

Exam Questions

Surds

Simplifying Surds / Rationalising Denominators

Medium (20 questions)	/47
Hard (17 questions)	/51
Very Hard (15 questions)	/50
Total Marks	/148

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Medium Questions

1 Simplify

$$\sqrt{32} + \sqrt{98}$$

(2 marks)

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

(2 marks)

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

(2 marks)

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

(2 marks)

4 Rationalise the denominator of $\frac{10}{\sqrt{5}}$. Give your answer in its simplest form.

(2 marks)

5 Show that $\frac{\sqrt{12}}{\sqrt{3+2}}$

can be written in the form $a\sqrt{b}$ where a is a simplified fraction and b is an integer.

(2 marks)

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

Show each stage of your working.

(3 marks)

7 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)

8 Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$

Show your working clearly.

(2 marks)

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

Give your answer in its simplest form

(2 marks)

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

(2 marks)

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

(3 marks)

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

(2 marks)

13 Simplify fully by rationalising the denominator.

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

(3 marks)

14 Simplify fully.

$$\sqrt{200}$$

(2 marks)

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

(3 marks)

16 Simplify fully.

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

(2 marks)

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

Give your answer as an integer.

(3 marks)

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

(2 marks)

19 $8300 = 100 \times 83$

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

A. 19

B. 90

C. 830

D. 900

(1 mark)

20 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 Rationalise the denominator

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

(2 marks)

2 (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)

3 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)

4 (a) Martin did this question.

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

Here is how he answered the question.

$$\begin{aligned}\frac{14}{2 + \sqrt{3}} &= \frac{14 \times (2 - \sqrt{3})}{(2 + \sqrt{3})(2 - \sqrt{3})} \\ &= \frac{28 - 14\sqrt{3}}{4 + 2\sqrt{3} - 2\sqrt{3} + 3} \\ &= \frac{28 - 14\sqrt{3}}{7} \\ &= 4 - 2\sqrt{3}\end{aligned}$$

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.

$$\begin{aligned}\frac{5}{\sqrt{12}} &= \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}} \\ &= \frac{5 \times 3\sqrt{2}}{12} \\ &= \frac{5\sqrt{2}}{4}\end{aligned}$$

Sian's answer is wrong.

Find Sian's mistake.

(1 mark)

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

You must show your working.

(3 marks)

6 $\sqrt{5}(\sqrt{8} + \sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.

Find the value of a .

(3 marks)

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

(2 marks)

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

(2 marks)

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

(3 marks)

- 9 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)

- 10 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)

- 11 Without using a calculator, rationalise the denominator of $\frac{6}{3 - \sqrt{7}}$

Simplify your answer.

You must show each stage of your working.

(3 marks)

- 12 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)

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

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

(2 marks)

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

(5 marks)

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

(3 marks)

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

(3 marks)

17 Show that $\frac{\sqrt{98} - 3\sqrt{2}}{4\sqrt{2} - 4}$ can be written as $a + b\sqrt{2}$, where a and b are integers.

(4 marks)

Very Hard Questions

$$a = \sqrt{8} + 2$$

$$1 \quad b = \sqrt{8} - 2$$

$$T = a^2 - b^2$$

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

(3 marks)

- 3 Show that $\frac{1}{1 + \frac{1}{\sqrt{2}}}$ 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 cm^2

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

Without using a calculator and 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 $n = 7$.

$k = \dots\dots\dots$ [2]

ii) Find n when $k = 64$.

$n = \dots\dots\dots$ [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.

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

Work out the next term.

(1 mark)

(b) Find the n th 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)