TRICKY POINTS DEALING WITH SURDS.

Many students perpetually make the mistake of writing things like:

***√(x2 + y2) = x + y***

They simply need to be shown what we can and cannot do by considering problems which can be worked out two ways so that we can verify certain procedures.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

eg Consider √(4 × 9)

If we multiply first, we get √36 which of course equals 6

Then we TEST whether we can do the following:

√(4 × 9) = √(4) × √(9)

 = 2 × 3

 = 6

So it appears that *√****(a × b) =*** *√****a ×*** *√****b ( but not always, as we shall see soon!)***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now consider √ (16 + 9 )

If we do the brackets first, we get √25 which of course equals 5

Then we TEST whether we can do the following:

√ ( 16 + 9 ) = √(16) + √(9)

 = 4 + 3

 = 7

So it appears that *√****(a + b) ≠*** *√****a +*** *√****b***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

It still “looks” tempting to put ***√(x2 + y2) = x + y***

but we can show that it is only ***√(x2 + 2xy + y2) = √(x + y)2 = x + y***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Students should satisfy themselves about what we can or cannot do with other numerical cases which can be done two ways like:

 √ (100 – 64) = √ (36) = 6 which is correct

 but √ (100 – 64) = √(100) – √(36) = 10 – 6 = 4 which is clearly wrong.

Have you ever seen this point addressed in any text?

 We know *√(a×b) = √(a) × √(b)*

 Example *√(4 × 9) = √(4) × √(9) TRUE*

But is this true ? *√(–4 × –9) = √(–4) × √(–9) = 2i×3i = –6*

 It is NOT true! because *√(–4 × –9) = √(36) = +6*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The following “algebra” is **not valid**:

 *√(–1)2 = √(–1 × –1) = √(–1) × √(–1) = i × i = –1*

because *√(–1)2 = √ (+1) = 1* (squaring first then square root)

**however** *√(–1)* ***2*** *= (i)2 = –1* (square root first then square)

but in general for positive *a* and *b* it is true to say :

 *√****(a×b)*** *= √****(a)*** *× √****(b)***

It seems reasonable to say that the operation √ can be sort of used distributively over multiplication

ie *a×b* but only when *a* and *b* are > 0

**or when only one of *a* or *b* is negative** eg *√(4×–9) = √(4) × √(–9)*

 *= 2 × 3i*

 *= 6i*

**but not when both *a* and *b* are negative.**