

Powers and Roots

Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (4 marks)

Work out

(a) 6^2

6^2 means 6×6

$$6 \times 6 = 36$$

Answer: 36

(b) 2^5

2^5 means five 2s multiplied together.

$$2 \times 2 \times 2 \times 2 \times 2$$

$$2 \times 2 = 4, 4 \times 2 = 8, 8 \times 2 = 16, 16 \times 2 = 32$$

Answer: 32

Tip: The power tells you how many times to write the number in a multiplication. 2^5 is not 2×5 .

(c) $\sqrt{144}$

Which number times itself makes 144?

$$12 \times 12 = 144$$

Answer: 12

(d) $\sqrt[3]{125}$

Which number, used three times in a multiplication, makes 125?

$$5 \times 5 \times 5 = 125$$

Answer: 5

2 (1 mark)

Circle the value of 10^4

Options: 40, 1000, 10 000, 14

10^4 means four 10s multiplied together.

$$10 \times 10 \times 10 \times 10 = 10\,000$$

That is 1 followed by 4 zeros.

Answer: 10 000

3 (1 mark)

Use a calculator to work out the value of $50 - \sqrt{729}$

Work out the square root first: $\sqrt{729} = 27$

Then subtract: $50 - 27 = 23$

Answer: 23

4 (1 mark)

Write 1 000 000 as a power of 10

1 000 000 is 1 followed by 6 zeros.

So it is six 10s multiplied together: $10 \times 10 \times 10 \times 10 \times 10 \times 10$

$$= 10^6$$

Answer: 10^6

Tip: “As a power of 10” means write it as 10 with a power, like 10^n . 1×10^6 is standard form, which is not what is asked.

5 (1 mark)

What is 243 as a power of 3?

Keep multiplying by 3 until you reach 243:

$$3 \times 3 = 9$$

$$9 \times 3 = 27$$

$$27 \times 3 = 81$$

$$81 \times 3 = 243$$

That is five 3s multiplied together, so $243 = 3^5$.

Answer: 3^5

6 (2 marks)

Work out $3^2 + 4^3$

$$3^2 = 3 \times 3 = 9$$

$$4^3 = 4 \times 4 \times 4 = 64$$

$$9 + 64 = 73$$

Answer: 73

Marks: 1 mark for 9 or 64. 1 mark for 73.

7 (1 mark)

Work out $(-4)^3$

$$(-4)^3 = (-4) \times (-4) \times (-4)$$

$$(-4) \times (-4) = 16 \text{ (negative} \times \text{negative} = \text{positive)}$$

$$16 \times (-4) = -64 \text{ (positive} \times \text{negative} = \text{negative)}$$

Answer: -64

Tip: A negative number squared is positive, but a negative number cubed is negative.

8 (2 marks)

Work out $\sqrt{3^2 + 4^2} \times 2^3$

Work out inside the square root first.

$$3^2 + 4^2 = 9 + 16 = 25$$

$$\sqrt{25} = 5$$

$$2^3 = 2 \times 2 \times 2 = 8$$

$$5 \times 8 = 40$$

Answer: 40

Marks: 1 mark for 25, 5 or 8. 1 mark for 40.

9 (1 mark)

m is a square number.

$$\sqrt{m} = 7$$

Circle the value of $2m$

Options: 14, 49, 98, 196

$$\sqrt{m} = 7, \text{ so } m = 7 \times 7 = 49$$

The question asks for $2m$, which means $2 \times m$.

$$2m = 2 \times 49 = 98$$

Answer: 98

Tip: Find m first by squaring 7. 14 is a common wrong answer: it is 2×7 , not 2×49 .

10 (1 mark)

Between which two consecutive whole numbers does $\sqrt{50}$ lie?

Find the square numbers either side of 50.

$7^2 = 49$, which is just below 50.

$8^2 = 64$, which is above 50.

So $\sqrt{50}$ is between 7 and 8.

Answer: 7 and 8

Tip: Give the whole numbers 7 and 8, not the square numbers 49 and 64.

11 (2 marks)

Use a calculator to work out $\sqrt{12.4^2 + 5.9^2}$

Give your answer to 1 decimal place.

$$12.4^2 = 153.76$$

$$5.9^2 = 34.81$$

$$\text{Add: } 153.76 + 34.81 = 188.57$$

$$\text{Square root: } \sqrt{188.57} = 13.732 \dots$$

The second decimal place is 3, so round down: 13.7

Answer: 13.7

Marks: 1 mark for 188.57. 1 mark for 13.7.

12 (1 mark)

Alex says,

$$'3^4 = 12'$$

Is Alex correct? Tick a box.

Give a reason for your answer.

3^4 means $3 \times 3 \times 3 \times 3$

$$3 \times 3 = 9, 9 \times 3 = 27, 27 \times 3 = 81$$

So $3^4 = 81$, not 12. Alex has worked out 3×4 .

Answer: No, $3^4 = 81$

13 (2 marks)

Here are four numbers.

$$2^6 \quad 4^3 \quad 5^3 \quad 8^2$$

Three of them have the same value.

Which number is the odd one out?

You must show your working.

Work out each one:

$$2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$$

$$4^3 = 4 \times 4 \times 4 = 64$$

$$5^3 = 5 \times 5 \times 5 = 125$$

$$8^2 = 8 \times 8 = 64$$

2^6 , 4^3 and 8^2 are all equal to 64, so 5^3 is the odd one out.

Answer: 5^3 (it is 125; the others are all 64)

Tip: The power tells you how many copies of the number to multiply together. 2^6 is not $2 \times 6 = 12$, and 8^2 is not $8 \times 2 = 16$.

Marks: 1 mark for working out at least three of the values correctly. 1 mark for 5^3 with all four values shown.

14 (2 marks)

A square number and a cube number add up to 44

Both numbers are greater than 1

Work out the square number and the cube number.

List the cube numbers less than 44 (and greater than 1): 8, 27

Take each one away from 44 and check if the answer is a square number:

$$44 - 8 = 36 = 6^2 \quad \checkmark$$

$$44 - 27 = 17 \text{ (not a square number)}$$

So the square number is 36 and the cube number is 8.

$$\text{Check: } 36 + 8 = 44$$

Answer: 36 and 8

Tip: Cube numbers are $1 \times 1 \times 1$, $2 \times 2 \times 2$, $3 \times 3 \times 3$, ... (1, 8, 27, 64), not multiples of 3.

Marks: 1 mark for taking a cube number (or a square number) away from 44 and testing the result. 1 mark for 36 and 8.

15 (2 marks)

n is a whole number.

$\sqrt{n}$ is 4, to the nearest whole number.

Write down all the possible values of n .

Numbers that round to 4 (to the nearest whole number) are from 3.5 up to, but not including, 4.5

So $\sqrt{n}$ is at least 3.5 and less than 4.5

$$3.5^2 = 12.25 \text{ and } 4.5^2 = 20.25$$

So n is at least 12.25 and less than 20.25

The whole numbers in this range are 13, 14, 15, 16, 17, 18, 19, 20

Check the ends: $\sqrt{12} = 3.46 \dots$ rounds to 3, $\sqrt{13} = 3.60 \dots$ rounds to 4

$\sqrt{20} = 4.47 \dots$ rounds to 4, $\sqrt{21} = 4.58 \dots$ rounds to 5

Answer: 13, 14, 15, 16, 17, 18, 19, 20

Tip: Don't just list numbers near 16. Find where $\sqrt{n}$ changes from rounding to 3 to rounding to 4, and from 4 to 5.

Marks: 1 mark for 3.5^2 or 4.5^2 (12.25 or 20.25), or for testing square roots of numbers near 12 or 20. 1 mark for all eight values and no others.
