



Collins



# Edexcel GCSE Maths

Edexcel Achieve Grade 7–9 Workbook



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# 1 Number

## 1.1 Estimating powers and roots

**Hint:** In question 1(f), write 0.126 as  $126 \times 10^{-3}$ .

**1** Use powers and roots that you know to estimate the value of each of the following.

**a**  $3.1^4 =$  \_\_\_\_\_ **b**  $\sqrt{63.8} =$  \_\_\_\_\_ **c**  $(0.49)^3 =$  \_\_\_\_\_

**d**  $82^{\frac{1}{4}} =$  \_\_\_\_\_ **e**  $\sqrt[3]{26.85} =$  \_\_\_\_\_ **f**  $(0.126)^{\frac{2}{3}} =$  \_\_\_\_\_

**Hint:** In questions 2 and 3, use a number line to help.

**2** Estimate the following to 1 decimal place.

**a**  $\sqrt{34.5} =$  \_\_\_\_\_ **b**  $\sqrt{219.8} =$  \_\_\_\_\_ **c**  $\sqrt{1.36} =$  \_\_\_\_\_

**3** Estimate the following to the nearest whole number.

**a**  $(5.6)^2 =$  \_\_\_\_\_ **b**  $(12.3)^2 =$  \_\_\_\_\_ **c**  $(14.8)^2 =$  \_\_\_\_\_

**4** Estimate the value of the following. Show your working.

**a**  $18.7 \times \sqrt{10.01 - 0.45}$  \_\_\_\_\_

**b**  $\sqrt{\frac{31.74^2}{8.75 + 6.61}}$  \_\_\_\_\_

**c**  $\sqrt{0.23} \times \sqrt{0.17}$  \_\_\_\_\_

**d**  $\frac{10 - \sqrt{9.09}}{\sqrt{0.26}}$  \_\_\_\_\_

**e**  $\sqrt{\frac{3\sqrt{15.8} - 2.1^3}{(6.1)^4}}$  \_\_\_\_\_

**Hint:** A realistic mental estimate of  $17.5 \times \sqrt{39}$  is  $20 \times 6 = 120$

## 1.2 Combinations and factors

**Hint:** If there are  $p$  ways of doing one task and  $q$  ways of doing a second task, then the total number of ways of doing the first task followed by the second task is  $p \times q$ .

- 1** An ice cream shop has 15 flavours of ice cream.  
Petra wants one scoop of each of three different flavours.  
Show that there are 2730 different ways of choosing the three scoops of ice cream.

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**Hint:** There are 15 ways to choose the first scoop, how many ways are there to choose the second and then the third if the three scoops are all different?

- 2** A group of students go on a school exchange visit with their teacher.  
There are 12 girls and 15 boys in the group.
- a** The teacher wants one girl and one boy from the group to attend a presentation  
Work out the number of different ways one girl and one boy can be chosen from the group.

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- b** The teacher decides to take three students from the group to meet the local mayor.  
Work out the number of different ways three students can be chosen from the group.

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- 3** A pizza menu has the following toppings for pizza:
- six different meats
  - five different vegetables
  - three different cheeses.

Customers can choose the following combinations of toppings:

- one meat, one vegetable and one cheese
  - one meat and one cheese
  - one meat and one vegetable
  - one vegetable and one cheese.
- a** Sophie wants a pizza with one vegetable topping and one cheese topping for her pizza.  
Work out the number of different pizzas she can choose from.

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- b** Carlos wants a pizza with one meat topping, one vegetable topping and one cheese topping.

Work out the number of different pizzas he can choose from.

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- c** Show that there are 63 different ways of choosing a pizza with two toppings from the menu.

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**4**

- a** Write 28, 105 and 350 as products of their prime factors.

- b** Use a Venn diagram to work out the HCF and LCM of the following.

**i** 28 and 105 \_\_\_\_\_

**ii** 28 and 350 \_\_\_\_\_

**iii** 105 and 350 \_\_\_\_\_

**iv** 28, 105 and 350 \_\_\_\_\_



**5**

In a group of 150 students, 77 study English, 71 study Maths, 52 study Biology 20 study Maths and English, and 10 do not study any of these subjects.

Given that twice as many students study Maths and Biology as study all three subjects:

- a** Complete a Venn diagram to show this information

- b** Work out the number of students who study all three subjects.

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## 1.3 Reverse percentages

**Hint:** If an item decreases in value by 10% it is worth 90% of its original value. To find the value after a decrease of 10% you can multiply by 0.9 to find the new value in one step. 0.9 is called the 'multiplier'.

**1**

A Formula One racing car tyre loses approximately 10% of its weight during a race, due to wear. After a race a complete set of tyres weighs about 18 kg. What does the set weigh before the race?

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2 In 2018, after a 150% increase in salary, a Formula One driver was estimated to earn around \$18 million. How much did he earn in 2017?

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3 If, three years ago, a Formula One driver had put all his earnings into a bank account at 5% compound interest, he would now have \$7 938 000 in his account. How much did he earn three years ago?

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4 A new Lexus car lost 33% of its value in year 1 and 19% of its value in year 2. At the end of year 2 the value of the car was £36 825. What was the value of the car when new?

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5 Brad invested some money in shares. In the first year the value of the shares increased by 2.9%. In the second year the value increased by 3.15%.  
What was the overall percentage change in the value of the shares?

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6 Kerry bought a flat. The value of her flat went down by 2% in the first year. In the second year the value went up by 5%. At the end of the second year, her house was worth £265 700.

a What was the percentage change in the value of the house? \_\_\_\_\_

b Work out how much Kerry paid for her flat.

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## 1.4 Standard form

**Hint:** A number is in standard form when it is in the form  $a \times 10^n$ , where  $1 \leq a < 10$  and  $n$  is an integer.

1

An average person has approximately  $2 \times 10^{13}$  red corpuscles in their bloodstream. Each red corpuscle weighs about 0.000 000 000 1 grams. Work out the approximate total mass of the red corpuscles in an average person, in kilograms.

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2

A factory produces nails. Each nail has a mass of  $5 \times 10^{-3}$  kg.

0.75% of the nails produced by the factory are faulty.

**a** The factory produces  $3.6 \times 10^6$  nails in one year.

Work out the total mass of the faulty nails produced in one year.

**b** The mass of the faulty nails in one batch produced by the factory was  $1.35 \times 10^2$  kg.

**i** Work out the total mass of the nails in the batch. Give your answer in standard form.

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**ii** How many nails were in the batch? Give your answer in standard form.

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3

The speed of light is  $3 \times 10^8$  metres per second.

**a** The distance between the Earth and the Sun is  $1.5 \times 10^8$  kilometres.

How many seconds does it take for light to travel from the Sun to the Earth?

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**b** Light takes 1 hour 25 minutes to travel from the Sun to Saturn. How far is the Sun from Saturn, in kilometres? Give your answer in standard form.

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4

The surface area of Earth is 510 072 000 km<sup>2</sup>.

The surface area of Saturn is 42.7 billion km<sup>2</sup>.

How many times greater is the surface area of Saturn than the surface area of Earth?

Give your answer in standard form.

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5

$$p^2 = \frac{a - b}{ab}$$

$$a = 6.2 \times 10^8$$

$$b = 4.5 \times 10^7$$

Find the value of  $p$ .

Give your answer in standard form correct to 2 significant figures.

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6

There are approximately 15 500 bacterium cells per square centimetre of skin on the human body.

An average human body has 2 square metres of skin.

The mass of one bacterium is  $9.5 \times 10^{-13}$  g.

What is the total weight in grams of the bacteria on an average human body?

Give your answer in standard form.

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## 1.5 Bounds

**Hint:** The bounds of a measure are the highest and lowest possible values of the measure according to the limits of accuracy provided, e.g. the bounds of a weight  $w$  kg, which is 1.3 kg, rounded to 1 decimal place are  $1.25 \leq w < 1.35$ ; where 1.25 is the **lower bound** and 1.35 kg is the **upper bound**. The **error interval** for  $w$  is  $1.25 \leq w < 1.35$ .

1

Given  $x = 2.25$  correct to 2 decimal places and  $y = 1.4$  correct to 1 decimal place, find the maximum and minimum values and state the error intervals for

a  $x + y$  \_\_\_\_\_

b  $x - y$  \_\_\_\_\_

c  $xy$  \_\_\_\_\_

d  $\frac{x}{y}$  \_\_\_\_\_

2

A card measuring 12.5 cm by 8.5 cm (both measured to the nearest 0.1 cm) is to be posted in an envelope that is 13 cm by 10 cm (both to the nearest 1 cm).

Can you guarantee that the card will fit into the envelope? Explain your answer.

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3

Sammi runs a 50 m race at an average speed of 6 m/s.

Both values are measured to an accuracy of 1 significant figure.

a What is Sammi's fastest possible time to complete the race?

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Sammi has an average stride length of 1.32 m, to the nearest centimetre.

b What is the smallest number of strides she will take to complete the race?

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4

The maximum load a van can carry is 1600 kg to the nearest 10 kg.

The van is to be loaded with boxes of beans. Each box weighs 12 kg to the nearest 0.1 kg.

Assuming the van is large enough, what is the minimum number of boxes of beans it can carry?

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5

A rubber brick is in the shape of a cuboid.

The length of the brick is  $l$  cm.

The cross section of the brick is a square of side  $h$  cm.

The mass of the brick is  $M$  kg.

$l = 32$  correct to the nearest centimetre

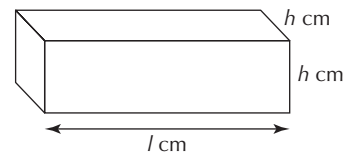
$M = 3.99$  correct to 2 decimal places

$h = 10.2$  correct to 1 decimal place

Find the value of the density of the rubber correct to an appropriate degree of accuracy.

Give your answer in  $\text{g/cm}^3$ .

Explain why your answer is to an appropriate degree of accuracy.



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Hint: density =  $\frac{\text{mass}}{\text{volume}}$

## 1.6 Indices

1

Work out the following.

a  $4^4 \times 4^{-2}$  \_\_\_\_\_ b  $4^2 \div 4^{-2}$  \_\_\_\_\_

c  $8^4 \times 8^{-4}$  \_\_\_\_\_ d  $\frac{2^5}{2^9}$  \_\_\_\_\_



**Hint:** When powers of the same number are multiplied or divided, the rules of indices should be followed, i.e. for multiplication add the powers, and for division subtract the powers. For example,  $5^5 \times 5^{-2} = 5^{5+(-2)} = 5^3$  and  $2^7 \div 2^{-3} = 2^{7-(-3)} = 2^{10}$ .

**2** Find the value of the following.

- a  $1^0$  \_\_\_\_\_      b  $4^{-2}$  \_\_\_\_\_      c  $125^{\frac{1}{3}}$  \_\_\_\_\_  
 d  $32^{-\frac{1}{5}}$  \_\_\_\_\_      e  $9^{\frac{3}{2}}$  \_\_\_\_\_      f  $\left(\frac{81}{16}\right)^{-\frac{3}{4}}$  \_\_\_\_\_

**Hint:** Remember  $x^{-n} = \frac{1}{x^n}$ . Use the rules of indices to simplify, e.g.  $125^{\frac{2}{3}} = \left(125^{\frac{1}{3}}\right)^2 = 5^2 = 25$ . Always take the root part (the denominator) first as it makes the number smaller and easier to deal with.

**3**  $5 \times \sqrt{125} = 5^n$

Find the value of  $n$  \_\_\_\_\_



**4**  $2^x \times 2^y = 128$

$2^x \div 2^y = 8$

Find the values of  $x$  and  $y$  \_\_\_\_\_

**Hint:** Write 128 and 8 as powers of 2, then use the rules of indices to form simultaneous equations for  $x$  and  $y$ .



**5**  $x = 3^p, y = 3^q$

a Express the following in terms of  $x$  and/or  $y$ .

i  $3^{p+q}$  \_\_\_\_\_

ii  $3^{2p}$  \_\_\_\_\_

iii  $3^{q-1}$  \_\_\_\_\_

$xy = 27$

and  $3x^2y = 27$

\_\_\_\_\_

b Find the value of  $p$  and the value of  $q$ .

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# 1.7 Recurring decimals to fractions

**Hint:** Multiply by  $10^n$  using suitable values of  $n$  to form a pair of simultaneous equations and find a solution.

**1** Convert each of these recurring decimals to a fraction in its simplest form.

**Hint:** To convert  $0.\dot{9}$  to a fraction, start by writing  $x = 0.9999\dots$ , hence  $10x = 9.9999\dots$  then you can find the value of  $9x$ .

a  $0.\dot{1}$  \_\_\_\_\_ b  $0.\dot{4}$  \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**2** Ben says that  $0.\dot{9}$  is equivalent to 1. Claire thinks he is wrong.

How can Ben use recurring decimals and fractions to show Claire that  $0.\dot{9}$  is equivalent to 1?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**3** Convert each of these recurring decimals to a fraction in its simplest form.

**Hint:** Use values of  $10^n$  to form a pair of simultaneous equations, e.g. if  $x = 0.\dot{1}\dot{4}$  find  $10x$  and  $100x$  to set up the simultaneous equations.

a  $0.\dot{2}\dot{3}$  \_\_\_\_\_ b  $0.0\dot{2}$  \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

c  $0.24\dot{3}$  \_\_\_\_\_ d  $0.22\dot{0}4$  \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4

Convert each of these fractions to decimal form.

a  $\frac{7}{9}$  \_\_\_\_\_ b  $\frac{41}{45}$  \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

c  $\frac{103}{330}$  \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## 1.8 Surds

Hint: Remember: identify any square numbers that are factors.  $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$  and  $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ .

1

Write each of these expressions as a single square root in its simplest form.

a  $\sqrt{3} \times \sqrt{5}$  \_\_\_\_\_

b  $\sqrt{3} \times \sqrt{2} \times \sqrt{10}$  \_\_\_\_\_

2

Work out the value of each of the following.

a  $\sqrt{5} \times \sqrt{5}$  \_\_\_\_\_

b  $\sqrt{3} \times \sqrt{2} \times \sqrt{6}$  \_\_\_\_\_

c  $\sqrt{10} \times \sqrt{40}$  \_\_\_\_\_

d  $\sqrt{6} \times \sqrt{2} \times \sqrt{12}$  \_\_\_\_\_

e  $\sqrt{600} \div \sqrt{6}$  \_\_\_\_\_

f  $\sqrt{63} \div \sqrt{7}$  \_\_\_\_\_

3 Write the following in the form  $a\sqrt{b}$  where  $b$  is a prime number.

Hint: Look for square numbers that are factors of the root shown and then use  $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ .

a  $\sqrt{12}$  \_\_\_\_\_

b  $\sqrt{80}$  \_\_\_\_\_

4 Simplify these expressions. Write your answers in surd form where necessary.

a  $3\sqrt{5} \times 2\sqrt{3}$  \_\_\_\_\_

b  $3\sqrt{8} \times 3\sqrt{3}$  \_\_\_\_\_

c  $\frac{4\sqrt{30}}{\sqrt{6}}$  \_\_\_\_\_

d  $\frac{8\sqrt{125}}{2\sqrt{20}}$  \_\_\_\_\_

e  $\sqrt{50} + 2\sqrt{32}$  \_\_\_\_\_

f  $6\sqrt{12} - 3\sqrt{27}$  \_\_\_\_\_

5 Evaluate the following.

Hint: Break down the numerators and denominators into factors and the surds into their simplest form. Cancel where possible.

a  $\frac{18}{\sqrt{5}} \times \frac{\sqrt{20}}{3}$  \_\_\_\_\_

b  $\frac{15\sqrt{70}}{\sqrt{5}} \times \frac{2\sqrt{2}}{3\sqrt{7}}$  \_\_\_\_\_

6 Simplify by rationalising the denominator.

Hint: If a number is multiplied by 1 its value remains the same. Importantly, 1 can be written as  $\frac{\sqrt{a}}{\sqrt{a}}$ .

a  $\frac{12}{\sqrt{3}}$  \_\_\_\_\_

b  $\frac{12}{\sqrt{8}}$  \_\_\_\_\_

c  $\frac{3\sqrt{5}}{2\sqrt{45}}$  \_\_\_\_\_

d  $\frac{4}{1+\sqrt{3}}$  \_\_\_\_\_

7 Expand the brackets and simplify.

a  $(2 + \sqrt{3})(4 + \sqrt{3})$  \_\_\_\_\_

b  $(4 - 3\sqrt{3})(5 + 4\sqrt{3})$  \_\_\_\_\_

c  $(1 - 2\sqrt{7})^2$  \_\_\_\_\_

8 Show that  $(\sqrt{15} - \sqrt{12})(\sqrt{15} + \sqrt{12}) = 3$ .

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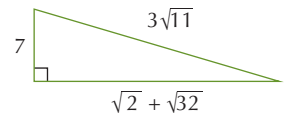
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9 Simplify  $\frac{8 + \sqrt{27}}{4} - \frac{2 + 2\sqrt{3}}{3}$ .

\_\_\_\_\_

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10 a Show that this triangle is right-angled.



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\_\_\_\_\_

\_\_\_\_\_

b Find the exact area of the triangle.

\_\_\_\_\_

\_\_\_\_\_

11 Simplify each of the following, rationalising the denominator where necessary.

a  $\sqrt{72}$  \_\_\_\_\_

b  $\sqrt{27} \times \sqrt{54}$  \_\_\_\_\_

c  $\frac{\sqrt{15} \times \sqrt{35}}{\sqrt{21}}$  \_\_\_\_\_

d  $\frac{2\sqrt{5} \times 5\sqrt{12}}{5\sqrt{2}}$  \_\_\_\_\_

e  $\frac{a\sqrt{5x} - b\sqrt{35x}}{5ab\sqrt{x}}$  \_\_\_\_\_