# Edexcel GCSE

## Mathematics

# Higher Tier

## Number: Roots and powers

### Information for students

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 6 questions in this selection.

### Advice for students

Show all stages in any calculations.
Work steadily through the paper. Do not spend too long on one question.
If you cannot answer a question, leave it and attempt the next one.
Return at the end to those you have left out.

### Information for teachers

The questions in this document are taken from the 2009 GCSE Exam Wizard and include questions from examinations set between January 2003 and June 2009 from specifications 1387, 1388, 2540, 2544, 1380 and 2381.

Questions are those tagged as assessing "Roots and powers" though they might assess other areas of the specification as well. Questions are those tagged as "Higher" so could have (though not necessarily) appeared on either an Intermediate or Higher tier paper.

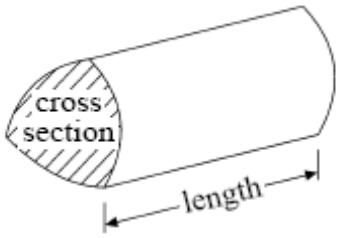
**GCSE Mathematics**

Formulae: Higher Tier

**You must not write on this formulae page.**

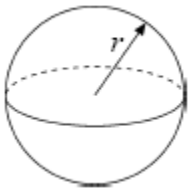
**Anything you write on this formulae page will gain NO credit.**

**Volume of prism** = area of cross section × length



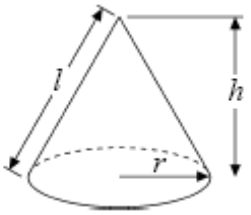

**Volume of sphere** $\frac{4}{3}\pi r^3$

**Surface area of sphere** $= 4\pi r^2$

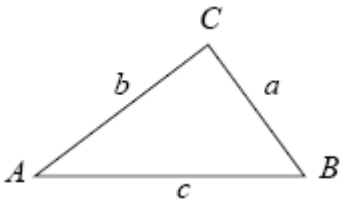



**Volume of cone** $\frac{1}{3}\pi r^2 h$

**Curved surface area of cone** $= \pi rl$




**In any triangle ABC**




**Sine Rule** $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

**Cosine Rule** $a^2 = b^2 + c^2 - 2bc\cos A$

**Area of triangle =** $\frac{1}{2}ab\sin C$

**The Quadratic Equation**

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

**1.** Work out the value of

(i) $(2^2)^3$

.....

(ii) $\left(\sqrt{3}\right)^2$

.....

(iii) $\sqrt{2^4 \times 9}$

.....

**(Total 4 marks)**

**2.** Work out

(i) $4^0$

.....

(ii) $4^{-2}$

.....

(iii) $16^{\frac{3}{2}}$

.....

**(Total 3 marks)**

**3.** (a) Evaluate

(i) $3^{-2}$

……

(ii) $36^{\frac{1}{2}}$

……

(iii) $27^{\frac{2}{3}}$

……

(iv) $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$

……

**(5)**

(b) (i) Rationalise the denominator of $\frac{21}{\sqrt{7}}$ and simplify your answer.

……

(ii) Expand $\left(\sqrt{5}+2\sqrt{3}\right)\left(\sqrt{5}-2\sqrt{3}\right)$
Express your answer as simply as possible.

……

**(4)**
**(Total 9 marks)**

**4.** $2^x \times 2^y = 2^{10}$

and

$2^x \div 2^y = 2^4$

Work out the value of $x$ and the value of $y$.

$x$ = …….

$y$ = …….
**(Total 3 marks)**

**5.** (a) Write down the value of $36^{\frac{1}{2}}$

……

**(1)**

(b) $4n^{\frac{3}{2}} = 8^{-\frac{1}{3}}$

Find the value of $n$.

$n$ = ……

**(3)**
**(Total 4 marks)**

**6.** Write down the value of

(a) $7^0$

.....

**(1)**

(b) $4^{-1}$

.....

**(1)**
**(Total 2 marks)**

**01.** (i) 64 4

*B1 cao*

(ii) 3

*B1 cao*

(iii) 12

$\sqrt{16 \times 9} = \sqrt{144}$

*B2 cao*

*(B1 for sight of $\sqrt{2^4} \times \sqrt{9}$ or better, or 144 seen)*

**[4]**

**02.** (i) 1 1

*B1 cao*

(ii) $\frac{1}{16}$ 1

*B1 cao accept 0.0625*

(iii) 64 1

*B1 cao condone ± 64*

**[3]**

**03.** (a) (i) $\frac{1}{9}$ 5

*B1 cao*

(ii) 6

*B1 cao*

(iii) 9

*B1 cao*

(iv) $\frac{27}{8}$ oe

$\left(\frac{2}{3}\right)^{-3} = \left(\frac{3}{2}\right)^{3}$

*B2 for $\frac{27}{8}$ oe*

*(B1 for $\left(\frac{81}{16}\right)^{\frac{3}{4}}$ or $\left(\frac{2^3}{3^3}\right)^{-1}$ or $\left(\frac{2}{3}\right)^{-3}$ or $\left(\frac{3}{2}\right)^{3}$ or better) or*

$\frac{1}{\frac{8}{27}}$ *or* $\frac{8}{27}$

(b) (i) $3\sqrt{7}$ 4

$$\frac{21\sqrt{7}}{\sqrt{7}\times\sqrt{7}}$$

*M1 for* $\frac{21\sqrt{7}}{\sqrt{7}\times\sqrt{7}}$

*A1 cao*

(ii) $-7$

$5+2\sqrt{3}\sqrt{5}-2\sqrt{3}\sqrt{5}-12$

*M1 for correct expansion with at least one non zero integer term or 3 of our 4 terms correct and slip in 4th ; or for 5 + k – k – 12 where k is a surd*

*A1 for –7 with no error seen*

**[9]**

**04.** $x = 7$
$y = 3$ 3

$x + y = 10$ and $x - y = 4$

*M1 for either x + y = 10 or x – y = 4*

*A2 for both values correct [(A1 for one value correct)*

*If M0, award B3 for both values correct or B2 for one value correct, otherwise B0]*

*SC B2 for x = 3 or y = 7*

**[3]**

**05.** (a) 6 1

*B1 cao*

(b) $\frac{1}{4}$ 3

$4n^{\frac{3}{2}} = \frac{1}{2}$

$n^{\frac{3}{2}} = \frac{1}{8}$

$n^3 = \frac{1}{64}$

$n = \frac{1}{4}$

*M1 for* $\frac{1}{2}$ *coming from* $8^{-1/3}$ *or* $4^{6y}\ n^{9y} = 8^{-2y}$

*M1 for* $n^x = \frac{1}{2^{2x}}$, *2x a positive integer*

*[eg* $n^{\frac{1}{2}} = \frac{1}{2}$, $n^3 = \frac{1}{64}$ *]*

*A1 for* $n = \frac{1}{4}$

**[4]**

**06.** (a) 1 1

*B1 cao*

(b) ¼ oe 1

*B1 for ¼ or 0.25*

**[2]**

**01. Mathematics A Paper 3**

There was quite a selection of answers to this question, and candidates who achieved success in one part sometimes made errors in the other parts; there appeared little consistency to their approach. Part (i) was answered best of all. In part (ii) $\sqrt{3} = 1.5$ was a common error, as was $1.5^2 = 3$. In part (iii) many candidates got as far as 144, but then halved the 144 rather than finding the square root. It was disappointing to find so many (able) candidates unable to perform the calculation $8 \times 9$ correctly.

**Mathematics B Paper 16**

Understanding of powers and roots was not well demonstrated by large numbers of candidates. In part (i) answers of $2 \times 2 \times 3 = 12$ and $6^2 = 6 \times 6 = 12$ were seen often. Even some candidates who wrote $4 \times 4 \times 4$ failed to compute this accurately. It was however, the most successfully completed part of the question by the more able candidates. In part (ii) understanding of root 3 was limited, quite often this was taken as 1.5, and this could lead to the correct answer by doubling. This was penalised. In part (iii) $2^4$ was correctly evaluated regularly, then multiplying by 9 often introduced inaccuracies. At times when 144 was found it was often then halved or doubled in an attempt to work out the square root.

**02.** Most candidates gave the correct value 1 in part (i) although 0 and 4 were common wrong answers. In part (ii) the answer was sometimes left in an incomplete form as $\frac{1}{4^2}$ with other common wrong answers 0.04 and –16 appearing. The final part was, as expected, only generally answered correctly by the more able candidates although some others simplified the given expression to $4^3$ but then evaluated this to 32 (or 48).

**03.** In part (a) although many candidates gained some credit, it was rare to find correct answers to all four parts. A common error in (iii) and (iv) was to use the numerator of the index as a multiplier rather than a power which led to the wrong answers 6 and 4.5 respectively. In part (b)(i), some candidates just multiplied the denominator by $\sqrt{7}$ to get the wrong answer 3 or started the solution by squaring the given expression to eliminate the square root. Some better candidates gained the method mark for multiplying both the numerator and the denominator by $\sqrt{7}$ but then failed to simplify $\frac{21\sqrt{7}}{7}$. Many of the candidates who correctly expanded the brackets in part (b)(ii) failed to correctly simplify the resulting surds to –7. Only a small minority immediately saw it as a difference of two squares.

**04.** **Specification A**

**Higher Tier**

The majority of candidates solved the simultaneous equations by inspection or by systematically testing pairs of positive numbers. A common answer was $x = 8$, $x = 2$, indicating that the indices rules were better understood for multiplication than for division.

**Intermediate Tier**

This question proved a good discriminator. Most candidates appeared to understand the rules of indices, but failed to apply a logical method of finding the missing numbers. there were many trial & improvement techniques, many of which failed to elicit the correct combination of numbers to fit. The most popular incorrect answer was 8 and 2, as candidates first chose two numbers that summed to 10, but then could not make these fit the second condition.

**Specification B**

$x = 7$ and $y = 3$ was a common correct answer, usually found by trial and error rather than via any algebraic approach. $x = 8$ and $y = 2$ was a common mistake; giving values of $x$ and $y$ satisfying just the first equation and their incorrect interpretation of the second equation.

**05.** Correct answers to (a) were very centre dependent. 18 was a common incorrect answer. Part (b), as expected, was a challenge to even the most able. Some very elegant correct solutions were seen but they were rare. Good candidates generally picked up partial credit for realising that the right hand side was equal to ½. A common error was to assume that the coefficient 4 was also being raised to the power $\frac{3}{2}$.

**06.** This was again a very straightforward question but only about 50% could write down that $7^0$ was equal to 1 and only 30% could write $4^{-1}$ as ¼.