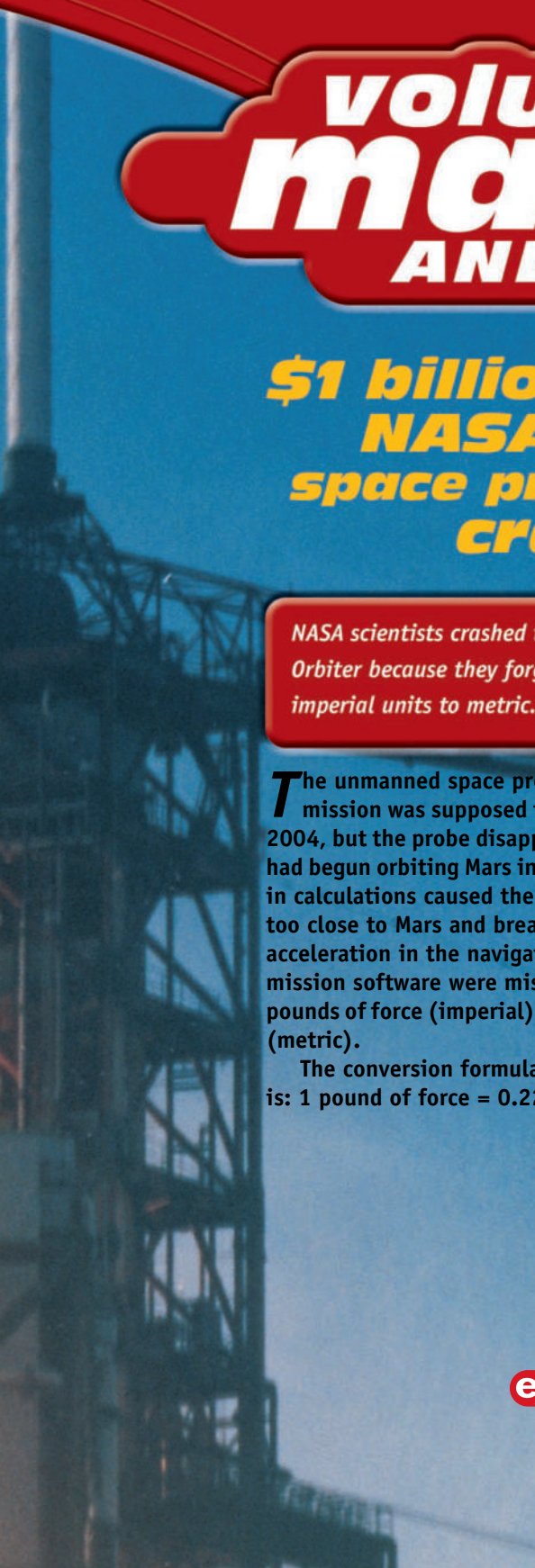
RETURN TO MAIN MENU

volume, mass AND TIME 11



$1 billion NASA space probe crash

NASA scientists crashed the Mars Climate Orbiter because they forgot to convert imperial units to metric.

The unmanned space probe's primary mission was supposed to end in December 2004, but the probe disappeared soon after it had begun orbiting Mars in 1999. The mistake in calculations caused the satellite to move too close to Mars and break apart. Units for acceleration in the navigation-related mission software were mistakenly given in pounds of force (imperial) instead of newtons (metric).

The conversion formula for the two units is: 1 pound of force = 0.225 newtons.

outcomes

After completing this chapter you will be able to:

- calculate the volume of solids based on rectangles
- understand the difference between volume and capacity
- understand the relationship between volume and mass of water
- measure, estimate and calculate time
- produce and interpret timelines
- produce and interpret timetables
- work with Australian and international time zones.

e hi.com.au

prepzone 11

Prepare for this chapter by attempting the following questions. If you have difficulty with a question, click on the Replay Worksheet icon on your *eMaths Zone* CD or ask your teacher for the Replay Worksheet.

Worksheet R11.1

1 Calculate the following.

(a) $3 \times 2 \times 4$ **(b)** $2 \times 10.1 \times 4$ **(c)** $1.7 \times 3.2 \times 22$

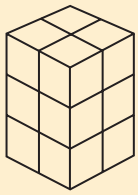
Worksheet R11.2

2 Copy and complete the following conversions.

(a) 2 km = ___ m **(b)** 0.25 m = ___ mm **(c)** 435 cm = ___ km

Worksheet R11.3

3 How many sugar cubes are in the stack shown here?



Worksheet R11.4

4 Write these as digital times.

(a) twelve minutes past seven **(b)** quarter past three

(c)

(d)

Worksheet R11.5

5 Convert:

(a) 180 seconds to minutes **(b)** $2\frac{1}{2}$ years to months

(c) 11 weeks to days **(d)** 50 hours to minutes

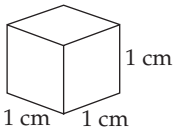
KEY WORDS

capacity	kilogram	rectangular prism	time zone
cubic centimetre	litre	time	tonne
cubic metre	mass	timeline	24-hour time
gram	millilitre	timetable	volume

11.1 Volume

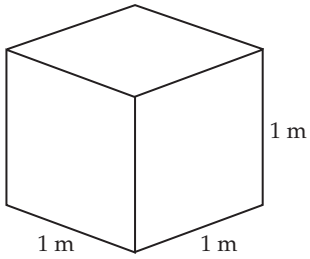
Volume is the amount of space occupied by a three-dimensional object.

We can measure the volume of an object by counting or calculating the number of **cubic centimetres** that would fit inside it. A cubic centimetre is shown opposite.



The short way of writing cubic centimetres is cm^3 (sometimes called 'centimetres cubed').

Larger volumes, such as that occupied by the water in a swimming pool, may be measured in **cubic metres** (m^3). A cubic metre of water is the amount that would fit into a box with all edges 1 m long. We can write a cubic metre as m^3 and say 'metres cubed'.



We will now look at some **rectangular prisms**.

exercise 11.1 Volume

Preparation: Prep Zone Q1 and 3

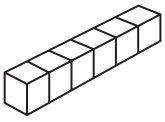
Core

1 How many cubic centimetres are there in the following solids? (Each small cube represents 1 cm^3.)

Worksheet C11.1

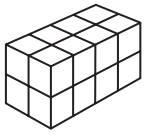
Hint

(a)

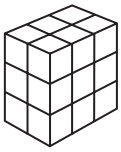


(b)

(c)



(d)



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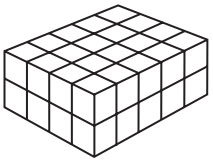

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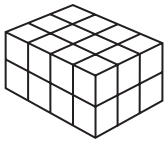

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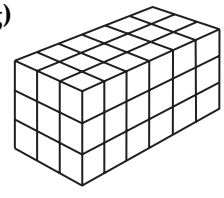

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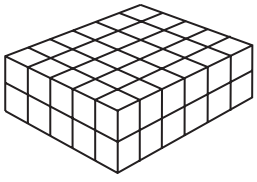
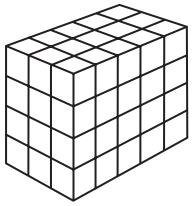
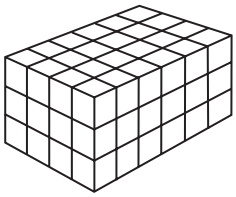
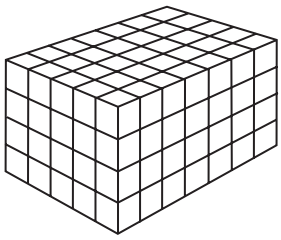
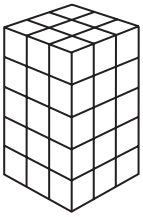


(i)

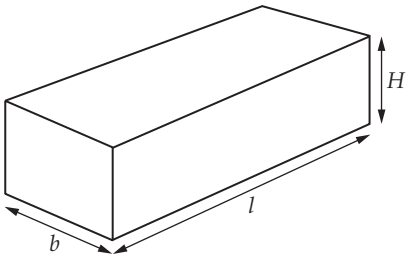


(j) 

(k) 

(l) 

2 The dimensions of a rectangular prism are its length (l), breadth (b) and height (H), as shown on the prism.



(i) Copy and complete the table below using information from Question **1**.

Hint

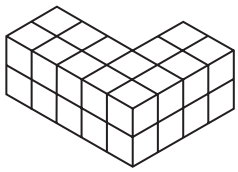
Solid	*Length l* (cm)	*Breadth b* (cm)	*Height H* (cm)	*Volume V* (cm^3)
(a)				
(b)				
(c)				
etc.				

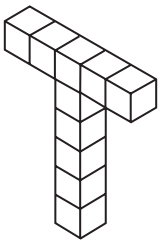
(ii) Can you see a connection between l, b, H and V? How could you calculate the volume of a rectangular prism without counting individual cubes?

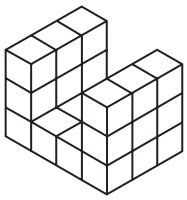
Extension

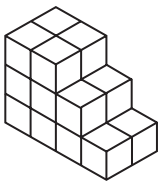
3 Find the volume of each of these compound solids.

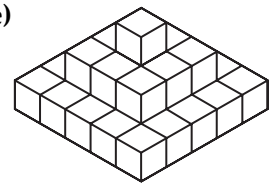
Hint

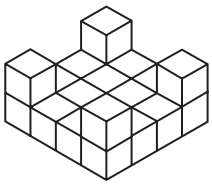
(a) 

(b) 

(c) 

(d) 

(e) 

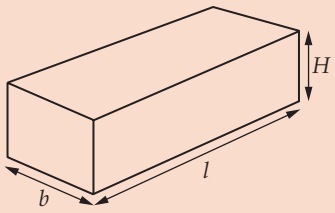
(f) 

4 A particular rectangular prism is made of 30 one-centimetre cubes. Give possible values for the length, breadth and height of the prism.

11.2 Volume of rectangular prisms

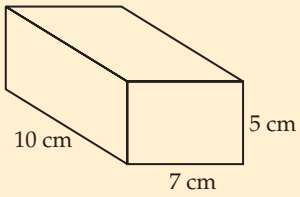
As we have seen, rectangular prisms are three-dimensional solids that have the same rectangular cross-section all the way through. To calculate their volume you multiply their length, breadth and height values together.

$V = l \times b \times H$ or $V = lbH$



worked example 1

Find the volume of the following rectangular prism.



Steps

1. State the formula for calculating the volume of rectangular prisms.
2. Substitute the values for l, b and H into the formula and evaluate.

Solution

$V = lbH$

$V = 10 \times 7 \times 5$
$= 350 \text{ cm}^3$

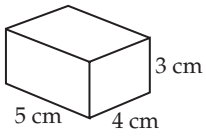
exercise 11.2 Volume of rectangular prisms

Preparation: Prep Zone Q1, Ex 11.1

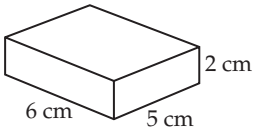
Core

1 Use the formula to find the volume of the following rectangular prisms in cm^3.

(a)



(b)



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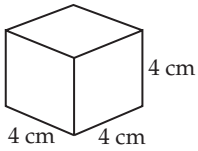
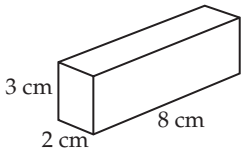


Hint

(d)



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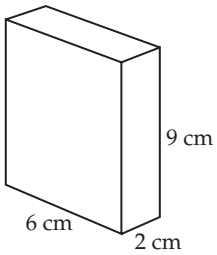

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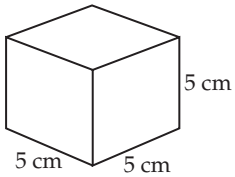

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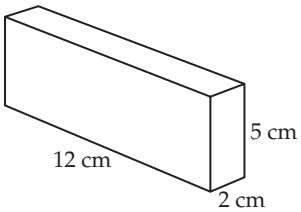
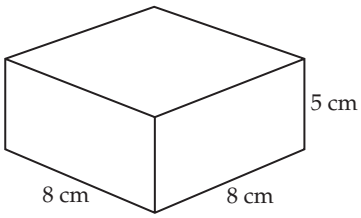


(h)



2 A room is 3 m long, 2 m wide and 2 m high. What is its volume in metres cubed?

3 A pocket speller has a cover 12 cm long and 9 cm wide and is 2 cm thick. Find the volume of this book.

Hint

4 Choose the correct answer.
The volume occupied by 24 chocolate bars if each bar is 16 cm long, 8 cm wide and 2 cm thick would be:

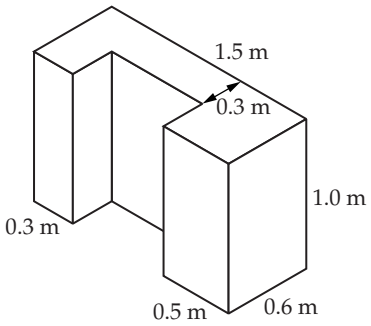
A 624 cm^3 **B** 3072 cm^3 **C** 6144 cm^3 **D** 256 cm^3

5 If a cake in the shape of a rectangular prism is 20 cm long, 10 cm wide and 8 cm thick when baked, what will its volume be after it is iced all over (including the bottom) with a layer of icing 0.5 cm thick?

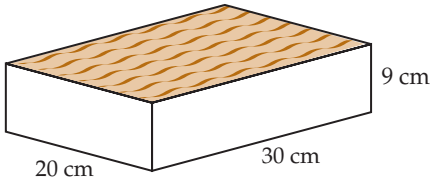
Extension

6 Lachlan has finished the brickwork for his backyard barbecue, shown opposite. Find the volume of bricks used in building the barbecue.

Hint



7 Hilda has prepared a large lasagna to serve 6 people.
If she divides all of it equally, what volume of lasagna does each person receive?



11.3 Capacity

Liquids take up space—that is, they have volume. **Capacity** is a term used for the size of the space inside a container for liquids (and gases). Like volume, capacity may be measured in cubic centimetres or cubic metres. However other units—**litres** and **millilitres**—are also used, for both capacity (the volume inside the container) and the volume of liquid or gas.

A millilitre is the same volume as a cubic centimetre, and a litre equals 1000 millilitres.

A standard milk carton has a capacity of 1 litre.

A small medicine dropper holds about 1 millilitre of liquid.

1 litre = 1000 millilitres

or

1 L = 1000 mL

1 litre of milk

About 1 millilitre

The decimal point movement chart for litres and millilitres is shown below.

Common units of capacity are litres (L) and millilitres (mL).

1 L = 1000 mL

× 1000 →

L ⌒⌒ mL

← ÷ 1000

worked example 2

Convert:

(a) 2.25 L to mL **(b)** 600 mL to L

Steps

(a) 1. Move the decimal point 3 places to the right as indicated on the chart.

2. Since the answer is a whole number, the decimal point may be left off.

(b) 1. Begin with 600.0 mL and move the decimal point 3 places to the left as shown on the chart.

2. Place a zero in the units space for neatness.

Solutions

(a)

2.25 L

2.25 L = 2250 mL

(b)

600.0 mL

600 mL = 0.6 L

The methods for calculating both capacity and volume are very closely linked. We know that 1 mL = 1 cm^3 and 1 L = 1000 mL, so 1 L occupies 1000 cm^3. Therefore, it is possible to calculate the capacity of a container shaped as a prism if we know the volume of space it encloses.

worked example 3

Find the capacity of a rectangular prism, of length 6 cm, breadth 4 cm and height 5 cm. Give your answer in millilitres.

Steps

1. Write down the general formula for the volume of a rectangular prism.
2. Substitute the values for *l* (6), *b* (4) and *H* (5).
3. Evaluate.
4. Convert the answer to mL. Note that 1 mL = 1 cm^3.

Solution

$V = lbH$

$V = 6 \times 4 \times 5$

$V = 120$ cm^3

Capacity = 120 mL

1 mL = 1 cm^3
1 L = 1000 mL
So 1 L = 1000 cm^3

exercise 11.3 Capacity

Preparation: Prep Zone Q1 and 2, Ex 11.2

Core

1 Copy and complete the following conversions.

Hint

(a) 7 L = ___ mL	**(b)** 55 000 mL = ___ L	**(c)** 2000 mL = ___ L
(d) 9 L = ___ mL	**(e)** 600 mL = ___ L	**(f)** 7.1 L = ___ mL
(g) 800 mL = ___ L	**(h)** 40 mL = ___ L	**(i)** 5 mL = ___ L
(j) 95 L = ___ mL	**(k)** 3.57 L = ___ mL	**(l)** 200 mL = ___ L
(m) 5000 L = ___ mL	**(n)** 0.03 L = ___ mL	**(o)** 0.025 L = ___ mL
(p) 6 mL = ___ L	**(q)** 52 mL = ___ L	**(r)** 8750 mL = ___ L

2 Choose the correct answer.
16 L is equal to:
A 0.016 mL **B** 160 mL **C** 1600 mL **D** 16 000 mL

3 Choose the correct answer.
3450 mL is equal to:
A 0.003 45 L **B** 3.45 L **C** 34.5 L **D** 3 450 000 L

Hint

4 Germans drink an average of 143 000 mL of beer per person each year. How many litres is this?

5 The French consume on average 74 litres of champagne per person annually. How many millilitres is this?

Hint

6 The instructions on a pack of orange juice concentrate say to add water to the contents to make up 2 L. If the pack contains 500 mL of concentrate, how much water should be added? (Answer in litres.)

7 During a science experiment, Polly pours 45 mL of acid into a beaker already containing 0.75 L of acid. How much acid is there in the beaker now? (Answer in mL.)

Extension

8 Find the capacity (in mL) of rectangular prisms with the following dimensions.

(a) length = 12 cm, breadth = 5 cm, height = 9 cm
(b) length = 11 cm, breadth = 8 cm, height = 2 cm
(c) length = 6.2 cm, breadth = 3 cm, height = 2.5 cm
(d) length = 12.6 cm, breadth = 10 cm, height = 18.2 cm

9 Larissa and Dave are installing a pool in their backyard. It is rectangular and will be 4 m wide, 12 m long, and have a depth of 1.5 m.

(a) What volume of soil needs to be removed for the installation of the pool?

(b) Given that 1 m^3 = 1000 L, what is the capacity of the pool?

(c) If it costs 68 cents for every 1000 litres of water, what will it cost to fill the pool to its rim?

Hint

Working mathematically

problem solving

Measuring mayhem

Al needs 600 mL of water to add to a curry he is making for his family. He only has jugs that can hold 400 mL and 900 mL. How can Al use these two jugs to accurately measure 600 mL?

Working mathematically

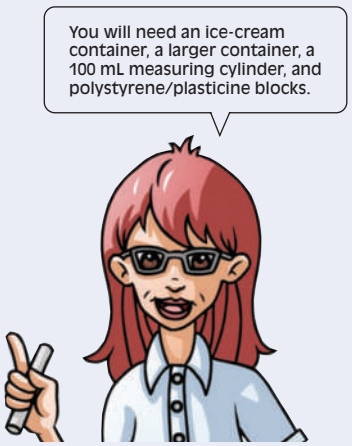
investigation

Volume and liquid displacement

1 Using the plasticine or polystyrene, make a 1 cm cube. If you have blocks of this size already available these can be used instead.

2 Fill the measuring cylinder to the 50 mL mark. Place the 1 cm cube in the cylinder and note the water level afterwards. If your cube doesn't submerge completely, carefully use a pen or compass to push it just under the water level. The increase in the measured volume of water represents its volume.
What can you say about the volume of the 1 cm cube?

3 Now add another 2 cubes to the cylinder.
What do you notice about the water level now? Record your results in the table on the next page.



4 Place the ice-cream container in the bigger container and fill it with water to its brim. Find or make a cube of dimension 10 cm (i.e. 10 cm by 10 cm by 10 cm) and place it in the ice-cream container. Carefully pour the water overflow into the measuring cylinder and record the results in the table below.
What is the volume of this cube?

5 Using the available materials, investigate the volume of different sized objects, recording your results in a table like the one below. Before each measurement, estimate the volume of each item.

Object	*Estimated volume* (mL)	*Measured volume* (mL)	*Volume* (cm^3)
1 cm^3			
2 cm^3			
10 cm cube			

11.4 Mass

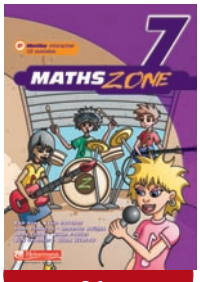
Mass is measured in a variety of units that include **grams** (g), **kilograms** (kg) and **tonnes** (t).

Gram comes from the Greek word *gramma*, meaning 'little weight'. Since 'kilo' means 1000, a kilogram equals 1000 grams. A tonne is equal to 1000 kilograms.

1 tonne = 1000 kilograms
1 kilogram = 1000 grams

Four sumo wrestlers would have a combined mass of about 1 tonne, this text book has a mass of about 2 kilograms, and a chocolate button has a mass of approximately 2 grams.

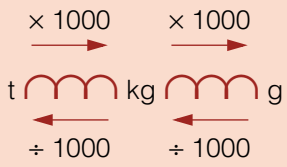

1 t



2 kg


2 g

As the measurement of mass is based on the metric system, conversion of units is very easy. The decimal point movement chart for converting between tonnes, kilograms and grams appears as follows:



worked example 4

Convert:

(a) 3.1 t to kg **(b)** 5200 kg to t **(c)** 400 000 g to t

Steps

(a) 1. Begin with 3.1 t and move the decimal point 3 places to the right.

2. Fill in the spaces with zeros.

(b) 1. Start with 5200.0 kg and move the decimal point 3 places to the left. (Remember 5200 is the same as 5200.0.)

2. Leave off unnecessary zeros.

(c) 1. Move the decimal point a total of 6 places to the left.

2. Put a zero in the units space to emphasise the placement of the decimal point.

Solutions

(a) 3.1 t

3.1 t = 3100 kg

(b) 5200.0 kg

5200 kg = 5.2 t

(c) 400000.0 g

400 000 g = 0.4 t

exercise 11.4 Mass

Preparation: Prep Zone Q2

Core

1 State which unit would be most appropriate for measuring the following.

Hint

(a) the mass of a gum leaf **(b)** the mass of a car

(c) the mass of your teacher **(d)** the mass of a chair

(e) the mass of 20 paper clips **(f)** the mass of 1000 bricks

2 Choose the correct answer.
The heaviest land animal is the African elephant. Its mass is said to be approximately the same as a small truck. Therefore, its mass would be approximately:
A 500 g
B 50 kg
C 500 kg
D 5000 kg

3 Copy and complete the following conversions.

Worksheet C11.2
Hint
eTester

(a) 5 t = ____ kg
(b) 647 t = ____ kg
(c) 8 kg = ____ g
(d) 0.033 kg = ____ g
(e) 7.1 t = ____ g
(f) 0.35 t = ____ g
(g) 9.17 kg = ____ t
(h) 455 g = ____ kg
(i) 5000 kg = ____ t
(j) 7000 g = ____ t

4 Choose the correct answer.
The masses 1.52 t, 152 kg and 15 200 g arranged in order from smallest to largest would appear as follows:

Hint

A 1.52 t, 152 kg, 15 200 g
B 1.52 t, 15 200 g, 152 kg
C 15 200 g, 1.52 t, 152 kg
D 15 200 g, 152 kg, 1.52 t

5 Which is heavier, 20 kg of feathers or 20 kg of bricks?

6 The mass of the average adult male human brain is 1408 g. What is this in kilograms?

Hint

7 A car tows a 260 kg trailer to collect an 830 kg load of crushed rock. What total mass must the car tow when the trailer is loaded? (Answer in tonnes.)

8 Bridget places masses of 5 kg and 2750 g on her dumb-bell before lifting it. If the dumb-bell itself has a mass of 4 kg, what total mass does she lift? (Answer in kilograms.)

Extension

9 Australia produces on average 416 kg of gold per day. How many tonnes is this:

Hint

(a) per month (30 days)
(b) per year (365 days)? Give your answer to the nearest 10 tonnes.

10 Baby Karl arrived home from hospital 1 week old and weighing 4480 g. During the next four weeks he put on 420 g, 570 g, 530 g and 650 g. What is his mass at age 5 weeks? (Answer in kilograms.)

11 A delicatessen advertises blue vein cheese for $18 per kilogram. How much would a 225 g piece cost?

e Hint

12 The mass of 1 cubic centimetre of water (or 1 mL) is 1 gram. Answer the following questions using this information.

(a) What is the mass of each of the following quantities of water?

(i) 235 mL **(ii)** 32.5 mL **(iii)** 7.65 L

(b) What is the mass of the water inside each of the following filled containers? Give answers in the units indicated.

(i) a 1.5 L jug (kg)

(ii) a bottle of capacity 3.75 L (kg)

(iii) a container of volume 960 cm^3 (g)

(iv) a rectangular fish tank of length 12 cm, width 9 cm and height 5 cm (g)

(v) a rectangular prism of length 16.5 cm, width 12.2 cm and height 20 cm (kg)

Not every substance weighs 1 g per 1 cm^3. Many substances (solids and liquids) are heavier or lighter than water. Even gases have different weights.

e Homework 11.1

Working mathematically

problem solving

Mass puzzlement

The fake gold coin

You have been given 9 gold coins. One of them is a fake that looks identical to the genuine coins, but has less mass. What is the minimum number of times you need to use a balance like the one shown here to separate the fake coin from the others? Explain your procedure.

Making masses

If you have only a 1 kg, a 2 kg, a 4 kg and an 8 kg mass, how many different total masses could you make? Show how you could make each different mass.
For example, 5 kg = 1 kg + 4 kg.

What extra masses could you make if you also had a 16 kg mass?

Make a list of possible combinations.

11.5 Time and timelines

Humans have always known that things related to time don't always stay the same. Seasons change, and the positions of the sun, the moon and the stars also change.

Unlike the other measurements in this chapter, time is not a metric measure. It is not based on tens. The measurements of time we use most frequently are:

1 minute = 60 seconds
1 hour = 60 minutes
1 day = 24 hours
1 week = 7 days

In addition, we usually say that a year is 365 days, or 366 days in a leap year.

One of the most common and easiest ways of measuring time is with clocks and watches.

A good way of displaying time is with **timelines**. This allows important events to be marked on a scale or diagram that represents a period of time. Although it may be a little inaccurate, it is a very good way of showing visually a chain of events.

worked example 5

The following dates represent the birth dates of famous mathematicians:

Pythagoras (585 BC)	Famous Greek mathematician who discovered a rule for the sides of right-angled triangles.
Archimedes (287 BC)	One of the greatest mathematicians of ancient times. He was involved in the calculation of π as well as finding areas and volumes of shapes.
Fibonacci (1175)	Talented Italian mathematician of the Renaissance who is well known for his study of the Fibonacci sequence.
Isaac Newton (1642)	English mathematician who invented calculus. He also made many discoveries in physics.

Draw a timeline showing these mathematicians' birth dates.

Steps

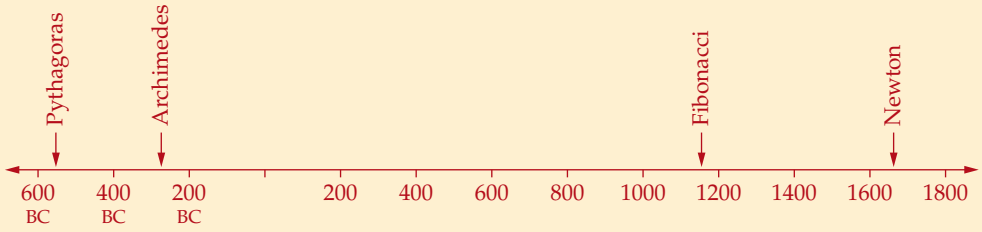
1. Determine the time interval we are interested in.
2. Determine the line length and scale to be used. Assume 1 cm = 200 years.

Solution

Time interval = 585 BC to 1642
= 2227 years

$2227 \div 200 \approx 12$
$\therefore$ Line length = 12 cm

3. Draw the timeline.



exercise 11.5 Time and timelines

Preparation: Prep Zone Q5

Core

1 (a) Draw a timeline that is 30 units long. You need to devise a scale that allows it to fit on your page. Number your timeline from 0 to 30 with each mark representing a year in your life.

Hint

(b) On your timeline, mark off each of the following events:

(i) started primary school
(ii) first family holiday
(iii) started secondary school
(iv) first rode a bike
(v) earliest memory
(vi) any other events that are important to you

(c) Predict when you expect the following events to occur and label them on your timeline.

(i) first job
(ii) first boyfriend or girlfriend
(iii) attend first social
(iv) finish secondary school
(v) get your driving licence
(vi) travel overseas
(vii) get married

2 What would be the best unit of time to use to measure how long each of the following takes—seconds, minutes, hours, days, weeks, months or years?

Hint

(a) cooking spaghetti
(b) flying from Sydney to London by aeroplane
(c) counting from 1 to 100
(d) swimming 25 metres
(e) learning to speak Japanese
(f) blinking four times, as fast as possible
(g) playing a game of Test cricket
(h) having a shower

(i) playing a game of netball **(j)** walking a kilometre
(k) playing a game of noughts and crosses
(l) having a good night's sleep **(m)** building a house

Extension

3 State TRUE or FALSE for the following.

(a) It takes about $365\frac{1}{4}$ days for the Earth to travel around the Sun.
(b) A leap year has 365 days.
(c) 1996 is a leap year because it is divisible by 4.
(d) Century years such as 1900, 2000 are always leap years.
(e) The BC in the date 340 BC stands for Before Christ's birth.
(f) Someone born in 205 BC would have died before someone born in 610 BC.
(g) A coin found at an archaeological site with the date 500 BC marked on it *must* be a forgery.
(h) The date of the year we are in at the moment can be written with AD after it.
(i) 2000 AD means two thousand years after the *birth* of Christ.
(j) A day is the time taken for the Earth to rotate once about its axis.
(k) There are exactly 52 weeks in a year.
(l) There are exactly 4 weeks in a month.
(m) There are exactly ten years in a decade.
(n) The months with exactly 30 days are September, April, June and November.
(o) February always has exactly 28 days.
(p) When daylight saving time starts, the clocks are put forward an hour so that 2 a.m. becomes 3 a.m.

speedingzone

Do these in your head as quickly as you can and write down the answers.

Time target: 2 minutes

1 $8100 \div 90$
2 $\frac{1}{5}$ of \$12.50
3 $2.37 + 1.52$
4 $10 - 4.68$
5 $289 - 310$
6 $5 \times 6 \div 2 \times 3$
7 $12 \div 0.4$
8 $2 \div \frac{1}{7}$
9 How many 45c stamps can you buy for \$5.00?
10 What size is the third angle in a triangle with angles of 65° and 70°?

11.6 Working with time

worked example 6

How much time has passed from 10.56 a.m. to 3.33 p.m.?

Steps	Solution
1. Look at the starting time and work out how many minutes to the next hour.	4 min
2. Work out how many whole hours before the finishing time.	11.00 a.m. to 3.00 p.m. = 4 h
3. Work out the remaining minutes to the finishing time.	3.00 p.m. to 3.33 p.m. = 33 min
4. Add up the times you've worked out.	4 min + 4 h + 33 min = 4 h 37 min

worked example 7

What is the time $4\frac{1}{2}$ hours after 11.47 a.m.?

Steps	Solution
1. Ignore the fraction and add the whole number hours onto the time.	11.47 a.m. + 4 h = 3.47 p.m.
2. Work out how many minutes the fraction part is.	$\frac{1}{2}$ h = 30 min
3. Add this onto the time. Make sure you go up to the next hour when you reach 60 minutes.	3.47 p.m. + 30 min = 3.47 p.m. + 13 min + 17 min = 4.00 p.m. + 17 min
4. Write down the answer.	= 4.17 p.m.

Twenty-four hour clock time is another way of expressing time and is commonly used when travelling. To calculate with **24-hour time** you need to remember that 12.00 midnight is your starting point and that it is expressed with 4 digits. Therefore, midnight is 0000, 1.00 a.m. is 0100 and 10.30 p.m. is 2230.

worked example 8

Express the following in 24-hour time.

(a) 6.30 a.m. **(b)** 7.45 p.m.

Steps

(a) 1. Calculate how many hours forward from 12.00 midnight the required time is.

2. Convert to a 4 digit number.

(b) 1. Calculate how many hours forward the required time is from 12.00 midnight.

2. Convert to a 4 digit number.

Solutions

(a) 12.00 to 6.30 a.m. = 6.30 hours

0630

(b) 12.00 to 7.45 p.m. = 19.45 hours

1945

A calculator can be useful when calculating with time. Most calculators have a button that looks similar to this [° ′ ″] or it may just say [DMS]. Both of these buttons are referring to degrees, minutes and seconds. There are 60 minutes in a degree, just as there are 60 minutes in an hour. There are 60 seconds in one minute whether we are referring to angles or time.

A calculator will convert hours, minutes and seconds into decimal values, then back again if necessary. For example, we know 3 hours and 15 minutes is three and a quarter hours. On the calculator press [3] [° ′ ″] [1] [5] [° ′ ″]. 3.25 should appear on the screen because 3 hours and 15 minutes is the same as 3.25 hours. After converting these times into decimal form you can use the calculator to add and subtract. When you need to convert back to degrees and minutes, and even seconds, you just press [SHIFT] or [2nd F] then [° ′ ″].

worked example 9

Carly purchased a CD single that had a title track on it and three remixes. The cover listed the following times per track:

Title track 3 min 42 s
Femsta remix 9 min 36 s
Wave Brothers remix 7 min 14 s
Madzone remix 6 min 17 s

What is the total playing time for the CD single?

Steps

1. Press the following on your calculator:

[3] [° ′ ″] [4] [2] [° ′ ″] [+] [7]
[° ′ ″] [1] [4] [° ′ ″] [+] [9] [° ′ ″]
[3] [6] [° ′ ″] [+] [6] [° ′ ″] [1]
[7] [° ′ ″] [=]

Solution

Screen reads 26.81666667

2. Convert back into minutes and seconds by pressing SHIFT or 2nd F then °′″. Write the answer.

The total playing time is 26 min 49 s.

eTutorial

exercise 11.6 Working with time

Preparation: Prep Zone Q4 and 5, Ex 11.5

Core

1 Work out how much time has passed between the times given.

Hint

(a) 2.55 a.m. to 5.41 a.m.
(b) 6.49 p.m. to 11.04 p.m.
(c) 7.34 p.m. to 10.20 p.m.
(d) 1.22 a.m. to 6.13 a.m.
(e) 10.52 p.m. to 1.09 a.m.
(f) 11.40 p.m. to 2.43 a.m.
(g) 1.43 a.m. to 11.52 a.m.
(h) 2.03 a.m. to 12.44 a.m.
(i) 12.01 a.m. to 11.54 p.m.
(j) 12.03 p.m. to 11.28 a.m.
(k) 10.27 a.m. to 1.00 a.m.
(l) 9.49 p.m. to 3.01 p.m.

2 What is the time:

Hint

(a) 3 hours after 4.15 a.m.
(b) 5 hours after 1.23 a.m.
(c) 6 hours after 8.12 p.m.
(d) 4 hours after 11.59 p.m.
(e) 5 hours after 10.55 a.m.
(f) 7 hours after 8.43 p.m.
(g) $3\frac{1}{2}$ hours after 4.21 p.m.
(h) $4\frac{1}{2}$ hours after 1.08 a.m.
(i) $7\frac{1}{4}$ hours after 9.49 a.m.
(j) $9\frac{1}{4}$ hours after 11.58 a.m.?

3 Copy and complete the following. The first one has been done for you.

Hint

(a) **(i)** 2.30 a.m. written in 24-hour time is 0230
(ii) 2.30 p.m. written in 24-hour time is 1430
(b) **(i)** 3.40 a.m. written in 24-hour time is ____
(ii) 3.40 p.m. written in 24-hour time is ____
(c) **(i)** 11.43 a.m. written in 24-hour time is ____
(ii) 11.43 p.m. written in 24-hour time is ____
(d) **(i)** 6.15 a.m. written in 24-hour time is ____
(ii) 6.15 p.m. written in 24-hour time is ____
(e) **(i)** 12.00 midday written in 24-hour time is ____
(ii) 12.00 midnight written in 24-hour time is ____

4 Write these 24-hour times as a.m. or p.m. times.

(a) 1354 **(b)** 0833 **(c)** 0539 **(d)** 1634
(e) 1830 **(f)** 1902 **(g)** 0147 **(h)** 0320

5 The following decimal calculator displays refer to number of hours. Write each decimal hour in hours and minutes. You can press SHIFT or 2nd F then °′″ on your calculator to check your answer.

Calculator

(a) 2.25 **(b)** 6.5 **(c)** 0.2 **(d)** 5.3333333
(e) 19.4 **(f)** 13.75 **(g)** 1.6666667 **(h)** 15.1

6 Jodie left home at seventeen minutes past eight in the morning and got to school at quarter to nine that morning. How long did it take her?

Hint

7 Nijina left home at twenty-five past eight in the morning and arrived at school thirty-six minutes later. What time did she get to school?

8 Choose the correct answer.
Mark 'Rabbit' Warren started the City Coast Fun Run at 10.49 a.m. and he finished at 2.36 p.m. The length of time that he took was:

A 3 h 47 min **B** 4 h 13 min
C 4 h **D** 8 h 13 min

Extension

9 Dirk left home at five past eight in the morning and caught the 8.13 train, which was one minute late. The train trip took twelve minutes, and it took him six minutes to walk from the station to the school.

Hint

(a) What time did he get to school?

(b) How many minutes did it take him to get from his home to school?

10 Gordon's flight to Cairns departed at 0915. If the flight takes three and a half hours, what 24-hour time will he arrive in Cairns?

Hint

11 Marcia wants to set her video, which uses 24-hour times, to tape the Wimbledon Tennis Final. She knows the telecast starts at ten thirty in the evening and goes for two and a half hours. What does she set the two time settings (start and finish) to?

12 The following are the playing times for the songs on the latest Hot Staff CD *Rock Classics*. What is the total playing time of the CD?

Hint

Kelly Watch the Stars	3 min 45 s
House on Fire	5 min 28 s
Around the World	7 min 9 s
Brick	1 min 50 s
Bentley's Gonna Sort You Out	4 min 55 s
Road Trippin'	3 min 25 s
Losing My Love	4 min 29 s
Clint Eastwood	5 min 42 s
One	7 min 29 s
Virtual Insanity	5 min 43 s

13 Check your answer to Question **12** using a calculator.

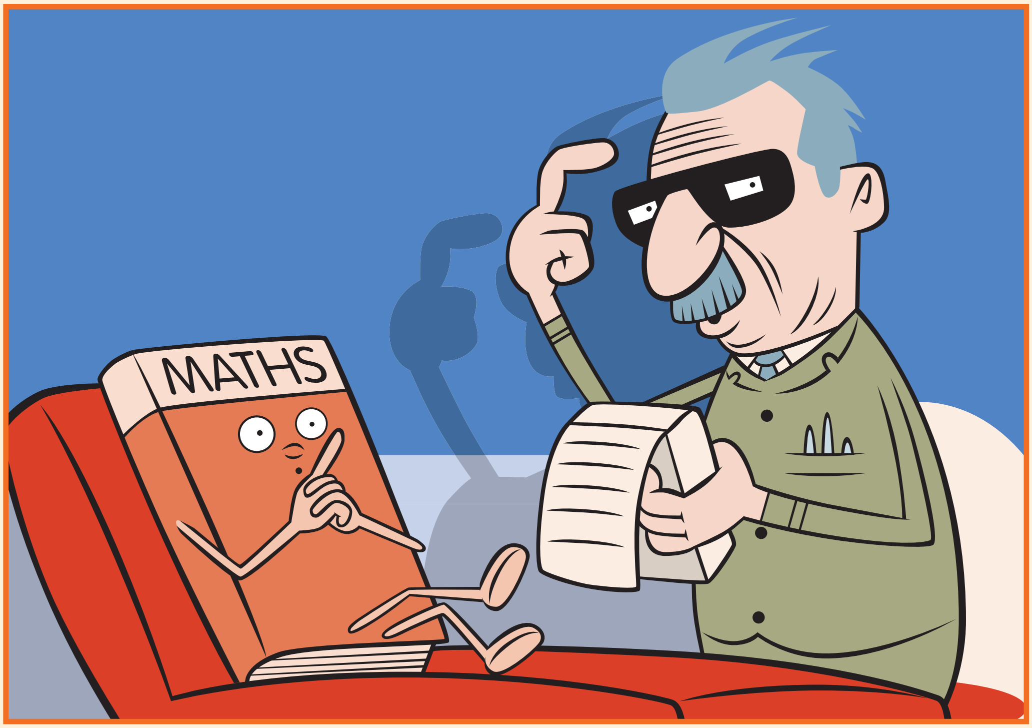
Calculator

Worksheet C11.3

eQuestions

RETURN TO MAIN MENU

laughzone



Answer the following, showing your working, then arrange the letters in the order shown by the corresponding answers to find the cartoon caption.

Find how many days each of the following represents.

3 weeks	**P**	February in a leap year	**B**
one year	**L**	one fortnight	**H**
120 hours	**V**	84 hours	**S**
6 hours	**R**	9 hours	**T**
From 18 March to 29 May	**F**	From 6 September to 5 December	**M**

From 0900 to 2100 on the same day **O**

From 0400 to 1600 the next day **A**

From 6.15 p.m. to 9.15 a.m. three days later **I**

From 12.14 p.m. to 9.14 a.m. two days later **E**

‘

2.625	14	1.5	5	1.875	1.5	365	0.5	0.375	

0.5	72	21	0.25	0.5	29	365	1.875	90	3.5

’

11.7 Timetables and time charts

Most people use **timetables** almost daily. Whether you have to catch a bus or train in the morning, or even just know what subject you have during the day, you need to know how to read a timetable accurately.

It is also important to consider the **time zones** of different places. You may need to calculate the time in another country if you are booking an air ticket or making an overseas phone call.

worked example 10

Natasha lives in St Leonards and wishes to catch the 8.16 a.m. train to her work in North Sydney.

(a) How long will her train trip be?

(b) How long does it take the train to travel from Wollstonecraft to Waverton?

MONDAY TO FRIDAY	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.
St Leonards	8.01	8.06	. .	8.10	8.16	8.21
Wollstonecraft	8.03	. .	. .	8.12	8.18	. .
Waverton	8.06	. .	. .	8.15	8.21	. .
North Sydney	8.09	8.12	8.16	8.18	8.24	8.27

Steps

(a) 1. Find St Leonards on the timetable.

2. Read across to the 8.16 a.m. train.

3. Read down to the North Sydney arrival time.

4. Calculate the travelling time.

(b) 1. Find Wollstonecroft on the timetable.

2. Read across to the column commencing at 8.16 a.m. in St Leonards. State the arrival time in Wollstonecraft.

3. Read down to the Waverton arrival time.

4. Calculate the travelling time.

Solutions

(a)

8.24 a.m.

From 8.16 to 8.24 is 8 minutes.

(b)

8.18 a.m.

8.21 a.m.

From 8.18 to 8.21 is 3 minutes.

eTutorial

exercise 11.7 Timetables and time charts

Preparation: Prep Zone Q4 and 5, Ex 11.6

Core

1 Look at the following train timetable which shows times from Bankstown to the city for Monday to Friday.

		A.M.	A.M.	A.M.	A.M.	A.M.	A.M.
Bankstown	DEP	10.00	10.15	10.30	10.45	11.00	11.15
Punchbowl		10.03	10.17	10.33	10.48	11.03	11.18
Wiley Park		10.05	10.19	10.34	10.49	11.04	11.19
Lakemba		10.06	10.21	10.36	10.51	11.06	11.21
Belmore		10.08	10.23	10.38	10.53	11.08	11.23
Campsie		10.11	10.25	10.41	10.55	11.11	11.25
Canterbury		10.13	10.28	10.43	10.58	11.13	11.28
Hurlstone Park		10.15	10.30	10.45	11.00	11.15	11.30
Dulwich Hill		10.17	10.31	10.47	11.01	11.17	11.31
Marrickville		10.19	10.33	10.49	11.03	11.18	11.33
Sydenham		10.22	10.37	10.52	11.07	11.22	11.37
St Peters		10.24	10.39	10.54	11.09	11.24	11.39
Erskineville		10.26	10.41	10.56	11.11	11.26	11.41
Redfern		10.30	10.45	11.00	11.15	11.30	11.45
Central		10.32	10.47	11.02	11.17	11.32	11.47
Museum		10.35	10.50	11.05	11.20	11.35	11.50
St James		10.36	10.51	11.06	11.21	11.36	11.51
Circular Quay		10.40	10.55	11.10	11.25	11.40	11.55
Wynyard		10.42	10.57	11.12	11.27	11.42	11.57
Town Hall	ARR	10.44	10.59	11.14	11.29	11.44	11.59

Hint

(a) How many minutes does the train take to get from Lakemba to Belmore?

(b) How many minutes does the train take to get from Erskineville to Redfern?

(c) What is the longest time taken between two consecutive stations?

(d) How many minutes does the train take to get from Sydenham to Town Hall station?

(e) How many minutes does the train take to get from Bankstown to St James?

(f) If you wanted to get to Town Hall station by 11.29 a.m., what time should you be at Marrickville station?

(g) If you wanted to get to Town Hall station by 10.59 a.m., what time should you be at Belmore station?

(h) If you wanted to get to St James station by 11.51 a.m., what time should you be at Campsie station?

(i) If you wanted to get to Circular Quay by 11.40 a.m., what time should you be at Hurlstone Park station?

2 The following shows when high and low tides occurred at Fort Denison in the first half of September in a certain year.

September	High water		Low water	
	a.m.	*p.m.*	*a.m.*	*p.m.*
1 W	1213	–	0518	1800
2 T	0017	1257	0614	1849
3 F	0109	1332	0700	1930
4 S	0152	1404	0740	2004
5 S	0229	1434	0815	2038
6 M	0303	1505	0848	2111
7 T	0336	1537	0922	2143
8 W	0411	1610	0957	2215
9 T	0448	1644	1030	2245
10 F	0528	1718	1104	2316
11 S	0614	1757	1140	2354
12 S	0706	1845	1222	–
13 M	0808	1948	0041	1315
14 T	0917	2111	0141	1425
15 W	1024	2238	0255	1543

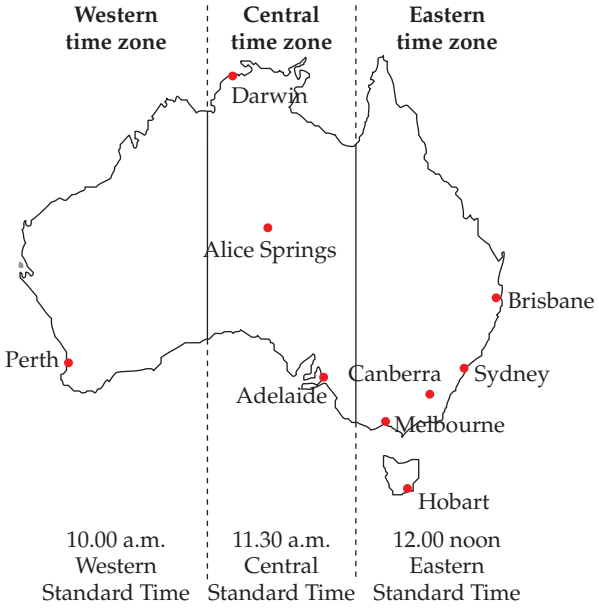
Give your answers to these questions in a.m. or p.m. times.

Hint

(a) When was high water at Fort Denison on 3 September?
(b) When was high water at Fort Denison on 14 September?
(c) When was low water at Fort Denison on 1 September?
(d) When was low water at Fort Denison on 8 September?
(e) How much earlier was the a.m. high water on 4 September than on 5 September?
(f) How much time was there between the first low water and the first high water on 14 September?
(g) On which dates did low water occur between 5 a.m. and 9 a.m.?
(h) How much later was the p.m. low water on 1 September than on 15 September?

3 Look at this map showing the three Australian time zones. Central Standard Time is half an hour behind Eastern Standard Time. Western Standard Time is 2 hours behind Eastern Standard Time.

(a) If it is 3.00 p.m. in Sydney, what time is it in Perth?
(b) If it is 4.15 p.m. in Sydney, what time is it in Adelaide?
(c) If it is 3.53 a.m. in Perth, what time is it in Sydney?
(d) If it is 11.45 p.m. in Adelaide, what time is it in Melbourne?



(e) If it is 7.10 a.m. in Perth, what time is it in Darwin?

(f) If a plane leaves Brisbane at 0930 local time and arrives in Alice Springs at 1300 local time, how long has the trip taken?

(g) If a plane leaves Canberra at 1422 local time and arrives in Perth at 1715 local time, how long has the trip taken?

(h) A plane leaves Hobart at 1305 local time and the flight to Adelaide takes one hour. What local time will it arrive in Adelaide?

Hint

Extension

4 Time worldwide is measured from a place called Greenwich near London. This system is called Greenwich Mean Time (GMT) (now officially referred to as Universal Coordinated Time (UCT), but GMT is still in common use). The east of Australia is 10 hours ahead of GMT, so we say that our Eastern Standard Time is GMT plus 10. The following table shows time zones around the world in relation to GMT.

Location	*Time*
Athens (Greece)	GMT plus 2
Beijing (China)	GMT plus 8
Dhaka (Bangladesh)	GMT plus 6
London (Great Britain)	GMT
Los Angeles (USA)	GMT minus 8
Panama City (Panama)	GMT minus 5
Sydney (Australia)	GMT plus 10

Use the table to answer the following questions.

(a) At noon in London what time is it in:
(i) Dhaka **(ii)** Los Angeles **(iii)** Athens?

Hint

(b) At 6.30 p.m. in Sydney what time is it in:
(i) London **(ii)** Beijing **(iii)** Panama City?

(c) Greg flew to London from Sydney, taking a total of 26 hours. If he left Sydney at 6 a.m. Friday local time, find:
(i) the day and time of Greg's arrival in London in Sydney time.
(ii) the day and time of Greg's arrival in London in London time.

(d) If a plane leaves Sydney at 11 a.m. local time, and arrives in Los Angeles at 6 a.m. local time on the same day, how long did the flight take?

eQuestions

Homework 11.2

Millennium madness

The photograph above, taken on 31 December 1999, shows a celebration attended by people who think they are celebrating the end of the millennium. Were they? No! Does it matter? Not really! What is certain is that if it were not for mathematicians, no one would have been celebrating anything that night.

We are used to thinking of 0 as the beginning of things, but this is not the case with our present calendar. The confusion arises from some work done on the calendar in the sixth century when our system of numbering the years was established. This work was done at the instruction of Pope John I by a monk called Dionysius Exiguus. Based on the existing

Roman dates, he fixed the year of the birth of Christ as 1 BC (before Christ) and made the following year AD 1. Why no year 0? At this time Western mathematicians were still using Roman numerals and did not have a way of writing 0!

The calendar we now follow is known as the Gregorian calendar. It is an amendment of the Julian calendar, which itself was the last amended version of the Roman calendar. The Julian calendar was introduced by the emperor of Rome, Julius Caesar, in the year we now call 45 BC. The Julian calendar had 365 days in each year, except each fourth year had 366 days, and was based on the idea that a year was actually 365 days and 6 hours long.

In the sixteenth century Pope Gregory XIII recognised that a more accurate system was required, so he appointed a well known mathematician, Christopher Clavius, to devise a new calendar. This work was completed in 1582 and the new calendar was proclaimed. It eliminated 10 days—5 to 14 October 1582 did not exist!

The Gregorian calendar removed the extra days that had accumulated and brought in a new rule for when leap years should be inserted. Every year divisible by 4 is a leap year, unless it is also divisible by 100. However, if a year is divisible by 400 it is a leap year after all.

The Gregorian calendar is the most commonly used calendar in the world today and is used for dealings between countries. International trade would be very inconvenient if different countries followed different calendars and delivery dates had to be converted from one calendar system to another! However, other calendars are used, especially for religious purposes.

Questions

1 A year is actually 365 days, 5 hours, 48 minutes and 46 seconds long. How far off this was the estimate of a year that the Julian calendar was based on?

2 When Greece adopted the Gregorian calendar in 1924 the Greek Orthodox Church attempted to improve the rule for leap years. It was proposed that every year which left a remainder of 200 or 600 when divided by 900 would be a leap year. For example, $1900 \div 900 = 2$ remainder 100, so 1900 is not a leap year. When will the Greek Orthodox calendar first differ from the Gregorian calendar?

3 Draw a timeline that shows each of the following events:

753 BC	Founding of the city of Rome (traditional start to the Roman calendar)
45 BC	Introduction of the Julian calendar
8 BC	July and August introduced as months in the Julian calendar
AD 1582	The Gregorian calendar first used (Italy, Poland, Portugal and Spain)
AD 1700	Norway introduces the Gregorian calendar
AD 1752	Great Britain and its dependencies introduce the Gregorian calendar
AD 1926	Turkey introduces the Gregorian calendar

4 Under the Gregorian calendar, how many times has there been a leap year on a century year?

5 When we want to do calculations of time across the BC/AD dividing line we need to be a little bit careful, because there is no year 0. Calculations can be done as with other directed number questions, but then you must subtract 1 from the answer.

(a) How many years were there between the introduction of the Julian and Gregorian calendars?

(b) It is now commonly accepted that the year of Christ's birth should be placed at 4 BC. How many years were there between this date and the introduction of the Gregorian calendar?

Research

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All the great civilisations of the ancient world used calendars. For instance, the Mayans, Aztecs and other central American civilisations followed two cycles: a 260 day ritual cycle and a 365 day vague year. The ritual cycle was set out using the first thirteen numbers on one wheel with the twenty named days on a second interlocking wheel.

The central wheel of an Aztec calendar stone

The Chinese calendar, on the other hand, is a lunisolar calendar, based on the positions of both the sun and the moon.

Find out about the Chinese calendar or the Mayan calendar. Prepare a poster, a web page using software such as FrontPage or Netscape Communicator, or a computer presentation using software such as PowerPoint or Presentation, about the calendar you have chosen.

languagezone

Summary

Copy and complete the following summary of this chapter using the words and phrases from the list. A word or phrase may be used more than once.

1 2.30 p.m. written in _____ _____ is 1430.

2 _____, _____ and _____ are all units of mass.

3 560 mL of water weighs 560 _____.

4 A box with a _____ of 145 cubic centimetres has a capacity of 145 _____.

5 At the train station the _____ shows what times the trains are expected.

6 To find the volume of a _____ _____ we multiply length by breadth by height.

Questions

1 Explain the difference between a timetable and a timeline.

2 'Milli' means 'one-thousandth'. Write the words for one-thousandth of a litre, one-thousandth of a metre and one-thousandth of a second.

3 Separately list all the units from the above list related to capacity and list all the words related to mass.

4 Use the word 'volume' in a sentence where it has a meaning different to the one in this chapter.

5 Make at least ten words of four letters or more from the letters in the grid. All words must include the middle letter. Can you find the nine-letter word?

T	E	T
B	A	M
E	L	I

6 Write the symbols for kilograms, grams, tonnes, millilitres, litres, centimetres cubed and metres cubed.

Key words

capacity
cubic centimetres
cubic metres
grams
kilograms
litres
mass
millilitres
rectangular prism
time
timeline
timetable
time zones
tonnes
24-hour time
volume

e Worksheet L11.1

e Worksheet L11.2

chapter 11 REVIEW

FAQs

Is there an easy way to remember that the basic unit for volume is m^3?
Just remember that volume describes how many cubes fit into the space (hence metres cubed). Also, remember that volume refers to three dimensions, so the units are expressed to the power of three.

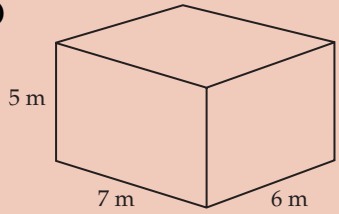
How can I remember whether to multiply or divide when converting units of mass?
If you are converting to a smaller unit, for example from kilograms to grams, you need more grams than kilograms so you need to multiply. If you are converting to a larger unit, for example from grams to tonnes, you need fewer tonnes than grams so you need to divide.

How are midday and midnight written in 12-hour and 24-hour time?
Midday is 12 p.m. or 1200 hours. Midnight is 12 a.m. or 0000 hours.

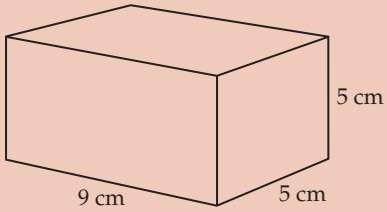
Core

1 Determine the volume of each of the following solids. **11.2**

(a)



(b)



2 Copy and complete the following conversions. **11.3**

(a) 5 L = _____ mL **(b)** 48 000 mL = _____ L
(c) 3.57 L = _____ mL **(d)** 80 mL = _____ L
(e) 0.045 L = _____ mL **(f)** 15 mL = _____ L

3 Convert the following masses to the units shown in brackets. **11.4**

(a) 456.6 g (kg) **(b)** 0.76 t (g)
(c) 39 t (kg) **(d)** 5001 kg (t)
(e) 4.5 kg (g) **(f)** 230 000 g (t)

4 Two leatherback turtles have masses of 453 kg and 397 kg. What is the total mass of the pair in tonnes? **11.4**

5 A jug of capacity 1.8 L is half filled with water. How much does the water in the jug weigh? **11.4**

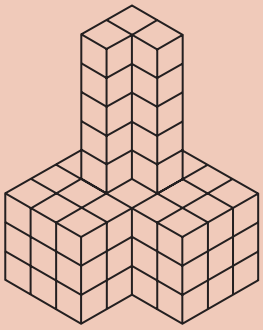
6 **(a)** How much time has passed from 4.58 a.m. to 3.41 p.m.? **11.6**
(b) What time is it $4\frac{1}{2}$ hours after 9.14 a.m.?

7 **(a)** Write 7.38 p.m. as a 24-hour time. 11.6
(b) Write 1.22 a.m. as a 24-hour time.
(c) Write 2321 as an a.m. or p.m. time.

Extension

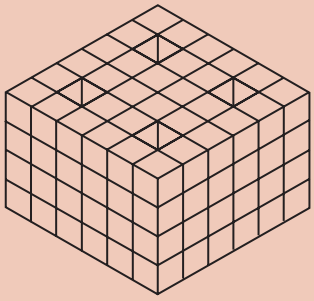
8 Determine the volume of each of the following solids. 11.1

(a)



(Each small cube represents 1 cm^3.)

(b)



(Each small cube represents 1 cm^3.)

9 Five blocks of dimensions 3 cm × 5 cm × 6 cm are placed in a toy-box of length 40 cm, width 20 cm and height 9 cm. Find the volume of space left in the box. 11.2

10 The time in Miami (USA) is GMT minus 5, while in Sydney, time is GMT plus 10. 11.7
(a) If it is 6 a.m. in Sydney on Monday, what day and time is it in Miami?
(b) What day and time is it in Sydney if it is midday on Wednesday in Miami?
(c) If it takes 18 hours to fly to Sydney from Miami, what day and time will I arrive in Sydney (local time) if I leave Miami at 10 a.m. Monday?

REPLAY

1 Calculate: 1.6
(a) $7 + 32 \div 4 \times 2$ **(b)** $(33 + 12) \div 3 + 19$ **(c)** $6 \times 9 \div 2 + 4$

2 Calculate: 2.5
(a) $-100 + 67$ **(b)** $32 - 68$ **(c)** $4 - 30 - 12$

3 List all the factors of each of the following numbers. 3.3

(a) 12 **(b)** 28 **(c)** 16

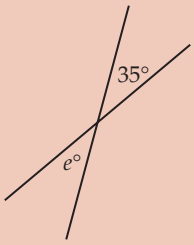
4 Copy and complete the following number patterns. 4.1

(a) 2, __, 16, 23, __, __ **(b)** 2, 33, 444, __, __, __

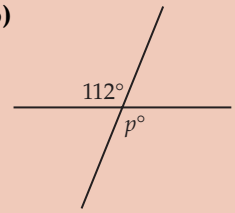
(c) 20, 25, 35, 50, __, __, __

5 Find the value of the pronumeral in each of the following. 5.7

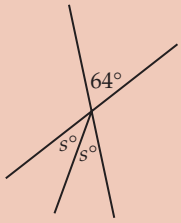
(a)



(b)



(c)



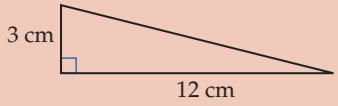
6 Arrange the following decimals in order from smallest to largest. 6.2

(a) 2.3, 2.003, 2.33, 2.323, 2.302

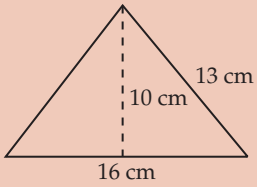
(b) 0.089, 0.129, 0.091, 0.0909, 0.0199

7 Find the area of each of the following triangles. 7.8

(a)



(b)



8 Which of the following are examples of polyhedra? 8.5
sphere, cube, dodecahedron, pentagonal prism, cone, nonagon

9 Convert the following decimals into fractions in simplest form. 9.3

(a) 0.23 **(b)** 0.06 **(c)** 0.505

10 Calculate: 9.6

(a) $\frac{3}{4} \times \frac{16}{21}$ **(b)** $1\frac{1}{8} \times 3\frac{1}{5}$ **(c)** $2\frac{2}{5} \times \frac{3}{4} \times -1\frac{2}{3}$

11 Substitute $a = 2$ and $b = -3$ into the following expressions, and then simplify. 10.2

(a) $2b$ **(b)** $4a + b$ **(c)** $\frac{12}{b} + ab$

12 Factorise the following expressions. 10.6

(a) $2a + 6$ **(b)** $pqr - pq$ **(c)** $8xy + 20y$

Assignment 11