**DEALING WITH SURDS.**

**Dealing with surds is NOT a matter of using “rules” but of using “logic”.**

1. Consider: √9 × √9

 Obviously this is 3 × 3

 = 9

But notice that we can do this **in a different order**: √9 × √9

 = √( 9 × 9)

 = √ (81)

 = 9 as above!

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2. This means that we can write:

 √3 ×√5 = √(3×5) = √15

Or in general : ***√a×√b = √(ab)***

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3. BUT consider √(9 + 16)

 = √(25)

 = 5

But if we try it **in a different order like before it is not correct:**

 Consider √(9 + 16)

 = √(9) + √(16)

 = 3 + 4

 = 7

because we know the real answer is 5.

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4. This means that ***√(a + b) ≠ √a + √b***

 So even though it **looks** **tempting** to do the following:

***√(x2 + 16) = x + 4*** we cannot do it!

But notice that ***√(x2 + 8x + 16)***

 ***= √ (x + 4)2***

 ***= x + 4***

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5. Consider √(62 + 82)

It does look very tempting to put:

 √(62 + 82) = 6 + 8 = 14 but we can see that the correct answer is:

 √(62 + 82) = √ (36 + 64)

 = √100

 = 10.

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6. Clearly we can deal with fractions as follows: $\sqrt{\frac{16}{25}}= \frac{\sqrt{16}}{\sqrt{25}}= \frac{4}{5}$

so that $\sqrt{\frac{a }{b} }$ = $\frac{\sqrt{a}}{\sqrt{b}}$

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7. **Some** surds may be simplified as follows as long as a factor is a perfect square: $\sqrt{48 }=\sqrt{16×3} $

 = $\sqrt{16}$ × $\sqrt{3}$

 = 4×$\sqrt{3}$

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8. It is not possible to add √20 + √30

but √50 + √72 can be simplified:

 = √(25×2) + √(36×2)

 = 5√2 + 6√2

 = 11√2

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9. Similarly $\sqrt{63}+ \sqrt{28}$

 = $\sqrt{9×7 }+\sqrt{4×7}$
 = 3$\sqrt{7}+2\sqrt{7}$  = 5$\sqrt{7}$

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10. Surds are easier to deal with if they have **rational** denominators.

The two types are:

(a) $\frac{3}{\sqrt{5}}= \frac{3}{\sqrt{5}} ×\frac{\sqrt{5}}{\sqrt{5}}= \frac{3\sqrt{5}}{5}$

(b) $\frac{5+ \sqrt{2}}{4- \sqrt{2}}$ = $ \frac{5+\sqrt{2}}{4-\sqrt{2}} ×\frac{4+\sqrt{2}}{4+\sqrt{2}}$

 = $\frac{20+4\sqrt{2 }+5\sqrt{2}+2}{16+ 4\sqrt{2 }-4\sqrt{2 }-2}$

 = $\frac{22+9\sqrt{2}}{14} or \frac{22}{14}+ \frac{9\sqrt{2}}{14}$

(we usually write irrationals in the form ***a + b√c*** rather than $\frac{a+b\sqrt{c}}{d}$ )

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