"Full Coverage": Surds

This worksheet is designed to cover one question of each type seen in past papers, for each GCSE Higher Tier topic. This worksheet was automatically generated by the DrFrostMaths Homework Platform: students can practice this set of questions interactively by going to www.drfrostmaths.com/homework, logging on, *Practise* → *Past Papers/Worksheets* (or *Library* → *Past/Past Papers* for teachers), and using the 'Revision' tab.

Question 1

Categorisation: Simplify a surd.

[Edexcel GCSE Nov2006-5H Q21c]

Write $\sqrt{50}$ in the form $k\sqrt{2}$, where k is an integer.

.....

Question 2

Categorisation: Simplify a multiple of a surd.

[Edexcel GCSE June2006-5H Q20c Edited]

$8\sqrt{8}$ can be expressed in the form $m\sqrt{2}$ where m is a positive integer.

Express $8\sqrt{8}$ in the form $m\sqrt{2}$

.....

Question 3

Categorisation: Add an subtract surds that require prior simplification.

Fully simplify $\sqrt{27} + \sqrt{3}$.

.....

Question 4

Categorisation: As above but with multiples of surds.

Fully simplify $2\sqrt{5} + \sqrt{20}$.

.....

Question 5

Categorisation: Multiply multiples of surds.

Simplify $5\sqrt{2} \times 3\sqrt{2}$

.....

Question 6

Categorisation: Expand out two brackets involving surds, and simplify.

[Edexcel GCSE June2008-3H Q23b]

(b) Expand $\left(2 + \sqrt{3}\right)\left(1 + \sqrt{3}\right)$

Give your answer in the form $a + b\sqrt{3}$, where a and b are integers.

.....

Question 7

Categorisation: As above, but where subsequent simplification of surds required.

[Edexcel IGCSE May2015-4H Q19a Edited]

Find $\left(5 - \sqrt{8}\right)\left(7 + \sqrt{2}\right)$, leaving your answer in the form $a + b\sqrt{2}$

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Question 8

Categorisation: As above, but involving multiples of surds.

[Edexcel IGCSE May2016-4H Q19]

Simplify

$$(7 + 2\sqrt{50})(5 - 2\sqrt{2})$$

Give your answer in the form $a + b\sqrt{18}$ where a and b are integers.

.....

Question 9

Categorisation: Square a bracket involving surds.

[Edexcel GCSE Jun2015-1H Q22c]

Work out the value of $\left(\sqrt{12} - \sqrt{3}\right)^2$

.....

Question 10

Categorisation: Simplify more complicated expressions involving surds.

[Edexcel GCSE Nov2012-1H Q26b]

Expand and simplify

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

.....

Question 11

Categorisation: Expand out a single bracket and simplify, potentially involving algebraic surds.

[Edexcel IGCSE May2016(R)-3H Q20b Edited]

Given that a is a positive integer, show that

$$\sqrt{3a}\left(\sqrt{12a} + a\sqrt{3a}\right)$$

is always a multiple of 3.

Input note: write the expression in the form $3(\ldots)$

.....

Question 12

Categorisation: Compare surd terms and non-surd terms on each side of the equation. e.g. If $\boldsymbol{a + b + c\sqrt{2} = 3 + 4\sqrt{2}}$, then $\boldsymbol{a + b = 3}$ and $\boldsymbol{c = 4}$.

[Edexcel GCSE(9-1) Mock Set 2 Spring 2017 2H Q22]

$\left(a + \sqrt{8}\right)^2$ can be written in the form $c + d\sqrt{2}$, where a, c and d are integers. Find, in terms of a, an expression for c and an expression for d.

.....

Question 13

Categorisation: As above, but involving multiples of surds

[Edexcel IGCSE May2015(R)-4H Q19c Edited]

$$\left(e - 2\sqrt{3}\right)^2 = f - 20\sqrt{3}$$

where e and f are integers.

Find the value of e and the value of f

.....

Question 14

Categorisation: Solve ratio problems involving surds.

[Edexcel GCSE(9-1) Mock Set 2 Spring 2017 3H Q14]

$a = \sqrt{7} + \sqrt{c}$ and $b = \sqrt{63} + \sqrt{d}$ where c and d are positive integers.

Given that $c : d = 1 : 9$
find, in its simplest form, the ratio $a : b$

..... : .....

Question 15

Categorisation: Rationalise the denominator of a fraction.

[Edexcel GCSE June2014-1H Q25a]

Rationalise the denominator of $\frac{12}{\sqrt{3}}$.

.....

Question 16

Categorisation: Rationalise the denominator of a fraction where the denominator is a multiple of a surd.

[Edexcel GCSE June2006-5H Q20d]

Rationalise the denominator of

$$\frac{1}{8\sqrt{8}}$$

Give your answer in the form $\frac{\sqrt{2}}{p}$ where p is a positive integer.

.....

Question 17

Categorisation: Rationalise the denominator a fraction where the numerator involves a mixed of surd and non-surd terms.

[Edexcel GCSE Nov2006-5H Q21d]

Rationalise

$$\frac{1+\sqrt{2}}{\sqrt{2}}$$

.....

Question 18

Categorisation: Rationalise the denominator of a fraction where the denominator is in the form $a + b\sqrt{c}$ (NEW TO GCSE9-1).

[Edexcel GCSE(9-1) Mock Set 1 Autumn 2016 - 1H Q21 Edited]

Write $\frac{3+\sqrt{2}}{5+\sqrt{8}}$ in the form $\frac{a+b\sqrt{2}}{17}$

.....

Question 19

Categorisation: Rationalise the denominator of a fraction where prior expansion is required.

[Edexcel GCSE June2003-5H Q18]

Work out

$$\frac{(5+\sqrt{3})(5-\sqrt{3})}{\sqrt{22}}$$

Give your answer in its simplest form.

.....

Question 20

Categorisation: Rationalise the denominator of a fraction involving embedded fractions.

[Edexcel GCSE(9-1) Mock Set 2 Spring 2017 1H Q18]

Fully simplify

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

.....

Question 21

Categorisation: Rationalise the denominator of a fraction involving algebraic surds.

[Edexcel IGCSE May2015-4H Q19b]

Given that c is a prime number, rationalise the denominator of

$$\frac{3c-\sqrt{c}}{\sqrt{c}}$$

Simplify your answer.

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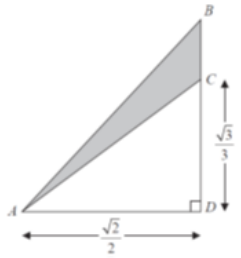
Question 22

Categorisation: Use surds in the context of area.

[Edexcel GCSE Jun2016-1H Q25]

ABD is a right-angled triangle.



All measurements are given in centimetres.

C is the point on BD such that $CD = \frac{\sqrt{3}}{3}$

$$AD = BD = \frac{\sqrt{2}}{2}$$

Work out the exact area, in cm^2, of the shaded region.

..... cm ^{2}

Question 23

Categorisation: Use surds in the context of Pythagoras.

[Edexcel GCSE Nov2011-3H Q21]

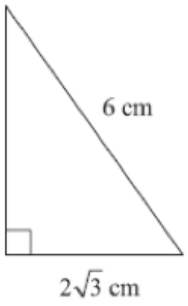


Diagram **NOT** accurately drawn

The diagram shows a right-angled triangle.

The length of the base of the triangle is $2\sqrt{3}$ cm.

The length of the hypotenuse of the triangle is 6 cm.

The area of the triangle is A cm^2.

Show that $A = k\sqrt{2}$ giving the value of k .

$k =$ .....

Question 24

Categorisation: As above, but involving more complex surd expressions as sides.

[Edexcel GCSE Nov2005-5H Q20bii]

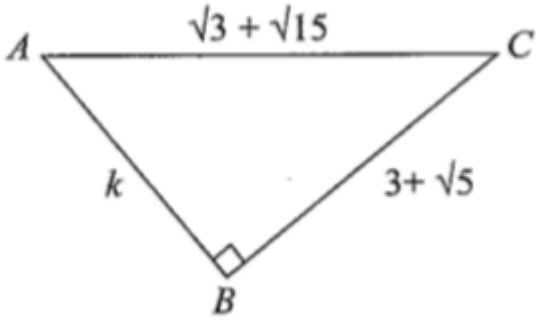


Diagram **NOT** accurately drawn

All measurements on the triangle are in centimetres.
ABC is a right-angled triangle. k is a positive integer.
Find the value of k .

$k =$ .....

Question 25

Categorisation: Use surds in the context of volume.

[Edexcel IGCSE Jan2016-4H Q23]

The diagram shows a solid cylinder.

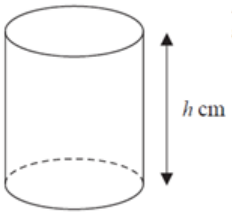


Diagram **NOT** accurately drawn

The cylinder has radius $4\sqrt{3}$ cm and height h cm.
The total surface area of the cylinder is $56\pi\sqrt{6}cm^2$.
Find the exact value of h.
Give your answer in the form $a\sqrt{2} + b\sqrt{3}$ where a and b are integers.
Show your working clearly.

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Answers

Question 1
$5\sqrt{2}$

Question 2
$16\sqrt{2}$

Question 3
$4\sqrt{3}$

Question 4
$4\sqrt{5}$

Question 5
30

Question 6
$5 + 3\sqrt{3}$

Question 7
$31 - 9\sqrt{2}$

Question 8
$-5 + 12\sqrt{18}$

Question 9
3

Question 10
$8\sqrt{3}$

Question 11
$3(2a + a^2)$

Question 12
$c = a^2 + 8$, $d = 4a$

Question 13
$e = 5$, $f = 37$

Question 14
1: 3

Question 15
$4\sqrt{3}$

Question 16
$\frac{\sqrt{2}}{32}$

Question 17
$\frac{\sqrt{2}+2}{2}$

Question 18
$\frac{11-\sqrt{2}}{17}$

Question 19
$\sqrt{22}$

Question 20
$\sqrt{3}$

Question 21
$3\sqrt{c} - 1$

Question 22
$\frac{1}{4} - \frac{\sqrt{6}}{12}$

Question 23
$k =$ 6

Question 24
$k = 2$

Question 25
$7\sqrt{2} - 4\sqrt{3}$