1.1 Higher Surds: Simplifying, Multiplying and Dividing: 2-hour Pack

AQA 8365 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Work out $4\sqrt{15} \times 3\sqrt{10}$. Give your answer in its simplest surd form.

(Total for Question 1 is 3 marks)

2 Show that $(\sqrt{2} - 2\sqrt{15})^2$ can be written in the form $p + q\sqrt{r}$, and find p, q and r. Give your answer as $p + q\sqrt{r}$.

(Total for Question 2 is 3 marks)

3 Work out $(18\sqrt{60}) / (3\sqrt{6})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 3 is 3 marks)

4 Expand and simplify $(-1 + 4\sqrt{7})(-3 - \sqrt{7})$. Give your answer in the form $p + q\sqrt{s}$.

(Total for Question 4 is 3 marks)

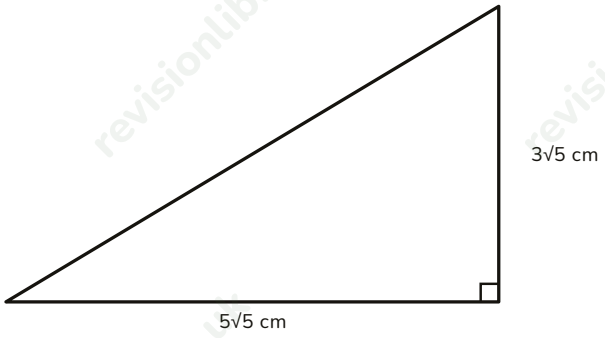
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5 Work out $4\sqrt{24} \times 3\sqrt{14}$. Give your answer in its simplest surd form.

(Total for Question 5 is 3 marks)

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6 A right-angled triangle has shorter sides of length $5\sqrt{5}$ cm and $3\sqrt{5}$ cm. Find the exact length of the hypotenuse, in the form $a\sqrt{b}$ where b has no square factors (or as an integer).



(Total for Question 6 is 3 marks)

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7 Simplify $2\sqrt{63} + \sqrt{7}$, giving your answer in the form $a\sqrt{b}$.

(Total for Question 7 is 3 marks)

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8 Work out $(13\sqrt{91}) / (6\sqrt{7})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 8 is 3 marks)

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9 Show that $(2\sqrt{7} + 2\sqrt{13})^2$ can be written in the form $p + q\sqrt{r}$, and find p, q and r. Give your answer as $p + q\sqrt{r}$.

(Total for Question 9 is 3 marks)

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10 Work out $\sqrt{24} \times 3\sqrt{20}$. Give your answer in its simplest surd form.

(Total for Question 10 is 3 marks)

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11 Expand and simplify $(3 - 2\sqrt{2})(-3 + 2\sqrt{2})$. Give your answer in the form $p + q\sqrt{s}$.

(Total for Question 11 is 3 marks)

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12 Simplify $\sqrt{208} + 4\sqrt{117} + 3\sqrt{52}$, giving your answer in the form $a\sqrt{b}$.

(Total for Question 12 is 3 marks)

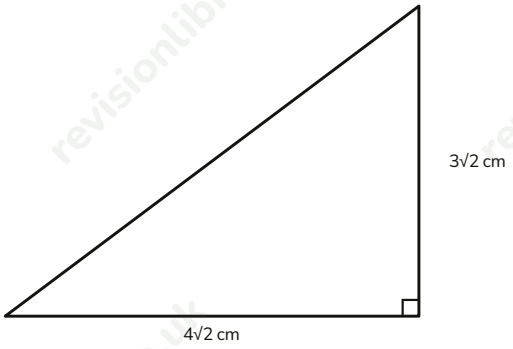
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13 Work out $(20\sqrt{18}) / (8\sqrt{3})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 13 is 3 marks)

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14 A right-angled triangle has shorter sides of length $4\sqrt{2}$ cm and $3\sqrt{2}$ cm. Find the exact length of the hypotenuse, in the form $a\sqrt{b}$ where b has no square factors (or as an integer).



(Total for Question 14 is 3 marks)

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15 Work out $4\sqrt{6} \times 2\sqrt{8}$. Give your answer in its simplest surd form.

(Total for Question 15 is 3 marks)

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16 Show that $(2\sqrt{6} - 2\sqrt{11})^2$ can be written in the form $p + q\sqrt{r}$, and find p, q and r. Give your answer as $p + q\sqrt{r}$.

(Total for Question 16 is 3 marks)

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17 Simplify $\sqrt{325} + \sqrt{208}$, giving your answer in the form $a\sqrt{b}$.

(Total for Question 17 is 3 marks)

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18 Work out $(5\sqrt{30}) / (6\sqrt{6})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 18 is 3 marks)

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19 Expand and simplify $(5 + 2\sqrt{6})(5 + \sqrt{6})$. Give your answer in the form $p + q\sqrt{s}$.

(Total for Question 19 is 3 marks)

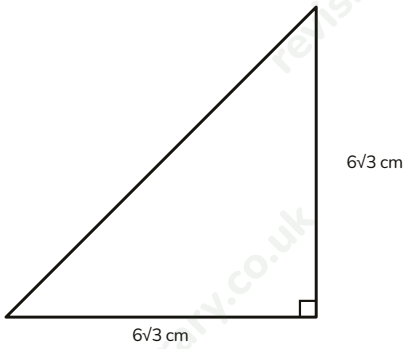
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20 Work out $4\sqrt{12} \times 3\sqrt{27}$. Give your answer in its simplest surd form.

(Total for Question 20 is 3 marks)

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21 A right-angled triangle has shorter sides of length $6\sqrt{3}$ cm and $6\sqrt{3}$ cm. Find the exact length of the hypotenuse, in the form $a\sqrt{b}$ where b has no square factors (or as an integer).



(Total for Question 21 is 3 marks)

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22 Work out $(20\sqrt{15}) / (4\sqrt{5})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 22 is 3 marks)

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23 Show that $(4\sqrt{3} - \sqrt{5})^2$ can be written in the form $p + q\sqrt{r}$, and find p, q and r. Give your answer as $p + q\sqrt{r}$.

(Total for Question 23 is 3 marks)

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24 Simplify $3\sqrt{52} + 4\sqrt{208}$, giving your answer in the form $a\sqrt{b}$.

(Total for Question 24 is 3 marks)

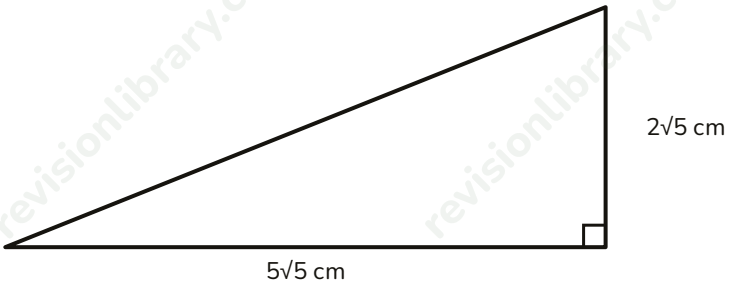
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25 Work out $(16\sqrt{66}) / (6\sqrt{6})$. Give your answer in the form $a\sqrt{b}$, where a is a fraction or integer.

(Total for Question 25 is 3 marks)

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26 A right-angled triangle has shorter sides of length $5\sqrt{5}$ cm and $2\sqrt{5}$ cm. Find the exact length of the hypotenuse, in the form $a\sqrt{b}$ where b has no square factors (or as an integer).



(Total for Question 26 is 3 marks)

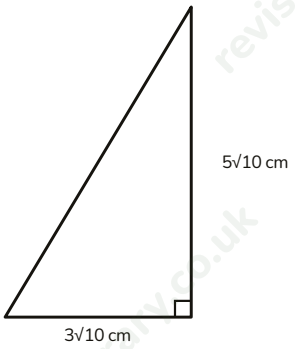
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27 Expand and simplify $(6 + 4\sqrt{7})(-1 + \sqrt{7})$. Give your answer in the form $p + q\sqrt{s}$.

(Total for Question 27 is 3 marks)

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28 A right-angled triangle has shorter sides of length $3\sqrt{10}$ cm and $5\sqrt{10}$ cm. Find the exact length of the hypotenuse, in the form $a\sqrt{b}$ where b has no square factors (or as an integer).



(Total for Question 28 is 3 marks)

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29 Show that $(3\sqrt{15} - \sqrt{7})^2$ can be written in the form $p + q\sqrt{r}$, and find p, q and r. Give your answer as $p + q\sqrt{r}$.

(Total for Question 29 is 3 marks)

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30 Expand and simplify $(1 - 2\sqrt{2})(1 - 3\sqrt{2})$. Give your answer in the form $p + q\sqrt{s}$.

(Total for Question 30 is 3 marks)

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31 Simplify $(5 + \sqrt{3}) / (2 - \sqrt{3})$ fully, giving your answer in the form $a + b\sqrt{3}$, where a and b are integers.

(Total for Question 31 is 4 marks)

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32 Consider the expression $(\sqrt{x} + 2) / (\sqrt{x} - 2)$, where x is greater than 4.

(a) Rationalise the denominator of the expression, giving your answer in terms of x. **(3)**

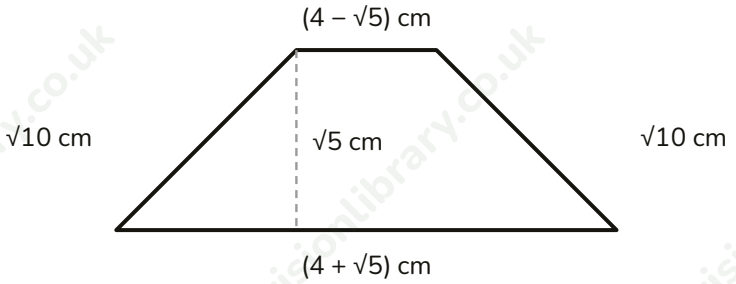
(b) Hence, or otherwise, find the value of the expression when $x = 9$. **(3)**

(Total for Question 32 is 6 marks)

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33 A trapezium has parallel sides of length $(4 + \sqrt{5})$ cm and $(4 - \sqrt{5})$ cm, and height $\sqrt{5}$ cm.

Diagram NOT accurately drawn



(a) Find the exact area of the trapezium, giving your answer in the form $k\sqrt{5}$. **(3)**

.....

(b) Given that each sloped side of the trapezium has length $\sqrt{10}$ cm, find the exact perimeter of the trapezium. **(2)**

.....

(Total for Question 33 is 5 marks)

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Mark scheme · 1.1 Higher Surds: Simplifying, Multiplying and Dividing: 2-hour Pack

Question 1

$12\sqrt{150}$ or equivalent	**M1**
$\sqrt{150} = 5\sqrt{6}$ or a square factor extracted	**M1**
$60\sqrt{6}$ cao	**A1**

Answer: $60\sqrt{6}$

Question 2

expands with at least 3 terms correct	**M1**
simplifies $\sqrt{ab}$ term	**M1**
$62 - 4\sqrt{30}$ cao	**A1**

Answer: $62 - 4\sqrt{30}$

Question 3

$\sqrt{60} / \sqrt{6} = \sqrt{10}$ or equivalent	**M1**
18/3 simplified or used as the coefficient	**M1**
$6\sqrt{10}$ cao	**A1**

Answer: $6\sqrt{10}$

Question 4

at least 3 of the 4 terms correct	**M1**
collects rational and surd parts	**M1**
$-25 - 11\sqrt{7}$ cao	**A1**

Answer: $-25 - 11\sqrt{7}$

Question 5

$12\sqrt{336}$ or equivalent	**M1**
$\sqrt{336} = 4\sqrt{21}$ or a square factor extracted	**M1**
$48\sqrt{21}$ cao	**A1**

Answer: $48\sqrt{21}$

Question 6

squares the two sides and adds	**M1**
$\sqrt{170}$ or equivalent	**A1**
$\sqrt{170}$ cm cao	**A1**

Answer: $\sqrt{170}$

Question 7

at least two surds simplified to a multiple of $\sqrt{7}$	**M1**
all surds expressed as multiples of $\sqrt{7}$	**M1**
$7\sqrt{7}$ cao	**A1**

Answer: $7\sqrt{7}$

Question 8

$\sqrt{91} / \sqrt{7} = \sqrt{13}$ or equivalent	**M1**
13/6 simplified or used as the coefficient	**M1**
$13\sqrt{13}/6$ cao	**A1**

Answer: $13\sqrt{13}/6$

Question 9

expands with at least 3 terms correct	**M1**
simplifies $\sqrt{ab}$ term	**M1**
$80 + 8\sqrt{91}$ cao	**A1**

Answer: $80 + 8\sqrt{91}$

Question 10

$3\sqrt{480}$ or equivalent	**M1**
$\sqrt{480} = 4\sqrt{30}$ or a square factor extracted	**M1**
$12\sqrt{30}$ cao	**A1**

Answer: $12\sqrt{30}$

Question 11

at least 3 of the 4 terms correct	**M1**
collects rational and surd parts	**M1**
$-17 + 12\sqrt{2}$ cao	**A1**

Answer: $-17 + 12\sqrt{2}$

Question 12

at least two surds simplified to a multiple of $\sqrt{13}$	**M1**
all surds expressed as multiples of $\sqrt{13}$	**M1**
$22\sqrt{13}$ cao	**A1**

Answer: $22\sqrt{13}$

Question 13

$\sqrt{18} / \sqrt{3} = \sqrt{6}$ or equivalent	**M1**
20/8 simplified or used as the coefficient	**M1**
$5\sqrt{6}/2$ cao	**A1**

Answer: $5\sqrt{6}/2$

Question 14

squares the two sides and adds	**M1**
$\sqrt{50}$ or equivalent	**A1**
$5\sqrt{2}$ cm cao	**A1**

Answer: $5\sqrt{2}$

Question 15

$8\sqrt{48}$ or equivalent	**M1**
$\sqrt{48} = 4\sqrt{3}$ or a square factor extracted	**M1**
$32\sqrt{3}$ cao	**A1**

Answer: $32\sqrt{3}$

Question 16

expands with at least 3 terms correct	**M1**
simplifies $\sqrt{ab}$ term	**M1**
$68 - 8\sqrt{66}$ cao	**A1**

Answer: $68 - 8\sqrt{66}$

Question 17

at least two surds simplified to a multiple of $\sqrt{13}$	**M1**
all surds expressed as multiples of $\sqrt{13}$	**M1**
$9\sqrt{13}$ cao	**A1**

Answer: $9\sqrt{13}$

Question 18

$\sqrt{30} / \sqrt{6} = \sqrt{5}$ or equivalent	**M1**
5/6 simplified or used as the coefficient	**M1**
$5\sqrt{5}/6$ cao	**A1**

Answer: $5\sqrt{5}/6$

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Question 19

at least 3 of the 4 terms correct	**M1**
collects rational and surd parts	**M1**
$37 + 15\sqrt{6}$ cao	**A1**

Answer: $37 + 15\sqrt{6}$

Question 20

$12\sqrt{324}$ or equivalent	**M1**
$\sqrt{324} = 18\sqrt{1}$ or a square factor extracted	**M1**
216 cao	**A1**

Answer: 216

Question 21

squares the two sides and adds	**M1**
$\sqrt{216}$ or equivalent	**A1**
$6\sqrt{6}$ cm cao	**A1**

Answer: $6\sqrt{6}$

Question 22

$\sqrt{15} / \sqrt{5} = \sqrt{3}$ or equivalent	**M1**
20/4 simplified or used as the coefficient	**M1**
$5\sqrt{3}$ cao	**A1**

Answer: $5\sqrt{3}$

Question 23

expands with at least 3 terms correct	**M1**
simplifies $\sqrt{ab}$ term	**M1**
$53 - 8\sqrt{15}$ cao	**A1**

Answer: $53 - 8\sqrt{15}$

Question 24

at least two surds simplified to a multiple of $\sqrt{13}$	**M1**
all surds expressed as multiples of $\sqrt{13}$	**M1**
$22\sqrt{13}$ cao	**A1**

Answer: $22\sqrt{13}$

Question 25

$\sqrt{66} / \sqrt{6} = \sqrt{11}$ or equivalent	**M1**
16/6 simplified or used as the coefficient	**M1**
$8\sqrt{11}/3$ cao	**A1**

Answer: $8\sqrt{11}/3$

Question 26

squares the two sides and adds	**M1**
$\sqrt{145}$ or equivalent	**A1**
$\sqrt{145}$ cm cao	**A1**

Answer: $\sqrt{145}$

Question 27

at least 3 of the 4 terms correct	**M1**
collects rational and surd parts	**M1**
$22 + 2\sqrt{7}$ cao	**A1**

Answer: $22 + 2\sqrt{7}$

Question 28

squares the two sides and adds	**M1**
$\sqrt{340}$ or equivalent	**A1**
$2\sqrt{85}$ cm cao	**A1**

Answer: $2\sqrt{85}$

Question 29

expands with at least 3 terms correct	**M1**
simplifies $\sqrt{ab}$ term	**M1**
$142 - 6\sqrt{105}$ cao	**A1**

Answer: $142 - 6\sqrt{105}$

Question 30

at least 3 of the 4 terms correct	**M1**
collects rational and surd parts	**M1**
$13 - 5\sqrt{2}$ cao	**A1**

Answer: $13 - 5\sqrt{2}$

Question 31

multiplies numerator and denominator by $(2 + \sqrt{3})$	**M1**
expands numerator to $10 + 5\sqrt{3} + 2\sqrt{3} + 3$	**M1**
simplifies denominator to $4 - 3 = 1$	**M1**
$13 + 7\sqrt{3}$ cao	**A1**

Answer: $13 + 7\sqrt{3}$

Question 32

(a) multiplies numerator and denominator by $(\sqrt{x} + 2)$	**M1**
(a) expands numerator to $x + 4\sqrt{x} + 4$ and denominator to $x - 4$	**M1**
(a) $(x + 4\sqrt{x} + 4) / (x - 4)$ oe cao	**A1**

(a) Answer: $(x + 4\sqrt{x} + 4) / (x - 4)$

(b) substitutes $x = 9$ and uses $\sqrt{9} = 3$	**M1**
(b) evaluates numerator $= 9 + 12 + 4 = 25$ and denominator $= 9 - 4 = 5$ (or uses (3+2)/(3-2))	**M1**
(b) 5 cao	**A1**

(b) Answer: 5

Question 33

(a) adds the parallel sides: $(4+\sqrt{5})+(4-\sqrt{5}) = 8$	**M1**
(a) Area $= 1/2 \times 8 \times \sqrt{5}$	**M1**
(a) $4\sqrt{5}$ cm^2 cao	**A1**

(a) Answer: $4\sqrt{5}$ cm^2

(b) sums all four sides: $(4+\sqrt{5})+(4-\sqrt{5})+2\sqrt{10}$	**M1**
(b) $8 + 2\sqrt{10}$ cm oe cao	**A1**

(b) Answer: $8 + 2\sqrt{10}$ cm

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