GCSE · Edexcel · Maths

2 hours 49 questions

Exam Questions

Surds

Simplifying Surds / Rationalising Denominators

Medium (18 questions)	/43
Hard (16 questions)	/49
Very Hard (15 questions)	/50
Total Marks	**/142**

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Medium Questions

1 (a) Rationalise the denominator of $\frac{12}{\sqrt{3}}$.

(2 marks)

(b) Work out the value of $(\sqrt{2} + \sqrt{8})^2$.

(2 marks)

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

(2 marks)

3 Rationalise the denominator of $\frac{10}{\sqrt{5}}$.

Give your answer in its simplest form.

(2 marks)

4 Show that $(6 + 2\sqrt{12})^2 = 12(7 + 4\sqrt{3})$

Show each stage of your working.

(3 marks)

5 Show that $\frac{\sqrt{20} + \sqrt{80}}{\sqrt{3}}$ can be expressed in the form $\sqrt{a}$ where a is an integer.

Show your working clearly.

(3 marks)

6 Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$
Show your working clearly.

(2 marks)

7 Rationalise the denominator of $\frac{10}{\sqrt{6}}$

Give your answer in its simplest form

(2 marks)

8 Show that $\sqrt{20} = 2\sqrt{5}$.

(2 marks)

9 Write $(1 + \sqrt{3})^2$ in the form $a + b\sqrt{3}$.

(3 marks)

10 Simplify $\sqrt{6} \times \sqrt{3}$.

(2 marks)

11 Simplify fully by rationalising the denominator.

$$\frac{20}{\sqrt{5}}$$

(3 marks)

12 Simplify fully.

$\sqrt{200}$

(2 marks)

13 Write $\sqrt{12} + \sqrt{75}$ in the form $k\sqrt{3}$.

(3 marks)

14 Simplify fully.

$\sqrt{50} + \sqrt{2}$

(2 marks)

15 Work out $2\sqrt{10} \times \sqrt{80} \times \sqrt{18}$

Give your answer as an integer.

(3 marks)

16 Rationalise the denominator and simplify $\frac{10}{3\sqrt{5}}$

(2 marks)

17 $8300 = 100 \times 83$

Choose the number that is closest in value to $\sqrt{8300}$

A. 19

B. 90

C. 830

D. 900

(1 mark)

18 Show that $\frac{14}{\sqrt{7}}$ can be written in the form $a\sqrt{b}$ where a and b are integers.

(2 marks)

Hard Questions

1 (a) Rationalise the denominator of $\frac{5}{\sqrt{2}}$.

(2 marks)

(b) Expand and simplify $(2+\sqrt{3})^2-(2-\sqrt{3})^2$.

(2 marks)

2 Expand $(1+\sqrt{2})(3-\sqrt{2})$

Give your answer in the form $a + b\sqrt{2}$ where a and b are integers.

(2 marks)

3 (a) Martin did this question.

> Rationalise the denominator of $\frac{14}{2+\sqrt{3}}$

Here is how he answered the question.

$$\frac{14}{2+\sqrt{3}} = \frac{14 \times (2-\sqrt{3})}{(2+\sqrt{3})(2-\sqrt{3})}$$

$$= \frac{28-14\sqrt{3}}{4+2\sqrt{3}-2\sqrt{3}+3}$$

$$= \frac{28-14\sqrt{3}}{7}$$

$$= 4-2\sqrt{3}$$

Martin's answer is wrong.

Find Martin's mistake.

(1 mark)

(b) Sian did this question.

Rationalise the denominator of $\frac{5}{\sqrt{12}}$

Here is how she answered the question.

$$\frac{5}{\sqrt{12}} = \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}}$$

$$= \frac{5 \times 3\sqrt{2}}{12}$$

$$= \frac{5\sqrt{2}}{4}$$

Sian's answer is wrong.

Find Sian's mistake.

(1 mark)

4 Simplify fully $\dfrac{(6-\sqrt{5})(6+\sqrt{5})}{\sqrt{31}}$

You must show your working.

(3 marks)

5 $\sqrt{5}(\sqrt{8}+\sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.

Find the value of a.

(3 marks)

6 Show that $\dfrac{(4-\sqrt{3})(4+\sqrt{3})}{\sqrt{13}}$ simplifies to $\sqrt{13}$.

(2 marks)

7 (a) Express $\sqrt{3}+\sqrt{12}$ in the form $a\sqrt{3}$ where a is an integer.

(2 marks)

(b) Express $\left(\dfrac{1}{\sqrt{3}}\right)^7$ in the form $\dfrac{\sqrt{b}}{c}$ where b and c are integers.

(3 marks)

8 Rationalise the denominator of $\frac{4}{7 - \sqrt{5}}$

Show each stage of your working.

Give your answer in the form $a + b\sqrt{5}$ where a and b are fractions in their simplest forms.

(3 marks)

9 Given that y is a prime number, express $\frac{3}{2 - \sqrt{y}}$ in the form $\frac{a + b\sqrt{y}}{c - y}$ where a, b and c are integers.

(2 marks)

10 Rationalise the denominator of $\frac{6}{3 - \sqrt{7}}$

Simplify your answer.
You must show each stage of your working.

(3 marks)

11 Show that $\frac{\sqrt{8}}{\sqrt{8} - 2}$ can be written in the form $n + \sqrt{n}$, where n is an integer.

Show your working clearly.

(3 marks)

12 Express $\frac{2}{\sqrt{3}-1}$ in the form $p+\sqrt{q}$

where p and q are integers.
Show your working clearly.

(2 marks)

13 Show that $\frac{14}{3-\sqrt{2}}$ can be written in the form $a+b\sqrt{2}$.

(5 marks)

14 Show that $\frac{\sqrt{150}-\sqrt{6}}{\sqrt{2}\times\sqrt{3}}$ simplifies to an integer.

(3 marks)

15 Show that $\left(5\sqrt{3}-\sqrt{12}\right)^2$ simplifies to an integer.

(3 marks)

16 Show that $\frac{18}{\sqrt{2}}-\frac{16}{\sqrt{8}}+3\sqrt{32}$ can be written in the form $a\sqrt{2}$ where a is an integer to be found.

(4 marks)

Very Hard Questions

1 $a = \sqrt{8} + 2$
$b = \sqrt{8} - 2$
$T = a^2 - b^2$

Work out the value of T.
Give your answer in the form $c\sqrt{2}$ where c is an integer.

(4 marks)

2 Show that $\dfrac{6 - \sqrt{8}}{\sqrt{2} - 1}$ can be written in the form $a + b\sqrt{2}$ where a and b are integers.

(3 marks)

3 Show that $\dfrac{1}{1 + \dfrac{1}{\sqrt{2}}}$ can be written as $2 - \sqrt{2}$

(3 marks)

4 $a = \sqrt{8} + 4$

$b = \sqrt{8} - 4$

$(a - b)(a + b)$ can be written in the form $y\sqrt{4y}$

Find the value of y

Show your working clearly.

(3 marks)

5 Rationalise the denominator of $\frac{a + \sqrt{4b}}{a - \sqrt{4b}}$ where a is an integer and b is a prime number.

Simplify your answer.

(3 marks)

6 Show that $\frac{2}{6 - 3\sqrt{2}}$ can be written in the form $\frac{a + \sqrt{a}}{b}$

where a and b are integers.

Show your working clearly.

(3 marks)

7 Express $\frac{8}{\sqrt{5}-1}$ in the form $\sqrt{a}+b$ where a and b are integers.

Show each stage of your working clearly.

(3 marks)

8 The area of a rectangle is $18\ \text{cm}^2$

The length of the rectangle is $\left(\sqrt{7}+1\right)\ \text{cm}$.

Showing each stage of your working, find the width of the rectangle.

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

.....cm

(3 marks)

9 Show that $\frac{4+\sqrt{8}}{\sqrt{2}-1}$ can be written in the form $a+b\sqrt{2}$, where a and b are integers.

Show each stage of your working clearly and give the value of a and the value of b.

(3 marks)

10 In the following equation, n is an integer greater than 1.

$$(\sqrt{2})^n = k\sqrt{2}$$

i) Find k when $n = 7$.

k = ... [2]

ii) Find n when $k = 64$.

n = ... [2]

(4 marks)

11 Show that $\frac{(4 + 2\sqrt{5})}{\sqrt{5} - 1}$ can be simplified to $\frac{3\sqrt{5} + 7}{2}$

(4 marks)

12 (a) Here is a sequence.

5, $5\sqrt{3}$, 15, $15\sqrt{3}$

Work out the next term.

(1 mark)

(b) Find the nth term.

(3 marks)

13 Simplify $\sqrt{80} + \sqrt{2\frac{2}{9}}$

Give your answer in the form $\frac{a\sqrt{5}}{b}$ where a and b are integers.

(3 marks)

14 Work out $\sqrt{18} - \frac{28}{\sqrt{50}}$

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

(4 marks)

15 Show that $\frac{2\sqrt{6}}{\sqrt{5}} - \frac{\sqrt{3}}{\sqrt{10}}$ can be written in the form $\frac{c\sqrt{d}}{10}$

where c and d are integers.

(3 marks)