Name: SOLUTIONS

GCSE (1 - 9) Surds	Solutions:

These questions are compiled from *released* Pearson Edexcel GCSE maths exam papers
They contain exam questions from up until the ***November 2021*** exam series
More recent exam papers do exist but are withheld for mock exams
As new exam papers are released these worksheets will gradually be updated
The ***most current*** version of these worksheets will always be available at: kennethstafford.co.uk
These worksheets were made using examq.co.uk

Question	Paper where the question appeared
1	Edexcel, GCSE, Autumn 2021, Paper 1H, Q19
2	Edexcel, GCSE, Autumn 2020, Paper 1H, Q20
3	Edexcel, GCSE, Autumn 2020, Paper 3H, Q19
4	Edexcel, GCSE, Autumn 2019, Paper 1H, Q16
5	Edexcel, GCSE, Summer 2019, Paper 1H, Q14
6	Edexcel, GCSE, Summer 2019, Paper 1H, Q18
7	Edexcel, GCSE, Autumn 2018, Paper 1H, Q20
8	Edexcel, GCSE, Summer 2018, Paper 1H, Q13
9	Edexcel, GCSE, Summer 2018, Paper 2H, Q20
10	Edexcel, GCSE, Autumn 2017, Paper 1H, Q20
11	Edexcel, GCSE, Autumn 2017, Paper 1H, Q21
12	Edexcel, GCSE, Autumn 2017, Paper 2H, Q23
13	Edexcel, GCSE, Summer 2017, Paper 1H, Q22

1

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.

$$\frac{8+\sqrt{12}}{5+\sqrt{3}} \times \frac{(5-\sqrt{3})}{(5-\sqrt{3})} = \frac{40-8\sqrt{3}+5\sqrt{12}-\sqrt{36}}{22} = \frac{40-8\sqrt{3}+10\sqrt{3}-6}{22}$$

$$\frac{34+2\sqrt{3}}{22}$$

$$\frac{17+\sqrt{3}}{11}$$

(Total for Question 19 is 4 marks)

[Edexcel, GCSE, Autumn 2021, Paper 1H, Q19]

2

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

$\sqrt{180} = \sqrt{36} \times \sqrt{5} = 6\sqrt{5}$

$6\sqrt{5} - 2\sqrt{5} = 4\sqrt{5}$

$$\frac{4\sqrt{5}}{5\sqrt{5}-5} \times \frac{(5\sqrt{5}+5)}{(5\sqrt{5}+5)} = \frac{20\sqrt{25}+20\sqrt{5}}{25\sqrt{25}-25}$$

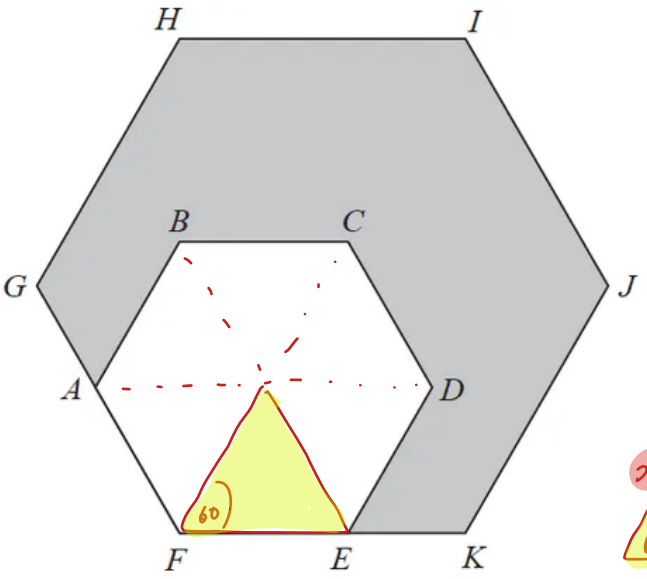
$$= \frac{20\times 5 + 20\sqrt{5}}{25\times 5 - 25}$$

$$= \frac{100+20\sqrt{5}}{100} = 1 + \frac{\sqrt{5}}{5}$$

(Total for Question 20 is 4 marks)

[Edexcel, GCSE, Autumn 2020, Paper 1H, Q20]

3



$\sin(60) = \frac{\sqrt{3}}{2}$

Area $= \frac{1}{2}ab\sin C$

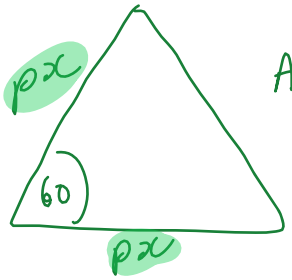
$= \frac{1}{2}x^2 \times \frac{\sqrt{3}}{2}$

$= \frac{\sqrt{3}x^2}{4}$

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 $\frac{3\sqrt{3}}{2}(p^2 - 1)x^2$

Area of hexagon ABCDEF $= \frac{\sqrt{3}x^2}{4} \times 6 = \frac{6\sqrt{3}x^2}{4} = \frac{3\sqrt{3}x^2}{2}$



Area $= \frac{1}{2}(px)(px) \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}p^2x^2}{4}$

Area of hexagon FGHIJK $= \frac{\sqrt{3}p^2x^2}{4} \times 6 = \frac{6\sqrt{3}p^2x^2}{4} = \frac{3\sqrt{3}p^2x^2}{2}$

Shaded Area $= \frac{3\sqrt{3}p^2x^2}{2} - \frac{3\sqrt{3}x^2}{2} = \frac{3\sqrt{3}}{2}(p^2 - 1)x^2$

(Total for Question 19 is 4 marks)

[Edexcel, GCSE, Autumn 2020, Paper 3H, Q19]

4

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

Give your answer in its simplest form.

$\frac{22}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}} = \frac{22\sqrt{11}}{11} = 2\sqrt{11}$

(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.

$\frac{\sqrt{3}}{2\sqrt{3}-1} \times \frac{(2\sqrt{3}+1)}{(2\sqrt{3}+1)} = \frac{2\sqrt{9}+\sqrt{3}}{4\sqrt{9}-1} = \frac{6+\sqrt{3}}{12-1}$

$\frac{6+\sqrt{3}}{11}$

(3)

(Total for Question 16 is 5 marks)

[Edexcel, GCSE, Autumn 2019, Paper 1H, Q16]

5

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

$\tan(30) = \frac{\sqrt{3}}{3}$

$\sin(60) = \frac{\sqrt{3}}{2}$

$\frac{\sqrt{3}}{3} \times \frac{\sqrt{3}}{2} = \frac{3}{6} = \frac{1}{2}$

.....

(Total for Question 14 is 2 marks)

[Edexcel, GCSE, Summer 2019, Paper 1H, Q14]

6

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

$\sqrt{3} + \sqrt{12}$

$\sqrt{3} + \sqrt{4} \times \sqrt{3}$

$\sqrt{3} + 2\sqrt{3} = 3\sqrt{3}$

(2)

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

$1^7 = 1$

$(\sqrt{3})^7 = \underbrace{\sqrt{3} \times \sqrt{3}}_{3} \times \underbrace{\sqrt{3} \times \sqrt{3}}_{3} \times \underbrace{\sqrt{3} \times \sqrt{3}}_{3} \times \sqrt{3} = 27\sqrt{3}$

$\frac{1}{27\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{27 \times 3} = \frac{\sqrt{3}}{81}$

(3)

(Total for Question 18 is 5 marks)

[Edexcel, GCSE, Summer 2019, Paper 1H, Q18]

7

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.

$\sqrt{18} = \sqrt{9} \times \sqrt{2} = 3\sqrt{2}$

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

$(4\sqrt{2})^2 = 16\sqrt{4} = 16 \times 2 = 32$

$\sqrt{8} - 2 = \sqrt{4}\sqrt{2} - 2 = 2\sqrt{2} - 2$

$$\frac{32}{(2\sqrt{2}-2)} \times \frac{(2\sqrt{2}+2)}{(2\sqrt{2}+2)} = \frac{64\sqrt{2}+64}{4\sqrt{4}-4} = \frac{64\sqrt{2}+64}{4}$$

$$= 16\sqrt{2} + 16$$

$$= 16(1+\sqrt{2})$$

(Total for Question 20 is 3 marks)

[Edexcel, GCSE, Autumn 2018, Paper 1H, Q20]

8

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

Find the value of a.

$\sqrt{8}+\sqrt{18} = \sqrt{4}\times\sqrt{2} + \sqrt{9}\times\sqrt{2} = 2\sqrt{2}+3\sqrt{2} = 5\sqrt{2}$

$\sqrt{5}(5\sqrt{2}) = 5\sqrt{10}$

$a =$ 5

(Total for Question 13 is 3 marks)

[Edexcel, GCSE, Summer 2018, Paper 1H, Q13]

9

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.

$\sqrt{3} \times -\sqrt{3} = -3$ not 3

(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.

$\sqrt{12} = 2\sqrt{3}$ not $3\sqrt{2}$

(1)

(Total for Question 20 is 2 marks)

[Edexcel, GCSE, Summer 2018, Paper 2H, Q20]

10

The table shows some values of x and y that satisfy the equation $y = a\cos x° + b$

x	0	30	60	90	120	150	180
y	3	$1 + \sqrt{3}$	2	1	0	$1 - \sqrt{3}$	-1

Find the value of y when $x = 45$

$\cos(90) = 0$

$1 = a \times 0 + b$

$b = 1$

$\cos(0) = 1$

$3 = a \times 1 + 1$

$3 = a + 1$

$a = 2$

$\cos(45) = \frac{\sqrt{2}}{2}$

$y = 2 \times \frac{\sqrt{2}}{2} + 1$

$y = \sqrt{2} + 1$

(Total for Question 20 is 4 marks)

[Edexcel, GCSE, Autumn 2017, Paper 1H, Q20]

11

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.

$6-\sqrt{8} = 6-\sqrt{4}\times\sqrt{2} = 6-2\sqrt{2}$

$\frac{6-2\sqrt{2}}{\sqrt{2}-1} \times \frac{(\sqrt{2}+1)}{(\sqrt{2}+1)} = \frac{6\sqrt{2}+6-2\sqrt{4}-2\sqrt{2}}{2-1} = \frac{2+4\sqrt{2}}{1}$

$= 2+4\sqrt{2}$

(Total for Question 21 is 3 marks)

[Edexcel, GCSE, Autumn 2017, Paper 1H, Q21]

12

S is a geometric sequence.

(a) Given that $(\sqrt{x} - 1)$, 1 and $(\sqrt{x} + 1)$ are the first three terms of S, find the value of x.
You must show all your working.

$\sqrt{x} - 1$, 1 , $\sqrt{x} + 1$

$\times (\sqrt{x} + 1)$ $\times (\sqrt{x} + 1)$

$(\sqrt{x} - 1)(\sqrt{x} + 1) = 1$

$x - 1 = 1$

$x = 2$

$x = 2$

(3)

(b) Show that the 5th term of S is $7 + 5\sqrt{2}$

3rd term

$(\sqrt{2} + 1)(\sqrt{2} + 1) = 2 + \sqrt{2} + \sqrt{2} + 1 = 3 + 2\sqrt{2}$

4th term

$(3 + 2\sqrt{2})(\sqrt{2} + 1) = 3\sqrt{2} + 3 + 2\sqrt{4} + 2\sqrt{2}$

$= 5\sqrt{2} + 3 + 4$

5th term

$= 7 + 5\sqrt{2}$

(2)

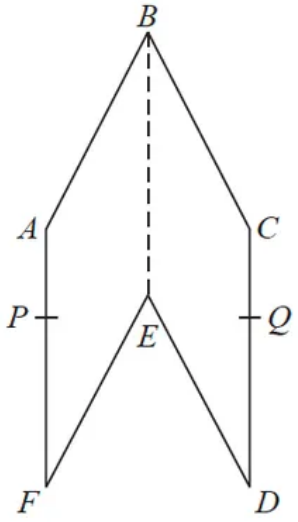
(Total for Question 23 is 5 marks)

[Edexcel, GCSE, Autumn 2017, Paper 2H, Q23]

13

The diagram shows a hexagon $ABCDEF$.

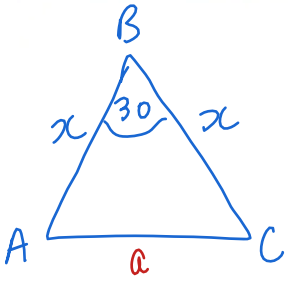
$\cos(30) = \frac{\sqrt{3}}{2}$



$ABEF$ and $CBED$ are congruent parallelograms where $AB = BC = x$ cm.
P is the point on AF and Q is the point on CD such that $BP = BQ = 10$ cm.

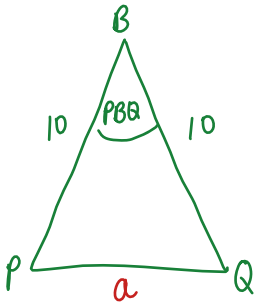
Given that angle $ABC = 30°$,

prove that $\cos PBQ = 1 - \frac{(2-\sqrt{3})}{200}x^2$



$a^2 = x^2 + x^2 - 2(x)(x)\cos(30)$

$a^2 = 2x^2 - 2x^2\left(\frac{\sqrt{3}}{2}\right)$



$\cos(PBQ) = \frac{10^2 + 10^2 - \left(2x^2 - 2x^2\frac{\sqrt{3}}{2}\right)}{2(10)(10)}$

$= \frac{200 - \left(2x^2 - 2x^2\frac{\sqrt{3}}{2}\right)}{200}$

$= \frac{200}{200} - \frac{2x^2 - \sqrt{3}x^2}{200}$

$= 1 - \frac{2-\sqrt{3}}{200}x^2$

(Total for Question 22 is 5 marks)

[Edexcel, GCSE, Summer 2017, Paper 1H, Q22]