

Appendix A: Ways of Indicating What Cubes Mean in Equations

Some General Principles

1. Each Equation-writer must not only create a correct Solution but must also clearly *communicate* the Solution to the Checker(s) so that they can verify that the Solution equals the writer's interpretation of the Goal.
2. An Equation-writer must remove all ambiguity from the Solution and Goal so that there is no question that the two sides of the Equation are equal. Removing ambiguity has two components: **(a)** using grouping symbols to specify the order of operations and **(b)** indicating the value of any cube that may have multiple meanings. It is component **(b)** that is the subject of this Appendix, although in some cases placement of parentheses may clarify the meaning of a symbol.
3. In general, an Equation-writer should write in the main line of the Equation the *value* of each cube that represents something other than its "face value." For example, write the value of the wild cube in the Equation and indicate above or below that the value comes from a wild cube. This principle is implemented in the *Recommended* methods in this Appendix. The reverse technique, listing the wild cube in the Equation and indicating its value from the side, is *Acceptable* only.
4. If the Equation-writer does a good job, the Checker(s) should not have to ask a single question about the Equation. It should be clear what each symbol means and which interpretation of the Goal the writer has chosen.
5. In general, arrows are preferable for indicating what a cube means, like this.

$$\begin{array}{c} 0 \\ \downarrow \\ 7 \end{array}$$

The arrow can come from above or below and can point to or from the symbol in the Equation. Writing the meaning just above or just below the mainline of the Equation without an arrow is acceptable but has the drawback that the two digits may overlap and confuse rather than clarify. This should not be the case where several letters like sw or ud indicate the meaning; hence an arrow is not needed (although acceptable) in these situations.

Explanation of Terms

Methods of clarifying symbols in Equations are divided into three categories in the list in this Appendix: *Recommended*, *Acceptable*, and *Unacceptable*. Here are the intended meanings of these terms.

Recommended This is the method that should be taught to players.

Acceptable Any method in this category will be accepted by judges as correct.

Unacceptable These methods will cause the Equation to be ruled incorrect by judges.

This Appendix also lists a Default interpretation for many ambiguous symbols. The Default meaning is how the symbol will be interpreted if the writer does not clarify its meaning. If a symbol has no Default meaning, the writer must indicate the desired interpretation. Otherwise, the opponent may interpret it so as to make the Solution incorrect.

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Division	Variations	Examples	Default
		or the same methods with the arrows pointing the opposite way (or no arrows at all) or sc or swc in place of sw, etc.	
All	Upside-down, 0 wild	$\begin{array}{c} 0 \\ \downarrow \\ \text{Recommended: } 7 \\ \text{ud} \\ 0 \text{ ud } 7 \text{ } \angle \text{ ud } 0 \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \text{ud} \\ \text{Acceptable: } \angle, 0, 0, 7, \angle, 0, 0, 7, 7 \\ \quad \quad \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad 0 \\ \quad \quad \quad 0 \text{ ud} 7 \text{ } \angle \text{ ud} 0 \end{array}$ <p>or same methods with the arrows pointing the opposite way (or no arrows at all), uc or usd in place of ud, etc.</p>	A 0 in the Goal is ambiguous for upside-down. Default is 0 cube is right-side up zero.
All	Multiple operations	$\begin{array}{c} 4 \\ \downarrow \\ \text{Recommended: } \sqrt{\quad} \end{array}$ <p>if used consecutively (or number below or no arrow). In any case, you may write the operation sign as many times as you want it.</p>	The operation is used just once.
All	# factors or (E only) smallest prime	$6 \times 7 \rightarrow$ must be multiplication $x67 \rightarrow$ # factors (or smallest prime) $8xx7$ or $8x(x7) \rightarrow$ 1st x = mult., 2nd = # factor (or sm. prime) $xx5$ or $x(x5) \rightarrow$ both # fac. (or sm. prime)	Context (placement of the symbol) determines the interpretation of the x. <i>Usually no indication is necessary.</i>
All	Mult. op., # factors or (E only) sm. pr.	<p>Recommended: $x2$ or $x2$</p> $\begin{array}{cc} 10 \leftarrow & 10 \text{ x's} \leftarrow \\ \uparrow & \uparrow \\ 10 & 10 \end{array}$ <p>(or point from top)</p>	The x is used just once.
E	LCM	<p>Recommended: $8 \sqrt{2}$ or LCM</p> $\begin{array}{cc} \uparrow & \downarrow \\ \text{LCM} & 8 \sqrt{2} \end{array}$ <p>Acceptable: Same with no arrow.</p>	$\sqrt{\quad}$ = root
E	GCF	<p>Recommended: $8 * 2$ or GCF</p> $\begin{array}{cc} \uparrow & \downarrow \\ \text{GCF} & 8 * 2 \end{array}$ <p>Acceptable: Same with no arrow.</p>	* = exponentiation
EM	Decimal point	<p>Recommended: .23, 23.+5, 2.3 (that is, write a decimal point, not *)</p> <p>Acceptable: *23, *23, *23 (or same)</p> $\begin{array}{ccc} \text{dp} & \uparrow & \uparrow \\ . & & \text{dec} \end{array}$ <p>methods with indication from above) In most cases, context determines what * means; for example: *23 \rightarrow decimal point 23*+5 \rightarrow decimal point (continue next page)</p>	If context (placement of the symbol) does not determine, <i>default to exponentiation</i> . For order of operations, decimal point takes precedence. (See the examples listed after the variation in Elementary variations section of the Tournament Rules.)

Division	Variations	Examples	Default
JS	Base 11 or 12	<p>Use of * and $\sqrt{\quad}$ as digits creates ambiguities. If context does not determine meaning, player must indicate. Examples: $7+^*4$ or $4^*+7 \rightarrow *$ is ten.</p> <p>$3\sqrt{4}$ is not ambiguous (without i in Sr.). $6^{**}2$ is ambiguous. In base 12, $\sqrt{4}+2$ is ambiguous.</p> <p><i>Recommended:</i> $(6^*)^2$ which means $(6^*)^2$ or $6^*(^*2)$ for 6^{*2} or $6^* * 2$</p> <p style="text-align: center;"> $\begin{array}{c} * \\ \uparrow \\ \text{exp. ten} \end{array}$ </p> <p>For $\sqrt{4}+2$, write $(\sqrt{4})+2$ or $(\sqrt{4})+2$ or</p> <p style="text-align: center;"> $\begin{array}{c} \uparrow \qquad \qquad \uparrow \\ \text{root} \quad 11 \text{ or eleven} \end{array}$ </p> <p>$\sqrt{(4+2)}$ [$\sqrt{\quad}$ must be root if no i in Senior].</p>	Context determines; if context cannot determine, expression is ambiguous.
JS	Base m , Powers of Base	<p>Side indications of pob may be in either base ten or base m as long as <i>they are all in one base or the other.</i></p> <p><i>Recommended:</i> $(100 \div 4) - (10 + 10)$</p> <p style="text-align: center;"> $\begin{array}{c} \uparrow \qquad \qquad \uparrow \quad \uparrow \\ 1 \qquad \qquad 1 \quad 1 \end{array}$ </p> <p><i>Acceptable:</i> With base 8,</p> <p style="text-align: center;"> $\begin{array}{c} (1 \div 4) - (1 + 1) \quad \text{or} \\ \uparrow \qquad \quad \uparrow \quad \uparrow \\ 100 \qquad \quad 10 \quad 10 \\ (1 \div 4) - (1 + 1) \\ \uparrow \qquad \quad \uparrow \quad \uparrow \\ 64 \text{ (or } 8^2) \quad 8 \quad 8 \end{array}$ </p> <p><i>Unacceptable:</i> With base 8,</p> <p style="text-align: center;"> $\begin{array}{c} (1 \div 4) - (1 + 1) \\ \uparrow \qquad \quad \uparrow \quad \uparrow \\ 100 \text{ or } 10^2 \quad 8 \quad 8 \end{array}$ </p>	

Senior Division Variations are on the next page.

Division	Variations	Examples	Default
S	x wild	See examples for 0 wild.	x = x if placement of the x allows it to be an operation; also see the note for 0 wild for all divisions on page A1 .
S	$\sqrt{\quad} = i$	<i>Recommended:</i> Since $\sqrt{\quad}$ must be i , just write the $\sqrt{\quad}$. <i>Acceptable:</i> Write i in place of $\sqrt{\quad}$.	None since (without base 12) $\sqrt{\quad}$ must be i .
S	0 or x wild, $\sqrt{\quad} = i$	For 0 representing i in the Equation, use any method listed for 0 wild on page A3 . To indicate $0 = i$ in the <i>Goal</i> 804: <i>Recommended:</i> $8\sqrt{4}$ <i>Acceptable:</i> $8i4$ plus the methods for 0 wild in Equations <i>Unacceptable:</i> $32i$ or $32\sqrt{\quad}$	None
S	$\sqrt{\quad} = i$, base 12	Placement of $\sqrt{\quad}$ may determine its meaning. For example, in $3\sqrt{4}$, $64\sqrt{\quad}$, or $\sqrt{64}$, $\sqrt{\quad}$ must be i . However, $6+(2\sqrt{\quad})$, $\sqrt{\quad}+7$, and $6\sqrt{\sqrt{2}}$ are ambiguous. <i>Recommended:</i> If $\sqrt{\quad} = i$, write $6+(2i)$, $i + 7$, or $6ii2$. If $\sqrt{\quad} = 11$, write $6+(2\sqrt{\quad})$, $\sqrt{\quad}+7$, or $6\sqrt{\sqrt{2}}$ $\begin{array}{ccccccc} & & \uparrow & \uparrow & & \uparrow & \uparrow \\ & & 11 & \text{eleven} & & \text{eleven} & \text{(or point from above)} \end{array}$ <i>Acceptable:</i> $6+(2\sqrt{\quad})$ $\begin{array}{c} \uparrow \\ i \text{ (or point from above or no } \uparrow \text{)} \end{array}$	Context; if context does not determine, $\sqrt{\quad}$ is ambiguous.
S	Log	<i>Recommended:</i> $8 \cdot 2$ <i>Acceptable:</i> $8 \div 2$, $8 \div 2$, $8 \log 2$, $\log_2 8$ $\begin{array}{cc} \uparrow & \uparrow \\ \log & \text{sw (or any other sw method)} \end{array}$ <i>Unacceptable:</i> $8 \div 2$ (\div defaults to division)	$\div =$ division
S	Decimal in Goal	<i>Recommended:</i> Write a decimal point to indicate placement. For example, if the Goal is $15x8$, write $1.5x8$, $15x.8$, $.15x.8$, etc. <i>Acceptable:</i> $15x8$, $15x8$, $15x8$, etc. $\begin{array}{ccccccc} & & \uparrow & & \uparrow & \uparrow & \uparrow \\ & & . & & \text{dp} & \text{dec.pt.} & \end{array}$ (Notice how carefully the arrow must be drawn to the exact place where the point goes.)	No decimal point in the Goal

