Powers of 10

- Working with positive and negative powers of 10
- Multiplying and dividing by powers of 10
- Writing numbers in standard form

Keywords

You should know

explanation 1a explanation 1b

1 Find the value of each of these numbers.

a 10^3 **b** 10^6 **c** 10^0 **d** 10^8

e 10^{10} **f** 10^{-1} **g** 10^{-2} **h** 10^{-4}

2 Write these numbers as powers of 10.

a one thousand **b** 10 000 **c** one million **d** 100 000

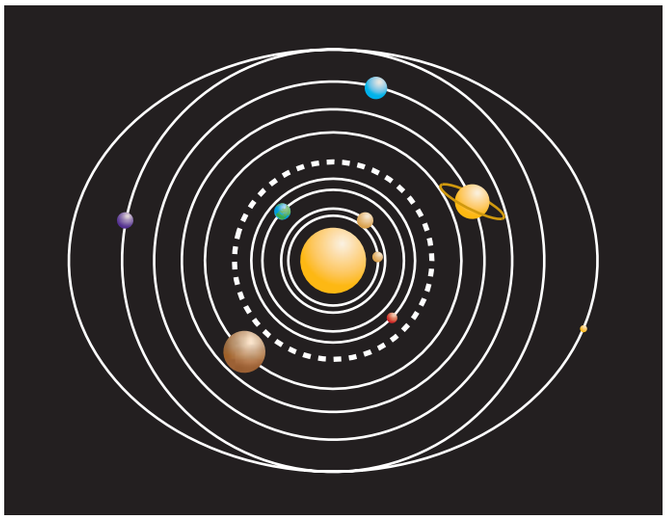
e 1 **f** one tenth **g** 0.001 **h** one millionth

3 Write these quantities using powers of 10.

a The length of the Earth's orbit around the Sun is about 1 000 000 000 km.

b The distance between two nearby stars is about 10 000 000 000 000 km.

c In a hydrogen bomb explosion about 0.001 kg of mass converts into energy.



4 Write each number as a multiple of a power of 10.

One billion = one thousand million

a 800 **b** five hundred thousand

c 90 000 000 **d** 6 billion **e** 0.4

f 0.0005 **g** 0.000 000 03

5 Write each expression as a number.

a 5×10^3 **b** 4.2×10^4 **c** 1.7×10^1

d 0.9×10^4 **e** 6×10^0 **f** 5×10^{-2}

g 41×10^{-3} **h** 0.31×10^{-1}

6 These prefixes are associated with given powers of 10.

Power	Prefix	Power	Prefix
10^9	giga	10^{-2}	centi
10^6	mega	10^{-6}	micro
10^3	kilo	10^{-9}	nano

1 megabyte = 1×10^6 bytes
= $1 \times 1\,000\,000$ bytes

a Write 2 megabytes in bytes. **b** Write 8 kilowatts in watts.

c Write 6 nanoseconds in seconds. **d** Write 4 micrometres in metres.

e Write 12 centilitres in litres. **f** Write 0.3 gigahertz in hertz.

explanation 2a explanation 2b explanation 2c

7 Work these out without using a calculator.

a 29×1000 **b** $215 \times 10\,000$ **c** 23.6×1000

d $0.894 \times 100\,000$ **e** 2.8×0.1 **f** 15.706×0.01

g 450.8×0.001 **h** 0.64×0.0001 **i** $0.98 \times 0.000\,01$

8 Work these out without using a calculator.

a $68 \div 1000$ **b** $5.2 \div 100$ **c** $78.8 \div 10\,000$

d $0.432 \div 1000$ **e** $4.6 \div 0.01$ **f** $26.3 \div 0.001$

g $12.5 \div 0.0001$ **h** $0.37 \div 0.01$ **i** $0.024 \div 0.0001$

9 Find the value of the missing number that would make each statement true.

a $6.3 \times \square = 630$ **b** $\square \times 1000 = 440$ **c** $0.081 \times \square = 810$

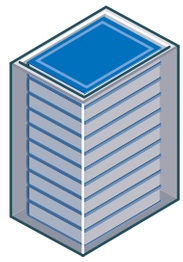
d $\square \times 0.1 = 120$ **e** $730 \div \square = 7300$ **f** $\square \div 0.01 = 0.45$

g $0.6 \div \square = 0.006$ **h** $\square \div 1000 = 0.14$ **i** $4.76 \times \square = 4760$

j $\square \div 0.001 = 5600$ **k** $\square \times 0.1 = 0.0701$ **l** $11.7 \div \square = 1170$

10 **a** Cartons of maths textbooks weigh 17.15 kg each.

Each carton contains 10 books.
What is the weight of each book?



b A container holds 100 000 cartons.
What is the total weight of these cartons?

11 For commercial use, metered water is priced at 0.01 pence per litre.

Four shops receive these bills for the water they used.

How many litres of water has each used?

a £39.50 **b** £62.15 **c** £152.33 **d** £201.03

12 **a** David used this method to work out 0.3×10^2 and $45 \div 10^{-2}$.

$0.3 \times 10^2 = 0.3 \times 100 = \square$ $45 \div 10^{-2} = 45 \div \frac{1}{100} = 45 \times 100 = \square$

Copy and complete David's working.

b Use David's method to find answers to these.

i 0.5×10^2 **ii** 0.36×10^3 **iii** $34 \div 10^2$ **iv** $218.4 \div 10^3$

v 61×10^{-1} **vi** 302×10^{-3} **vii** $73 \div 10^{-2}$ **viii** $12.71 \div 10^{-3}$

explanation 3a explanation 3b

13 Work these out without using a calculator.

a 500×0.3 **b** $80\,000 \times 0.4$ **c** $0.09 \times 50\,000$

d 0.3×0.07 **e** 0.0008^2 **f** $0.6 \times 0.000\,045$

g 0.0023×0.07 **h** $0.000\,11 \times 0.0012$ **i** $0.006 \times 0.003 \times 0.2$

14 Work these out without using a calculator.

a $400 \div 0.8$ **b** $540 \div 0.9$ **c** $720 \div 0.08$

d $3600 \div 0.06$ **e** $4.2 \div 0.7$ **f** $0.64 \div 0.8$

g $0.0063 \div 0.003$ **h** $0.049 \div 0.0007$ **i** $12.1 \div 0.011$

j $0.0125 \div 0.0025$ **k** $0.000\,96 \div 0.0012$ **l** $0.0072 \div 0.03 \div 0.4$

15 Find the missing number in each calculation.

a $400 \times \square = 40$ **b** $700 \times \square = 0.7$ **c** $4.5 \div \square = 450$

d $\square \div 0.001 = 360$ **e** $800 \times \square = 400$ **f** $48 \times \square = 2.4$

g $2.6 \div \square = 130$ **h** $\square \div 0.02 = 32$

16 These tables give the approximate numbers of kilojoules (kJ) in some raw fruits.

	kJ per gram
Apples	1.9
Bananas	3.6

	kJ per 100 g
Pears	280
Oranges	180

Find the number of kilojoules in these.

a 600 g of apples **b** 900 g of bananas

c 70 g of pears **d** 60 g of oranges

For parts **c** and **d** find the mass as a decimal fraction of 100 g.

17 Write two possible questions using multiplication or division by decimals (as in questions **7** to **16**) which would give you each answer.

a 280 **b** 6.3 **c** 0.22 **d** 7500 **e** 0.0081

explanation 4a explanation 4b explanation 4c

18 Which of these are written in standard form?

a 7.3×10^4 **b** 63.8×10^2 **c** 0.76×10^3 **d** 6.01×10^{-3}

e 7.6^{-3} **f** 7.4×10^1 **g** 45.8×10^{-4} **h** 1.067×10^{-23}

19 Find the missing index number for these conversions from ordinary numbers to standard form. The first one has been done for you.

a $45.6 = 4.56 \times 10^{1}$

b $654.2 = 6.542 \times 10^{\square}$

c $65 = 6.5 \times 10^{\square}$

d $4362 = 4.362 \times 10^{\square}$

e $34.6 = 3.46 \times 10^{\square}$

f $116.7 = 1.167 \times 10^{\square}$

g $6092 = 6.092 \times 10^{\square}$

h $760\,203 = 7.602\,03 \times 10^{\square}$

i $44.81 = 4.481 \times 10^{\square}$

20 Write these numbers in standard form.

a 72	**b** 623	**c** 6382	**d** 5460	**e** 45.3
f 2000	**g** 70.3	**h** 602	**i** 430	**j** 620.5
k 30.67	**l** 45.65	**m** 412.3	**n** 273.62	**o** 1976.3

21 Write each expression as a number.

a 3.4×10^{2}	**b** 8.2×10^{4}	**c** 7.92×10^{3}	**d** 2.91×10^{5}
e 9.47×10^{1}	**f** 3.2×10^{9}	**g** 3.6×10^{0}	**h** 8.05×10^{2}
i 2.84×10^{3}	**j** 9.006×10^{2}	**k** 1.212×10^{6}	**l** 1.009×10^{4}
m 6.98×10^{5}	**n** 3.06×10^{3}	**o** 9.99×10^{4}	

22 **a** Copy and complete this table converting ordinary numbers to standard form.

Ordinary number	Standard form
5600	5.6×10^{3}
560	
56	
5.6	5.6×10^{0}
0.56	
0.056	5.6×10^{-2}
0.0056	

b What do you notice about the powers of 10 in the standard form, as the ordinary numbers get smaller?

c Copy and complete this statement: *When converting ordinary numbers less than 1 into standard form, the index number is always a _____ number.*

23 Match the ordinary numbers in Box A with their equivalent standard form in box B.

Box A

0.51	0.0004
0.705	
0.093	0.0093
0.051	
0.007 05	0.000 093
0.004	

Box B

5.1×10^{-2}	7.05×10^{-1}
4.0×10^{-3}	
9.3×10^{-2}	7.05×10^{-3}
9.3×10^{-3}	
5.1×10^{-1}	4.0×10^{-4}
9.3×10^{-5}	

24 Write these numbers in standard form.

a 0.56	**b** 0.832	**c** 0.0072	**d** 0.043	**e** 0.6205
f 0.0006	**g** 0.0026	**h** 0.004 55	**i** 0.0632	**j** 0.467
k 0.000 87	**l** 0.004 28	**m** 0.009	**n** 0.0205	**o** 0.0051

25 Write each expression as a number.

a 7.04×10^{-3}	**b** 5.9×10^{-1}	**c** 5.0×10^{-4}	**d** 4.02×10^{-4}
e 6.19×10^{-3}	**f** 8.0×10^{-6}	**g** 8.05×10^{-2}	**h** 1.604×10^{-7}
i 5.9×10^{-4}	**j** 9.006×10^{-3}	**k** 4.8×10^{-5}	**l** 3.002×10^{-4}

26 Ruth completed these tables by filling in the blue shaded boxes.

Some of her answers are incorrect.

Find the wrong answers and correct them.

	Ordinary number	Standard form
a	354.7	3.547×10^2
b	0.00598	5.98×10^{-3}
c	0.483	4.83×10^2
d	407 000	4.07×10^4

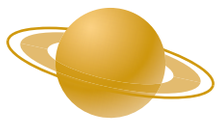
	Ordinary number	Standard form
e	0.00001008	1.008×10^5
f	0.0068	6.8×10^{-3}
g	862	8.62×10^{-2}
h	2006.4	2.0064×10^2

27 The diameter of an atom is about 0.000 000 000 1 mm.

Write this measurement in standard form.

28 Write these facts about Saturn in standard form.

a	Average distance from the Sun	1 426 700 000 km
b	Diameter	120 540 km
c	Orbital period	29.4 years
d	Orbital velocity	79 390 km/h



29 Write these facts about light as ordinary numbers.

a The speed of light is about 2.99×10^5 km/s.

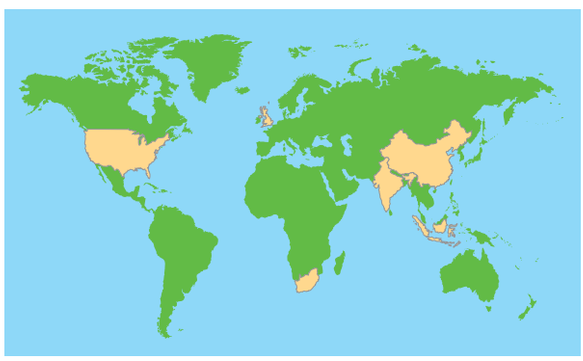
b In a year, light travels about 9.46×10^{12} km (one light-year).

c The wavelength of visible light is about 5.0×10^{-5} cm.

d Some of the most distant objects are 1.5×10^{10} light-years from Earth.

30 Find the corresponding ordinary number or standard form number for the population figures in this table.

Country	Population (ordinary number)	Population (standard form)
China	1 330 000 000	**a**
South Africa	**b**	4.43×10^7
United Kingdom	60 000 000	**c**
USA	300 000 000	**d**
Indonesia	**e**	2.375×10^8
India	**f**	1.15×10^9



Rounding and estimation

- Rounding numbers appropriately for the question
- Writing numbers to a given number of significant figures
- Using rounding to make estimates

Keywords

You should know

explanation 1a explanation 1b

1 Round each number to the degree of accuracy given.

a 342 (nearest 10) **b** 5387 (nearest 100) **c** 4098 (nearest 10)

d 86 495 (nearest 1000) **e** 5000 (nearest 10 000) **f** 398 999 (nearest 10)

2 Copy and complete this table of world population data.

Always work with the original population numbers.

Country	Rounded to nearest 1000	Rounded to nearest 100 000	Rounded to nearest 1 000 000
Australia 21 007 310			
Canada 33 212 696			
France 64 057 792			
India 1 147 995 904			
World 6 706 993 152			

3 Glenn had these number cards.

3 5 7 0 2 8

a What is the closest number that he could make to 570 000 using all the cards?

b Glenn made the number 275 308. He rounded it to 275 000.

What degree of accuracy might he have used in his rounding?

c Glenn was given another card: 5. He made the number 5 275 308.

He said that he had made a number just bigger than five million.

What degree of accuracy was he using?

4 Round these decimals to the nearest whole number.

a 34.8 **b** 103.2 **c** 134.62 **d** 1005.56

e 4419.652 **f** 4805.993 **g** 2989.57 **h** 369 999.56

5 When Vicky checked her online bank statement she had these totals in her different accounts.

Cheque £132.56 Savings £1084.37 Visa statement £245.86

Round each amount to the nearest pound sterling (£).

6 The cost of a twin pack of tennis balls is £6, rounded to the nearest pound.

a What is the smallest amount of money that the twin pack could cost?

b What is the largest amount?

explanation 2a explanation 2b explanation 2c

7 Round each number to the degree of accuracy given.

a 24.35 (1 d.p.) **b** 609.604 (2 d.p.) **c** 90.899 (2 d.p.)

d 207.806 (1 d.p.) **e** 0.0877 (3 d.p.) **f** 9.035 63 (4 d.p.)

g 455.987 (1 d.p.) **h** 340.4704 (3 d.p.) **i** 1.000 654 (4 d.p.)

j 3.333 33... (3 d.p.) **k** 67.6767 (2 d.p.) **l** 0.999 (1 d.p.)

8 Use a calculator to work these out.

Round each answer to the number of decimal places given.

a 82 ÷ 11 (1 d.p.) **b** 2.7 ÷ 31 (2 d.p.)

c 1.8 × 2.6 × 1.3 (1 d.p.) **d** 84.3 × 3.67 (1 d.p.)

e 0.23 × 4.6 ÷ 0.4 (1 d.p.) **f** 52.7 ÷ 2.6 (2 d.p.)

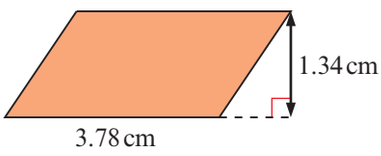
9 The value of the number pi (π) to 10 d.p. is 3.141 592 653 5 .

Round this number to these numbers of decimal places.

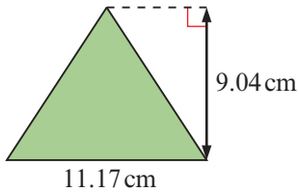
a 1 d.p. **b** 2 d.p. **c** 3 d.p. **d** 4 d.p. **e** 5 d.p.

10 Calculate the area of each shape. Round each answer to two decimal places.

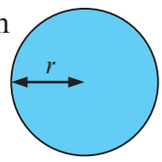
a



b



c $A = \pi r^2$
$r = 2.6$ cm



11 At the National Swimming Competition, Sally was recorded as swimming 100 m in 58.7 seconds, rounded to one decimal place.

What are her fastest and slowest possible times to get this result?

explanation 3a | explanation 3b | explanation 3c

12 How many significant figures does each of these numbers have?

a 628 **b** 0.0042 **c** 90.43 **d** 0.000 504
e 4.00 **f** 23.0302 **g** 34 066.04 **h** 1.000 000 03

13 Round these numbers to **i** one significant figure, **ii** two significant figures.

a 0.234 **b** 0.3615 **c** 0.4368 **d** 0.0288 **e** 0.005 62
f 0.020 54 **g** 0.604 **h** 0.000 455 5 **i** 563 **j** 3607
k 2005 **l** 5564 **m** 44 355 **n** 10 543 **o** 48 704

14 Round these numbers to three significant figures.

a 36.15 **b** 204.99 **c** 3.562 **d** 550.606 **e** 203.9
f 10.6505 **g** 56.037 **h** 40.943 **i** 45.606 **j** 67.988

15 Round these numbers to the degree of accuracy given.

a 0.210 23 (3 s.f.) **b** 0.004 003 02 (4 s.f.) **c** 450.43 (3 s.f.)
d 35.0055 (3 s.f.) **e** 0.077 77 (2 s.f.) **f** 0.000 007 0 (2 s.f.)

16 The mass of a car and trailer is 1370.056 kg.

Round this mass to these numbers of significant figures.

a 1 s.f. **b** 2 s.f. **c** 3 s.f. **d** 4 s.f. **e** 5 s.f.