero.

Example: –9
–9 + 9 = 0 9 is the additive inverse, since –9 + 9 = 0

a. –7

b. –9

c. –10

d. –20

e. 3

f. –15

Term 1

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4. Complete.

Example: $4 \times \_\_\_ = 1$

$4 \times \frac{1}{4} = 1$

a. $5 \times \_\_\_ = 1$

b. $7 \times \_\_\_ = 1$

c. $\frac{1}{15} \times \_\_\_ = 1$

d. $\_\_\_ \times \frac{1}{2} = 1$

e. $\_\_\_ \times \frac{1}{12} = 1$

f. $9 \times \_\_\_ = 1$

5. What is the reciprocal of the following? Show your calculation to check that a number multiplied by its reciprocal equals 1.

Example:
The reciprocal of 4 is $\frac{1}{4}$ since $4 \times \frac{1}{4} = 1$

a. 5

b. $\frac{1}{8}$

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

d. 7

e. 3

f. 11

Problem solving

The square of a number added to its inverse gives 20. What is the number?

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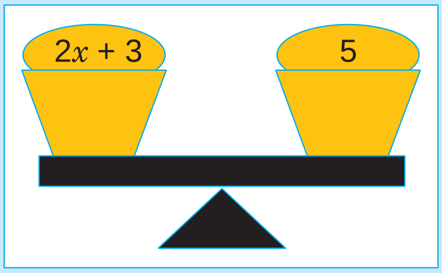
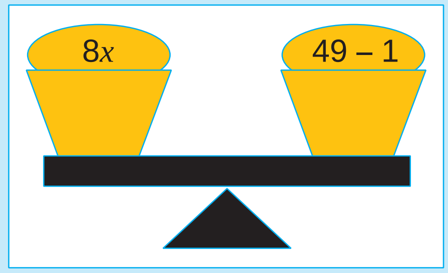
35 Balance an equation

How will you balance these?





Write down the equations to represent the given information above.

1. Solve for x.

Example: $x + 5 = -4$
$x + 5 - 5 = -4 - 5$
$x = -9$

a. $x + 3 = 7$

b. $x - 6 = 2$

c. $x - 10 = 5$

d. $x - 8 = 6$

e. $x + 5 = 4$

f. $x - 11 = 7$

2. Solve for x:

Example: $x + 3 + 2 = -8$
$x + 5 = -8$
$x + 5 - 5 = -8 - 5$
$x = -13$

a. $x + 2 - 4 = 6$

b. $x + 7 + 2 - 3 = 9$

c. $x + 5 + (-8) = -5$

d. $x - 8 + 3 = 7$

e. $x + 4 - 2 + 6 = -2$

f. $x + 11 - 7 + 9 = 7$

3. Solve for x:

Example:
$x - 2 + 3 = -5$
$x + 1 = -5$
$x + 1 - 1 = -5 - 1$
$x = -6$

a. $x + 3 + 2 = 4$

b. $x + 8 + 7 = -8$

c. $x + 6 + 6 = 3$

d. $x - 9 - 8 = -3$

e. $x - 5 - 4 = 7$

f. $x - 11 + 5 = -7$

4. Solve for x:

Example:
$2x = 16$
$\frac{2x}{2} = \frac{16}{2}$
$x = 8$

a. $3x = 27$

b. $5x + x = 18$

c. $2x - 4 = 10$

d. $7x = 28$

e. $5m = 25$

f. $15ab = 30$

5. Solve for x:

Example:
$\frac{2x}{3} = 12$
$\frac{2x}{3} \times 3 = 12 \times 3$
$\frac{2x}{2} = \frac{36}{2}$
$x = 18$

a. $\frac{4x}{6} = 12$

b. $\frac{x}{5} = 15$

c. $\frac{x}{2} = 30$

d. $\frac{x}{3} = 6$

e. $\frac{x}{3} = 24$

f. $\frac{x}{7} = 7$

Problem solving

Solve for a, if a divided by 25 equals 100.

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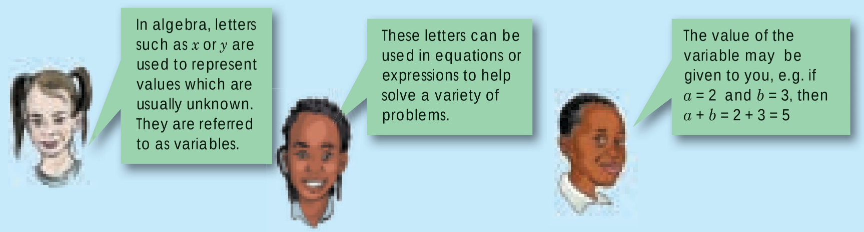
36a Substitution

What does it mean to substitute in mathematics?



1. If $x = 2$, then:

Example: $2x + 5$
$= 2(2) + 5$
$= 4 + 5$
$= 9$

a. $4x + 8 =$
b. $6 + 3x =$
c. $5x + 3x =$
d. $8x + 3 =$
e. $9 + 5x =$
f. $7x - 4x =$

2. Evaluate if $x = -2$.

a. $4x + 8 =$
b. $6 + 3x =$
c. $5x + 3x =$
d. $8x + 3 =$
e. $9 + 5x =$
f. $7x - 4x =$

3. If $x = 3$, then:

Example: $x^2 + 5$
$= (3)^2 + 5$
$= 9 + 5$
$= 14$

a. $x^2 + 2 =$
b. $x^2 + 11 =$
c. $x^3 + 10 =$
d. $x^2 - 3 =$
e. $x^3 + 30 =$
f. $x^2 - 14 =$

4. Evaluate if $x = -3$.

a. $x^2 + 2 =$
b. $x^2 + 11 =$
c. $x^3 + 10 =$
d. $x^2 - 3 =$
e. $x^3 + 30 =$
f. $x^2 - 14 =$

5. If $x = 4$, then:

Example: $(x^2) - x$
$= (4^2) - (4)$
$= 16 - 4$
$= 12$

a. $x^2 + x =$
b. $-x + x^2 =$
c. $x^2 + x^2 =$
d. $x^3 - x =$
e. $-x^3 - x =$
f. $x - x^3 =$

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0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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36b Substitution continued

6. Evaluate if $x = -4$.

a. $x^2 - x =$

b. $-x + x^2 =$

c. $x^2 + x^2 =$

d. $x^3 - x =$

e. $-x^3 - x =$

f. $x - x^3 =$

7. Solve for x:

Example: $-5x = 10$

$\frac{-5x}{-5} = \frac{10}{-5}$

$x = -2$

a. $-2x = 10$

b. $-6x = -12$

c. $2x = 4$

d. $-3x = 9$

e. $7x = 14$

f. $-4x = 16$

8. Solve for x:

Example: $2x - 6x = 16$

$-4x = 16$

$\frac{-4x}{-4} = \frac{16}{-4}$

$x = -4$

a. $4x - 5x = 8$

b. $8x + 4x = 4$

c. $-2x - 10x = 3$

d. $3x + 11x = 7$

e. $9x - 4x = 5$

f. $x - 3x = 2$

Problem solving

Create a three-term algebraic expression using x as your variable and then substitute –6 for x.

You must include fractions in your expression.

What is the value of your expression if $x = 3$?

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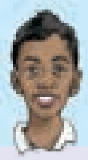
37 Algebraic equations

You know that an **expression** is a collection of quantities linked by operators (+, –, × and ÷) that together show the value of something.

What is an **equation**?



An equation says that two things are the same, using mathematical symbols.

An equation uses the equal (=) sign.

Example: 6 + 4 = 11 – 1

1. Solve for x and test your answer.

Example:

Solve for x if $-2x = 8$

To solve the equation: divide both sides of the equation by –2

$-2x = 8$

$\frac{-2x}{-2} = \frac{8}{-2}$

$x = -4$

Test: $-2x$

$= -2(-4)$

$= 8$

Note that $-2 \div -2 = \frac{-2}{-2} = 1$ (positive one)

a. $4x = 16$

b. $5x = 25$

c. $-8x = 64$

d. $9x = -81$

e. $-7x = 49$

f. $-11x = 88$

2. Solve for x and test your answer.

Example:

Solve for x if $3x + 1 = 7$

To solve the equation requires two steps.

Add –1 to both sides of the equation.

$3x + 1 - 1 = 7 - 1$

$3x = 6$

Then divide both sides of the equation by 3

$\frac{3x}{3} = \frac{6}{3}$

$x = 2$

Test: $3x + 1$

$= 3(2) + 1$

$= 6 + 1$

$= 7$

a. $4x + 1 = 9$

b. $5x + 2 = 12$

c. $2x - 4 = 6$

d. $2x - 8 = -10$

e. $-2x - 6 = -14$

f. $3x - 6 = -3$

Problem solving

a. Write an algebraic equation for twice a number is twenty-four.

b. Write an algebraic equation for twice a number, decreased by twenty-nine, is seven.

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38 Solving problems

Write down the key words you use when solving a word problem.

1. Revision: Solve for x.

a. $x + 5 = 13$

b. $x - 8 = 16$

c. $x - 7 = -9$

d. $-2x = 4$

e. $-3x = -6$

f. $3x + 1 = 13$

2. Solve the following:

a. When six is added to four times a number the result is 50. Find the number.

b. The sum of a number and nine is multiplied by –2 and the answer is –8. Find the number.

c. The length of a rectangular map is 37,5 cm and the perimeter is 125 cm. Find the width.

d. Find the area of a rectangle with a length of $2x$ cm and a breadth of $2x + 1$ cm. Write your answer in terms of x.

e. If the area of a rectangle is $(4x^2 - 6x)$ cm^2, and its breadth is $2x$ cm, what will its length be in terms of x?

f. If $y = x^3 + 1$, calculate y when $x = 4$

g. Thandi is six years older than Sophie. In three years Thandi will be twice as old as Sophie. How old is Thandi now?

h. In a given amount of time, Mr Shabalala drove twice as far as Mrs Shabalala. Altogether they drove180 km. Find the number of kilometres driven by each.

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39 Divide monomials, binomials and trinomials by integers or monomials

Look and discuss

exponents

$2x^4 + x^2 + 6x - 1$

terms

Monomial (1 term)	$8x^4$
Binomial (2 terms)	$3x^2 + 4$
Trinomial (3 terms)	$4x^2 + x^2 + 3$
Polynomial	$4x^2 - 5xy^2 + y^2 + 2$

1. Simplify and test your answer. Test using any number.

Example: $\frac{x^4}{x^2}$

$= \frac{xxxx}{xx}$ (This is a monomial)

$= x \cdot x$

$= x^2$

Another method is to use the law of exponents

$\frac{x^4}{x^2} = x^{4-2} = x^2$

Test through substitution: $x = 2$

$\frac{x^4}{x^2}$	x^2
$= \frac{2^4}{2^2}$	$= (2)^2$
$= \frac{16}{4}$	$= 4$
$= 4$	

a. $\frac{x^2}{x}$

b. $\frac{x^3}{x^2}$

c. $\frac{x^3}{x}$

d. $\frac{4x^2}{2x}$

e. $\frac{6x^3}{2x^2}$

f. $\frac{8x^2}{4x}$

2. Simplify.

Example: $\frac{x^4 - x^2}{x^2}$ (This is a binomial)

$= \frac{x^4}{x^2}$

$= \frac{x^4}{x^2} - \frac{x^2}{x^2}$

$= x^2 - 1$

Test through substitution: $x = 2$

$\frac{x^4 - x^2}{x^2}$	$x^2 - 1$
$= \frac{2^4 - 2^2}{2^2}$	$= (2)^2 - 1$
$= \frac{16 - 4}{4}$	$= 3$
$= \frac{12}{4}$	
$= 3$	

a. $\frac{x^6 - x^2}{x^2} =$

b. $\frac{x^9 - x^3}{x^3} =$

c. $\frac{x^8 - x^4}{x^4} =$

3. Simplify.

Example: $\frac{x^4 - 6x^2 - 1}{x^2}$

$= \frac{x^4}{x^2} - \frac{6x^2}{x^2} - \frac{1}{x^2}$

$= x^2 - 6 - \frac{1}{x^2}$

Test through substitution:

$x = 2$

$\frac{x^4 - 6x^2 - 1}{x^2}$	$x^2 - 6 - \frac{1}{x^2}$
$= \frac{2^4 - 6(2)^2 - 1}{2^2}$	$= (2)^2 - 6 - \frac{1}{(2)^2}$
$= \frac{16 - 24 - 1}{4}$	$= 4 - 6 - \frac{1}{4}$
$= \frac{-9}{4}$	$= -2 - \frac{1}{4}$
$= -2\frac{1}{4}$	$= -2\frac{1}{4}$

a. $\frac{x^4 - 2x^2 - 3}{x^2} =$

b. $\frac{x^6 - 2x^3 - 1}{x^3} =$

c. $\frac{x^8 - 2x^4 - 2}{x^2} =$

Problem solving

Divide a polynominial (multi-term algebraic expression) by a monomial. Simplify it.

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0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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40 Simplify algebraic expressions

Look at the following. What do you notice?

$2\,(x + 5)$

2	x	5

$2x + 10$

$2\,(x^2 + 3x + 4)$

2	x^2	$3x$	4

$2x^2 + 6x + 8$

Why are these called algebraic expressions?

1. Revision: calculate the following making use of the distributive property:

Example: $2\,(3 + 4)$
$= 2 \times 3 + 2 \times 4$ or
$= (2 \times 3) + (2 \times 4)$
$= 6 + 8$
$= 14$

You can write it in brackets, if that is easier for you.

2	3	4

$6 + 8$

3 and 4 are rows so we can add them.

a. $2\,(3 + 6) =$

b. $4\,(8 + 1) =$

c. $6\,(9 + 4) =$

d. $8\,(2 + 3) =$

e. $3\,(5 + 6) =$

f. $10\,(7 + 8) =$

2. Simplify.

Example: $2\,(x + 5)$
$= (2 \times x) + (2 \times 5)$
$= 2x + 10$

$2\,(x + 5)$
$= 2x + 10$

2	x	5

$2x + 10$
$= 2x + 10$

x and 5 are not like terms. We cannot simplify $(x + 5)$.

a. $2\,(x + 4) =$

b. $4\,(x + 7) =$

c. $5\,(x + 2) =$

d. $6\,(3 + x) =$

e. $3\,(6 + x) =$

f. $7\,(x - 9) =$

3. Simplify.

Example: $2\,(x^2 + x + 3)$
$= (2 \times x^2) + (2 \times x) + (2 \times 3)$
$= 2x^2 + 2x + 6$

$2\,(x^2 + x + 3)$
$= 2x^2 + 2x + 6$

2	x^2	x	3

$2x^2 + 2x + 6$

a. $2\,(x^2 + x + 4) =$

b. $4\,(3 + x + x^2) =$

c. $6\,(7 + x + x^2) =$

d. $7\,(2 + x + x^2) =$

e. $3\,(x^2 + x + 3) =$

f. $3\,(5 + x + x^2) =$

Problem solving

Multiply any number by a trinomial (three-term algebraic expression). Simplify it.

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41 Calculate the square numbers, cube numbers and square roots of single algebraic terms

Revise: laws of exponents.

$x^m \times x^n = x^{m+n}$

1. Revision: calculate.

Example: $x^m \times x^n$
$= x^{m+n}$

a. $x^a \times x^b =$ b. $a^c \times a^d =$ c. $c^e \times c^f =$

d. $m^a \times m^b =$ e. $y^c \times y^a =$ f. $t^x \times t^y =$

2. Revision: calculate.

Example: $x^2 \times x^3$
$= x^{2+3}$
$= x^5$

a. $x^4 \times x^3 =$ b. $a^5 \times a^2 =$ c. $b^6 \times b^4 =$

d. $c^3 \times c^2 =$ e. $m^4 \times m^5 =$ f. $x^3 \times x^3 =$

3. Use the example to complete the following:

Examples: $4x^6$
$= 2x^3 \times 2x^3$

a. $16x^4 =$ ____ × ____ b. $18x^{10} =$ ____ × ____ c. $64x^4 =$ ____ × ____

d. $15x^8$ e. $60x^6$ f. $144x^{12}$

4. Calculate.

Example: $\sqrt{36x^{36}}$
$= \sqrt{6x^{18} \times 6x^{18}}$
$= 6x^{18}$

a. $\sqrt{25x^4}$ b. $\sqrt{49x^9}$

c. $\sqrt{100x^6}$ d. $\sqrt{4x^{12}}$

e. $\sqrt{16x^{18}}$ f. $\sqrt{121x^{22}}$

Problem solving

Write five different equations where the answers are all equal to: $x = -9$.

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42 Multiple operations: rational numbers

Do this activity with a friend.

What do you notice?

$\frac{1}{3}a^2 + \frac{1}{4}a^2 =$

$\frac{1}{3}a^2 - \frac{1}{4}a^2 =$

$\frac{1}{3}a^2 \times \frac{1}{4}a^2 =$

$\frac{1}{3}a^2 \div \frac{1}{4}a^2 =$

1. Calculate the following:

Example: $\left(\frac{1}{2}a^2 + \frac{1}{5}a^2\right) + \left(\frac{1}{2}a^2 \times \frac{1}{2}a^2\right)$

$= \frac{5a^2 + 2a^2}{10} + \frac{1}{4}a^4$

$= \frac{7a^2}{10} + \frac{a^4}{4}$

What are the like terms?

a. $\left(\frac{1}{8}a^2 + \frac{1}{8}a^2\right) + \left(\frac{2}{8}a^2 \times \frac{1}{8}a^2\right) =$

b. $\left(\frac{1}{5}x^2 + \frac{1}{2}x^2\right) + \left(\frac{1}{5}a^2 + \frac{1}{10}a^2\right) =$

c. $\left(\frac{1}{2}y^2 + \frac{1}{3}y^2\right) + \left(\frac{1}{2}y^2 \times \frac{1}{3}y^2\right) =$

Make notes about what you learned.

2. Simplify:

Example: $\left(\frac{1}{2}a^2 + \frac{1}{4}a^2\right) + (3a^2 + 4a^2) + (3a^2 - 4a^2)$

$= \left(\frac{2}{4}a^2 + \frac{1}{4}a^2\right) + 7a^2 + (-a^2)$

$= \frac{3}{4}a^2 + \frac{6}{1}a^2$

$= \frac{3}{4}a^2 + \frac{24}{4}a^2$

$= \frac{27}{4}a^2$

$= 6\frac{3}{4}a^2$

a. $(7a^2 + 2a^2) + \left(\frac{1}{2}a^2 + \frac{1}{4}a^2\right) + (6a^2 - 4a^2) =$

b. $\left(\frac{1}{2}y^2 + \frac{1}{5}y^2\right) + (-9y^2 - 2y^2) - (8y^2 \div 4y^2) =$

c. $\left(\frac{1}{2}x^2 + \frac{1}{2}x^2\right) + (7x^2 \times 2x^2) - (8x^2 - 3x^2) =$

Make notes about what you learned.

Problem solving

Write a polynomial using rational numbers and like and unlike terms. Simplify.

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43 More multiple operations

Do this activity with a friend.

$\frac{1}{5}x^2 + \frac{1}{6}x^2 =$

$\frac{1}{5}x^2 - \frac{1}{6}x^2 =$

$\frac{1}{5}x^2 \times \frac{1}{6}x^2 =$

$\frac{1}{5}x^2 \div \frac{1}{6}x^2 =$

1. Simplify:

Example: $2(5 + x - x^2) - x(3x + 1)$

$= 10 + 2x - 2x^2 - 3x^2 - x$

$= -5x^2 + 1x + 10$

$= -5x^2 + x + 10$

This will help you to multiply the constant with all the terms. We use the distributive property.

$2(5 + x - x^2) - x(3x + 1)$

a. $2(x^2 + x + 4) - x(2x + 1) =$

b. $5(x + x^2 + 2) + x(4x + 3) =$

c. $3(x^2 + x + 6) - x(5x + 2) =$

Make notes about what you learned.

2. Simplify.

Example: $\left(\frac{1}{3}a^2 \times \frac{1}{4}a^2\right) + 4(3a^2 + 4a^2) + a(2a + 4)$

$= \frac{1}{12}a^4 + 4 \times 7a^2 + 2a^2 + 4a$

$= \frac{1}{12}a^4 + 30a^2 + 4a$

a. $2(x^2 + x + 8) + x(5x + 2) + (9x^2 - 5x) =$

b. $\left(\frac{1}{4}x^2 + \frac{1}{5}x^2\right) - x(-9x^2 - x^2) - 2(x + 2x + 8) =$

c. $(3x^2 + 6x^2) + 3\left(\frac{1}{6}x^2 - \frac{1}{3}x^2\right) + (2x^2 \div 3x^2) =$

d. $5(4x + 3x^2 + 6) - (8x^2 \times 4x^2) + \left(\frac{1}{4}x^2 \times \frac{1}{5}x^2\right) =$

e. $4(6 + 3x + 2x^2) + \left(\frac{1}{9}x^2 \div \frac{1}{5}x^2\right) - x(-5x + 2x) =$

Activity

Write a polynomial using rational numbers and like and unlike terms. Simplify it.

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44 Division operations

Compare the three blocks.

Which are the same?

$\frac{x^2(x^2+1)}{x^2}$ | $\frac{x^4+x^2}{x^2}$ | $\frac{x^4}{x^2}+\frac{x^2}{x^2}$

Are any different?

1. Revision: Simplify.

Example: $\frac{x^4-6x^2-1}{x^2}$

$= \frac{x^4}{x^2} - \frac{6x^2}{x^2} - \frac{1}{x^2}$

$= x^2 - 6 - \frac{1}{x^2}$

a. $\frac{x^5+3x^2+2}{x^2}$

b. $\frac{x^4+2x^2-3}{x^3}$

c. $\frac{x^3-4x^2+6}{x^2}$

2. Simplify.

Example: $\left(\frac{x^4+6x^2-1}{x^2}\right) + (3x^2+4x^2) + \left(\frac{1}{3}x^2 + \frac{1}{3}x^2\right) + 2(5+x-x) + (-x)(3x+1)$

$= x^2 + 6 - \frac{1}{x^2} + 7x^2 + \frac{2}{3}x^2 + 10 - 3x^2 - x$

$= x^2 + 7x^2 - 3x^2 + \frac{2}{3}x^2 + 10 + 6 - \frac{1}{x^2} - x$

$= 5x^2 + \frac{2}{3}x^2 - x + 16 - \frac{1}{x^2}$

$= \frac{15}{3}x^2 + \frac{2}{3}x^2 - x + 16 - \frac{1}{x^2}$

$= \frac{17}{3}x^2 - x + 16 - \frac{1}{x^2}$

$= 5\frac{2}{3}x^2 - x - \frac{1}{x^2} + 16$

a. $3(7+x-x^2) + 2(3x+1) + 4\left(\frac{1}{2x^2} + \frac{1}{4x^2}\right) + (2x^2 - 2x^2) =$

b. $\left(\frac{x^5+2x^3+4}{x^3}\right) + 2(4x^2+2x^2) + \left(\frac{x^4-6x^4-2}{x^2}\right) - \left(\frac{1}{3x^2} \div \frac{1}{4x^2}\right) =$

c. $\left(\frac{x^6+4x^2+2}{x^2}\right) + \left(\frac{1}{3x^2} \div \frac{1}{4x^2}\right) - (4x^2+2x^2) - \left(\frac{x^5+x^4}{x^3}\right)$

Activity

Write a polynomial using rational and whole numbers and like and unlike terms. Simplify it.

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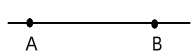
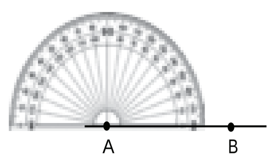
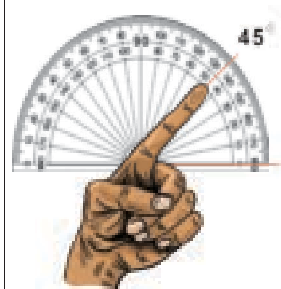
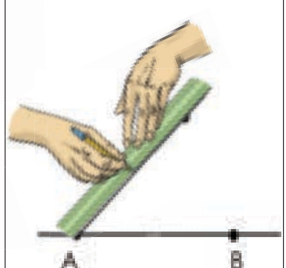
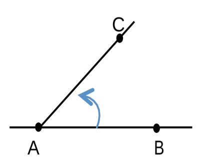
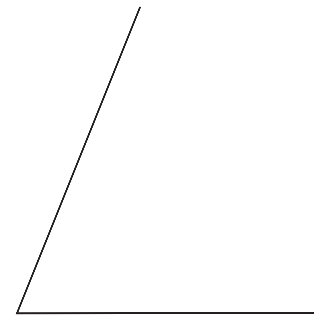
45a Constructing geometric figures

Revise the following:

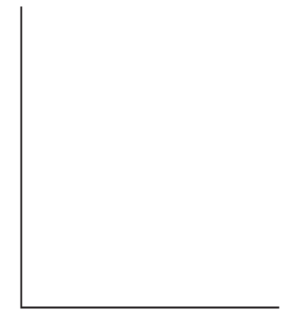
Step 1: Draw a line. Label a segment AB. 	**Step 2:** Place the protractor so that the origin (small hole) is over point A. Rotate the protractor so that the base line is exactly along the line AB. 	**Step 3:** Using (in this case) the inner scale, find the angle desired – here 45°. 
Step 4: Make a mark at this angle, and remove the protractor. 	**Step 5:** With a ruler, draw a line from A to the mark you have just made. Label this point C. 	**Step 6:** The line drawn (a ray) makes an angle with a measure of 45° between the two rays AC and AB. 

1. **Label and measure the following angles. You might need to extend the lines.**

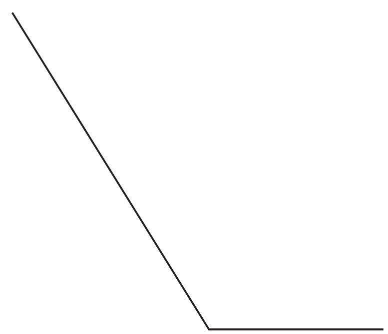
a. Acute angle: ABC



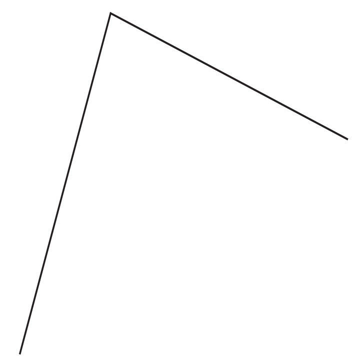
b. Right angle: DEF



c. Obtuse angle: ABC



d. Reflex angle: XYS



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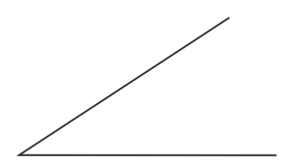
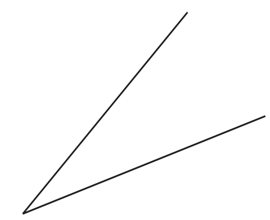
Constructing geometric figures continued

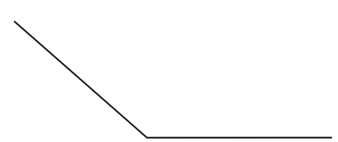
e. Acute angle: GHI



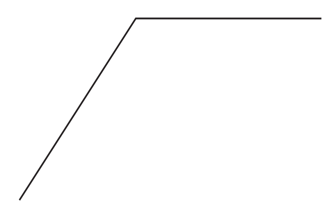
f. Reflex angle: KLM



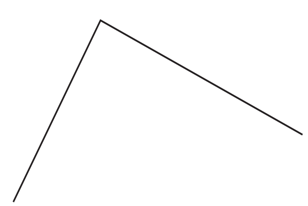
g. Obtuse angle: MNO



h. Obtuse angle: PQR



i. Right angle: GHI



j. List all the different kinds of angles. Use the first one to guide you.

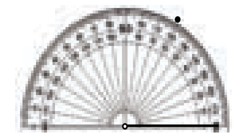
An acute angle is smaller than 90º.

A straight line ______________

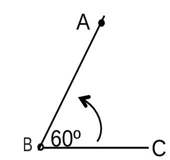
2. Draw the following using a protractor. Label your geometric figures.

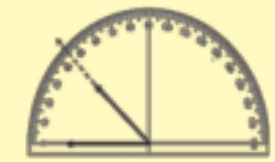
Example: a 60º angle ABC.

Step 1



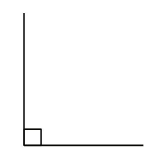
Step 2





In the questions that follow the ray of the angle may be too short to reach the scale on the protractor. Use your ruler to extend the ray to make it easier to read the measurement. The second ray on this angle above points to 45, so this is a 45° angle.

a. Right angle



An angle with a 90º angle.

b. Acute angle

c. Reflex angle

d. Scalene triangle

e. Right angled triangle

f. Isosceles triangle

Problem solving

How would you construct an angle that is bigger than 180° with a protractor?

Remember that angles are parts of a circle. This will help you to understand the design of the protractor .

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46 Construction with a protractor

Term 2

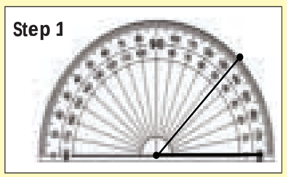
Remember that if the ray of an angle does not reach the scale on the protractor, then use the ruler to extend the ray to make it easier to read the measurement.

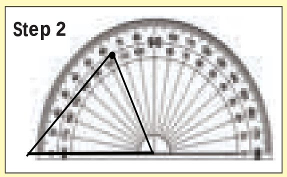
Geometry requires the use of polygons such as triangles and quadrilaterals. You should know how to construct these shapes. While some of these shapes can be created with a compass and ruler, it is often faster to create them with a protractor.

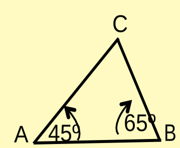
Find out who use protractors in their jobs.

1. Use the example to guide you. Construct a triangle with two given angles. Name the type of triangle.

Example: a triangle of which the angles include 45° and 65°.







a. 90° and 45°

b. 60° and 60°

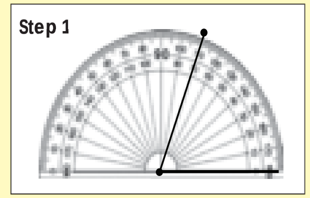
Acute angled triangle

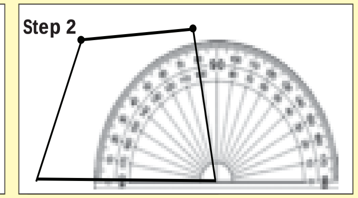
c. 80° and 45°

d. Write down step by step what you did.

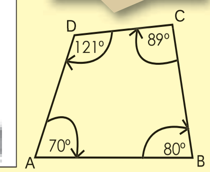
2. Use the example to guide you. Construct a quadrilateral with the two angles given. Label it.

Example: a quadrilateral of which the angles include a 70° angle and a 80° angle.





Remember that the angles of a quadrilateral always add up to 360°.



a. 68° and 118°

b. 135° and 70°

c. 70° and 110°

d. Write down step by step what you did.

Problem solving

Using a protractor, construct:
(a) any polygon other than a triangle, and
(b) a quadrilateral.

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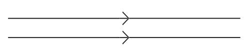
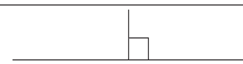
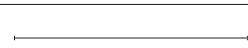
47 Parallel and perpendicular lines

Look at this structure – it is the Nelson Mandela bridge in Johannesburg. Identify the parallel lines, perpendicular lines and line segments.

1. Who will use a compass in their work? For what?

2. Revision: Match column B with column A.

Column A	Column B
Line segment	
Parallel lines	
Perpendicular lines	

3. Draw the following line segments with a ruler.

5,23 cm

7,55 cm

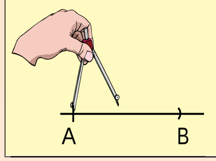
65,5 mm

23,5 mm

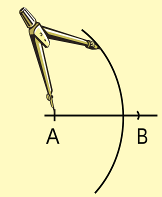
8,95 cm

4. Revision: Construct a perpendicular line to bisect a given line. Use the guidelines to help you

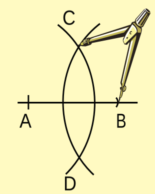
Step 1
Draw a line and mark points A and B on it. Put the compass point on A and open it so that the pencil touches point B. (So you "measured" the length of AB with the pair of compasses.)



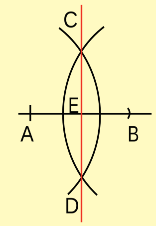
Step 2
Leaving the compass point on A, draw an arc with the compass approximately two thirds of the line length.



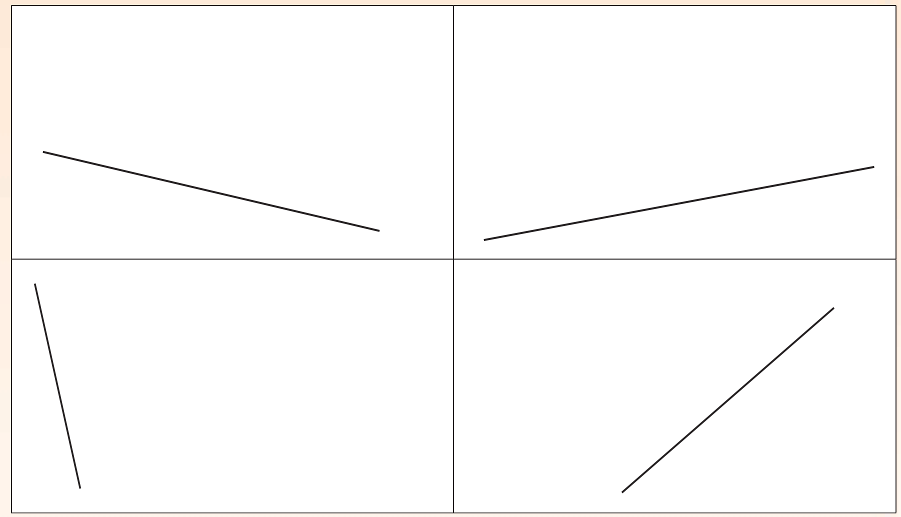
Step 3
With the compasses' width the same, move the compass point to B and draw another arc which crosses the first arc at two points. Label these points C and D.



Step 4
Draw a line through points C and D bisecting the line AB at E.

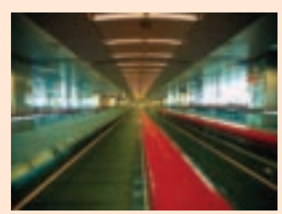


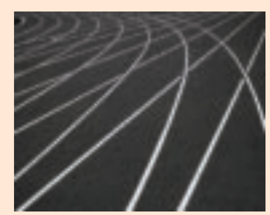
5. Construct lines perpendicular to these using a pair of compasses.



Activity

Are these lines parallel or not? Say why or why not.





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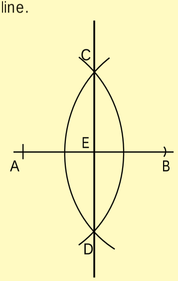
48a Construct angles and a triangle

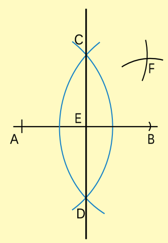
Identify the triangles and estimate the size of the angles.

1. Construct a 45° angle. Use the guidelines to help you.

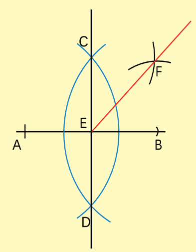
Step 1
Follow the steps for drawing a perpendicular line.



Step 2
Place the compass point on C and draw an arc with the compass a little more than half way between C and B. Then place the compass point on B and draw a same size arc crossing the first one. Label the crossing point F



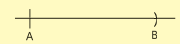
Step 3
Draw a line through F to E. This creates two 45° angles (FEC and FEB).



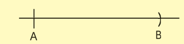
2. Give five real-life examples of where we might find 45° angles.

3. Construct an equilateral triangle. Follow the steps and construct your triangle below.

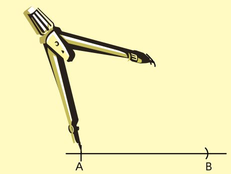
Step 1
Draw a line AB.



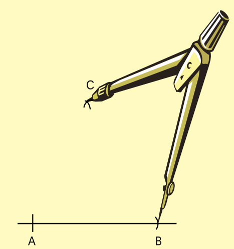
Step 2
Put the compass point on A and open it so that the pencil touches B. (So you have "measured" the length of AB with the pair of compasses.)



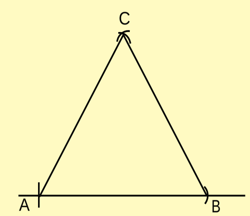
Step 3
Leaving the compass point on A, draw an arc with the compass roughly where you think the other vertex (corner) of the triangle is going to be. (The distance from A to this point is going to be the same as the length of AB.)



Step 4
Do not adjust your compass. Now move the compass point to B and draw another arc which crosses the first. Label it C.



Step 5
Step 5: Since the lengths of AC and BC are both equal to the length of AB, we have three points all the same distance from each other. If we join them up, we therefore have an equilateral triangle, with each angle equal to 60°.



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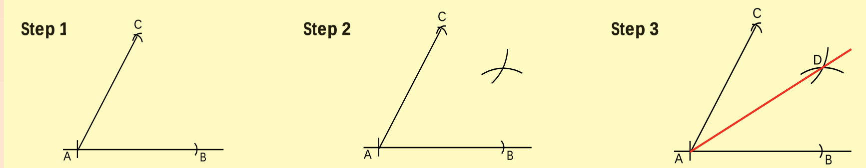
48b Construct angles and a triangle continued

4. Construct a triangle of your own choice that is different from the previous one.

5. Construct a 30° angle. Use the guidelines below.
Follow the steps to construct a 60° angle (as in Question 2) and then bisect it (as in question 1).



6. How will you construct a 15° angle? Construct it showing it step by step.

7. Construct a triangle with one 30° angle.

Problem solving

Construct any figure with at least one 30° and one 45° angle.

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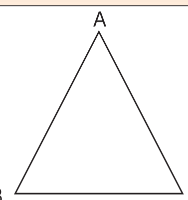
49 The sum of the interior angles of any triangle equals 180°

How can you prove that the sum of the interior angles of a triangle is equal to 180° using paper and some glue? Paste your proof here.

1. Measure the interior angles of the triangles and add them together. What do you notice?

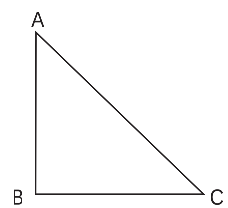
a.



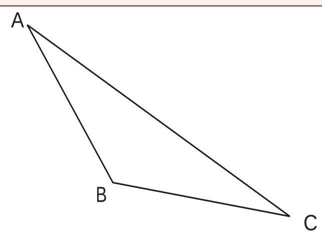
A = 60°
B = 60°
C = 60°

A + B + C
= 60° + 60° + 60° = 180°

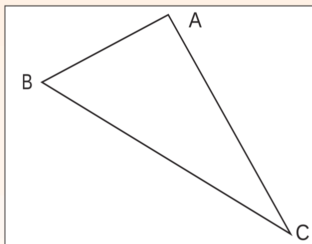
b.



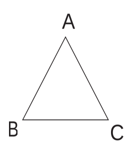
c.



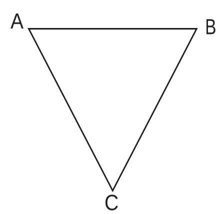
d.



e.

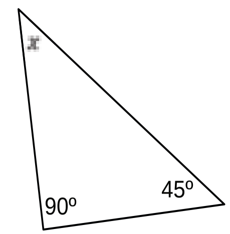


f.



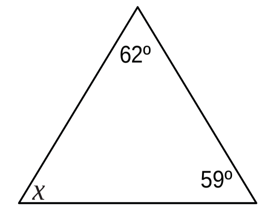
2. Calculate the size of x.

a.

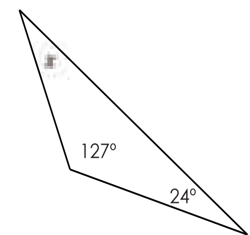


$x + 90° + 45° = 180°$
$x = 180° - 90° - 45°$
$x = 45°$

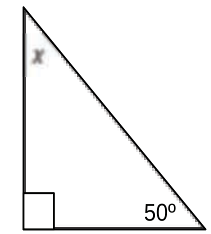
b.



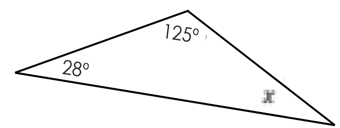
c.



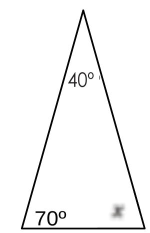
d.



e.



f.



3. If the one angle is ____°, what can the other two be? Give 2 pairs of options.

a. 41
b. 63
c. 90
d. 72
e. 100

Activity

If one angle of the triangle equals 32°, give five pairs of possible answers for what the other angles could be.

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Term 2

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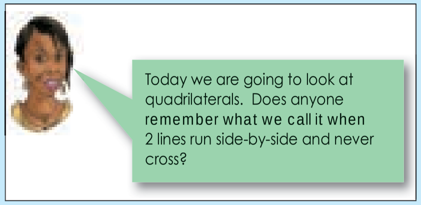
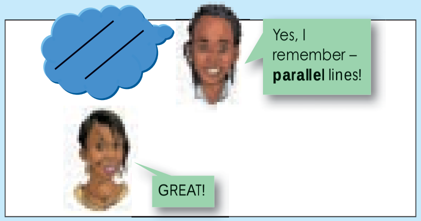
50a Constructing quadrilaterals

What is a quadrilateral? You can read the rest of the comic strip at the end of this worksheet.

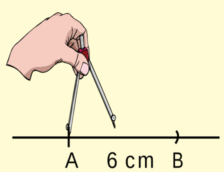




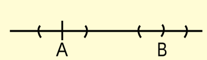
1. Construct and label a quadrilateral with a 90° angle ABC.

What type of quadrilateral(s) could this be?

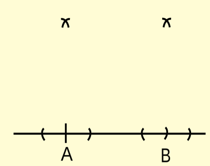
Step 1: Use a ruler to draw a line and label point A on the line. With your pair of compasses set at 6 cm, mark point B.



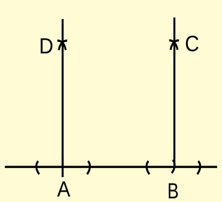
Step 2: Draw arcs 1 cm on either side of A. Do the same at point B.



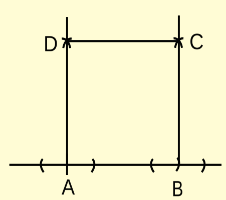
Step 3: Use the arcs to construct lines that are perpendicular to AB, one through A and one through B. When drawing the arcs set your compass to 6 cm.



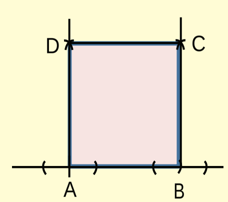
Step 4: Label the crossing points D and C.



Step 5: Join points D and C.



Step 6: Use your protractor to check that the angles are 90° each.



Measure the angles of the quadrilateral ABCD.

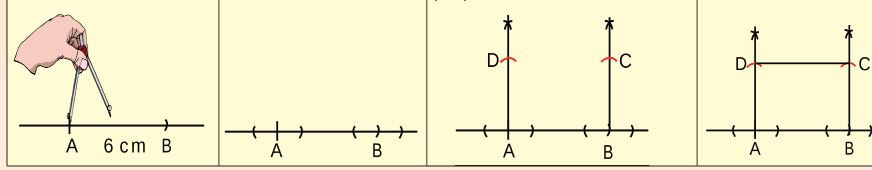
2. Use a ruler and a pair of compasses to construct a rectangle with a length of six centimetres and a width of four centimetres.

Step 1: Use a ruler to draw a line and label point A on the line. With your pair of compasses set at 6 cm, mark point B.

Step 2: Draw arcs 1 cm on either side of A. Do the same at point B.

Step 3: Use the arcs to construct lines that are perpendicular to AB, one through A and one through B. Set your pair of compasses at 4 cm. Place the compass-point at A and mark off and label D on the perpendicular line. Using the same compass setting, place the compass-point at B and mark off and label point C on the perpendicular line.

Step 4: Join DC.



Measure the angles of ABCD.

3. Construct the following using a pair of compasses:

a. A square with sides equal to 4 cm.

b. A rectangle with sides equal to 3,5 cm and 4,2 cm.

Problem solving

Can you construct a quadrilateral with only one 90° angle? Show it.

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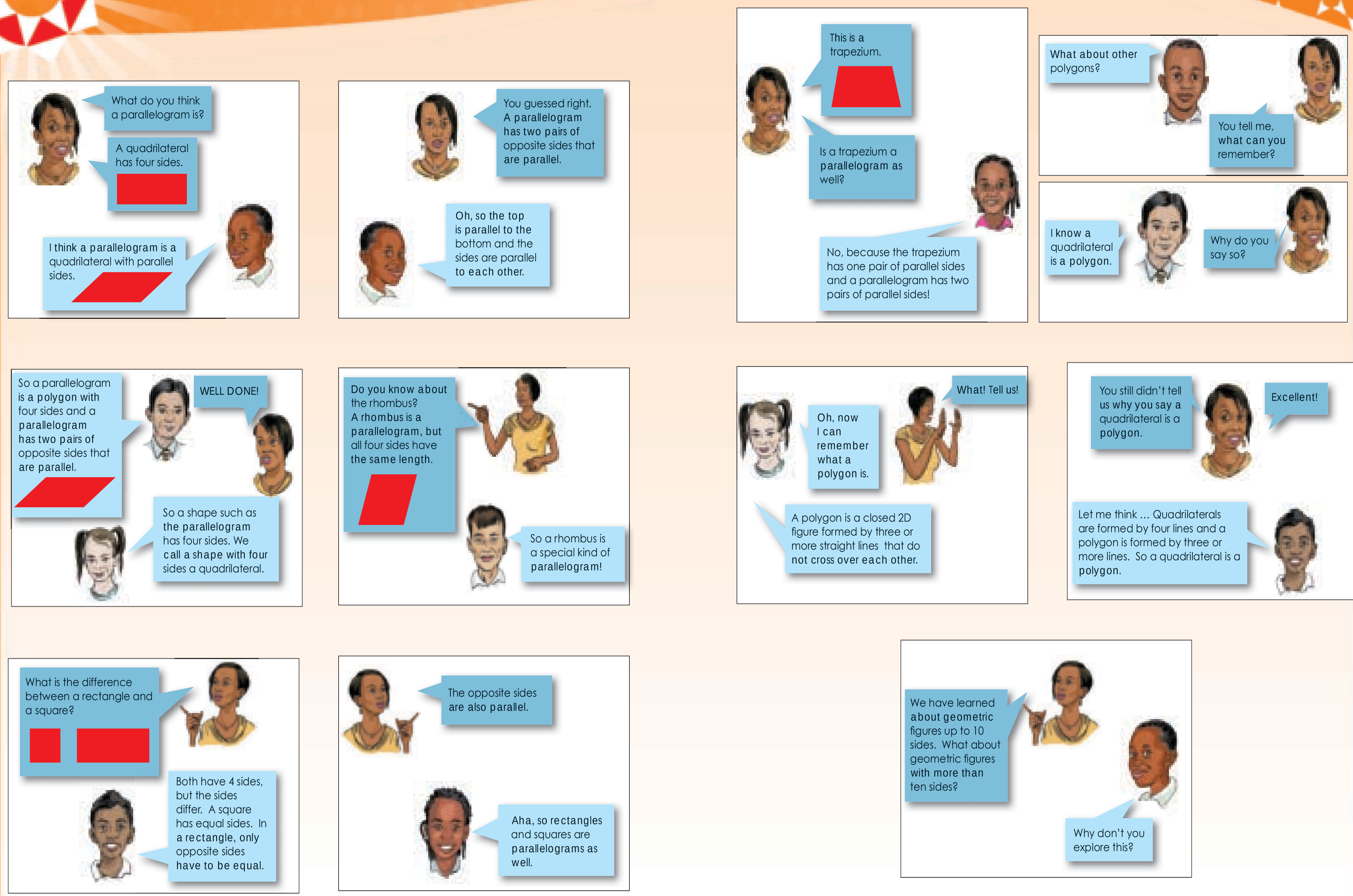
50b Constructing quadrilaterals continued



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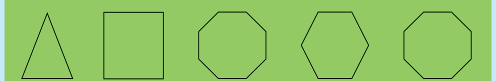
51 Constructing polygons

What is a polygon?

A polygon is a closed two–dimensional figure formed by three or more line segments that do not cross over each other.

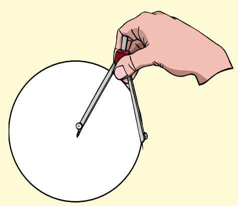


triangle square pentagon hexagon octagon

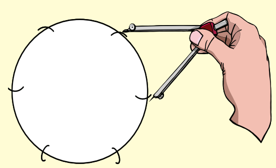
Polygons can be regular or irregular. Regular means a polygon's sides are all equal. Irregular means a polygon's sides are not equal.

1. Use a ruler and pair of compasses to construct a hexagon.

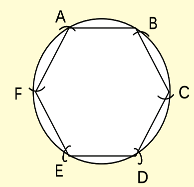
Step 1: Draw a circle. Measure the radius with a pair of compasses.



Step 2: Make markings the same distance apart on the circumference, using the compasses.

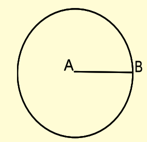


Step 3: Label and join the points.

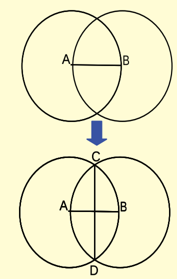


2. Use a ruler and compasses to construct a pentagon on a separate sheet of paper.

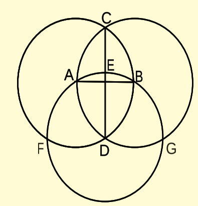
Step 1: Draw a circle around A with radius AB. Draw a line to join A to B.



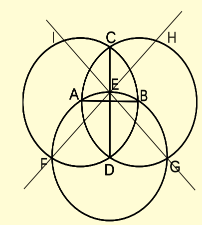
Step 2: Draw a circle around B with radius AB. Call their intersection points C and D.



Step 3: Draw a circle around D with radius DA. Circle D intersects line CD at E, circle A at F and circle B at G.

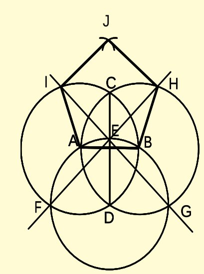


Step 4: Draw a straight line from F through E to intersect circle B at H and a line from G through E to intersect circle A at I.



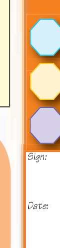
Step 5: Draw an arc at I with radius IA. Draw an arc at H with radius HB. Arcs I and H intersect at J.

Step 6: All the points A, B, I, H and J are vertices



Activity

Construct a polygon different from the ones in this worksheet.



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52 Polygons

The formula for calculating the sum of the interior angles of a polygon is:

$$(\text{number of sides} - 2) \times 180°$$

Show that this formula is correct using a triangle.

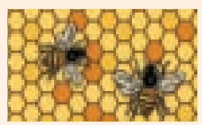
1. Complete the table.

Polygon	Number of sides	Angle size	Total sum of angles

2. What is this? What polygon/s can you identify?

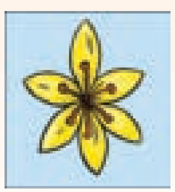
a.

b.

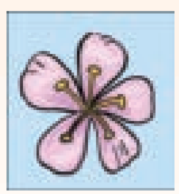


3. What geometric figure do you see?

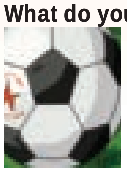
a.



b.



4. What do you think this is?



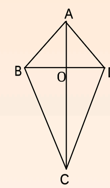
Which shapes would you find on this object?

5. Use this flow diagram to prepare for a 5 minute presentation.

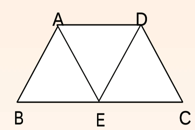
Polygon

- **Triangles**
  - right-angled triangle
  - scalene triangle
  - isosceles triangle
  - equilateral triangle
- **Quadrilaterals**
  - parallelogram
  - rectangle
  - square
  - rhombus
  - kite
  - trapezium
- **Shapes with more than 4 sides**
  - pentagon
  - hexagon
  - heptagon
  - octagon
  - nonagon
  - decagon

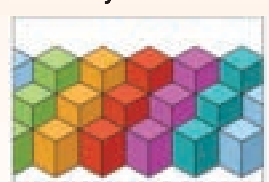
6. Divide a kite into four triangles and describe the triangles.



7. Divide a trapezium into triangles and describe the triangles.



8. Identify and then name the following polygons. Describe each quadrilateral.



Problem solving

A polygon has 5 t sides. What is the sum of its interior angles in terms of t ?

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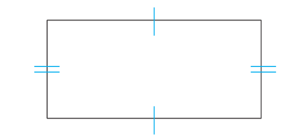
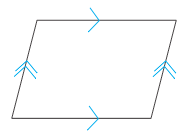
53 More about polygons

Revision: How do you label a geometric figure showing the sides are equal?

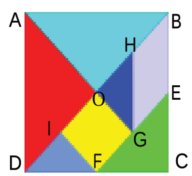


How do you label a geometric showing parallel sides?



What is a regular and an irregular polygon?

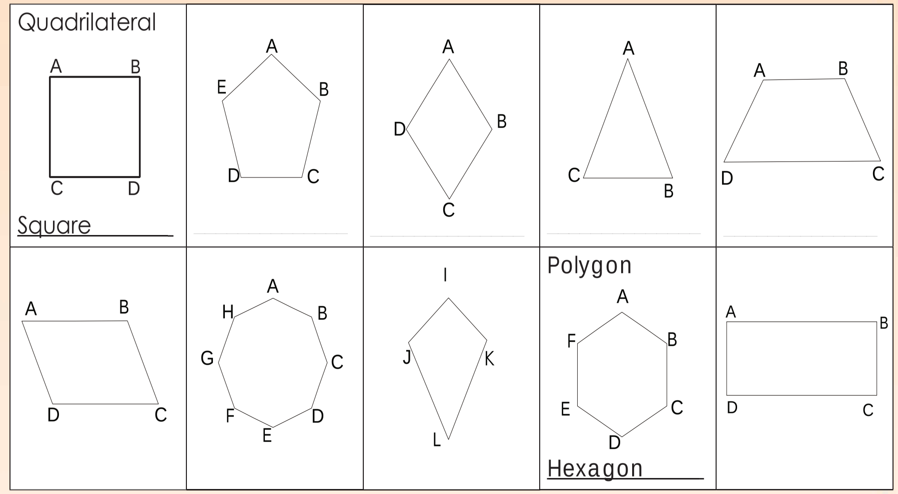
1. **Complete the following using Cut-out 1.**

a. Identify *IOGF* What fraction of the square ABCD is this shape?  	b. Identify ΔABO and ΔADO and make a square. What fraction of the square ABCD is this square?	c. Identify ΔHGO and ΔDIF and make a square. What fraction of the square ABCD is this square?
d. What shape can you make from ΔHGO, ΔDIF, and ΔECF? What fraction of the square ABCD is this shape?	e. What shape can you make from ΔHGO, ΔDIF and HBEG? What fraction of square ABCD is this shape?	f. What shape can you make from ΔHGO, ΔDIF, ΔABO, HBEG and IOGF?

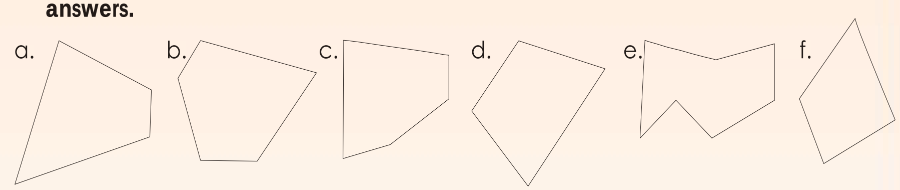
2. **Look at the shapes on the next page.**
   a. What are the differences and similarities between the quadrilaterals and other polygons?

b. Name each polygon.

c. Label the equal and parallel sides on each polygon.



3. **State whether or not the following shapes are polygons. Give reasons for your answers.**



Problem solving

Name the first ten polygons. Try to give an everyday example of each.

Term 2

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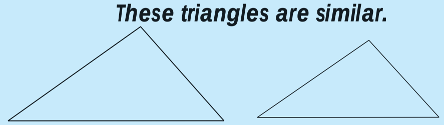
54 Similar Triangles

What is similarity?

Similar triangles have the following properties:

- They have the same shape but not the same size.
- Each corresponding pair of angles is equal.
- The ratio of any pair of corresponding sides is the same.

These triangles are similar.



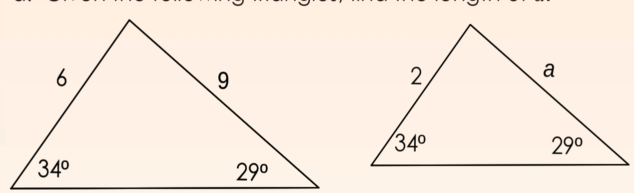
We can tell whether two triangles are similar without testing all the sides and all the angles of the two triangles. There are two rules to check for similar triangles. They are called the AA rule and RAR rule. As long as one of the rules is true, the two triangles are similar.

1. Discuss these rules.

AA rule (Angle Angle)

If two angles of one triangle are equal to two angles of another triangle, then the triangles are similar.

a. Given the following triangles, find the length of a.



Solution:

Step 1: The triangles are similar because of the AA rule.

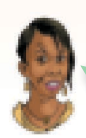
Step 2: The ratios of the lengths are equal. $\frac{6}{2} = \frac{9}{a}$

Step 3: Make use of cross-multiplication to find the unknown value.

$\frac{6}{2} \times \frac{9}{a}$ or $\frac{6}{2} \times 2a = \frac{9}{a} \times 2a$

$6a = 18$ $\quad$ $6a = 18$

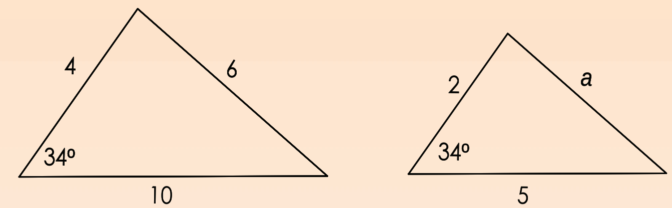
$a = 3$ $\quad$ $a = 3$



A ratio shows the relative sizes of two or more values. Example: 2:3

RAR rule (Ratio Angle Ratio)

If the angle of one triangle is the same as the angle of another triangle and the sides containing these angles are in the same **ratio**, then the triangles are similar.



b. Given the following triangles, find the length of a.

Solution:

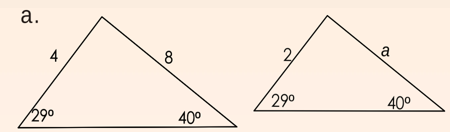
Step 1: The triangles are similar because of the RAR rule

Step 2: The ratios of the lengths are equal.

Step 3: The length of a is 3.

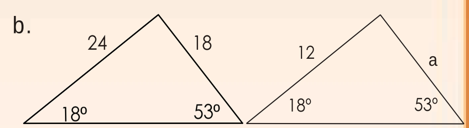
2. Find the length of *a*. State the rule you are using.

a.



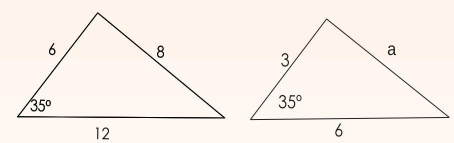
a = ______

b.



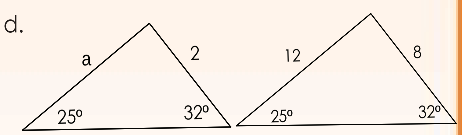
a = ______

c.



a = ______

d.



a = ______

Activity

Describe how you would find a missing angle or side of a triangle that is similar to another.

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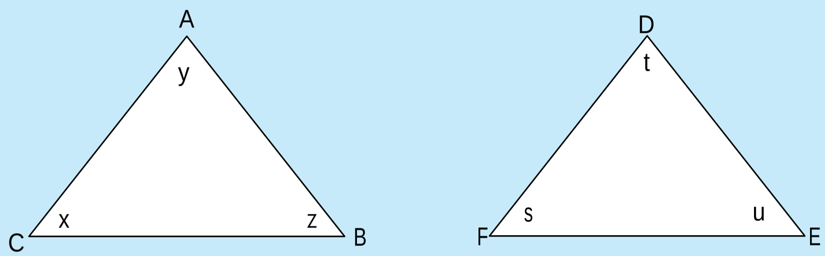
Term 2

55a Congruent shapes

Congruent shapes are shapes that have the same size and shape. This means that the corresponding sides are equal and the corresponding angles are equal.



- The corresponding sides are: AC and DF, AB and DE and CB and FE.
- The corresponding angles are: y and t, x and s, z and u.

a. Draw any two congruent triangles.
Label them. Name the corresponding equal sides and the corresponding angles.

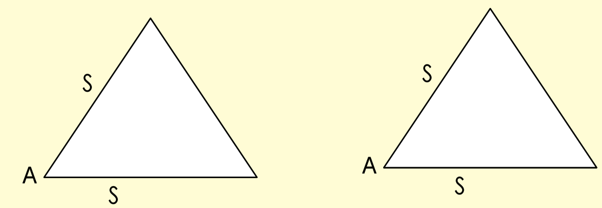
b. Draw any two congruent quadrilaterals.
Label them. Name the corresponding equal sides and the corresponding angles.

c. Draw any two congruent pentagons.
Label them. Name the corresponding equal sides and the corresponding angles.

d. Draw any two congruent circles. What makes you think that the circles you have drawn are congruent to each other?

SAS rule (Side Angle Side)

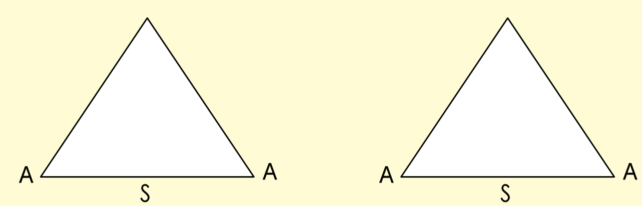
If two sides and the included angle of one triangle are equal to two sides and the included angle of another triangle, then the triangles are congruent.



b. Draw congruent triangles using the SAS rule. Indicate the length of the sides of the triangles.

ASA rule (Angle Side Angle)

If two angles and the included side of one triangle are equal to two angles and the included side of another triangle, then the triangles are congruent.



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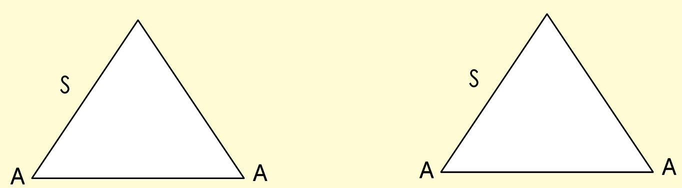
55b Congruent triangles continued

c. Draw congruent triangles using the ASA rule. Indicate the length of the sides of the triangles.

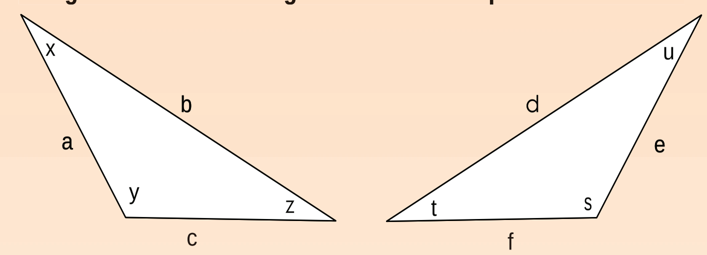
AAS rule (Angle Angle Side)

If two angles and a non–included side of one triangle are equal to two angles and a non–included side of another triangle, then the triangles are congruent. Note that we can also say SAA.



d. Draw congruent triangles using the AAS rule. Indicate the length of the sides of the triangles.

2. Which of the following conditions would be sufficient for the triangles below to be congruent? Give an explanation for each.



a. a=e, x=u, c=f

b. a=e, y=s, z=t

c. x=u, y=t, z=s

d. a=f, y=t, z=s

Problem solving

Where in everyday life will we find congruent triangles?

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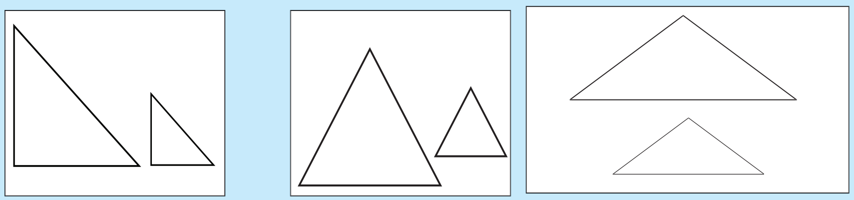
Term 2

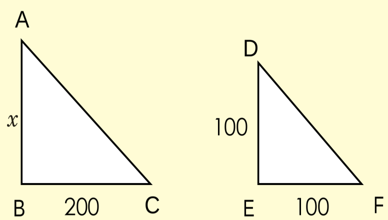
56 Similar triangles problems

What is the ratio between the sides of these triangles? You might need a calculator. Make the corresponding sides the same colour.



1. Solve for x.

Example:



$\Delta ABC \sim \Delta DEF$

We know that the ratio of corresponding sides are equal.

$\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$

$\frac{x}{100} = \frac{200}{100}$

We do cross multiplication.

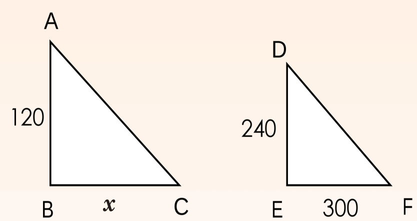
$100x = 20\ 000$

$x = 200$

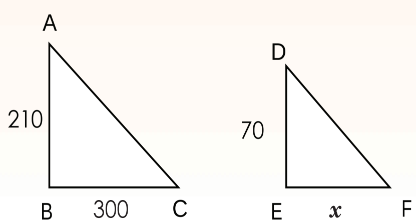
~ means similar

We only need two sides to calculate x.

a.

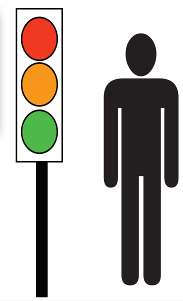


b.

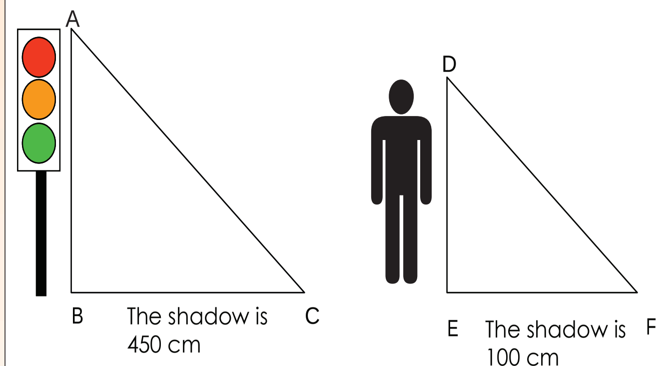


2. A traffic light has a shadow 450 cm long. Ben is 200 cm tall and his shadow is 100 cm long. What is the height of the traffic light? Your friend gave you his two drawings to help you. He explained it and gave you some incomplete notes. Complete it.

Draw the traffic light and Ben.



Draw the similar triangle next to them.



Label the triangles $\Delta ABC \sim \Delta DEF$

The symbol ~ means similar

So we can say:

$\frac{AB}{DE} = \_\_\_ = \frac{AC}{DF}$

$\frac{BC}{EF} = \_\_\_$ $\frac{AB}{EF} = \frac{AB}{200}$

We do cross multiplication

Problem solving

Write your own problem using 'similarity of triangles' to solve it.

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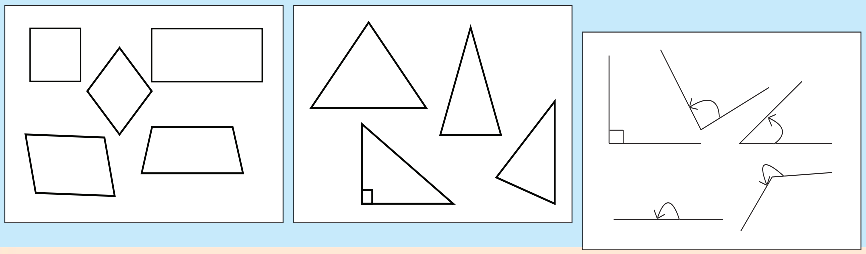
57 Quadrilaterals, triangles & angles

Name the quadrilaterals, triangles and angles.



1. Explore these sets of three angles each.

a. What do they have in common? What could each set of angles represent?
(30°, 120°, 30°); (50°, 80°, 50°); (55°, 70°, 55°); (20°, 140°, 20°); (70°, 40°, 70°)

b. Use the sets of angles given in a. above to draw, label and name the geometric figures in the spaces provided below.

2. Explore these sets of four angles each.

a. What do they have in common? What could each set of angles represent?
(90°, 90°, 90°, 90°); (120°, 60°, 120°, 60°); (135°, 62°, 47°, 116°); (71°, 130°, 109°, 50°).

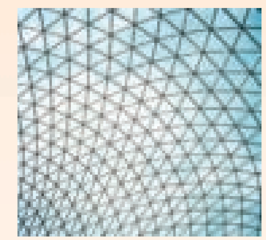
b. Draw, label and name the geometric figures.

3. One of the interior angles of a triangle is 60°. The largest angle in the triangle is twice as large as the smallest. What are the two other angle sizes of this triangle? Make a drawing.

4. Two opposite angles of a quadrilateral are 110° each. What will the other two angles measure?

5. A quadrilateral with two pairs of equal sides and four equal angles is divided into two congruent triangles. What are the possible sizes of the angles of the triangles? Explain and make a drawing.

6. Identify all the triangles and quadrilaterals in this net?



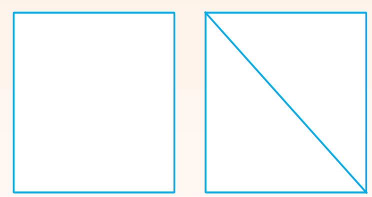
____

____

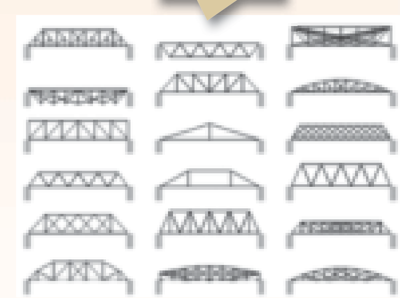
What other polygons can you identify?

____

7. Which will make the strongest shape? Explain.



These are called truss bridges.



Where is this strongest shape used often?

____

Activity

Find a structure in your environment made up with triangles and quadrilaterals. Draw and describe it.

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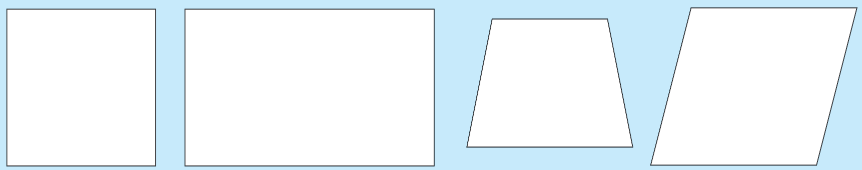
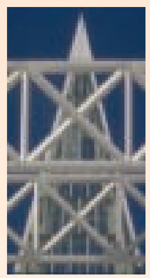
58 Polygons and quadrilaterals

Look at these quadrilaterals and name them. Divide each so that it forms two triangles. Name the triangles.



1. Look at this photograph.



a. What quadrilateral do the beams form? ____________________

b. What will the sum of the interior angles of that quadrilateral be? Calculate it without the use of a protractor. ____________________

c. Identify the triangles. ____________________

d. What will the sum of the angles in the triangle be? ____________________

e. What do you notice about the lengths of the sides of the quadrilateral and the triangle? ____________________

2. The bottom row of the structure in the photograph is made up of squares divided into triangles. The sides of the squares are equal, and the sides of the triangles are equal. Now answer these questions.

a. What about the diagonals – are they the same length as each side of the four triangles?

b. Are the diagonals the same length as the square sides? Check this.

c. Why do we use diagonals and triangles in the structures? ____________________

3. Look at the geometric figures on these knitted hats.

a. Identify the triangles on these hats.

b. Identify the quadrilaterals on these hats.

c. Don't measure the angles with a protractor to answer this question. What are the sizes of the angles? Make drawings to support your answer.

4. Divide:

a. An equilateral triangle into 4 equilateral triangles.

b. A hexagon into triangles.

Activity

Share some of these drawing with your friends.. Ask them what shapes they can see in them.

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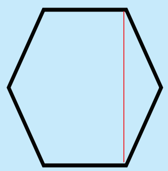
59 Diagonals

What is a diagonal?



A **diagonal** is a straight line inside a shape drawn between two vertices that are not adjacent to each other.

Oh, so we can say, if you join two vertices of a polygon which are not already joined by one edge, you get a diagonal.

1. Identify the quadrilaterals outlined on a knitted piece of fabric then, in accordance with the definition, draw that quadrilateral and show its diagonals.

2. Look at the previous worksheet again.

a. Draw all the quadrilaterals and triangles done in the previous worksheet.

b. Draw as many diagonal lines on them as you can.

c. What do you notice?

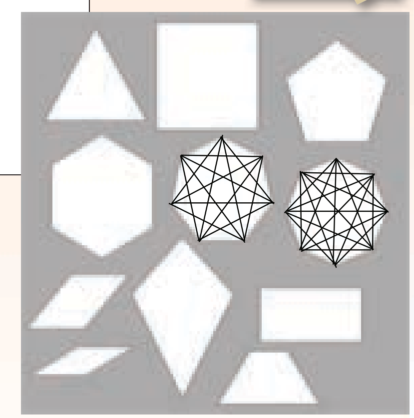
3. Draw a trapezium and draw in two diagonals.
(You could cut the trapezium up into the triangles, to help you to find the answer.)

4. Complete the table.

Shape	Number of sides	Number of diagonals	Difference between number of diagonals
Triangle	3	0	2
Quadrilateral	4		1
Pentagon	5		
Hexagon			
Heptagon			
Octagon			
Nonagon			
Decagon			

A quadrilateral has two more diagonals than a triangle

This template will help you.



Problem solving

Find the relationship between the number of diagonals and the number of sides in a polygon.

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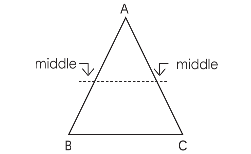
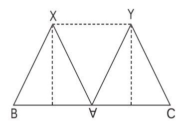
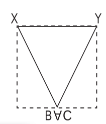
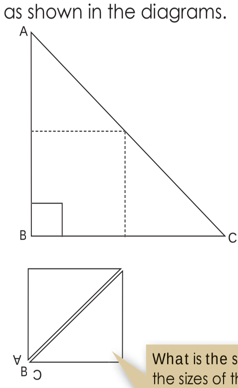
60a Quadrilaterals, angles and diagrams

Do the following practical activities in pairs.

Draw any triangle (like △ ABC) on paper and cut it out. Find the middle of AB and of AC, and draw a line joining them up. Label it XY.	
Fold vertex A down over the line XY so that vertex A just touches BC.	
Fold B and C over as shown.	

Angles A, B and C fit together along the bottom edge of the paper (straight line). So the sum of ∠A, ∠B and ∠C are 180°

Fold a right-angled triangle as shown in the diagrams.



What is the sum of the sizes of the acute angles of the right–angled triangle?

1. What do you notice?

Look at the drawings above and answer these questions:

a. What geometric figure is formed after the triangles are folded?

b. What geometric figure is formed by the sum of the three angles of the triangle?

c. What kind of triangle is shown in the first practical activity at the top of the previous page?

d. Guess whether the paper–folding experiment will work equally well for an obtuse triangle.

e. Perform the same experiment using an obtuse triangle cut out of paper. Was your prediction correct?

f. Show that the sum of the angles of a quadrilateral is 360°. Use the introduction to guide you.

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continued ☛

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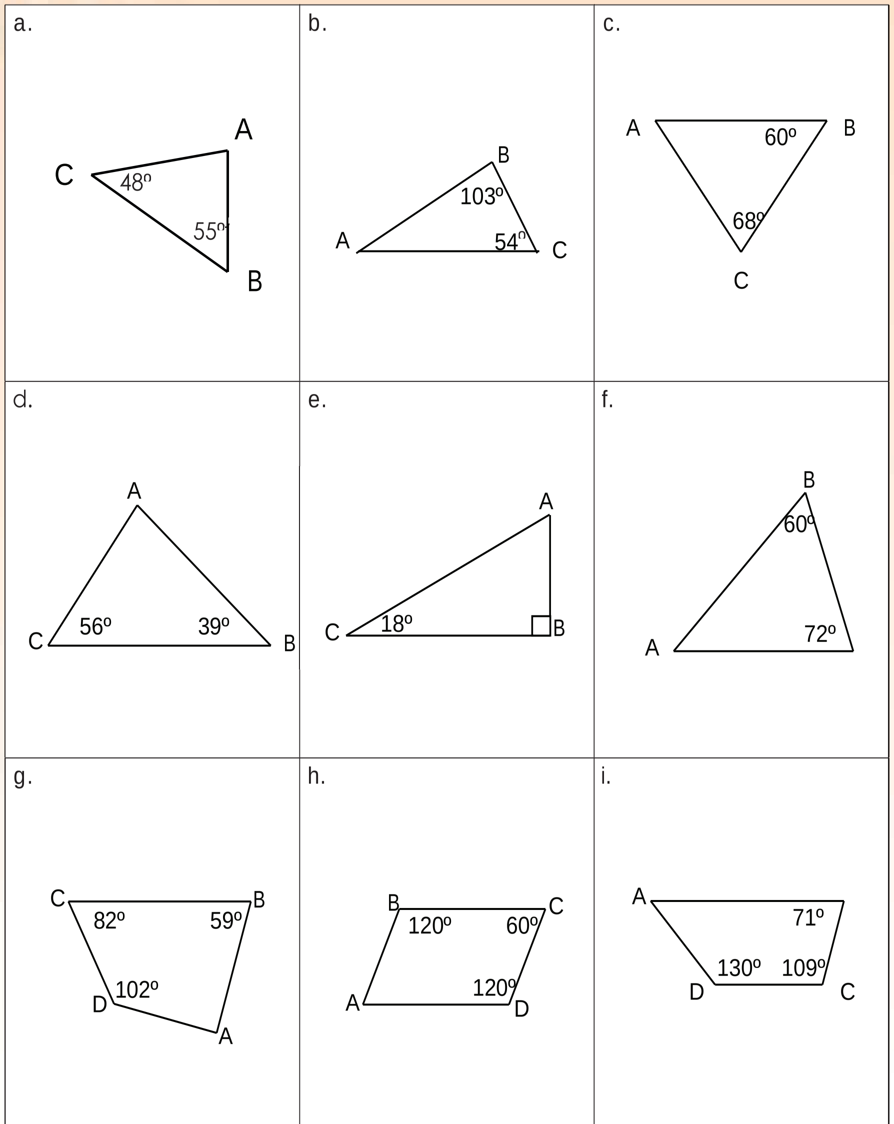
60b Quadrilaterals, angles and diagrams continued

2. In this activity you will work with angle sum relationships. Determine the size of angle A in each shape below.



3. Answer these questions.

a. An isosceles triangle has two angles that each measure 40º. What is the size of the third angle?

b. Determine the size of the third angle of a triangle if the sizes of the other two angles are 110º and 38º.

c. Determine the size of the fourth angle of a quadrilateral if the other three angles are 80º, 79º and 120º.

d. One of the acute angles of a right-angled triangle measures 39º. Determine the size of the other acute angle.

e. An obtuse angle of an isosceles triangle measures 110º. Determine the size of one of the acute angles.

Problem solving

a. If I draw two diagonal lines on a square, what will the sizes of the angles of each of the triangles be?

b. If I draw two diagonal lines on a parallelogram, one of the triangles has angle sizes of 27º, 27º and 126º. What are the sizes of the angles of the other triangles? Make a drawing to show your answer.

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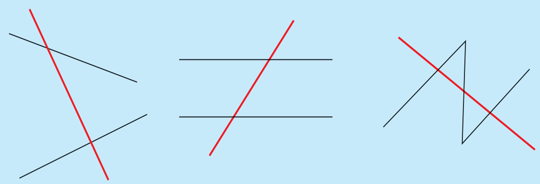
61 Parallel and perpendicular lines

Parallel lines are always the same distance apart and will never meet. We say they are equidistant.

Perpendicular lines are lines at right angles (90°) to each other.

The red lines are transversals. Describe them.

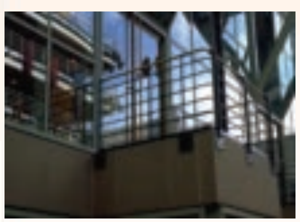


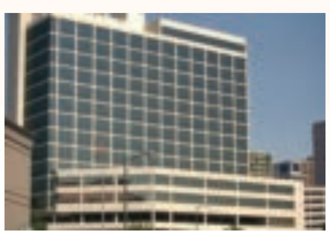
A **transversal** is a straight line intersecting two or more straight lines.

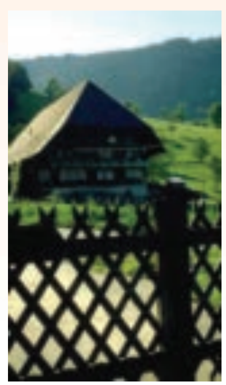
1. Highlight the parallel lines in these pictures.

Looking at what you highlighted, write your own definition for parallel lines.

2. Identify the parallel and perpendicular lines in these photographs.
What is each one a photo of?



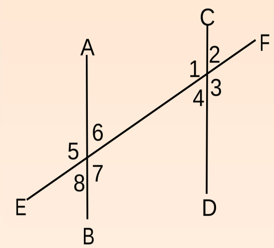




3. Draw two parallel lines with a line intersecting them. Number the angles.

Measure the angles.

4. Answer the questions on the following diagram.



a. Name a a pair of parallel lines.

b. How do we know they are parallel?

c. Name a transversal.

d. Measure the angles where the transversal crosses other lines.

Problem solving

Find a picture of a building and identify all the perpendicular and parallel lines.

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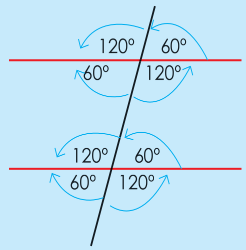
62 Pairs of angles

When parallel lines are crossed by another line (a transversal) there is a regular pattern in the angles around the crossing point. Why do many of the angles in this diagram look the same?



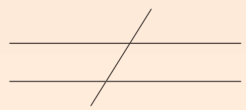
These angles form pairs of angles which have special names.

Use the information below to help you.

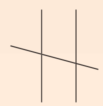
1a. Identify the pairs of vertically opposite angles.

(Show it by using coloured pencils or symbols.)

i.

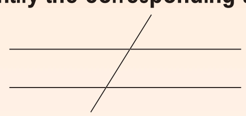


ii.

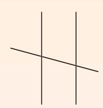


b. Identify the corresponding angles.

i.

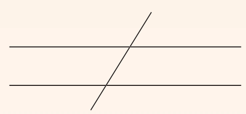


ii.

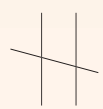


c. Identify the alternate angles.

i.

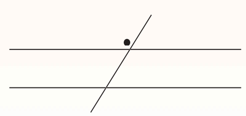


ii.

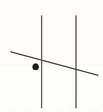


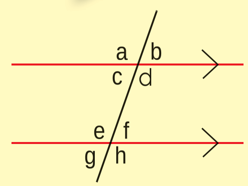
d. Identify all angles that will be equal to the one marked.

i.



ii.





Parallel lines

In the given diagram, the horizontal lines are parallel to each other and are cut by a transversal.

Transversal

Vertically opposite angles:
a = d; b = c; e = h; f = g

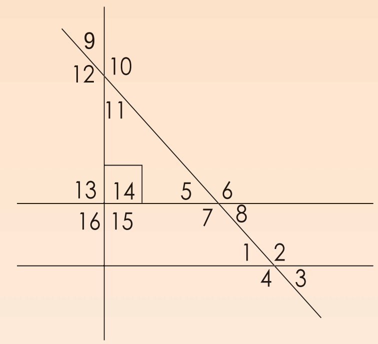
Corresponding angles:
a = e; b = f; c = g; d = h

Alternate interior angles
c = f; d = e

Alternate exterior angles
a = h; b = g

Consecutive interior angles (also called co-interior angles)
c + e = d + f = 180°

2. Explain what you see in this diagram using only words, without any calculations. How would you work out each angle, if only angle 1 was given and the two horizontal lines are parallel to each other?



Activity

Find a picture and identify alternate and corresponding angles.

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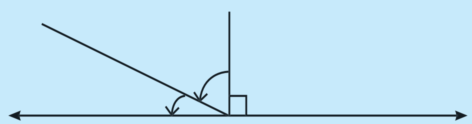
63 Problems

Revise the following:

Without measuring the angles, what could the possible sizes of angles be? Work in pairs to come up with a possible answer.



1. Solve the following:

a. If A, B and C are three angles on a straight line, with A = 55°, B = 75°, what is the size of C? Draw and name it.

b. If A, B and C are the angles of a triangle, with A = 90° and B = 35°, what size is C? Draw and name it.

c. If A, B, C and D are the angles of a quadrilateral, with A = 150°, B = 30° and C = 150°, what size is D? Draw and name it.

d. If A, B and C are three angles on a straight line, with A = 24°, B = 49°, what is the size of C? Construct and name it.

e. If A, B and C are the angles of a triangle, with A = 40° and B = 64°, what size is C? Construct and name it.

f. If A, B, C and D are the angles of a quadrilateral, with A = 99°, B = 48° and C = 72°, what size is D? Construct and name it.

Problem solving

In which job will a person need to calculate angles. Give an example of such a person and why the person is calculating angles.

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Term 2

64 Geometric figures puzzle fun

Warm up! How fast can you solve the following?

How do you play Sudoku?

How many squares are on a Sudoku puzzle? Think carefully.

Identify parallel lines on the Sudoku puzzle.

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

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

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

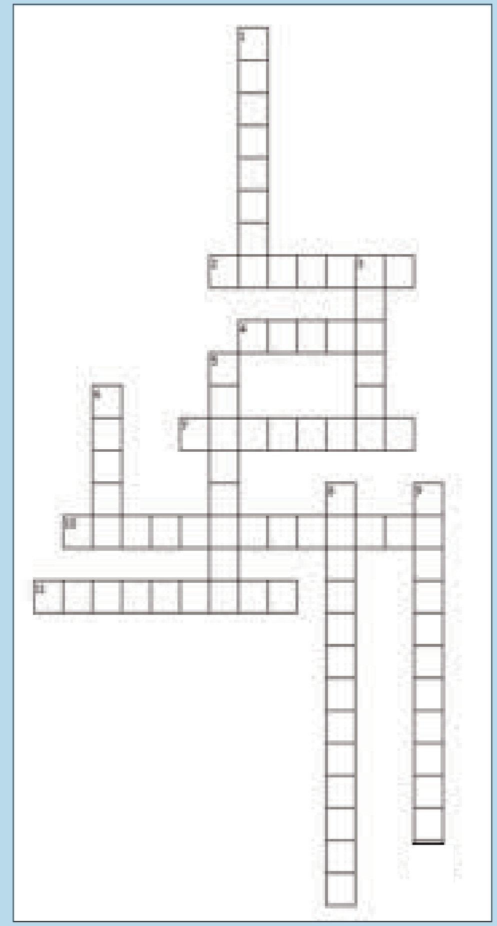
1. **Identify the names of six quadrilaterals, three types of angles and three types of triangles.**

T	G	P	B	C	S	B	E	J	M	E	E	M	E	J
R	S	U	B	M	O	H	R	N	S	L	A	A	R	D
A	W	E	S	V	P	T	R	U	E	R	B	V	A	T
P	D	N	T	E	K	R	T	I	G	L	F	M	U	C
E	A	C	U	T	E	B	E	O	G	N	A	P	Q	L
Z	C	D	X	C	O	N	L	C	A	H	J	C	S	Y
I	U	G	U	J	I	E	E	R	T	H	T	N	S	I
U	E	Q	U	I	L	A	T	E	R	A	L	D	S	B
M	I	A	X	L	D	A	E	Y	W	R	N	O	W	D
U	U	M	A	K	W	D	M	G	B	J	S	G	P	R
T	S	R	N	I	I	T	A	Q	W	C	Q	B	L	W
J	A	U	T	T	N	T	D	V	E	I	M	O	U	E
P	W	U	B	E	B	A	V	L	W	G	W	D	W	Z
T	K	J	Q	Q	R	B	E	L	R	I	E	D	Y	V
X	H	Q	L	F	K	S	K	B	S	Y	V	T	W	V

2. **Complete the crossword puzzle.**

Across
2. A geometric figure with six sides.
4. An angle that is ninety degrees.
7. Lines that are always the same distance apart and will never meet.
10. Lines that are at right angles (90°) to each other.
11. A triangle with two sides equal.

Down
1. A polygon with the least sides.
3. An angle bigger than ninety degrees.
5. A straight line inside a shape that goes from one vertex to another but not the side.
6. An angle smaller than ninety degrees.
8. Geometric figure with four sides.
9. Line that intersects (crosses over) parallel lines.



Puzzles

Find some puzzles in a newspaper and solve them with a family member.

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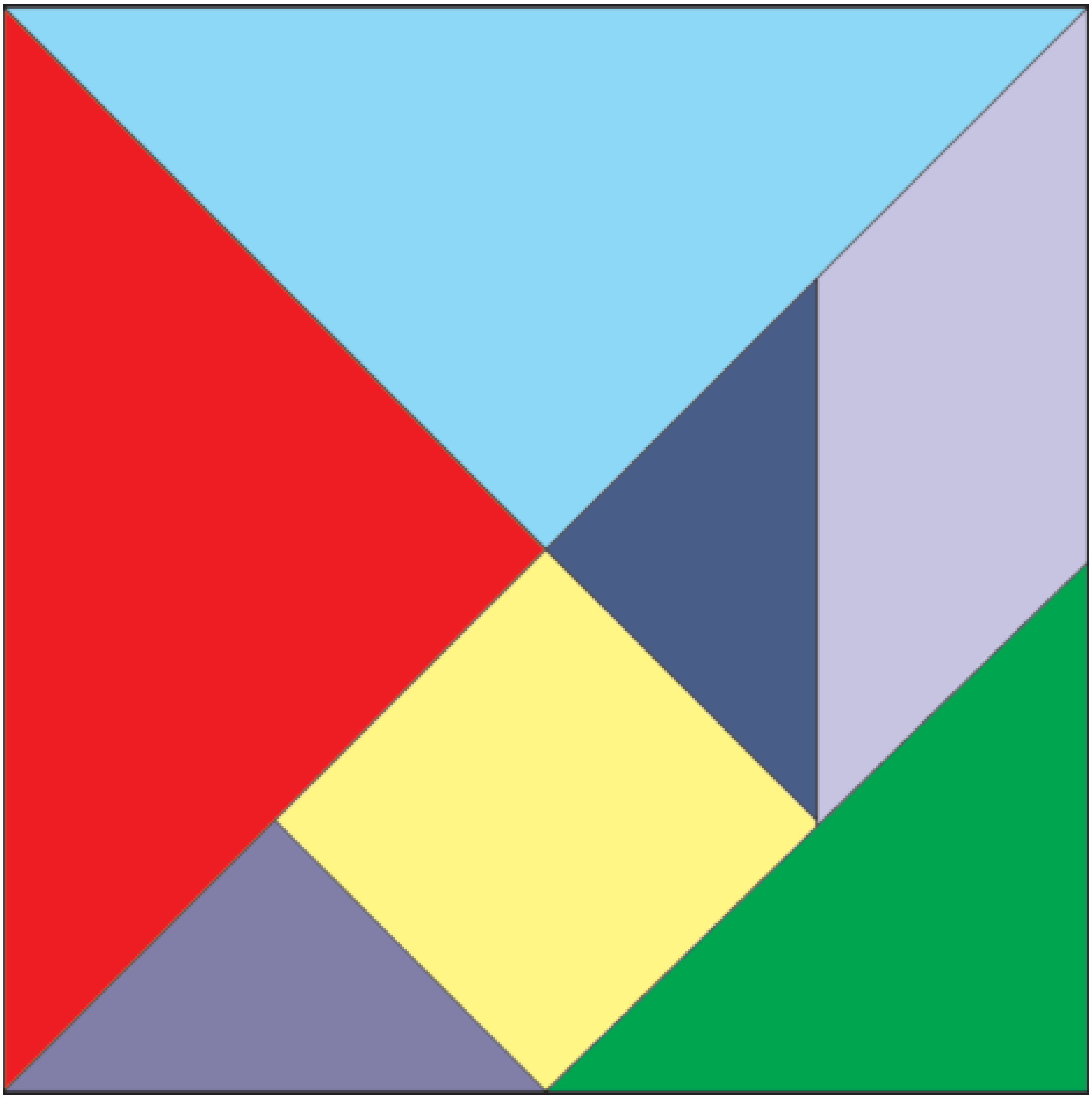

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