

Appendix A: Ways of Indicating What Cubes Mean in Solutions

Some General Principles

1. Each Solution 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. A Solution 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 on either side of the equation 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, a Solution 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 Solution-writer does a good job, the Checker(s) should not have to ask a single question about the Solution. 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 Solution. 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 writing entire Solutions or individual symbols in Solutions 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 Solution to be ruled incorrect by judges.

Last update 7/30/11

Division	Variations	Examples	Default
All	Sideways, 0 wild	$ \begin{array}{c} 0 \\ \downarrow \\ \text{Recommended: } 7 \\ \text{sw} \\ 0 \text{ sw } 7 \text{ sw } 0 \\ \downarrow \downarrow \downarrow \downarrow \\ \text{Acceptable: } \sim, 0, 0, 7, \sim, 0, 0, 7 \\ \uparrow \uparrow \uparrow \uparrow \\ 0 \text{ sw } 7 \text{ sw } 0 \end{array} $ <p>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.</p>	Cube is right-side up and 0 = zero.
All	Upside-down, 0 wild	$ \begin{array}{c} 0 \\ \downarrow \\ \text{Recommended: } 7 \\ \text{ud} \\ 0 \text{ ud } 7 \text{ ud } 0 \\ \downarrow \downarrow \downarrow \downarrow \\ \text{Acceptable: } \angle, 0, 0, 7, \angle, 0, 0, 7, 7 \\ \uparrow \uparrow \uparrow \uparrow \\ 0 \text{ ud } 7 \text{ ud } 0 \end{array} $ <p>or same methods with the arrows pointing the opposite way (or no arrows at all), uc or used 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} \text{ if used consecutively} \\ \text{(or number below or no arrow). In any case, you may write the operation sign as many times as you want it.} \end{array} $	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: $x2$</p> $ \begin{array}{c} 10 \text{ } \downarrow \text{ } \\ \text{(or "10 x's")} \\ \text{(or point from top)} \end{array} $	The x is used just once.
E	LCM	<p>Recommended: $8 \sqrt{2}$ or LCM</p> $ \begin{array}{c} \uparrow \quad \downarrow \\ \text{LCM} \quad 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}{c} \uparrow \quad \downarrow \\ \text{GCF} \quad 8 \wedge 2 \end{array} $ <p>Acceptable: Same with no arrow.</p>	* or \wedge = exponentiation

Division	Variations	Examples	Default
MJS	0 wild, red exponent	<p><i>Recommended:</i> For a Goal of 703 with red 3, write: 70^3, 75^3, 7×3, $7+3$, etc.</p> <p style="text-align: center;">↑ 0</p> <p><i>Acceptable:</i> Any method for writing 0 wild as an operation in the Solution (see p.A3).</p>	703 defaults to 70^3 . If 3 cannot be an exponent, there is no default.
MJS	Powers of the base	<p style="text-align: center;">1 ↓</p> <p><i>Recommended:</i> 10^3, 100, <u>1000</u>, etc.</p> <p style="text-align: center;">↑ 1 1</p> <p><i>Acceptable:</i> 1, 1 (or indicate from above)</p> <p style="text-align: center;">↑ ↑ 100 10²</p>	1 = one
JS	Base 11 or 12	<p>Use of * (or ^) and $\sqrt{\quad}$ as digits creates ambiguities. If context does not determine meaning, player must indicate. Examples: $7+^*4$ or $4^{\wedge}+7 \rightarrow$ * or ^ is ten. $3\sqrt{4}$ is not ambiguous (without <i>i</i> in Sr.). $6^{**}2$ is ambiguous. In base 12, $\sqrt{4}+5$ 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;"> * ↑</p> <p style="text-align: center;"> exp. ten</p> <p>For $\sqrt{4}+2$, write $(\sqrt{4})+2$ or $(\sqrt{4})+2$ or</p> <p style="text-align: center;"> ↑ ↑</p> <p style="text-align: center;"> root 11 or eleven</p> <p>$\sqrt{(4+2)}$ [$\sqrt{\quad}$ must be root if no <i>i</i> in Senior].</p>	Context determines; if context cannot determine, expression is ambiguous. In no case should ^ be placed sideways or upside-down in the Goal.
JS	Base <i>m</i> , Powers of Base	<p>Side indications of pob may be in either base ten or base <i>m</i> as long as they are all in one base or the other.</p> <p><i>Recommended:</i> $(100 \div 4) - (10 + 10)$</p> <p style="text-align: center;"> ↑ ↑ ↑ 1 1 1</p> <p><i>Acceptable:</i> With base 8,</p> <p style="text-align: center;">(1 \div 4) - (1 + 1) or</p> <p style="text-align: center;"> ↑ ↑ ↑ 100 10 10</p> <p style="text-align: center;">(1 \div 4) - (1 + 1) or</p> <p style="text-align: center;"> ↑ ↑ ↑ 64 (or 8²) 8 8</p> <p><i>Unacceptable:</i> With base 8,</p> <p style="text-align: center;">(1 \div 4) - (1 + 1)</p> <p style="text-align: center;"> ↑ ↑ ↑ 100 or 10² 8 8</p>	1 = 1

II. On-Sets

The following is the list of accepted ways of indicating in writing what cubes mean in On-Sets Solutions.

Division	Variations	Examples	Default		
All	Wild cube	<p><i>Recommended:</i> $R \overset{\uparrow}{\underline{U}} G$ or $B - \overset{\downarrow}{\underline{V}}$</p> <p style="text-align: center;">B U</p> <p>The arrows may come from the top or not appear at all.</p> <p><i>Acceptable:</i> $R \overset{\uparrow}{\underline{B}} G$ or $B \overset{\downarrow}{\underline{U}} \underline{V}$</p> <p style="text-align: center;">U -</p> <p>The arrows may come from the top or not appear at all.</p>	Wild cube = itself; it is also sufficient to indicate in <i>one</i> place in the Solution what the wild cube represents – it is understood to represent the same symbol throughout (Restriction and Set-Name).		
All	\underline{U}, \cap interchangeable	<p><i>Recommended:</i> Write the symbol (U or \cap) you want in each place in Solution; no other indication necessary.</p> <p><i>Acceptable:</i> Indicate the cube upside down in the same way as for a wild cube (above) or upside down cube in Equations.</p> <p><i>Caution:</i> Writing the bar ($_$) on an upside-down symbol causes confusion. It is best <i>not</i> to write the upside-down symbols like this: $\bar{\cup}$ (for upside-down intersect) or $\bar{\cap}$ (upside-down union).</p>	$U = \cup, \cap = \cap$		
All	\underline{V}, \wedge interchangeable	Same as for U, \cap interchangeable with the same caution.	$V = \vee, \wedge = \wedge$		
All	Multiple operations	<p><i>Recommended:</i> Write the operation sign as many times as you want; no special indication of mult. op. is necessary.</p> <p><i>Acceptable:</i> For multiple consecutive primes: R'</p> <p style="text-align: center;">↑ 4</p> <p><i>Unacceptable:</i> Writing the ' a huge number of times.</p>			
JS	Blank card wild	<p><i>Recommended:</i> Draw a “picture” of the blank card with the colors indicated, like this:</p> <div style="text-align: center; border: 1px solid black; padding: 5px; display: inline-block;"> <table style="border-collapse: collapse; margin: 0 auto;"> <tr><td style="padding: 2px 5px;">B</td></tr> <tr><td style="padding: 2px 5px;">G</td></tr> </table> </div> <p><i>Acceptable:</i> Blank = BG</p>	B	G	Blank card stays blank.
B					
G					