Surds - Worksheet

Skill

Group A - Simplify, add and subtract

Write in simplest form:

1) $\sqrt{16}$

2) $\sqrt{28}$

3) $\sqrt{63}$

4) $\sqrt{99}$

5) $\sqrt{120}$

6) $\sqrt{850}$

7) $2\sqrt{5} + 6\sqrt{5}$

8) $4\sqrt{11} - 2\sqrt{11} + \sqrt{11}$

9) $4\sqrt{2} - \sqrt{8}$

10) $3\sqrt{7} + \sqrt{28}$

11) $\sqrt{270} - \sqrt{120}$

12) $\sqrt{20} + \sqrt{80}$

Group B - Multiply and divide

Write in simplest form:

1) $\sqrt{5} \times \sqrt{2}$

2) $\sqrt{24} \div \sqrt{6}$

3) $(\sqrt{11})^2$

4) $\frac{10\sqrt{15}}{2\sqrt{3}}$

5) $\frac{\sqrt{12}+\sqrt{48}}{3}$

6) $\frac{2(\sqrt{5})^2}{10}$

7) $3(8 + \sqrt{5})$

8) $\sqrt{2}(6 - \sqrt{3})$

9) $\frac{3(\sqrt{18}-\sqrt{2})}{2}$

10) $(3 + \sqrt{3})(2 - \sqrt{2})$

11) $(4 + \sqrt{3})(4 - \sqrt{3})$

12) $(\sqrt{72} - \sqrt{50})^2$

Surds - Worksheet

Group C - Rationalise the denominator

Rationalise and simplify:

1) $\frac{1}{\sqrt{3}}$

2) $\frac{3}{\sqrt{6}}$

3) $\frac{22}{\sqrt{2}}$

4) $\frac{3}{\sqrt{24}}$

5) $\frac{-12}{\sqrt{72}}$

6) $\frac{\sqrt{20}}{\sqrt{50}}$

7) $\frac{\sqrt{8}}{\sqrt{3}}$

8) $\frac{2\sqrt{12}}{\sqrt{5}}$

9) $\frac{\sqrt{24}+\sqrt{54}}{\sqrt{3}}$

10) $\frac{1}{7+\sqrt{2}}$

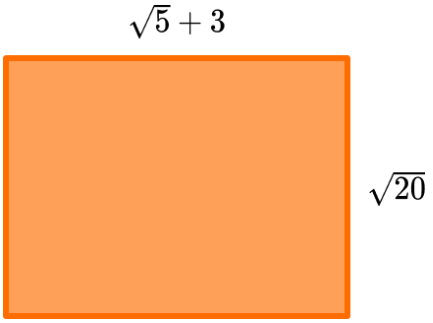
11) $\frac{40}{5-\sqrt{5}}$

12) $\frac{4\sqrt{3}}{3+\sqrt{6}}$

Surds - Worksheet

Applied

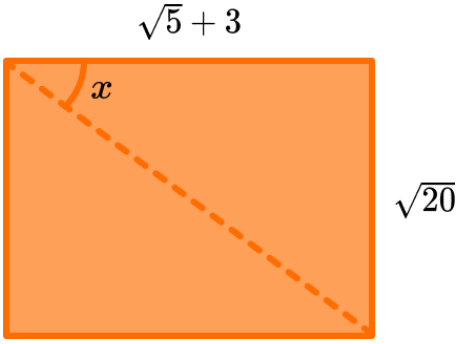
1) A rectangle has length $\sqrt{5} + 3$ and width $\sqrt{20}$.



(a) Find the perimeter of the rectangle in its simplest form.

(b) Find the area of the rectangle in its simplest form.

The angle x lies between the line of length $\sqrt{5} + 3$ and the diagonal.



(c) Show that $\frac{\sqrt{20}}{\sqrt{5}+3} = \frac{3\sqrt{5}-5}{2}$.

(d) Determine the size of angle x.

2) **(a)** 26 written as a product of prime factors is 2×13. Use this fact to explain why $\sqrt{26}$ will not simplify further.

(b) Simplify $\sqrt{52}$.

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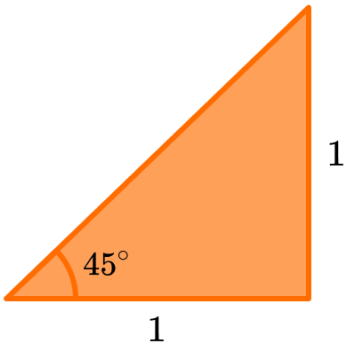
3) **(a)** Using Pythagoras' Theorem, find the length of the hypotenuse:



(b) Hence write down the value of $\cos(45)$ in its simplest form.

4) **(a)** Let $(3 + \sqrt{12})(a - \sqrt{b}) = -3$. Determine the values of a and b.

(b) Hence, or otherwise, fully simplify: $(3 + \sqrt{12})(3 - \sqrt{12})^3$.

Surds - Exam Questions

1) **(a)** Simplify $\sqrt{112}$

.....

(1)

(b) Simplify fully: $\frac{3\sqrt{38}}{\sqrt{2}}$

.....

(1)

(c) Simplify fully: $\sqrt{15} \times \sqrt{3}$

.....

(2)

(4 marks)

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2) Work out the value of: $(\sqrt{12})^2 \times (\sqrt{5})^2$

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(2 marks)

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3) Expand and simplify: $(12 - \sqrt{32})(3 + \sqrt{8})$

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(3 marks)

Surds - Exam Questions

4) Show that $\sqrt{2}(\sqrt{48} + \sqrt{27})$ can be written in the form $a\sqrt{6}$, where a is an integer to be found.

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(2 marks)

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5) Simplify fully: $\frac{(7-\sqrt{3})(7+\sqrt{3})}{\sqrt{92}}$

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(4 marks)

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6) Rationalise the denominator $\frac{5}{\sqrt{12}}$

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(2 marks)

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7) Show that $\frac{9-\sqrt{24}}{\sqrt{6}+3}$ can be written as $13 - 5\sqrt{6}$.

.....

(3 marks)

Surds - Answers

	Question	Answer
	Skill Questions	
Group A	Write in simplest form: **1)** $\sqrt{16}$ **2)** $\sqrt{28}$ **3)** $\sqrt{63}$ **4)** $\sqrt{99}$ **5)** $\sqrt{120}$ **6)** $\sqrt{850}$ **7)** $2\sqrt{5} + 6\sqrt{5}$ **8)** $4\sqrt{11} - 2\sqrt{11} + \sqrt{11}$ **9)** $4\sqrt{2} - \sqrt{8}$ **10)** $3\sqrt{7} + \sqrt{28}$ **11)** $\sqrt{270} - \sqrt{120}$ **12)** $\sqrt{20} + \sqrt{80}$	**1)** 4 **2)** $2\sqrt{7}$ **3)** $3\sqrt{7}$ **4)** $3\sqrt{11}$ **5)** $2\sqrt{30}$ **6)** $5\sqrt{34}$ **7)** $8\sqrt{5}$ **8)** $3\sqrt{11}$ **9)** $2\sqrt{2}$ **10)** $5\sqrt{7}$ **11)** $\sqrt{30}$ **12)** $6\sqrt{5}$

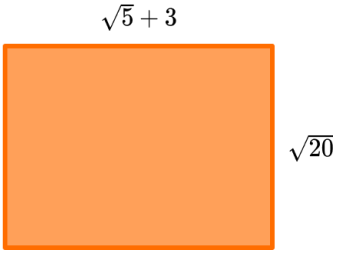
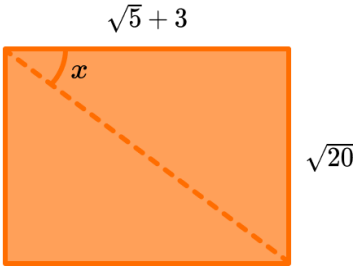
Surds - Answers

Group B	Write in simplest form:	
	1) $\sqrt{5} \times \sqrt{2}$	**1)** $\sqrt{10}$
	2) $\sqrt{24} \div \sqrt{6}$	**2)** 2
	3) $(\sqrt{11})^2$	**3)** 11
	4) $\frac{10\sqrt{15}}{2\sqrt{3}}$	**4)** $5\sqrt{5}$
	5) $\frac{\sqrt{12}+\sqrt{48}}{3}$	**5)** $2\sqrt{3}$
	6) $\frac{2(\sqrt{5})^2}{10}$	**6)** 1
	7) $3(8 + \sqrt{5})$	**7)** $24 + 3\sqrt{5}$
	8) $\sqrt{2}(6 - \sqrt{3})$	**8)** $6\sqrt{2} - \sqrt{6}$
	9) $\frac{3(\sqrt{18}-\sqrt{2})}{2}$	**9)** $3\sqrt{2}$
	10) $(3 + \sqrt{3})(2 - \sqrt{2})$	**10)** $6 - 3\sqrt{2} + 2\sqrt{3} - \sqrt{6}$
	11) $(4 + \sqrt{3})(4 - \sqrt{3})$	**11)** 13
	12) $(\sqrt{72} - \sqrt{50})^2$	**12)** 2

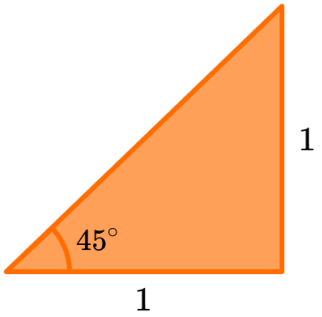
Surds - Answers

Group C	Rationalise and simplify:	
	1) $\frac{1}{\sqrt{3}}$	**1)** $\frac{\sqrt{3}}{3}$
	2) $\frac{3}{\sqrt{6}}$	**2)** $\frac{\sqrt{6}}{2}$
	3) $\frac{22}{\sqrt{2}}$	**3)** $11\sqrt{2}$
	4) $\frac{3}{\sqrt{24}}$	**4)** $\frac{\sqrt{6}}{4}$
	5) $\frac{-12}{\sqrt{72}}$	**5)** $-\sqrt{2}$
	6) $\frac{\sqrt{20}}{\sqrt{50}}$	**6)** $\frac{\sqrt{10}}{5}$
	7) $\frac{\sqrt{8}}{\sqrt{3}}$	**7)** $\frac{2\sqrt{6}}{3}$
	8) $\frac{2\sqrt{12}}{\sqrt{5}}$	**8)** $\frac{4\sqrt{15}}{5}$
	9) $\frac{\sqrt{24}+\sqrt{54}}{\sqrt{3}}$	**9)** $5\sqrt{2}$
	10) $\frac{1}{7+\sqrt{2}}$	**10)** $\frac{7-\sqrt{2}}{47}$
	11) $\frac{40}{5-\sqrt{5}}$	**11)** $10 + 2\sqrt{5}$
	12) $\frac{4\sqrt{3}}{3+\sqrt{6}}$	**12)** $4\sqrt{3} - 4\sqrt{2}$

Surds - Answers

	Question	Answer
	Applied Questions	
1)	A rectangle has length $\sqrt{5} + 3$ and width $\sqrt{20}$.  	
	a) Find the perimeter of the rectangle in its simplest form.	**a)** $6 + 6\sqrt{5}$
	b) Find the area of the rectangle in its simplest form.	**b)** $10 + 6\sqrt{5}$
	The angle x lies between the line of length $\sqrt{5} + 3$ and the diagonal.  	
	c) Show that $\frac{\sqrt{20}}{\sqrt{5}+3} = \frac{3\sqrt{5}-5}{2}$.	**c)** $\frac{\sqrt{20}}{\sqrt{5}+3} = \frac{2\sqrt{5}(\sqrt{5}-3)}{(\sqrt{5}+3)(\sqrt{5}-3)}$ $= \frac{10-6\sqrt{5}}{-4} = \frac{3\sqrt{5}-5}{2}$
	d) Determine the size of angle x.	**d)** $\tan(x) = \frac{3\sqrt{5}-5}{2}$ $x = \tan^{-1}\left(\frac{3\sqrt{5}-5}{2}\right)$ $= 40.5°$

Surds - Answers

2)	**a)** 26 written as a product of prime factors is 2×13. Use this fact to explain why $\sqrt{26}$ will not simplify further. **b)** Simplify $\sqrt{52}$.	**a)** The only two factors of 26 are 2 and 13. Neither of those are square numbers, so the surd cannot be simplified. **b)** $\sqrt{52} = \sqrt{4 \times 13}$ $= \sqrt{4} \times \sqrt{13} = 2\sqrt{13}$
3)	**a)** Using Pythagoras' Theorem, find the length of the hypotenuse:  **b)** Hence write down the value of $\cos(45)$ in its simplest form.	**a)** $\sqrt{2}$ **b)** $\frac{\sqrt{2}}{2}$
4)	**a)** Let $(3 + \sqrt{12})(a - \sqrt{b}) = -3$. Determine the values of a and b. **b)** Hence, or otherwise, fully simplify: $(3 + \sqrt{12})(3 - \sqrt{12})^3$.	**a)** $a = 3, b = 12$ **b)** $-3(3 - \sqrt{12})^2$ $= -3(21 - 12\sqrt{3})$ $= 36\sqrt{3} - 63$

Surds - Mark Scheme

	Question	Answer	
	Exam Questions		
1) (a)	Simplify $\sqrt{112}$	(a) $4\sqrt{7}$	(1)
(b)	Simplify fully: $\frac{3\sqrt{38}}{\sqrt{2}}$	(b) $3\sqrt{19}$	(1)
(c)	Simplify fully: $\sqrt{15} \times \sqrt{3}$	$\sqrt{45}$ $3\sqrt{5}$	(1) (1)
2)	Work out the value of: $(\sqrt{12})^2 \times (\sqrt{5})^2$	(a) $(\sqrt{12})^2 = 12$ or $(\sqrt{5})^2 = 5$ $12 \times 5 = 60$	(1) (1)
3)	Expand and simplify: $(12 - \sqrt{32})(3 + \sqrt{8})$	$(12 - \sqrt{32})(3 + \sqrt{8})$ $= 36 - 3\sqrt{32} + 12\sqrt{8} - 16$ $= 20 - 12\sqrt{2} + 24\sqrt{2}$ $= 20 + 12\sqrt{2}$	(1) (1) (1)
4)	Show that $\sqrt{2}(\sqrt{48} + \sqrt{27})$ can be written in the form $a\sqrt{6}$, where a is an integer to be found.	(a) $\sqrt{48} = 4\sqrt{3}$ or $\sqrt{27} = 3\sqrt{3}$ $\sqrt{2} \times 7\sqrt{3} = 7\sqrt{6}$ or $a = 7$	(1) (1)
5)	Simplify fully: $\frac{(7-\sqrt{3})(7+\sqrt{3})}{\sqrt{92}}$	(a) $(7 - \sqrt{3})(7 + \sqrt{3})$ $= 49 + 7\sqrt{3} - 7\sqrt{3} - 3$ $= 46$ $\sqrt{92} = 2\sqrt{23}$ $\frac{46}{2\sqrt{23}} = \frac{46\sqrt{23}}{2\times23} = \sqrt{23}$	(1) (1) (1) (1)
6)	Rationalise the denominator $\frac{5}{\sqrt{12}}$	(a) $\sqrt{12} = 2\sqrt{3}$ $\frac{5\sqrt{3}}{6}$	(1) (1)

Surds - Mark Scheme

7)	Show that $\frac{9-\sqrt{24}}{\sqrt{6}+3}$ can be written as $13 - 5\sqrt{6}$.	$\sqrt{24} = 2\sqrt{6}$ $\frac{(9-2\sqrt{6})(\sqrt{6}-3)}{(\sqrt{6}+3)(\sqrt{6}-3)}$ $= \frac{15\sqrt{6}-39}{-3} = 13 - 5\sqrt{6}$	**(1)** **(1)** **(1)**