# GCSE (9-1) MATHEMATICS

### Higher Check In – 3.01 Powers and roots

### Do not use a calculator.

- 1. Estimate  $\sqrt{177}$  to the nearest whole number.
- 2. Evaluate  $-\frac{1}{3^{-2}}$ .
- 3. If  $x^{a} = \frac{1}{\sqrt{x^{5}}}$ , find *a*.
- 4. Evaluate  $64^{\frac{2}{3}} \div 16^{-\frac{1}{4}}$ .
- 5. Find the value of x which will satisfy the equation  $2^{4x-6} = \frac{1}{4}$ .
- 6. Max is trying to complete his maths homework, but can't remember the rule to simplify (2<sup>3</sup>)<sup>4</sup>. Lin says the rule is multiply the powers so the answer is 2<sup>12</sup>; Kush says the rule is add the powers so the answer is 2<sup>7</sup>. Produce a step-by-step explanation to convince the three friends of the correct answer.
- 7. Using the laws of indices, show that any non-zero number raised to the power of zero equals one.
- 8. Marley says that  $9^{\frac{1}{3}} = 9 \times \frac{1}{3} = 3$ . You tell her that  $9^{\frac{1}{3}} = \sqrt[3]{9}$  but she doesn't believe you. By letting  $9^a \times 9^a \times 9^a = 9$ , prove that you are correct.
- 9. If  $x^{-\frac{3}{2}} = \frac{8}{27}$ , find *x*.
- 10. A cube has volume *V*. The area of one of the faces is *A*. Find a formula for *A* in terms of *V*, giving your answer in the form  $A = V^x$ .

### Extension

If  $\sqrt[3]{4096} = 16$ , evaluate  $4096^{\frac{5}{12}}$  without a calculator, demonstrating your working clearly.





## GCSE (9-1) MATHEMATICS

### Answers

- 1. 13
- 2. **-**9
- 3.  $a = -\frac{5}{2}$
- 4. 32
- 5. *x* = 1
- 6.  $(2^3)^4 = 2^3 \times 2^3 \times 2^3 \times 2^3$ =  $(2 \times 2 \times 2) \times (2 \times 2 \times 2) \times (2 \times 2 \times 2) \times (2 \times 2 \times 2)$ =  $2^{12}$  so Lin is correct.
- 7.  $\frac{a^2}{a^2} = \frac{a \times a}{a \times a} = 1$  and  $\frac{a^2}{a^2} = a^{2-2} = a^0$ , so  $a^0 = 1$  oe
- 8. Let  $9^a \times 9^a \times 9^a = 9$  3a = 1 (equating powers)  $a = \frac{1}{3}$ which gives  $9^{\frac{1}{3}} \times 9^{\frac{1}{3}} \times 9^{\frac{1}{3}} = 9$  or  $(9^{\frac{1}{3}})^3 = 9$ , so this means  $\sqrt[3]{9} = 9^{\frac{1}{3}}$ .
- 9.  $x = \frac{9}{4}$ , either by inspection i.e. spotting that  $\frac{27}{8} = \left(\frac{3}{2}\right)^3$ , or by taking the inverse.
- 10. If you let the length of a side be *I*,  $I = \sqrt[3]{V}$  and  $A = I^2$  so  $A = \left(\sqrt[3]{V}\right)^2 = V^{\frac{2}{3}}$ .

#### Extension

$$4096^{\frac{5}{12}} = (4096^{\frac{1}{12}})^5 = \left((4096^{\frac{1}{3}})^{\frac{1}{4}}\right)^5 = (16^{\frac{1}{4}})^5 = 2^5 = 32$$

We'd like to know your view on the resources we produce. By clicking on '<u>Like</u>' or '<u>Dislike</u>' you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you. If you do not currently offer this OCR qualification but would like to do so, please complete the Expression of Interest Form which can be found here: <u>www.ocr.org.uk/expression-of-interest</u>

#### OCR Resources: the small print

OCR's **resources** are provided to support the teaching of OCR specifications, but in no way constitute an endorsed teaching method that is required by the Board, and the decision to use them lies with the individual teacher. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources.

© OCR 2016 - This resource may be freely copied and distributed, as long as the OCR logo and this message remain intact and OCR is acknowledged as the originator of this work. OCR acknowledges the use of the following content: n/a

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk





## GCSE (9-1) MATHEMATICS

Assessment Objective	Qu.	Торіс	R	Α	G
AO1	1	Estimate a root to the nearest whole number			
AO1	2	Use a negative integer index to represent a reciprocal			
AO1	3	Use a fractional index to represent a combination of powers and roots			
AO1	4	Calculate fractional powers			
AO1	5	Calculate with integer powers			
AO2	6	Know and apply $(a^m)^n = a^{m \times n}$			
AO2	7	Know and apply $a^m \div a^n = a^{m-n}$			
AO2	8	Know and apply $a^m \times a^n = a^{m+n}$			
AO3	9	Solve a problem involving a fractional index			
AO3	10	Solve a contextual problem involving fractional indices			

Assessment Objective	Qu.	Торіс	R	Α	G
AO1	1	Estimate a root to the nearest whole number			
AO1	2	Use a negative integer index to represent a reciprocal			
AO1	3	Use a fractional index to represent a combination of powers and roots			
AO1	4	Calculate fractional powers			
AO1	5	Calculate with integer powers			
AO2	6	Know and apply $(a^m)^n = a^{m \times n}$			
AO2	7	Know and apply $a^m \div a^n = a^{m-n}$			
AO2	8	Know and apply $a^m \times a^n = a^{m+n}$			
AO3	9	Solve a problem involving a fractional index			
AO3	10	Solve a contextual problem involving fractional indices			

Assessment Objective	Qu.	Торіс	R	Α	G
AO1	1	Estimate a root to the nearest whole number			
AO1	2	Use a negative integer index to represent a reciprocal			
AO1	3	Use a fractional index to represent a combination of powers and roots			
AO1	4	Calculate fractional powers			
AO1	5	Calculate with integer powers			
AO2	6	Know and apply $(a^m)^n = a^{m \times n}$			
AO2	7	Know and apply $a^m \div a^n = a^{m-n}$			
AO2	8	Know and apply $a^m \times a^n = a^{m+n}$			
AO3	9	Solve a problem involving a fractional index			
AO3	10	Solve a contextual problem involving fractional indices			

Assessment Objective	Qu.	Торіс	R	Α	G
AO1	1	Estimate a root to the nearest whole number			
AO1	2	Use a negative integer index to represent a reciprocal			
AO1	3	Use a fractional index to represent a combination of powers and roots			
AO1	4	Calculate fractional powers			
AO1	5	Calculate with integer powers			
AO2	6	Know and apply $(a^m)^n = a^{m \times n}$			
AO2	7	Know and apply $a^m \div a^n = a^{m-n}$			
AO2	8	Know and apply $a^m \times a^n = a^{m+n}$			
AO3	9	Solve a problem involving a fractional index			
AO3	10	Solve a contextual problem involving fractional indices			



