

## Level 3 Algebra - Surds

June 2013 - Question 13

Jan 2014 - Question 15

Jan 2015 - Question 19

June 2015 - Question 17

Jan 2016 - Question 20

June 2016 - Question 12

Jan 2017 - Question 15

June 2017 - Question 19

Jan 2018 - Question 7

June 2018 - Question 16

Jan 2019 - Question 8

June 2019 - Question 18

Jan 2020 - Question 9

Jan 2020 - Question 14

Jan 2021 - Question 19

Jan 2022 - Question 17

June 2022 - Question 17

Jan 2023 - Question 14

June 2023 - Question 7

Jan 2024 - Question 17

13 (a) Simplify  $(3\sqrt{5})^2$

.....  
(1)

(b) Express  $\sqrt{98} + \sqrt{18}$  in the form  $n\sqrt{2}$  where  $n$  is an integer.

.....  
(2)

(c) Rationalise the denominator of  $\frac{1}{5 - \sqrt{2}}$

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

.....  
(2)

(Total for Question 13 is 5 marks)

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15 (a) Write  $\sqrt{108}$  in the form  $n\sqrt{3}$  where  $n$  is an integer.

.....  
(1)

(b) Simplify  $(2 - \sqrt{3})(2 + \sqrt{3})$

.....  
(2)

(c) Rationalise the denominator of  $\frac{1}{2\sqrt{3}}$

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

.....  
(2)

**(Total for Question 15 is 5 marks)**



19 Rationalise the denominator of  $\frac{5 + \sqrt{5}}{5 - \sqrt{5}}$

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

.....  
(Total for Question 19 is 4 marks)

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17 (a) Simplify  $\sqrt{3}\left(2\sqrt{3} + \frac{1}{\sqrt{3}}\right)$

.....  
(2)

(b) Rationalise the denominator of  $\frac{15}{5 - \sqrt{7}}$   
Give your answer in its simplest form.

.....  
(3)

**(Total for Question 17 is 5 marks)**

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20 (a) Rationalise the denominator of  $\frac{1}{5\sqrt{3}}$

.....  
(2)

(b) (i) Write  $\sqrt{18}$  in the form  $n\sqrt{2}$  where  $n$  is an integer.

(ii) Hence express  $\frac{1}{\sqrt{8}} + \frac{1}{\sqrt{18}}$  as a single fraction.

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

.....  
(4)

(Total for Question 20 is 6 marks)

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TOTAL FOR PAPER IS 90 MARKS

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12 (a) Find the value of  $(2\sqrt{7})^2$

.....  
(1)

(b) Express  $\sqrt{432} - \sqrt{27}$  in the form  $a\sqrt{3}$  where  $a$  is an integer.

.....  
(2)

(c) Rationalise the denominator of  $\frac{2}{7 + \sqrt{3}}$

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

.....  
(3)

(Total for Question 12 is 6 marks)



15 (a) Rationalise the denominator of  $\frac{1}{3 + \sqrt{7}}$

.....  
(2)

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

.....  
(ii) Hence find the value of  $[(\sqrt{5} + \sqrt{2})^2 - (\sqrt{5} - \sqrt{2})^2]^2$

.....  
(4)

(Total for Question 15 is 6 marks)



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19 Rationalise the denominator of  $\frac{4}{3 - \sqrt{5}}$   
Give your answer in its simplest form.

.....  
(Total for Question 19 is 3 marks)



(b) Make  $y$  the subject of  $x^2 + y^2 - 64 = 0$

.....  
(2)

**(Total for Question 6 is 4 marks)**

7 Express  $(\sqrt{125} - \sqrt{5})(\sqrt{8} - \sqrt{2})$  in the form  $a\sqrt{b}$  where  $a$  and  $b$  are integers.

.....  
**(Total for Question 7 is 3 marks)**

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16 (a) Write  $\frac{8}{5x + 5y} - \frac{x}{x^2 - y^2}$  as a single fraction.

Give your answer in its simplest form.

.....  
(4)

The integer  $p$  is not a square number.

(b) Rationalise the denominator of  $\frac{3p - \sqrt{p}}{2\sqrt{p}}$

Give your answer in its simplest form.

.....  
(3)

(Total for Question 16 is 7 marks)



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8  $c = 2\sqrt{5}$     $d = -\sqrt{5}$

Work out the exact value of

(a)  $c^2 + d^2$

.....  
(2)

(b)  $(c + 2)(d + 3)$

.....  
(2)

(c)  $\frac{c + d}{c - d}$

.....  
(2)

(Total for Question 8 is 6 marks)



18 (a) Find the value of  $\frac{4x + 7}{16 - 3\sqrt{x}}$  when  $x = 4$

.....  
(2)

(b) Rationalise the denominator of  $\frac{12 - \sqrt{7}}{6 - \sqrt{7}}$

Give your answer in the form  $\frac{p + q\sqrt{7}}{r}$  where  $p, q$  and  $r$  are integers.

.....  
(3)

**(Total for Question 18 is 5 marks)**

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9  $t = \frac{n}{5 - 2n}$

(a) Find the value of  $t$  when  $n = \frac{1}{2}$

.....  
(1)

(b) Find the value of  $t$  when  $n = \sqrt{5}$   
Give your answer in the form  $c + \sqrt{d}$  where  $c$  and  $d$  are integers.

.....  
(4)

(c) Make  $n$  the subject of the formula  $t = \frac{n}{5 - 2n}$

.....  
(3)

(Total for Question 9 is 8 marks)



14 (a) Simplify  $\frac{1}{\sqrt{2}} + \frac{1}{(\sqrt{2})^3} + \frac{1}{(\sqrt{2})^5}$

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

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.....  
(3)

(b) Simplify  $\frac{\sqrt{20} + \sqrt{5}}{\sqrt{20} - \sqrt{5}}$

.....  
(3)

(Total for Question 14 is 6 marks)



19 Rationalise the denominator of  $\frac{7}{3 + 2\sqrt{5}}$

Give your answer in its simplest form.

.....  
(Total for Question 19 is 3 marks)

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**TOTAL FOR PAPER IS 90 MARKS**

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17 (a) Simplify  $(\sqrt{3}) + (\sqrt{3})^2 + (\sqrt{3})^3 + (\sqrt{3})^4$

.....  
(2)

(b) Simplify  $\frac{1}{2 - \sqrt{5}} + \frac{1}{2 + \sqrt{5}}$

.....  
(3)

(Total for Question 17 is 5 marks)



17 (a) Expand and simplify  $(3 + \sqrt{12})(5 - 3\sqrt{3})$

.....  
(3)

(b) Rationalise the denominator of  $\frac{2 - \sqrt{13}}{1 - \sqrt{13}}$

Give your answer in the form  $\frac{p - \sqrt{13}}{q}$  where  $p$  and  $q$  are integers.

.....  
(3)

(Total for Question 17 is 6 marks)



14 (a) Rationalise the denominator of  $\frac{1}{7\sqrt{5}}$

.....  
(2)

(b) Simplify  $\frac{1}{1+\sqrt{2}} + \frac{1}{-1+\sqrt{2}}$

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

.....  
(3)

(Total for Question 14 is 5 marks)

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7 (a) Find the value of  $\frac{1 + 4\sqrt{u}}{12 - \sqrt{u}}$  when  $u = 25$

.....  
(2)

(b) Simplify  $(8 - \sqrt{32})(5 + \sqrt{8})$

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

.....  
(3)

**(Total for Question 7 is 5 marks)**

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17 (a) Expand and simplify  $\sqrt{5}(3 - \sqrt{5})^2$

.....  
(3)

(b) Rationalise the denominator of  $\frac{2 + \sqrt{7}}{3 - \sqrt{7}}$

Give your answer in the form  $\frac{p + q\sqrt{7}}{2}$  where  $p$  and  $q$  are integers.

.....  
(3)

(Total for Question 17 is 6 marks)

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