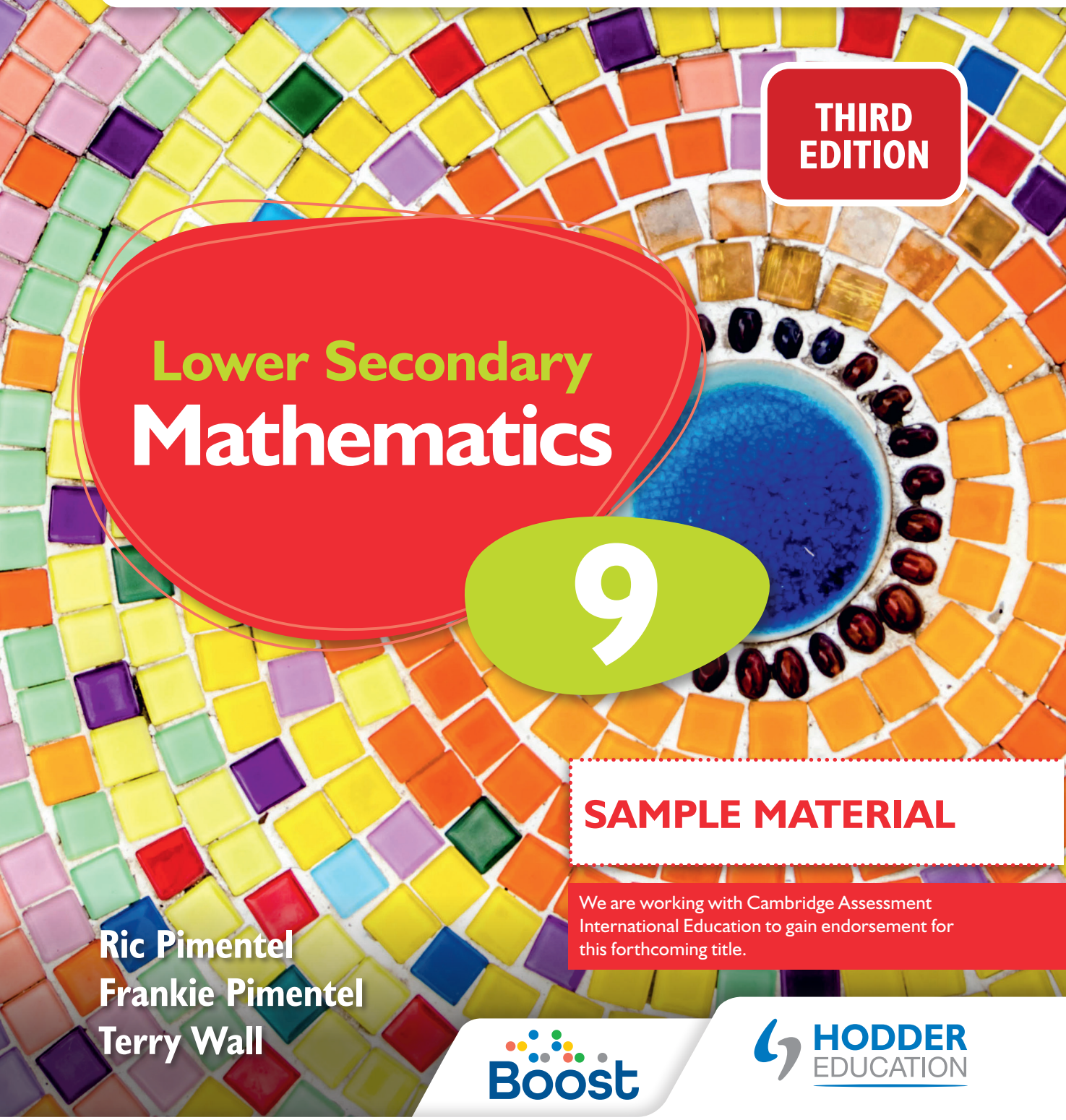
Cambridge checkpoint

Cambridge Assessment International Education

Endorsed for full syllabus coverage



THIRD EDITION

Lower Secondary Mathematics 9

SAMPLE MATERIAL

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming title.

Ric Pimentel
Frankie Pimentel
Terry Wall

Boost

HODDER EDUCATION

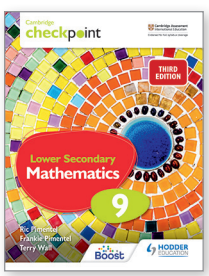
Please note this is a sample and not a full chapter

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming series.

Help students engage with and fully understand topics they are studying, with an emphasis on mathematical thinking and working, following the new Cambridge Lower Secondary Mathematics curriculum framework (0862) from 2020.

Student's Book £19.50 March 2021	Boost eBook £13 for 1-year access March 2021	Workbook £7.25 June 2021	Teacher's Guide with Boost subscription £150 for access until 2026 July 2021
Student's Book 7 9781398301948	Boost eBook 7 9781398301986	Workbook 7 9781398301269	Teacher's Guide 7 9781398300729
Student's Book 8 9781398301993	Boost eBook 8 9781398302037	Workbook 8 9781398301283	Teacher's Guide 8 9781398300736
Student's Book 9 9781398302044	Boost eBook 9 9781398302082	Workbook 9 9781398301306	Teacher's Guide 9 9781398300743

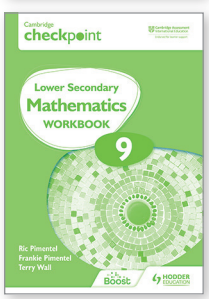
Boost eBooks – interactive, engaging and completely flexible



Boost eBooks use the latest research and technologies to provide the very best learning experience for students. They can be downloaded onto any device and used in the classroom, at home or on the move.

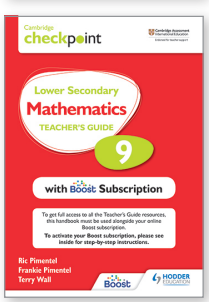
- **Interactive:** Packed with features such as notes, links, highlights, bookmarks, formative quizzes, flashcards, videos and interactive revision.
- **Accessible:** Effortlessly support different learning styles with text-to-speech function.
- **Flexible:** Seamlessly switch between the printed page view and interactive view.

Practise and consolidate knowledge gained from the Student's Book with this write-in workbook full of corresponding learning activities.



- Provides guidance for students on successfully covering all learning objectives within the new Cambridge Lower Secondary Mathematics framework.
- Reinforce student's understanding of key mathematical concepts with varied question types, quizzes and the use of ICT.
- Challenge students with extra practice activities to encourage regular self-assessment.

Created with teachers and students in schools across the globe, Boost is the next generation in digital learning for schools, bringing quality content and new technology together in one interactive website.



The Cambridge Checkpoint Lower Secondary Mathematics Teacher's Guides include a print handbook and a subscription to Boost, where you will find a range of online resources to support your teaching.

- **Confidently deliver the new curriculum framework:** Detailed guidance and explanations for new mathematical content, an introduction on the mastery approach and emphasis throughout on mathematical thinking and working.
- **Develop key concepts and skills:** A range of exercises including problem-solving and end-of-section tests, plus guidance on assessment, as well as ideas for supporting and extending students working at different levels.
- **Support the use of ESL:** Introductions and activities included that have been developed by an ESL specialist to help facilitate the most effective teaching in classrooms with mixed English abilities.
- **Enrich learning:** Audio versions of the glossary to help aid understanding, pronunciation and critical appreciation.

To explore the entire series, visit **www.hoddereducation.com/cambridge-checkpoint-maths**

We're here to help!

If we can help with questions, and to find out more, please contact us at **international.sales@hoddereducation.com**

Cambridge
checkpoint

THIRD EDITION

Lower Secondary Mathematics 9

Ric Pimentel
Frankie Pimentel
Terry Wall

HODDER EDUCATION
AN HACHETTE UK COMPANY

The Publishers would like to thank the following for permission to reproduce copyright material.

Photo credits

p.2 © royaltystockphoto /123RF.com

Acknowledgements

Every effort has been made to trace all copyright holders, but if any have been inadvertently overlooked, the Publishers will be pleased to make the necessary arrangements at the first opportunity.

Although every effort has been made to ensure that website addresses are correct at time of going to press, Hodder Education cannot be held responsible for the content of any website mentioned in this book. It is sometimes possible to find a relocated web page by typing in the address of the home page for a website in the URL window of your browser.

Hachette UK's policy is to use papers that are natural, renewable and recyclable products and made from wood grown in well-managed forests and other controlled sources. The logging and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

Orders: please contact Bookpoint Ltd, 130 Park Drive, Milton Park, Abingdon, Oxon OX14 4SE. Telephone: +44 (0)1235 827827. Fax: +44 (0)1235 400401. Email education@bookpoint.co.uk Lines are open from 9 a.m. to 5 p.m., Monday to Saturday, with a 24-hour message answering service. You can also order through our website: www.hoddereducation.com

ISBN: 9781398302044

First published in 2011
This edition published in 2021 by
Hodder Education,
An Hachette UK Company
Carmelite House
50 Victoria Embankment
London EC4Y 0DZ

www.hoddereducation.com

Impression number 10 9 8 7 6 5 4 3 2 1

Year 2025 2024 2023 2022 2021

Cover photo © tiverylucky - stock.adobe.com

Illustrations by Integra Software Services Pvt. Ltd., Pondicherry, India

Typeset in Integra Software Services Pvt. Ltd., Pondicherry, India

Printed in the UK

A catalogue record for this title is available from the British Library.

Contents

The units in this book have been arranged to match the Cambridge Lower Secondary Mathematics curriculum framework. Each unit is colour coded according to the area of the syllabus it covers:

- Number
- Geometry & Measure
- Statistics & Probability
- Algebra

Section 2

Section 3

6 Large and small units

- Know and recognise very small or very large units of length, capacity and mass.

Large and small distances

KEY INFORMATION
Although there are lots of different units for length the S.I. unit for length is the metre.

You will be familiar with the metre as a unit of measurement. Similarly, for longer distances, you will be used to using the kilometre. For smaller distances you will have used the millimetre.

However, these distances have limitations when distances are either very small or very large. Earlier in Chapter 1 of this book you looked at the use of standard form to describe large and small numbers. But there are other units of measurement that can be used.

LET'S TALK
What other units of length do you know?

The distance from the Earth to the Sun is approximately 149 million km. This can also be written as 149 000 000 km or 1.49×10^8 km. We can just about visualise this distance in our heads.

Apart from the Sun, the star nearest to Earth is called Proxima Centauri. Its distance from Earth is approximately 40 208 000 000 000 km away.

LET'S TALK
Discuss what is meant by a trillion.

This can also be written as 40.2 trillion km or 4.02×10^1 km. However, these numbers are more difficult to visualise.

A different unit is used when very large distances are being described and this is the **light year**.

KEY INFORMATION
Metres per second is usually shortened to either m/s or m s^{-1}.

Light can travel 299 792 458 metres per second. To two significant figures and in standard form this is 3.0×10^8 metres per second. A light year is therefore, as the name implies, how far light travels in 1 year and this is approximately equivalent to 9.46×10^{15} m.

The approximate distance from Earth to Proxima Centauri is therefore more commonly given as 4.25 light years.

KEY INFORMATION
The more accurate distance that light travels in 1 year is 9 460 730 472 580 800.

LET'S TALK
Using the word 'trillion', describe the distance of 1 light year.

KEY INFORMATION
Care must be taken as one of the distances is given in km, whilst the other is in m. For the calculation, both must be the given in the same units.

Worked example

The distance of the star Alpha Centauri A from Earth is 4.13×10^{13} km. Taking 1 light year as 9.46×10^{15} m, how many light years is Alpha Centauri A from Earth?

Changing km to m

$4.13 \times 10^{13}\,\text{km} = 4.13 \times 10^{16}\,\text{m}$

$4.13 \times 10^{16} \div 9.46 \times 10^{15} = 4.37$

Therefore, Alpha Centauri A is 4.37 light years from Earth.

KEY INFORMATION
This means that light would take 4.37 years to travel from Alpha Centauri A to Earth.

LET'S TALK
Why is looking into space looking back into time?

A light year is used for measuring very large distances.

For very small distances though the metre is split into smaller units. These are as follows:

1 **micrometre** = 1 millionth of a metre. Its symbol is µm.

Therefore $1\,\text{m} = 1 \times 10^{-6}\,\text{m}$

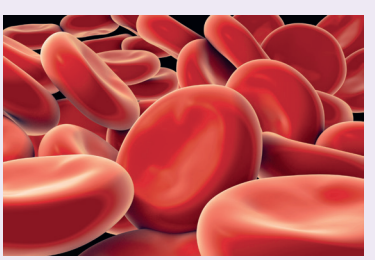
1 **nanometre** = 1 billionth of a metre. Its symbol is nm.

Therefore $1\,\text{nm} = 1 \times 10^{-9}\,\text{m}$

KEY INFORMATION
A billion is 1000 million.

Worked example

The average human red blood cell has a diameter of approximately 8 µm.



How many would need to be placed end to end in order to form a length of 1 cm?

Both lengths need to be using the same units e.g. metres.

$8\,\mu\text{m} = 8 \times 10^{-6}\,\text{m}$

$1\,\text{cm} = 0.01\,\text{m}$

$0.01 \div (8 \times 10^{-6}) = 1250$

Therefore, approximately 1250 red blood cells are needed to form a length of 1 cm.

Exercise 6.1

LET'S TALK
Does a light year take into account leap years?

1 a Decide whether the following statement is true or false:
A light year is a measure of time.
b Justify your answer.

2 Using the speed of light as 3.0×10^8 m/s, convert the following into km.
a 1.5 light years
b 8.245 light years

3 The distance from the Earth to the Sun is approximately 149 million km. Taking the speed of light as 3.0×10^8 metres per second, calculate how long it takes sunlight to reach the Earth. Give your answer in an appropriate unit.

4 a Write the following lengths in μm
i 0.00005 m
ii 7.0×10^{-8} m
iii 0.12 mm
b Write the following lengths in nm
i 5 μm
ii 2.0×10^{-12} m

5 Taking the speed of light as 3.0×10^8 m/s, work out which of the following pairs of distances is bigger.
a 2 000 000 000 000 km or 0.6 of a light year
b 10 000 km or 1 billionth of a light year?

KEY INFORMATION
In ascending order means starting with the smallest.

6 Rearrange the following table into ascending order of length.

Object	Length
Amoeba	500μm
Measles Virus	220nm
Grain of rice	6mm
Human Egg	0.00013m
Hepatitis Virus	4.5×10^{-8}m
Sesame seed	3×10^{-3}m

The Large Hadron Collider is the world's largest and most powerful particle accelerator. You may wish to investigate its uses and achievements further.

7 Sirius is the brightest star in the night sky. It is 8.66 light years away. Taking the speed of light as 3.0×10^8 m/s and the distance of the Sun from Earth as 149 million km, calculate how many times further Sirius is from Earth compared with the Sun.
Give your answer to two significant figures.

8 The Large Hadron Collider at CERN in Geneva is circular with a diameter of 8.5 km.
It has managed to accelerate particles up to a speed of 299.8 million m/s.
What is the maximum number of laps of the Collider that a particle can do in 1 second?
Give your answer to 2 s.f.

KEY INFORMATION
The word 'capacity' is a measure of volume dealing with liquids.

KEY INFORMATION
S.I. is short for Système Internationale and states the 7 base units from which all other units are derived.

LET'S TALK
Do you know the S.I. units for time, temperature and distance?

Units for mass and capacity

Just as with distances, there are also other units used for large and small masses and also large and small **capacities**.

The S.I. unit for mass is the kilogram (kg), but other units of mass are related to it. These are:

- **tonne** (t) – one thousand kilograms
- gram (g) – one thousandth of a kilogram
- **milligram** (mg) – one thousandth of a gram
- **microgram** (μg) – one millionth of a gram.

Each of these can be written in kilograms using standard form:

- 1 tonne = 1×10^{3} kg
- 1 gram = 1×10^{-3} kg
- 1 milligram = 1×10^{-3} g and therefore 1×10^{-6} kg
- 1 microgram = 1×10^{-6} g and therefore 1×10^{-9} kg.

Worked example

1 A grain of sugar has an approximate mass of 0.000 625 g.

a Write this mass in kg using standard form.

As a gram is $\frac{1}{1000}$th of a kilogram, divide by 1000.

Therefore $0.000\ 625 \div 1000 = 0.000\ 000\ 625$ kg

In standard form $0.000\ 000\ 625 = 6.25 \times 10^{-7}$ kg

b Write the mass in micrograms.

As a gram is 1 000 000 times bigger than a microgram, the mass must be multiplied by 1 000 000.

$0.000\ 625 \times 1\ 000\ 000 = 625$

Therefore the mass of a grain of sugar = 625 μg

c Approximately how many grains of sugar are in a 1 kg bag?

Using the same units:

$1 \div (6.25 \times 10^{-7}) = 1\ 600\ 000$

Approximately 1 600 000 grains of sugar in a 1 kg bag.

KEY INFORMATION
The prefix '*milli*' means one thousandth of the unit that follows it, i.e. *milli*litre is one thousandth of a litre.

The prefix '*micro*' means one millionth of the unit that follows it, i.e. *micro*litre is one millionth of a litre.

Capacity deals with a volume of liquid.

The S.I. unit for capacity is the litre. As with other units smaller quantities can be described using the millilitre (ml) and **microlitre** (μl).

KEY INFORMATION
Larger volumes litres are usually given in terms of m^3. However this will not be covered in this book.

Therefore as before:
- 1 millilitre = 1 thousandth of a litre
- 1 microlitre = 1 millionth of a litre.

In standard form these can be written as:
- 1 millilitre = 1×10^{-3} litre
- 1 microlitre = 1×10^{-6} litre

KEY INFORMATION
Dividing by 1 000 000 is the same as multiplying by 1×10^{-6}.

Worked example

A fine pipette can dispense a 1.5 µl of liquid each time.

It is used to add liquid to 5000 test tubes.

How much liquid is added in total? Give your answers in

i litres

ii millilitres

Total volume = $5000 \times 1.5 = 7500$ µl

i To convert µl to litres divide by 1 000 000

Therefore $7500 \div 1\ 000\ 000 = 7.5 \times 10^{-3}$ litres

ii To convert µl to millilitres divide by 1000

Therefore $7500 \div 1000 = 7.5$ ml

Exercise 6.2

1 The mass of a mosquito is given as 2.5×10^{-6} kg and the mass of a flea as 1.2×10^{-5} kg. Which is heavier? Justify your answer.

2 a How many grams are there in 2.5 t?

b How many milligrams are there in 0.75 kg?

c How many micrograms are there in 3.5 mg ?

d How many milligrams in 420 µg ?

e How many grams in 85 000 µg ?

3 A housefly has a mass of 2.5×10^{-5} kg. Express this mass in

a grams

b milligrams

c micrograms

4 A teaspoon holds 5 ml of liquid. How many teaspoons will be needed to fill a container of 420 litres? Give your answer in standard form.

5 The average human cell has a mass of 1.0×10^{-12} kg.

a Express the mass in micrograms

b If an adult has a mass of 81.5 kg, approximately how many cells will he have?
Give your answer in standard form to 3 s.f.

LET'S TALK

Will 1 cm^3 of all liquids and solids have the same mass?

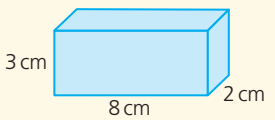
How does this question relate to the Greek mathematician Archimedes?

6 1 cm^3 of water has a mass of 1 gram.
1 litre of water has a mass of 1 kg.

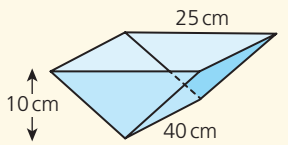
a How many cm^3 of water are equivalent to 1 litre?

b Calculate how many litres of water each of the following containers can hold.

i



ii



c Calculate the mass of water in each container.

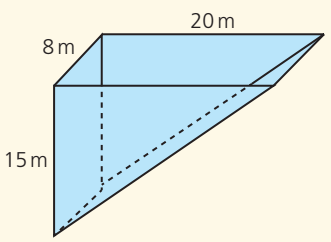
7 A laboratory assistant can use two types of micro pipette for an experiment. One with a capacity of 4 µl, the other 15 µl.
Which pipette should be used if exactly:

a 0.14 ml is needed?

b **i** 0.12 ml is needed?

ii Justify your choice to **i)** above.

8 The mass of 1 m^3 of water is given as 1 tonne.
The mass of 1 litre of water is 1 kg.
A large water container in the shape of a triangular prism is shown (not to scale).



a Calculate the mass of water needed to fill the container.

b If water is pumped in at a rate of 220 litres per minute, calculate how long it will take to fill.
Give your answer using suitable units and justify your choice of units.

Digital storage

The last thirty years has seen an explosion in the use of the computer in every aspect of our lives. From the storage in a phone to the storage capabilities of large digital companies, the ability to store huge amounts of data has become a central part of modern life.

LET'S TALK

If you have a smartphone compare its storage capacity with that of the IBM hard disk from 1956.

How much more data can your phone hold?

The unit of digital information is known as the **Byte (B)**.

Multiples of this unit are as follows:

- **megabyte** (MB) = 1 million bytes, i.e. 1×10^6 B
- **gigabyte** (GB) = 1 billion bytes, i.e. 1×10^9 B
- **terabyte** (TB) = 1 trillion bytes, i.e. 1×10^{12} B

The first computer with a hard disk was produced in 1956 by IBM. It could store 5 MB of data and weighed over a tonne.

Today home computers with a storage capability of 1 TB are not uncommon.

Worked example

A memory card for a camera has a storage capacity of 32 GB.

The digital camera takes photographs with an average file size of 12 MB.

How many photographs can be stored on the memory card?

Converting 32GB into MB so that we are working with the same units:

1 GB = 1000 MB, therefore 32 GB = 32 000 MB

$32000 \div 12 = 2667$ (4 s.f)

Therefore, the memory card can hold approximately 2667 photographs.

Exercise 6.3

1. Convert the following storage quantities:
   - a 10 000 000 B to MB
   - b 500 MB to GB
   - c 50 GB to TB
   - d $\frac{1}{5}$ TB to MB
   - e 0.45 GB to MB
2. A dual layer blu-ray disc can store 50 GB of data.
   How many blu-ray discs can be stored on a computer with a 4 TB capacity?
3. The book *War and Peace* by Leo Tolstoy is one of the longest novels written. When converted to digital format it occupies approximately 1.7 MB of storage. How many copies of *War and Peace* can be stored on a 1 GB hard drive?
4. A phone can hold 16 GB of data.
   An 8.3 GB video and 620 photos each of 6 MB are stored on the card. The Apps occupy a further 2.4 GB of storage.
   - a How many GB of storage is still left on the phone?
   - b Convert your answer to **(a)** into MB

5. A digital camera has a memory card with a storage capacity of 8 GB. The camera can take high resolution photographs with an average file size of 12 MB; medium resolution photographs with an average file size of 5 MB or low resolution photographs with an average file size of 1.5 MB.
   The memory card already has the following number of photographs on it:
   - 210 high resolution
   - 424 medium resolution
   - 1210 low resolution.

   The photographer isn't sure whether to take the rest of his photographs on a medium or a low resolution. How many fewer photographs can he take if he chooses to take them on the medium setting rather than the low resolution setting?

6 A 1 hour episode of a series when downloaded in high definition uses up 440 MB of storage.
Freya and Matthew want to download all the episodes from all the series of a popular TV programme. There are six episodes per series and eight series have been produced.
Their computer has 25 GB of available storage.

a Can they download all of the programmes? Justify your answer.

b They start to download the programmes at 8 p.m.
If their download speed is 60 MB per second at what time will all the programmes have been downloaded?

7 An average song lasts 3 minutes and occupies 4 MB of storage.
Francisco has downloaded 9.6 GB of songs onto his phone.
He decides to listen to all of his songs continuously in one go. He starts playing them at 9.00 a.m. on 1st January.
At what time and date will he have finished listening to all of his songs?

Now you have completed Unit 6, you may like to try the Unit 6 online quiz if you are using the Boost eBook.

Cambridge
checkpoint

Lower Secondary Mathematics 9

Help students engage with and fully understand topics they are studying with an emphasis on mathematical thinking and working throughout.

- Provide activities to increase student's subject knowledge and develop the skills necessary to think and work mathematically.
- Engage learners with chapter openers that include historical notes with a cultural focus encouraging them to spot cross curricular links.
- Support development of English language skills with the use of mathematical terms and activities to help facilitate effective teaching in classrooms with mixed English abilities.

For over 25 years we have been trusted by Cambridge schools around the world to provide quality support for teaching and learning.
For this reason we have been selected by Cambridge Assessment International Education as an official publisher of endorsed material for their syllabuses.

This resource is endorsed by Cambridge Assessment International Education

- ✓ Provides support as part of a set of resources for the Cambridge Lower Secondary Maths curriculum framework (0862) from 2020
- ✓ Has passed Cambridge International's rigorous quality-assurance process
- ✓ Developed by subject experts
- ✓ For Cambridge schools worldwide

Boost
This series includes eBooks and teacher support.
Visit www.hoddereducation.com/boost to find out more.

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming series.

HODDER EDUCATION
e: education@bookpoint.co.uk
w: hoddereducation.com

ISBN 978-1-3983-1035-3