

Grade 6 Math

Both Sides of Zero

40 sheets · every strand · the year the number line keeps going

THIS BOOK BELONGS TO

Find your strand



Number

a million · integers · thousandths · divisibility · GCF and LCM · ratios and percents

Sheets 1–14



Algebra

linear patterns · monomials · two-step inequalities · efficient code

Sheets 15–20



Data

discrete and continuous · histograms · broken-line graphs · the range

Sheets 21–26



Spatial Sense

quadrilaterals · four quadrants · 360° · the circle · nets and surface area

Sheets 27–36



Money

ways to pay · financial goals · interest rates

Sheets 37–40

Brand new this year

Integers

numbers below zero

GCF and LCM

the two factor tools

All four quadrants

the grid opens up

One million

and thousandths

Unlike denominators

fractions that don't match

The circle

radius, diameter, circumference

Divisibility rules

without dividing

Dividing by a fraction

any proper fraction now

Nets and surface area

unfold it, measure it

Grown-ups: Grade 6 is the last year of the junior division and the bridge into Grade 7. Two things carry the most weight:

integers , because every later grade assumes them, and

ratios, rates and percents ('B2.12'), which become the whole of Grade 7 proportional reasoning. If time is short, protect those two.

Ontario 2020 · 51 expectations



Up to a million

Six zeros. Say it out loud before you write it — and remember Canada uses spaces, never commas.

write

say it

Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones	The number
4	0	7	3	0	6	
9	5	0	0	2	8	
						680 401

What is the 7 worth?

in 470 306

in 7 015 200

in 3 720

How big is a million, really? If you counted one number every second, roughly how long would a million take? Days? Weeks?

.....

A million seconds is about 11 and a half days. A billion seconds is about 32 years. That gap is worth sitting with.



The line keeps going

Zero isn't the end. Below it the numbers carry on — and you already knew that, because you've seen a winter forecast.

8 mark it

write



Mark each of these on the line above: **-7 +3 -2 +8 -9**

Which is colder?

-4°C **-9°C**

-1°C **+2°C**

-12°C **-7°C**

The surprising bit. *-9* is *less* than *-4*, even though 9 is bigger than 4. Explain why, using the number line.

Integers are already everywhere. Temperature, elevation below sea level, a bank balance you've overdrawn, floors below ground in a lift, golf scores. Name two more.

Grown-ups: "-9 is less than -4" is the whole difficulty, and a thermometer settles it faster than any explanation. Grade 6 only reads and orders integers — adding and subtracting them is Grade 7.

B1.2



All the kinds of number, in one order

Integers, decimals and fractions on the same line. Turn everything into the same form first, then compare.

☒ convert☐ order

☒ Order these: 0.5, -2, $\frac{3}{4}$, 1, -0.5

Turn the fractions into decimals: $\frac{3}{4} = 0.75$. Now they're all comparable.

-2, -0.5, 0.5, 0.75, 1

Put in order, smallest first	Your answer
-3, $\frac{1}{2}$, 0, -1.5, 2	
0.3, $\frac{1}{4}$, -0.1, $\frac{1}{2}$, 0	
-5, -2.5, $-\frac{1}{2}$, -7, 0	

Write <, > or =

-3 -8 $\frac{1}{2}$ 0.5

-0.5 0 $\frac{3}{4}$ 0.7

Between any two numbers there is always another one. Name a number between 0.3 and 0.4. Now one between *that* and 0.4.

Grown-ups: the last question quietly introduces density — that there is no “next” decimal. It’s the idea Grade 7 builds rational numbers on.

B1.3

The third decimal place

Tenths, hundredths, and now thousandths. Each place is ten times smaller than the one before it.

compare

8

round

Number	Say it out loud	The 4 is worth
0.400		
0.040		
0.004		

0.5

0.475

0.09

0.089

1.203

1.23

0.6

0.600

Round each one.

Number	Nearest tenth	Nearest hundredth	Nearest whole
3.478			
0.995			
12.049			

Now a repeating one. $1 \div 3 = 0.333\ldots$ and $2 \div 3 = 0.666\ldots$ — the digits never stop.

0.333... to the nearest hundredth 0.666... to the nearest tenth

You can round a decimal that never ends. Explain how, when there is no last digit to stop at.

.....

0.995 is the interesting one. Round it to the nearest hundredth and watch what happens to every digit to its left.

Grown-ups: cascading rounding (0.995 → 1.00) surprises children every time. 'B1.5' names

both terminating and repeating

decimals, so 0.333... belongs here too.

B1.4 · B1.5



Fraction, decimal, percent – again, and further

Grade 5 got you to hundredths. Grade 6 takes it to thousandths and asks you to move between all three fluently.

 convert check

Fraction	Decimal	Percent
1/2		
1/4		
1/8		
	0.125	
1/1000		
3/5		

How to turn any fraction into a decimal

Divide the top by the bottom. $3/5$ means $3 \div 5 = 0.6$. That works for every fraction, always — and it's why a calculator gives you a decimal when you type a fraction in.

Try $1/3$. Divide 1 by 3. What happens? Write down what you see and what you'd call that kind of decimal.



Telling without dividing

The divisibility rules let you know the answer before you do the work. Learn these six and you'll use them for life.

test

☒ tick

The rules

- 2

— it ends in an even digit .
- 5

— it ends in 0 or 5 .
- 10

— it ends in 0
- 3

— the digits add up to a multiple of 3 .
- 9

— the digits add up to a multiple of 9
- 4

— the last two digits make a multiple of 4 .
- 6

— it passes both the 2 rule and the 3 rule
- 8

— the last three digits make a multiple of 8

Number	2	3	4	5	6	8	9	10
180								
324								
1 000								
567								

Why does the 3 rule work? You don't have to prove it — but try a few numbers and say whether you believe it. Then find a number where it fails, if you can.



The biggest shared factor, the smallest shared multiple

Two tools with confusingly similar names. The greatest common factor (GCF) goes down into a number. The lowest common multiple (LCM) goes up from it.



list



find it

☒ GCF of 24 and 36

Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24

Factors of 36: 1, 2, 3, 4, 6, 9, 12, 18, 36

Biggest one in both lists = 12

Numbers	Factors of each	GCF
18 and 30		
16 and 40		
45 and 60		

Now the other one – the lowest common multiple.

Numbers	Count up in each	LCM
4 and 6		
5 and 8		
3, 4 and 6		

Where you'll actually use them. The GCF simplifies a fraction. The LCM finds a common denominator. You'll need both on the very next sheet.



When the bottoms don't match

This is the big fraction step of Grade 6. You can't add quarters to thirds until you make the pieces the same size.

8 find the LCM

add

☒ $1/4 + 1/3$

The LCM of 4 and 3 is 12. So rewrite both in twelfths:

$$1/4 = 3/12 \cdot 1/3 = 4/12 \cdot 3/12 + 4/12 = 7/12$$

The pieces are now the same size, so you can count them.

$$1/2 + 1/3 = \dots\dots\dots$$

$$3/4 - 1/2 = \dots\dots\dots$$

$$2/3 + 1/6 = \dots\dots\dots$$

$$5/6 - 1/4 = \dots\dots\dots$$

$$1/5 + 1/2 = \dots\dots\dots$$

$$7/8 - 1/3 = \dots\dots\dots$$

A classmate writes $1/4 + 1/3 = 2/7$. Use a drawing to show them why that can't be right. Hint: is $2/7$ bigger or smaller than $1/2$?

.....

.....

Sanity check every answer. $1/4 + 1/3$ must be a bit more than a half. If your answer isn't, something went wrong.



Multiplying and dividing by a fraction

Grade 5 did unit fractions. Grade 6 does any proper fraction — and dividing still makes the answer bigger.

[draw it](#)[calculate](#)

☒ Two ideas, side by side

$12 \times \frac{3}{4}$ means three quarters of 12. A quarter of 12 is 3, so three quarters is 9.

$6 \div \frac{2}{3}$ asks how many two-thirds fit into 6. Each whole holds one and a half of them, so 9.

$8 \times \frac{3}{4} = \dots\dots\dots$

$4 \div \frac{2}{3} = \dots\dots\dots$

$10 \times \frac{2}{5} = \dots\dots\dots$

$6 \div \frac{3}{4} = \dots\dots\dots$

$15 \times \frac{2}{3} = \dots\dots\dots$

$5 \div \frac{1}{2} = \dots\dots\dots$

Which got bigger and which got smaller? Sort your six answers into two groups, then finish this sentence:

"Multiplying by a fraction under one makes it... but dividing by a fraction under one makes it..."

Grown-ups: this contradicts five years of "multiplying makes bigger." Naming that out loud helps more than repeating the rule.

B2.9 · B2.10



Multiplying and dividing with decimals

Estimate first, every time. It's the only way to catch a decimal point in the wrong place.

 estimate

 calculate

☒ **248 × 0.6**

Estimate: 250×0.6 is a bit over half of 250, so around 150.

Exactly: $248 \times 6 = 1488$, then one decimal place gives 148.8. That matches the estimate.

Question	Estimate	Exactly
324 × 0.4		
156 × 0.7		
480 ÷ 0.6		
2.436 ÷ 6		
9.045 ÷ 5		

Look at $480 \div 0.6$. Dividing by a number under one makes the answer *bigger* than what you started with — the same surprise as sheet 9, wearing decimals instead of fractions.

Adding and subtracting — estimate, then be exact.

$$46.85 + 12.7 = \dots\dots\dots$$

$$200 - 43.62 = \dots\dots\dots$$

$$7.045 + 0.9 = \dots\dots\dots$$

$$18\,401 - 9\,275 = \dots\dots\dots$$

Line up the decimal points, not the last digits. Fill the gaps with zeros so both numbers have the same number of places.



Percents in your head

Find 10% first. Everything else is built from it — and you'll use this in shops for the rest of your life.

8 mental math

write

Building from 10%

10% — divide by 10 · 1% — divide by 100 · 5% — half of 10% 15% — 10% plus 5% · 25% — a quarter, or half of a half · 50% — half

Of this	1%	5%	10%	15%	25%	50%
80						
240						
\$60						

A real one. A \$45 item has 20% off. What do you pay? Do it two different ways and check they agree.

13% tax, the quick way. 10% plus 1% plus 1% plus 1%. Try it on \$70 and see how close you get.



Ratios, rates and percents are one toolkit

This is the most important sheet in the book. All of Grade 7 is built on it.

8 scale

compare

Situation	Set it up	Answer
3 pens cost \$4.50. How much for 7?		
A car goes 240 km on 20 L. How far on 35 L?		
A recipe for 4 needs 300 g. How much for 10?		
18 of 25 students walk. What percent is that?		

The unit rate trick. Work out the cost of one, then multiply. It works for every question above.

3 pens for \$4.50 → one pen costs → 7 pens cost

Which is better value? 5 for \$6, or 8 for \$9.20? Show how you decided.

Notice. "3 pens for \$4.50" is a ratio, "\$1.50 per pen" is a rate, and "72% walk" is a percent. Three names, one piece of thinking.



Problems with several steps

Read it twice. Write down what you need to find first. Then check a different way.

 plan

 check

1. A shop buys 24 boxes of 15 items at \$2.40 each item. They sell 300 items at \$4 each. What is the profit?

First I need to find:

2. $\frac{2}{5}$ of a class of 30 walk to school. Half the rest come by bus. How many come by bus?

3. A jacket costs \$80. It is reduced by 25%, then 13% tax is added to the sale price. What do you pay?

4. In number 3, is the final price more or less than \$80? Say why *before* you work it out.

Grown-ups: number 3 is percent decrease then increase, and the answer surprises adults too. The discount comes off the larger number.

B2.1 · B2.12



Number – how am I doing?

Tick honestly. A blank is information, not a failure.

☒ tick

- | | |
|---|---|
| ☐ I can read and write numbers to one million | ☐ I can place integers on a number line |
| ☐ I know why -9 is less than -4 | ☐ I can order integers, decimals and fractions together |
| ☐ I can read and round decimals to thousandths | ☐ I can convert between fractions, decimals and percents |
| ☐ I know the divisibility rules | ☐ I can find a GCF and an LCM |
| ☐ I can add fractions with unlike denominators | ☐ I can multiply and divide by a proper fraction |
| ☐ I can find percents in my head | ☐ I can solve a ratio or rate problem |

The one I want to get better at is...

...and the sheet that would help is number



Which patterns are linear?

A pattern is linear if it goes up by the same amount every single time. Plot it and you get a straight line — that's where the name comes from.

☒ test it☐ decide

Pattern	Goes up by	Linear?	Next two
3, 7, 11, 15			
2, 4, 8, 16			
100, 90, 80, 70			
1, 4, 9, 16			
0.5, 1.0, 1.5, 2.0			

Prove it by drawing. Plot the first pattern and the second one on the same grid. Which makes a straight line and which curves away?

Careful with 100, 90, 80. It's going *down* by the same amount each time. Does that still count as linear? Say what you think and why.

Grown-ups: naming linear growth is new in Grade 6 and is the first step towards $y = mx + b$. A shrinking pattern with a constant step is still linear.

C1.1 · C1.3



Table, graph, rule – and now a formula

Grade 5 found the rule in words. Grade 6 writes it in algebra, and then uses it to jump anywhere.

build the table

write the rule

☒ A pattern of squares made from matchsticks

1 square needs 4. Two squares in a row need 7. Three need 10.

rule: sticks = $3n + 1$ so 10 squares need $3 \times 10 + 1 = 31$

Term (n)	Value
1	6
2	10
3	
4	
10	
n	

Start at _____, add _____ each time.

So the rule is: value = _____ n + _____

Work backwards. Which term has a value of 46? Show how you found it without listing them all.

Now one with decimals. A tap leaks 0.4 L every hour.

Hours	1	2	3	4	10
Litres	0.4				

The rule is: litres = _____ × hours

How long until it has leaked 6 litres? _____ hours

That last question is an equation in disguise. You solved $4n + 2 = 46$ without being told to.



Collecting like terms

A monomial is just one algebra term, like $3n$. You can add $3n$ and $4n$ because they're the same kind of thing — like adding 3 apples to 4 apples.

8 collect

simplify

✓ Why $3n + 4n = 7n$

Three lots of n , then four more lots of n . Seven lots of n altogether. You never had to know what n was.

$$3n + 4n = \dots\dots\dots$$

$$5x + x = \dots\dots\dots$$

$$2a + 7a = \dots\dots\dots$$

$$6m + 6m = \dots\dots\dots$$

The trap. Can you simplify $3n + 4$? Try it, then say why not.

Hint: one of them is "lots of n " and the other is just a number. Apples and oranges.

Now put a number in.

Expression	$n = 4$	$n = 10$	$n = 2.5$
$3n + 5$			
$2n + 2n$			
$10 - n$			

Grown-ups: " $3n + 4$ can't be simplified" is the single most useful thing on this page, and children resist it. Apples and oranges is the right metaphor.

C2.1 · C2.2



Equations with more than one step

Undo the operations in reverse order. Then always, always put your answer back in and check.

solve

verify

$3n + 7 = 25$

Take 7 off both sides $\rightarrow 3n = 18$. Divide both sides by 3 $\rightarrow n = 6$.

Check: $3 \times 6 + 7 = 18 + 7 = 25$. ✓

Equation	n =	Check – write it out
$2n + 9 = 31$		
$5n - 4 = 41$		
$4n + 12 = 60$		
$3n + 2n = 45$		

Two-step inequalities. Shade every whole number that works.

$$2n + 3 < 15$$



$$3n - 5 > 10$$



Check an inequality by testing. Pick a number you shaded and a number you didn't. Does each one behave as it should?



Code that does the same job with less

Grade 5 wrote code that worked. Grade 6 asks whether it could be shorter — and that's a real skill, not a tidiness rule.

8 trace

improve it

☒ Two programs, one result

```
forward 10
turn right 90
forward 10
turn right 90
forward 10
turn right 90
forward 10
turn right 90
```

```
repeat 4 times:
  forward 10
  turn right 90
```

Both draw a square. The second is more efficient — same result, fewer instructions, and much easier to change.

Make this efficient. Rewrite it using a loop.

add 5 · add 5 · add 5 · add 5 · add 5 · add 5

Now with a condition. Write code that goes through the numbers 1 to 20 and adds up only the ones divisible by 3. What is the total?

Total:

Why efficiency matters. If you wanted a 100-sided shape, which of the two programs above would you rather change?

Grown-ups: the word "efficient" is new in the Grade 6 coding expectations. The 100-sided shape question is the clearest way to show why it matters.

C3.1 · C3.2



Model something real

Pick one. You're judged on whether the reasoning holds together, not on getting a particular number.

 decide

 justify

Choose one:

- Which phone plan is better value over two years?
- How much would it cost to feed the whole class lunch for a week?
- If your class recycled everything for a month, how much would that be?

1. What exactly am I working out?

2. What do I need to know, and what am I assuming?

3. My working

4. My answer – and is it sensible?

5. Change one assumption. How much does the answer move?



Countable or measurable?

Discrete data you count in whole steps. Continuous data you measure, and it can fall anywhere in between.

[sort](#)[explain](#)

What is being collected	Discrete or continuous?	How do you know?
Number of pets each person has		
Height of each person in the class		
Time taken to run 100 m		
Number of books read last month		
Mass of each apple in a bag		
Shoe size		

The tricky one. Shoe size goes 7, 7½, 8 — it has halves but not everything in between. Is that discrete or continuous? Argue for your answer.

The test that works. Could there be a value halfway between two of your measurements? Height, yes. Number of pets, no.



Histograms – bars with no gaps

A histogram groups continuous data into intervals. The bars touch, because the data doesn't stop and start.

8 tally

draw

Heights in cm of 20 students:

142, 155, 148, 161, 137, 152, 149, 158, 144, 166,
151, 139, 157, 145, 163, 150, 147, 154, 141, 159

Interval	Tally	Frequency
135–139		
140–144		
145–149		
150–154		
155–159		
160–164		
165–169		

Draw the histogram. Bars touching, both axes labelled, and a title.

Why touching bars? A bar graph compares separate categories, so it has gaps. A histogram shows a continuous range, so it doesn't.



Broken-line graphs – change over time

Points joined by straight lines. Use one when the horizontal axis is time and the thing you're measuring changes continuously.

plot

read it

Month	Jan	Feb	Mar	Apr	May	Jun
Temp (°C)	-6	-4	2	9	16	21

Careful — your vertical axis has to go below zero. Where will you put the zero line?

Read your graph.

Biggest jump between two months:

When did it cross 0°C?

Estimate mid-April:

Which graph for which job? Histogram, bar graph or broken-line?

Favourite sports of the class

Heights of the class

Your height each birthday

Grown-ups: reading *between* the plotted points is what a broken-line graph allows and a bar graph does not. That's the reason for choosing it.

D1.3 · D1.6



How spread out is it?

Mean, median and mode all say what's **typical**. The **range** says how spread out things are — and two sets can match on one and differ wildly on the other.

calculate

compare

Team A scores

18, 20, 21, 19, 22

mean median

range

Team B scores

4, 35, 20, 8, 33

mean median

range

Both teams have the same mean. So what makes them different, and which team would you rather rely on in a final? Explain using the range.

.....

.....

Range

Range = biggest – smallest.

It's a measure of

spread, not of typical. One number tells you how consistent something is.

What should happen, and what did

Theoretical probability is what the maths says. **Experimental** is what actually happened when you tried it. They are rarely equal, and that's not a mistake.

8 predict

☒ **test**

Event	As a fraction	As a decimal	As a percent
A coin lands heads			
A die shows a 4			
A die shows an even number			
Picking red from 3 red, 7 blue			

Now roll a die 30 times. Tally how many times you get a 4.

Theoretical: $1/6$ of 30 = Experimental: I actually got

Are they the same? Should they be?

Roll it 300 times as a class and pool the results. Does the experimental figure get closer to the theoretical one, or further away?

Grown-ups: pooling class results so the experimental value converges on the theoretical is the whole lesson, and it needs a big enough sample to show.

D2.1 · D2.2



Make an infographic

Everything on it must be true, and everything must earn its place. The hardest part is the headline.



design



make it clear

My question:

Discrete or continuous data? So my graph should be a

Must include

- ☐ a title saying what it shows
- ☐ a histogram or broken-line graph
- ☐ the range, and one measure of centre
- ☐ where the data came from

The headline. One true sentence your data actually supports — no more:

.....



The quadrilateral family

Six shapes, and they overlap. A square is a rectangle. A rectangle is a parallelogram. Getting the family tree right is the job.

☐ measure☒ tick

Shape	4 equal sides	4 right angles	2 pairs parallel	Diagonals equal	Diagonals cross at 90°	Lines of symmetry
Square						
Rectangle						
Rhombus						
Parallelogram						
Trapezoid						
Kite						

True or false — and why?

Every square is a rectangle.

Every rectangle is a square.

Every rhombus is a parallelogram.

.....

Rotational symmetry. Turn a rectangle 180° about its centre and it looks unchanged — that's rotational symmetry of order 2. What order does a square have?

Grown-ups: "every square is a rectangle but not the reverse" is a genuine logical step, and children find it counter-intuitive. Cut the shapes out.

E1.1



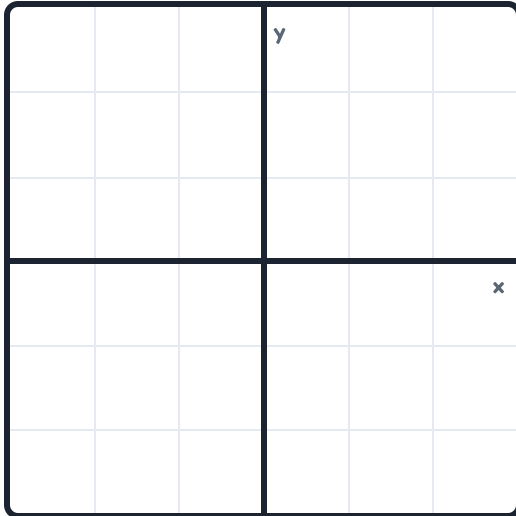
All four quadrants

The grid used to stop at zero in both directions. Now it opens all the way out — the same extension the number line got on sheet 2.

plot



translate



Label both axes from -3 to $+3$.

Plot and label these points:

A (2, 3) B (-2, 3) C (-2, -3) D (2, -3)

Join them in order. What shape?

From A to C is left and down.

Which quadrant? Work out the sign pattern for each of the four corners.

Top right: x is, y is Top left: x is, y is

Bottom left: x is, y is Bottom right: x is, y is



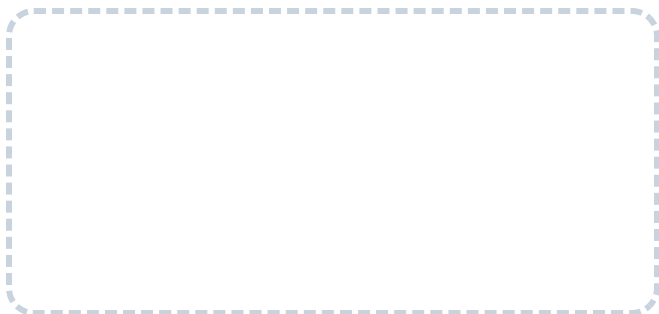
Slide, flip, turn – and combinations

Grade 5 stopped at 180° . Grade 6 goes all the way round to 360° , and asks you to do two moves in a row.

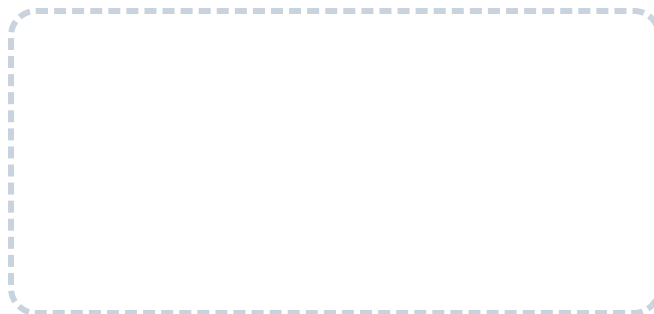
 transform

predict

Rotate 90° clockwise, then translate 3 right.



Reflect in the vertical line, then rotate 180° .



Transformation	Predict the result before you draw it
Rotate 360° about any point	
Rotate 90° clockwise, then 90° clockwise again	
Reflect in a line, then reflect back in the same line	
Rotate 270° clockwise	

Two of those give the same result. Which two, and can you explain why without drawing them?

Grown-ups: 270° clockwise and 90° anticlockwise land identically – a genuinely satisfying discovery. Tracing paper and a pin is the honest tool.

E1.4

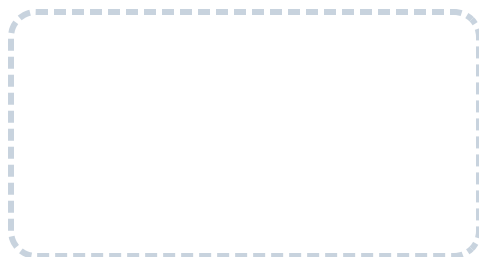


Building from three views

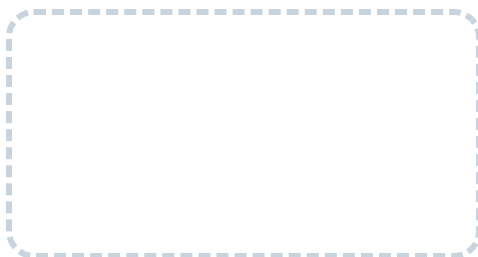
Grade 5 drew the views. Grade 6 goes the other way — you're given the drawings and you build the object.

 build check

Somebody has drawn three views of an object made from cubes. Build it, then draw what you built.



top view given



front view given



side view given

What I built



Cubes used:

Is there only one answer? Could a different arrangement give the same three views? Try to find one.

Often there isn't one answer. Three views can leave a hidden cube ambiguous. Engineers add a fourth view when that happens.



All the way round to 360°

Grade 5 measured to 180° . Now the protractor goes right round — and you need to know which way you're turning.

 measure construct **90°**

quarter turn

 180°

half turn

 270°

three quarters

 360°

all the way

Clockwise and counterclockwise

The two directions
always add to

 360°

. A turn of 90° clockwise is the same
finishing position as

 270°

counterclockwise

. Check it with
your hand.

Clockwise	Same as... counterclockwise
90°	
45°	
180°	
300°	

A reflex angle is bigger than 180° but less than 360° . Draw one, then measure it. How did you use a 180° protractor to do it?

Grown-ups: measuring a reflex angle with a 180° protractor — measure the smaller side and subtract from 360 — is a nice bit of problem solving.

E2.2

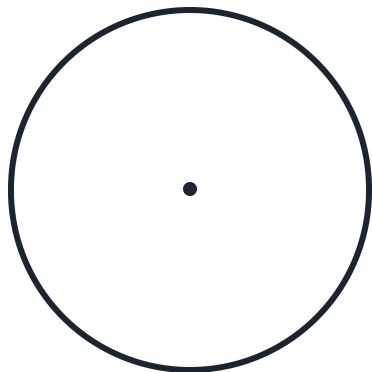


The circle, and the number that keeps turning up

Measure round several circles and divide by the distance across. You will get roughly the same answer every time. That number has a name.

measure

8 divide



Label the diagram.

The radius goes from

The diameter goes

The circumference is

So diameter = × radius

Find three round objects. Measure with string.

Object	Circumference (C)	Diameter (d)	$C \div d$

Look at your last column. All three should be close to the same number. What is it, roughly?

That number is called pi, written π , and it is about 3.14. So the formula is:

$$C = \pi \times d$$

You just discovered π by measuring. Nobody had to tell you — it fell out of three pieces of string.



Using π , and drawing circles

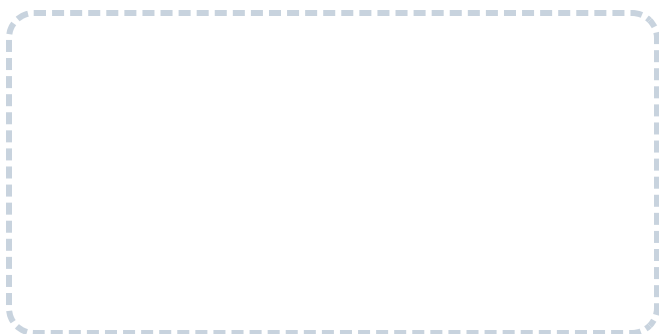
Now that you have the formula, use it both ways — forwards to find the circumference, backwards to find the diameter.

8 calculate construct

Radius	Diameter	Circumference (use $\pi \approx 3.14$)
5 cm		
10 cm		
	8 cm	
		about 31.4 cm

Construct these with a compass.

radius 3 cm · diameter 8 cm · circumference about 25 cm



A real one. A bicycle wheel has a diameter of 70 cm. How far does the bike travel in one full turn of the wheel?

How many turns to travel 100 m?

To draw a circle from its circumference, you have to work backwards to the radius first. Which two steps, in which order?



Unfold it, then measure it

A net is what a 3-D object looks like flattened out. Once it's flat, surface area is just areas added together.

unfold

8

add

☒ A box $5\text{ cm} \times 4\text{ cm} \times 3\text{ cm}$

Six faces, in three matching pairs:

two of $5 \times 4 = 20 \rightarrow 40$ · two of $5 \times 3 = 15 \rightarrow 30$ · two of $4 \times 3 = 12 \rightarrow 24$

Surface area = $40 + 30 + 24 = 94\text{ cm}^2$

Draw the net of a cereal box, then work out its surface area.

Object	Faces and their areas	Surface area
Cube, side 4 cm		
Box $6 \times 3 \times 2\text{ cm}$		
Triangular prism		

A cube is the easy one. Six identical squares. Can you write a rule for the surface area of any cube with side s ?



Converting both ways

Grade 5 went from big units to small. Grade 6 goes both directions — and small to big means dividing.

8 convert

estimate

Which way?

Big unit →
small unit:

multiply. The number gets bigger. 2
km → 2000 m

Small unit →
big unit:

divide. The number gets smaller.
2500 g → 2.5 kg

From	To	From	To
3.5 km		4500 g	
250 cm		0.75 L	
1800 mL		45 mm	

Check yourself every time. Ask: should this answer be bigger or smaller than what I started with? If your answer went the wrong way, you multiplied when you should have divided.

Convert 6000 mm to metres. Bigger or smaller? Answer:

Area units are different. 1 m is 100 cm, but 1 m² is **10 000** cm² — because you're converting in two directions at once. Draw a metre square and check.



Spatial Sense – how am I doing?

Tick honestly. A blank is information.

☒ tick

- | | |
|--|--|
| ☐ I can list the properties of each quadrilateral | ☐ I know every square is a rectangle |
| ☐ I can plot points in all four quadrants | ☐ I know the sign pattern of each quadrant |
| ☐ I can do two transformations in a row | ☐ I can build an object from three views |
| ☐ I can measure and construct angles to 360° | ☐ I know radius, diameter and circumference |
| ☐ I can use $C = \pi \times d$ | ☐ I can draw a net and find surface area |
| ☐ I can convert metric units in both directions | |

The one I want to get better at is...

.....
...and the sheet that would help is number

Ways to pay, weighed up

Grade 4 named the methods. Grade 6 asks what’s good and bad about each one — and every method has both.


weigh up


decide

Method	An advantage	A disadvantage
Cash		
Debit card		
Credit card		
Phone payment		
Gift card		

Which would you use, and when? Buying lunch. Buying something online. Buying a \$900 laptop. Give a different reason each time.

The one people underestimate. With cash you see the money go. With a card you don’t — and studies find people spend more by card. Is that an advantage or a disadvantage?

Goals, and what gets in the way

A financial goal without steps is a wish. Grade 6 asks for both the plan and the obstacles.

- 
plan
- 
anticipate

A saving goal

What I want:

What it costs:

I can save per week

So it will take weeks

An earning goal

How I could earn:

Roughly how much:

What it would ask of me:

.....

Now the harder half – what could get in the way?

Something that might interfere	What I'd do about it

Ideas: an unexpected cost · losing interest · a friend spending differently · prices going up · forgetting to put it away

Some obstacles aren't your fault. Not everybody has the same chance to earn or save. Naming that is part of the expectation, not a distraction from it.

Grown-ups:
'F1.3' names factors that help
or
interfere
. The Ministry's own materials frame this around inequity of access, so the last note is on-curriculum.
F1.2 · F1.3

What interest actually is

Interest is the price of money. If you save, you get paid it. If you borrow, you pay it.

8 calculate

compare

☒
\$200 in an account paying 3% a year
 3% of \$200 = \$6. After one year you have **\$206** without doing anything.

Amount	Rate	Interest in one year	Total after a year
\$100	5%		
\$400	2%		
\$250	4%		

The other side. You borrow \$500 at 19% a year — a typical credit card rate.

Interest for one year:

Total owed:

Compare the two rates. Saving earned 3%. Borrowing cost 19%. Why is the borrowing rate so much higher?

.....

.....

Go and look at a real rate. Find the interest rate on a savings account and on a credit card. Write both down. The gap is the point.

Grown-ups: the savings-versus-borrowing gap is the most useful financial fact a twelve-year-old can carry. Real numbers make it land.

F1.4 · F1.5



Moving money around

Trading, lending, borrowing, donating. Four ways resources move between people — and only one of them expects to be paid back.

sort

discuss

Way	What happens	Does anything come back?
Trading		
Lending		
Borrowing		
Donating		

Which is which?

Swapping a book for a game

Giving to a food bank

A bank giving a mortgage

Taking out a student loan

Lending and borrowing are the same event seen from two sides. Explain that in one sentence.

.....

Grade 6 review. Which money sheet did you find most useful, and what would you tell a Grade 5 to expect?

.....

Answers — Number

Only questions with one right answer are here. Anything asking you to explain or decide is judged on the reasoning.

1. 407 306 · 950 028 · 6/8/0/4/0/1. The 7 is worth 70 000, 7 000 000, 700. A million seconds is about 11½ days; a billion is about 32 years.

2. -9°C is colder than -4°C · -1°C is colder than $+2^{\circ}\text{C}$ · -12°C is colder than -7°C . Going left on the line always means smaller, so $-9 < -4$ even though $9 > 4$.

3. -3 , -1.5 , 0 , $1/2$, 2 · -0.1 , 0 , $1/4$, 0.3 , $1/2$ · -7 , -5 , -2.5 , $-1/2$, 0 . Then $> \cdot = \cdot < \cdot >$. Between 0.3 and 0.4 you could pick 0.35 ; between 0.35 and 0.4 , 0.37 — and it never runs out.

4. 0.400 is four tenths · 0.040 is four hundredths · 0.004 is four thousandths. Then $> \cdot > \cdot < \cdot =$. Rounding: $3.478 \rightarrow 3.5$, 3.48 , $3 \cdot 0.995 \rightarrow 1.0$, **1.00**, $1 \cdot 12.049 \rightarrow 12.0$, 12.05 , 12 . Repeating: $0.333\ldots$ to the nearest hundredth is **0.33**; $0.666\ldots$ to the nearest tenth is **0.7**. You round a never-ending decimal the same way — look only at the digit just past where you are stopping.

5. $1/2 = 0.5 = 50\%$ · $1/4 = 0.25 = 25\%$ · $1/8 = 0.125 = 12.5\%$ · $0.125 = 1/8$ · $1/1000 = 0.001 = 0.1\%$ · $3/5 = 0.6 = 60\%$. And $1 \div 3 = 0.333\ldots$ — a repeating decimal.

6. 180 is divisible by 2 , 3 , 4 , 5 , 6 , 9 , 10 (not 8) · 324 by 2 , 3 , 4 , 6 , 9 · 1000 by 2 , 4 , 5 , 8 , 10 · 567 by 3 and 9 only. The 3 rule has no exceptions — you won't find a counter-example.

7. GCF: 18 and $30 \rightarrow 6$ · 16 and $40 \rightarrow 8$ · 45 and $60 \rightarrow 15$. LCM: 4 and $6 \rightarrow 12$ · 5 and $8 \rightarrow 40$ · 3 , 4 and $6 \rightarrow 12$.

8. $1/2 + 1/3 = 5/6$ · $3/4 - 1/2 = 1/4$ · $2/3 + 1/6 = 5/6$ · $5/6 - 1/4 = 7/12$ · $1/5 + 1/2 = 7/10$ · $7/8 - 1/3 = 13/24$. And $2/7$ is less than a half, so it cannot be the answer to $1/4 + 1/3$.

9. $8 \times 3/4 = 6 \cdot 4 \div 2/3 = 6 \cdot 10 \times 2/5 = 4 \cdot 6 \div 3/4 = 8 \cdot 15 \times 2/3 = 10 \cdot 5 \div 1/2 = 10$. Multiplying by a fraction under one makes it smaller; dividing by one makes it bigger.

10. $324 \times 0.4 = 129.6$ · $156 \times 0.7 = 109.2$ · $480 \div 0.6 = 800$ · $2.436 \div 6 = 0.406$ · $9.045 \div 5 = 1.809$. Adding and subtracting: $46.85 + 12.7 = 59.55$ · $200 - 43.62 = 156.38$ · $7.045 + 0.9 = 7.945$ · $18\ 401 - 9\ 275 = 9\ 126$.

11. Of 80 : 0.8 , 4 , 8 , 12 , 20 , 40 · of 240 : 2.4 , 12 , 24 , 36 , 60 , 120 · of $\$60$: $\$0.60$, $\$3$, $\$6$, $\$9$, $\$15$, $\$30$. A $\$45$ item with 20% off costs **$\$36$** .

12. 7 pens $\$10.50$ (one pen is $\$1.50$) · 420 km · 750 g · 72% . Better value: 5 for $\$6$ is $\$1.20$ each; 8 for $\$9.20$ is $\$1.15$ each — so the **8-pack**.

13. **1.** $24 \times 15 = 360$ items costing $\$864$; 300 sold at $\$4 = \1200 ; profit **$\$336$** . **2.** $2/5$ of $30 = 12$ walk, 18 remain, half of those = **9** by bus. **3.** $\$80$ less $25\% = \$60$; plus $13\% = \textbf{\$67.80}$ — less than $\$80$, because the discount came off the larger number.

Answers — Algebra, Data

15. 3, 7, 11, 15 goes up by 4 — **linear** → 19, 23. 2, 4, 8, 16 doubles — **not linear** → 32, 64. 100, 90, 80 goes down by 10 — still **linear** (a constant step, just negative) → 60, 50. 1, 4, 9, 16 are square numbers — **not linear** → 25, 36. 0.5, 1.0, 1.5 goes up by 0.5 — **linear** → 2.5, 3.0.

16. Values 14, 18, and term 10 gives 42. Start at 6 and add 4, so the rule is **$4n + 2$** . A value of 46 means $4n + 2 = 46$, so $4n = 44$ and **$n = 11$** . The leaking tap: 0.8, 1.2, 1.6 and 4.0 litres; the rule is litres = **$0.4 \times$** hours, and 6 litres takes **15** hours.

17. $7n \cdot 6x \cdot 9a \cdot 12m$. **$3n + 4$ cannot be simplified** — one term is lots of n , the other is just a number. Evaluating: $3n + 5 \rightarrow 17, 35, 12.5 \cdot 2n + 2n (= 4n) \rightarrow 16, 40, 10 \cdot 10 - n \rightarrow 6, 0, 7.5$.

18. $n = 11 \cdot n = 9 \cdot n = 12 \cdot n = 9$ (since $3n + 2n = 5n = 45$). Inequalities: $2n + 3 < 15$ gives $n < 6$, so 0 to 5. $3n - 5 > 10$ gives $n > 5$, so 6 upwards.

19. The six additions become *repeat 6 times: add 5*. The multiples of 3 up to 20 are 3, 6, 9, 12, 15, 18 — total **63**.

21. Discrete: number of pets, number of books. Continuous: height, time, mass. Shoe size is arguable — it comes in fixed steps like discrete data, but it measures a continuous thing. Either answer is fine if defended.

22. Frequencies: 135–139 → 2 · 140–144 → 3 · 145–149 → 4 · 150–154 → 4 · 155–159 → 4 · 160–164 → 2 · 165–169 → 1. Total 20. Histogram bars touch because the data is continuous.

23. The biggest jump is March to April (7 degrees). It crosses 0°C between February and March. Graph choices: bar graph for favourite sports, histogram for heights, broken-line for your height each birthday.

24. Team A: mean **20**, median 20, range **4**. Team B: mean **20**, median 20, range **31**. Same mean, wildly different consistency — Team A is far more reliable.

25. Coin: $1/2 = 0.5 = 50\%$ · a 4: $1/6 \approx 0.167 \approx 16.7\%$ · even: $3/6 = 0.5 = 50\%$ · red: $3/10 = 0.3 = 30\%$. Theoretical for 30 rolls is 5 fours; your experimental figure will usually differ, and pooling the class brings it closer.

Answers – Spatial Sense, Money

27. Square: 4 equal sides, 4 right angles, 2 pairs parallel, diagonals equal and crossing at 90° , 4 lines of symmetry. Rectangle: right angles and equal diagonals, but not 4 equal sides, 2 lines of symmetry. Rhombus: 4 equal sides and diagonals at 90° , but not right angles, 2 lines. Parallelogram: 2 pairs parallel only, usually 0 lines. Trapezoid: one pair parallel. Kite: diagonals cross at 90° , 1 line of symmetry. **Every square is a rectangle** (it has all the rectangle properties and more), but not every rectangle is a square. Every rhombus *is* a parallelogram. A square has rotational symmetry of order 4.

28. A(2,3), B(-2,3), C(-2,-3), D(2,-3) make a **rectangle**. A to C is 4 left and 6 down. Signs: top right (+,+) · top left (-,+) · bottom left (-,-) · bottom right (+,-).

29. A 360° rotation changes nothing. Two 90° clockwise turns equal one 180° turn. Reflecting twice in the same line returns the original. **270° clockwise and 90° anticlockwise give the same result** — those are the matching two.

31. Clockwise → counterclockwise: $90^\circ \rightarrow 270^\circ$ · $45^\circ \rightarrow 315^\circ$ · $180^\circ \rightarrow 180^\circ$ · $300^\circ \rightarrow 60^\circ$. They always add to 360. To measure a reflex angle with a 180° protractor, measure the smaller angle and subtract from 360.

32. The radius runs from the centre to the edge; the diameter runs right across through the centre; the circumference is the distance all the way round. Diameter = $2 \times$ radius. Your C ÷ d column should come out near **3.14**.

33. radius 5 → diameter 10, C $\approx$ 31.4 cm · radius 10 → diameter 20, C $\approx$ 62.8 cm · diameter 8 → C $\approx$ 25.1 cm · C $\approx$ 31.4 → diameter 10, radius 5. The bicycle wheel travels about **219.8 cm** (2.2 m) per turn, so 100 m takes about **45** turns.

34. A cube of side 4: six faces of 16 = **96 cm^2** . A $6 \times 3 \times 2$ box: $2(18) + 2(12) + 2(6) = \mathbf{72 \text{ cm}^2}$. For any cube of side s the rule is **$6s^2$** .

35. $3.5 \text{ km} = 3500 \text{ m}$ · $250 \text{ cm} = 2.5 \text{ m}$ · $1800 \text{ mL} = 1.8 \text{ L}$ · $4500 \text{ g} = 4.5 \text{ kg}$ · $0.75 \text{ L} = 750 \text{ mL}$ · $45 \text{ mm} = 4.5 \text{ cm}$. And $6000 \text{ mm} = \mathbf{6 \text{ m}}$ — smaller, because you're going to a bigger unit.

39. \$100 at 5% → \$5, total \$105 · \$400 at 2% → \$8, total \$408 · \$250 at 4% → \$10, total \$260. Borrowing \$500 at 19% costs **\$95** in a year, so you'd owe \$595.

40. Swapping a book for a game is trading · giving to a food bank is donating · a bank giving a mortgage is lending · taking a student loan is borrowing.

The sheets with no answers here are not mistakes. Anything asking you to explain, design, predict or justify is judged on whether the reasoning holds together — not on matching a particular sentence.