Westminster Kingsway
central London's College

Squares, Cubes, powers and roots

GCSE MATHS

Name: ___________________________________
Teacher: _________________________________

Learning objectives

By the end this pack you will be able to:

1. **Find square/cube numbers up to 200**
2. **Use the laws of indices to simplify and evaluate numerical expressions involving powers**
3. **Convert between ordinary numbers and numbers in standard index form**
4. **Calculate with numbers in standard index form**

Key Points

POWERS AND ROOTS 'COLLECT A LETTER'

START	1000	8	32	49	64
P	O	U	E	T	A
2^3	9^2	5^2	7^3	6^3	2^4

27	121	36	100	1	125
E	D	L	N	H	I
4^3	2^5	5^3	10^3	6^2	0^2

216	16	343	0	25	81
I	C	R	S	T	R
10^2	1^5	END	7^2	3^3	11^2

1) $\sqrt{25}$ 3^2 $\sqrt{36}$ 2^3 $\sqrt{100}$

2) $\sqrt{100}$ 4^2 2^2 $\sqrt{81}$ $\sqrt{121}$

3) 5^2 $4^2 + 2^2$ $\sqrt{144}$ $\sqrt{25}+\sqrt{36}$ $1^3 + 3^3$

4) $\sqrt{36} - \sqrt{4}$ $4^2 - 2^2$ $1^3 + 2^3$ $\sqrt{100} - 3^2$ $1^3 + 1^2$

EXAM QUESTIONS

1. Write down the values of

(a) 4^2

(b) $\sqrt{81}$

2. Work out the value of 10^5

3.

(a) Work out 3.7^2

(b) Work out the cube of 4

(c) Work out $3 \div 0.7^2$

(i) Write down the full calculator display.

(ii) Give your answer to the nearest whole number.

4. (a) Calculate $2.7^2 + \sqrt{3.5}$

(b) Calculate the cube of 4.2

INDEX LAWS

1. Write each of these as simply as possible using indices.

a) 2x2x2x2x2 **b) y x y x y x y** **c) 9x9x9** **d) 8x8x8x8x8x8x8**

2. Write down the value of the missing index.

a) $2^2 \times 2^3 = 2^x$ **b)** $3^8 \times 3^x = 2^{12}$ **c)** $5^2 \times 5^x = 5^9$ **d)** $2^x \times 2^3 = 2^7$

e) $(2^2)^4 = 2^x$ **f)** $(2^6)^x = 2^{18}$ **g)** $\frac{3^9}{3^2} = 3^x$ **h)** $\frac{4^8}{4^x} = 4^5$

3. State whether each equation is TRUE or FALSE.

a) $7^2 \times 7^6 = 7^8$ **b)** $\frac{8^3}{8} = 8^2$ **c)** $(5^4)^2 = 5^6$

EXAM QUESTIONS

1. Simplify

(a) $c \times c \times c \times c$

(b) $d^3 \times d^2$

2. Simplify

(a) $w^6 \times w^2$

(b) $x^3 \div x^5$

3. Simplify

(b) $d^3 \times d^2$

4. Simplify

$$x^5 \times x^{-2}$$

EXAM QUESTIONS

1. $0.3 \times 100 + 2.4 \times 10$

2. Magazines are stored in piles of 100.
Each magazine is 0.4 cm thick.
Calculate the height of one pile of magazines.

3. Jane says,

"To multiply a number by 10, put a zero on the end."

She uses her rule to write these examples.

A $53 \times 10 = 530$	**B** $0.53 \times 10 = 0.530$
C $530 \times 10 = 5300$	**D** $5.3 \times 10 = 5.30$

(a) State which of Jane's examples are incorrect.

(b) Choose one of Jane's incorrect examples.

Write the example in the box below with the correct answer.

.... × 10 = ...

INDEX FORM (INDICES) WORKSHEET

Simplify

1. 3 x 3 x 3
2. 5 x 5 x 5 x 5 x 5 x 5
3. 6 x 6 x 2 x 2 x2
4. 7 x 7 x 7 x 8 x 8 x 8 x 8
5. 7 x 7 x 8 x 9 x 9 x 9
6. 3 x 4 x 3 x 4 x 5 x 5

Simplify the following

$7^{2} \times 7^{5} =$	$15^{10} \div 15^{7} =$
$7^{2} \times 7^{6} =$	$10^{10} \div 10^{1} =$
$7^{11} \times 7^{15} =$	$16^{13} \div 16^{4} =$
$1^{5} \times 1^{3} =$	$19^{15} \div 19^{6} =$
$10^{8} \times 10^{12} =$	$2^{15} \div 2^{10} =$
$17^{8} \times 17^{14} =$	$16^{17} \div 16^{2} =$
$13^{5} \times 13^{16} =$	$5^{20} \div 5^{5} =$
$19^{2} \times 19^{13} =$	$6^{14} \div 6^{7} =$
$6^{4} \times 6^{1} =$	$15^{14} \div 15^{8} =$
$17^{1} \times 17^{20} =$	$1^{14} \div 1^{3} =$

Now try these:

1. $(7^2)^3$ 2. $(3^5)^3$ 3. $(x^2)^{10}$ 4. $(11^5)^5$ 5. $(y^2)^{20}$ 6. $(17^5)^4$

Extension:

(c) $x^7 \times x^9$

(d) $m^4 \times m^3$

(e) $(m^4)^3$

(h) $x^6 \times x^{12} \times x^3$

(i) $(x^3)^4 \times x^5$

(j) $m^4 \times (m^5)^2 \times m$

MULTIPLYING AND DIVIDING BY POWERS OF 10

1	891.8	x	10	**21**	73.66	÷	10
2	59.15	x	100	**22**	70.07	÷	10
3	63.51	x	100	**23**	47.5	÷	100
4	3.107	x	100	**24**	261.6	÷	10
5	0.7303	x	10	**25**	0.1987	÷	10
6	0.7146	x	1000	**26**	1.914	÷	10
7	5.638	x	1000	**27**	0.8249	÷	10
8	539.7	x	100	**28**	552.5	÷	100
9	757.8	x	100	**29**	105.6	÷	10
10	2.023	x	100	**30**	695	÷	100
11	970.9	x	0.1	**31**	756	÷	10
12	942.3	x	0.1	**32**	54.6	÷	100
13	181.8	x	0.01	**33**	398	÷	10
14	0.7792	x	0.1	**34**	9364	÷	1000
15	0.7353	x	0.01	**35**	391	÷	10
16	558.6	x	0.1	**36**	34010	÷	1000
17	51.95	x	0.01	**37**	627100	÷	1000
18	0.9222	x	0.1	**38**	626000	÷	1000
19	359.6	x	0.1	**39**	77400	÷	1000
20	849.7	x	0.1	**40**	86.19	÷	1000

Very Big and Very Small Numbers

Mathematicians, scientists and engineers (and your calculator) prefer to write and work with very large and very small numbers in standard form.

A number is in standard form when it is written like this:

6.7×10^6

This part is made up of a number from 1 up to (but not including) 10.

This part is written as a power of 10, and the power is a whole number.

You could think of 1000 as being 1 x 10 x 10 x 10 and write it as 1×10^3 .

You could think of 10 000 as being 1 x 10 x 10 x 10 x 10 and write it as 1×10^4.

Complete the table below, the first three rows have been completed for you.

Number	Number in standard form
1 000 000	1×10^6
100 000	1×10^5
10 000	1×10^4
1 000	
100	
10	
1	
0.1	
0.01	
0.001	

The power of ten is the place value of the first significant

As the number is less than one the power of ten is

200 could be written as 2×10^2.

300 could be written as 3×10^2.

250 could be written as 2.5×10^2.

Complete the table on the left, the first three rows have been completed for you.

Number	Number in standard form
200	
230	
300	
399	
400	
415	
500	
550	
9870	

Standard Form

1. Convert these numbers into standard form

a 0.005
b 0.0002
c 0.004
d 0.000 003
e 0.000 000 8
f 0.2
g 0.004 3
h 0.000 056
i 0.000 131
j 0.030 03
k 0.0561
l 0.0042

2. Write these numbers as ordinary numbers

a 5×10^{-2}
b 6×10^{-4}
c 2×10^{-5}
d 7×10^{-7}
e 9×10^{-1}
f 8×10^{-4}
g 5.4×10^{-2}
h 8.6×10^{-6}
i 9.4×10^{-6}
j 1.02×10^{-3}
k 4.04×10^{-6}
l 8.39×10^{-9}

3. Convert these numbers to standard form (there are a mixture of large and small numbers)

a 0.003
b 5 000
c 0.4
d 7 000 000
e 20 000
f 0.000 5
g 45 000
h 3 700
i 0.0925
j 18 500
k 258 000 000
l 0.000 156

4. Write these numbers as ordinary numbers

a 6×10^{-6}
b 6×10^{6}
c 1×10^{-3}
d 1×10^{3}
e 8×10^{5}
f 8×10^{-5}
g 8.2×10^{-1}
h 9.5×10^{-4}
i 5.55×10^{8}
j 6.47×10^{-2}
k 3.001×10^{2}
l 9.1×10^{10}

Star Wars Standard Form

The Millennium Falcon flies at the speed of sound normally, but when it goes into hyper-drive flies at the speed of light.

The Speed of Sound is 3.4×10^2 metres per second.

The Speed of Light is 3×10^8 metres per second.

Calculate how long these journeys would take the Millennium Falcon, giving your answers in standard form and using appropriate units of time:

From	To	Distance (kilometres)	Hyper-drive used?	Time Taken (seconds)	Time Taken (hours/minutes)
Hoth	Naboo	1.224×10^7	No		
Tatooine	Dagobah	3.06×10^6	No		
Endor	Ord Mantell	1.35×10^{13}	Yes		
Dantooine	Kashyyyk		No	1.2×10^4	
Bespin	Kessel		Yes	7.5×10^3	

The Millennium Falcon has developed a fault in the hyper-drive meaning that it can't go at full speed.

It travels from Coruscant to Mon Calamari, a distance of 1.1664×10^{13} kilometres in 17 hours 45 minutes using the faulty hyper-drive. How fast is the Millennium Falcon going whilst the fault exists?

What percentage of the full hyper-drive speed is this?