SURDS

Summary:

1. *Surds are numbers left in square root form.*

2. *The following rules apply to surds:*

(i) $a\sqrt{b} + c\sqrt{b} = (a + c)\sqrt{b}$

(ii) $a\sqrt{b} - c\sqrt{b} = (a - c)\sqrt{b}$

(iii) $a\sqrt{b} - c\sqrt{d}$ *cannot be manipulated because the surds are different. Unlike*

surds cannot be added ***or*** *subtracted*

(iv) $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

(v) $a\sqrt{b} \times c\sqrt{d} = ac\sqrt{bd}$

(vi) $(\sqrt{a})^2 = \sqrt{a} \times \sqrt{a} = \sqrt{a^2} = a$

(vii) $\sqrt{a^2 b} = a\sqrt{b}$

(viii) $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

(3) (i) *The process of eliminating surds from the denominator is called* ***rationalizing the denominator.***

(ii) *To rationalize* $\frac{a}{\sqrt{b}}$, *multiply top and bottom by* $\sqrt{b}$.

(iii) *The conjugate surd of* $a + \sqrt{b}$ *is* $a - \sqrt{b}$ *and vice versa*

(iv) *To rationalize* $\frac{c}{a + \sqrt{b}}$, *multiply top and bottom by the conjugate of*

the

denominator.

EXAMPLES:

1. *Without using a calculator simplify:*

(i) $\sqrt{18}$ ***(ii)*** $\sqrt{50}$ ***(iii)*** $\sqrt{48}$

(vi) $\sqrt{52}$ ***(v)*** $\sqrt{90}$ ***(vi)*** $\sqrt{108}$

(vii) $\sqrt{98}$ ***(viii)*** $\sqrt{300}$ ***(ix)*** $\sqrt{32}$

2. *Without using a calculator simplify:*

(i) $\sqrt{3} + \sqrt{3}$

(ii) $3\sqrt{7} + \sqrt{7}$

(iii) $7\sqrt{5} - \sqrt{5}$

(iv) $\sqrt{50} + \sqrt{32} - \sqrt{18}$

(v) $\sqrt{80} + \sqrt{20} - \sqrt{45}$

(vi) $3\sqrt{28} + \sqrt{63} - \sqrt{112}$

(vii) $\sqrt{125} + \sqrt{20} - \sqrt{45}$

(viii) $\sqrt{40} + \sqrt{243} + \sqrt{10} - \sqrt{75}$

(ix) $\sqrt{75} + \sqrt{44} + \sqrt{27} + \sqrt{99}$

3. *Expand the following and simplify:*

(i) $2(5 - \sqrt{7})$

(ii) $\sqrt{2}(\sqrt{6} - \sqrt{2})$

(iii) $\sqrt{5}(3\sqrt{5} + 4\sqrt{15})$

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

(v) $(2 + \sqrt{5})(2 + \sqrt{5})$

(vi) $(\sqrt{7} + \sqrt{3})(\sqrt{7} - \sqrt{3})$

(vii) $(2 + \sqrt{3})^2$

(viii) $(4\sqrt{5} + 3\sqrt{2})^2$

(ix) $(3 + 2\sqrt{5})(4\sqrt{5} - 2)$

(x) $(4\sqrt{5} + 3\sqrt{2})(4\sqrt{5} - 3\sqrt{2})$

4. *Express* $(2\sqrt{5} + \sqrt{2})(\sqrt{5} + 3\sqrt{2})$ *in the form* $a + b\sqrt{c}$, *hence state the values of* ***a, b*** *and* ***c.***

5. *If* $(2\sqrt{7} + 3\sqrt{2})(4\sqrt{7} - 5\sqrt{2}) = a + b\sqrt{c}$, *find the values of* ***a, b*** *and* ***c.***

6. *If* $\sqrt{6} = 2 \cdot 44949,$ *without using tables or a calculator evaluate*

$5\sqrt{2}(2\sqrt{3} - \sqrt{2})$ *correct to* **3** *decimal places.*

6. *If* $\sqrt{14} = 3 \cdot 74166,$ *without using tables or a calculator evaluate*

$(2\sqrt{7} + 3\sqrt{2})(4\sqrt{7} - 5\sqrt{2})$ *correct to* **4** *decimal places.*

7. *A rectangle of length* $(x\sqrt{5} + y\sqrt{2})cm$ *and width* $(\sqrt{5} + 4\sqrt{2})cm$ *has an*

area of $(11 + 25\sqrt{10})cm^2$. *Without using tables or a calculator, find the*

the values of ***x*** *and* ***y.***

8. *Express the following with a rational denominator:*

(i) $\frac{14}{\sqrt{7}}$

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

(iii) $\frac{12}{\sqrt{18}}$

(iv) $\frac{\sqrt{2}}{4\sqrt{5} - 3\sqrt{2}}$

(v) $\frac{\sqrt{3} - 1}{2\sqrt{3} + 1}$

(iv) $\frac{3 + 2\sqrt{3}}{3 - 2\sqrt{3}}$

(v) $\frac{1+2\sqrt{3}}{2-\sqrt{3}}$

(vi) $\frac{1}{1+\sqrt{8}+\sqrt{18}-2\sqrt{2}}$

9. Express $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ in the form $a+b\sqrt{c}$.

10. Express $\frac{(1+\sqrt{3})^2}{\sqrt{3}-1}$ in the form $p+q\sqrt{r}$.

11. Without using tables or a calculator, simplify $\frac{1}{1+\sqrt{8}+\sqrt{18}-2\sqrt{2}}$

12. Express $\frac{3}{\sqrt{5}-2}+\frac{1}{\sqrt{5}}$ in the form $a+b\sqrt{c}$.

13. Simplify $\frac{\sqrt{63}+\sqrt{28}}{\sqrt{175}-\sqrt{63}}$ as far as possible

14. Without using tables or a calculator, simplify $\frac{\sqrt{30}}{\sqrt{6}}+\frac{\sqrt{35}}{\sqrt{7}}$

15. If $\sqrt{3}=1{\cdot}73205$, without using tables or a calculator evaluate $\frac{1+\sqrt{3}}{2+\sqrt{3}}$

correct to **4** decimal places.

16. Without using tables or a calculator, simplify $\frac{1}{\sqrt{3}+\sqrt{2}}+\frac{3}{\sqrt{3}-\sqrt{2}}$

17. If $\frac{\sqrt{2}}{\sqrt{3}+\sqrt{2}}=a+\sqrt{b}$, find the values of **a** and **b.**

18. *If* $\frac{6}{3\sqrt{2}-2\sqrt{3}} = a\sqrt{2}+b\sqrt{3}$, *find the values of* **a** *and* **b.**

19. *If* $\frac{3-2\sqrt{3}}{3+2\sqrt{3}} - \frac{3+2\sqrt{3}}{3-2\sqrt{3}} = a\sqrt{3}$, *find the value of* **a.**

EER:

2. *Without using a calculator simplify:* $\sqrt{20} - \sqrt{45} + \sqrt{125}$

20. *If* $\frac{5}{\sqrt{5}} + \sqrt{20} = a\sqrt{5}$, *find the value of* **a.**

4. *Express* $(2\sqrt{3} - \sqrt{2})(4\sqrt{3} + 5\sqrt{2})$ *in the form* $a + b\sqrt{c}$.

4. *Without using tables or a calculator, find the area of a triangle whose base is*

$(5\sqrt{3} - 3\sqrt{5})cm$ *and height* $(5\sqrt{3} + 3\sqrt{5})cm$.

4. *A rectangle of length* $(x\sqrt{5} + y\sqrt{2})cm$ *and width* $(\sqrt{5} + 4\sqrt{2})cm$ *has an*

area of $(11 + 25\sqrt{10})cm^2$. *Without using tables or a calculator, find the*

the values of **x** *and* **y.**

1. *Express* $\frac{2\sqrt{3}+5\sqrt{2}}{\sqrt{2}-\sqrt{3}}$ *in the form* $p + q\sqrt{r}$.

6. *Express* $\frac{\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ *without a surd in the denominator.*

5. *Express* $\frac{9}{\sqrt{5}-\sqrt{2}}$ *in the form* $a(\sqrt{b}+\sqrt{c})$.

5. *Express* $\frac{8}{3-\sqrt{5}}$ *in the form* $p+q\sqrt{5}$.

5. *Express* $\frac{1}{\sqrt{5}-\sqrt{2}}$ *with a rational denominator.*

8. *If* $\sqrt{3}=1{\cdot}732$, *without using tables or a calculator evaluate* $\frac{1+\sqrt{3}}{2+\sqrt{3}}$

correct to **4** *decimal places.*

2. *Express* $\frac{1+\sqrt{3}}{1-\sqrt{3}}$ *in the form* $a+b\sqrt{3}$. *Hence evaluate* $\frac{1+\sqrt{3}}{1-\sqrt{3}}$ *correct to*

3 *significant figures if* $\sqrt{3}=1{\cdot}732$.

2. *Express* $\frac{(1+\sqrt{3})^2}{\sqrt{3}-1}$ *in the form* $a+b\sqrt{3}$.

6. *Without using tables or a calculator, simplify* $\frac{2}{1+\sqrt{3}}-\frac{3}{3-2\sqrt{3}}$

8. *Use the fact that* $\sqrt{7}=2{\cdot}6458$, *to find the exact value of*

$$\frac{2}{3-\sqrt{7}}-\frac{2}{3+2\sqrt{7}}$$

6. Use the fact that $\sqrt{7}=2{\cdot}6458$, to find the exact value of

$$\frac{2}{3-\sqrt{7}}-\frac{2}{3+\sqrt{7}}$$