PROBLEM-SOLVING TACTICS

1. While changing units, one can visualize them as some constants multiplied to the numbers. This trick is very helpful particularly in understanding units. Like you can cut out units from both sides of equations very easily just like constants.
2. Application of dimensional analysis can possibly rule out inappropriate answers in multiple choice questions (MCQs).

   Further, dimensional analysis can also be used to eliminate invalid choices in MCQ even in mathematics. It definitely saves lot of time.
3. Be careful in handling error approximation. Binomial theorem can only be applied in very low percentage of errors (generally less than 5% error), else not.
4. One must accurately know the rules for determining significant digits and be precise while dealing with 0s and 5.

FORMULAE SHEET

(a) $\text{V.C.} = \text{L.C.} = \dfrac{1\text{M.S.D.}}{n} = \dfrac{\text{Smallest division on main scale}}{\text{Number of divisions on vernier scale}} = 1\text{M.S.D.} - 1\text{V.S.D.}$

(b) In ordinary Vernier calipers, $= 1\text{M.S.D.} = 1\text{mm}$ and $n = 10$; V.C. or $\text{L.C.} = \dfrac{1}{10}\text{mm} = 0.01\text{cm}$

(c) Total reading = $(N + n \times \text{V.C.})$

(d) Zero correction=–zero error. Zero error is algebraically subtracted, whereas the zero correction is algebraically added. If zero of Vernier scale lies to the right of zero of the main scale, then the error is positive. The actual length in this case is less than the observed length.

(e) If zero of Vernier scale lies to the left of zero of the main scale, then the error is negative and the actual length is more than the observed length.

(f) Positive zero error $= (N + x \times \text{V.C.})$

(g) **Least count:** The minimum measurement that can be measured accurately by an instrument is called the least count.

Least count of Vernier caliper

$= \{\text{value of 1 part of main scale(s)}\} - \{\text{value of one part of vernier scale (V)}\}$

or least count of Vernier calipers = 1MSD – 1VSD

where, MSD = Main scale division; VSD = Vernier scale division

$$\text{Least count} = \frac{\text{Value of 1 part of main scale (s)}}{\text{Number of parts on vernier scale (n)}}$$

$$\text{Least count of screw gauge} = \frac{\text{Pitch (p)}}{\text{Number of parts on circular scale (n)}}$$

(h) The maximum absolute error in x is $\Delta x = +(\Delta a + \Delta b)$

(i) Percentage error $= +- \dfrac{\Delta y}{y_m} \times 100$

(j) Errors never propagate in case of constants.

(k) If $x = a$ then $\dfrac{\Delta x}{x} = \dfrac{\Delta a}{a}$

(l) If $x = a - b$, then $\dfrac{\Delta x}{x} = \dfrac{\Delta a + \Delta b}{a - b}$

(m) If $x = a\,b$ or $x = \dfrac{a}{b}$, then $\dfrac{\Delta x}{x} = \left(\dfrac{\Delta a}{a} + \dfrac{\Delta b}{b}\right)$

(n) If $b = \dfrac{a^n b^m}{z^p y^k}$, then $\dfrac{\Delta x}{x} = \left(\dfrac{n\Delta a}{a} + \dfrac{m\Delta b}{b} + \dfrac{p\Delta z}{z} + \dfrac{k\Delta y}{y}\right)$

(o) Absolute error $\Delta x = x\left(\dfrac{n\Delta a}{a} + \dfrac{m\Delta b}{b} + \dfrac{p\Delta z}{z} + \dfrac{k\Delta y}{y}\right)$ or in general ; $\Delta x = x$ (relative error)