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GCSE MATHS

Number

Edexcel 1MA1 | Subtopic collection Topic 06

Surds

Higher tier

Past paper question booklet

49	2003-2025	Higher
question groups	available papers	tier

Before you begin

1. Show working and use units where appropriate.
2. Use extra paper if you need more space.
3. Print at actual size (100%) for measurement questions.

Name _____ **Date** _____

Whole questions are retained for context; some parts cover other points. Legacy sources are labelled.

17. (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)

18.

(a) Find the value of $16^{\frac{1}{2}}$

.....
(1)

(b) Given that $\sqrt{40} = k\sqrt{10}$, find the value of k.

.....
(1)

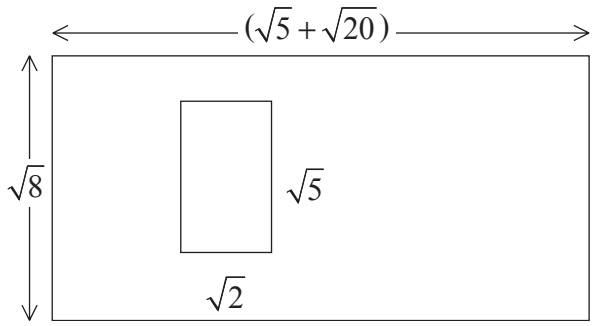


Diagram **NOT** accurately drawn

A large rectangular piece of card is $(\sqrt{5}+\sqrt{20})$ cm long and $\sqrt{8}$ cm wide.

A small rectangle $\sqrt{2}$ cm long and $\sqrt{5}$ cm wide is cut out of the piece of card.

(c) Express the area of the card that is left as a percentage of the area of the large rectangle.

%
.....
(4)

21. (a) Write down the value of $4^{\frac{3}{2}}$

.....

(1)

(b) Write $\sqrt{8}$ in the form $m\sqrt{2}$, where m is an integer.

.....

(2)

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

.....

(2)

(d) Rationalise $\dfrac{1+\sqrt{2}}{\sqrt{2}}$

.....

(2)

Q21

(Total 7 marks)

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

Q19

.....

(Total 2 marks)

14 (a) Express $5\sqrt{27}$ in the form $n\sqrt{3}$, where n is a positive integer.

.....

(2)

(b) Rationalise the denominator of $\frac{21}{\sqrt{3}}$

.....

(2)

(Total for Question 14 is 4 marks)

21.

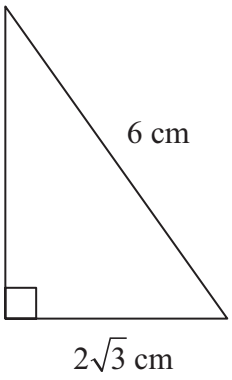


Diagram **NOT** accurately drawn

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.

.....

Q21

(Total 5 marks)

13 Rationalise the denominator $\frac{3}{\sqrt{7}}$

.....

(Total for Question 13 is 2 marks)

16 (a) Rationalise the denominator of $\frac{15}{\sqrt{5}}$

.....

(2)

$(1 + \sqrt{3})^2$ can be written in the form $a + b\sqrt{3}$, where a and b are integers.

(b) Work out the value of a and the value of b.

$a =$ .....

$b =$ .....

(2)

(Total for Question 16 is 4 marks)

14 (a) Write the recurring decimal $0.2\dot{5}$ as a fraction in its simplest form.

.....

(3)

(b) Rationalise the denominator of $\frac{12}{\sqrt{6}}$

Give your answer in its simplest form.

.....

(2)

(Total for Question 14 is 5 marks)

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

.....

(2)

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

.....

(2)

(Total for Question 26 is 4 marks)

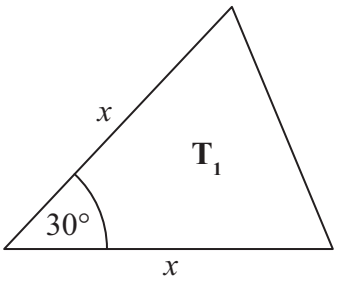
17 Rationalise the denominator of $\dfrac{(6-\sqrt{5})(6+\sqrt{5})}{\sqrt{31}}$

Give your answer in its simplest form.

.....

(Total for Question 17 is 3 marks)

25 Here are two triangles $\mathbf{T}_1$ and $\mathbf{T}_2$.



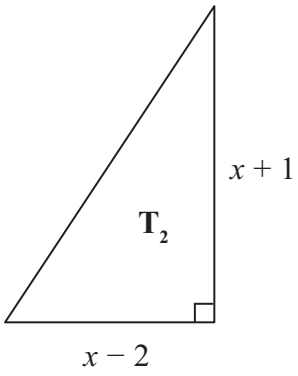


Diagram **NOT** accurately drawn

The lengths of the sides are in centimetres.

The area of triangle $\mathbf{T}_1$ is equal to the area of triangle $\mathbf{T}_2$.

Work out the value of x, giving your answer in the form $a + \sqrt{b}$ where a and b are integers.

.....

(Total for Question 25 is 5 marks)

17 (a) Write down the value of 10^{-1}

.....

(1)

(b) Find the value of $27^{\frac{2}{3}}$

.....

(2)

(c) Write $\sqrt{75}$ in the form $k\sqrt{3}$, where k is an integer.

.....

(2)

(Total for Question 17 is 5 marks)

13 The perimeter of a square is $\sqrt{120}$ cm.
Work out the area of the square.
Give your answer in its simplest form.

.....cm^2

(Total for Question 13 is 3 marks)

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

.....

(2)

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

.....

(2)

(Total for Question 25 is 4 marks)

Question 16

16 Write $(5 - \sqrt{5})^2$ in the form $a + b\sqrt{5}$, where a and b are integers.

.....

(Total for Question 16 is 2 marks)

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

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

.....

(Total for Question 21 is 2 marks)

10 (a) Write down the value of 7^0

.....

(1)

(b) Write down the value of 2^{-4}

.....

(1)

(c) Rationalise the denominator of $\frac{14}{\sqrt{7}}$

Give your answer in its simplest form.

.....

(2)

(Total for Question 10 is 4 marks)

22 (a) Find the value of 2^{-3}

.....

(1)

$5\sqrt{5}$ can be written in the form 5^k

(b) Find the value of k.

.....

(1)

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

.....

(2)

(Total for Question 22 is 4 marks)

15 (a) Factorise $y^2 - 5y - 14$

.....

(2)

(b) Expand and simplify $(2\sqrt{5} + 1)(3\sqrt{5} - 1)$

.....

(2)

(c) Write $\frac{6}{\sqrt{12}}$ in the form $\sqrt{n}$, where n is an integer.

.....

(2)

(Total for Question 15 is 6 marks)

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

Give your answer in its simplest form.

.....

(Total for Question 18 is 2 marks)

16 Rationalise the denominator of $\dfrac{(4+\sqrt{2})(4-\sqrt{2})}{\sqrt{7}}$

Give your answer in its simplest form.

.....

(Total for Question 16 is 3 marks)

25 *ABD* is a right angled triangle.

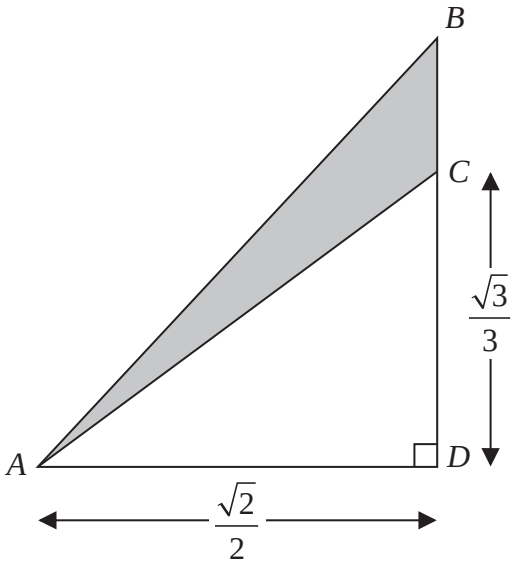


Diagram **NOT** accurately drawn

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

(Total for Question 25 is 3 marks)

***26** The diagram shows a triangle *DEF* inside a rectangle *ABCD*.

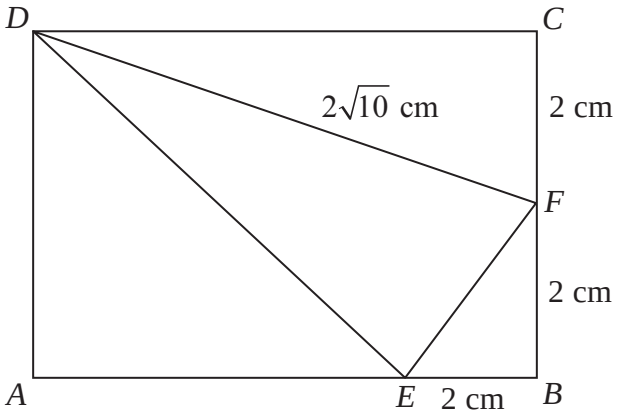


Diagram **NOT** accurately drawn

Show that the area of triangle *DEF* is 8 cm^2.
You must show all your working.

(Total for Question 26 is 4 marks)

16 Here is a trapezium.

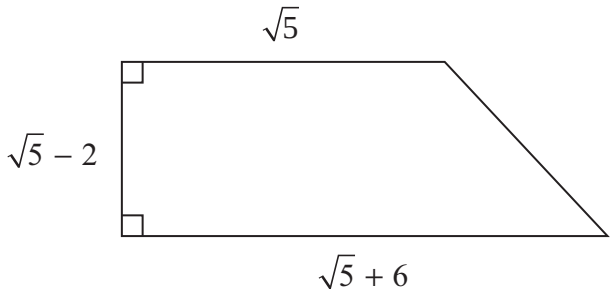


Diagram **NOT** accurately drawn

All measurements shown are in centimetres.

Work out the area of the trapezium.
Give your answer in cm^2 in the form $a\sqrt{5} + b$ where a and b are integers.

.....cm^2

(Total for Question 16 is 3 marks)

19 (a) Solve $x^2 + 2x - 35 = 0$

.....

(3)

(b) Solve $\frac{2}{x+1} + \frac{x}{2x+3} = 1$

Give your solutions as surds.

.....

(4)

(Total for Question 19 is 7 marks)

21 $a = \sqrt{8} + 2$

$b = \sqrt{8} - 2$

$T = a^2 - b^2$

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

.....

(Total for Question 21 is 4 marks)

Question 28

November 2017 | 1MA1/1H | Original Q21

21 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.

(Total for Question 21 is 3 marks)

Question 29

13 $\sqrt{5}(\sqrt{8} + \sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.

Find the value of a.

$a =$ .....

(Total for Question 13 is 3 marks)

20 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.

(a) Find Martin's mistake.

.....

.....

(1)

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.

(b) Find Sian's mistake.

.....

.....

(1)

(Total for Question 20 is 2 marks)

Question 31

20 Show that $\dfrac{(\sqrt{18}+\sqrt{2})^2}{\sqrt{8}-2}$ can be written in the form $a(b+\sqrt{2})$ where a and b are integers.

(Total for Question 20 is 3 marks)

Question 32

June 2019 | 1MA1/1H | Original Q14

14 Find the exact value of $\tan 30° \times \sin 60°$
Give your answer in its simplest form.

.....

(Total for Question 14 is 2 marks)

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

.....

(2)

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

.....

(3)

(Total for Question 18 is 5 marks)

16 (a) Rationalise the denominator of $\frac{22}{\sqrt{11}}$

Give your answer in its simplest form.

.....

(2)

(b) Show that $\frac{\sqrt{3}}{2\sqrt{3}-1}$ can be written in the form $\frac{a+\sqrt{3}}{b}$ where a and b are integers.

(3)

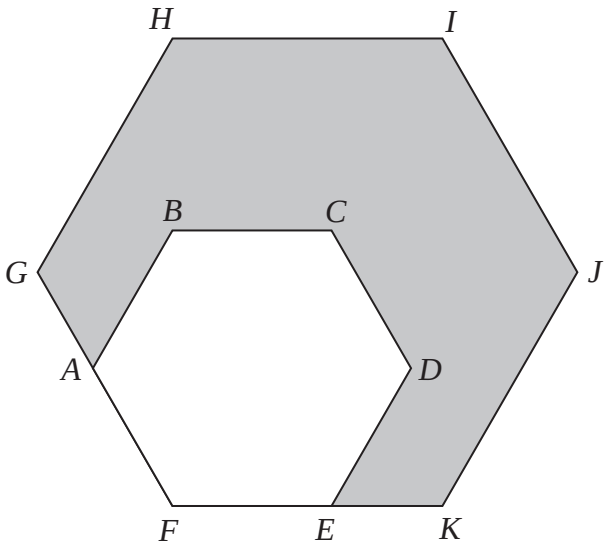
(Total for Question 16 is 5 marks)

Question 35

20 Show that $\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5}$ can be written in the form $a + \frac{\sqrt{5}}{b}$ where a and b are integers.

(Total for Question 20 is 4 marks)

19



ABCDEF is a regular hexagon with sides of length x.
This hexagon is enlarged, centre F, by scale factor p to give hexagon *FGHIJK*.

Show that the area of the shaded region in the diagram is given by $\frac{3\sqrt{3}}{2}(p^2 - 1)x^2$

(Total for Question 19 is 4 marks)

Question 37

19 Show that $\frac{8+\sqrt{12}}{5+\sqrt{3}}$ can be written in the form $\frac{a+\sqrt{3}}{b}$, where a and b are integers.

(Total for Question 19 is 4 marks)

Question 38

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.

.....

(Total for Question 19 is 4 marks)

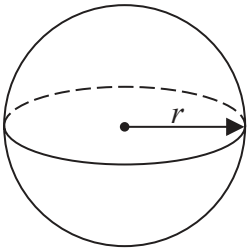
19 Solve $\frac{1}{x} - \frac{1}{x+1} = 4$

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

.....

(Total for Question 19 is 5 marks)

16 Here is a sphere.



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

$\frac{3}{8}$ of the surface area of this sphere is $75\pi\,\text{cm}^2$

Find the diameter of the sphere.
Give your answer in the form $a\sqrt{b}$ where a is an integer and b is a prime number.

..... cm

(Total for Question 16 is 4 marks)

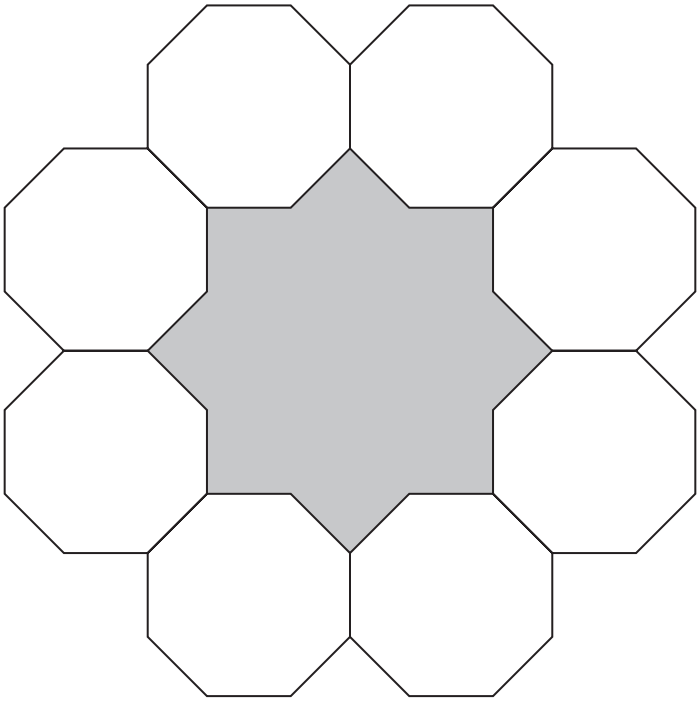
Question 41

23 Write $\frac{3\sqrt{3}}{4-\sqrt{3}} - \frac{2}{\sqrt{3}}$ in the form $\frac{a\sqrt{3}+b}{c}$ where a, b and c are integers.

.....

(Total for Question 23 is 4 marks)

24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



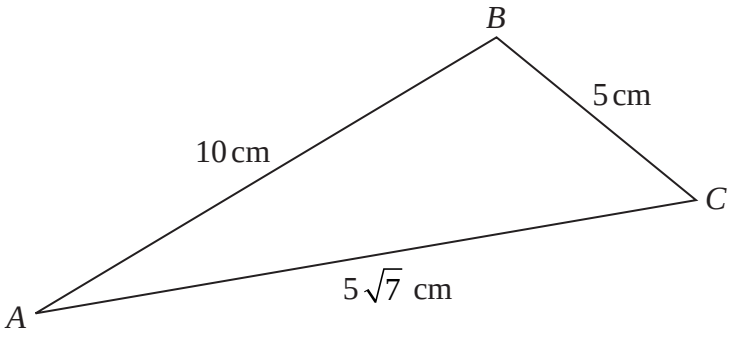
Each octagon has sides of length a.

Find, in terms of a, an expression for the area of the shaded shape.
Give your answer in the form $p\left(2+\sqrt{2}\right)a^2$ where p is an integer.
You must show all your working.

.....

(Total for Question 24 is 5 marks)

20 Here is triangle *ABC*.



Find the size of angle *ABC*.
You must show all your working.

.....°

(Total for Question 20 is 4 marks)

22 The 2nd term of a geometric sequence is $3 + 2\sqrt{2}$
The 3rd term of the sequence is $13 + 9\sqrt{2}$

Find the value of the common ratio of the sequence.
Give your answer in the form $a + \sqrt{b}$ where a and b are integers.
You must show all your working.

.....

(Total for Question 22 is 4 marks)

Question 45

17 (a) Rationalise the denominator of $\frac{1}{\sqrt{7}}$

.....

(1)

(b) Simplify fully $\sqrt{80} - \sqrt{5}$

.....

(2)

(Total for Question 17 is 3 marks)

Question 46

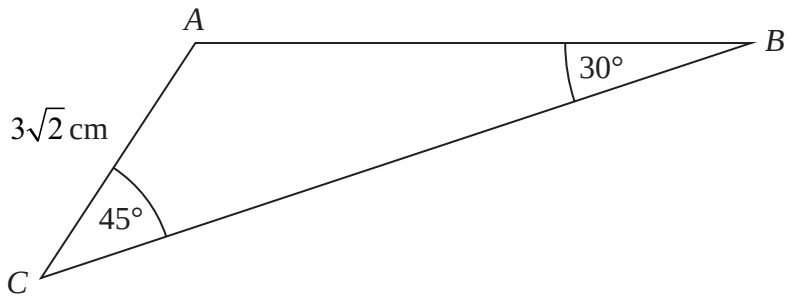
15 Given that a is a prime number, rationalise the denominator of $\frac{1}{\sqrt{a}+1}$

Give your answer in its simplest form.

.....

(Total for Question 15 is 2 marks)

14 ABC is a triangle.



Work out the length of AB.

..... cm

(Total for Question 14 is 3 marks)

16 (a) Rationalise the denominator of $\frac{15}{\sqrt{5}}$

Give your answer in its simplest form.

.....

(2)

(b) Write $\frac{\sqrt{75}-2}{1+2\sqrt{3}}$ in the form $\frac{a-b\sqrt{3}}{c}$ where a, b and c are integers.

.....

(4)

(Total for Question 16 is 6 marks)

16 (a) Rationalise the denominator of $\frac{35}{\sqrt{7}}$

Give your answer in its simplest form.

.....

(2)

$\frac{\sqrt{27}-1}{2-\sqrt{3}}$ can be written in the form $a + b\sqrt{3}$ where a and b are integers.

(b) Work out the value of a and the value of b.

a = ...

b = ...

(4)

(Total for Question 16 is 6 marks)