

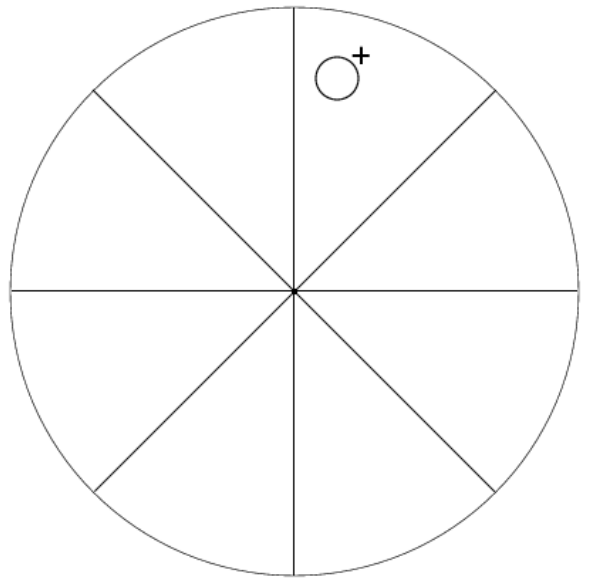
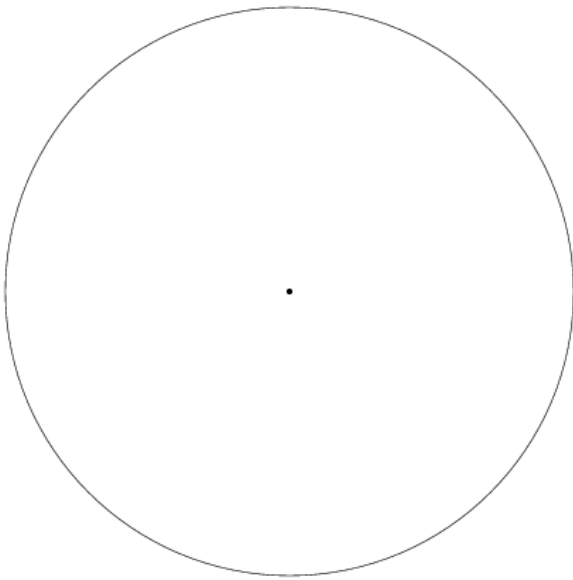
Stereographic symmetry and general position diagrams of the representative groups of the 343 types of spatio-temporal crystallographic point groups with time translations and time inversion

This document contains stereographic projections that show symmetry elements and general positions for all 343 listed space-time groups. A separate diagram for the elements and positions are drawn on each page. They are labeled below with the serial number of the group they are associated with that is assigned in the main listing.

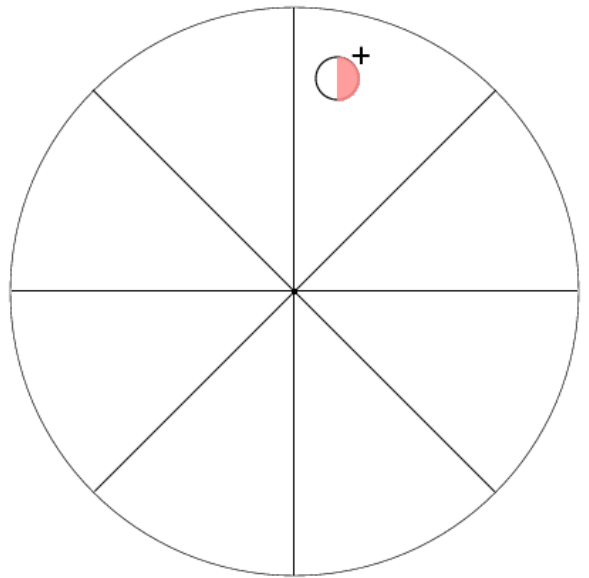
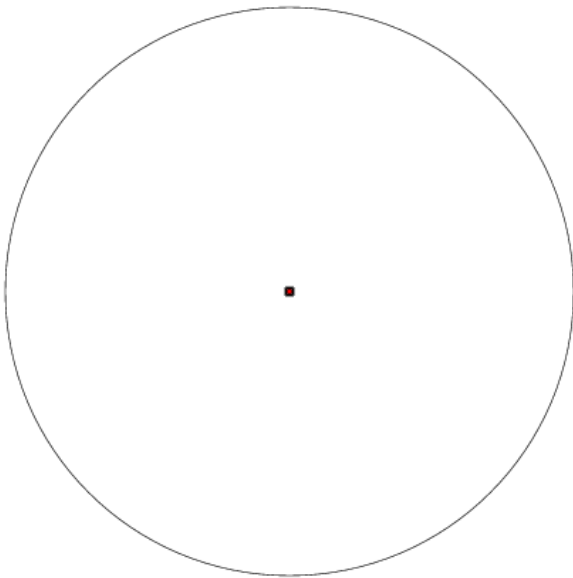
Anticlockwise is defined as the positive direction for axial rotations in all diagrams. For groups with three-fold and six-fold axial symmetry, the $[100]$ axis makes an angle of $-\pi/6$ with the in-plane horizontal direction. For all other groups, the $[100]$ axis is taken to be in the in-plane horizontal direction. The $[001]$ axis is taken to be in the out-of-plane direction for all groups.

Time reversal is indicated in the element and position diagrams through a red coloring of the element symbol and position marker respectively. Time translation is indicated by a blue fraction on all diagrams, with a “+” or “-” superscript on the position diagrams to indicate whether it is associated with the point above or below the plane. It should be noted that only right-handed rotations and their associated time translations are shown on the element diagrams. For symbols in the center of the diagram, time translations are plotted above the element diagram next to the symbol to avoid clutter. Furthermore, for groups where there is an equivalent element with time reversal for every operation (gray groups), element symbols are colored with both black and red.

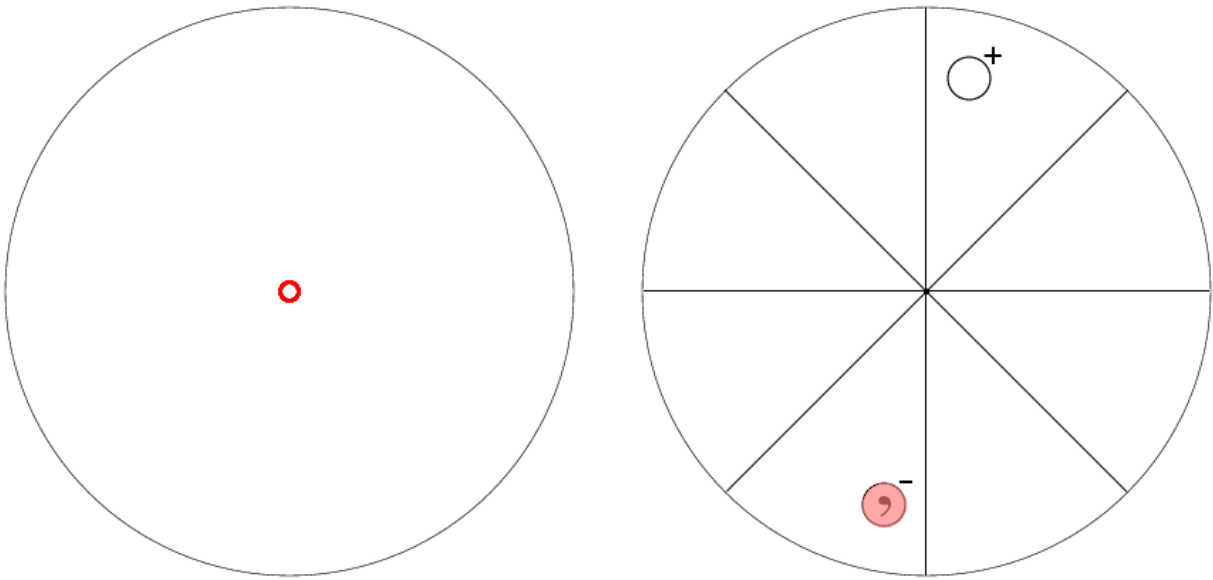
We would like to thank Jeremy Karl Cockcroft for giving permission to modify and use the stereographic projections from his online course on powder diffraction (Attfield 1997).



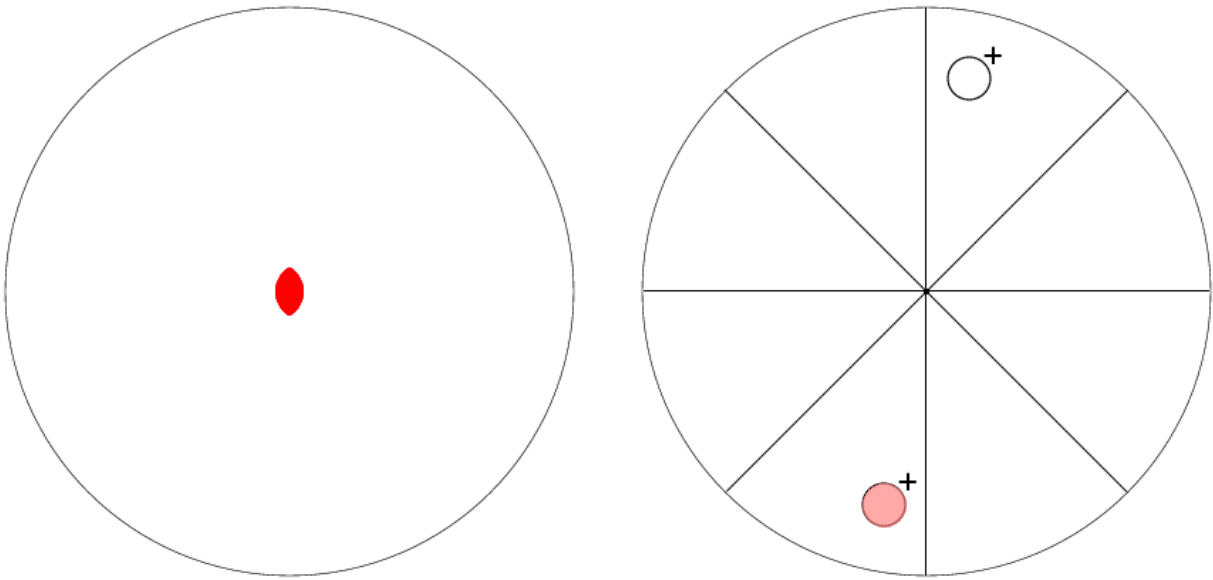
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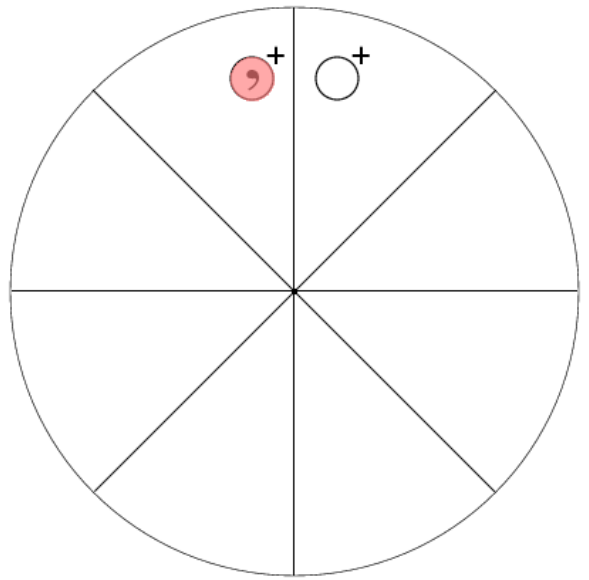
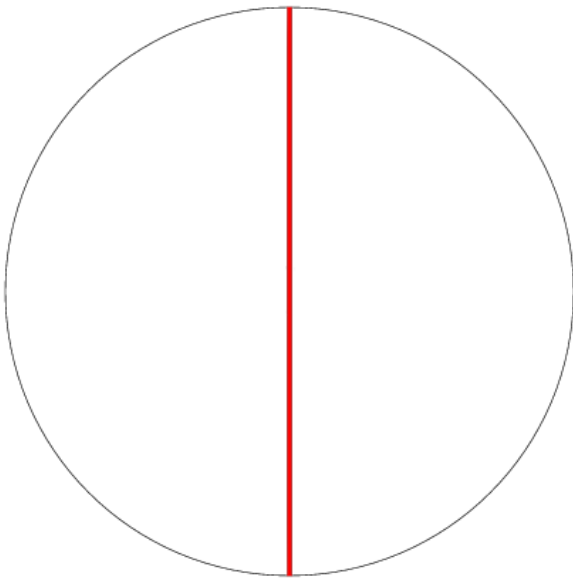
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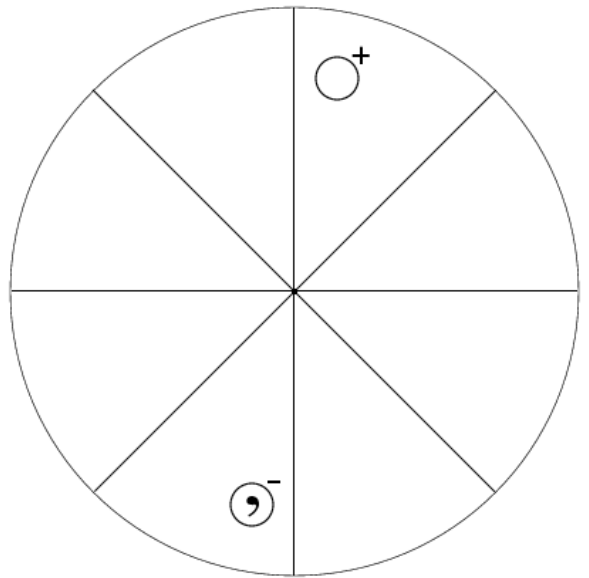
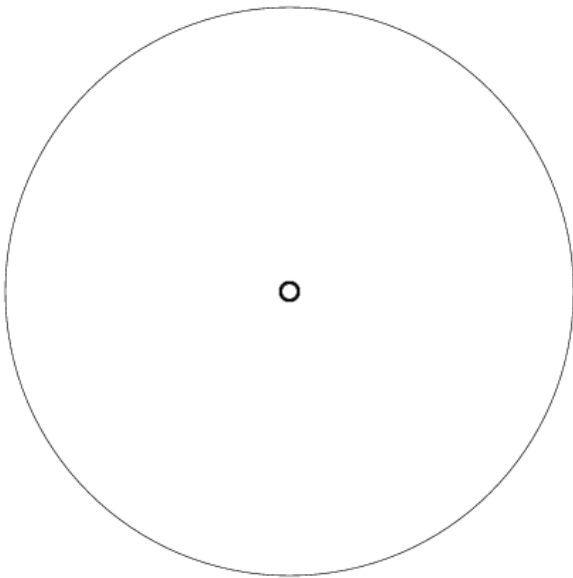
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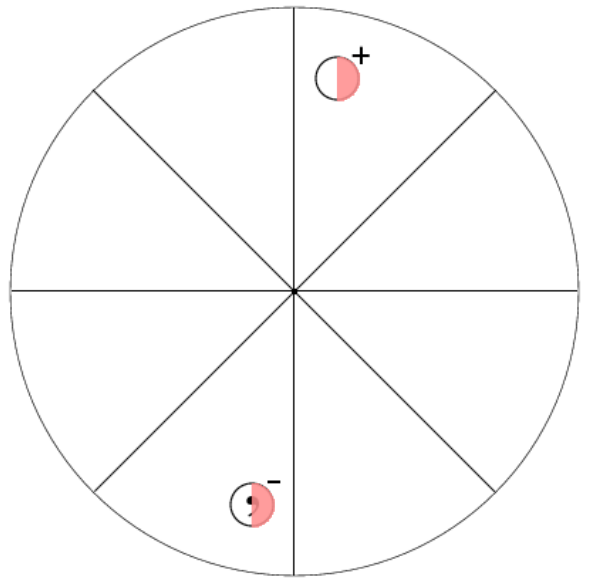
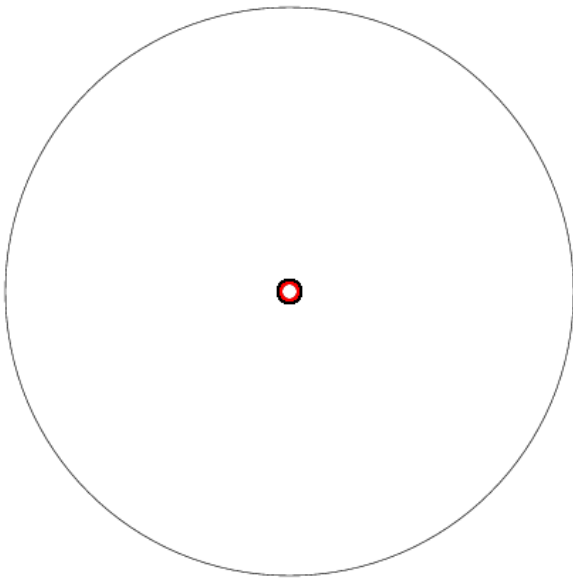
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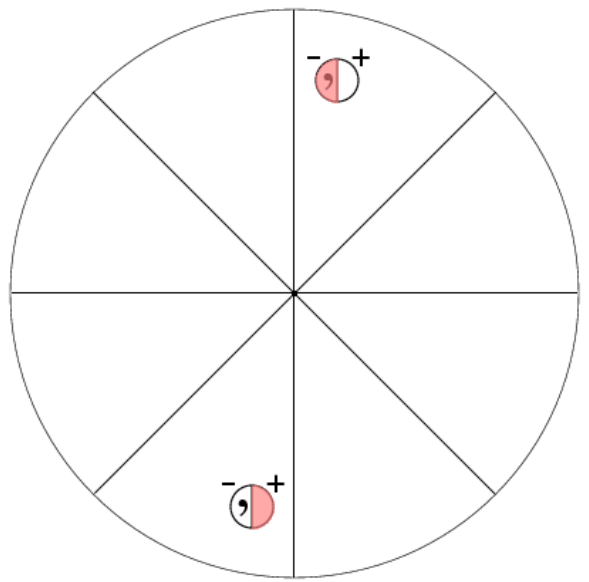
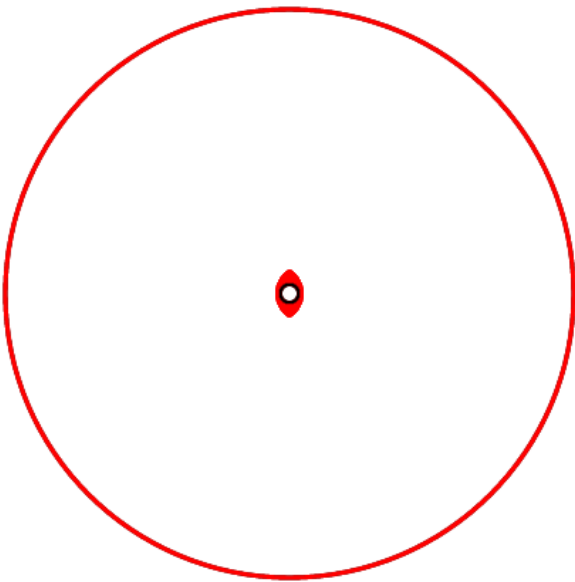
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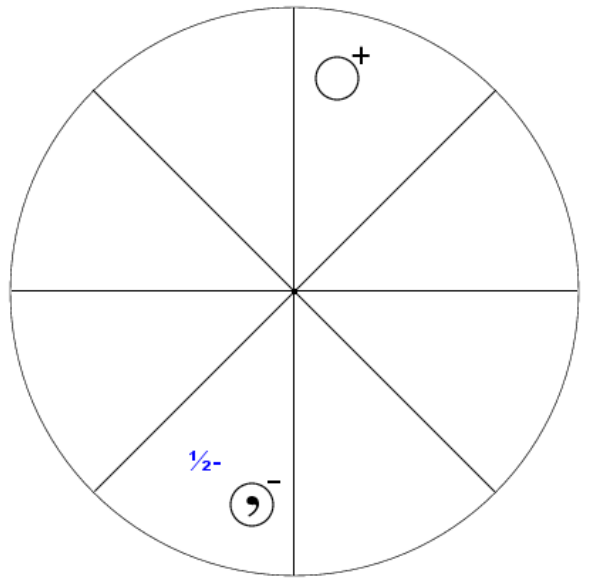
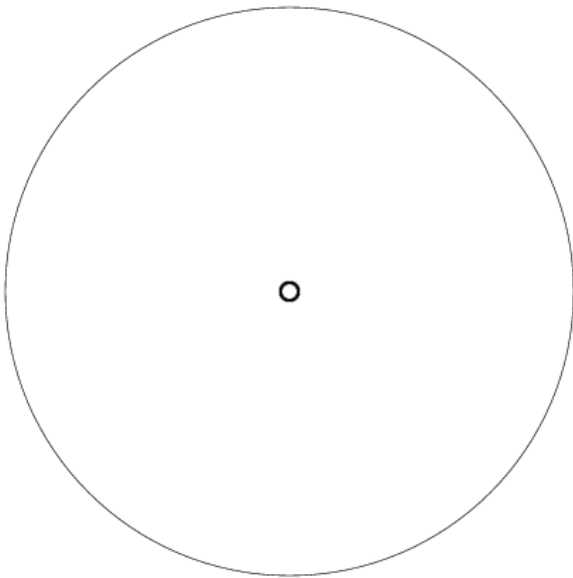


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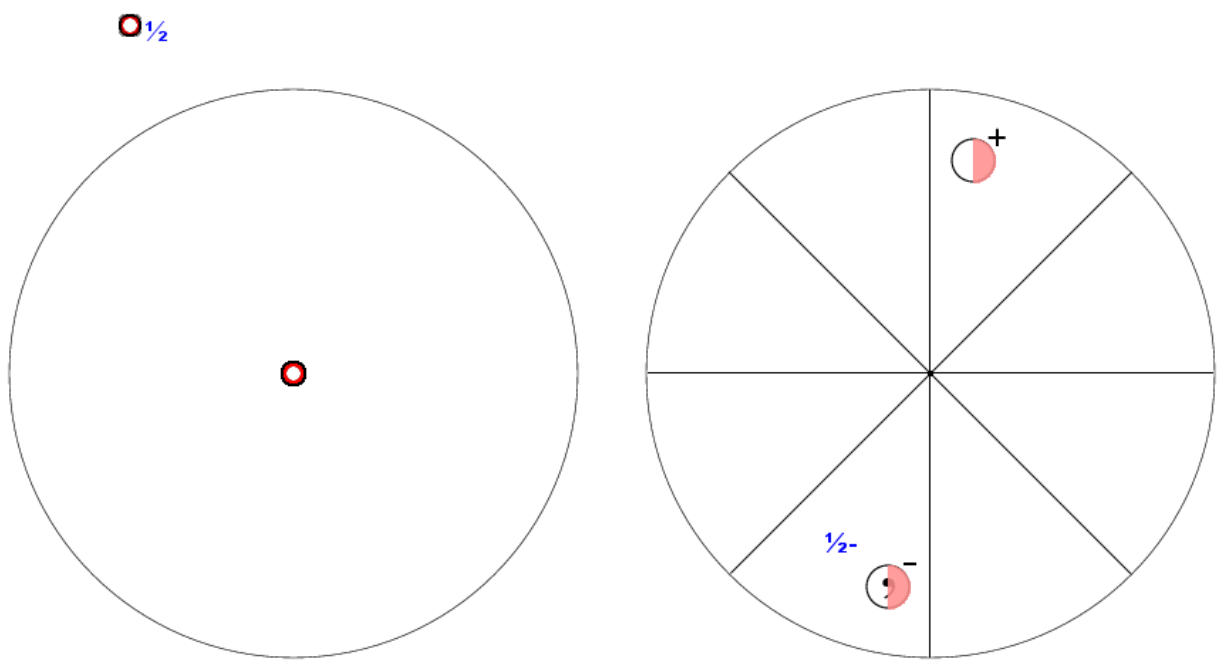


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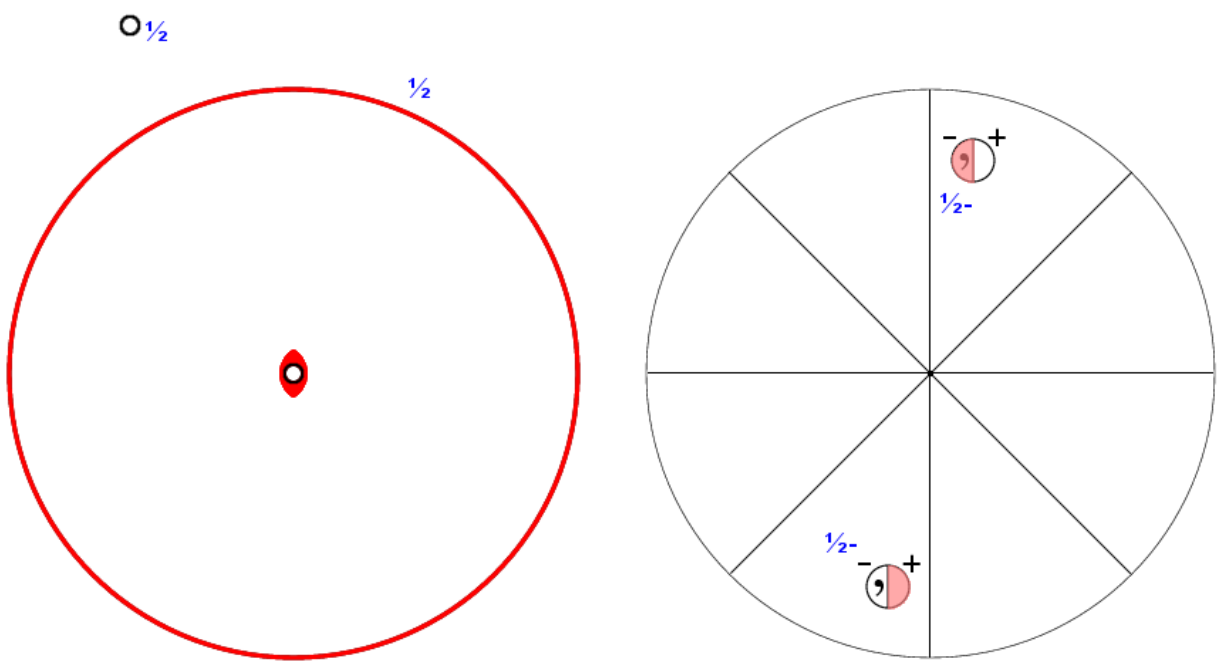
$\circ \frac{1}{2}$



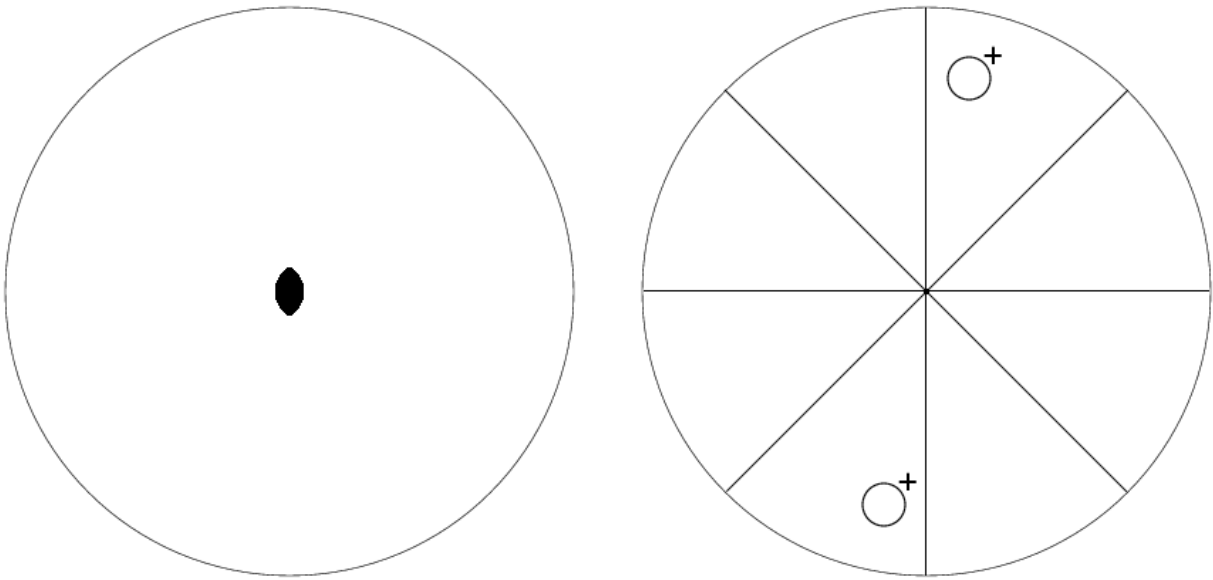
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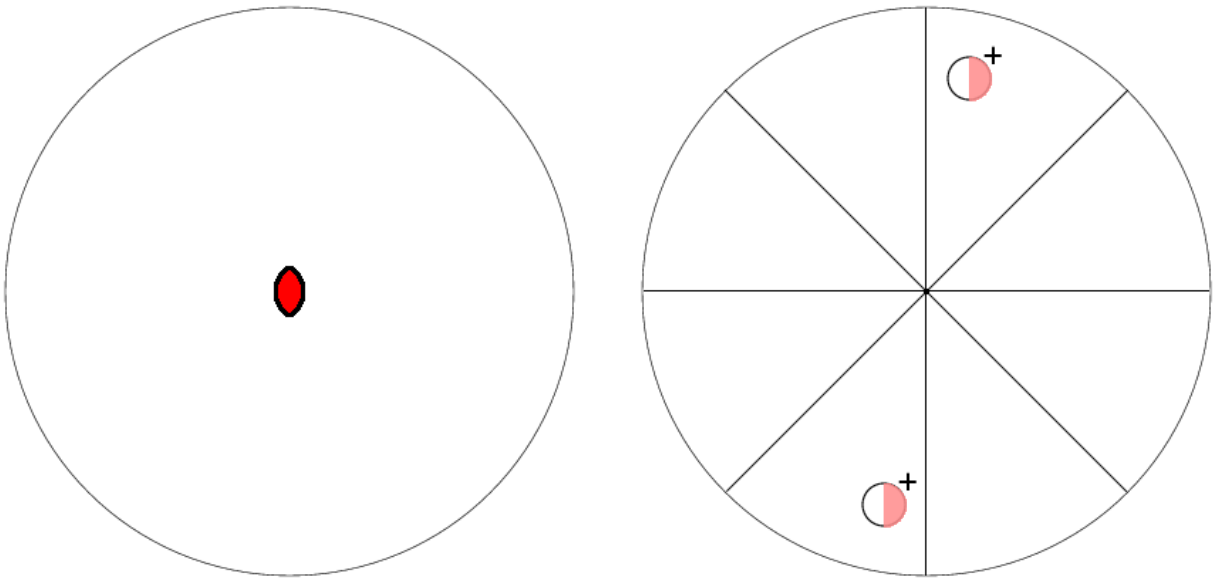
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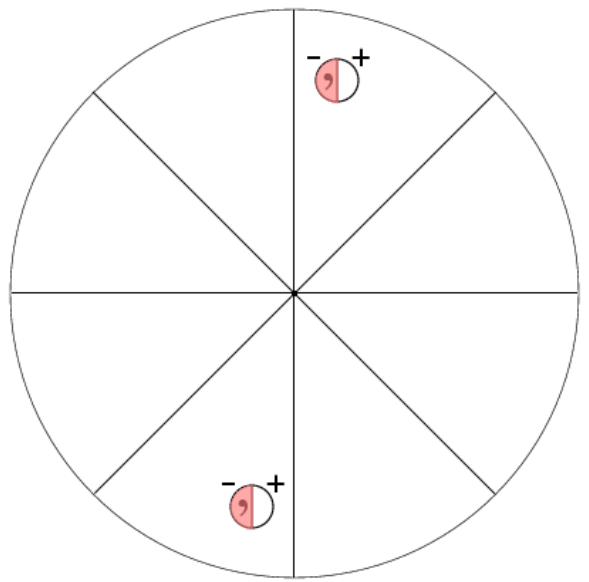
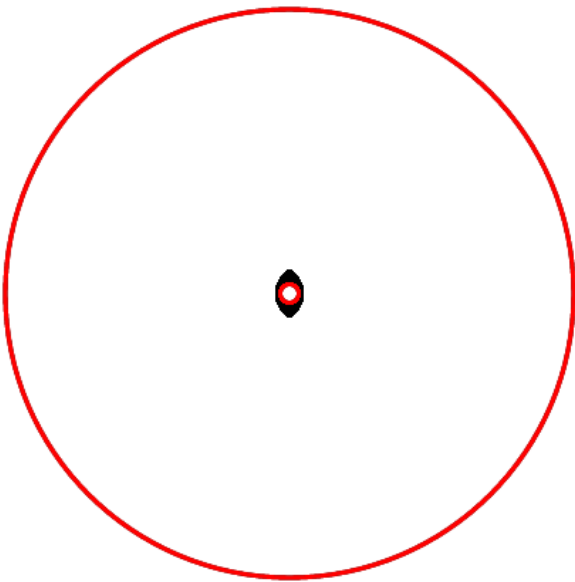
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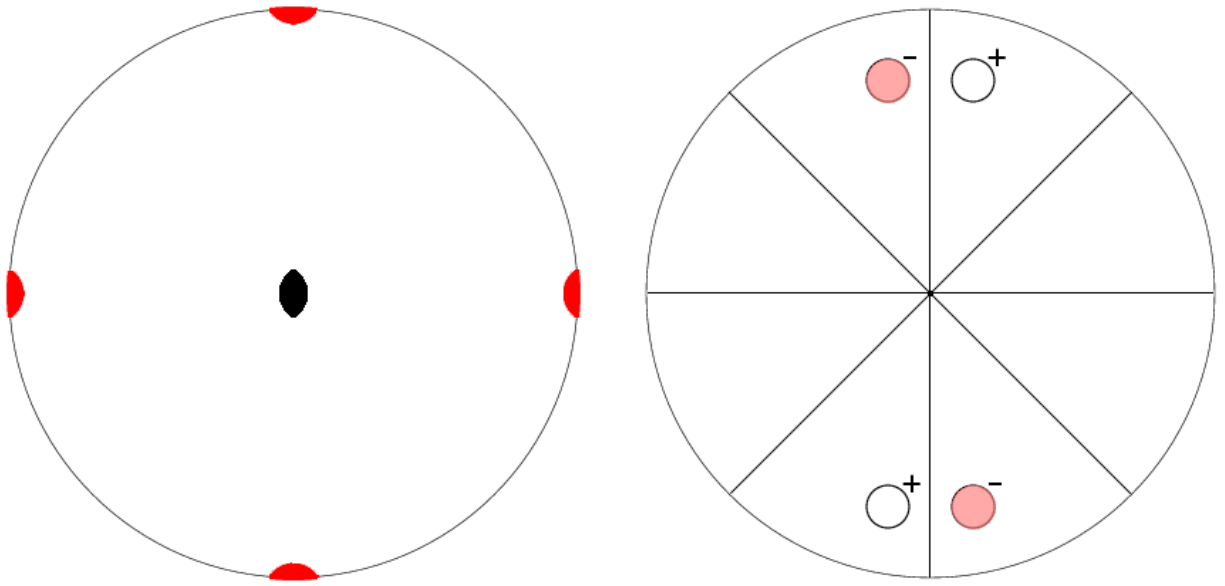
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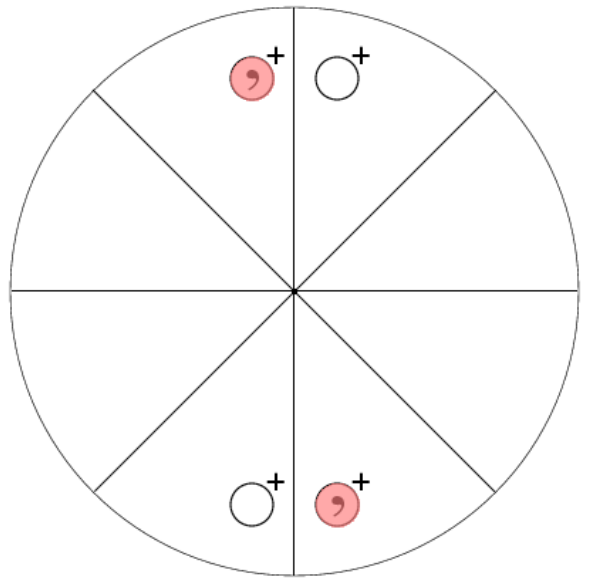
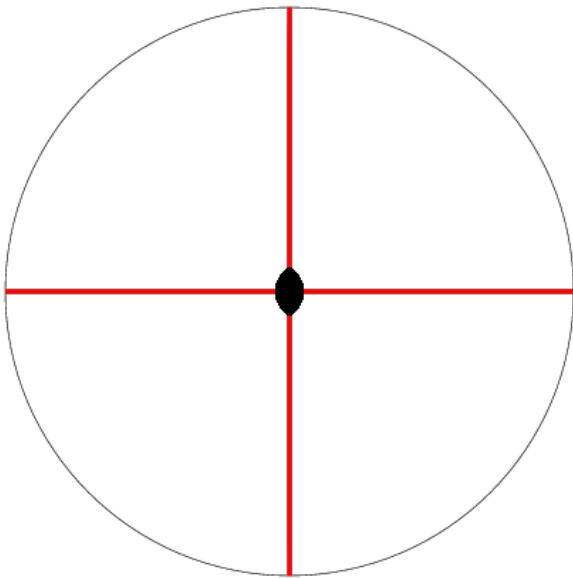
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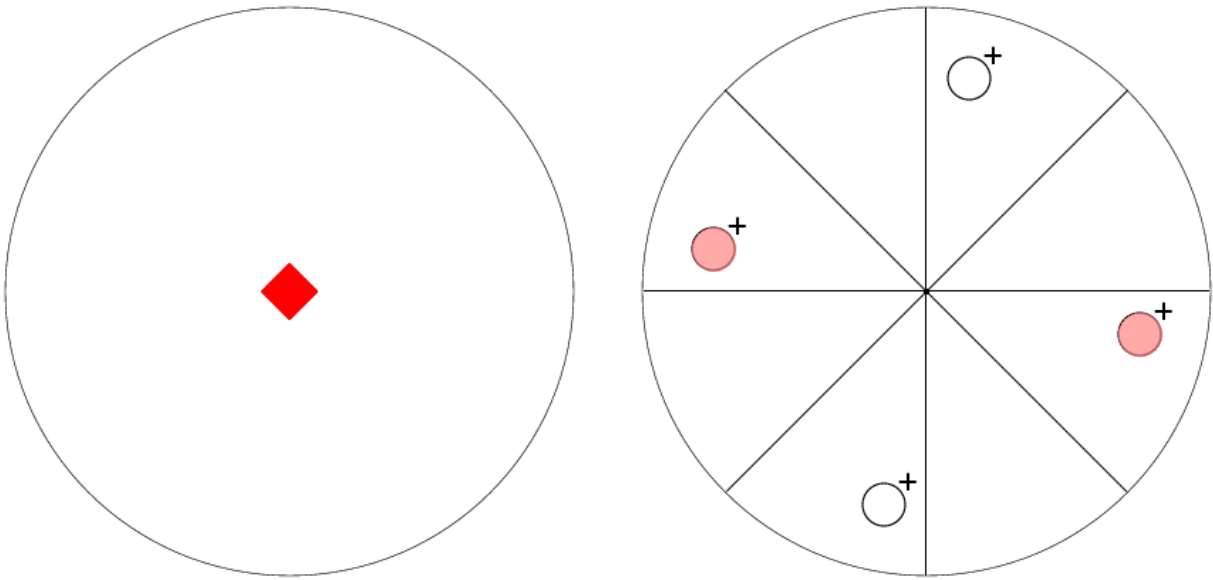
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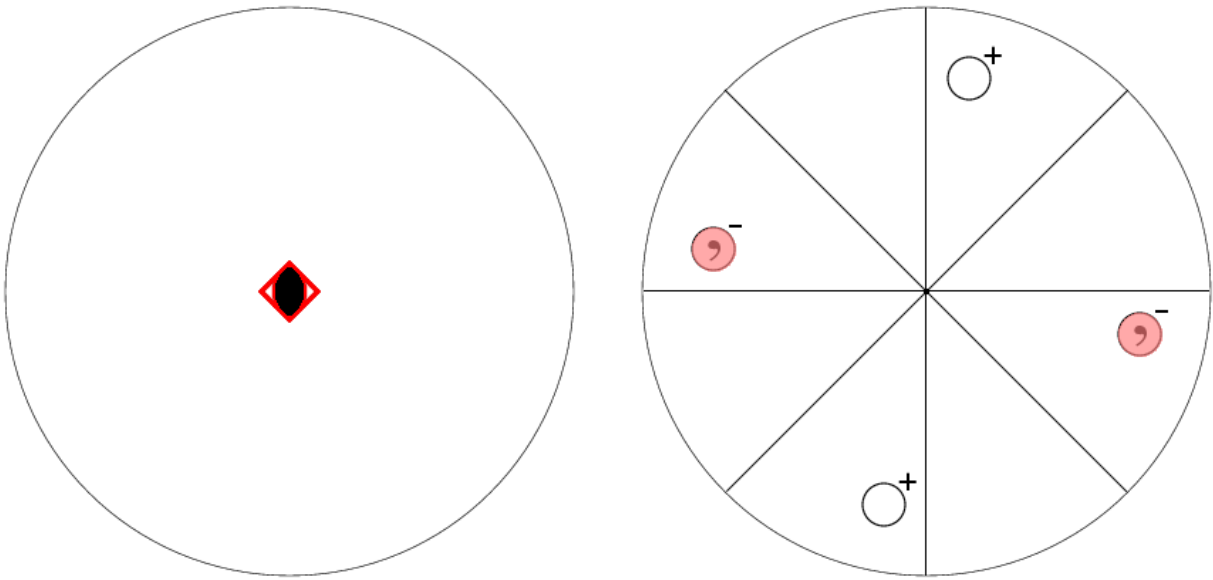
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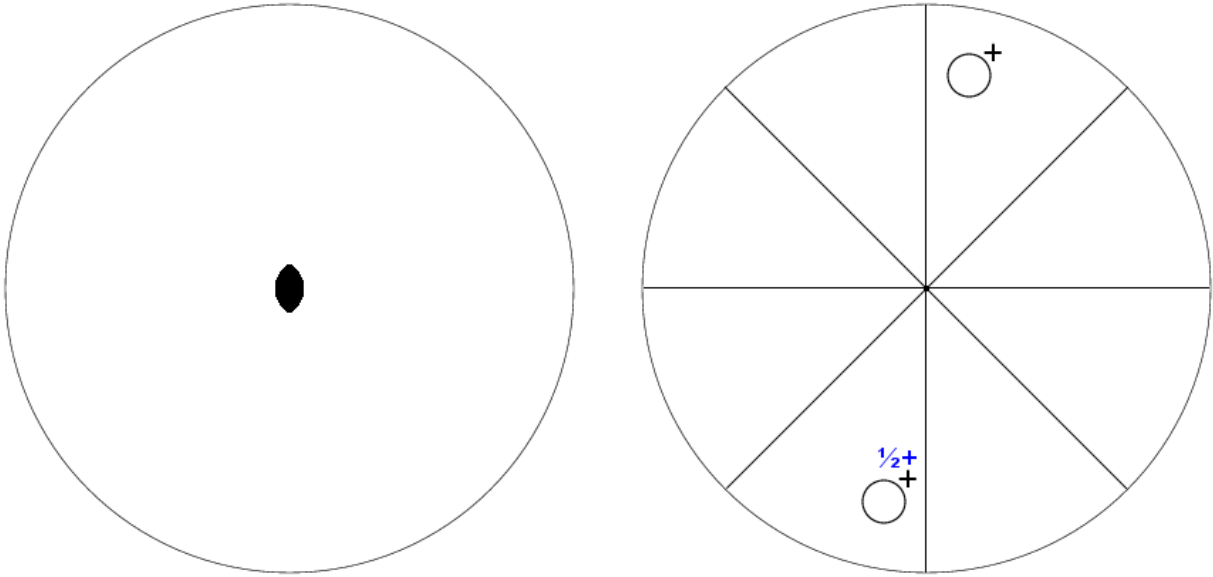
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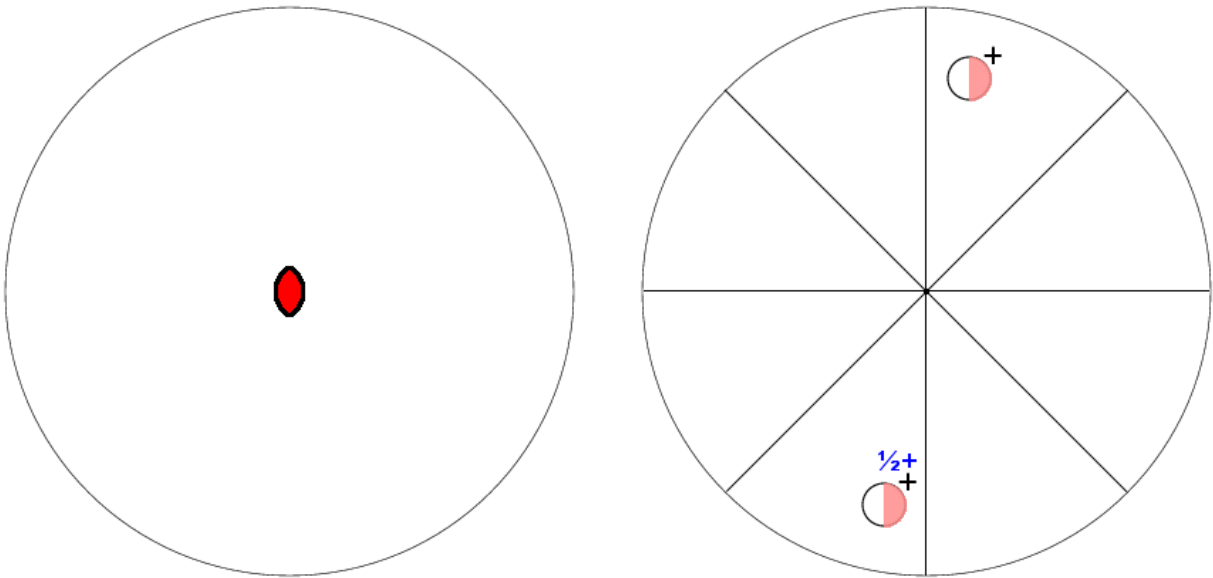
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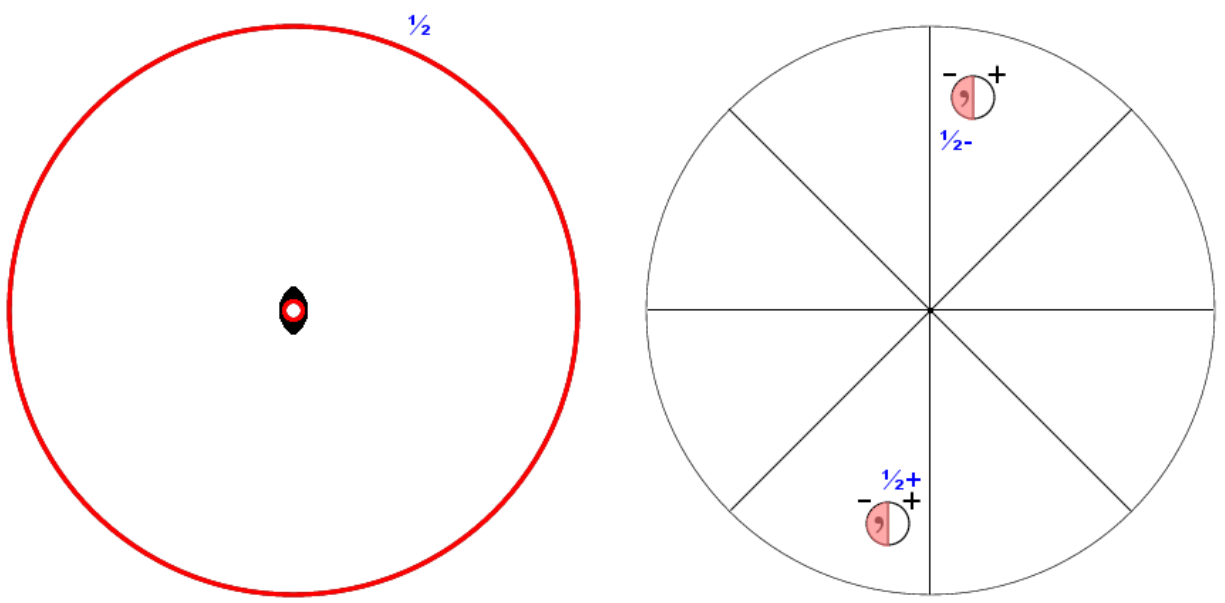
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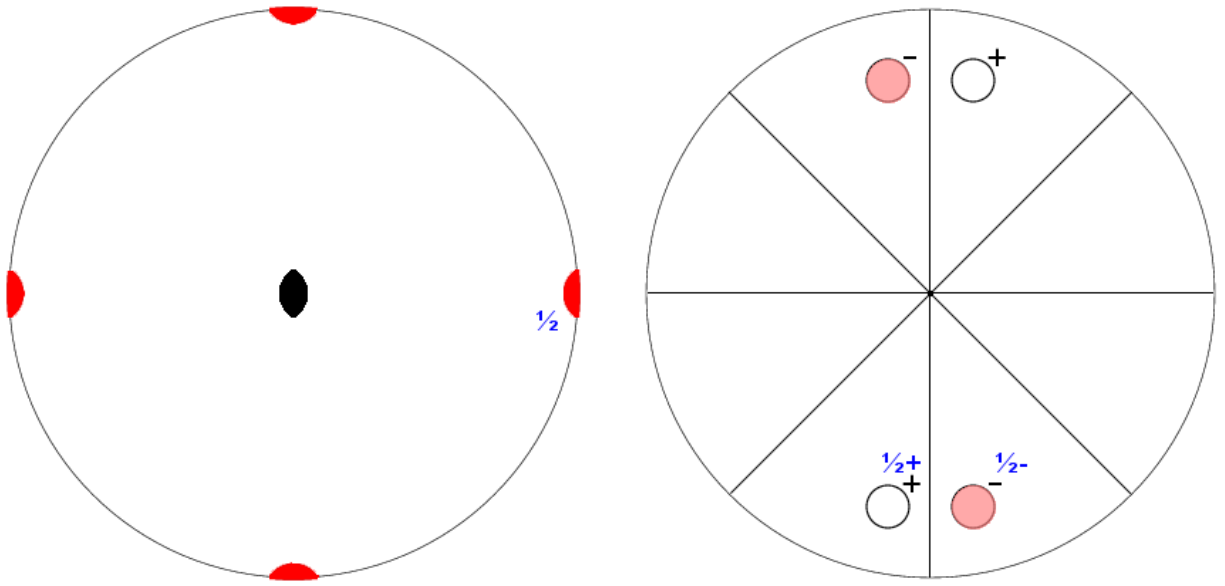
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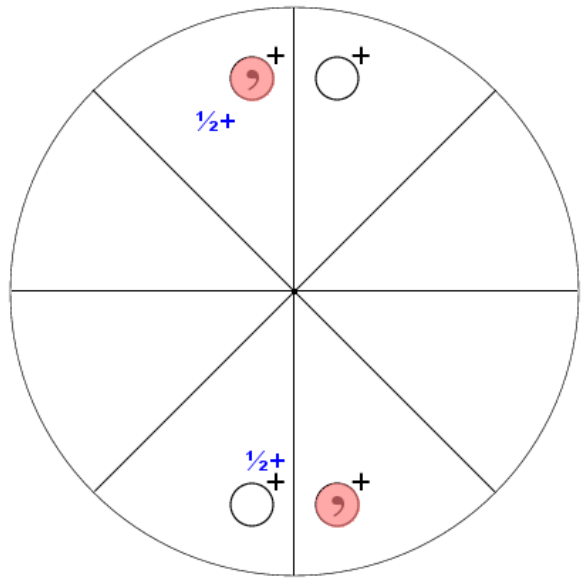
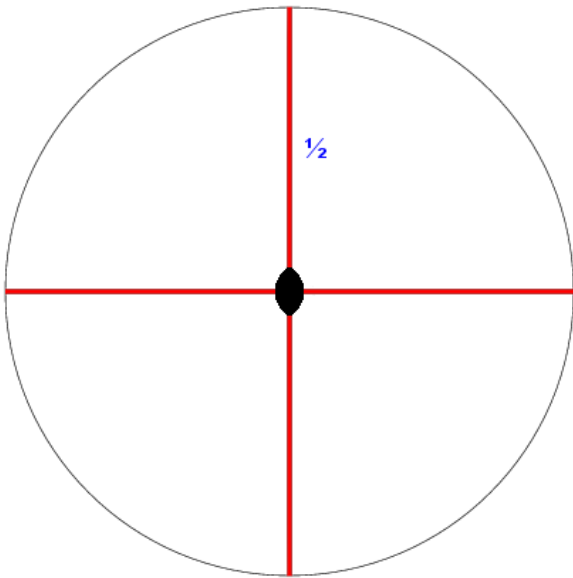
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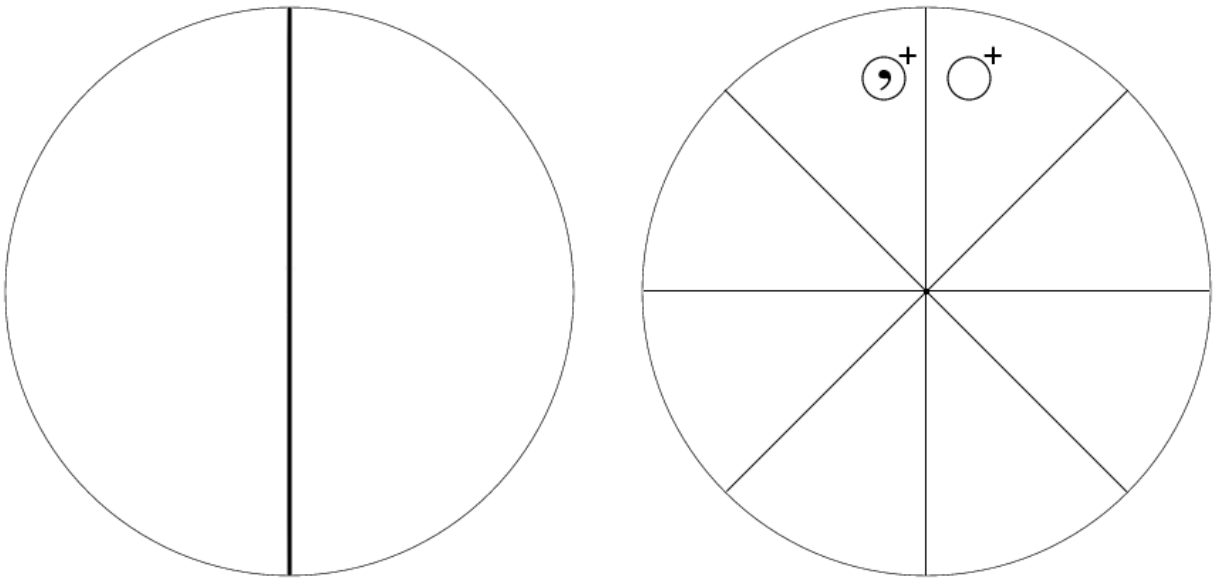
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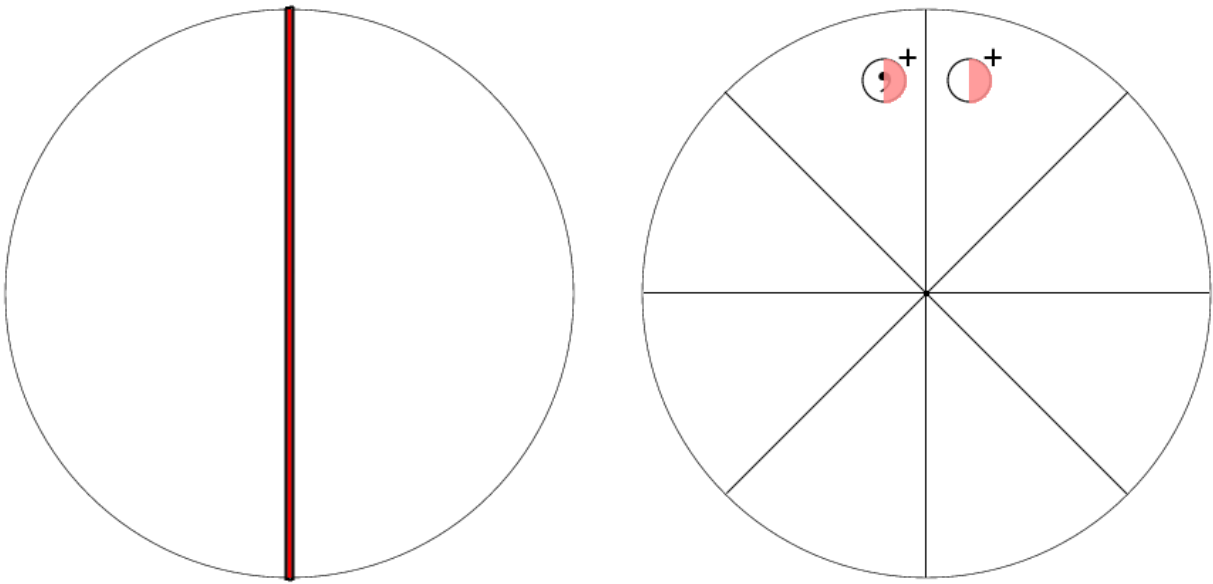
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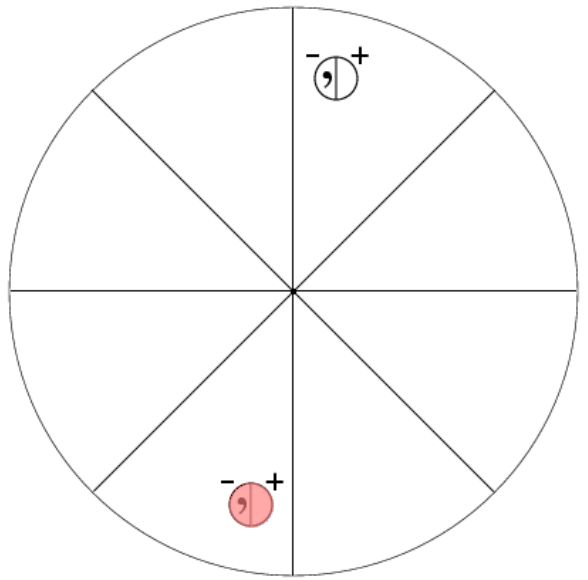
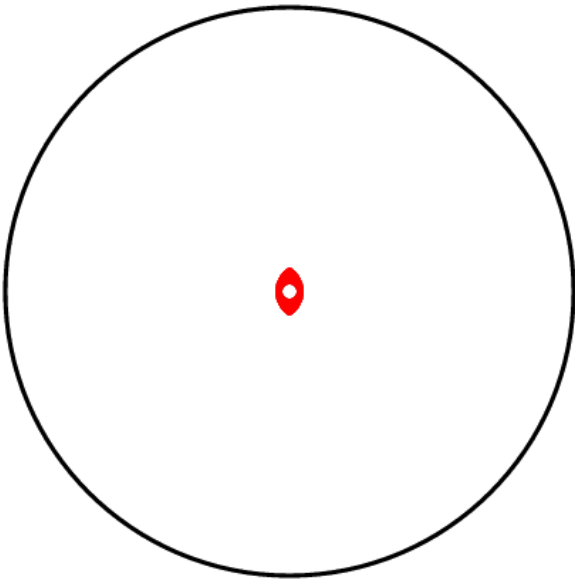
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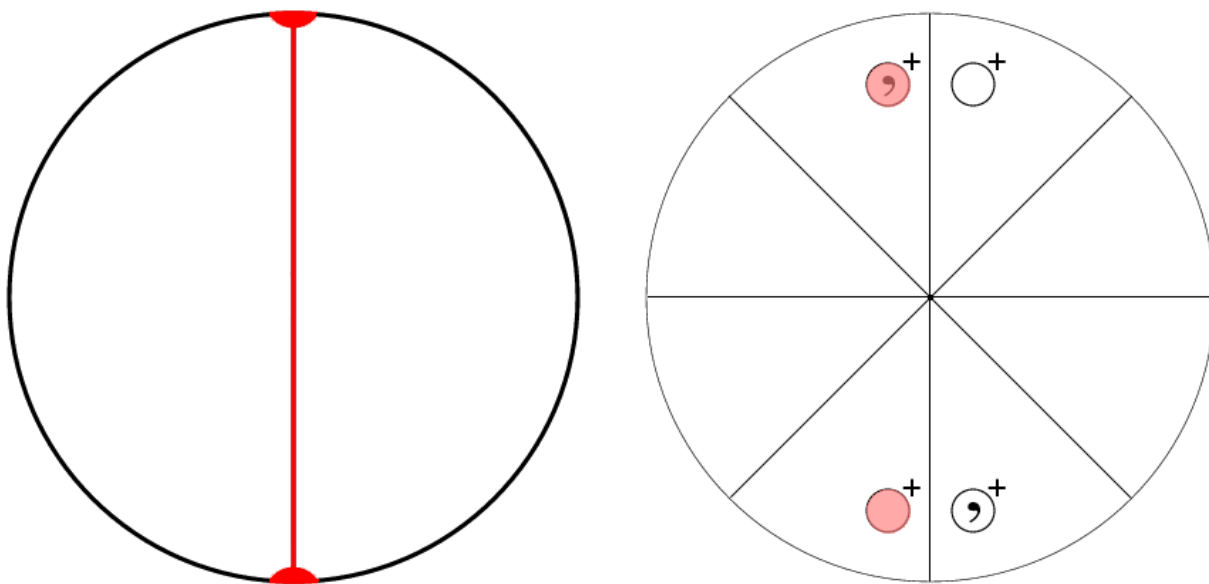
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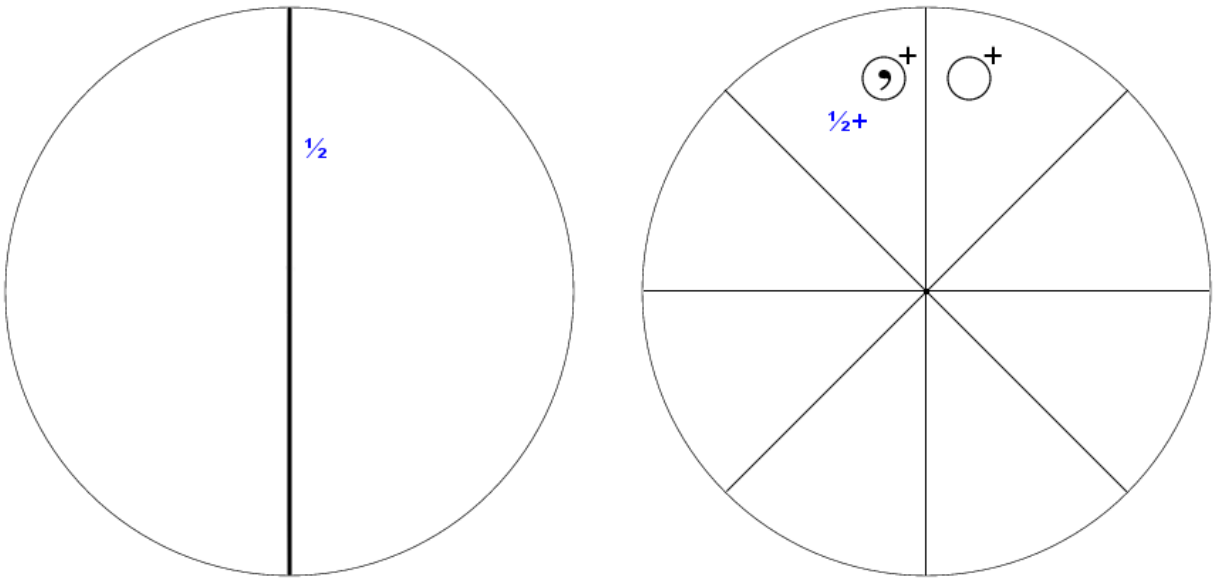
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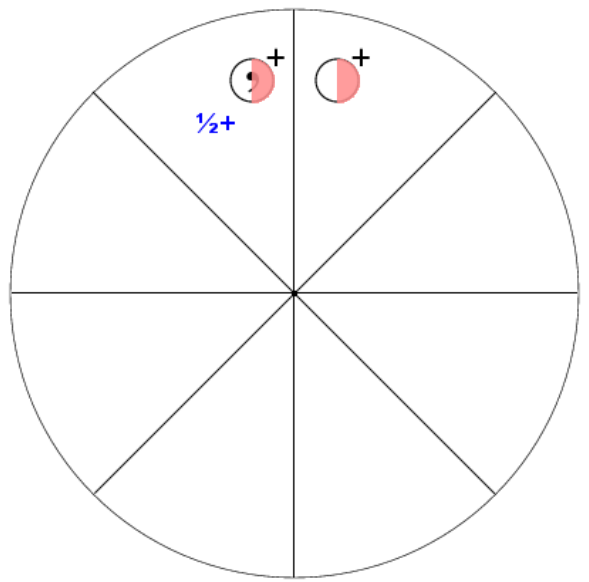
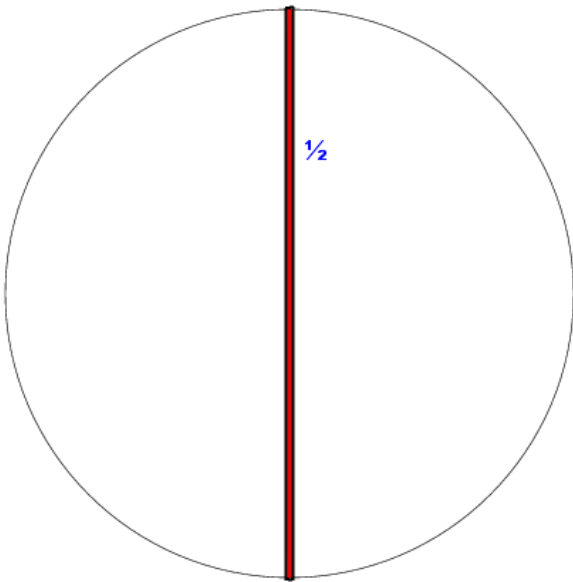
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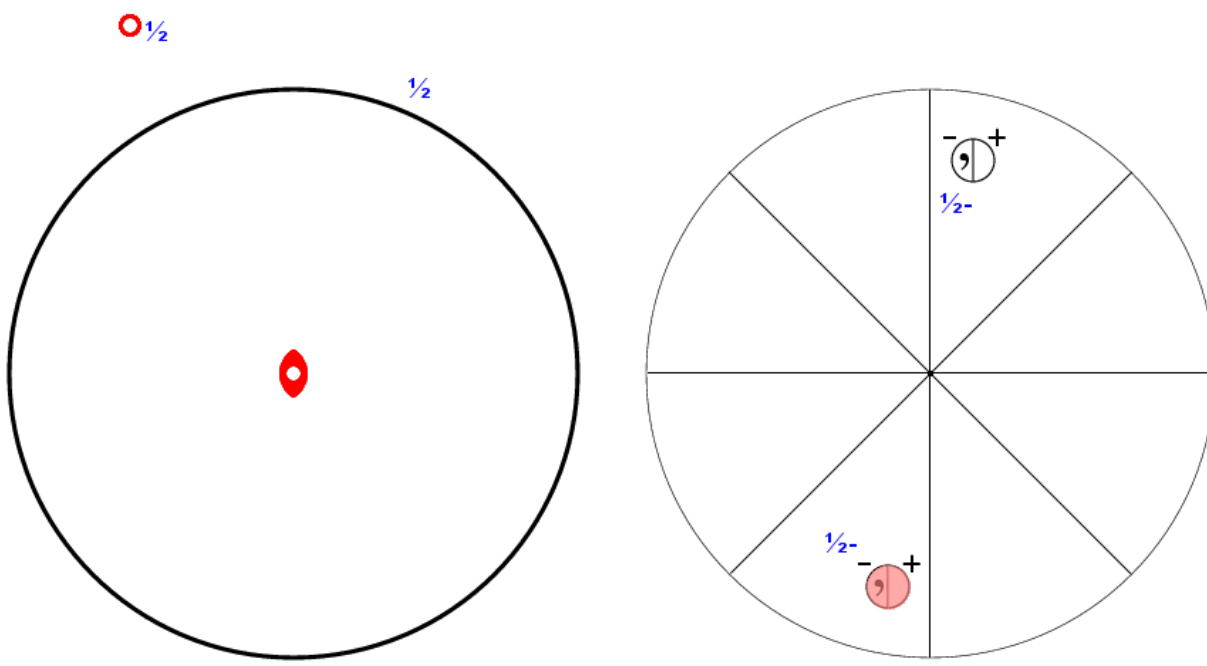
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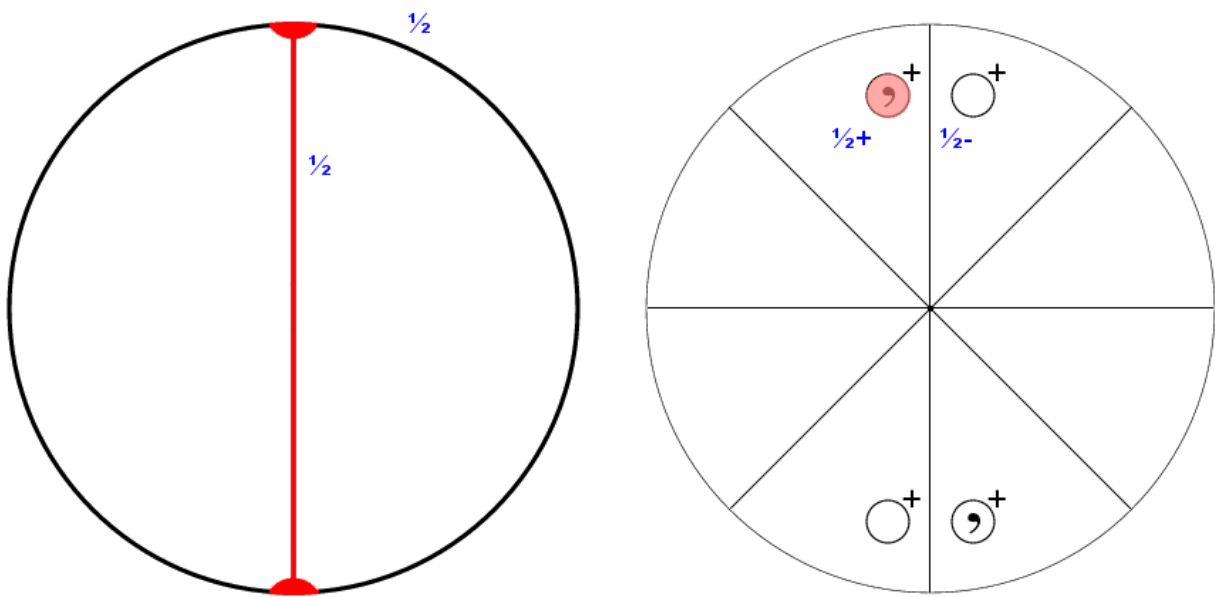
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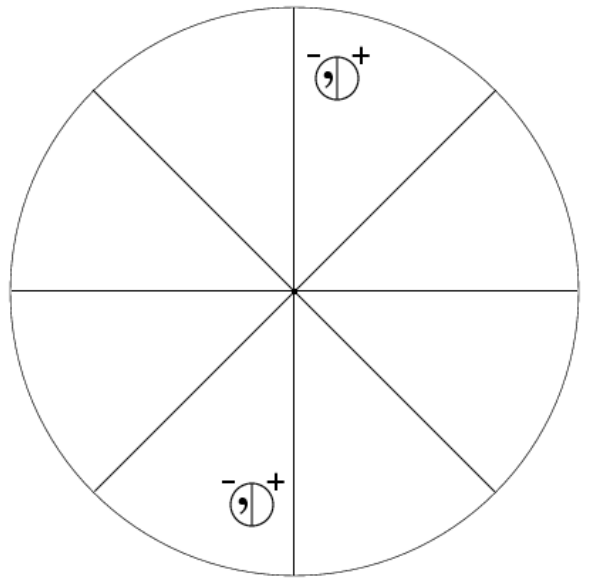
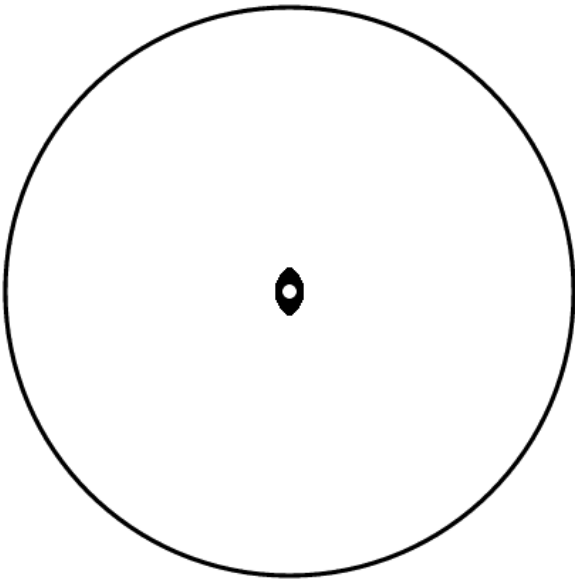
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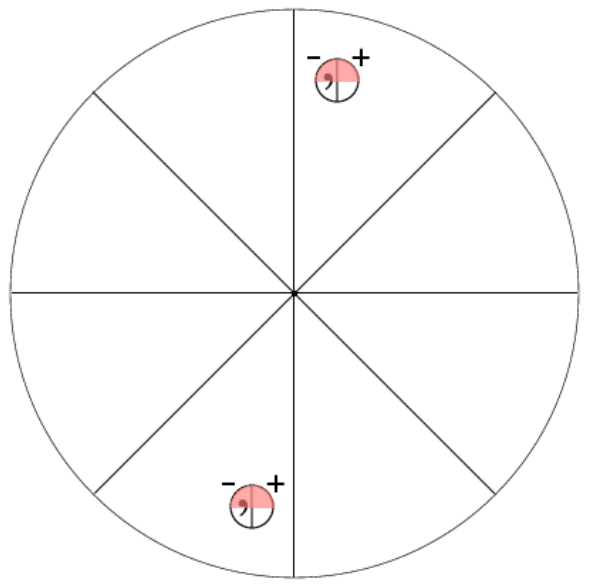
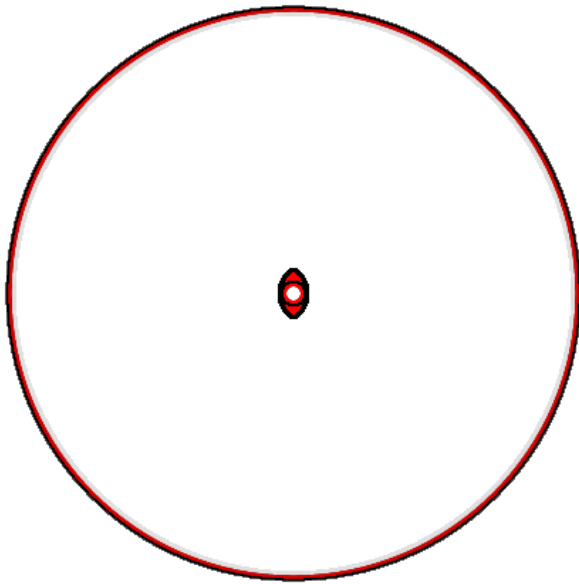
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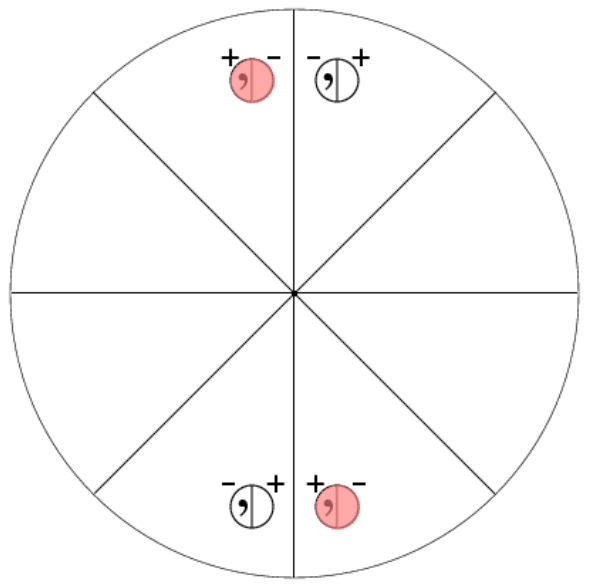
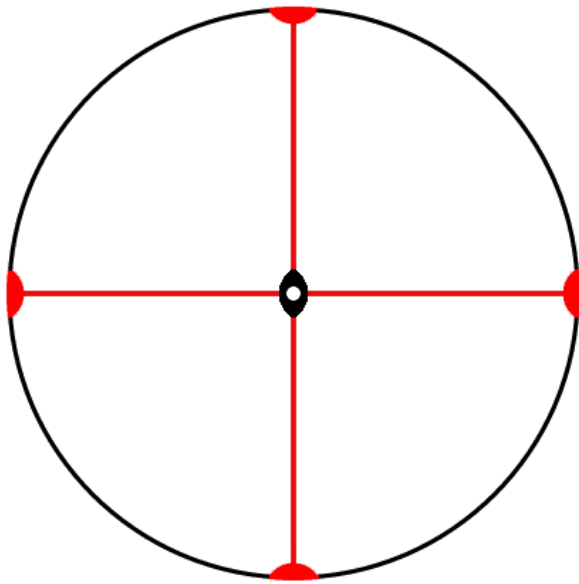
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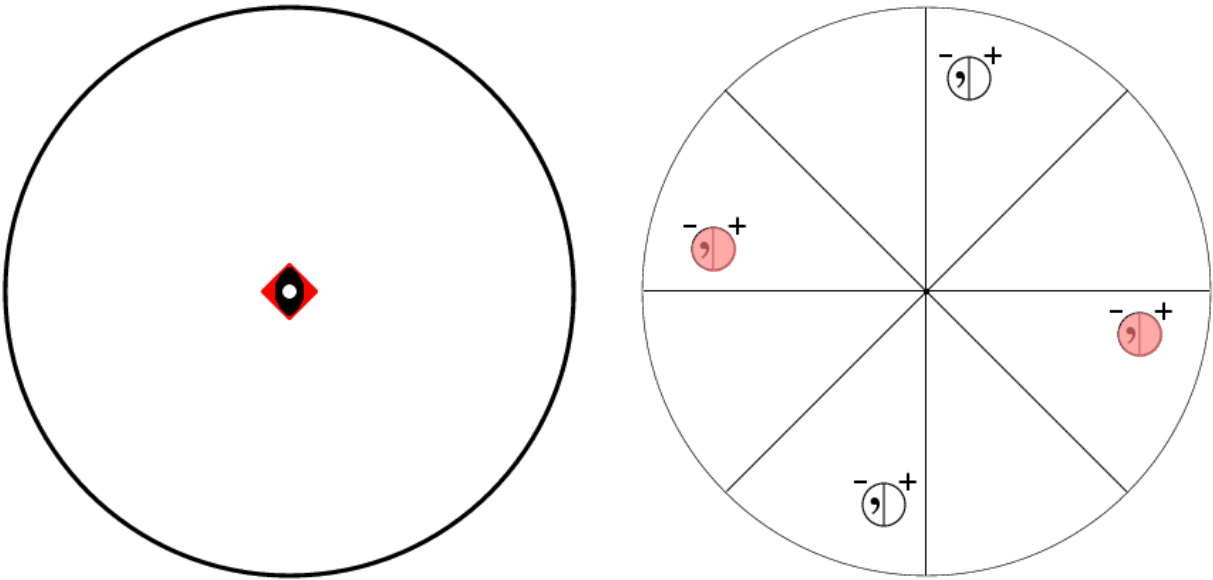
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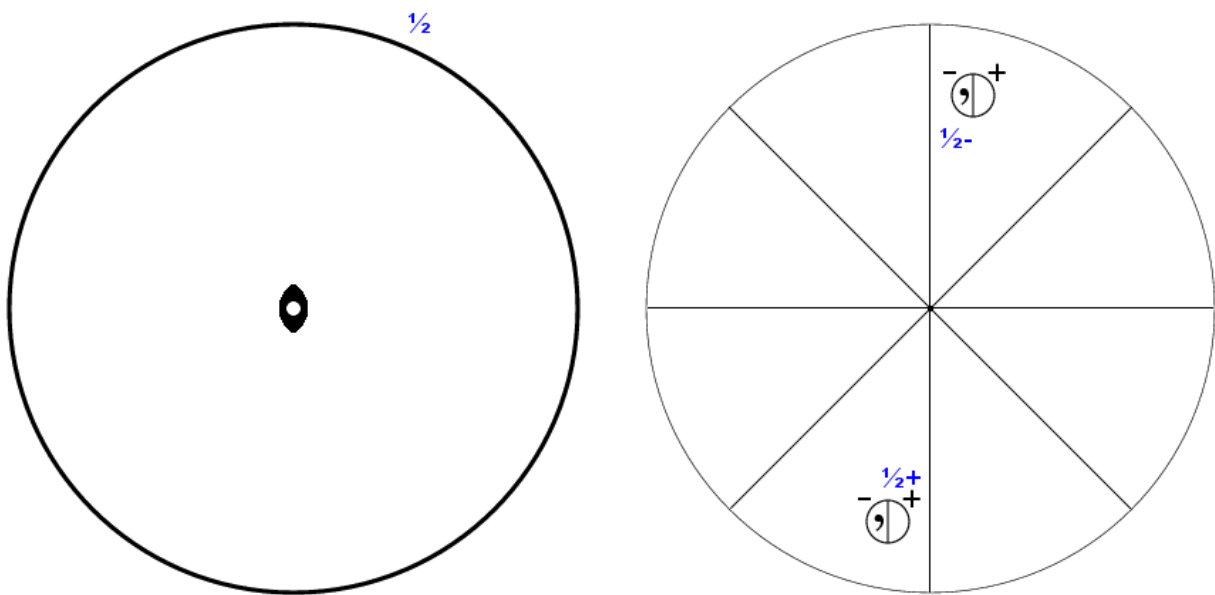
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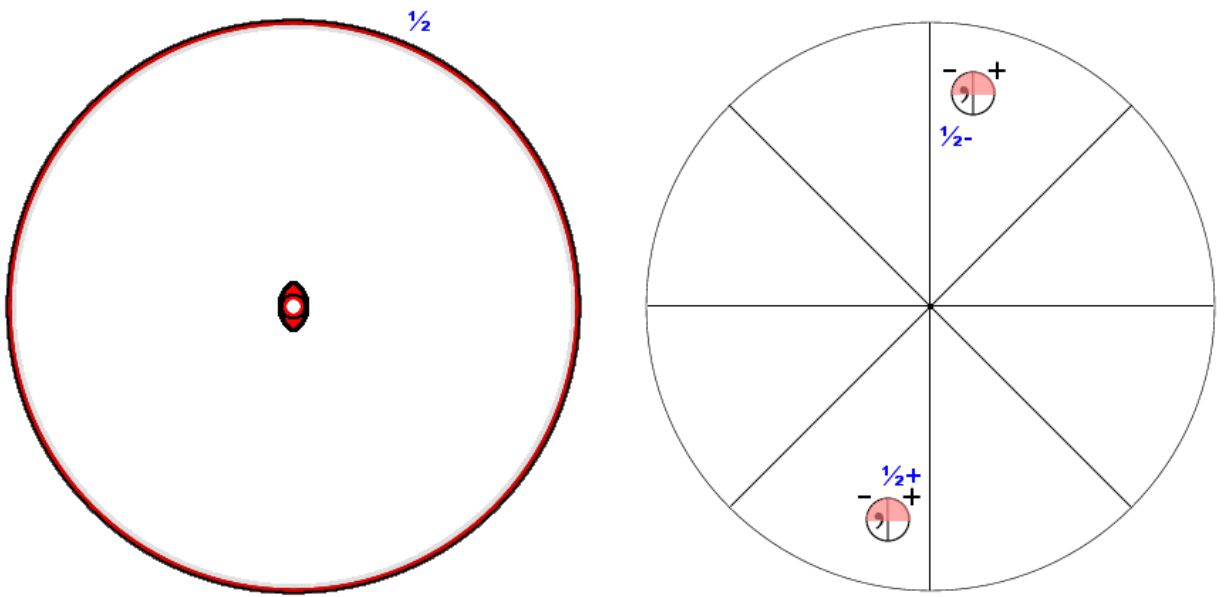
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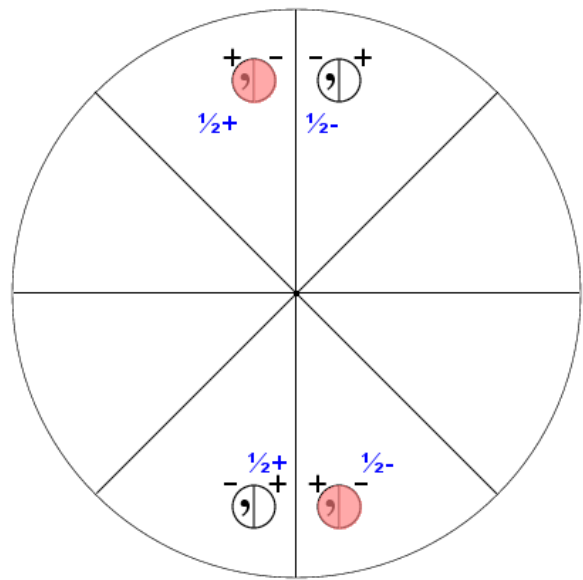
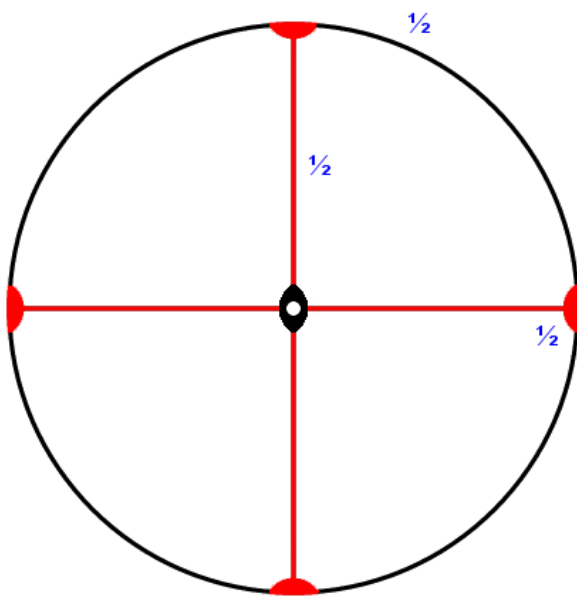
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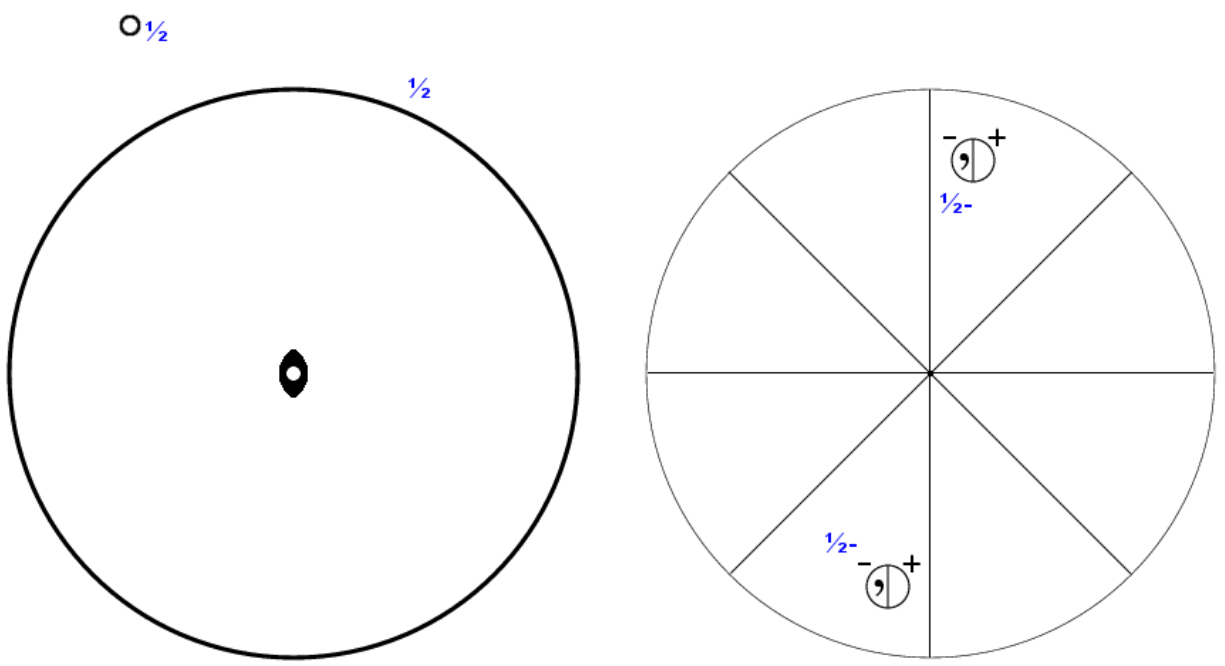
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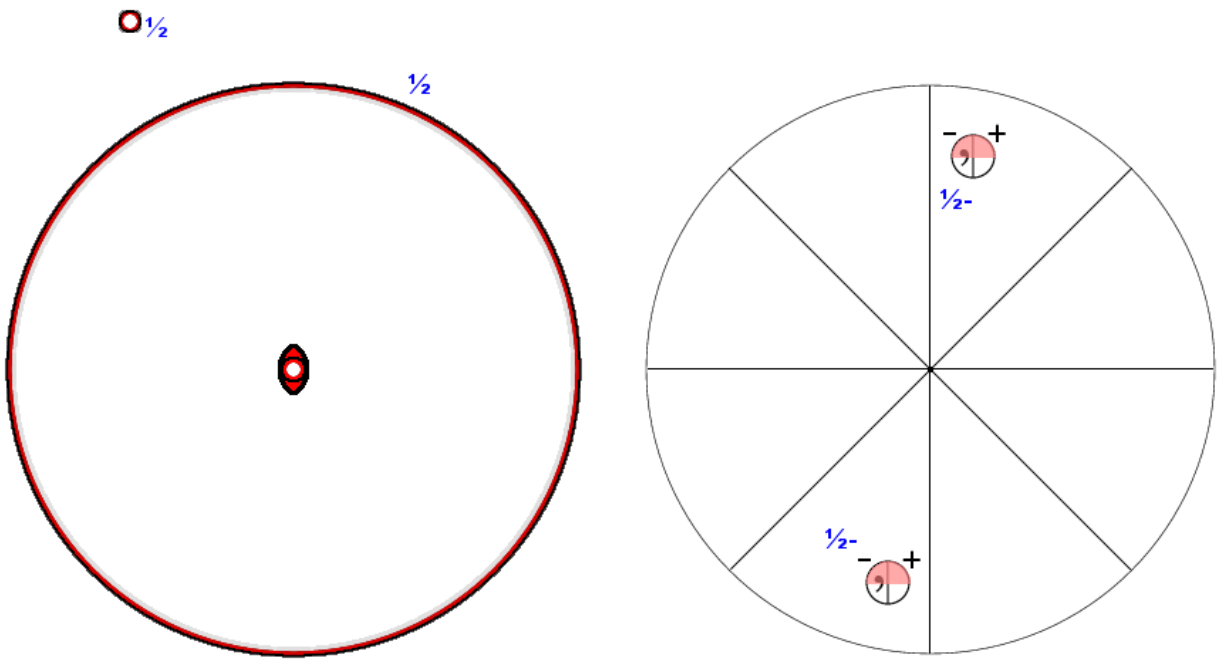
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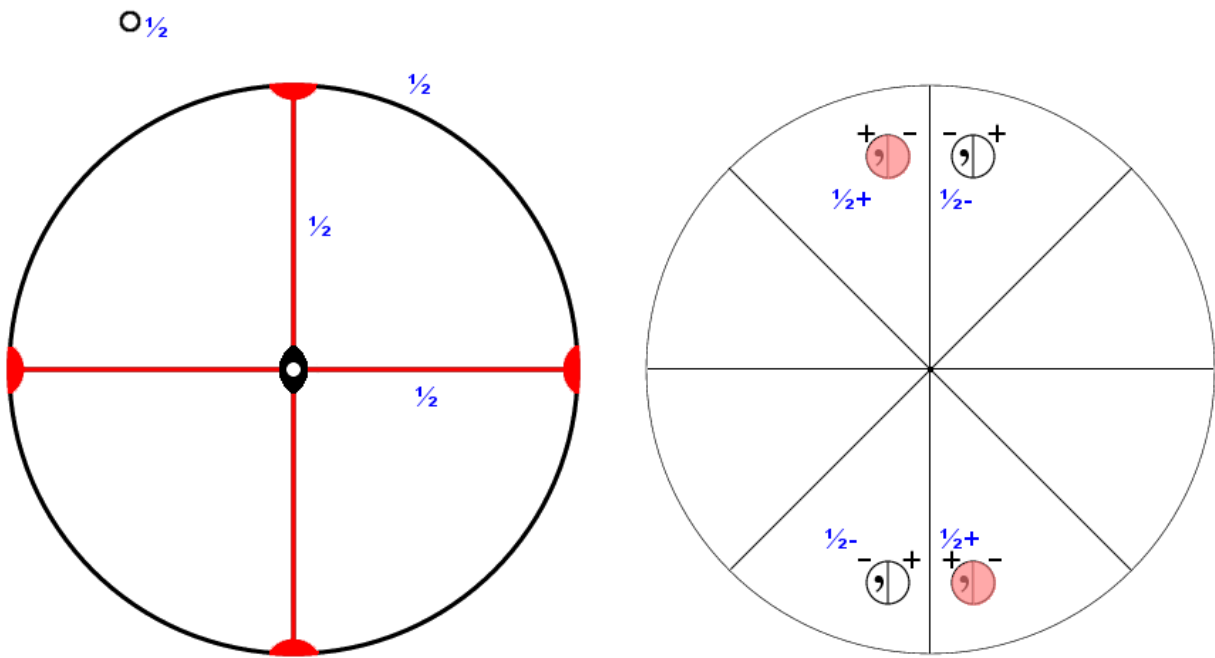
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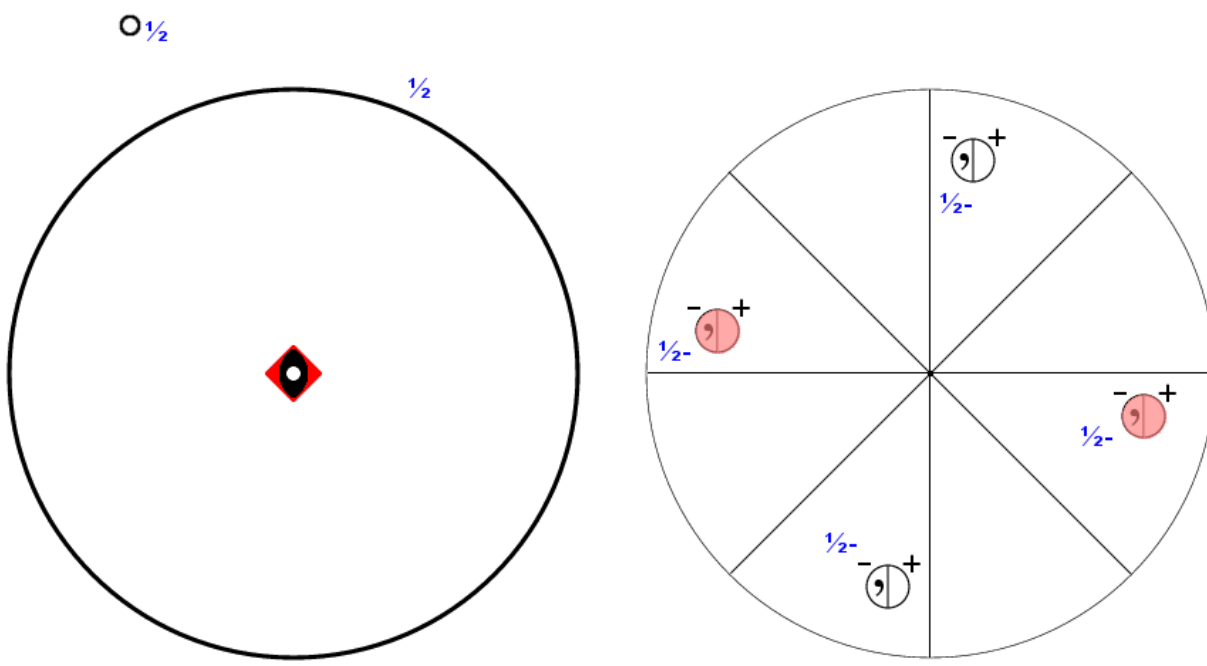
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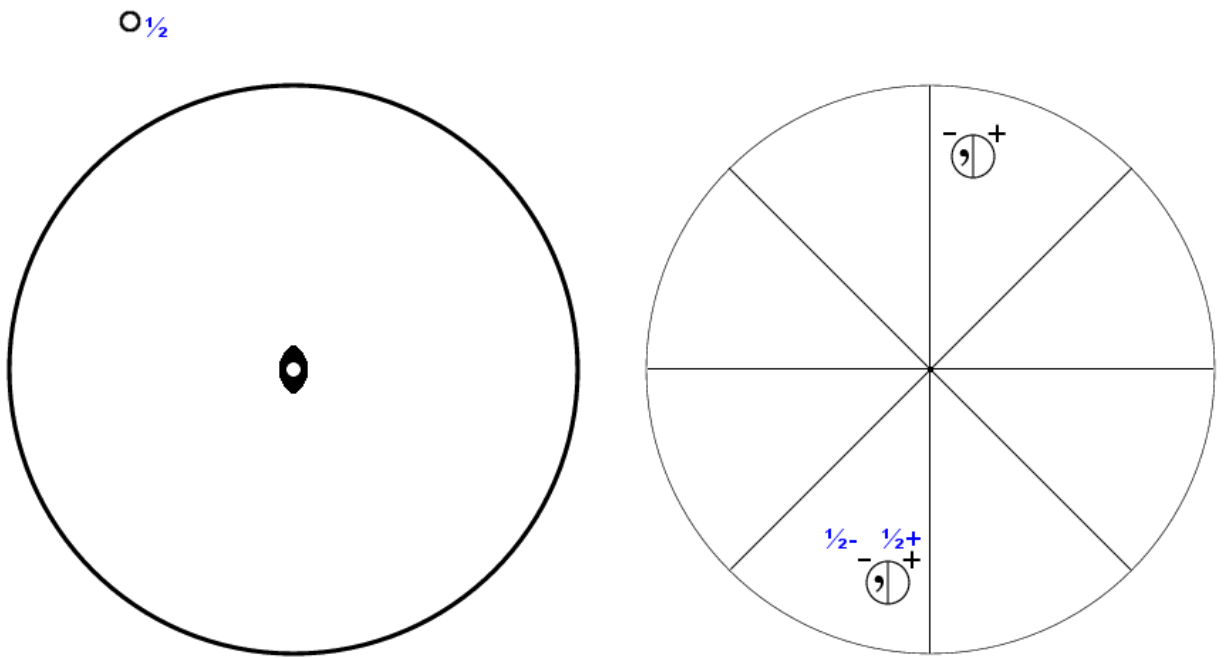
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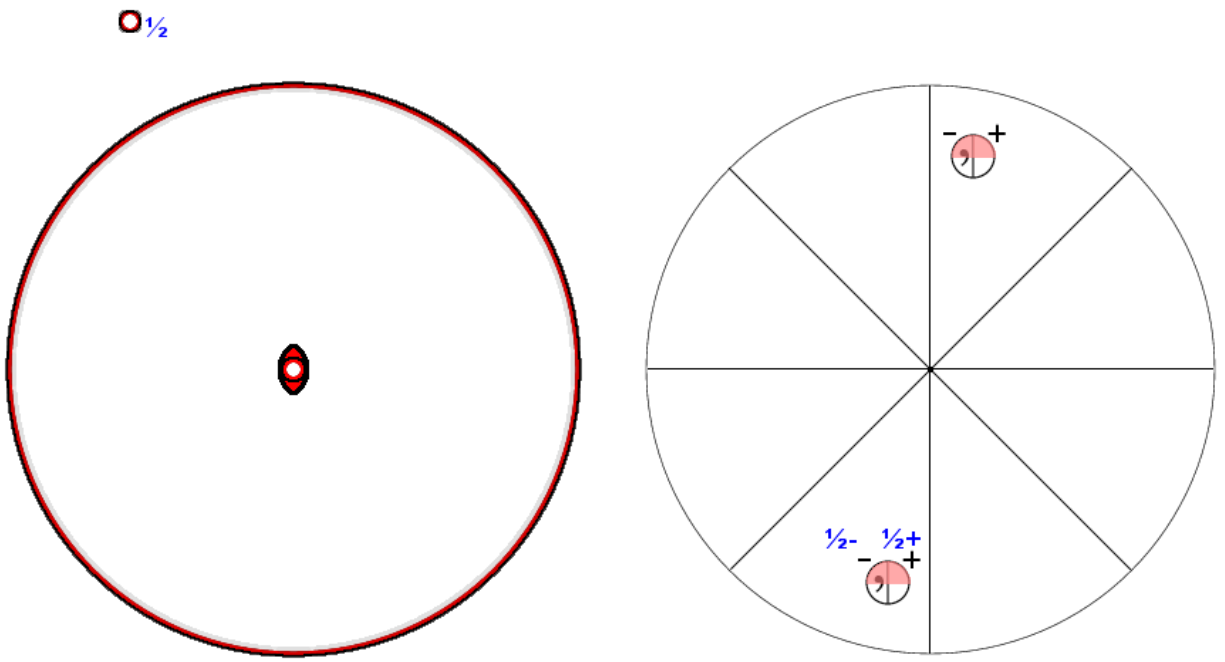
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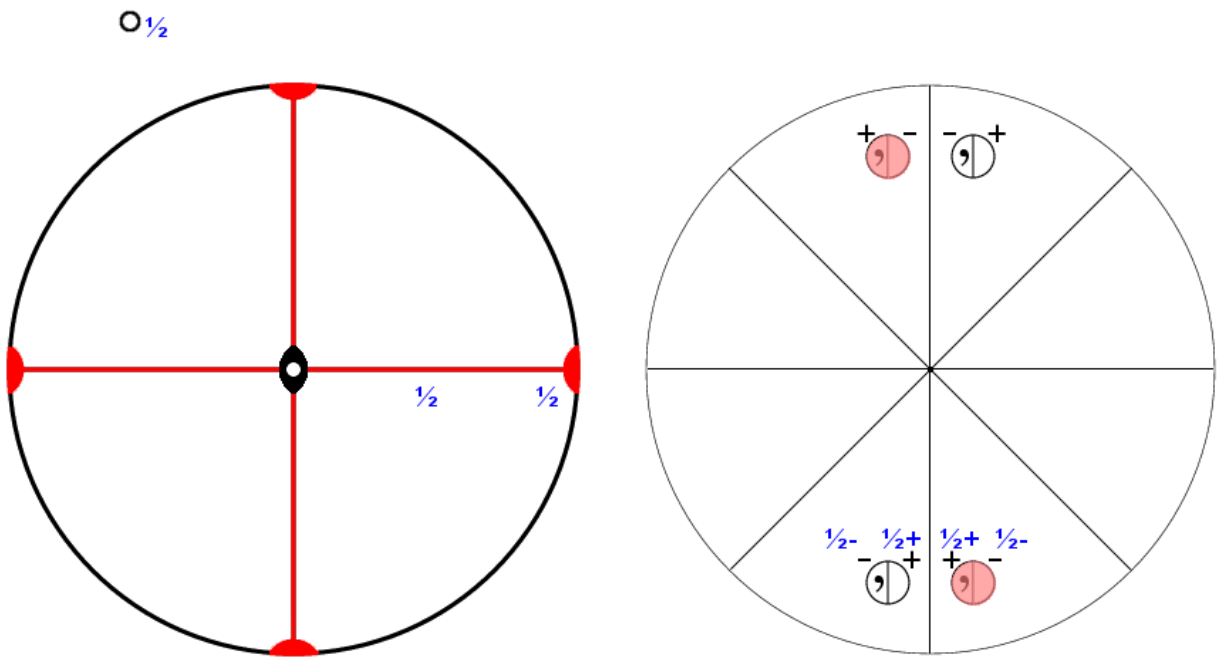
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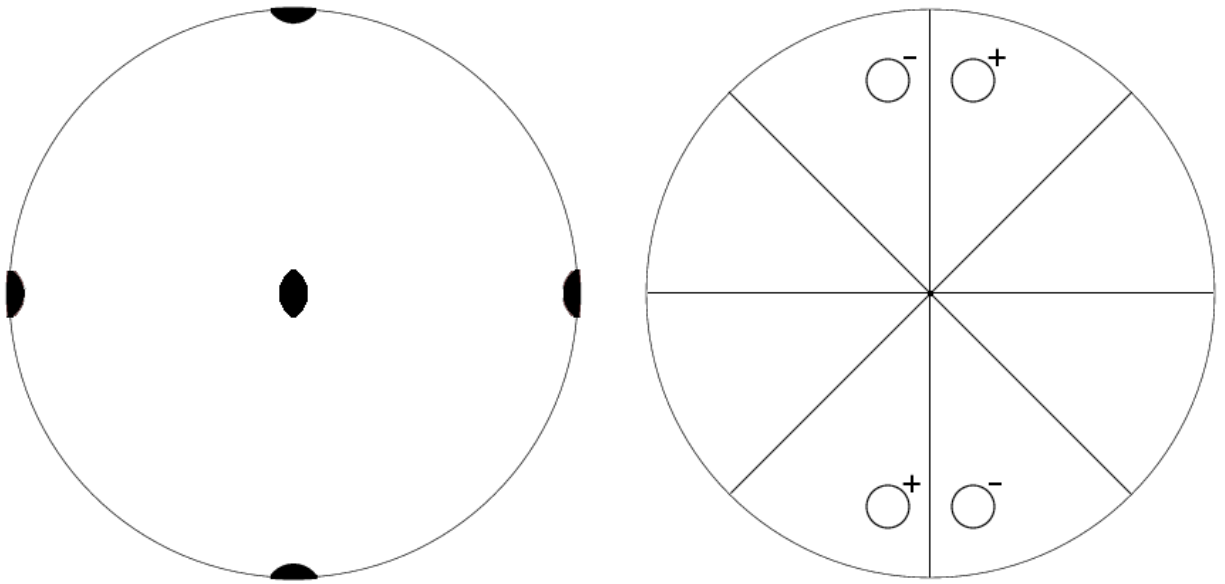
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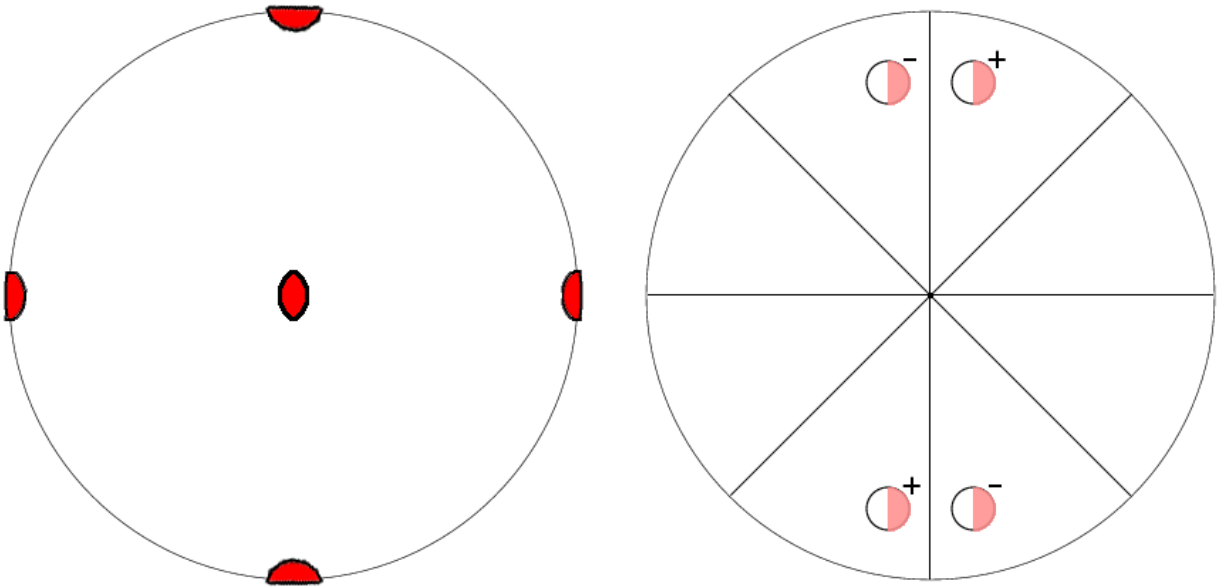
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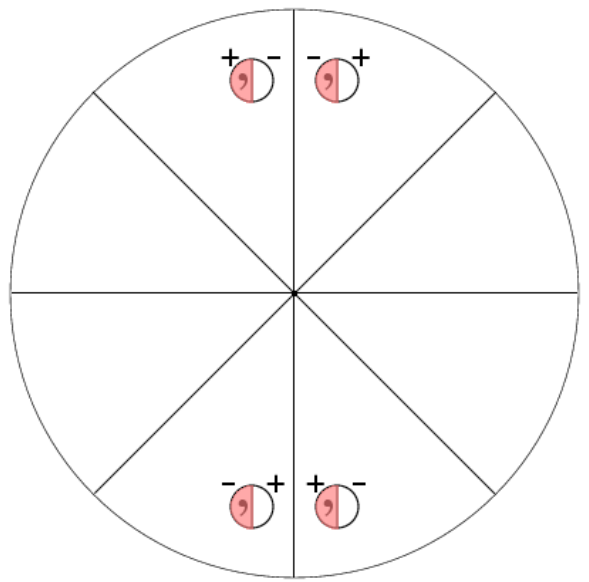
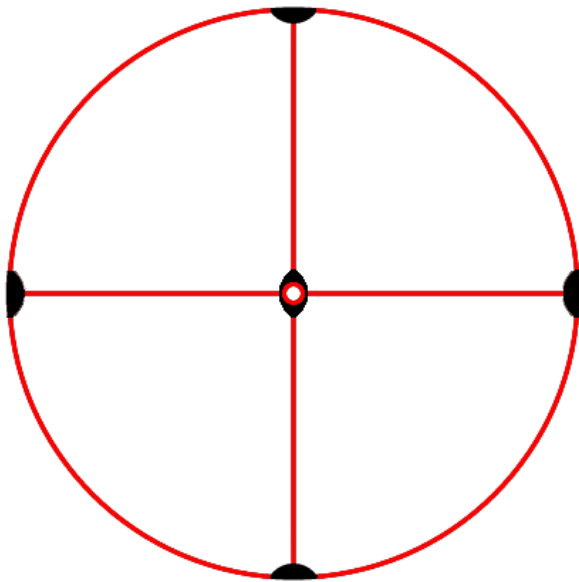
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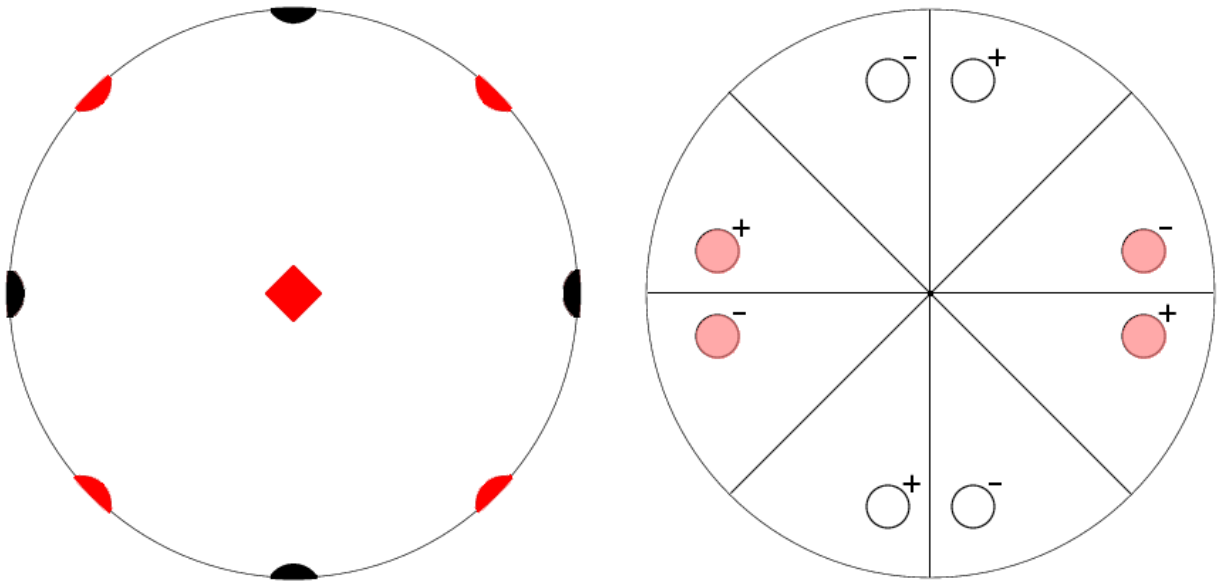
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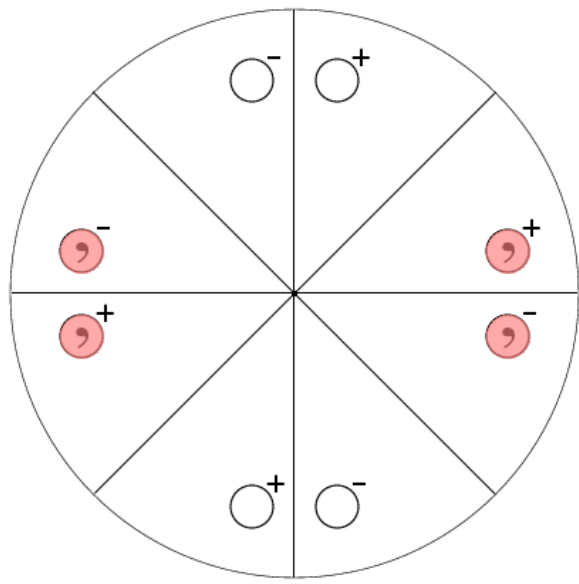
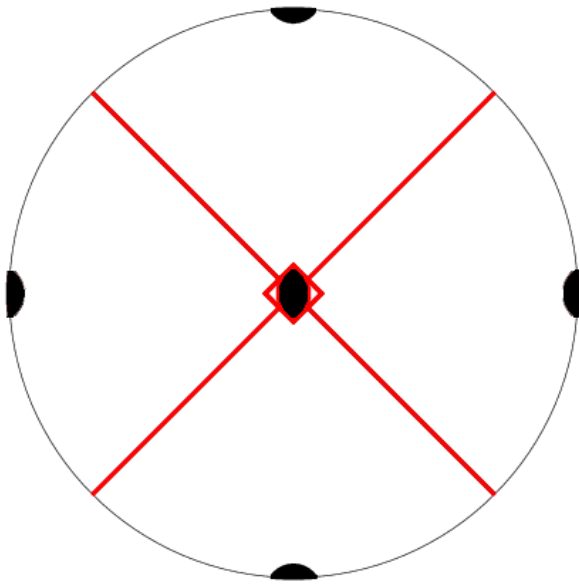
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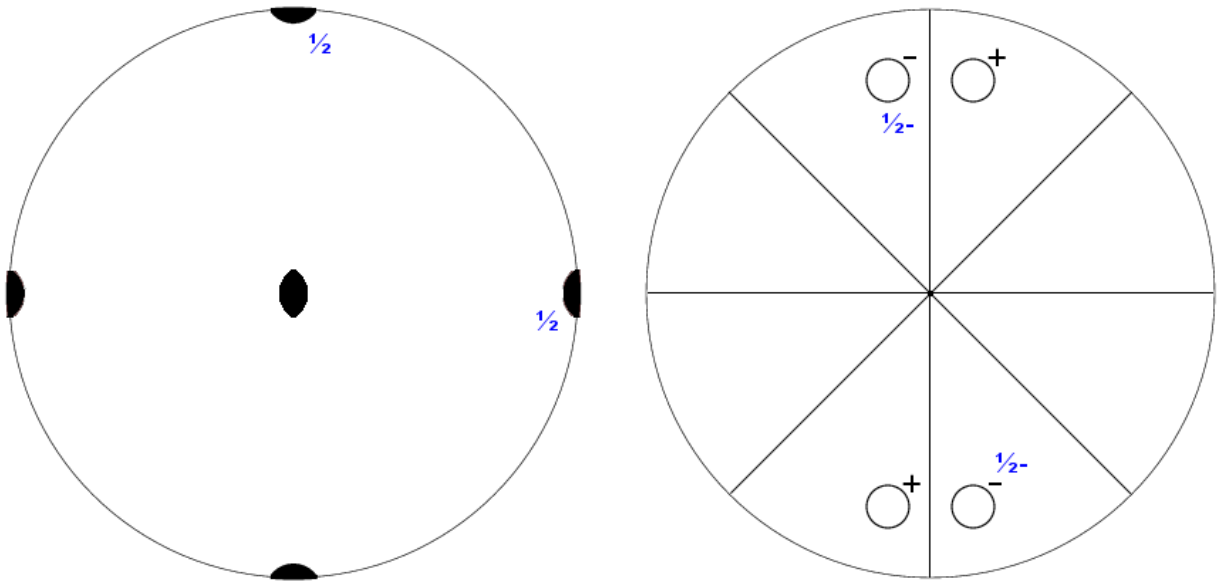
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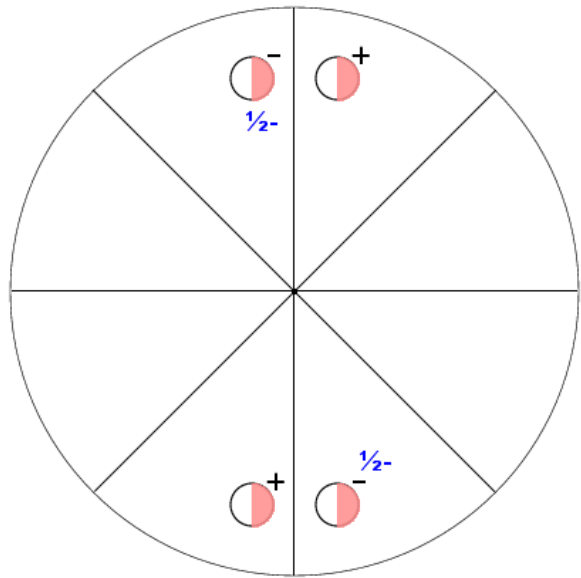
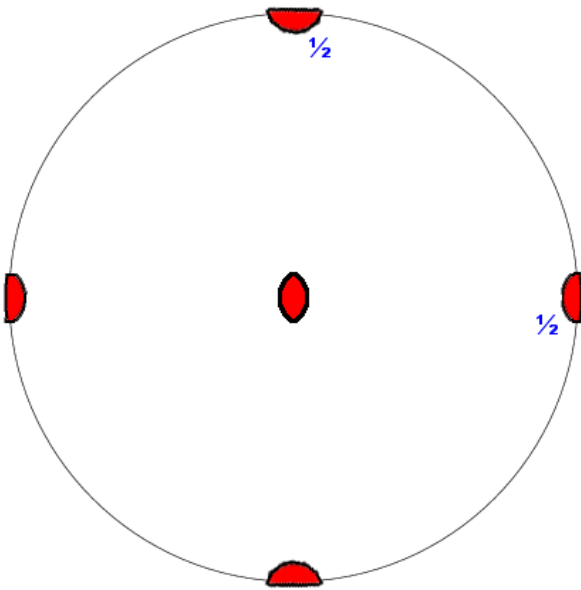
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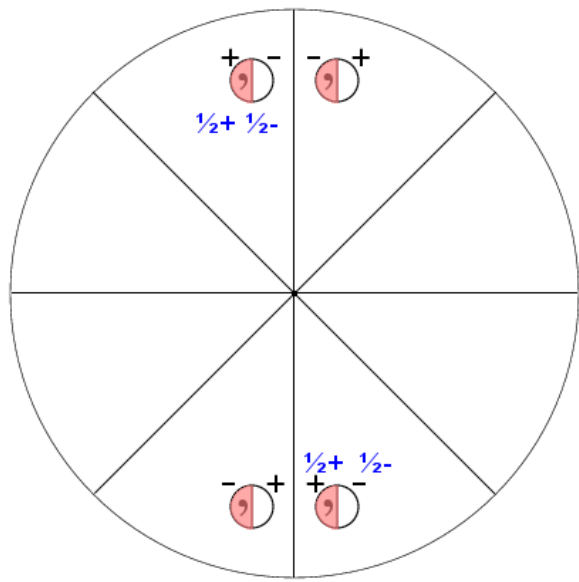
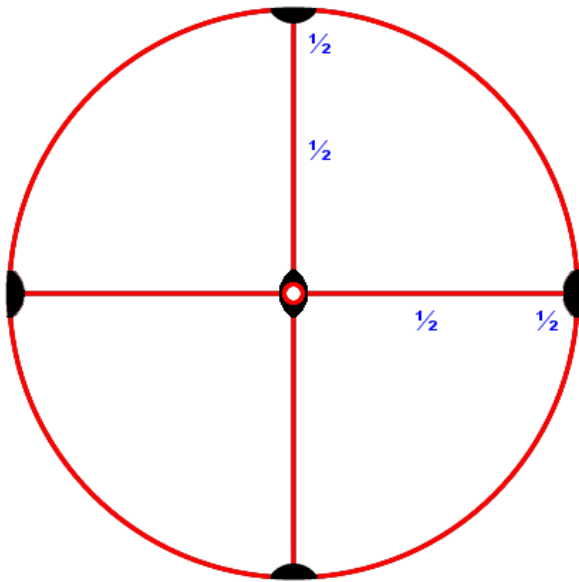
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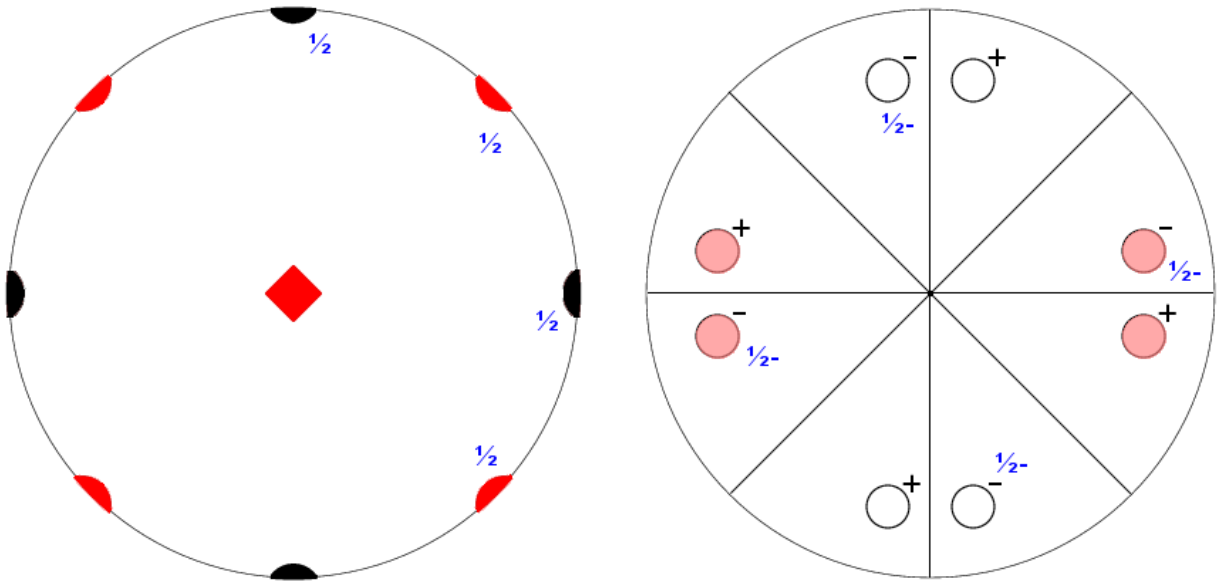
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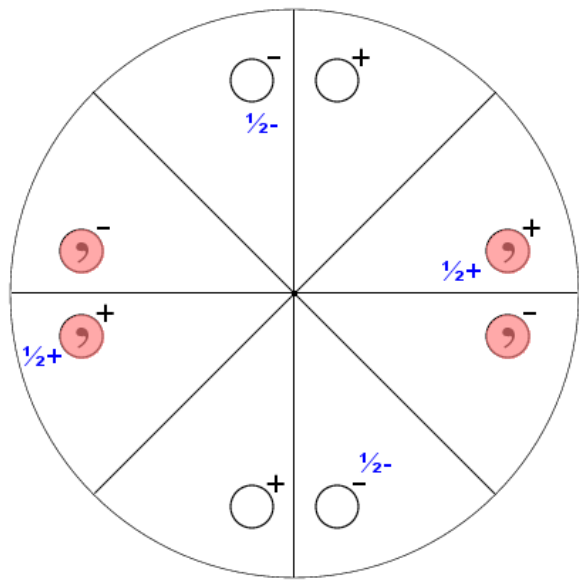
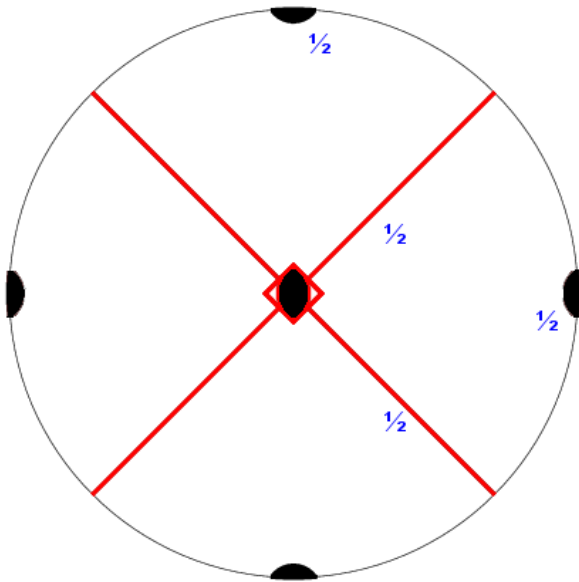
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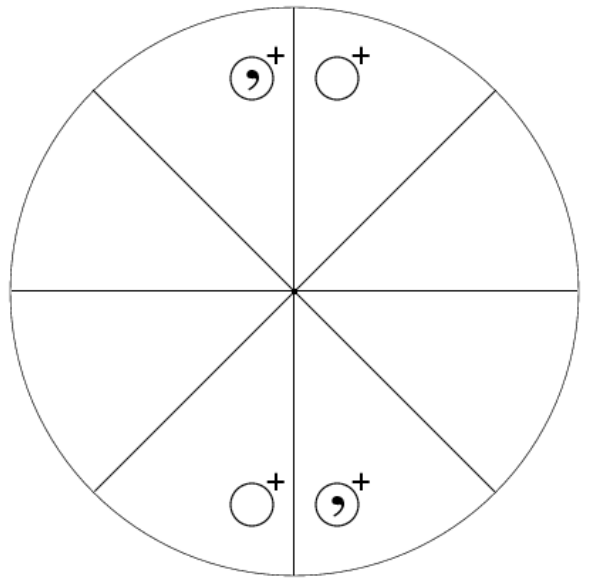
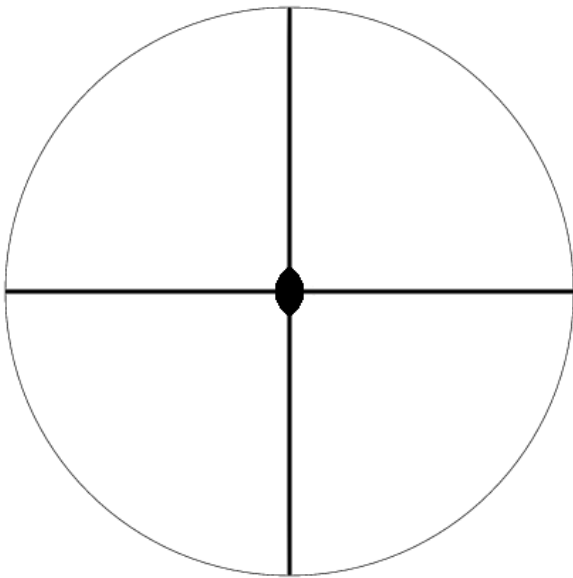
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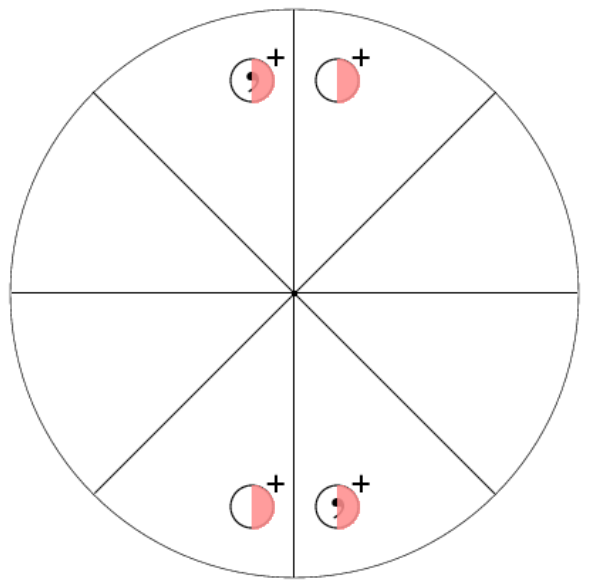
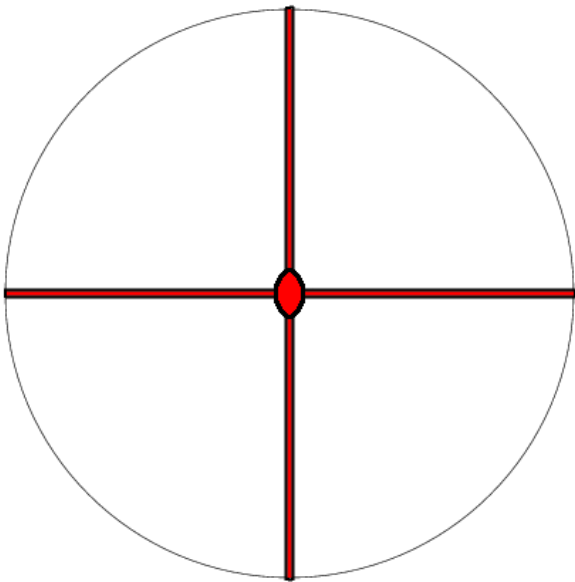
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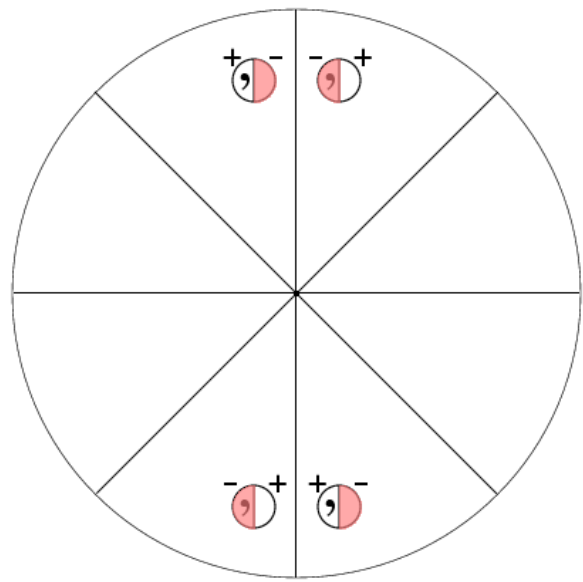
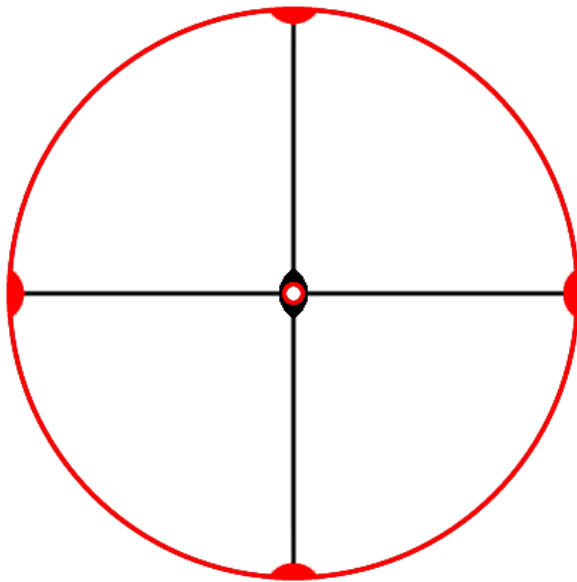
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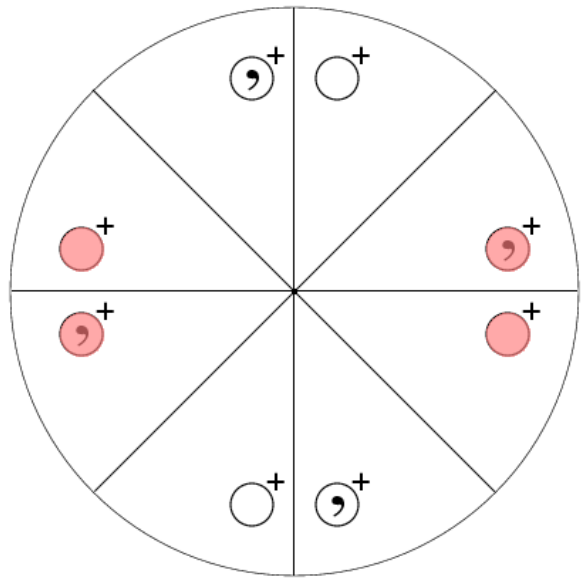
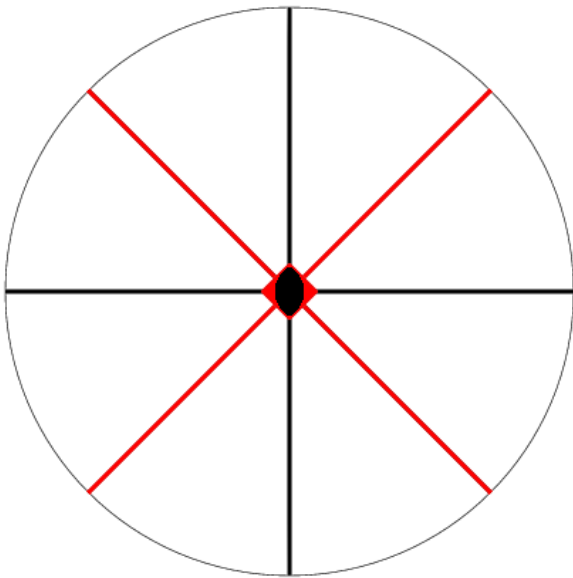
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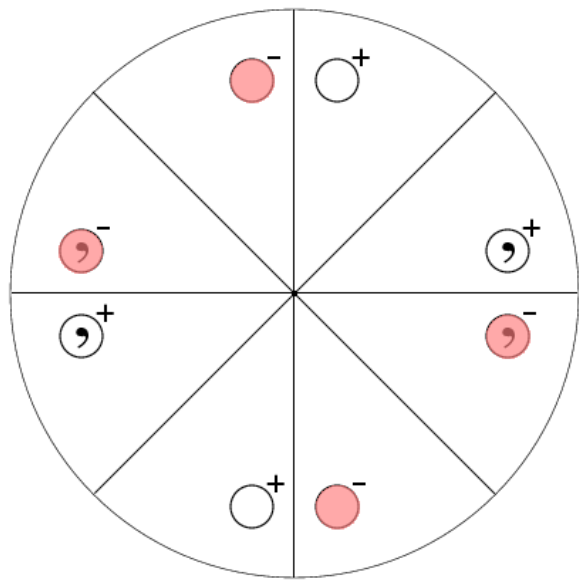
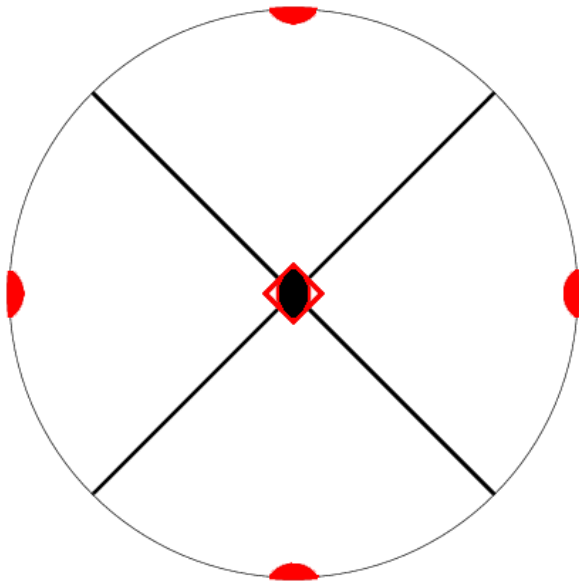
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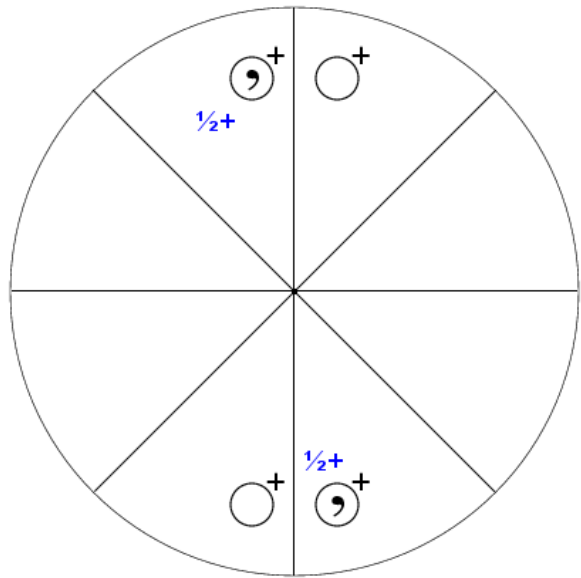
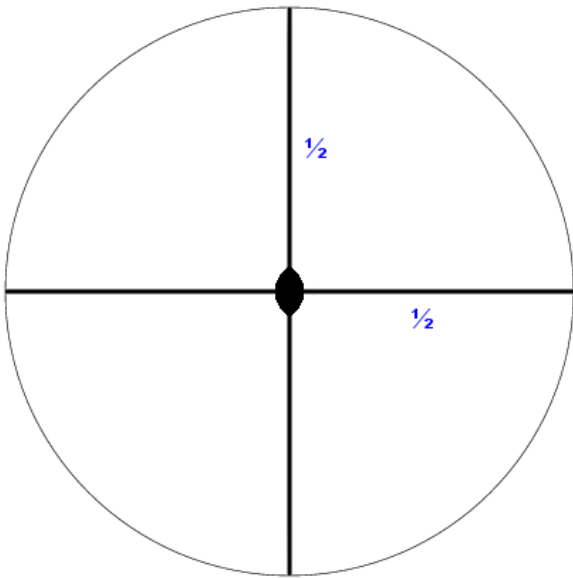
7.1.3.58



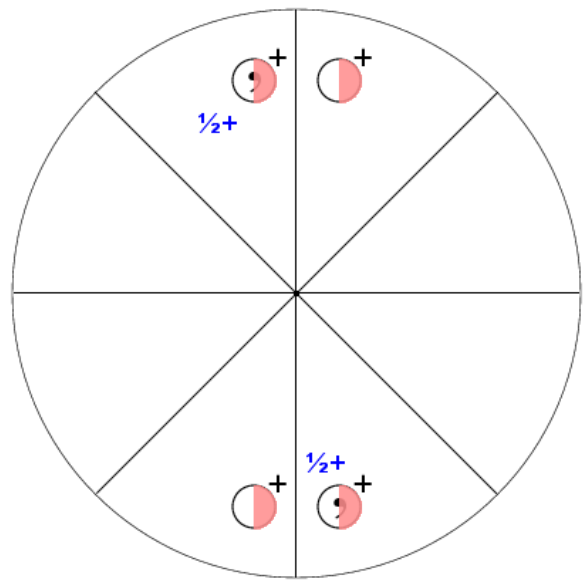
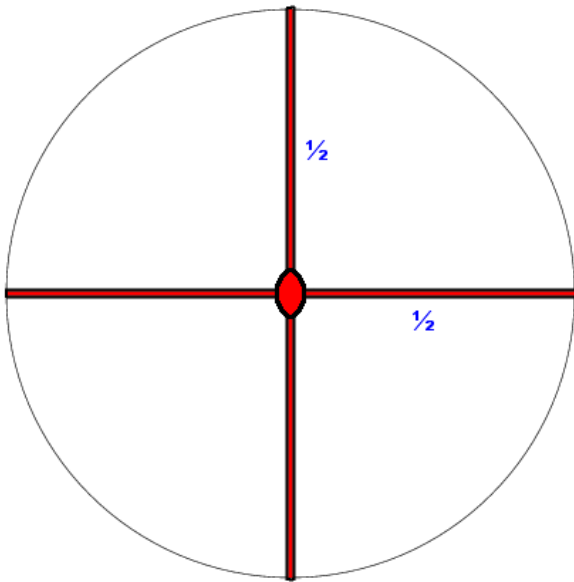
7.1.4.59



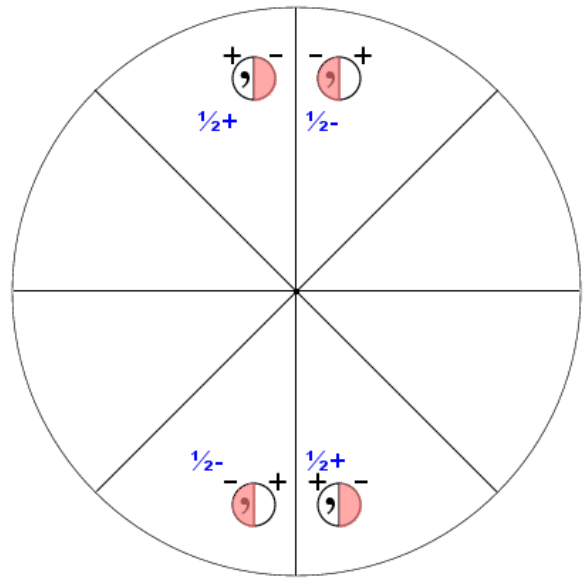
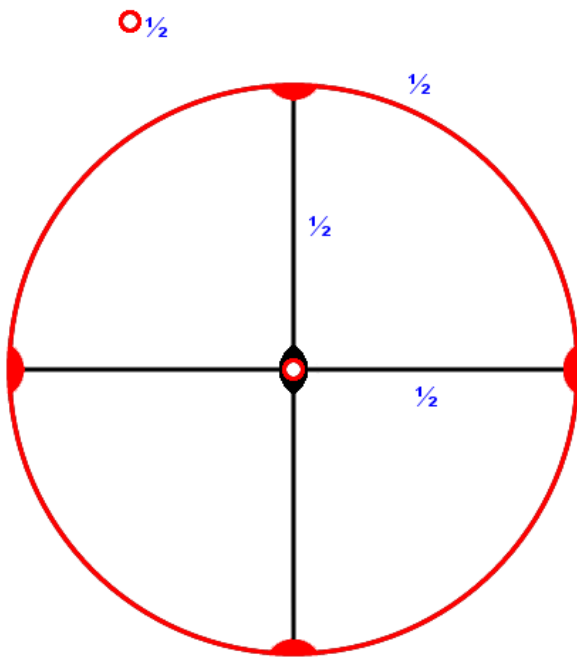
7.1.5.60



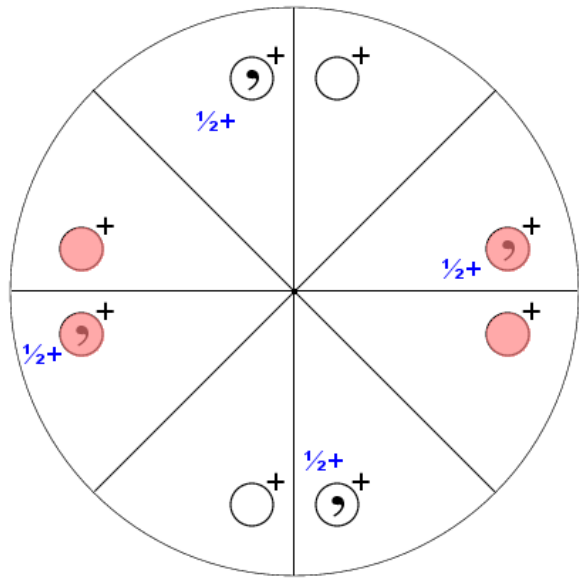
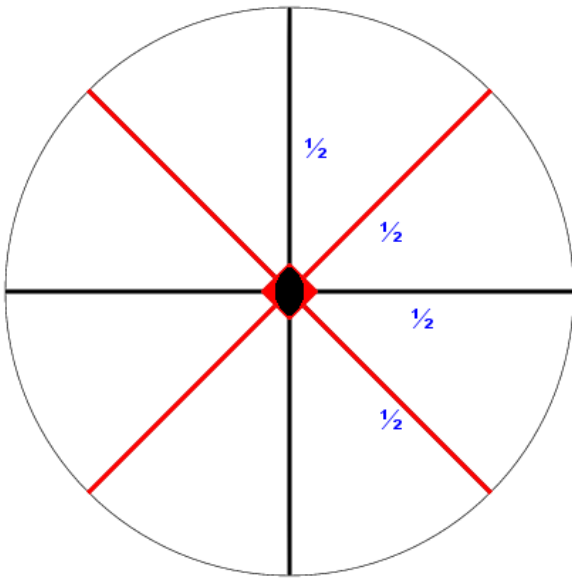
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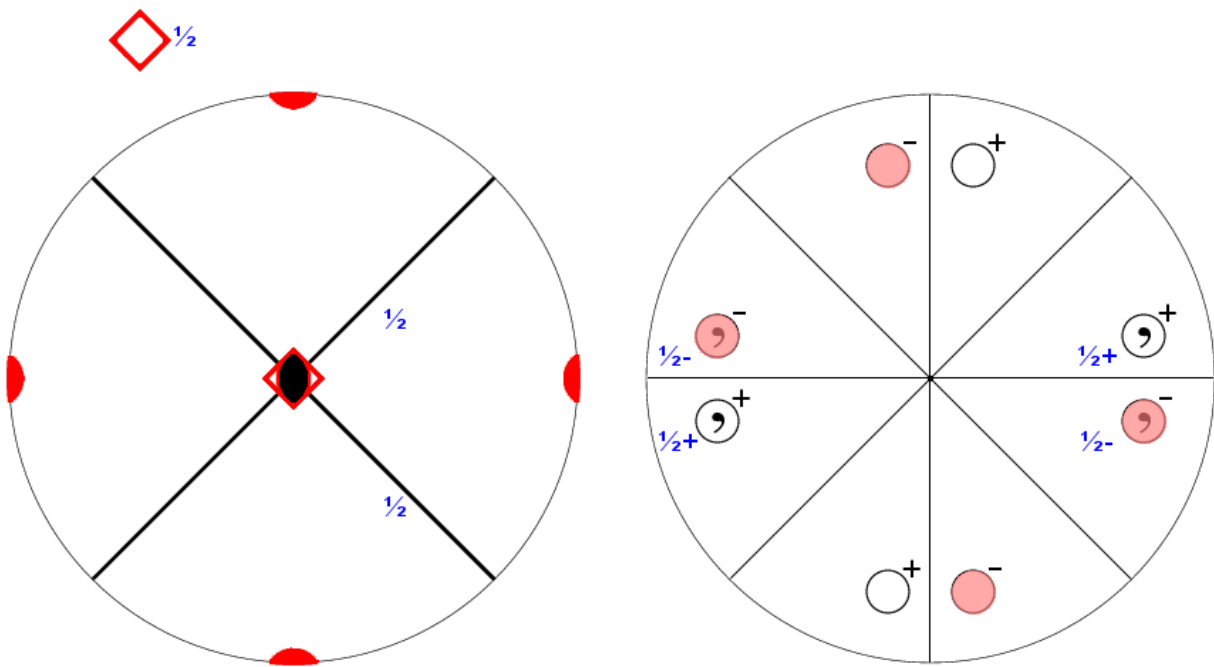
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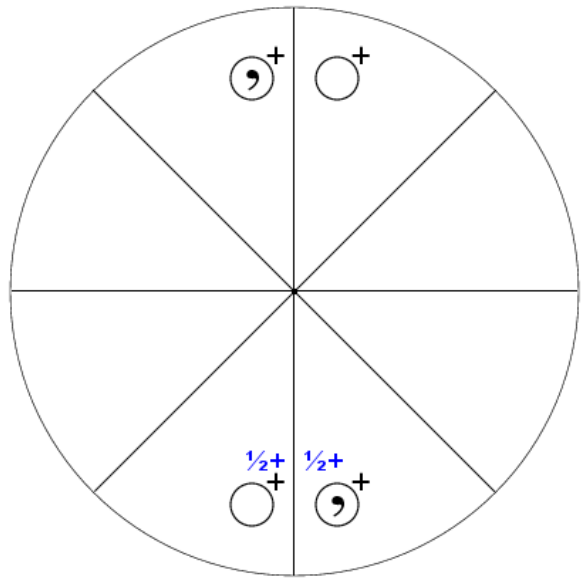
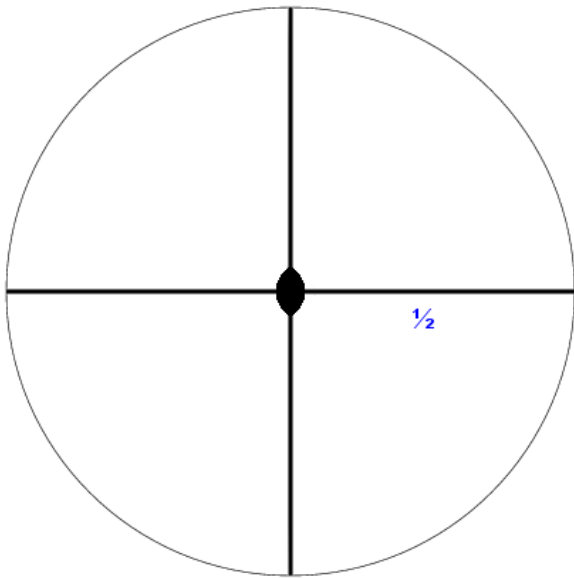
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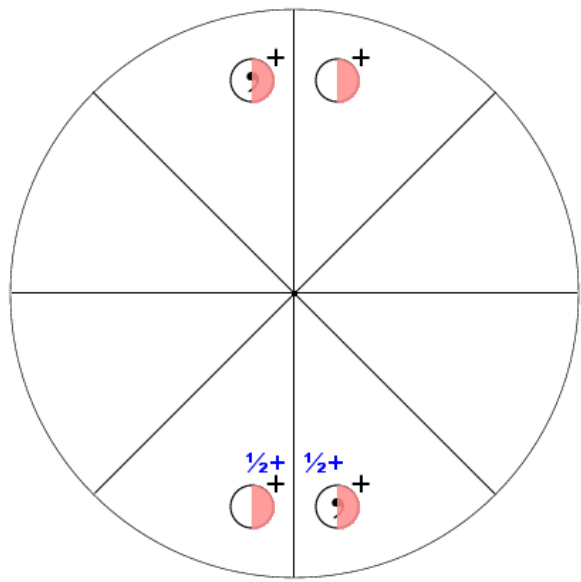
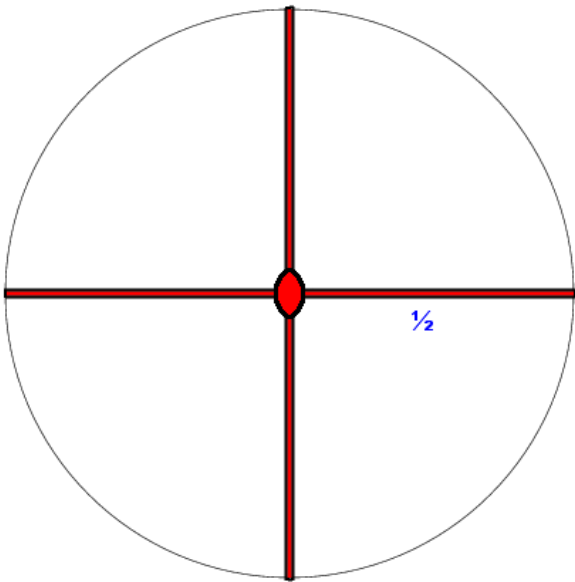
7.2.4.64



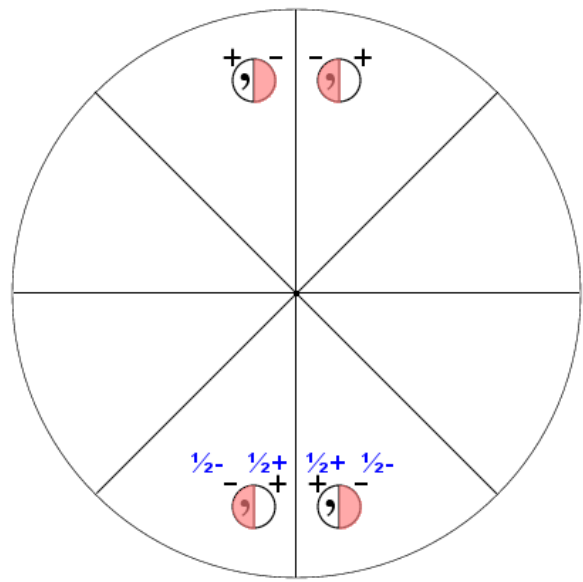
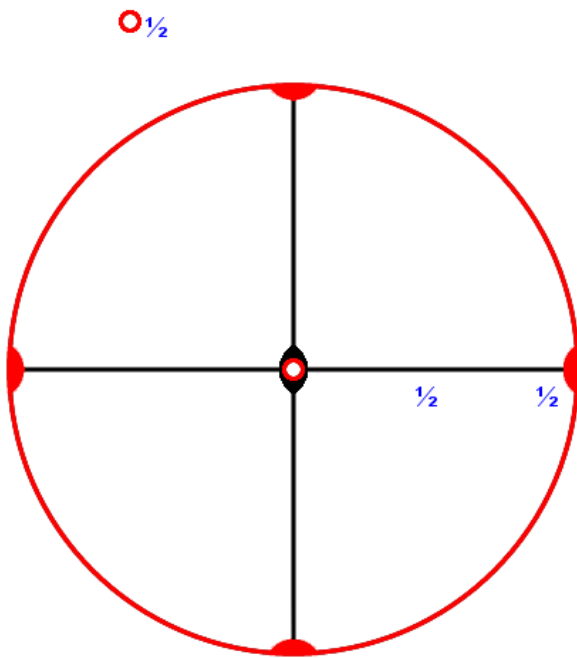
7.2.5.65



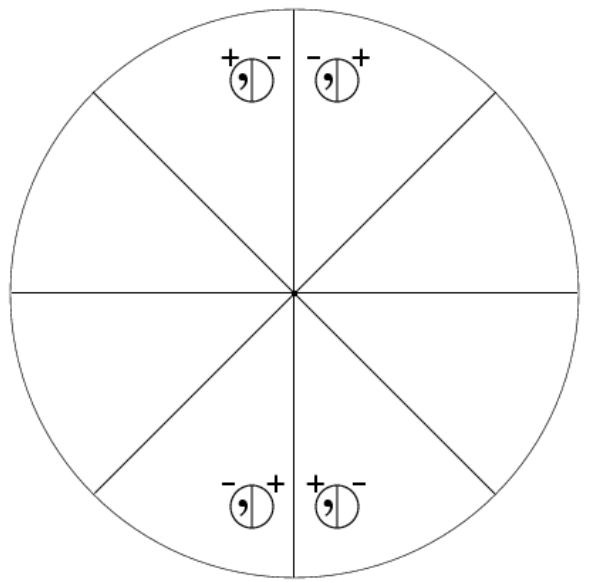
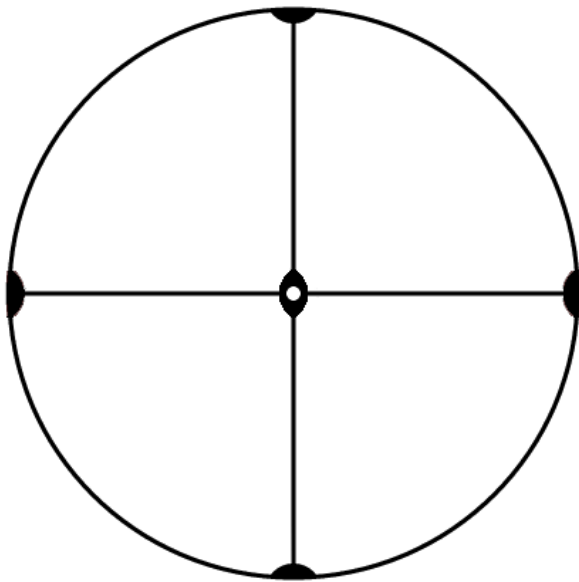
7.3.1.66



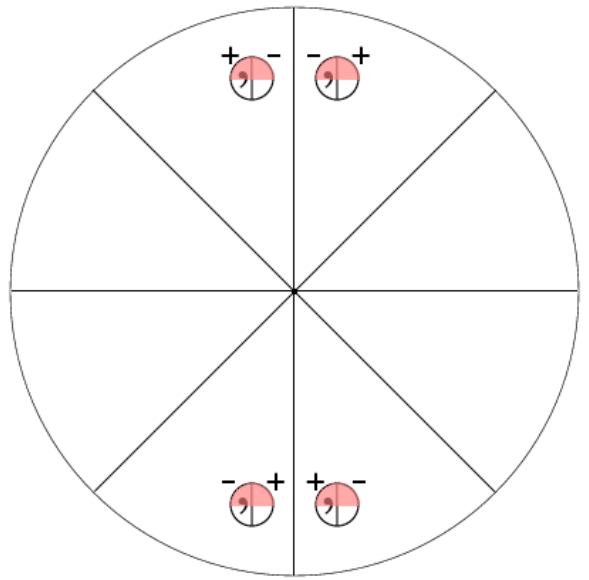
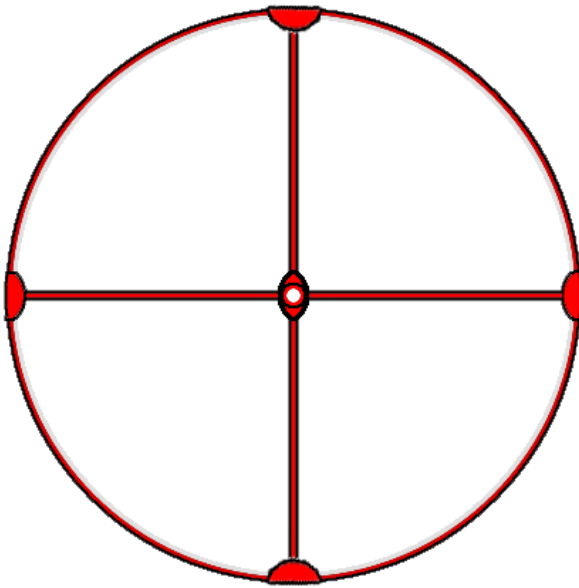
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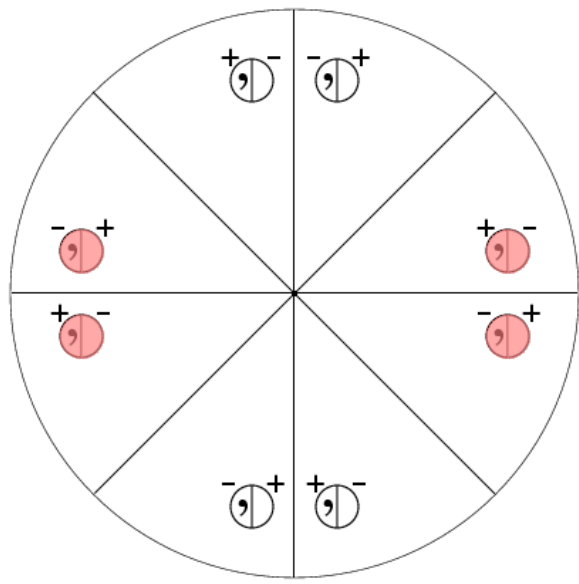
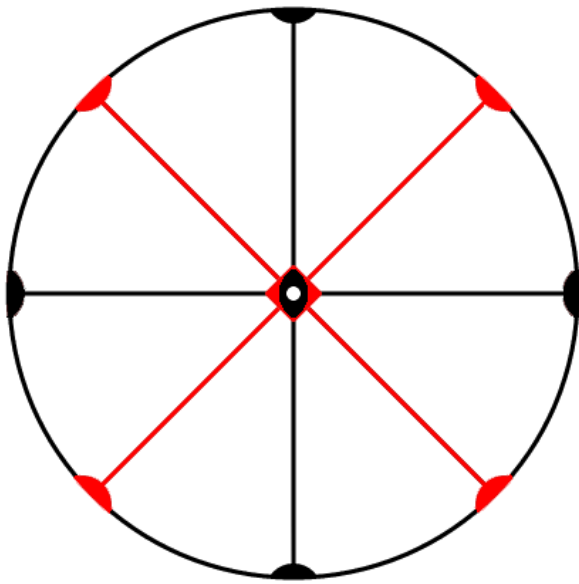
7.3.3.68



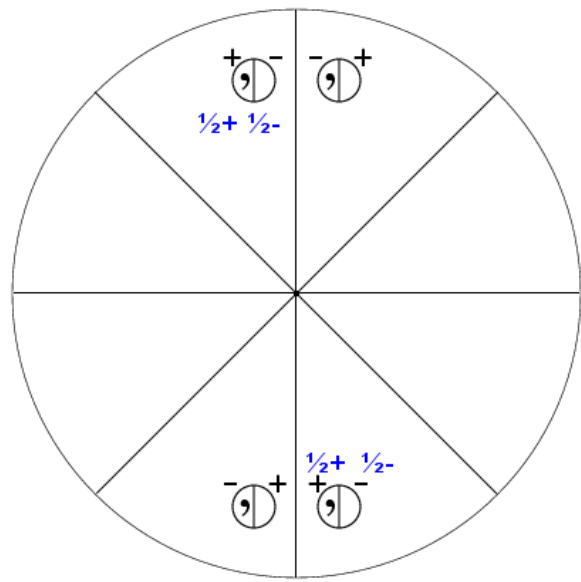
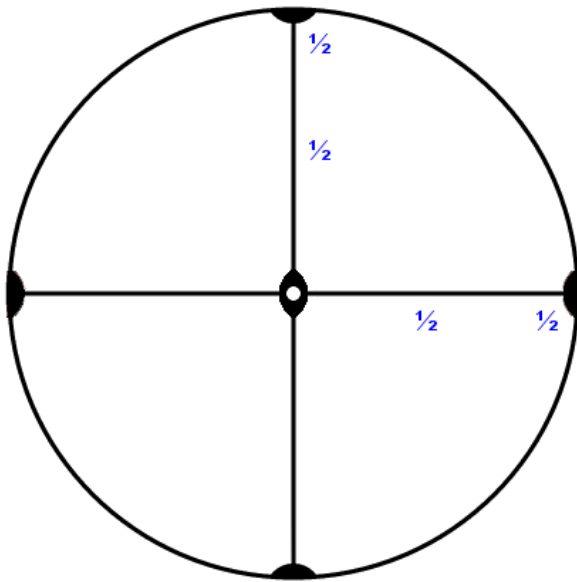
8.1.1.69



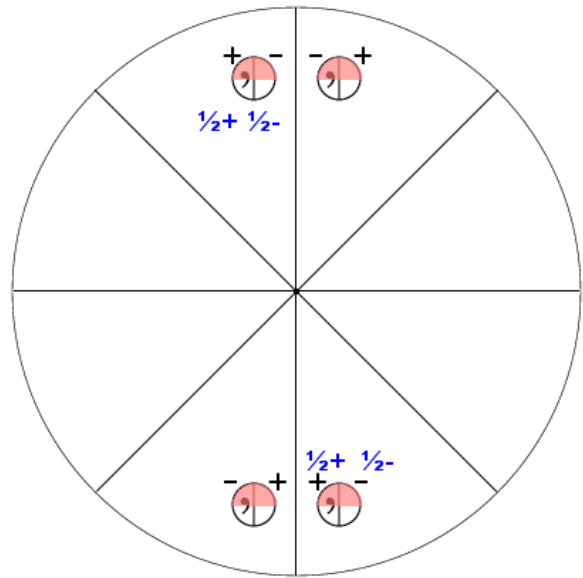
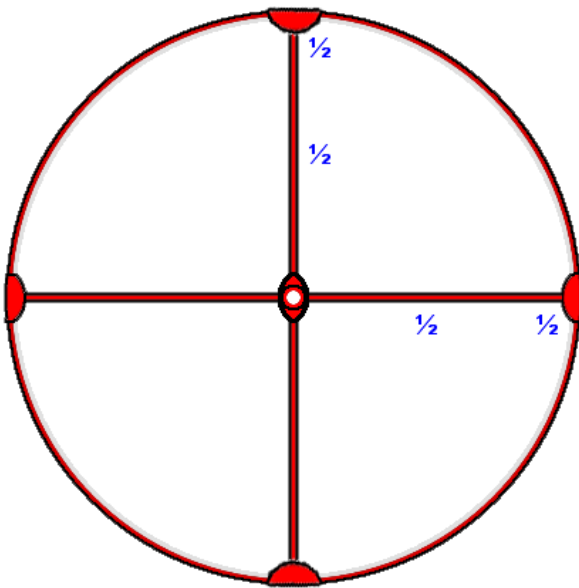
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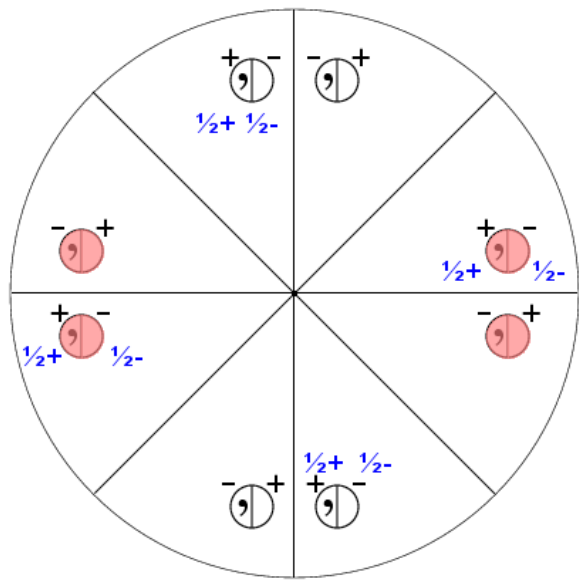
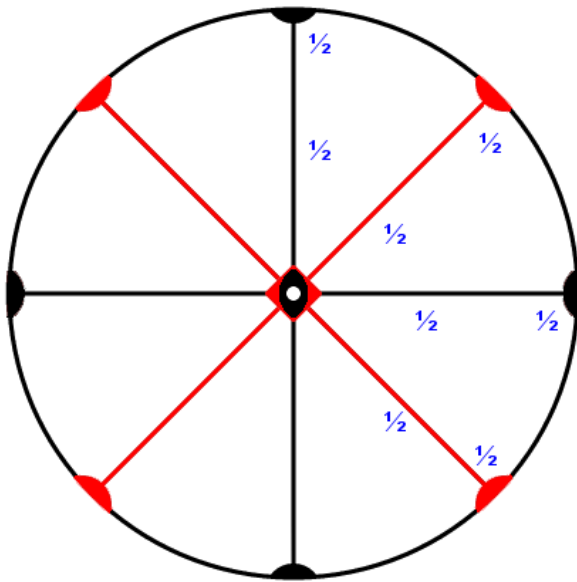
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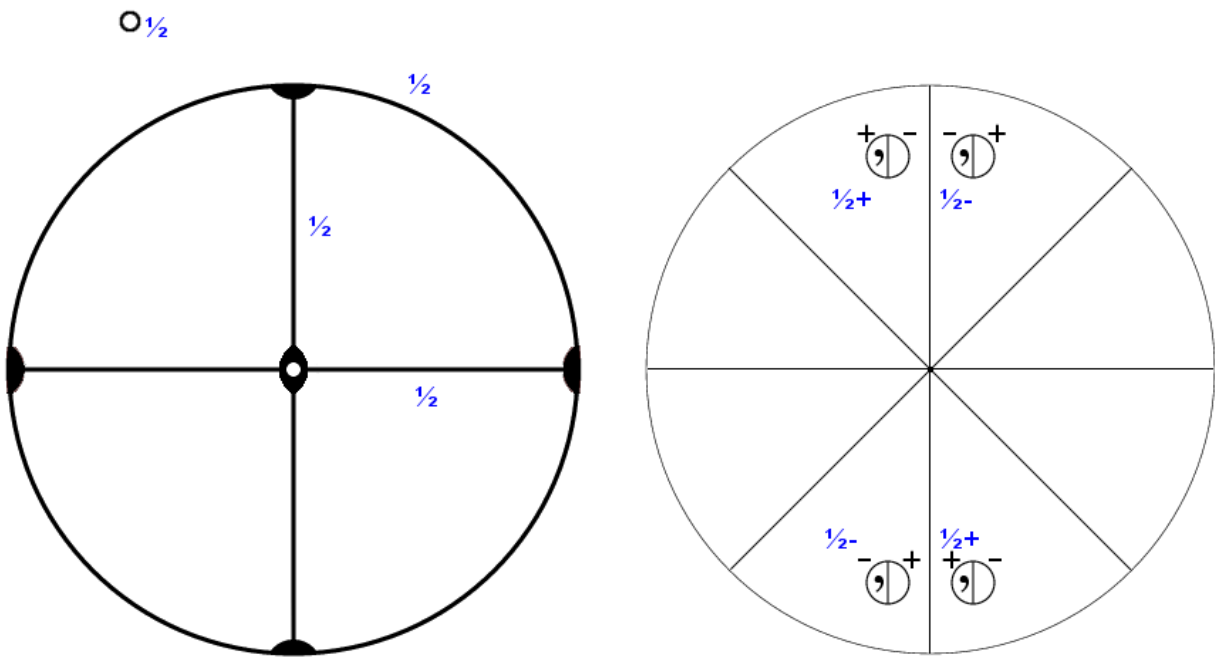
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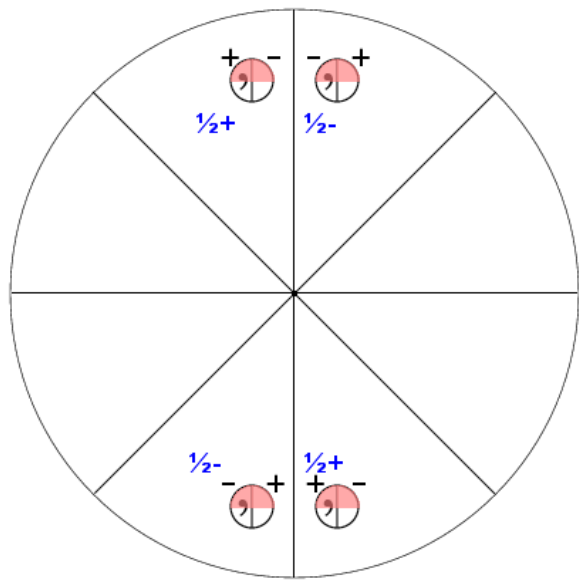
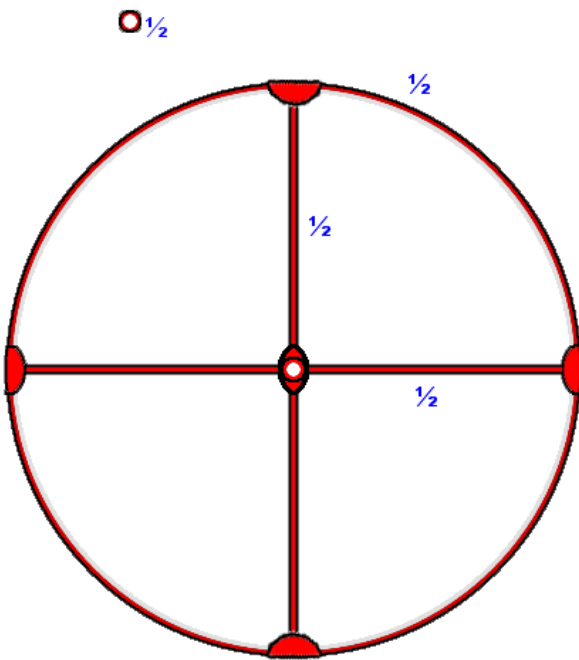
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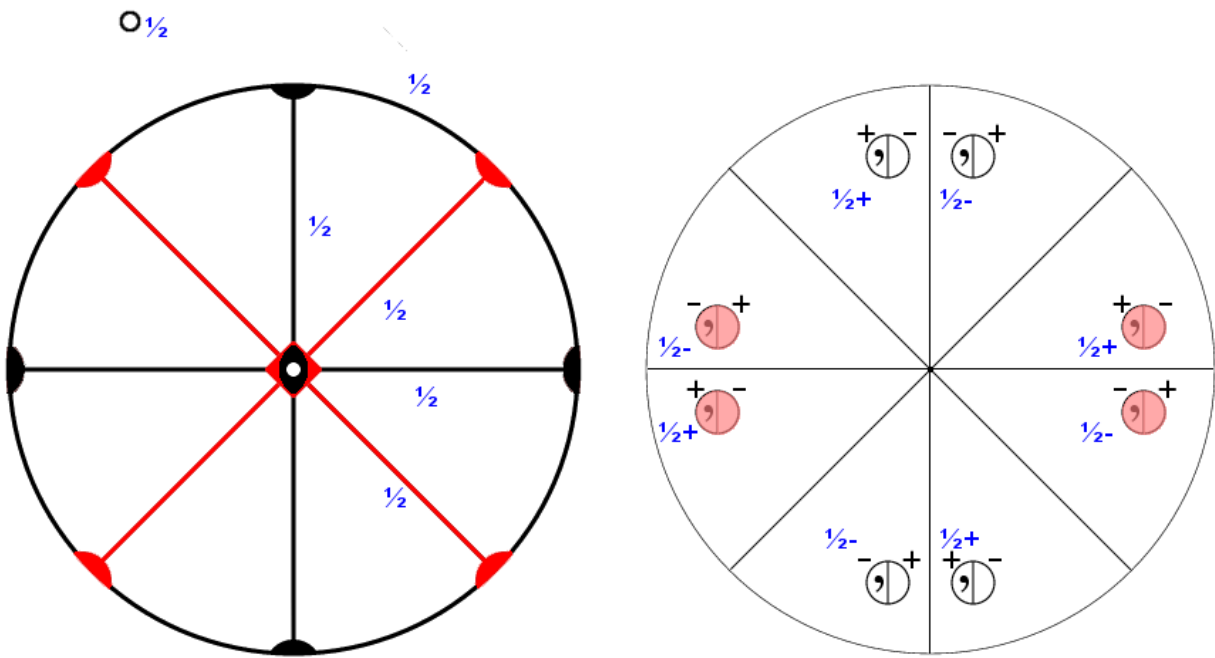
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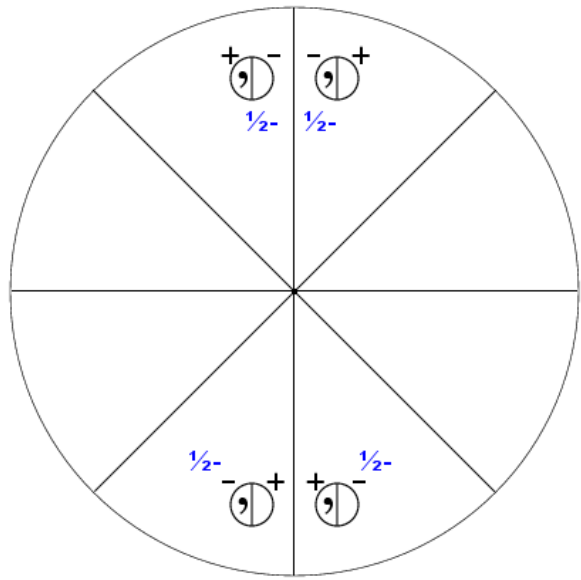
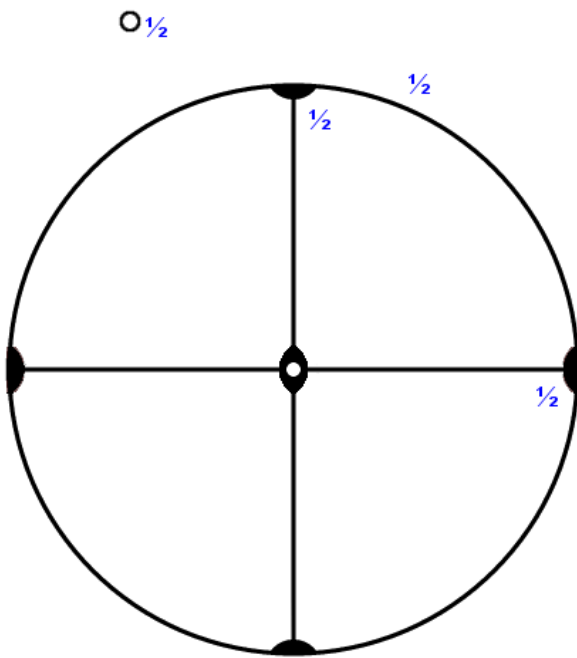
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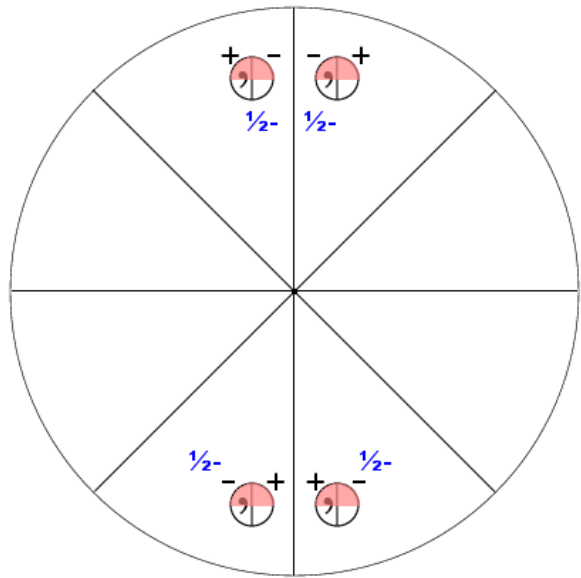
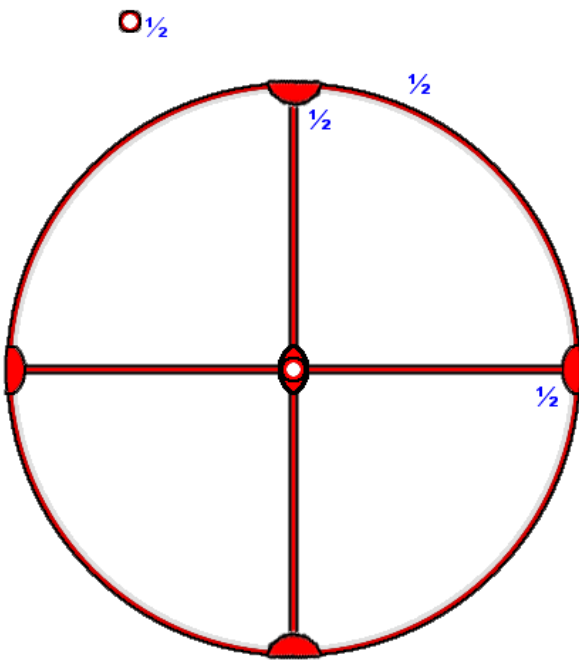
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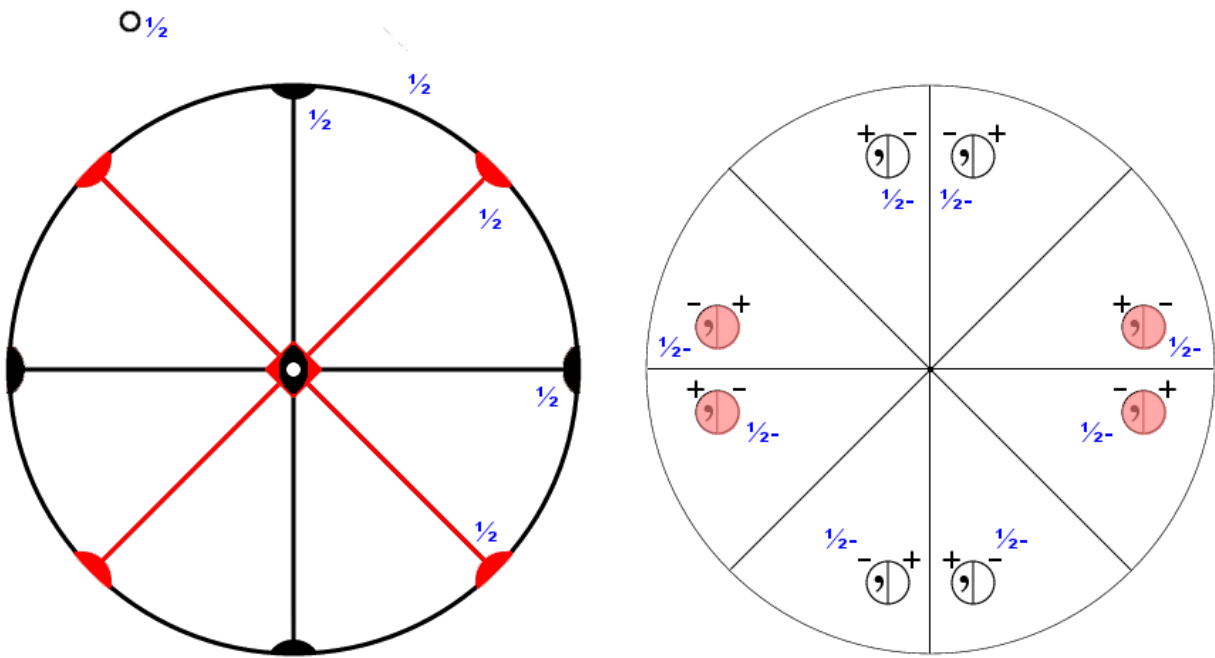
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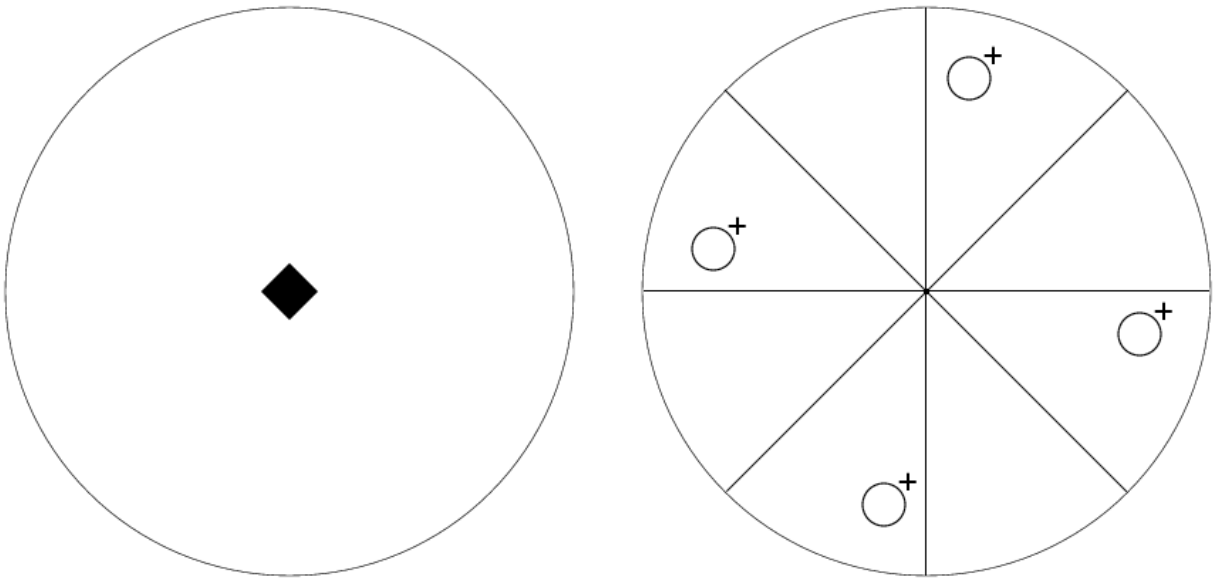
8.4.1.78



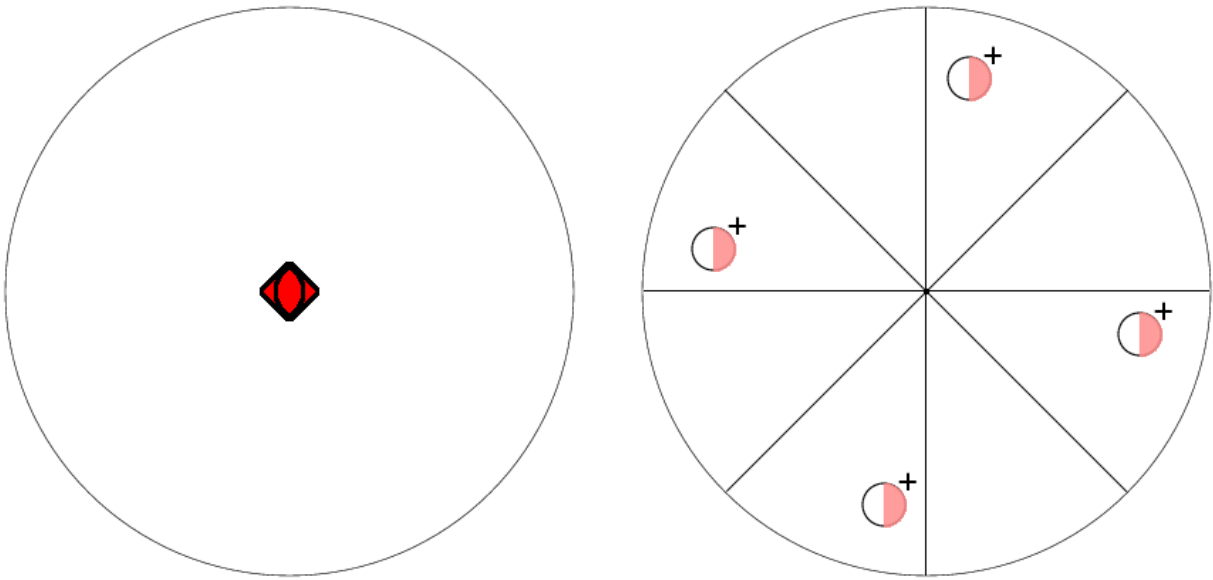
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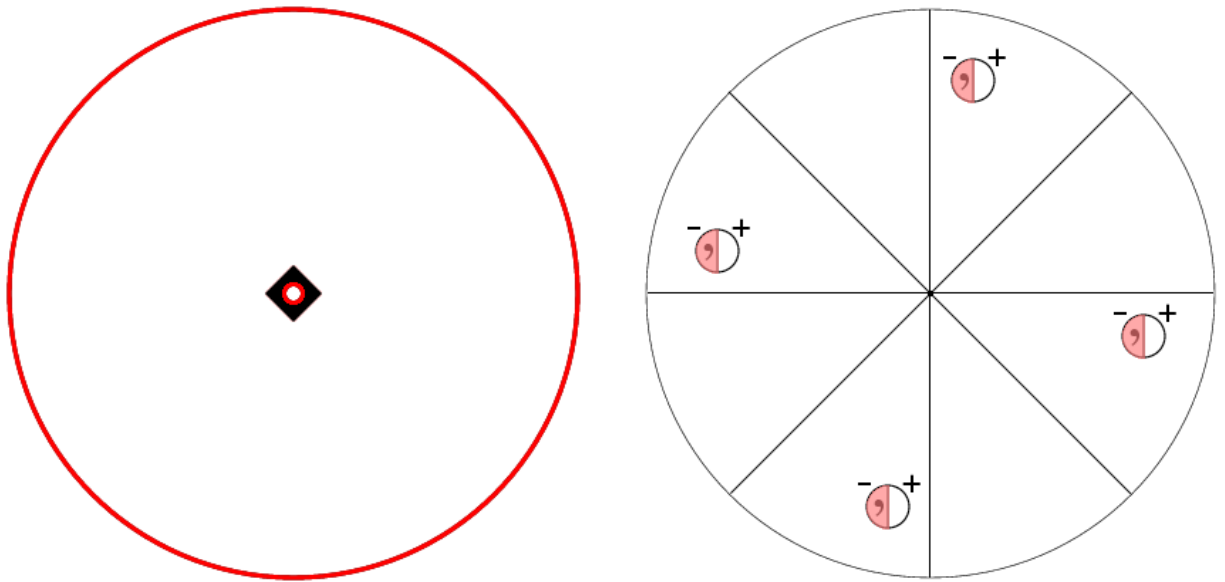
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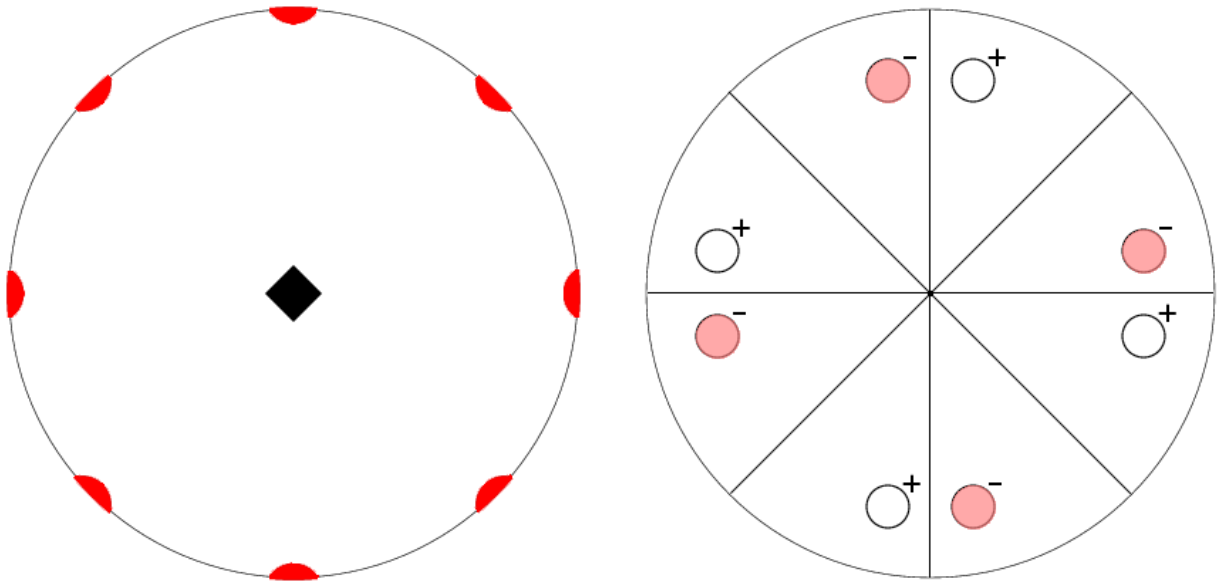
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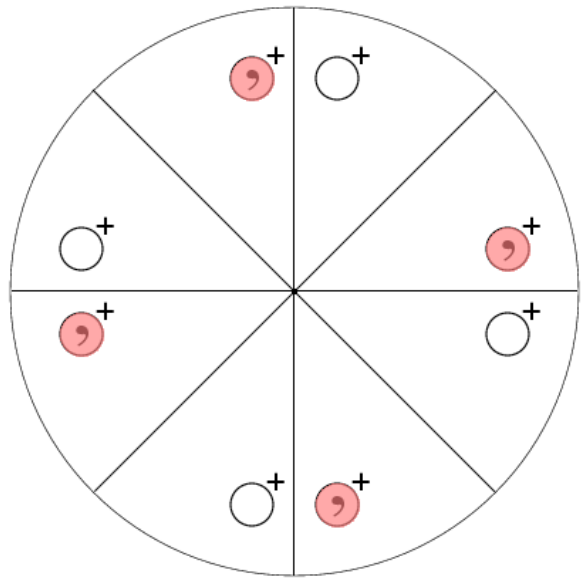
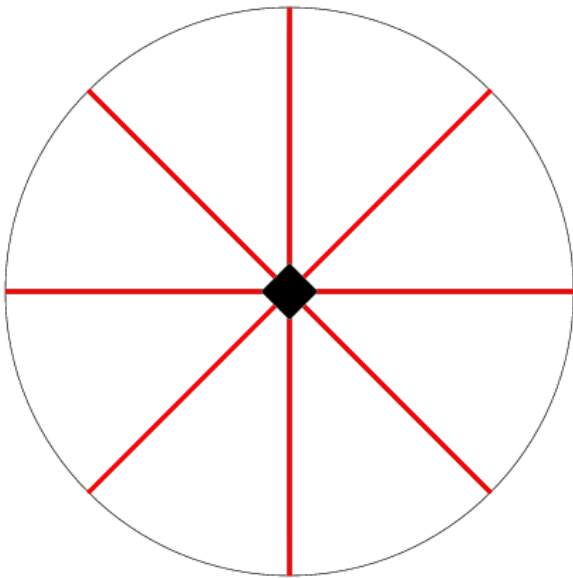
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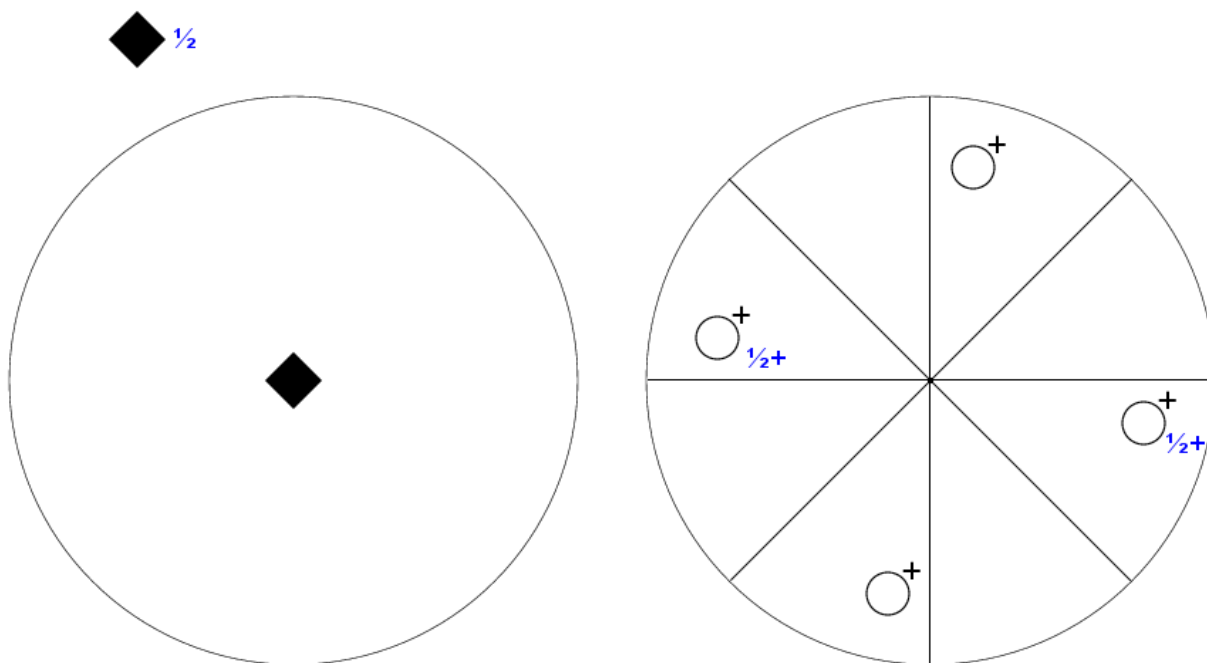
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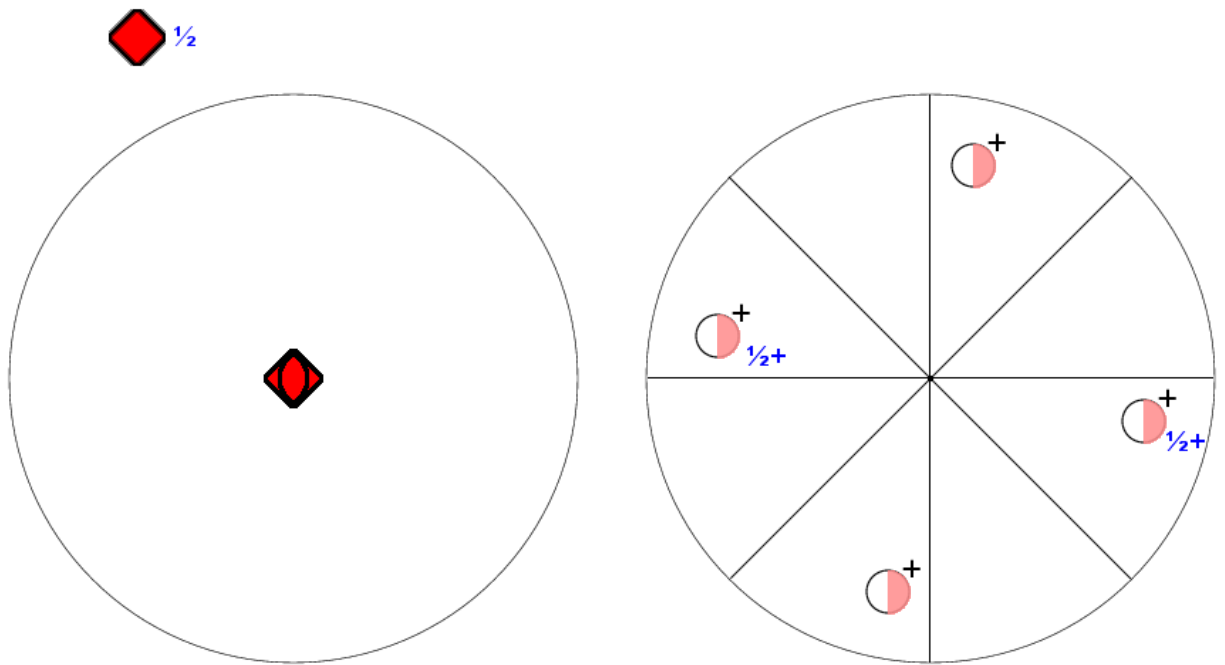
9.1.4.84



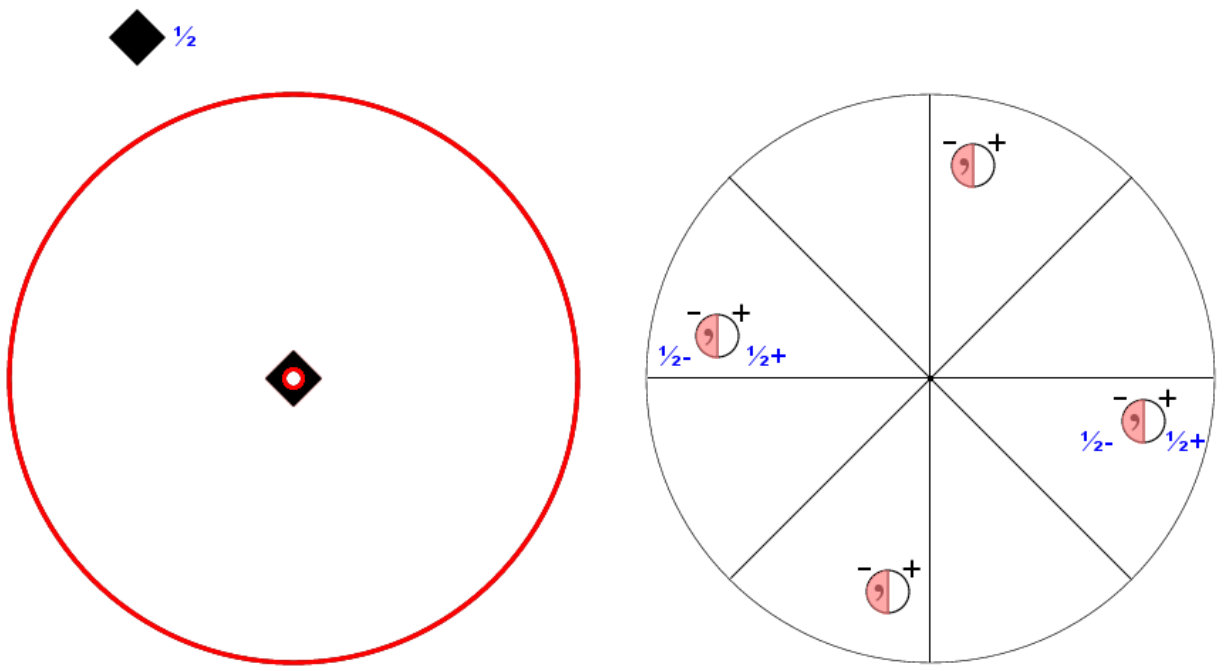
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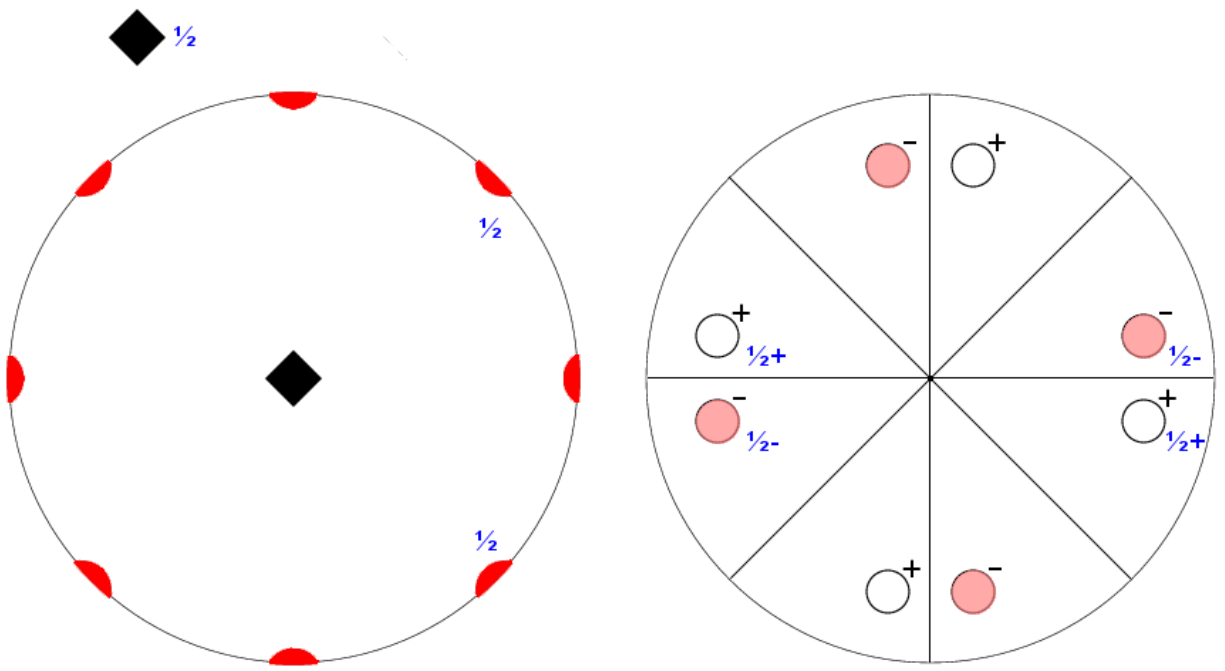
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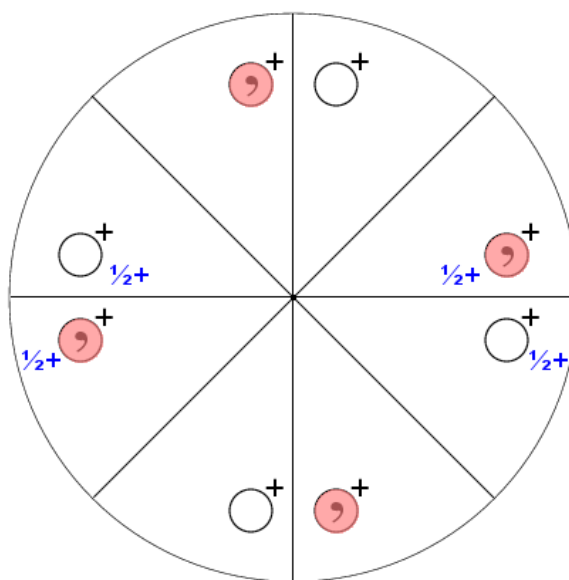
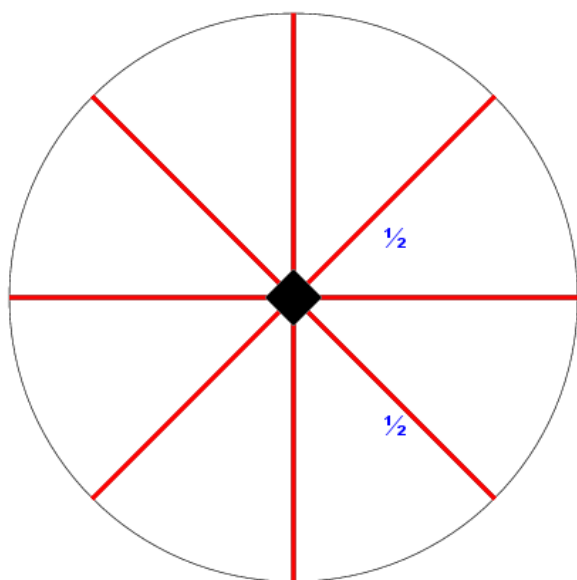
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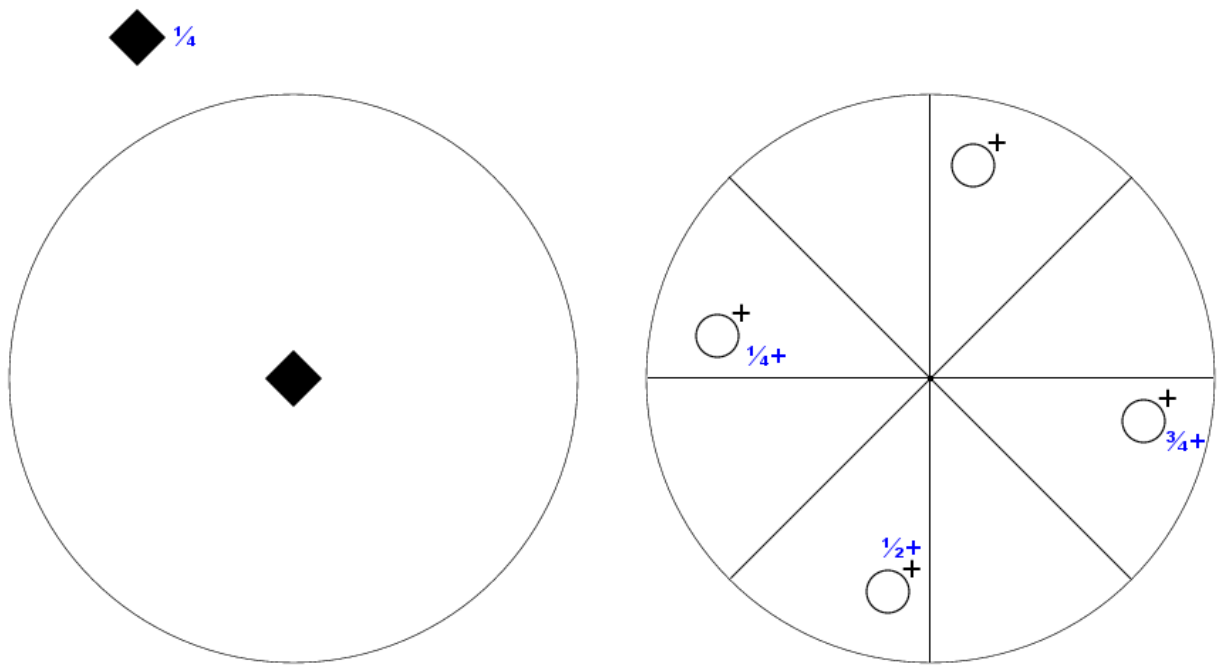
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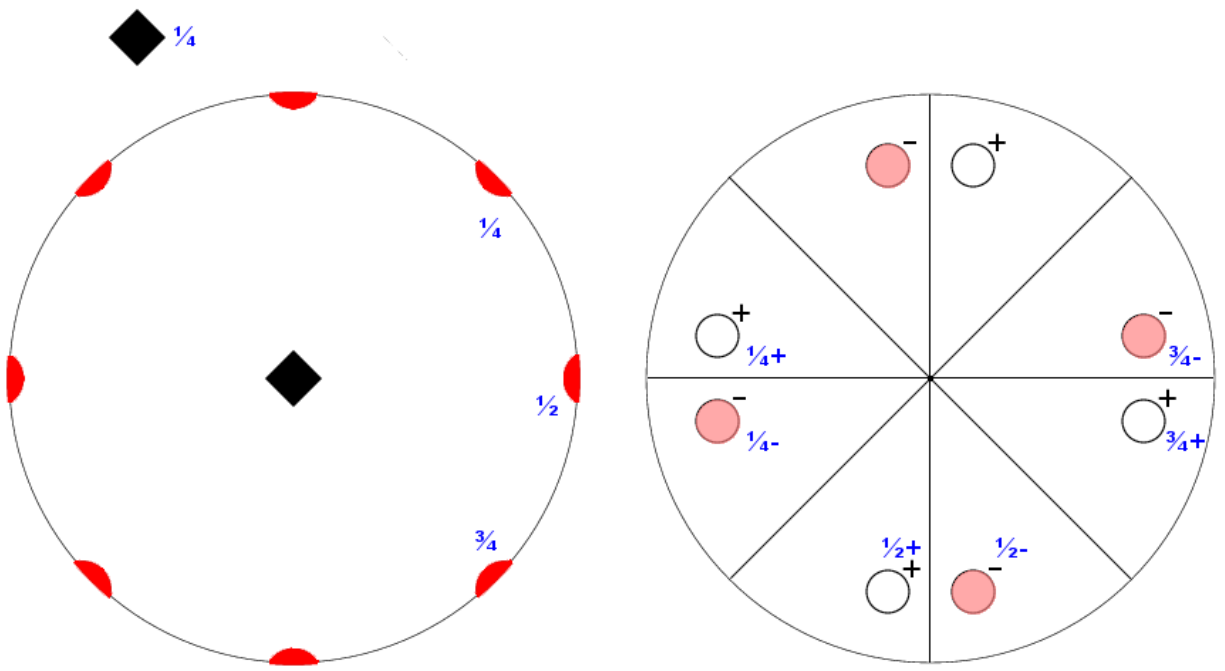
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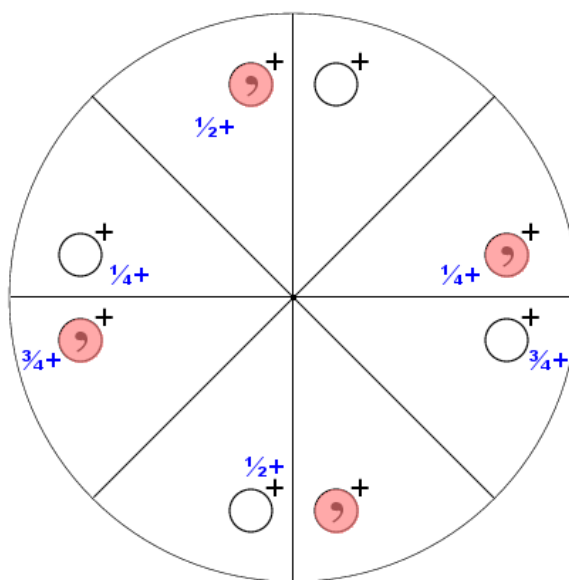
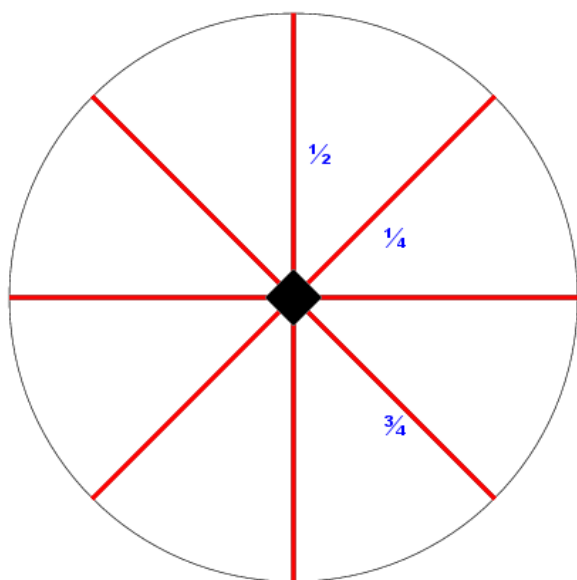
9.2.5.90



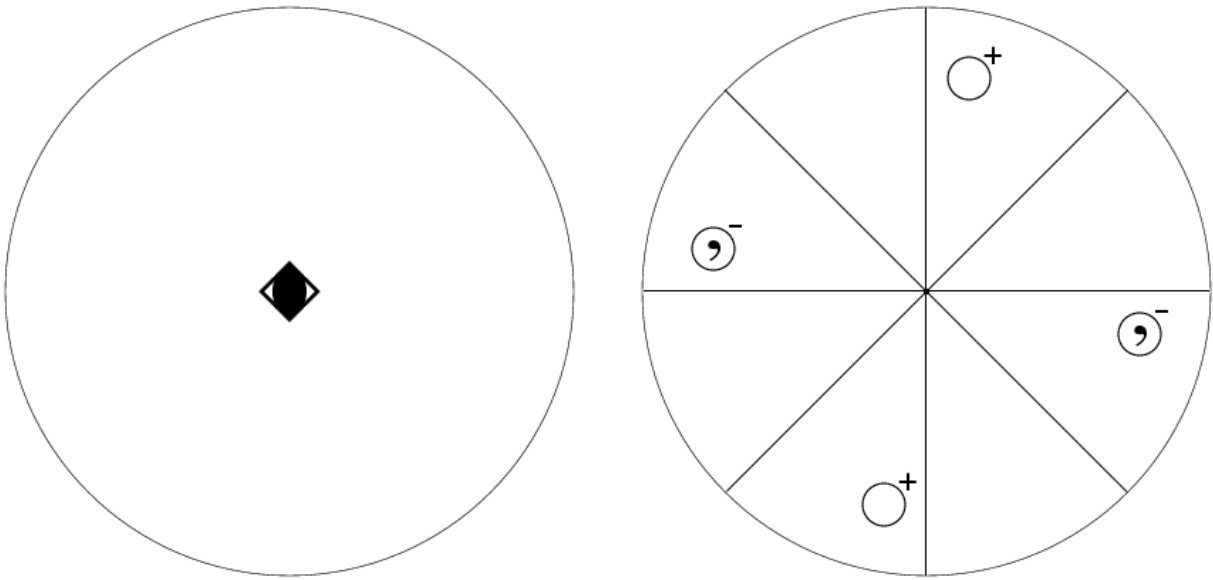
9.3.1.91



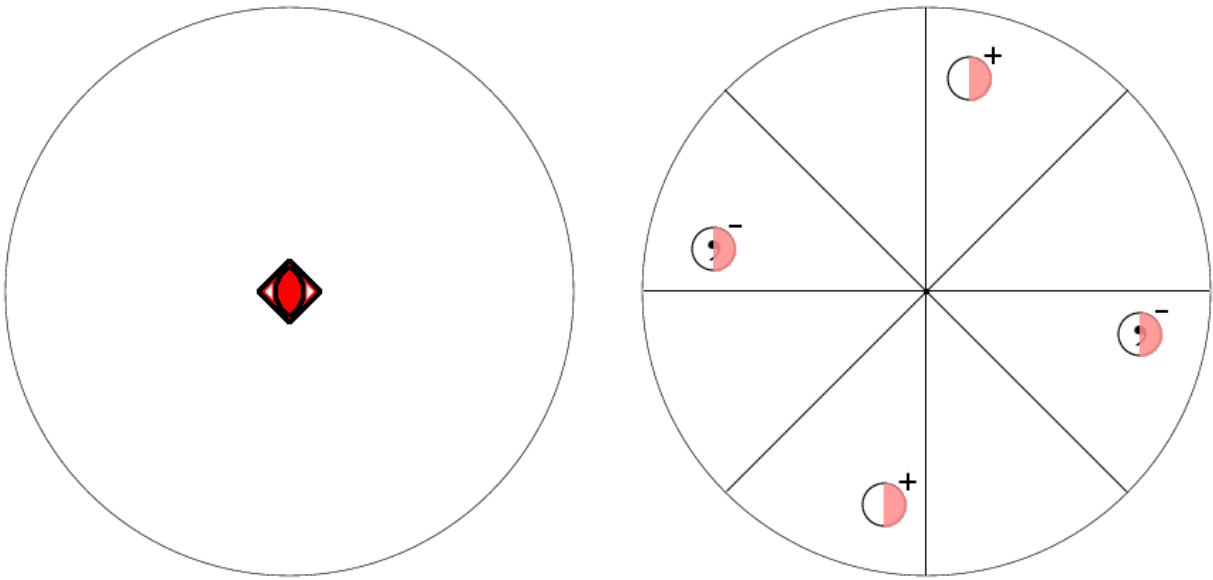
9.3.2.92



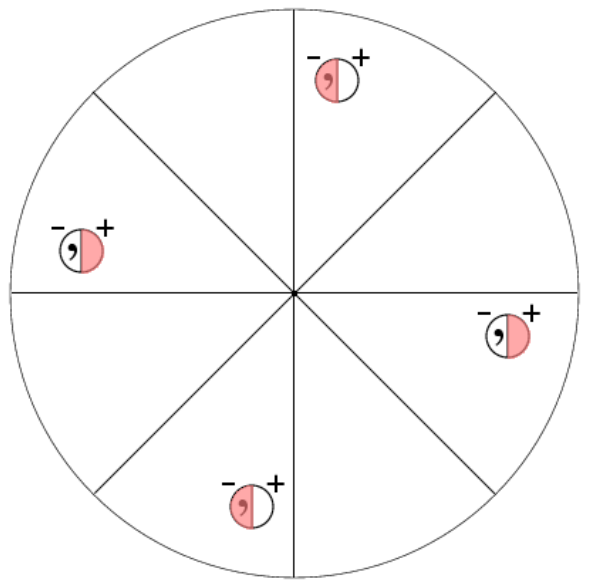
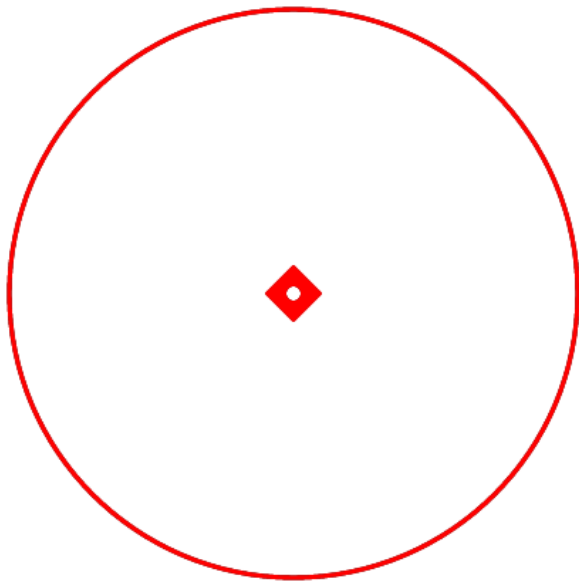
9.3.3.93



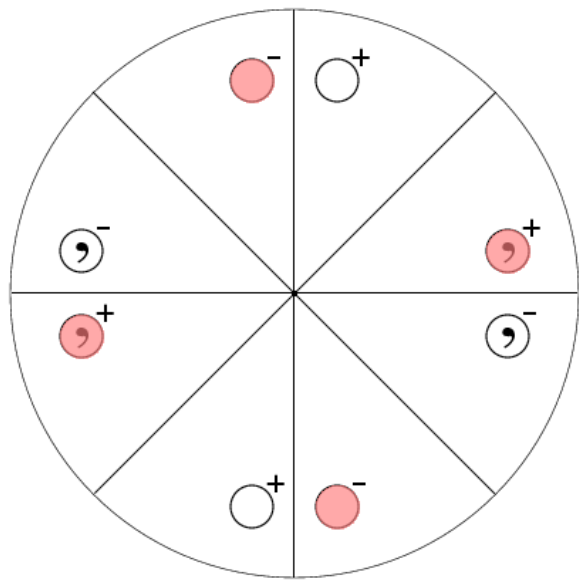
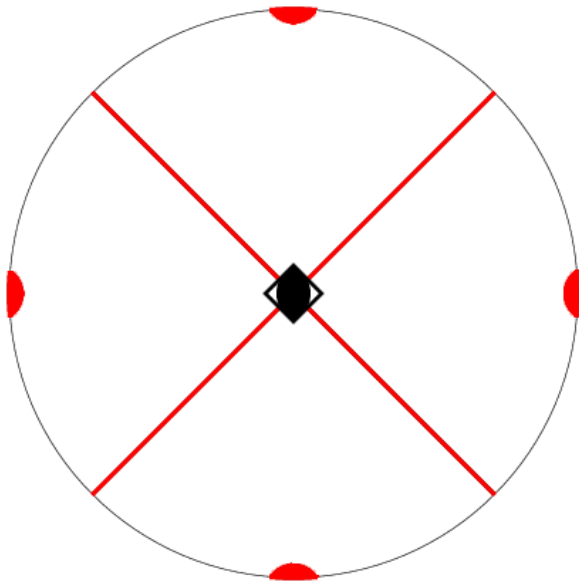
10.1.1.94



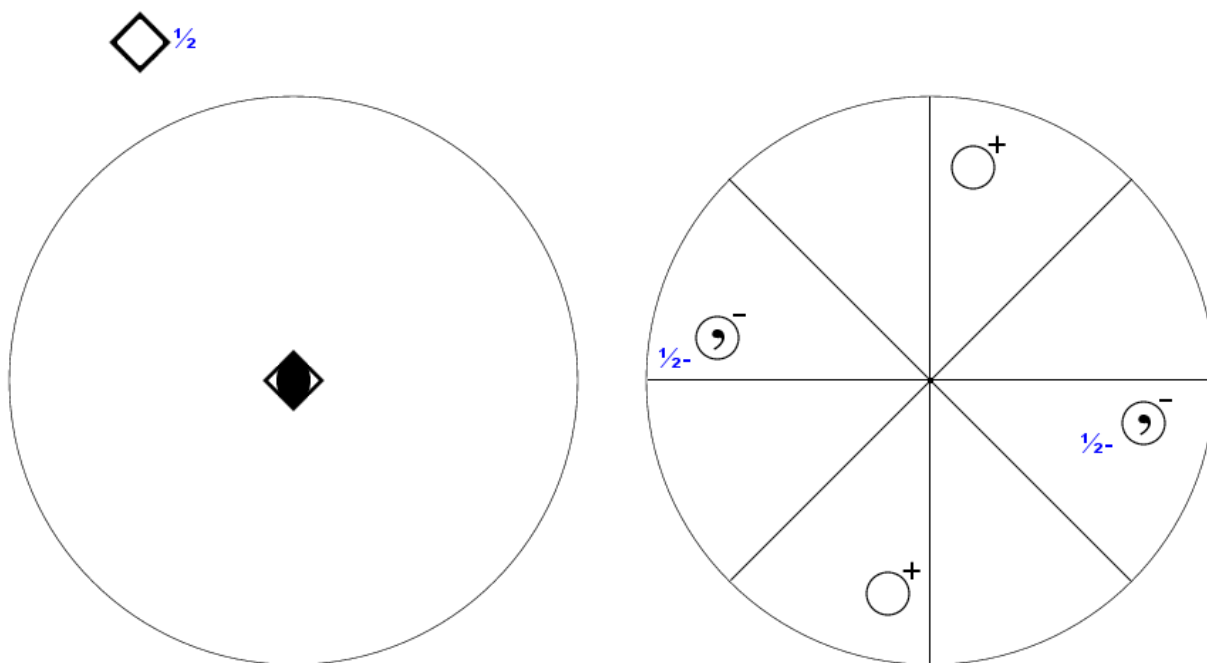
10.1.2.95



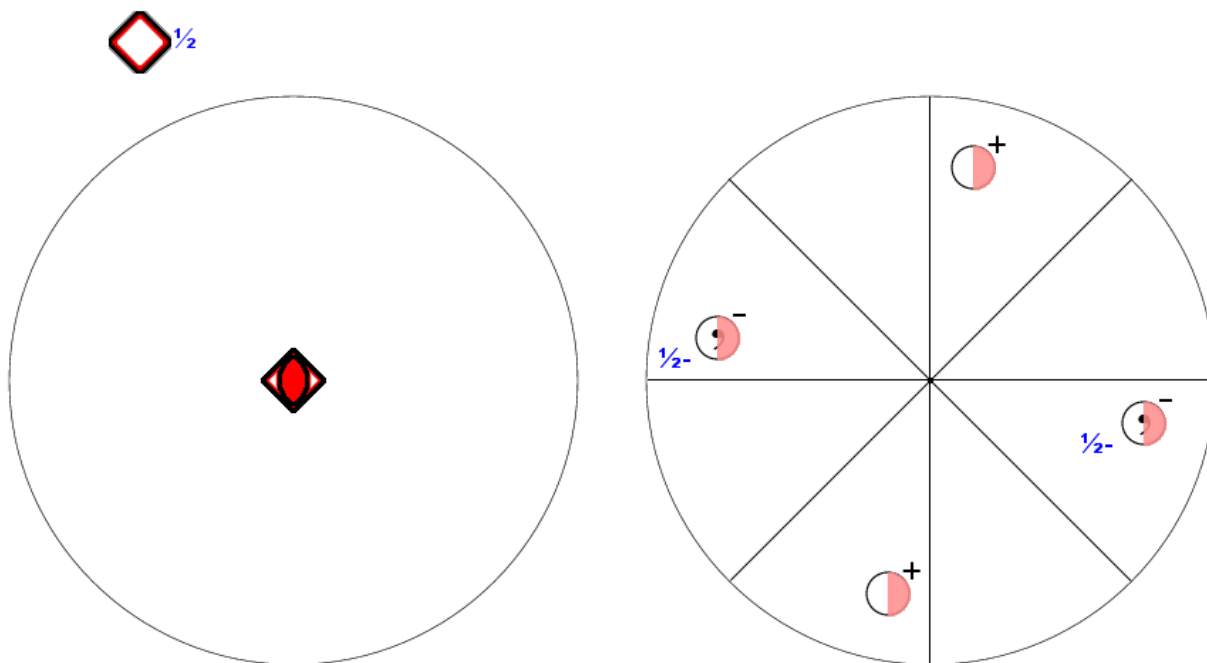
10.1.3.96



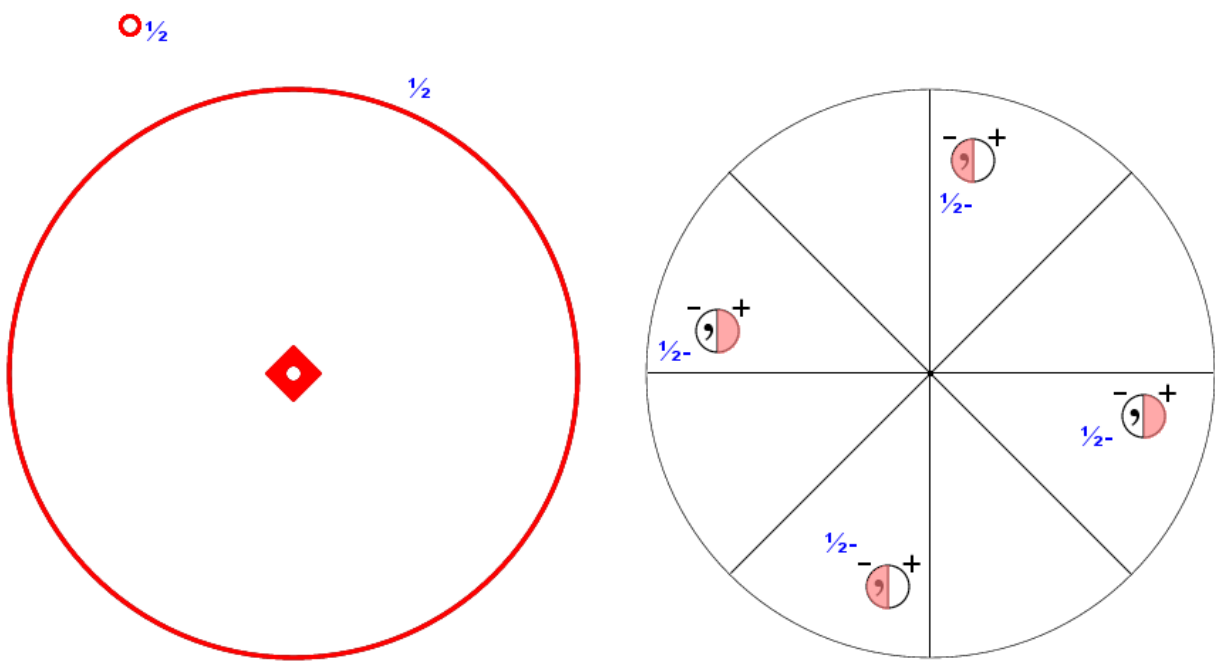
10.1.4.97



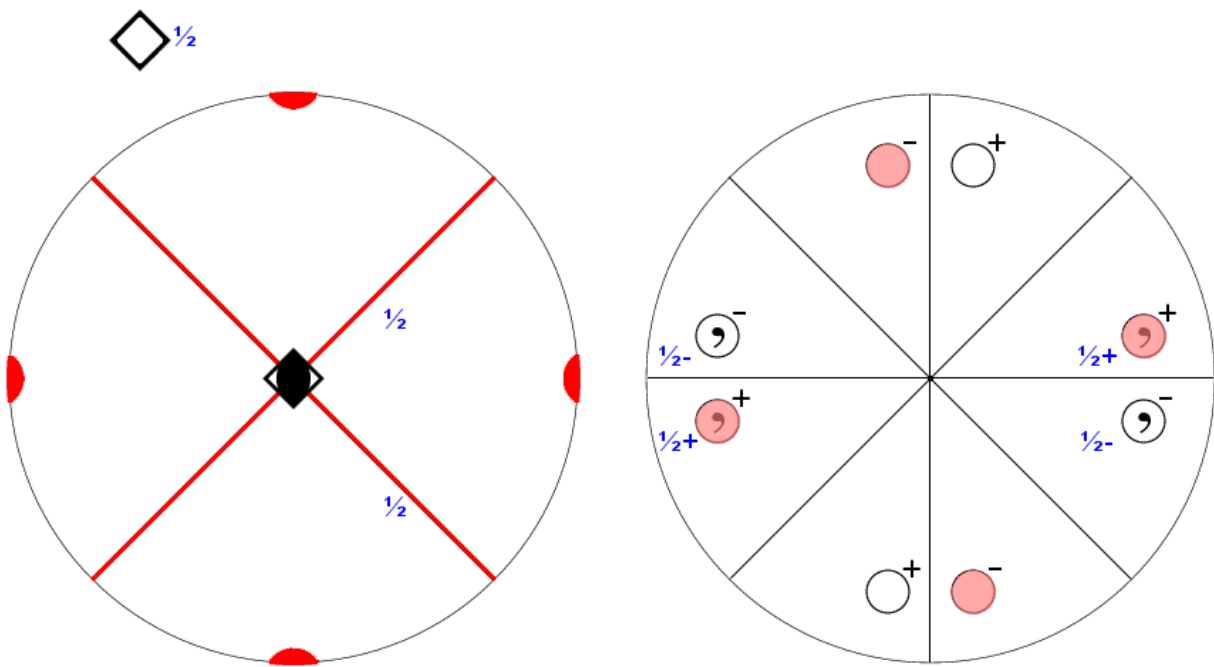
10.2.1.98



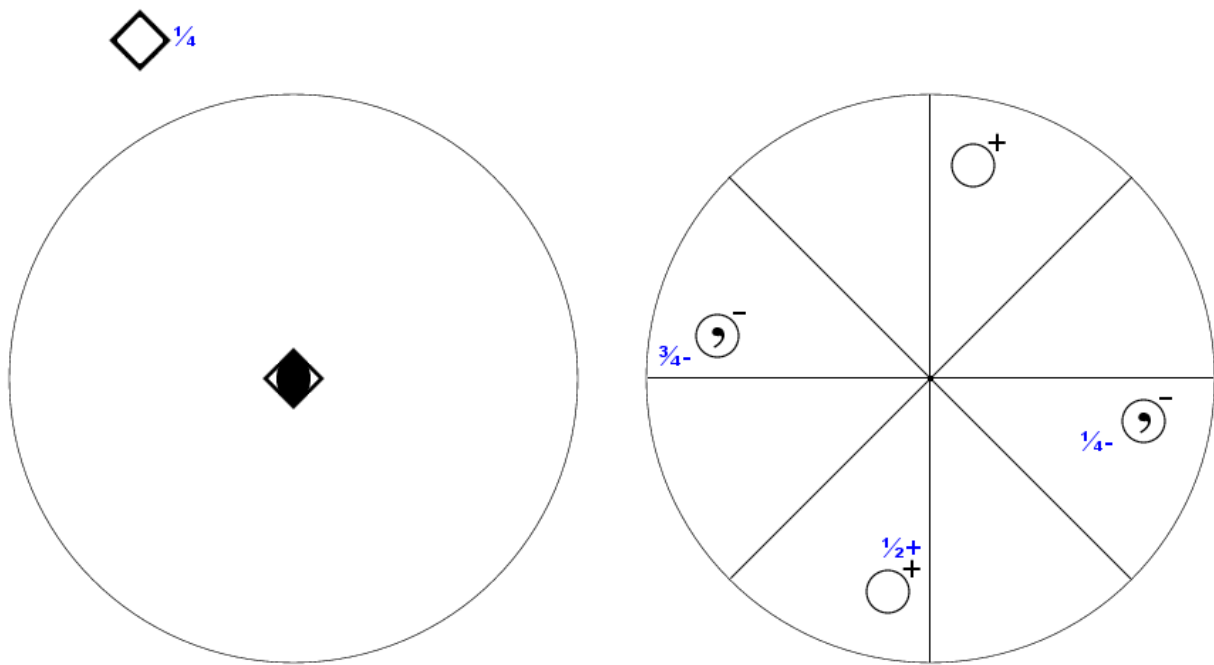
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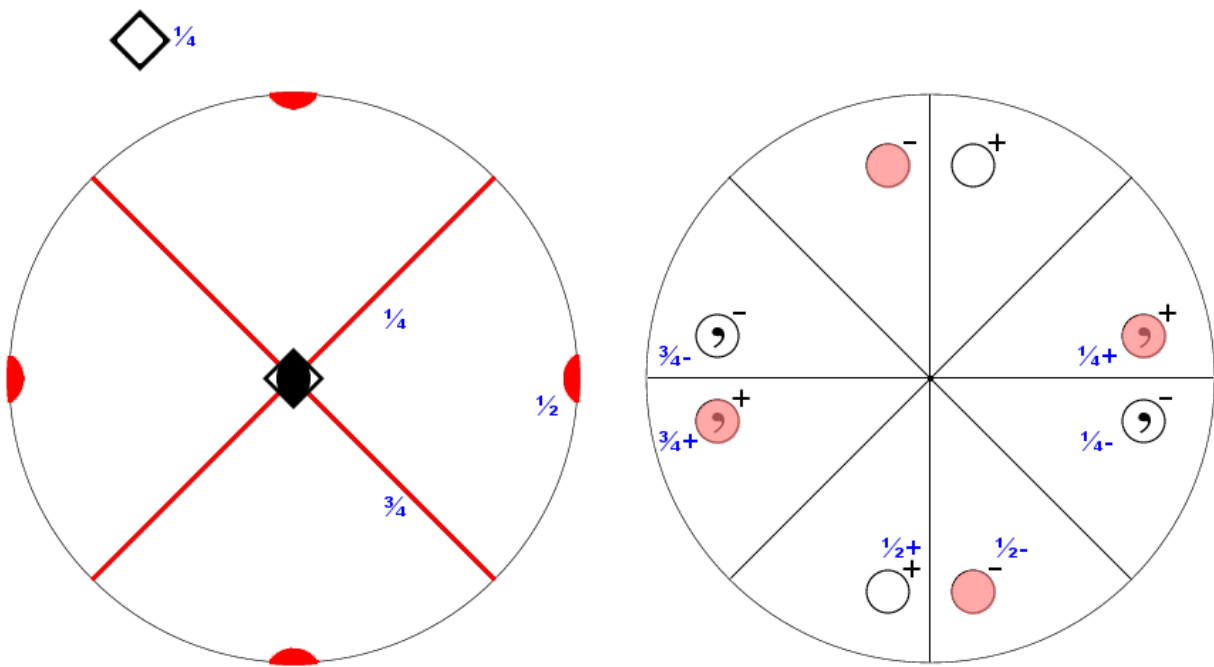
10.2.3.100



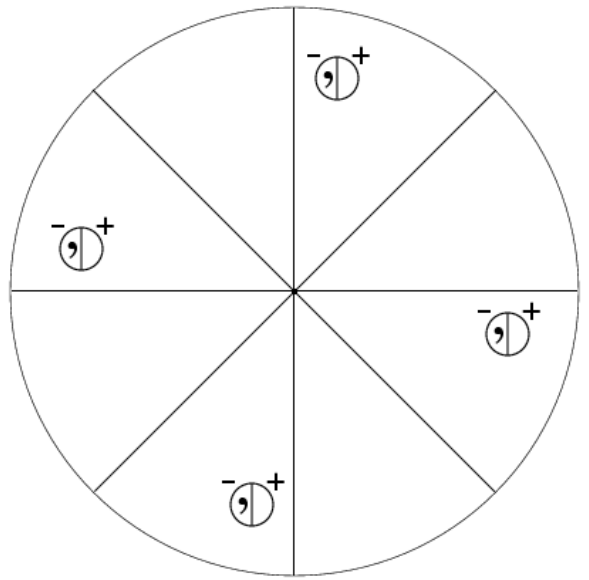
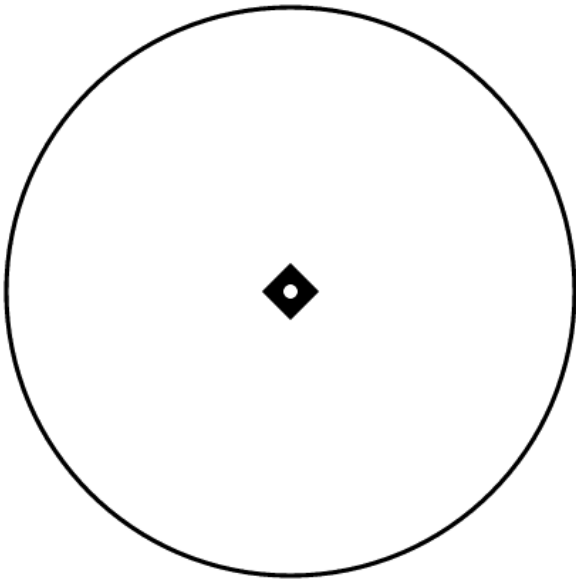
10.2.4.101



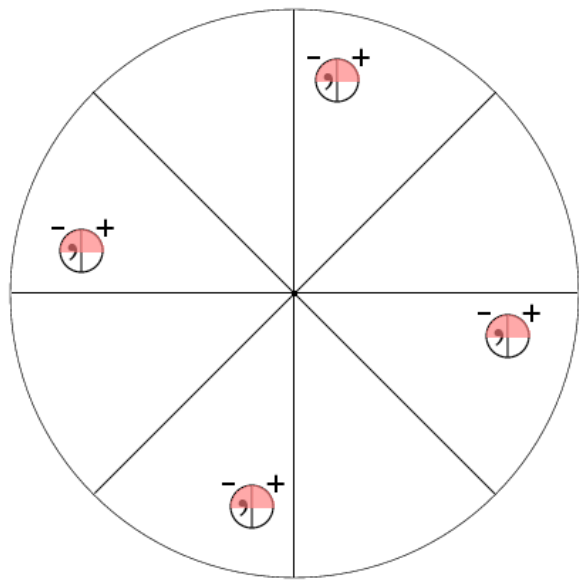
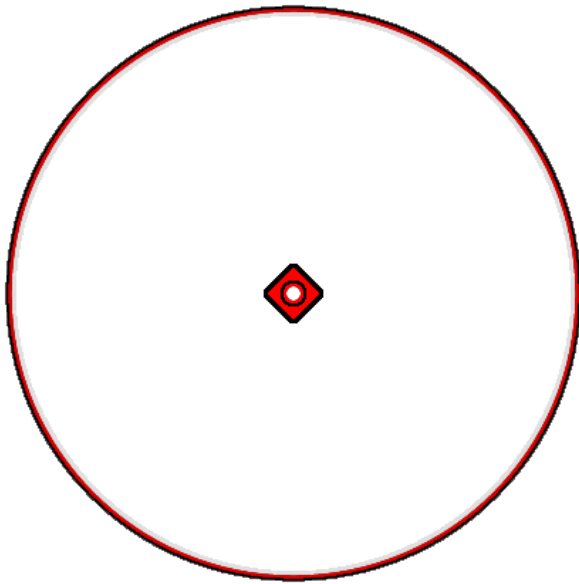
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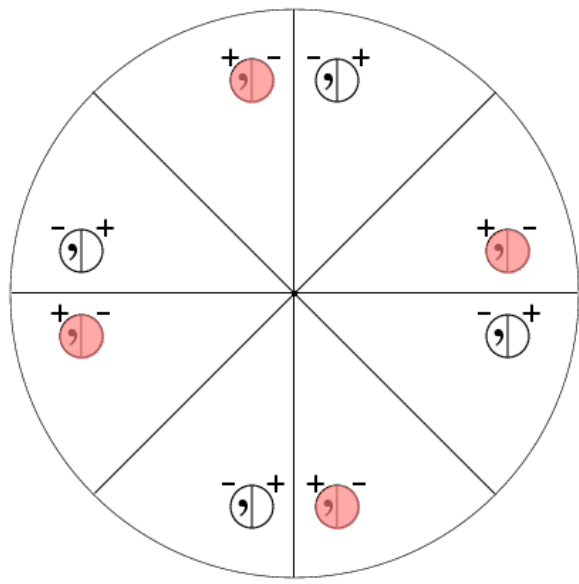
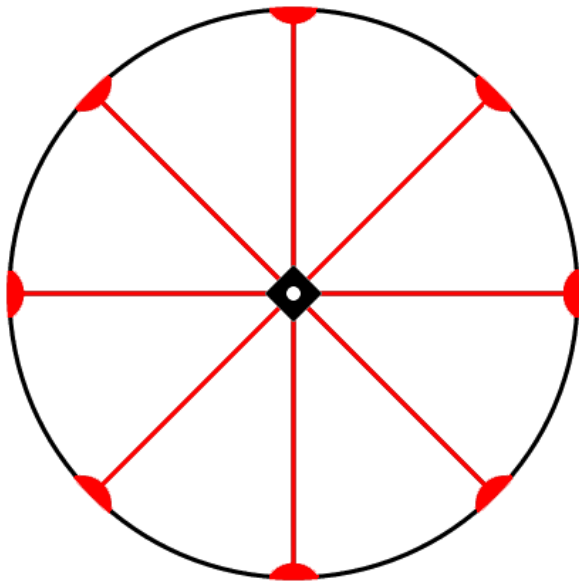
10.3.2.103



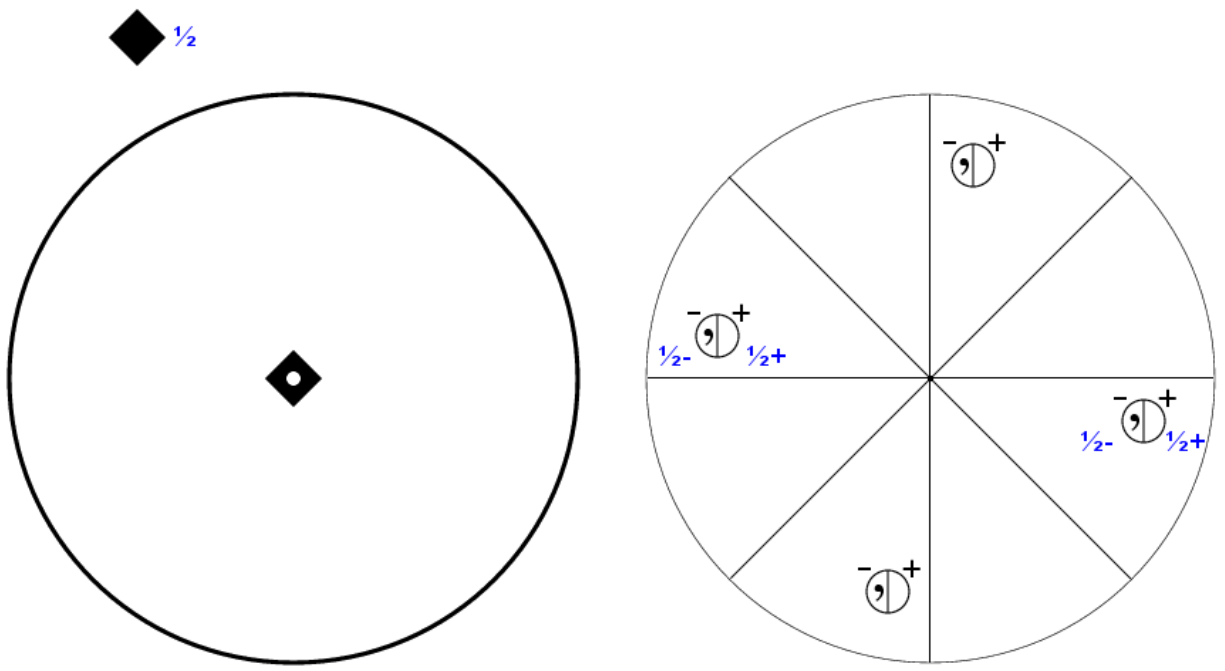
11.1.1.104



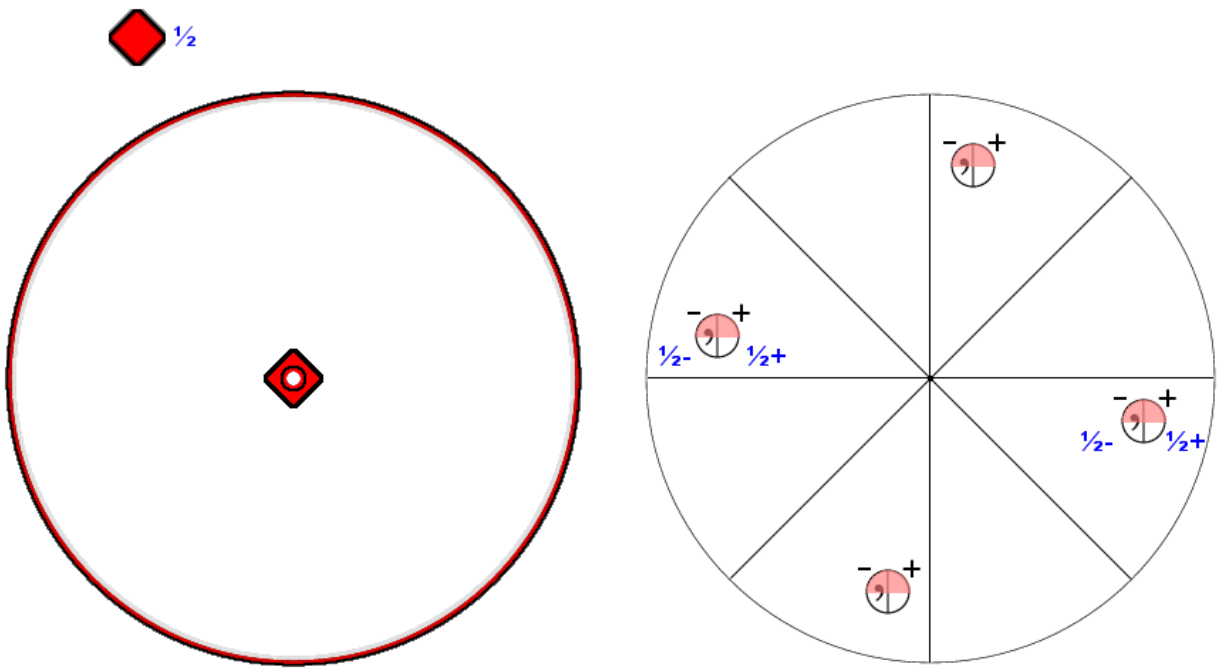
11.1.2.105



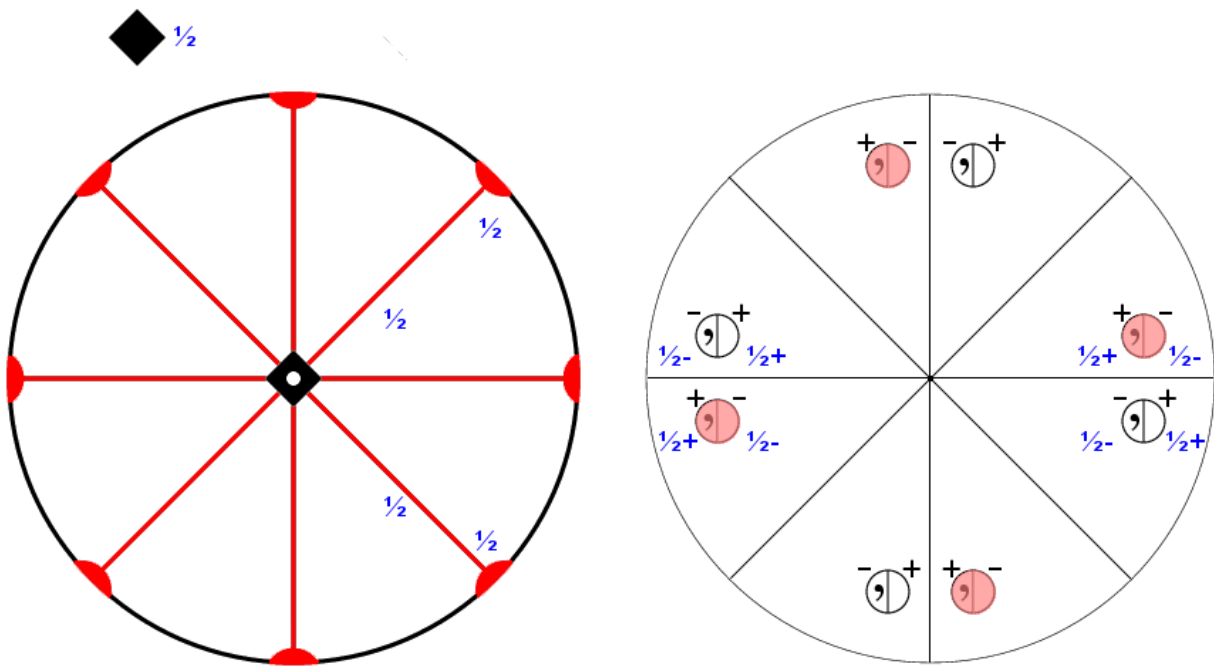
11.1.3.106



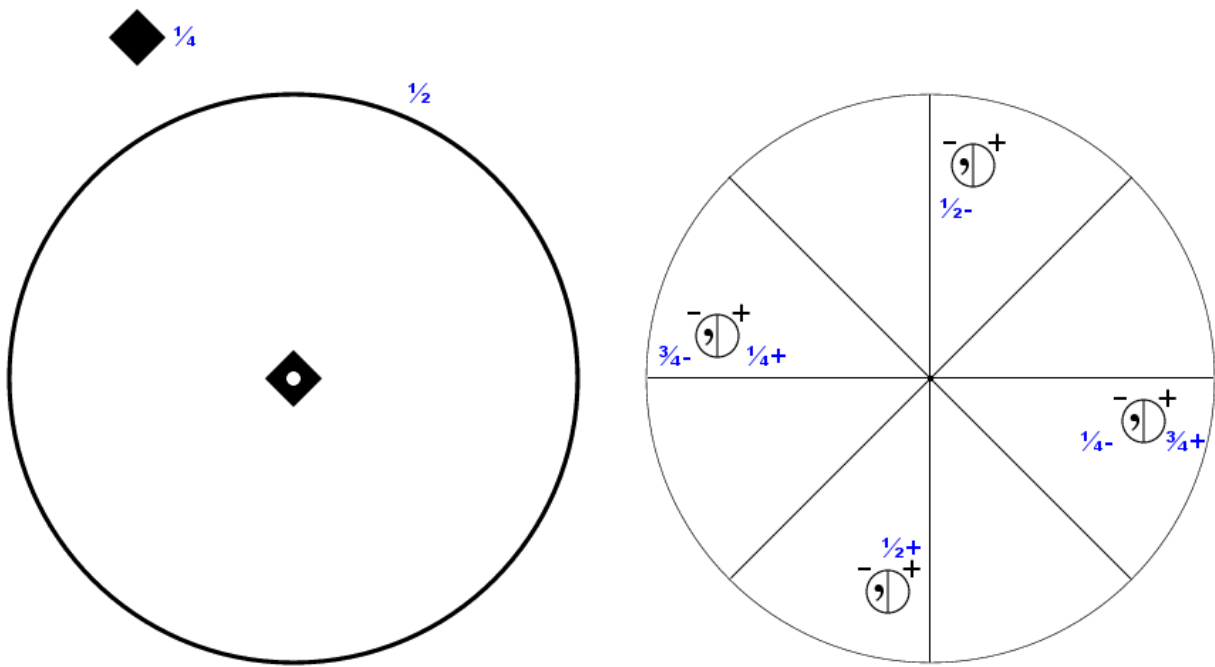
11.2.1.107



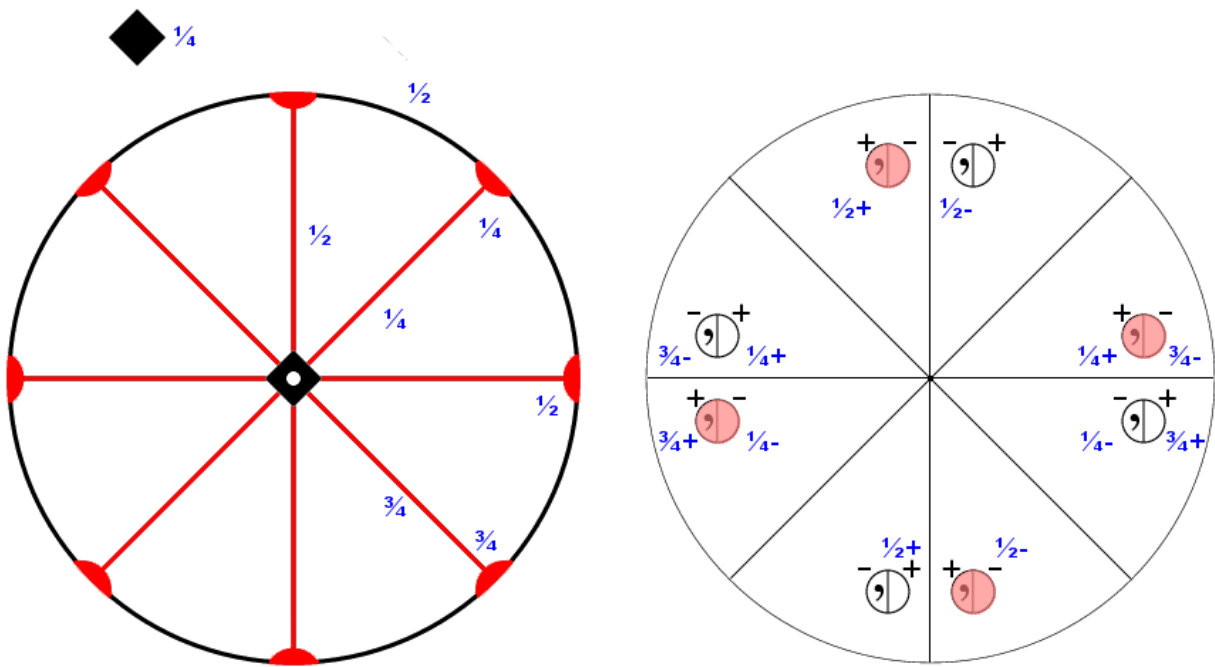
11.2.2.108



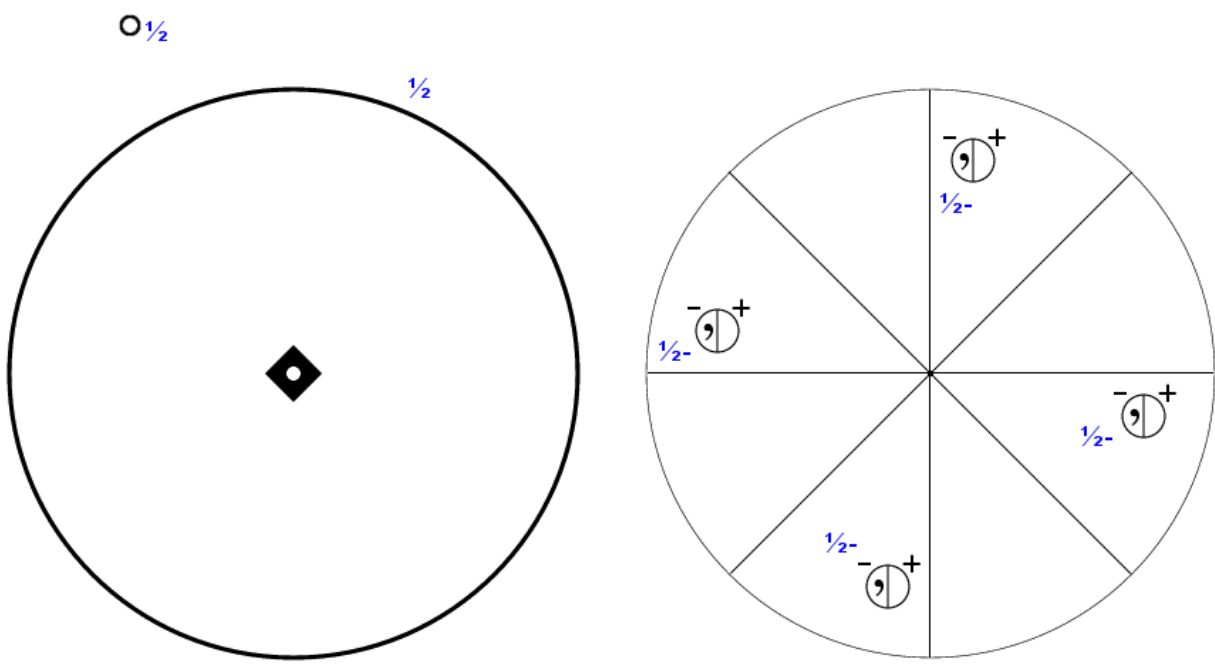
11.2.3.109



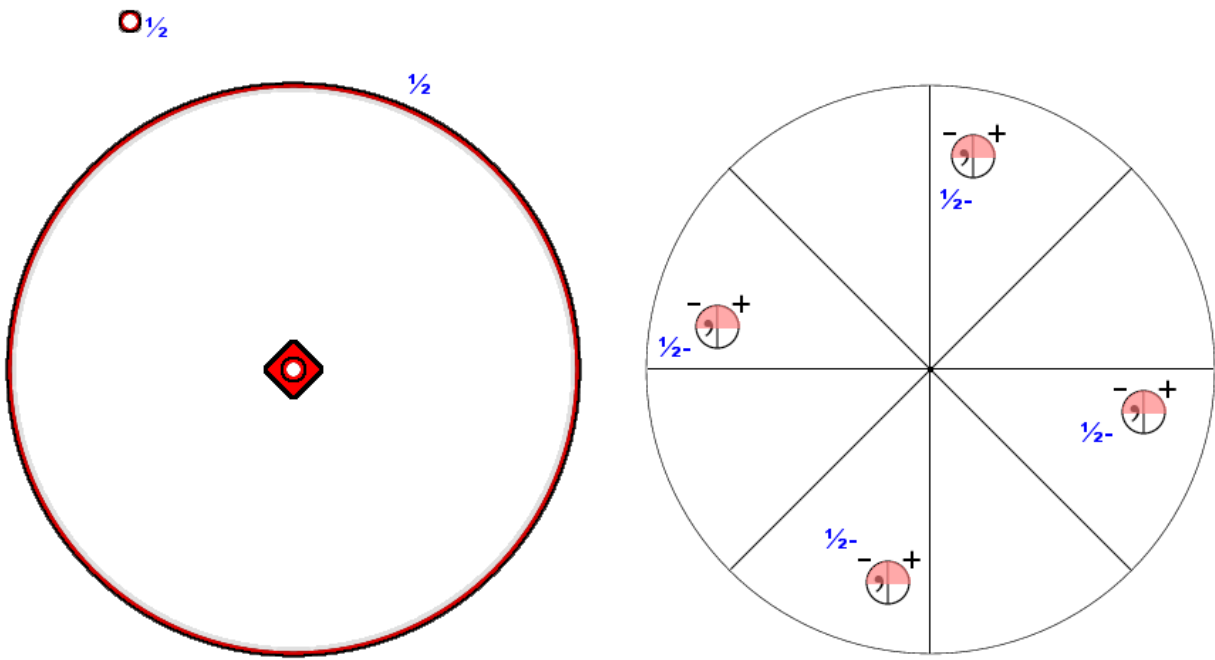
11.3.1.110



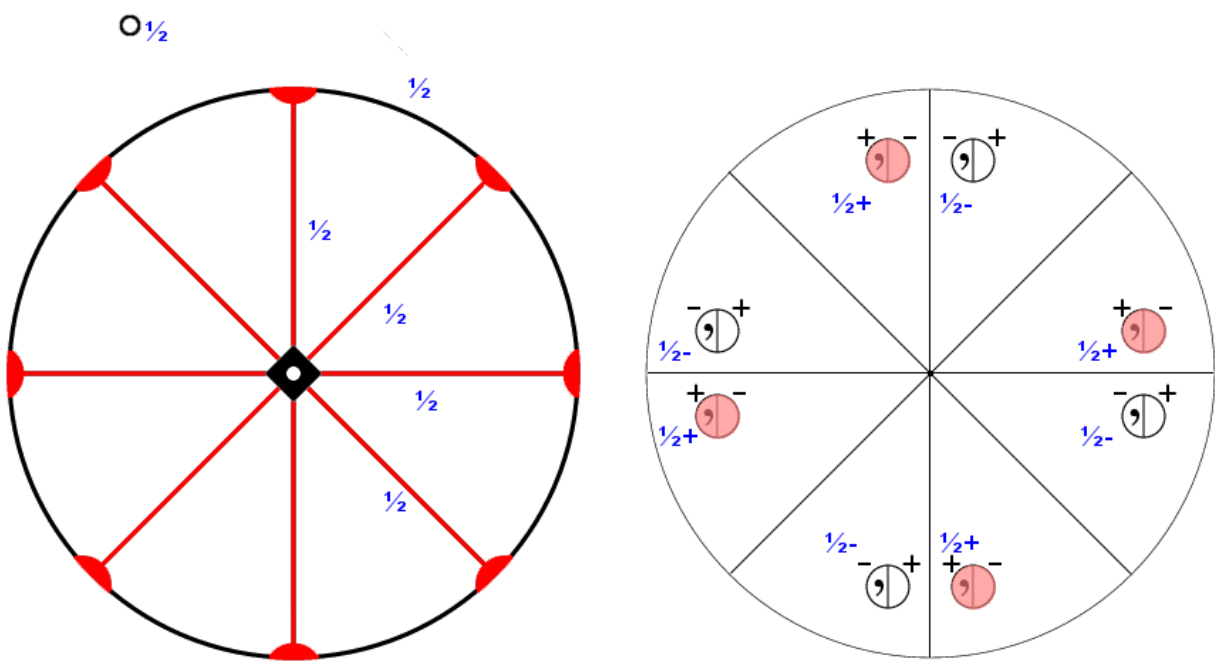
11.3.2.111



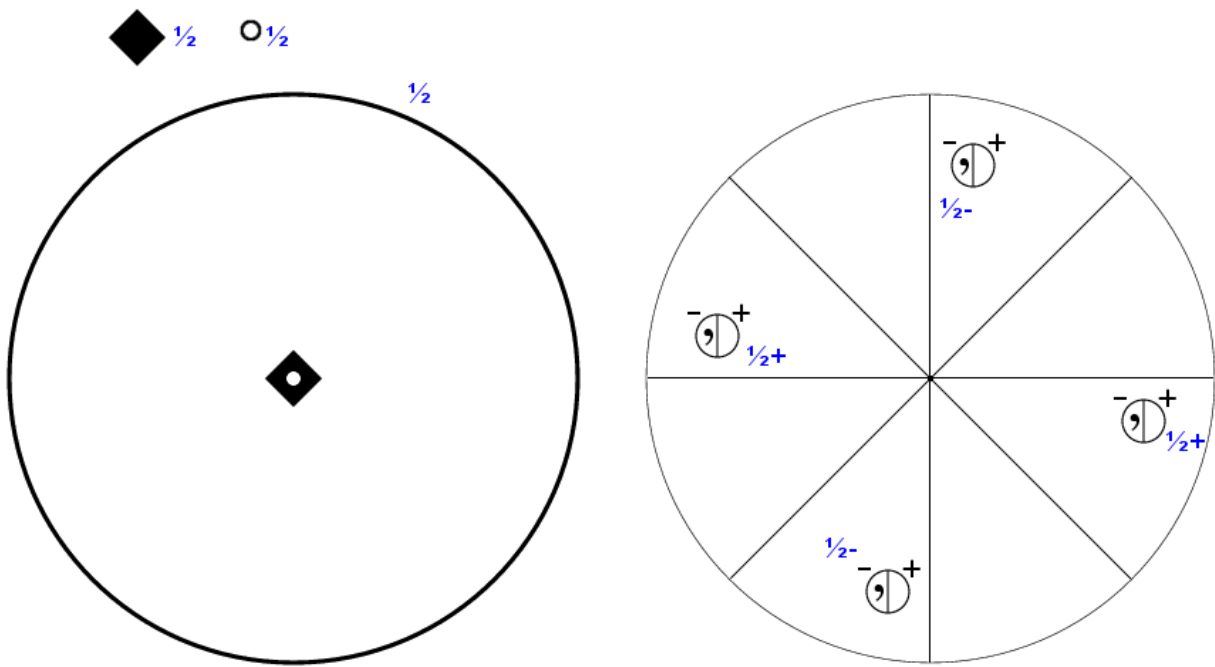
11.4.1.112



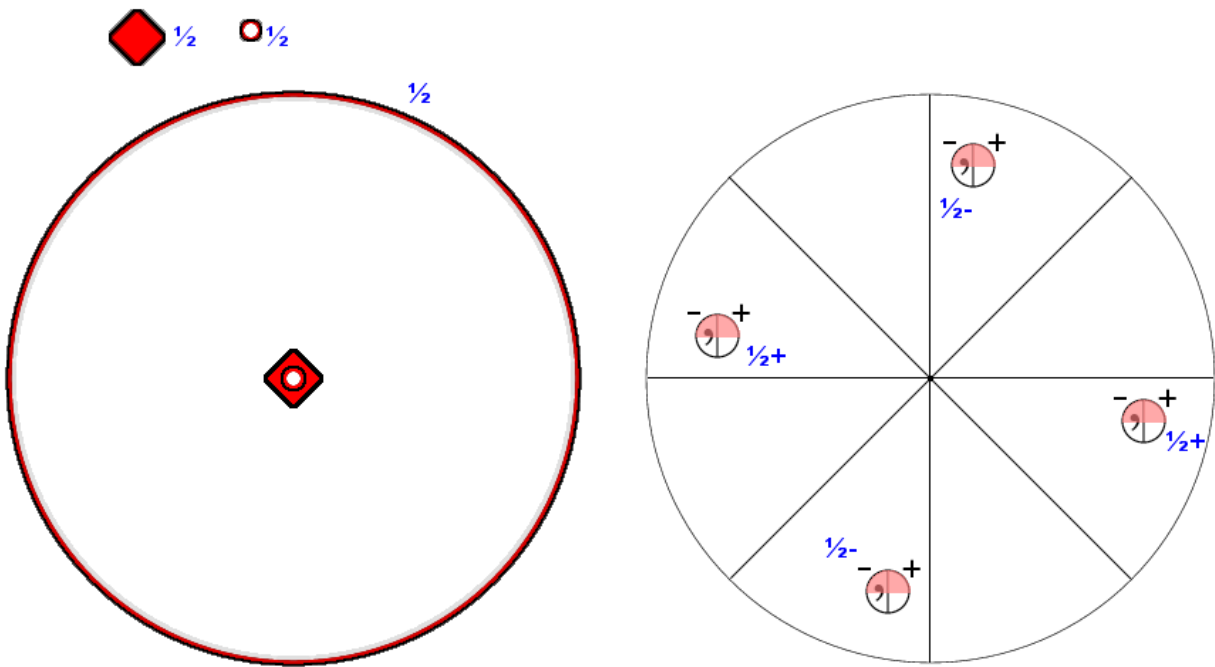
11.4.2.113



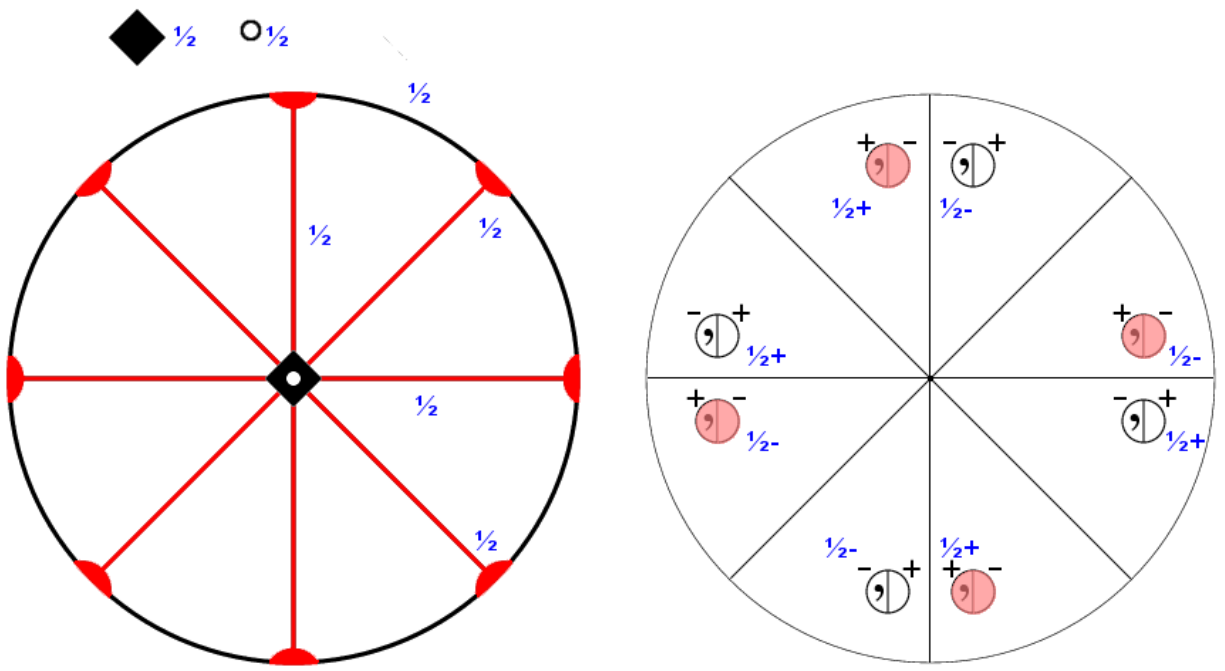
11.4.3.114



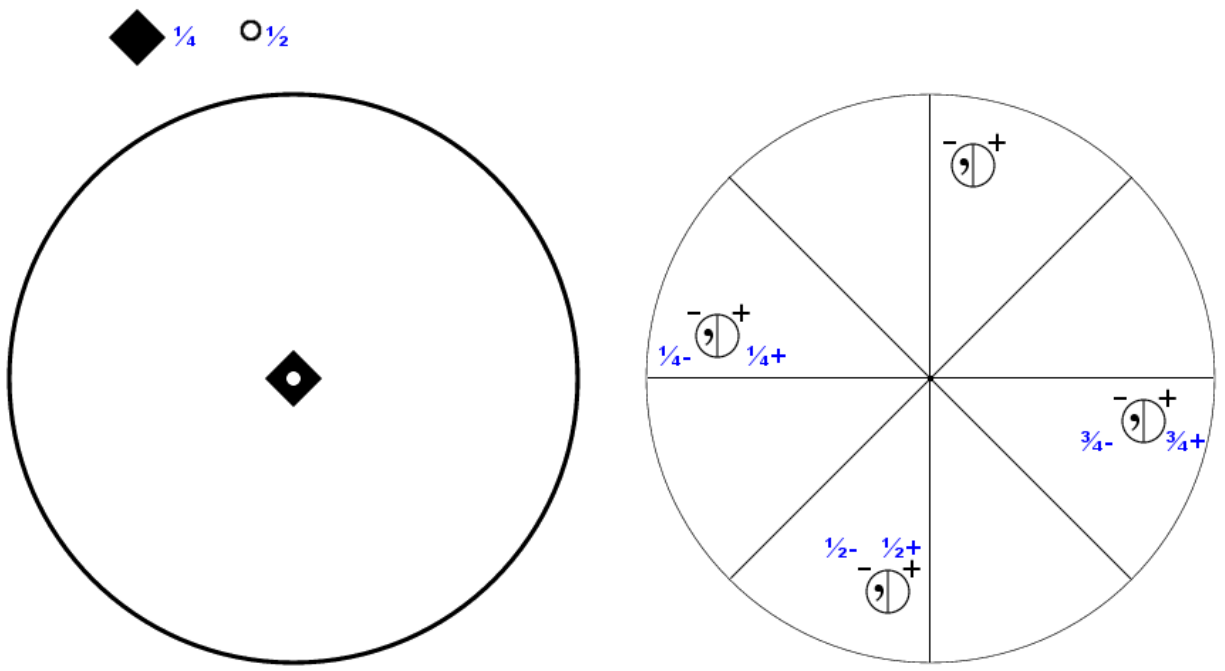
11.5.1.115



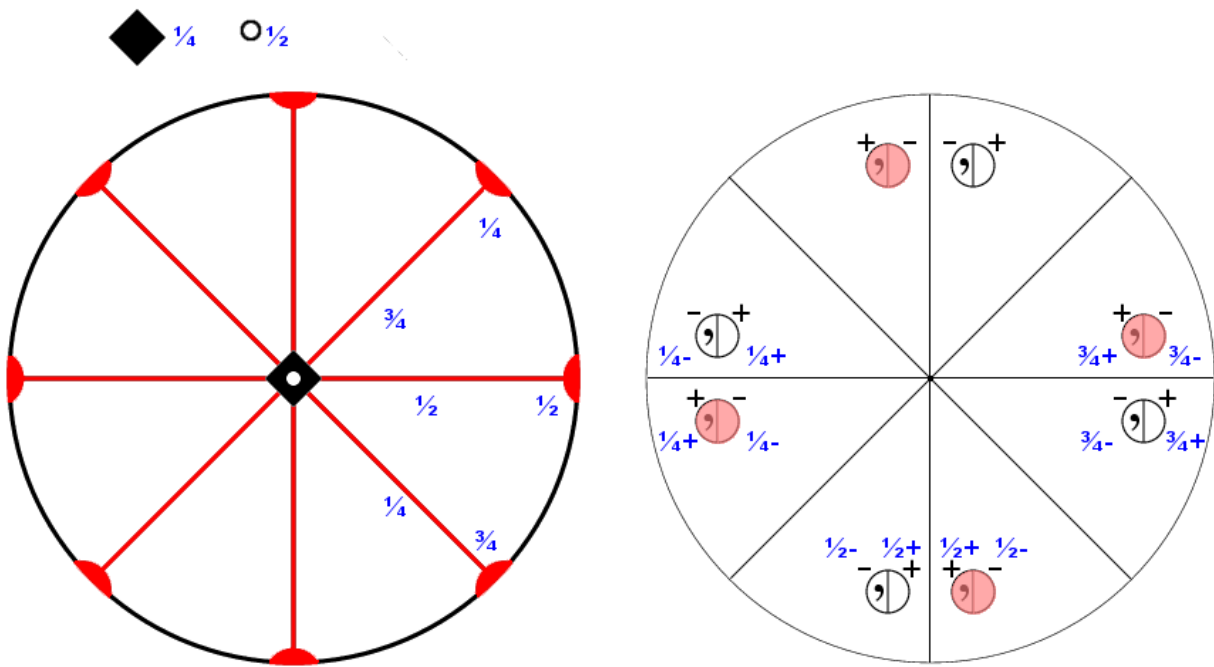
11.5.2.116



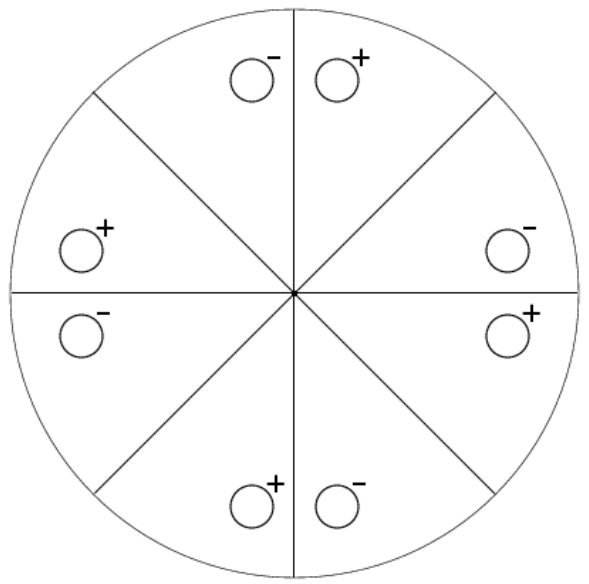
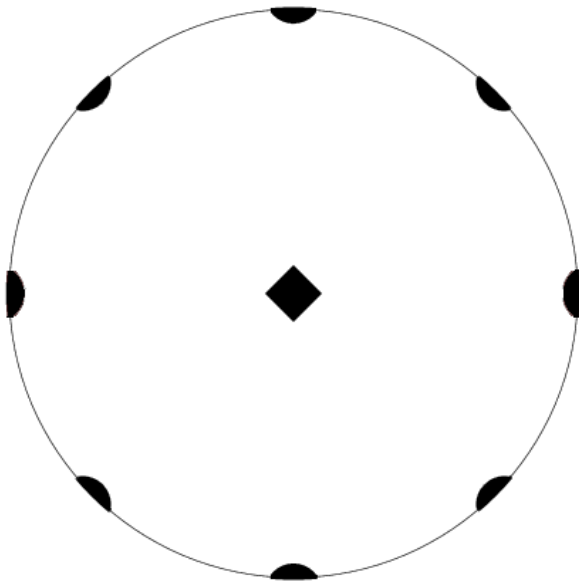
11.5.3.117



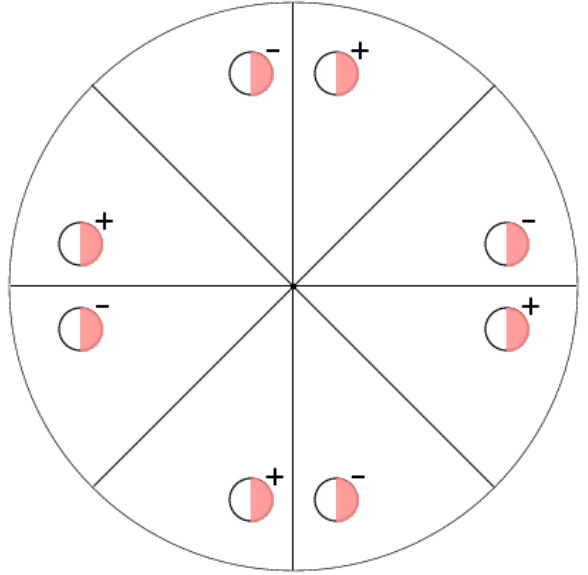
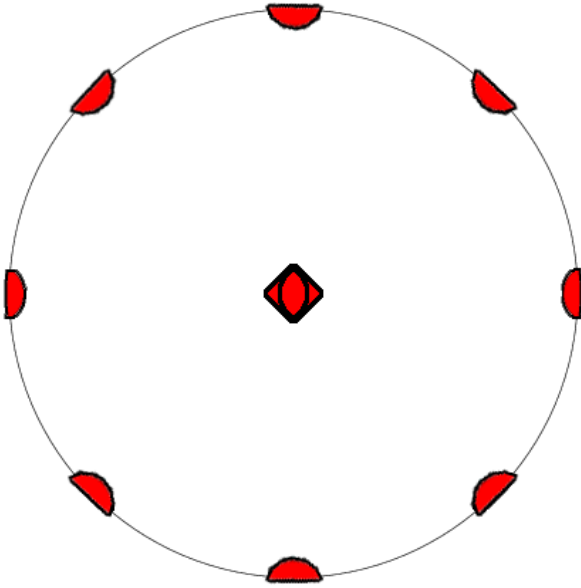
11.6.1.118



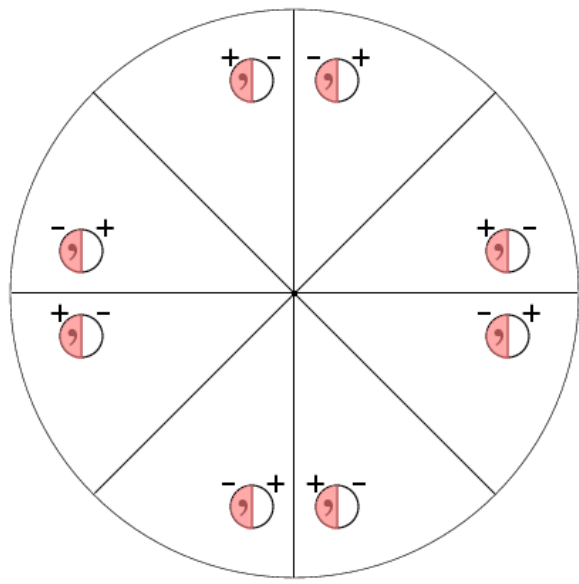
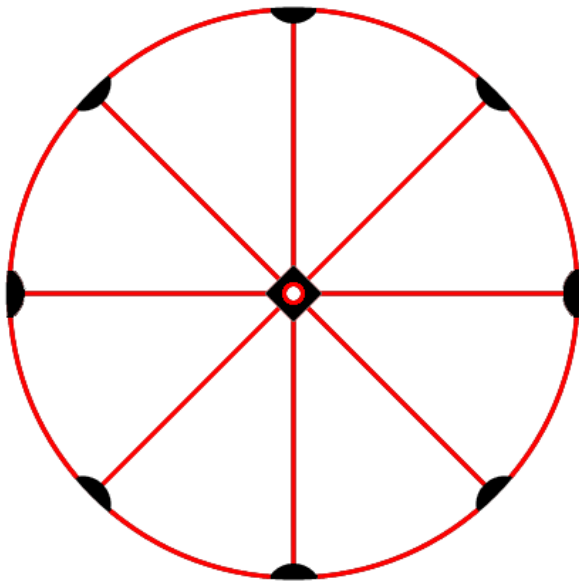
11.6.2.119



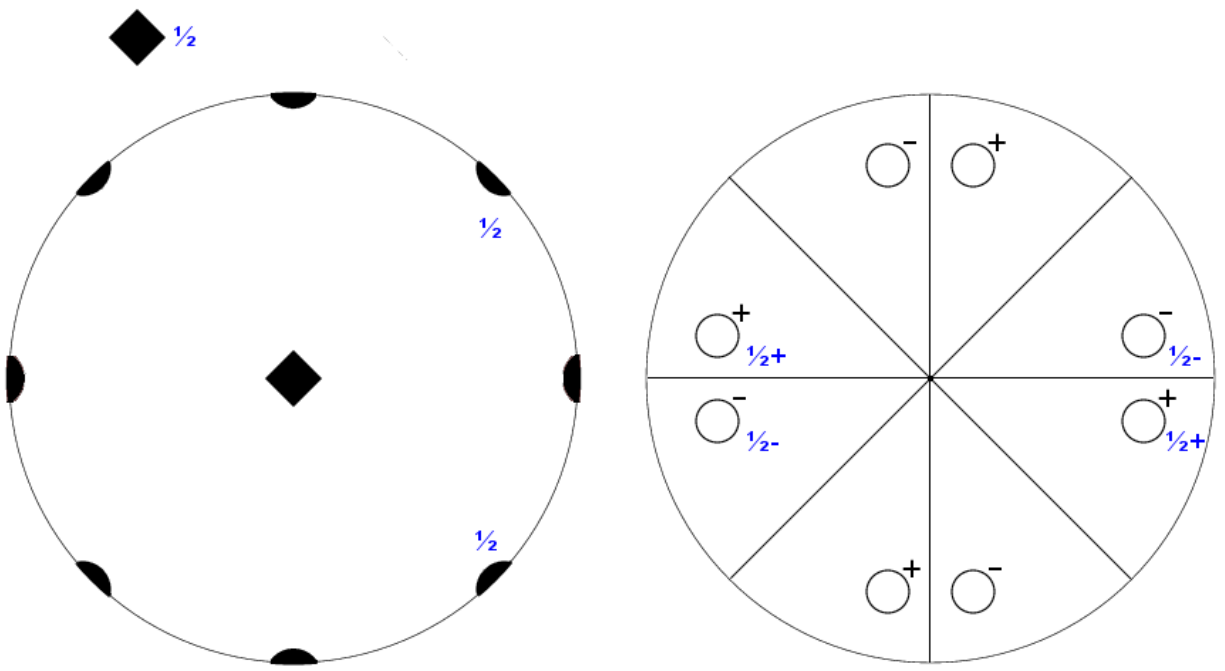
12.1.1.120



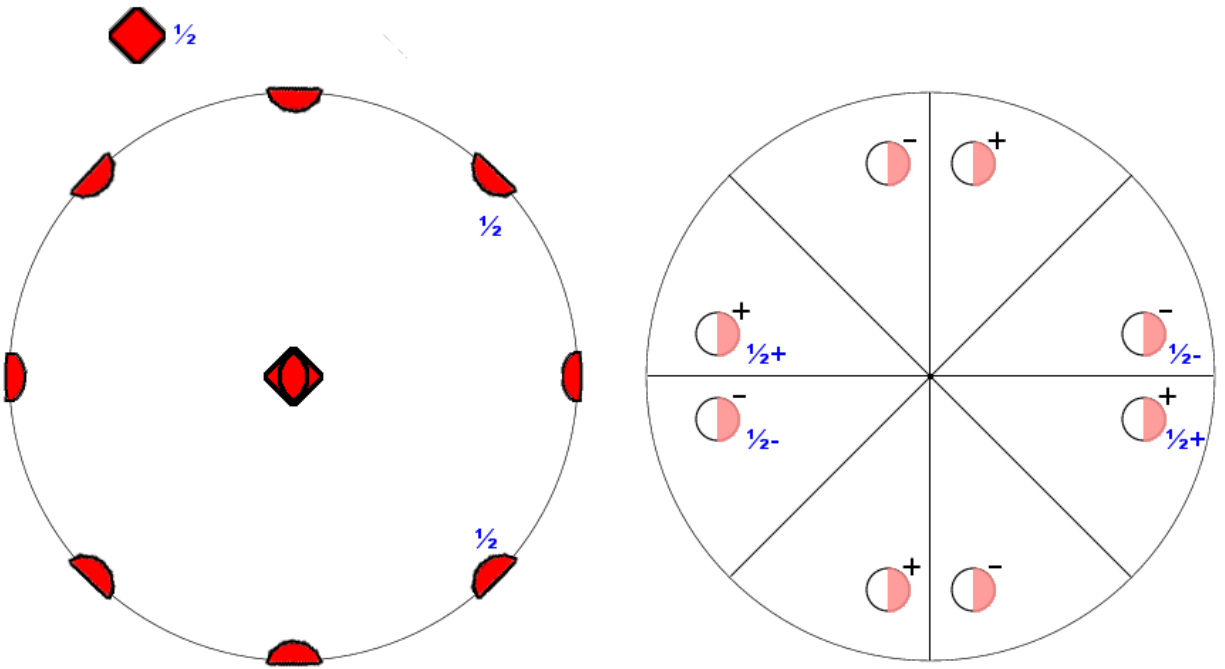
12.1.2.121



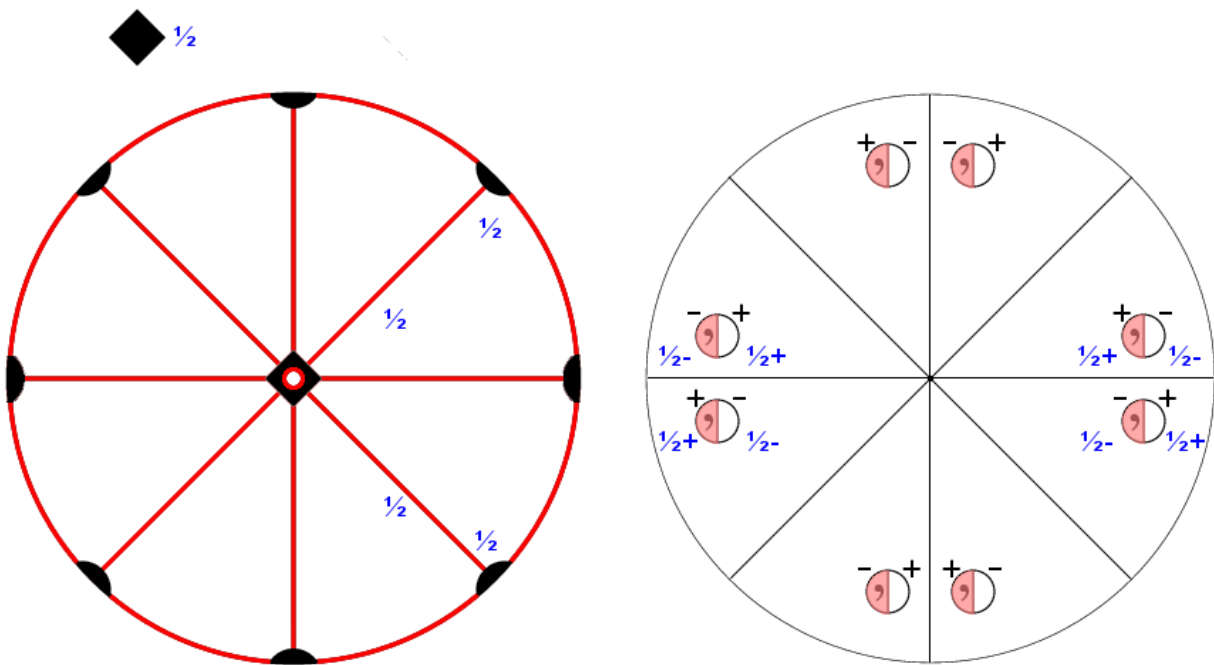
12.1.3.122



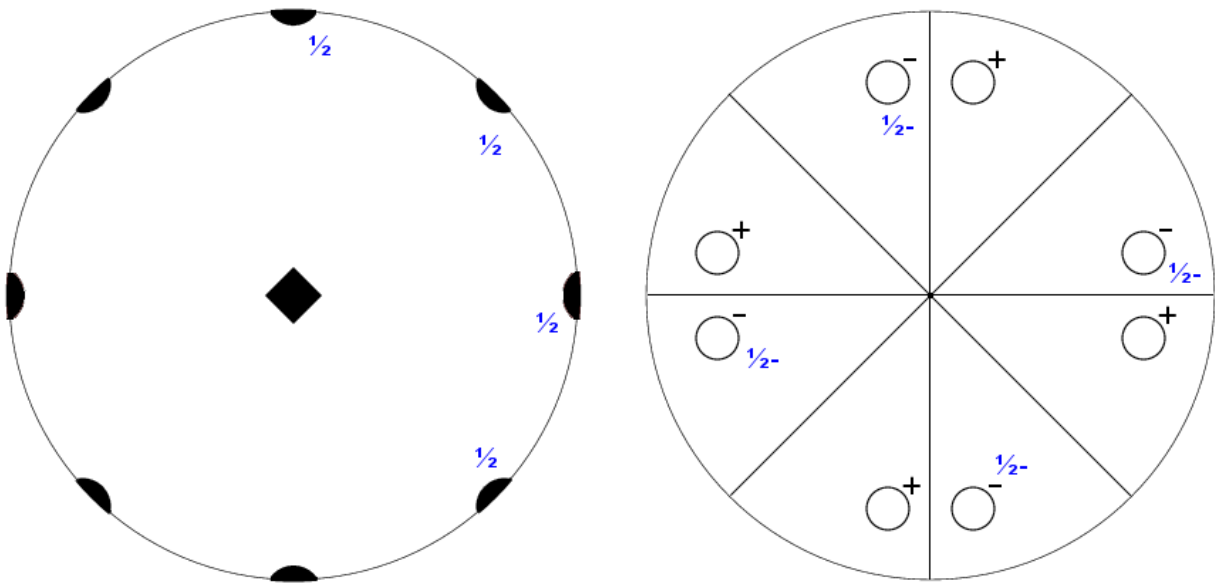
12.2.1.123



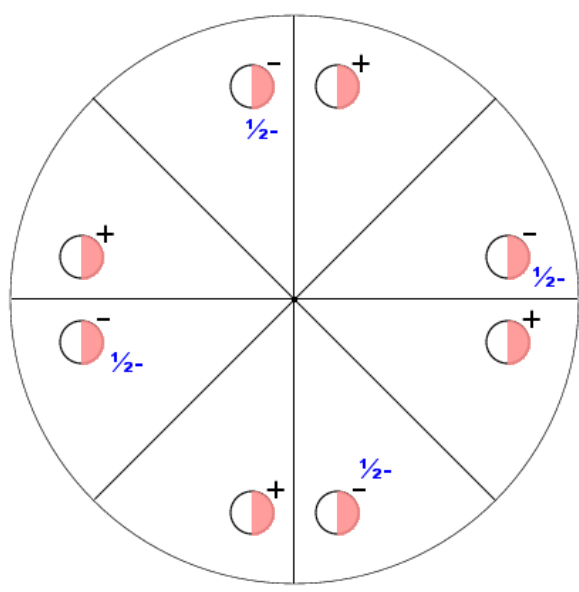
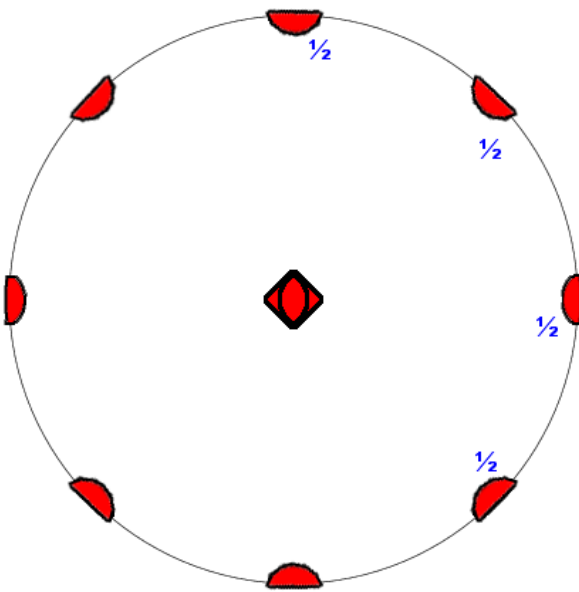
12.2.2.124



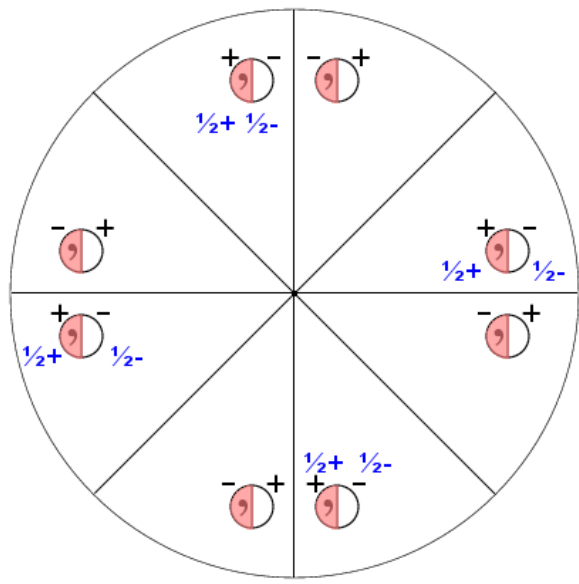
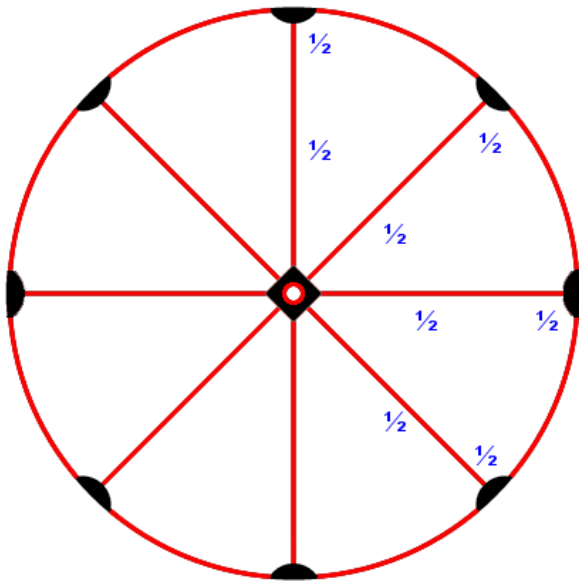
12.2.3.125



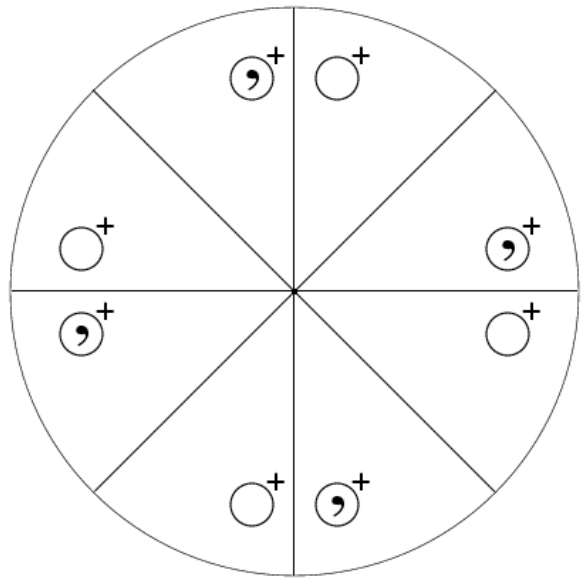
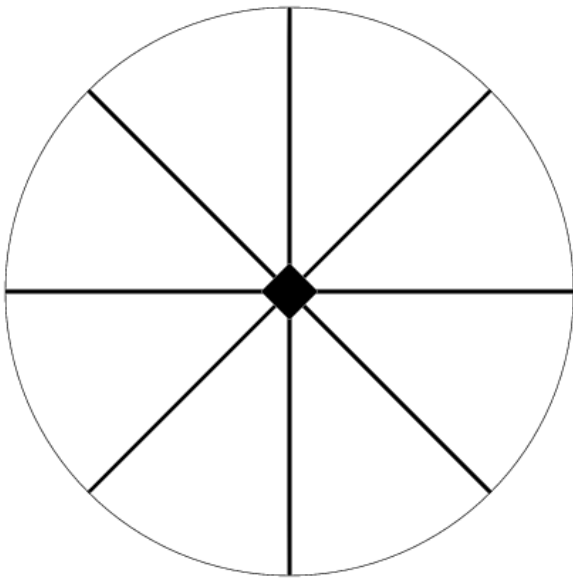
12.3.1.126



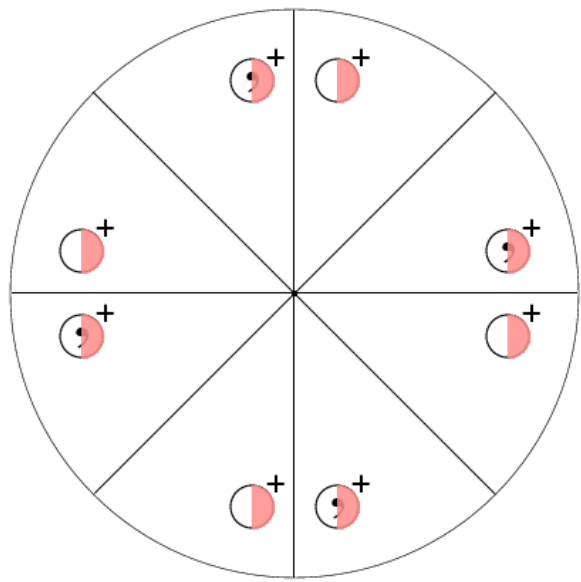
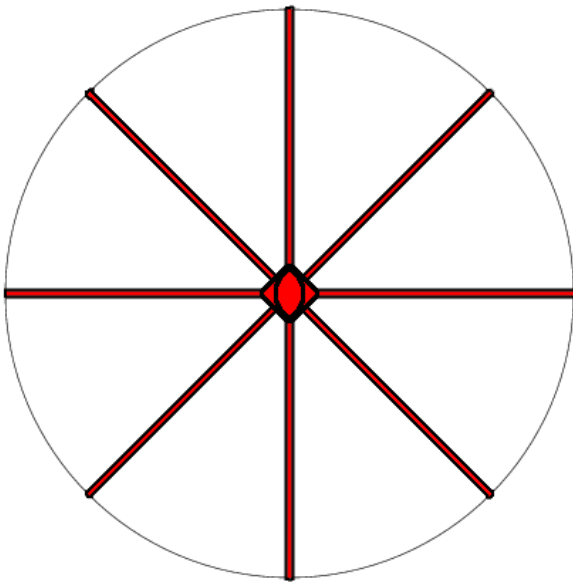
12.3.2.127



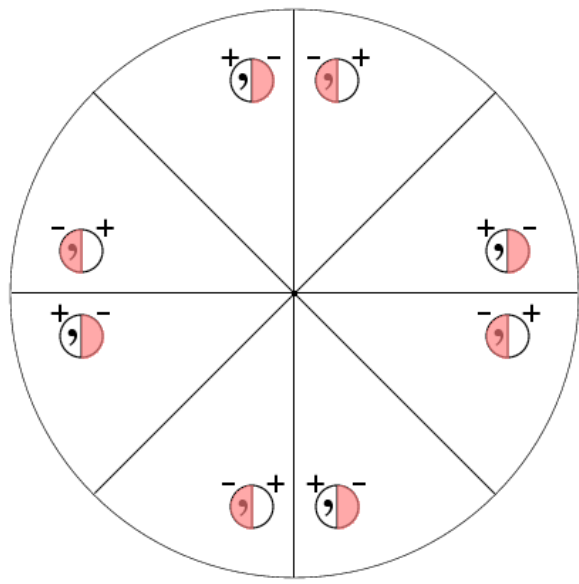
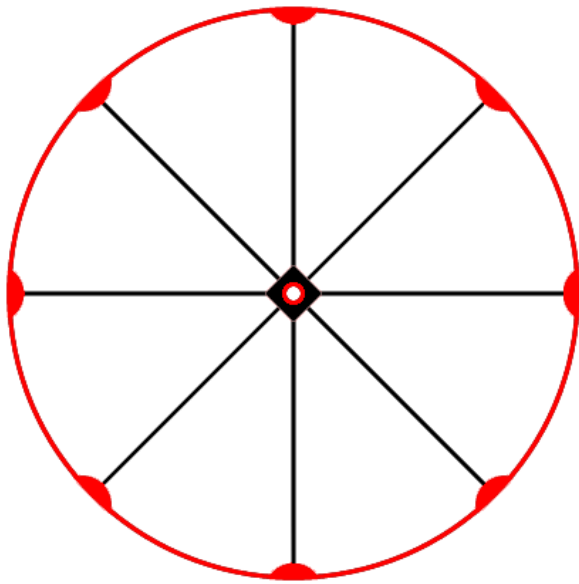
12.3.3.128



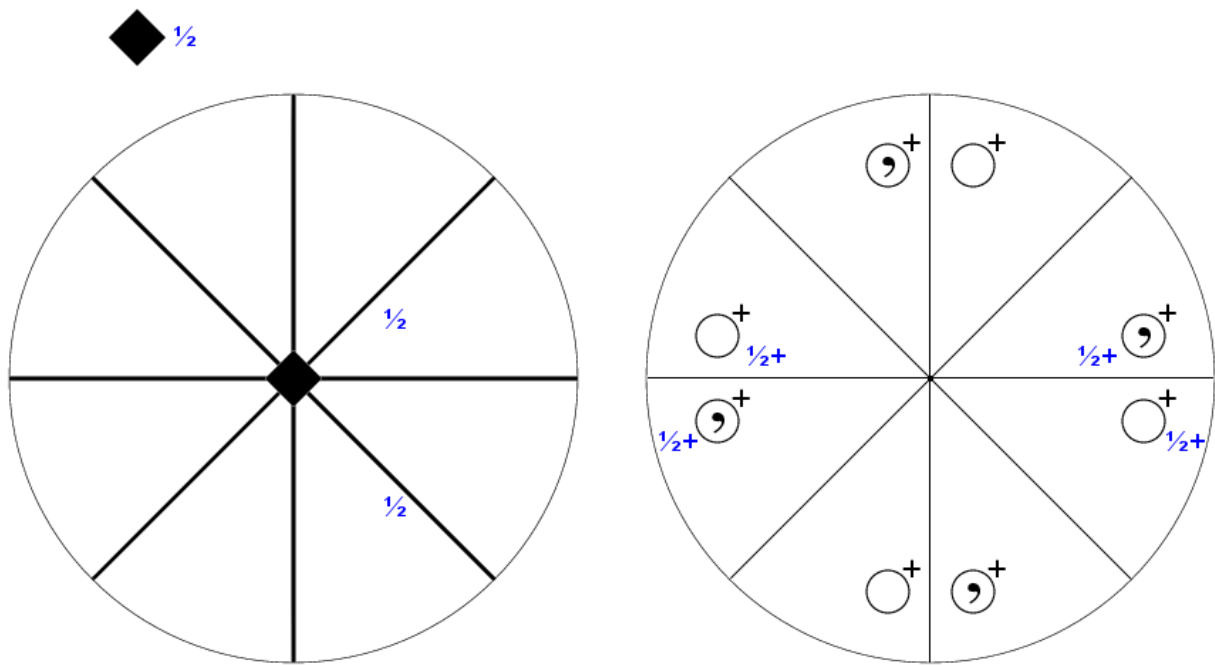
13.1.1.129



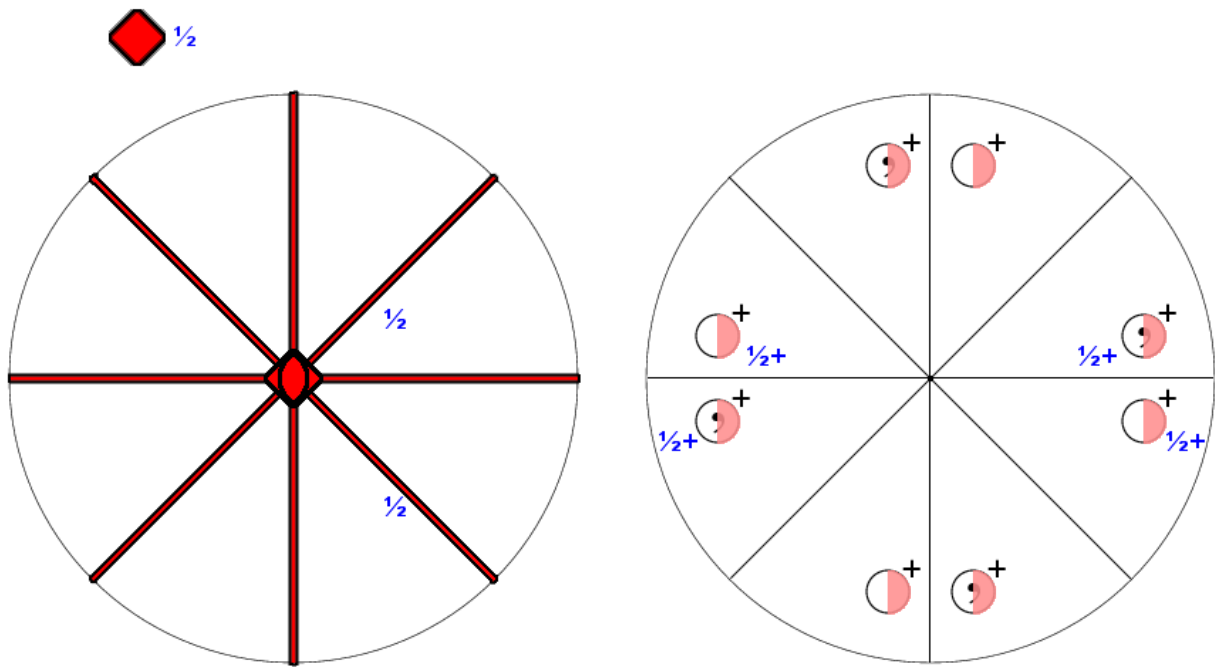
13.1.2.130



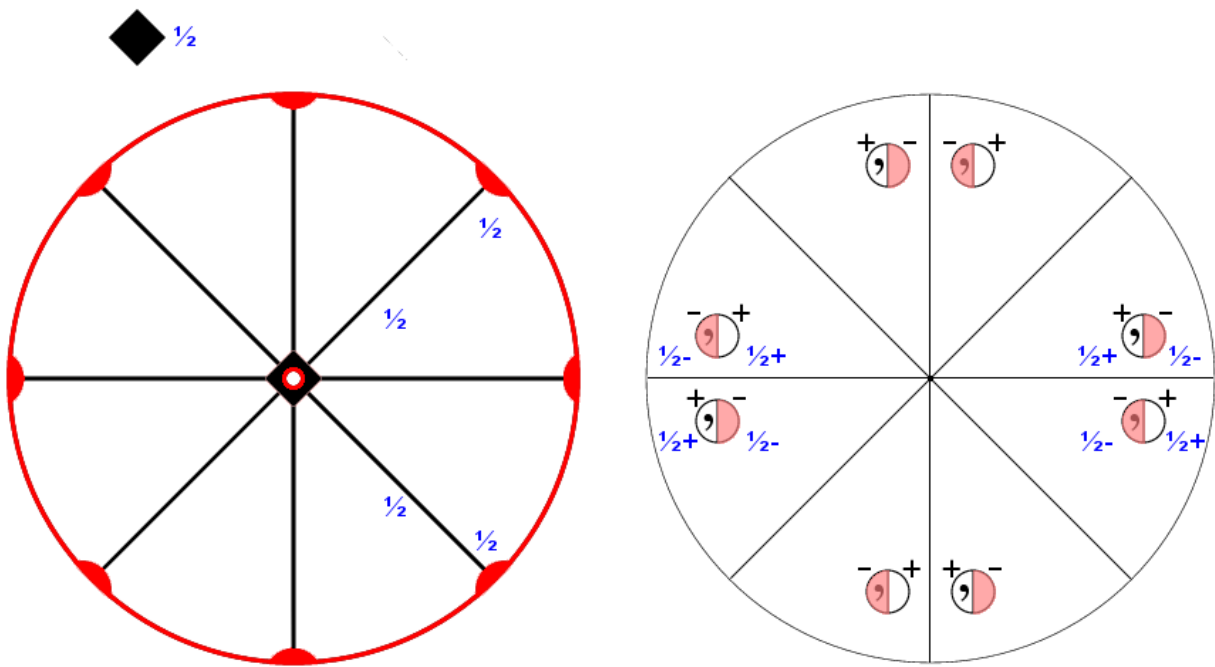
13.1.3.131



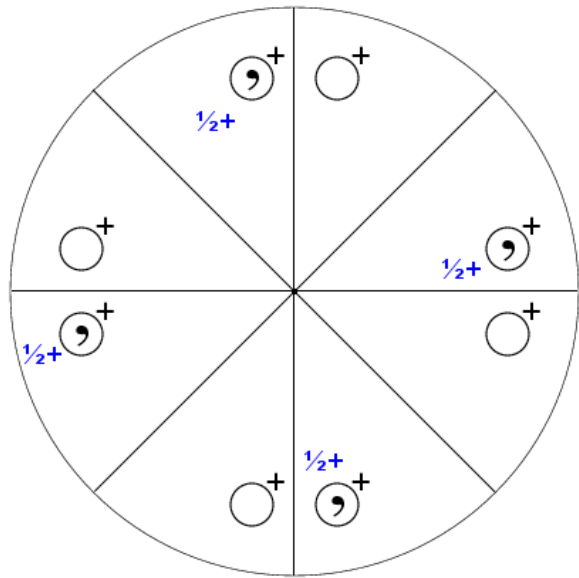
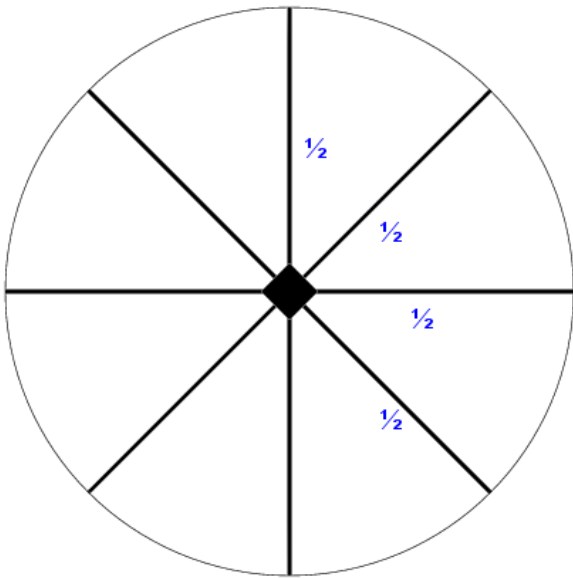
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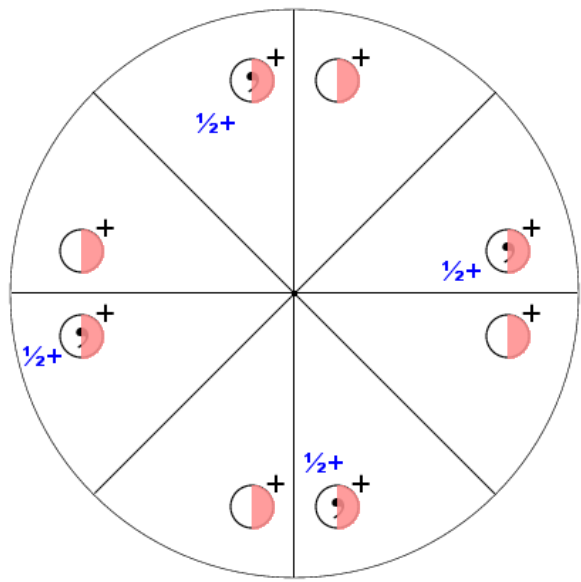
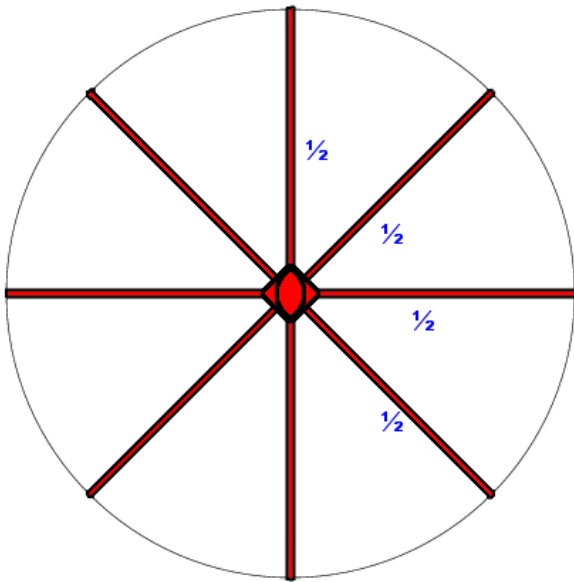
13.2.2.133



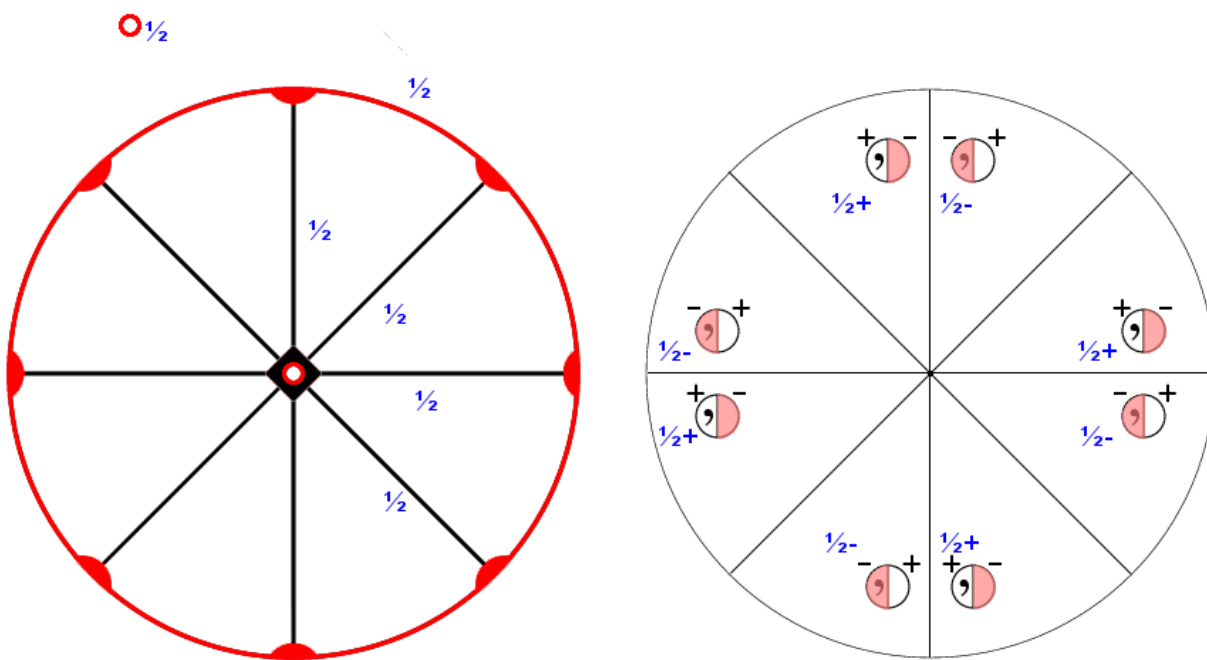
13.2.3.134



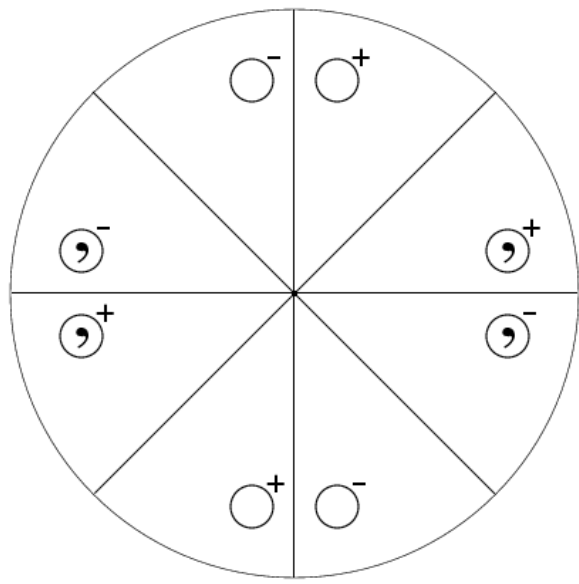
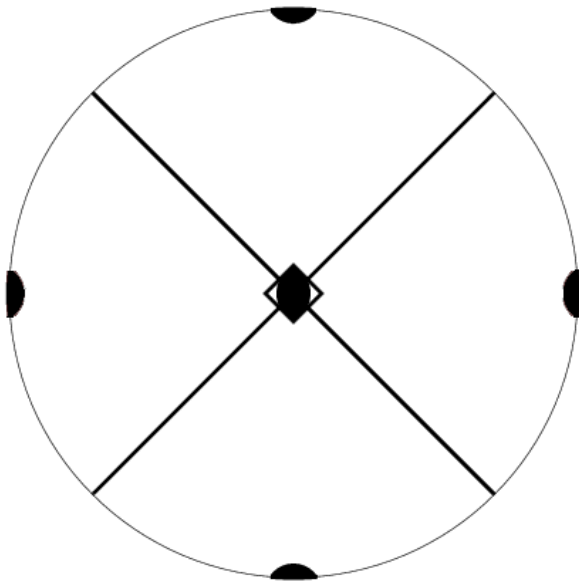
13.3.1.135



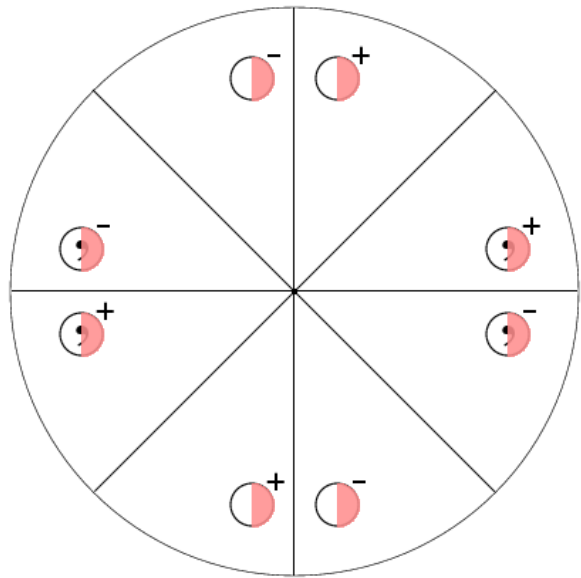
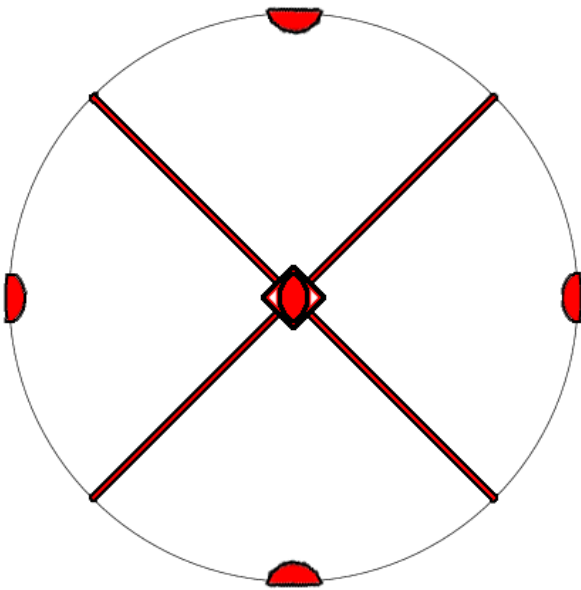
13.3.2.136



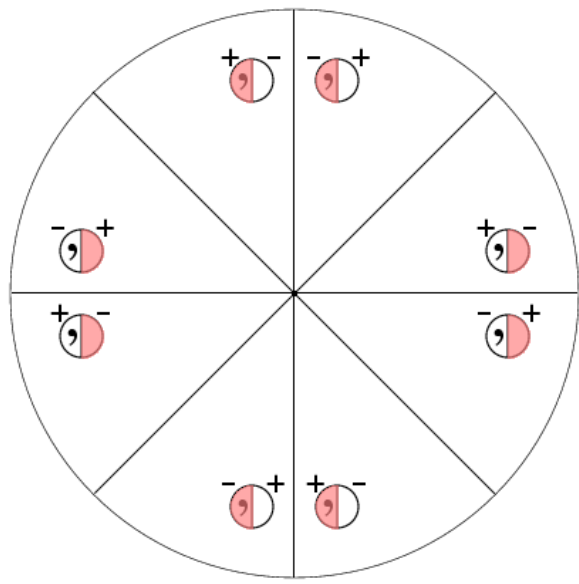
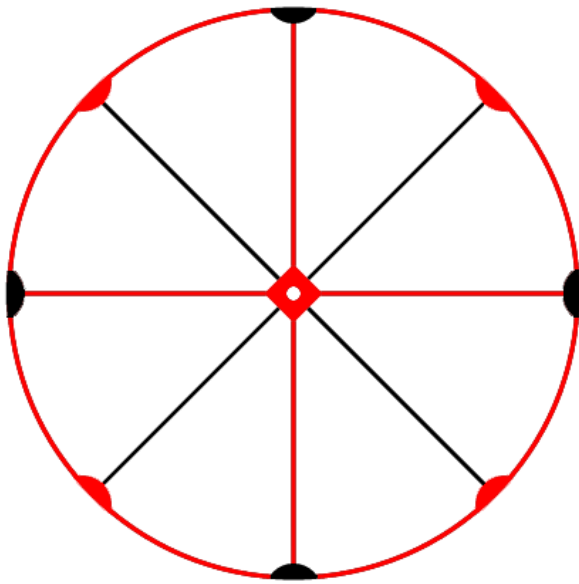
13.3.3.137



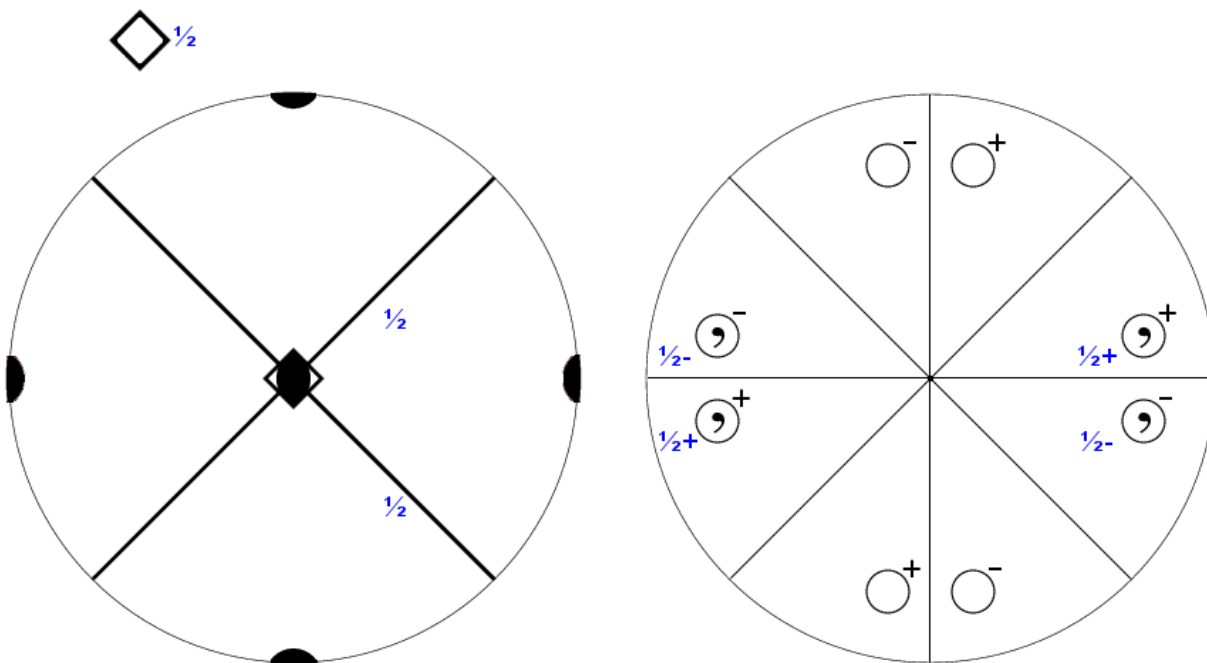
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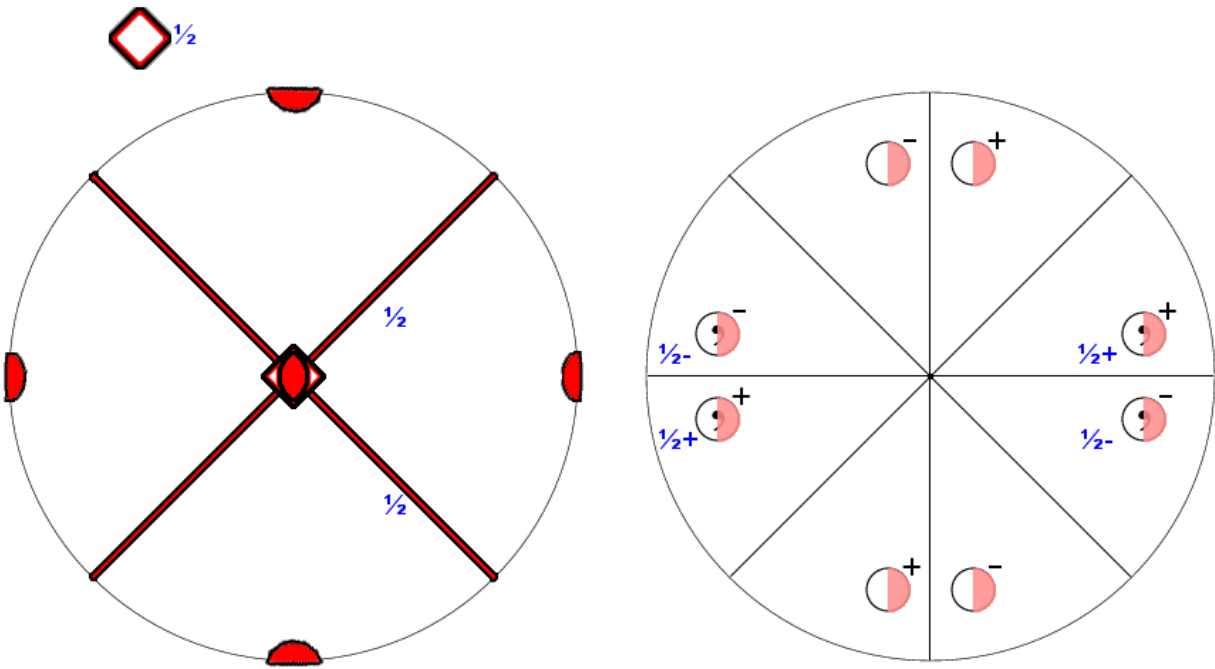
14.1.2.139



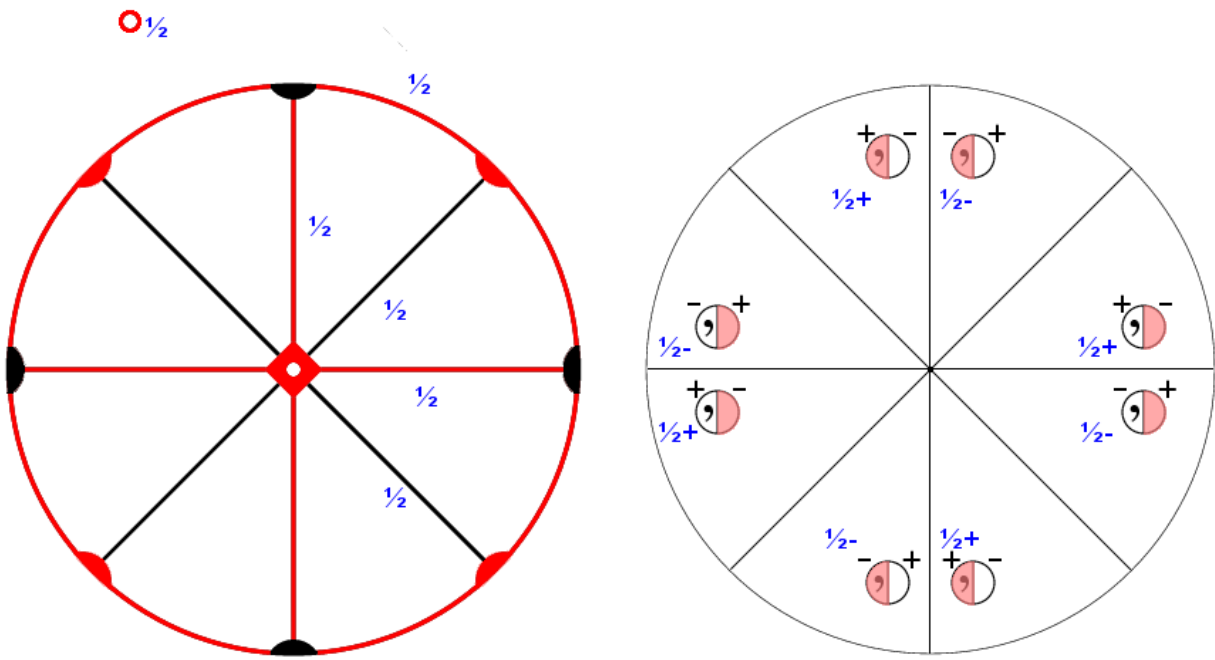
14.1.3.140



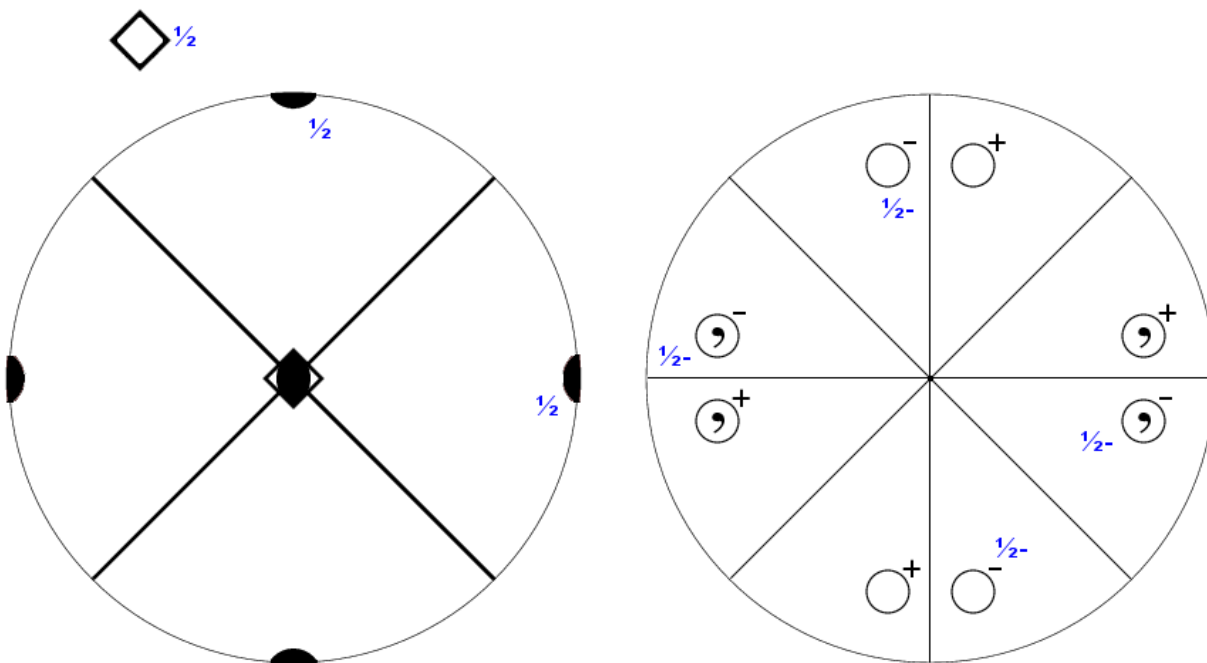
14.2.1.141



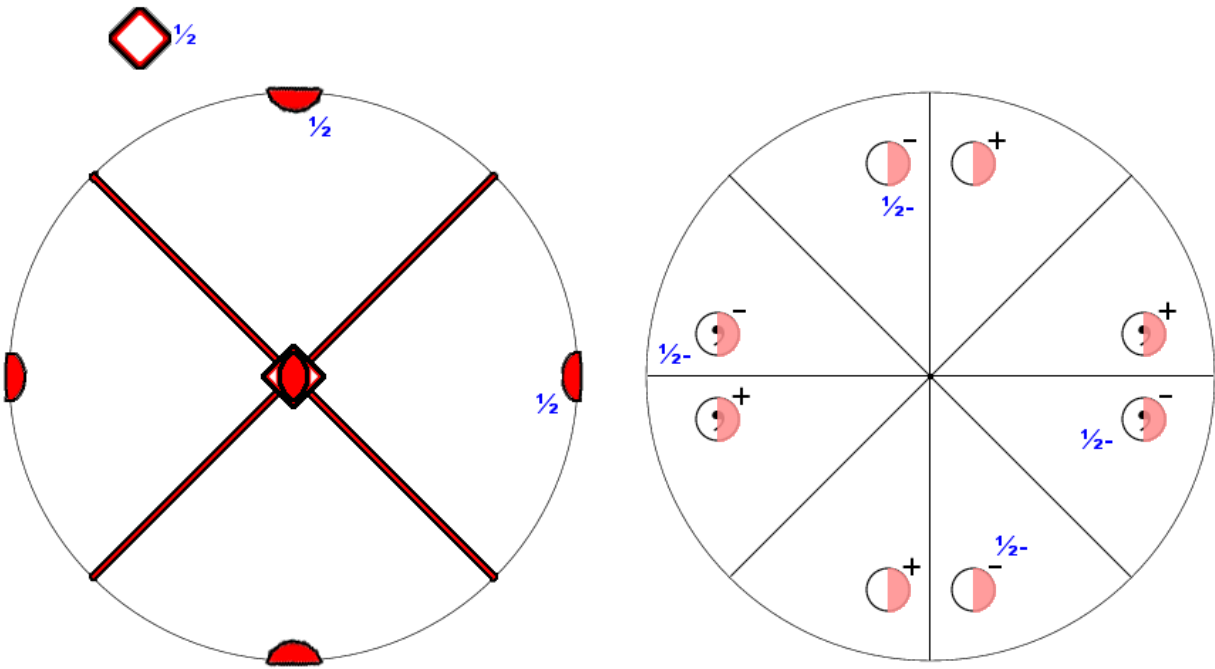
14.2.2.142



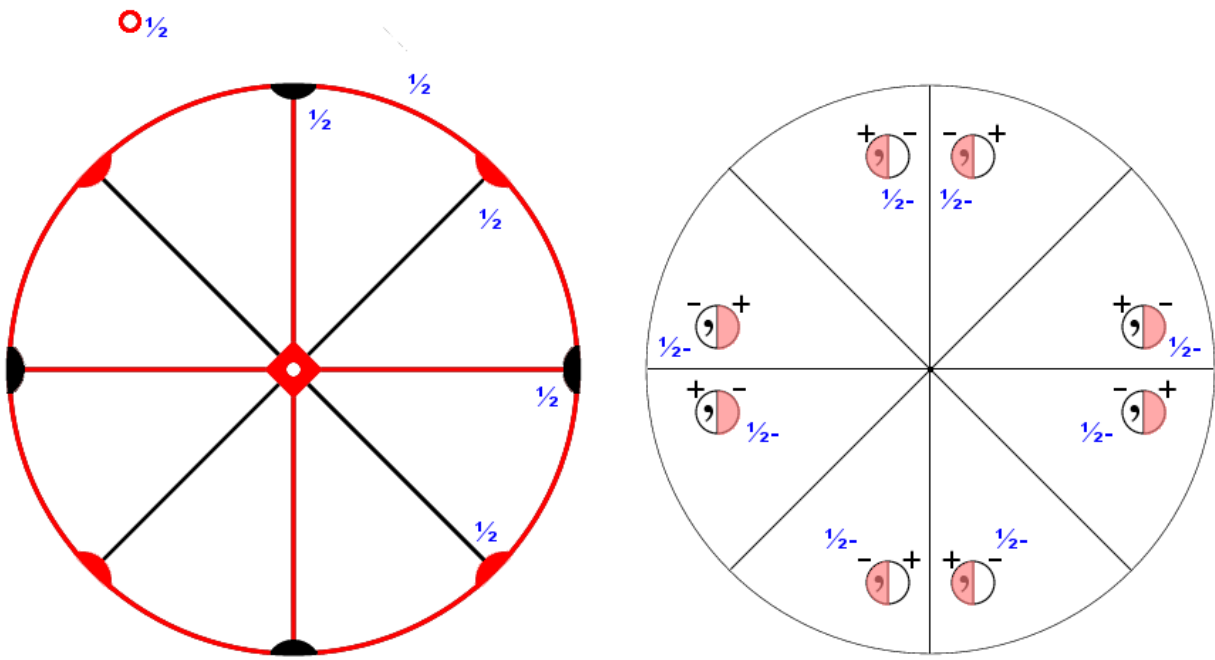
14.2.3.143



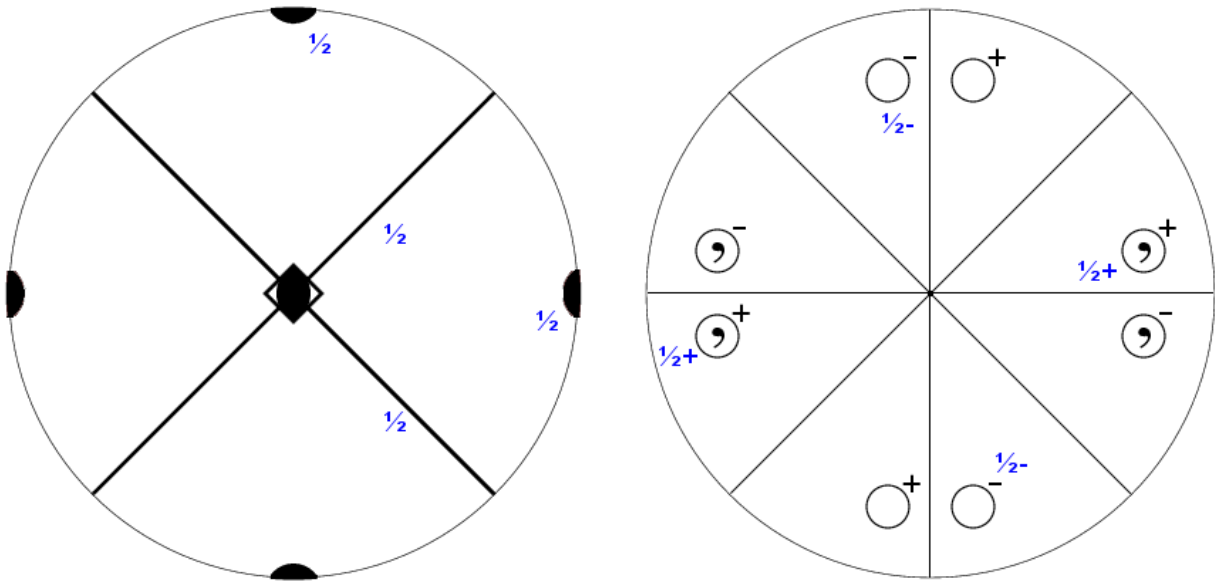
14.3.1.144



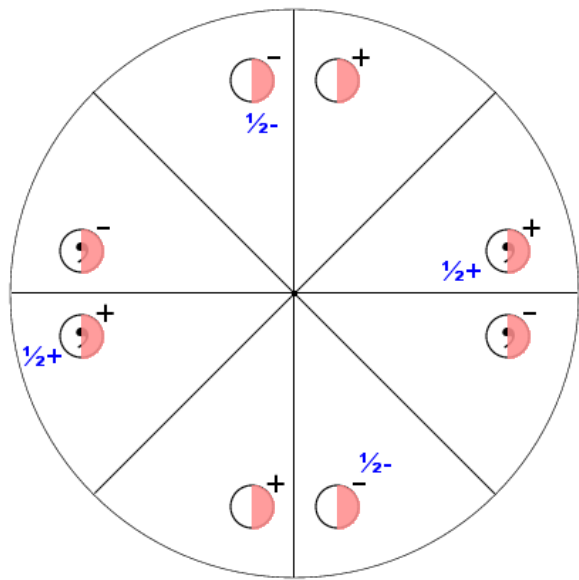
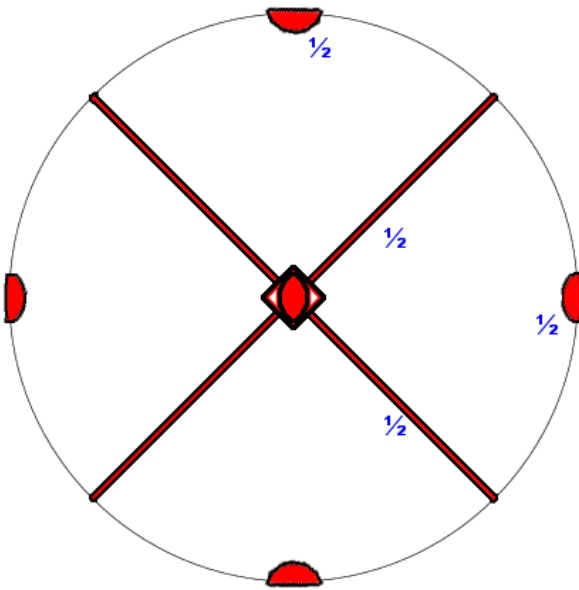
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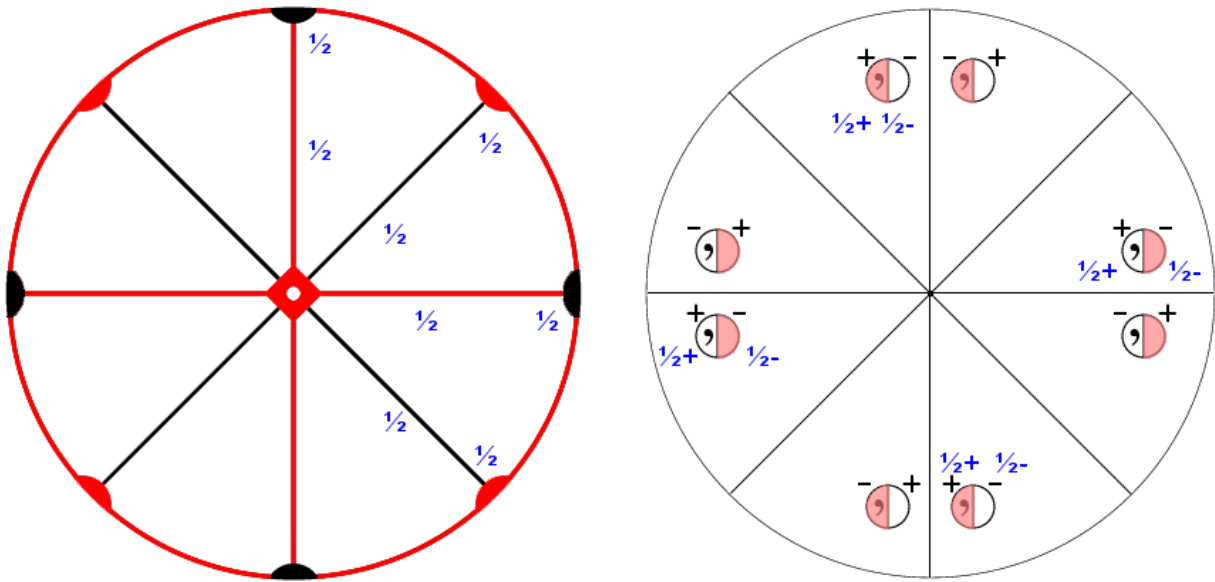
14.3.3.146



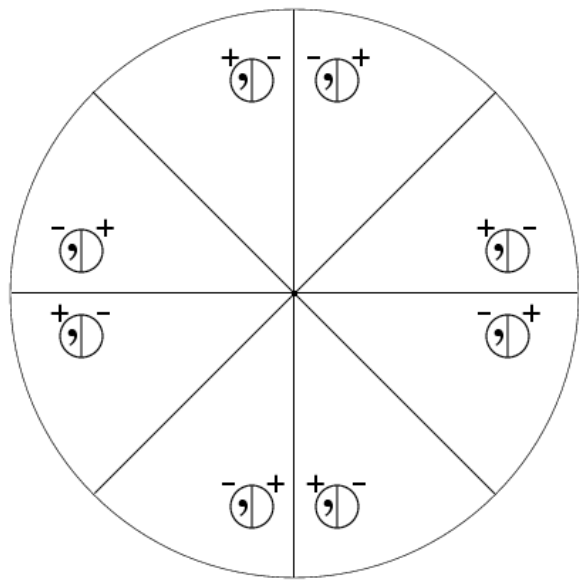
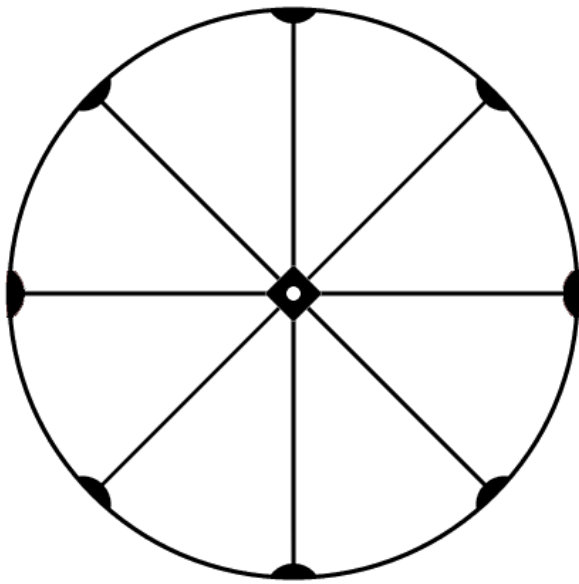
14.4.1.147



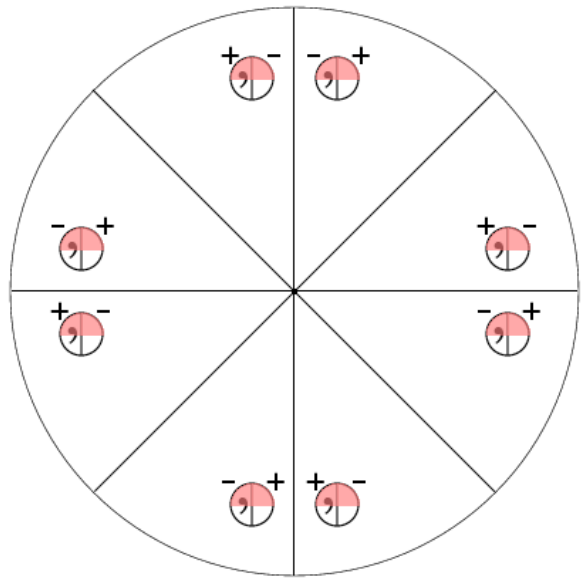
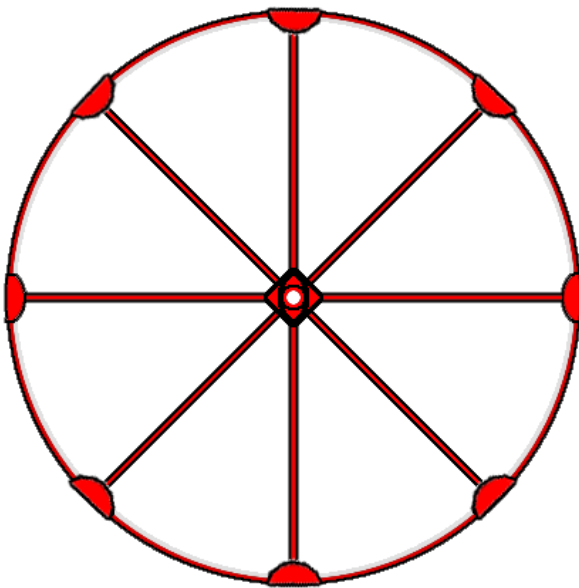
14.4.2.148



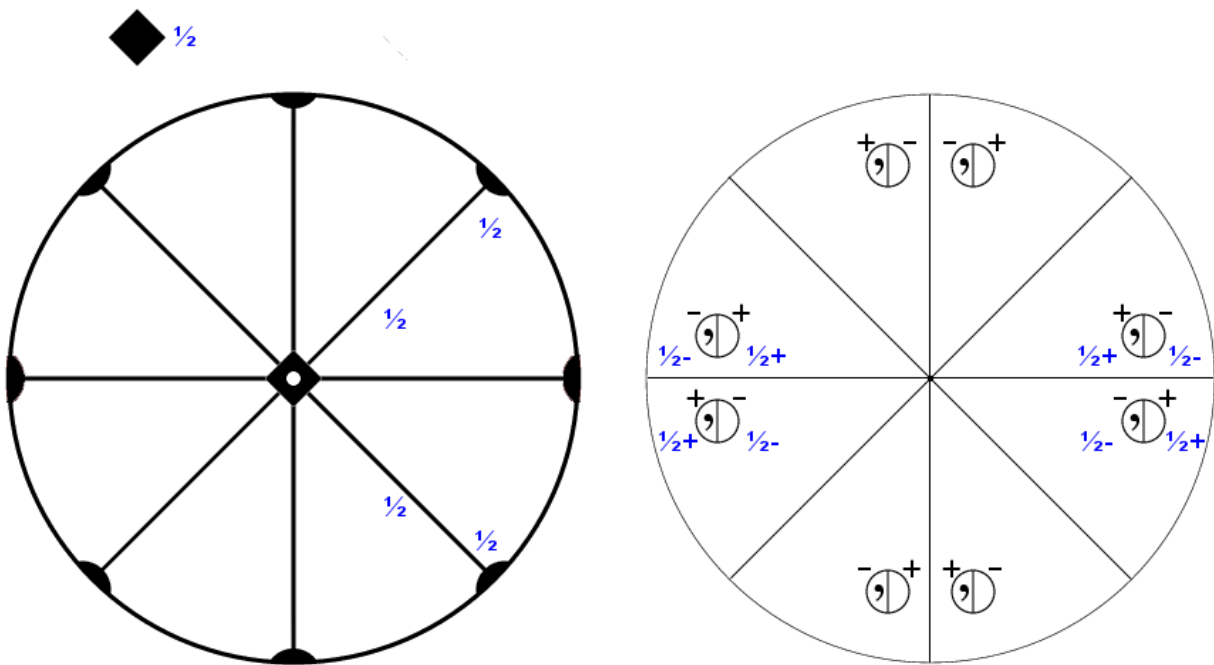
14.4.3.149



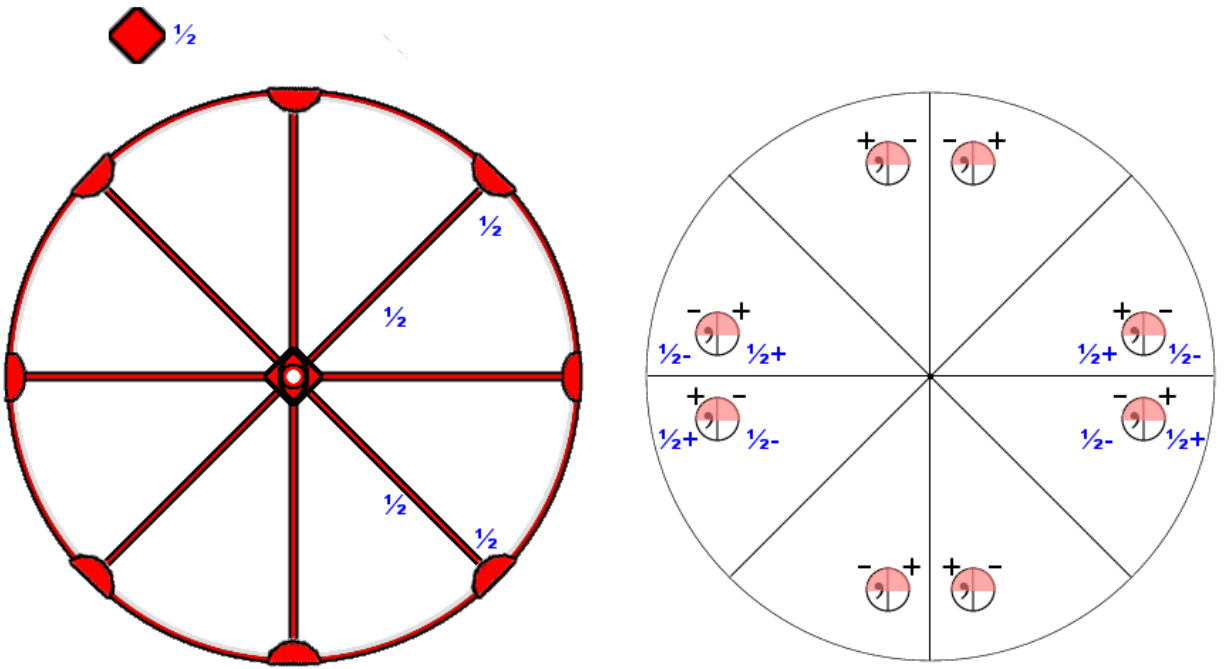
15.1.1.150



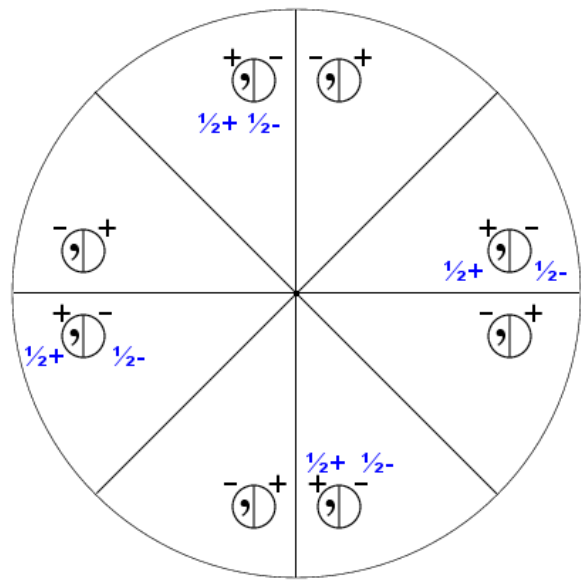
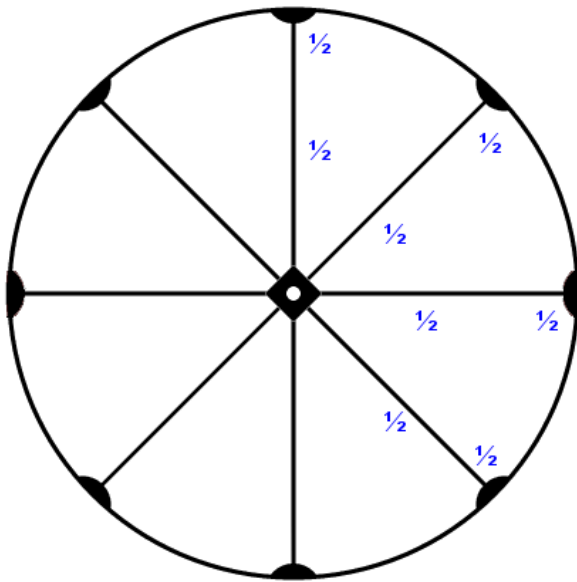
15.1.2.151



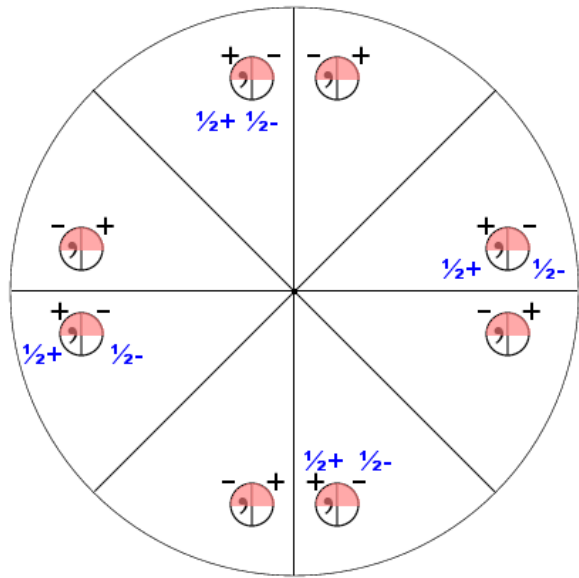
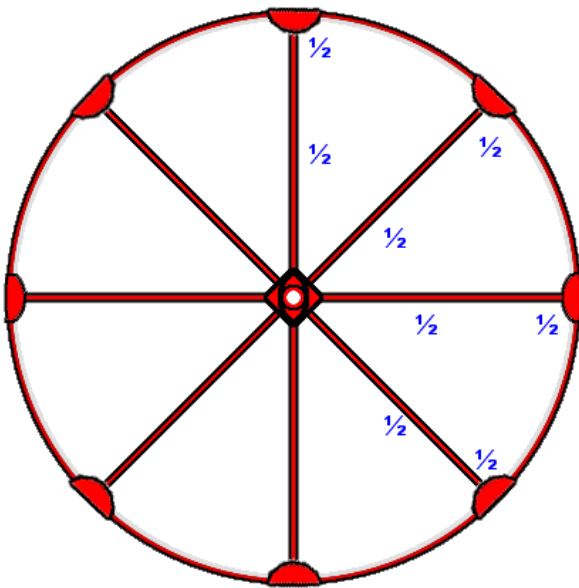
15.2.1.152



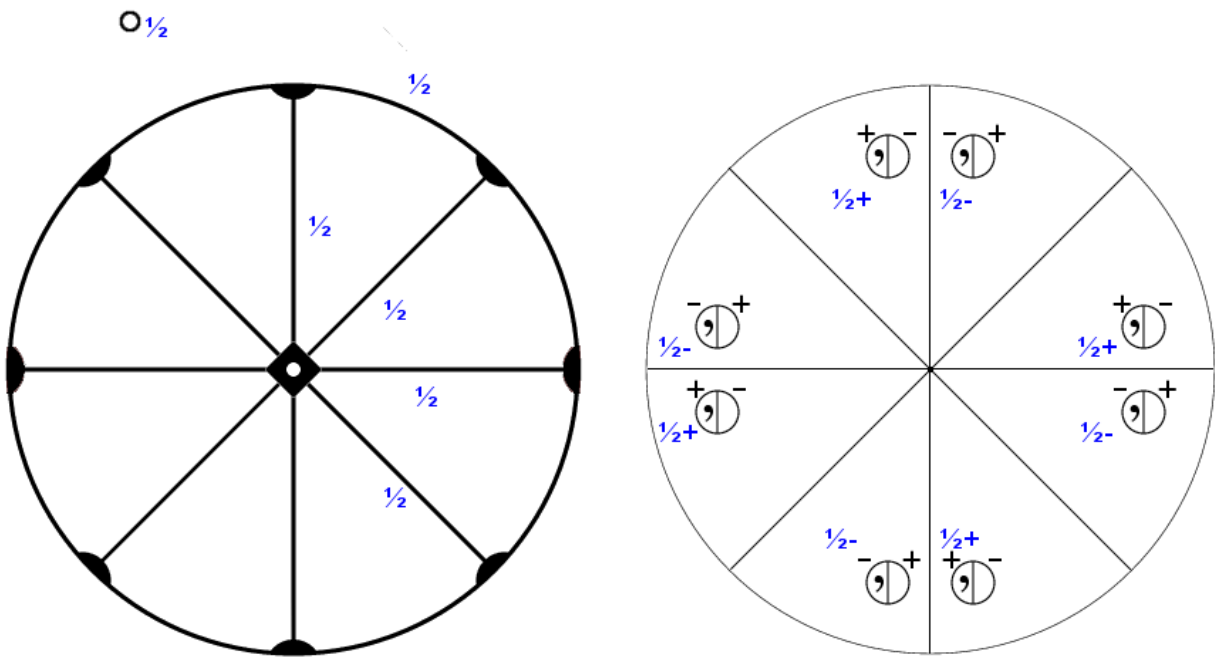
15.2.2.153



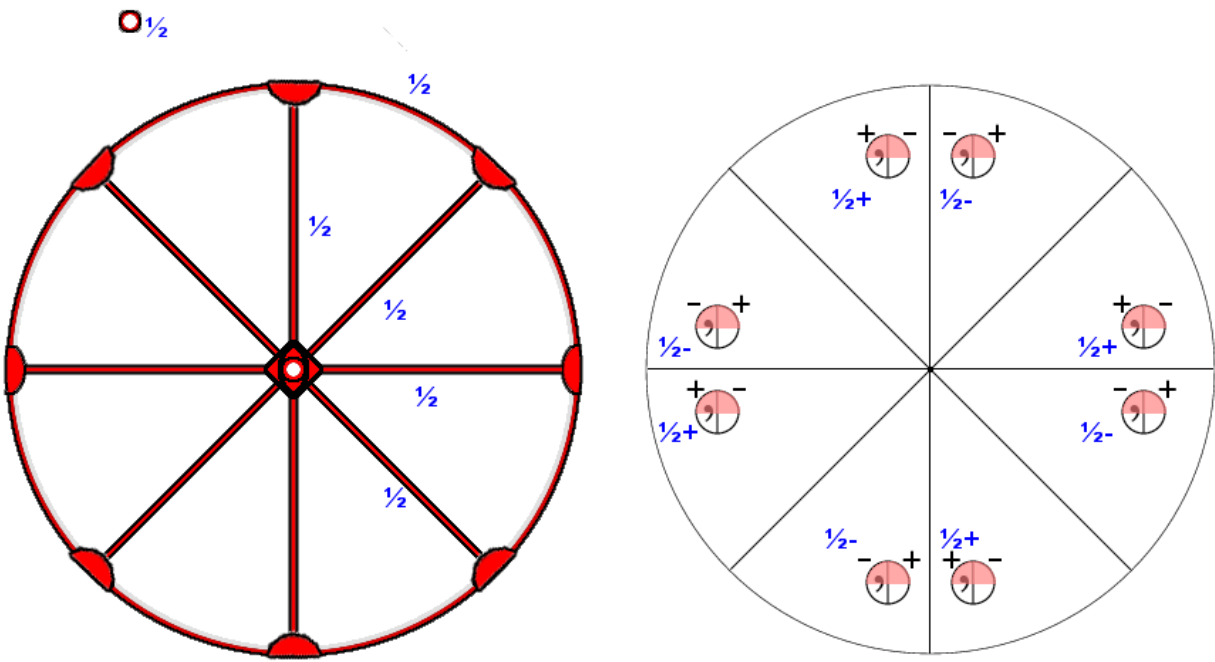
15.3.1.154



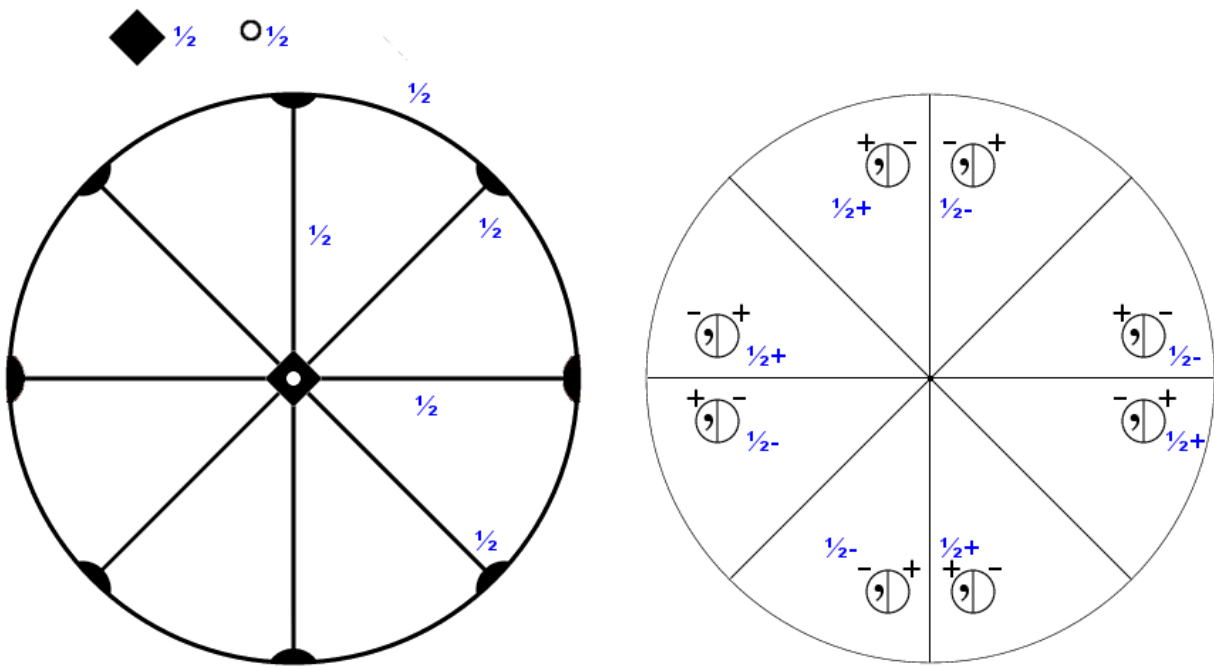
15.3.2.155



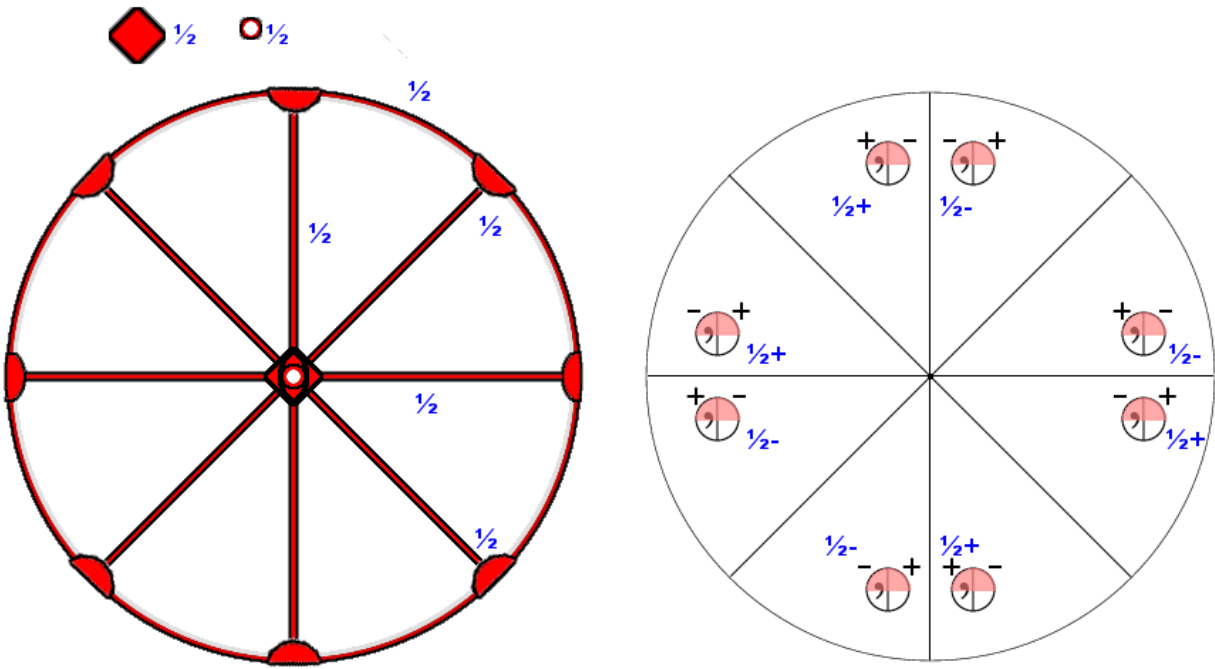
15.4.1.156



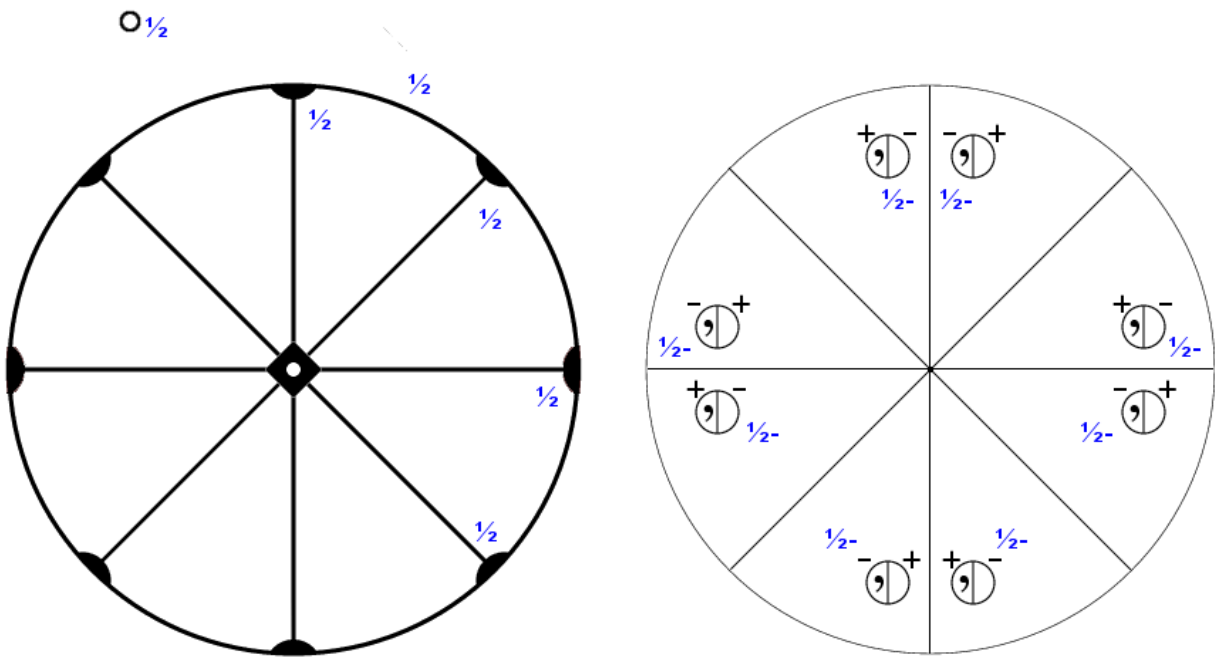
15.4.2.157



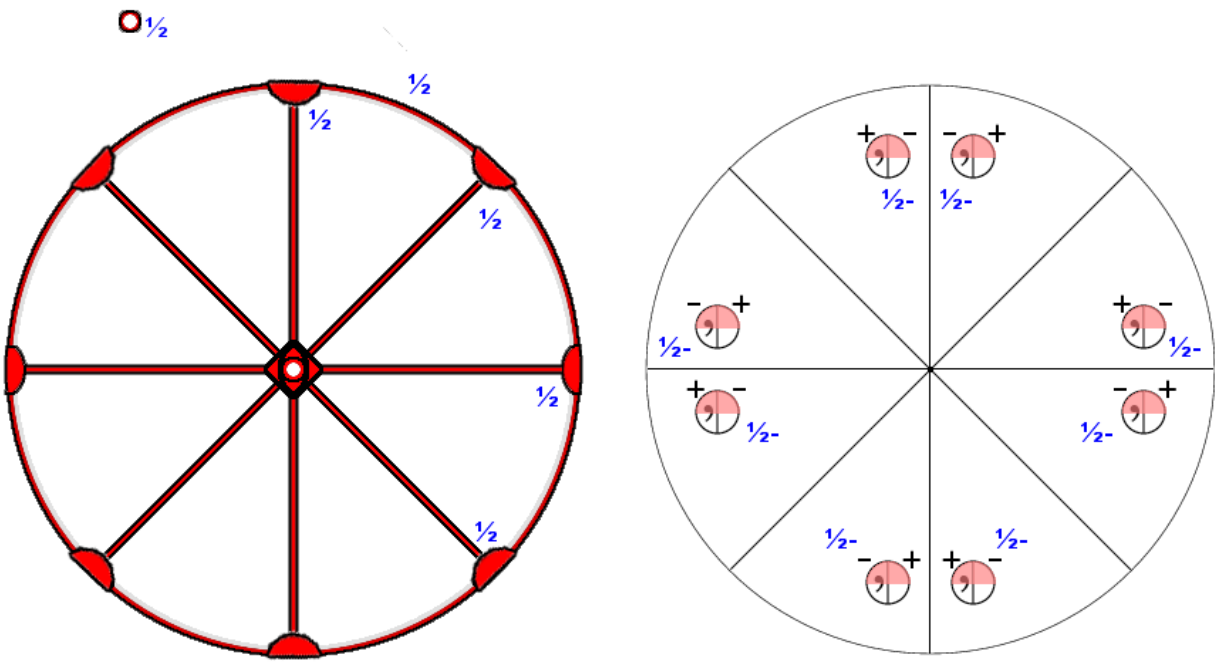
15.5.1.158



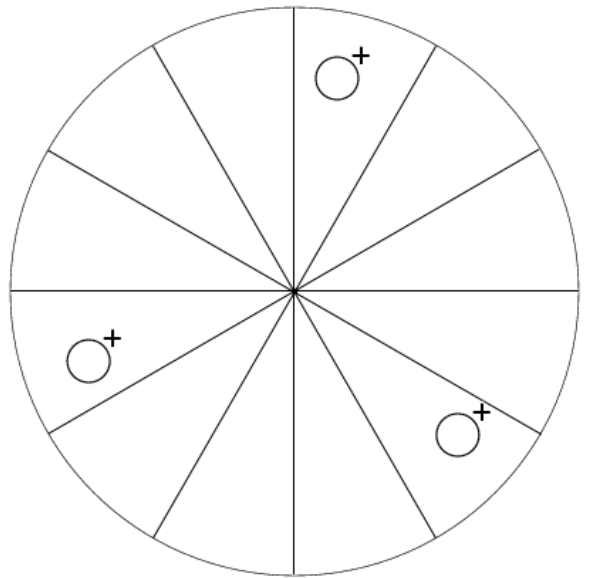
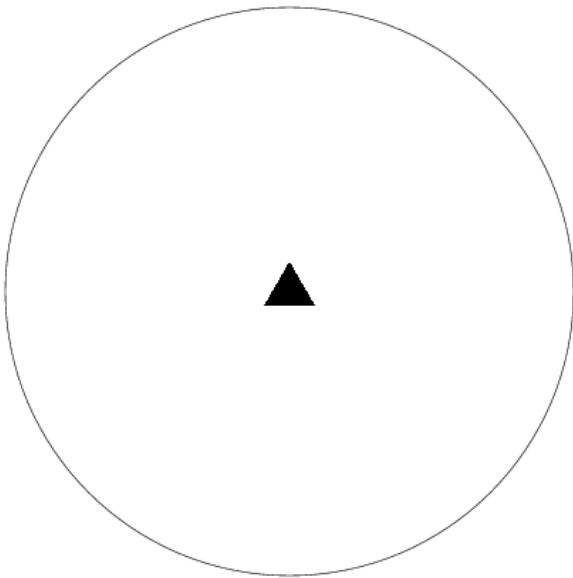
15.5.2.159



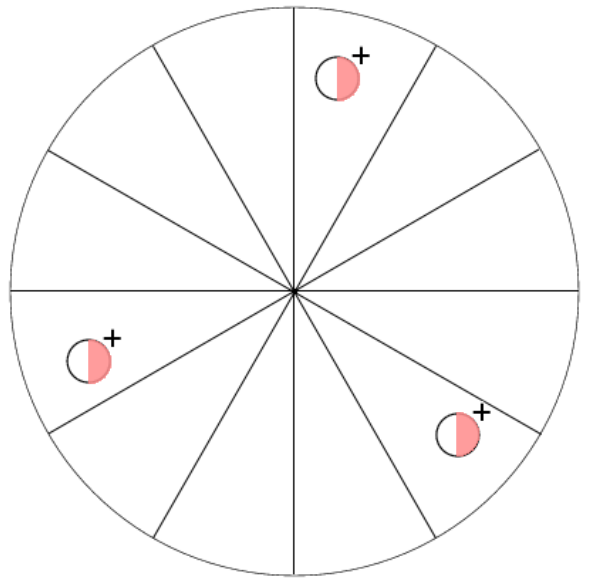
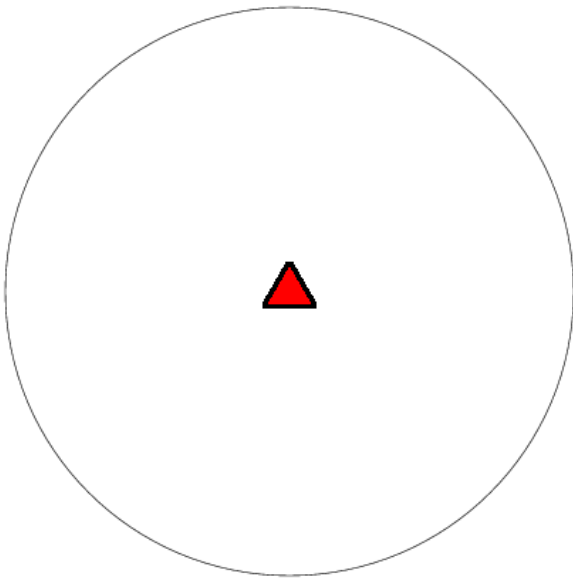
15.6.1.160



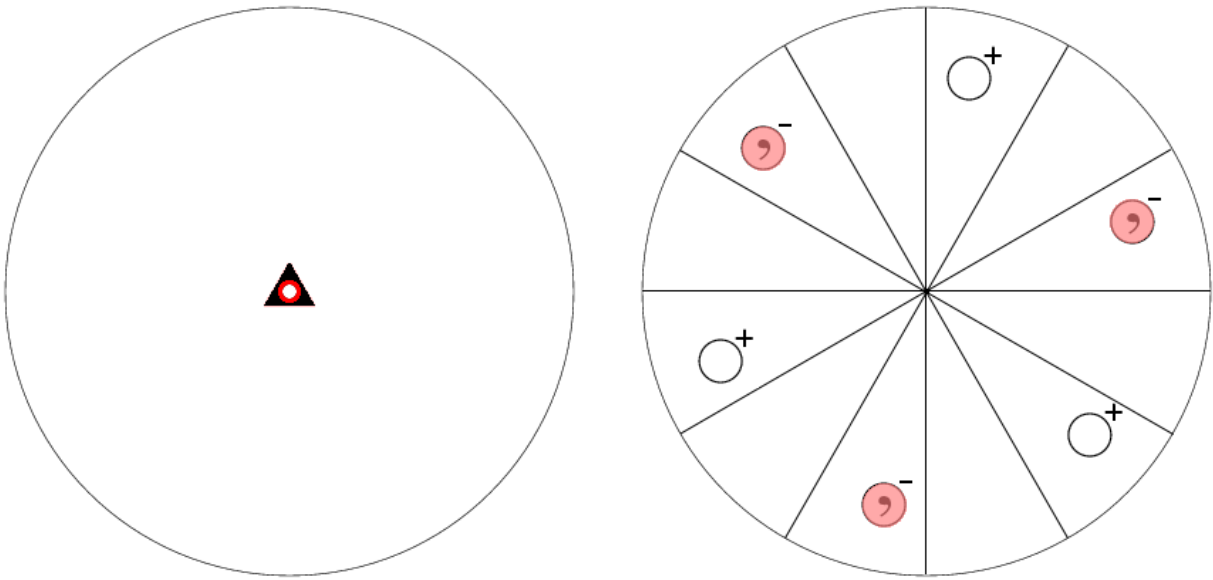
15.6.2.161



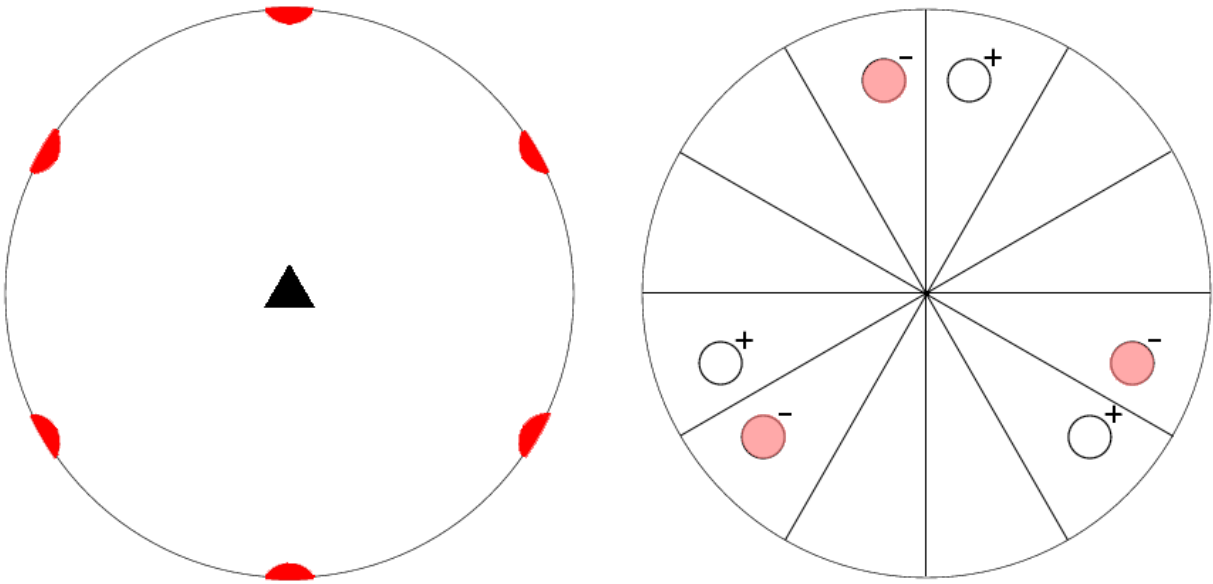
16.1.1.162



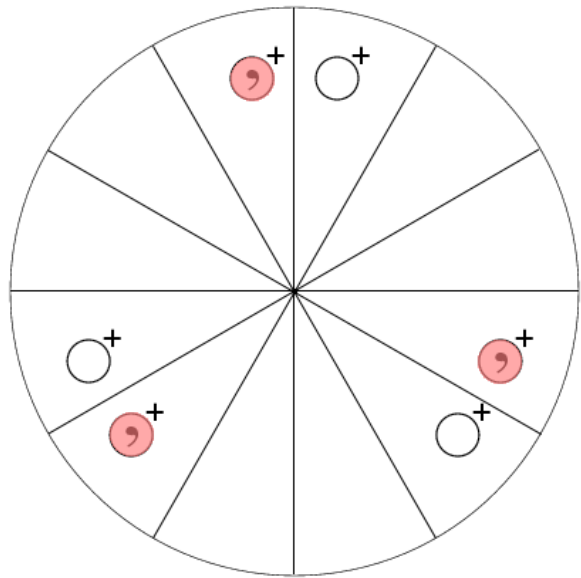
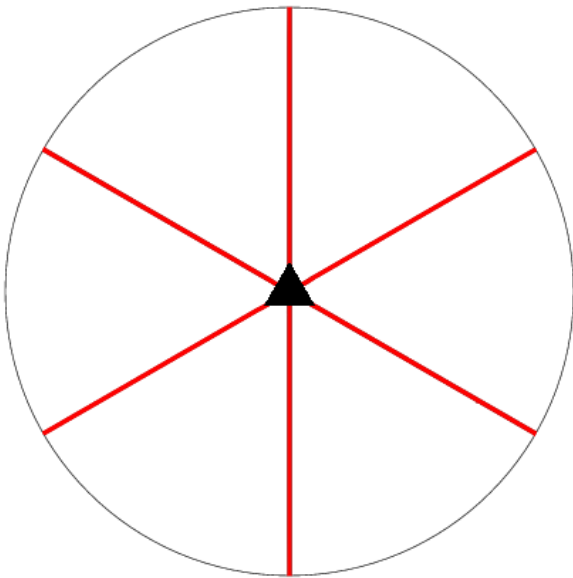
16.1.2.163



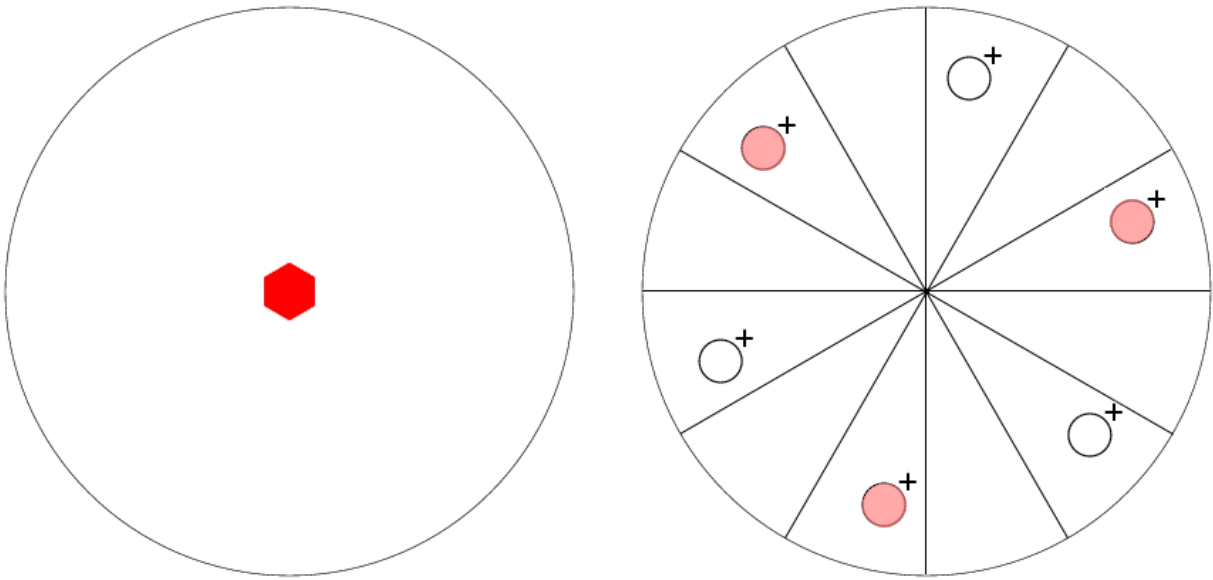
16.1.3.164



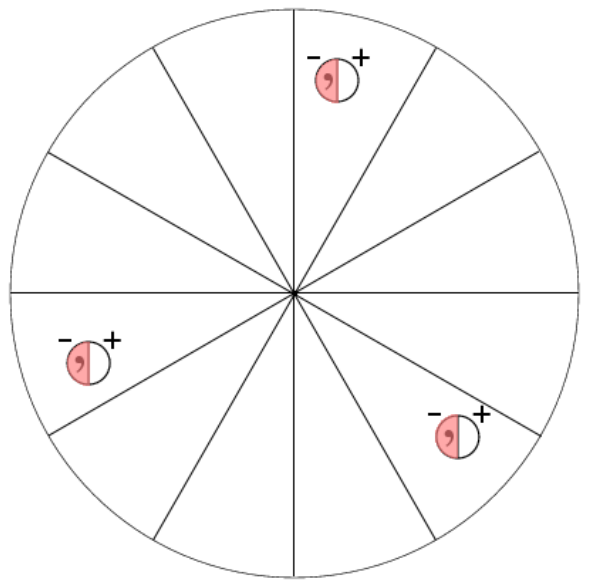
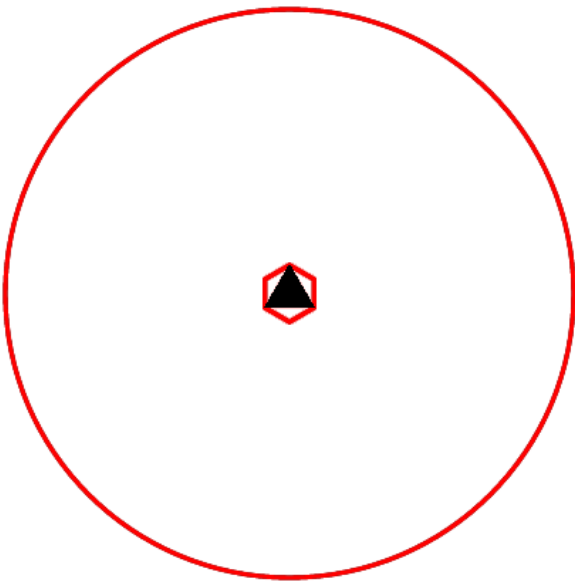
16.1.4.165



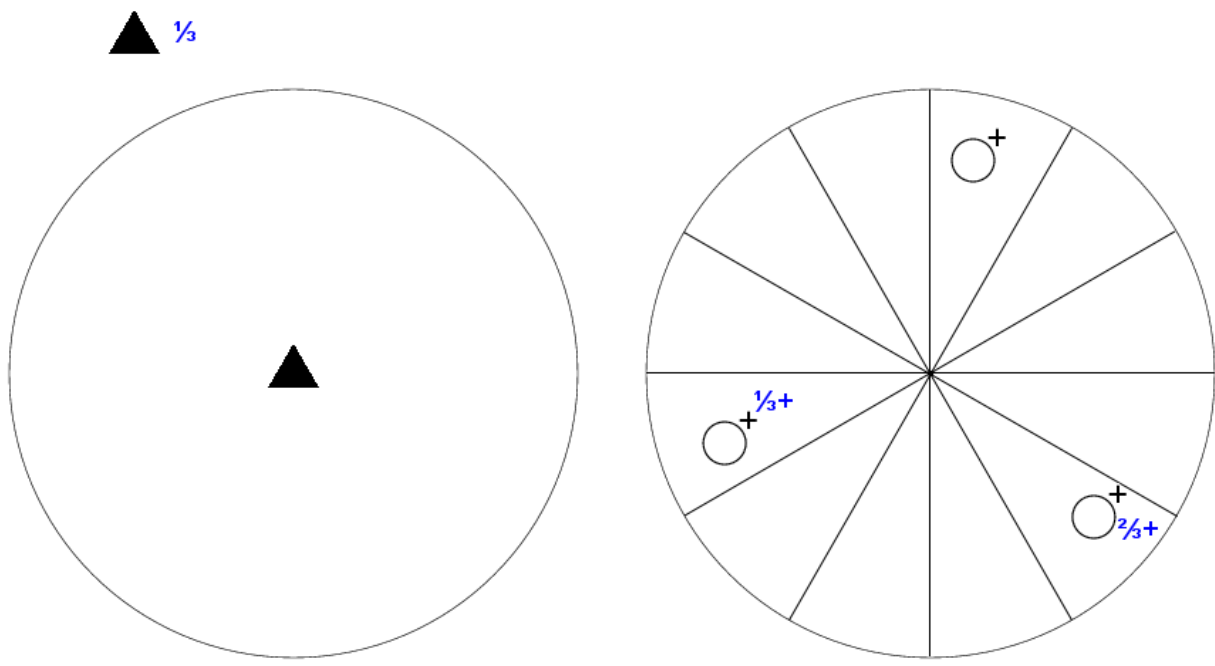
16.1.5.166



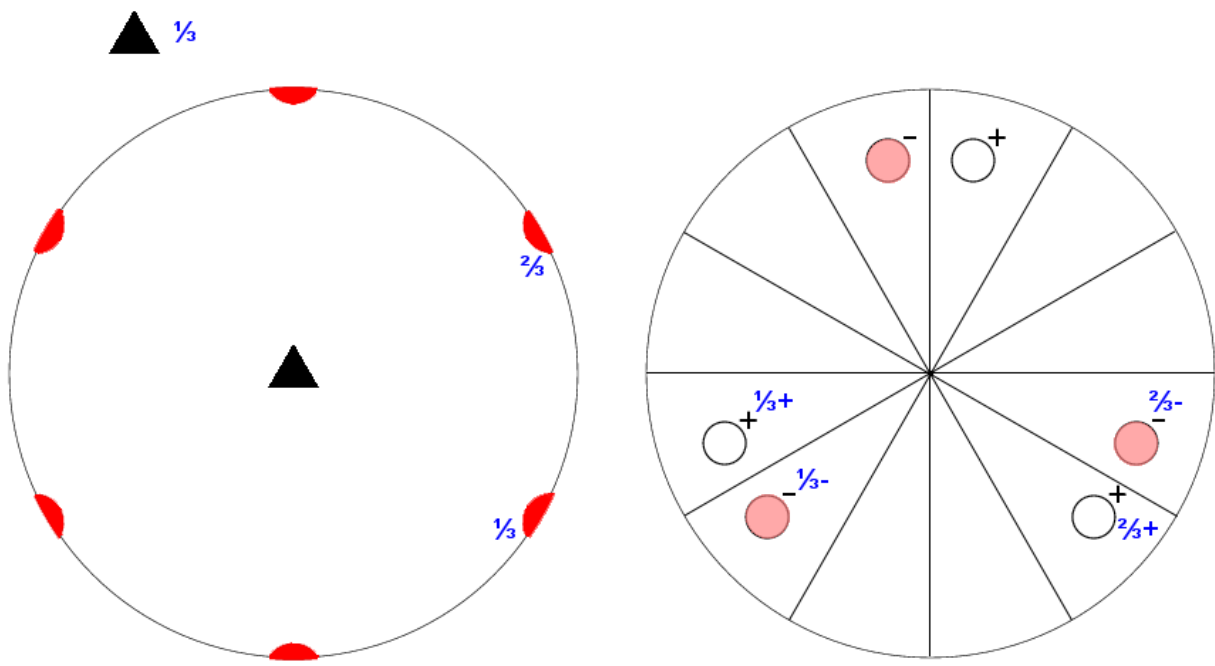
16.1.6.167



16.1.7.168

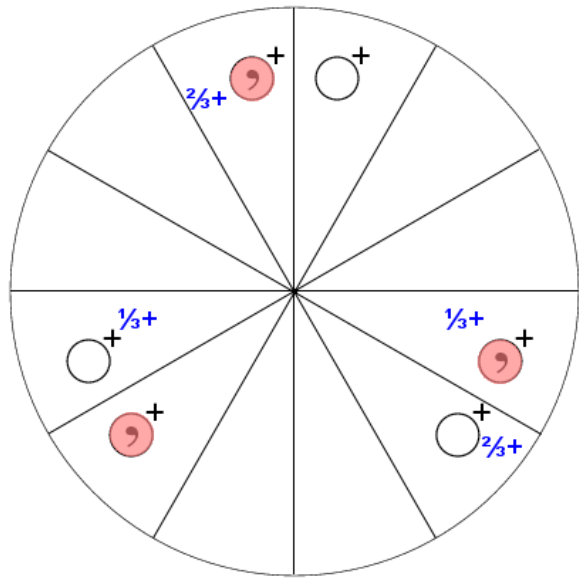
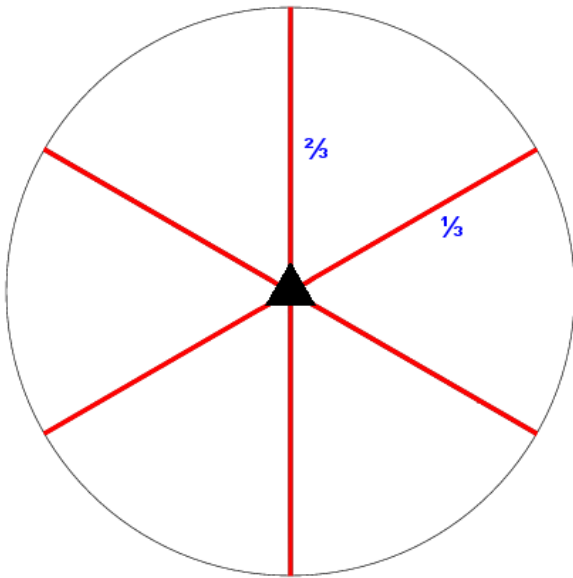


16.2.1.169

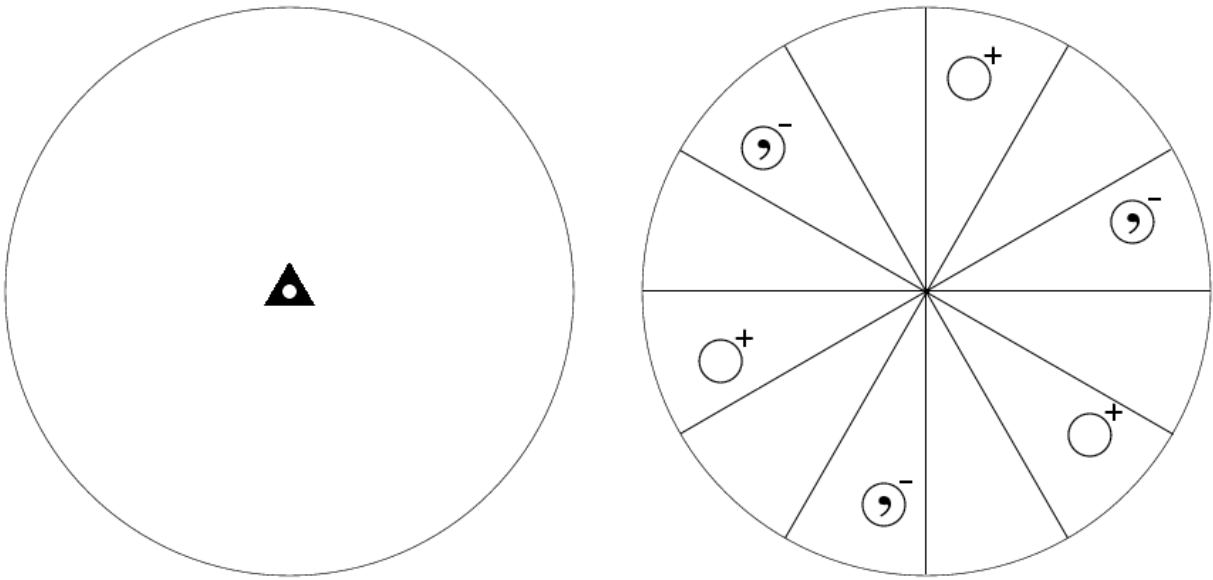


16.2.2.170

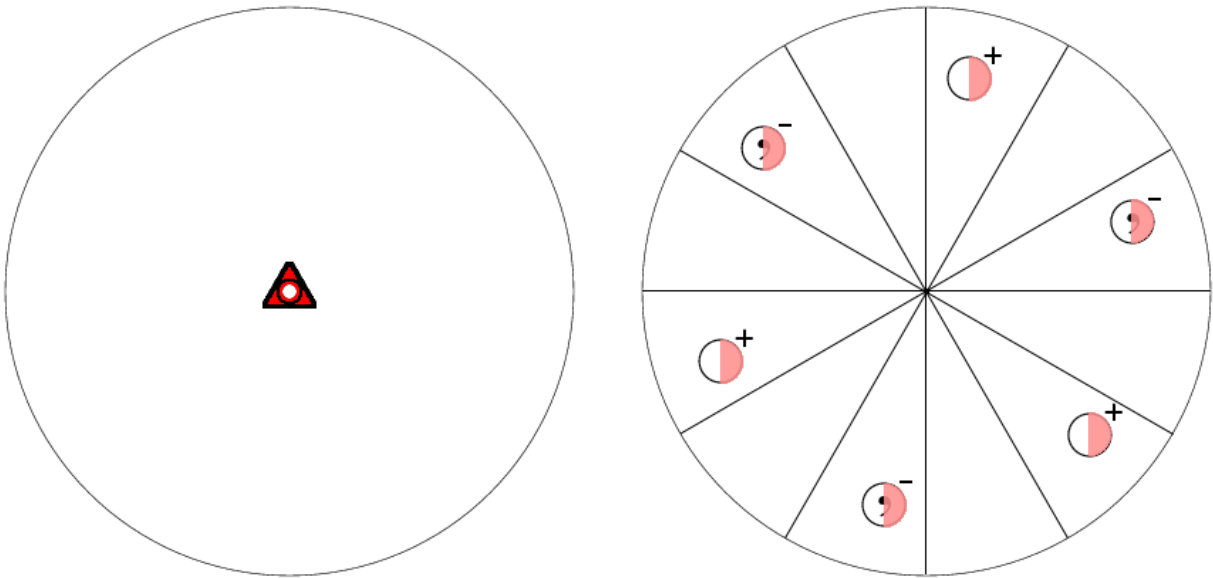
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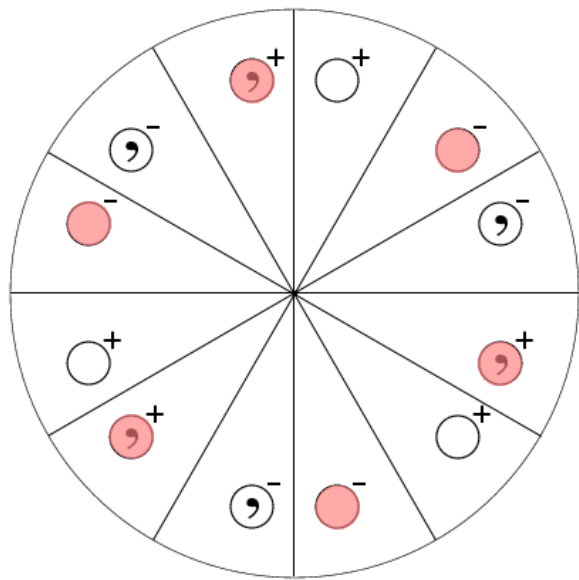
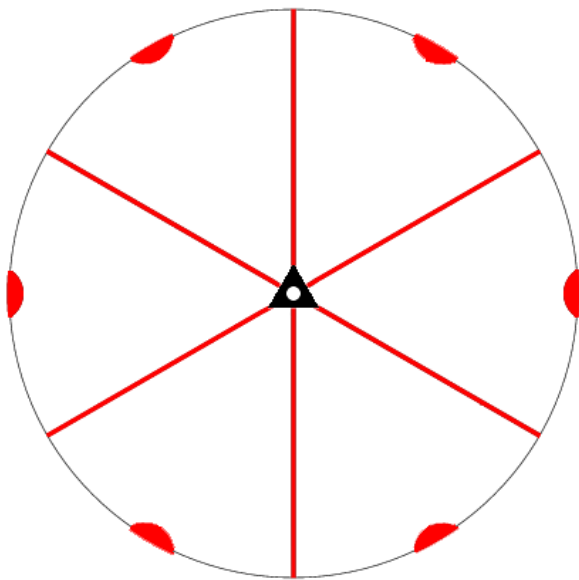
16.2.3.171



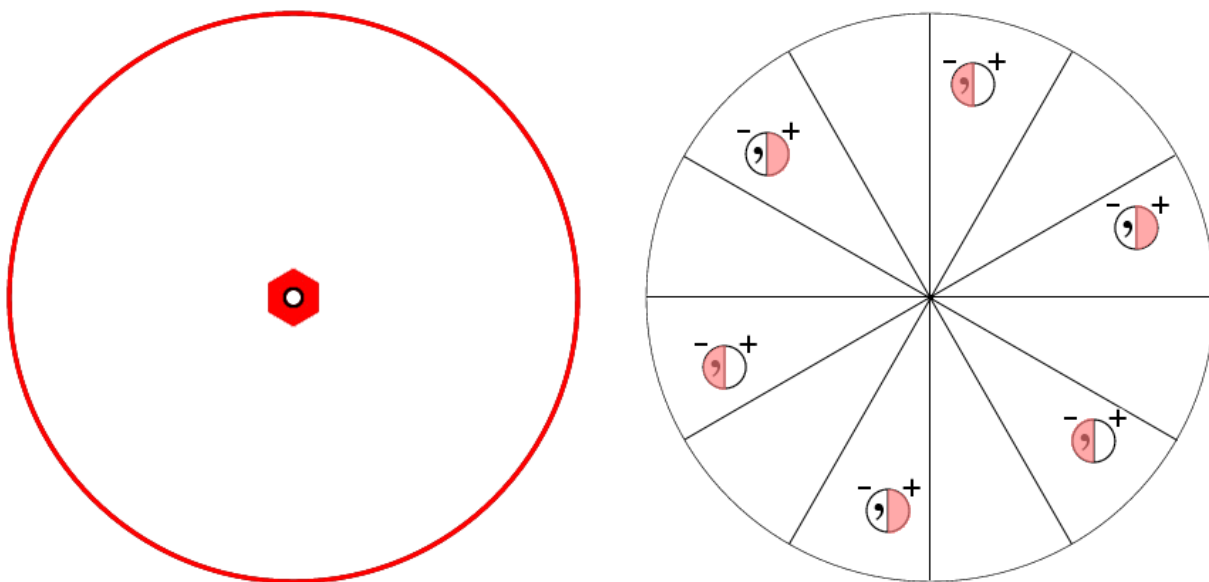
17.1.1.172



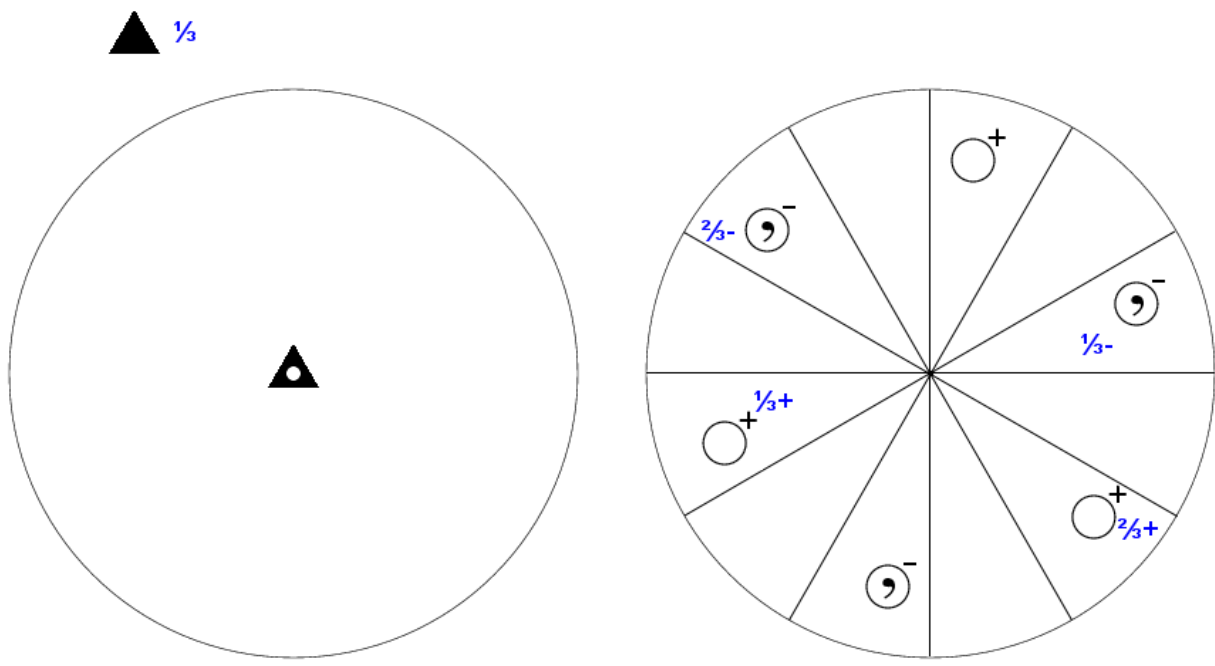
17.1.2.173



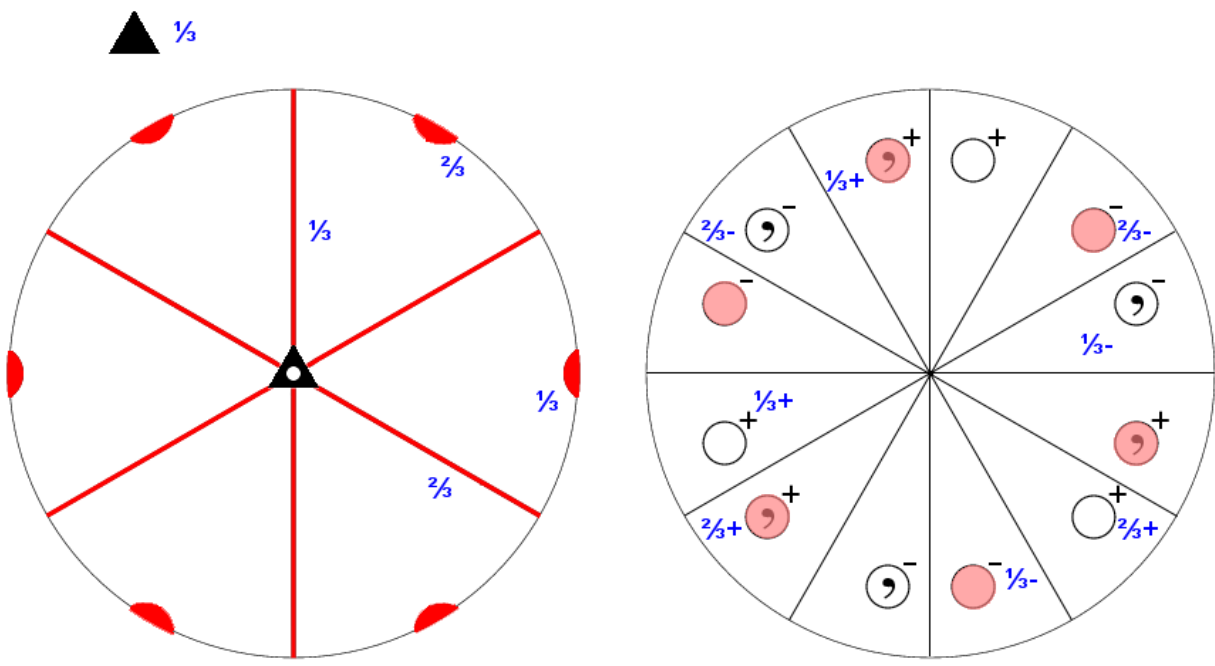
17.1.3.174



17.1.4.175

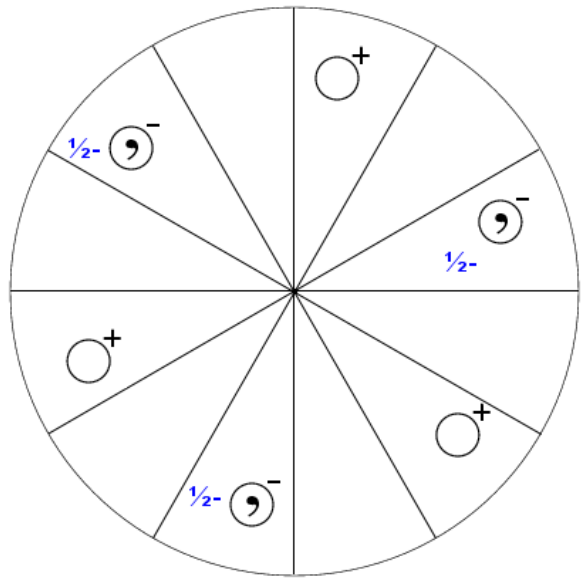
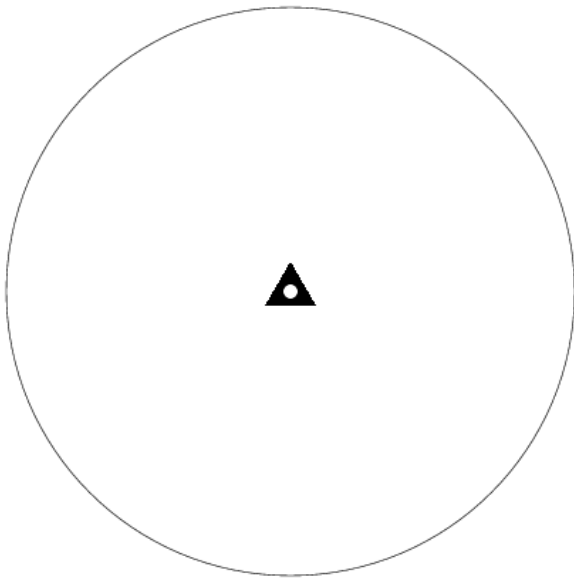


17.2.1.176



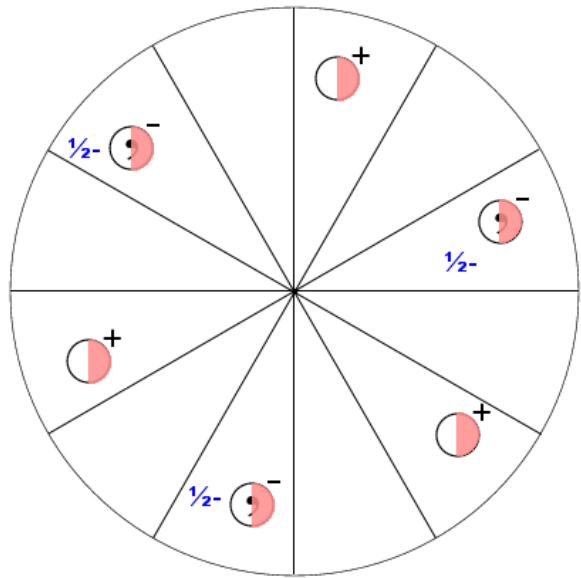
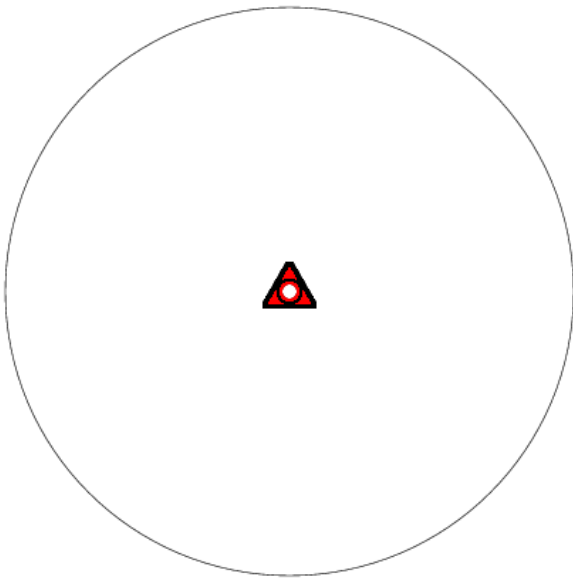
17.2.2.177

$\circ\frac{1}{2}$



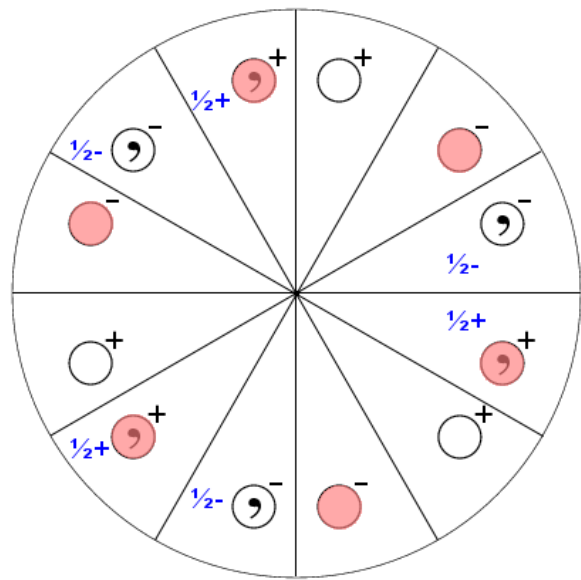
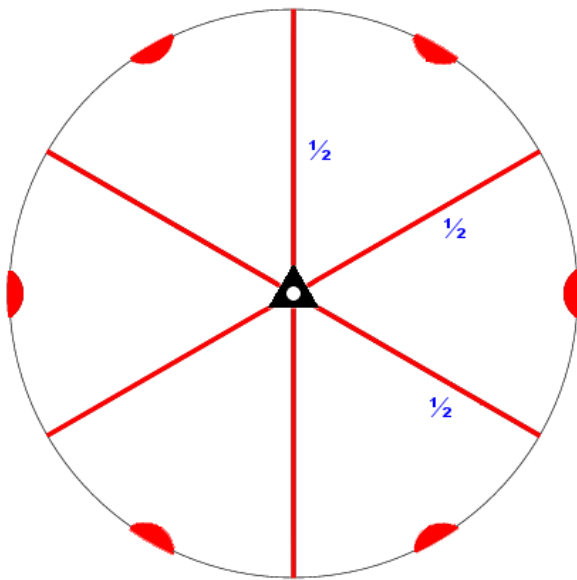
17.3.1.178

$\odot \frac{1}{2}$

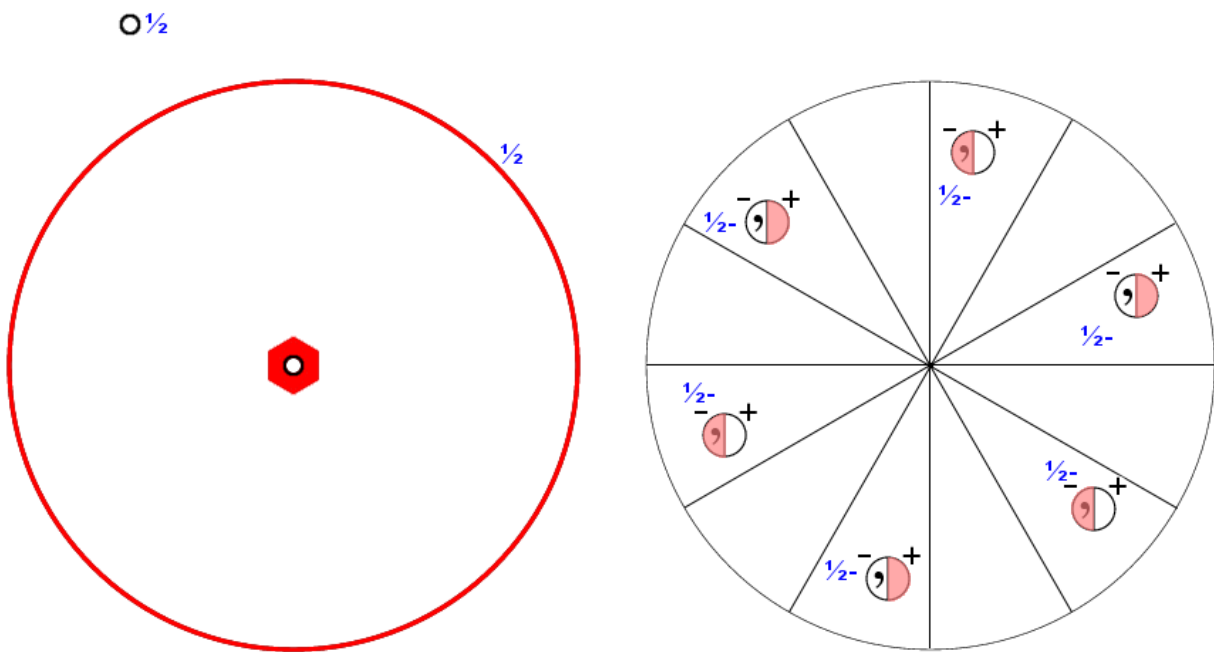


17.3.2.179

$\circ \frac{1}{2}$

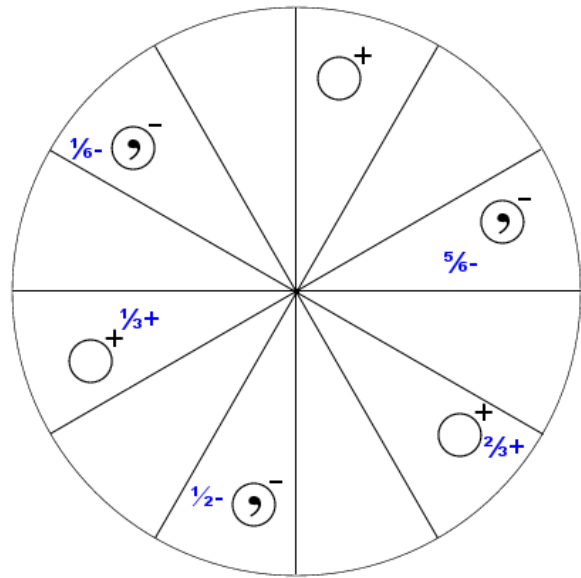
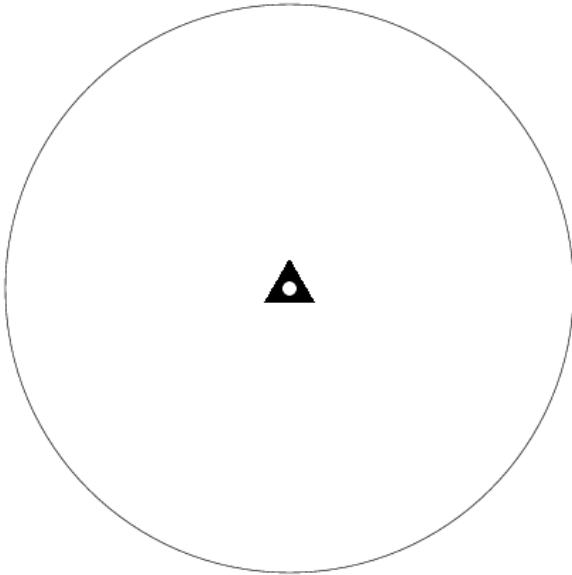


17.3.3.180

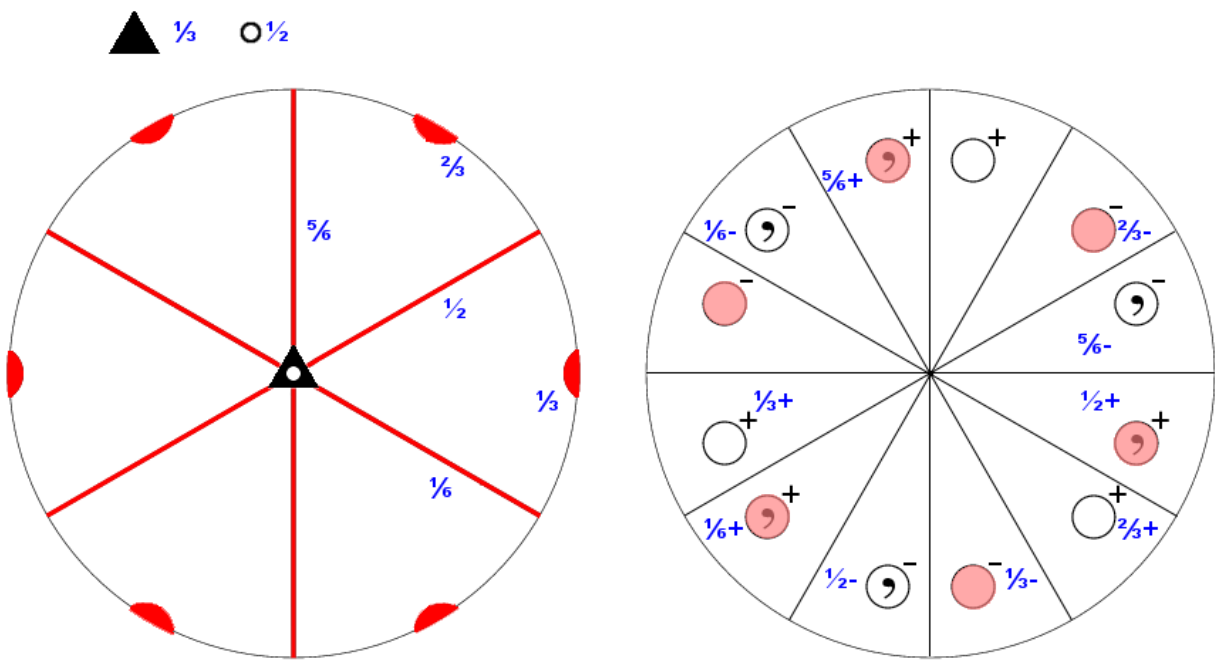


17.3.4.181

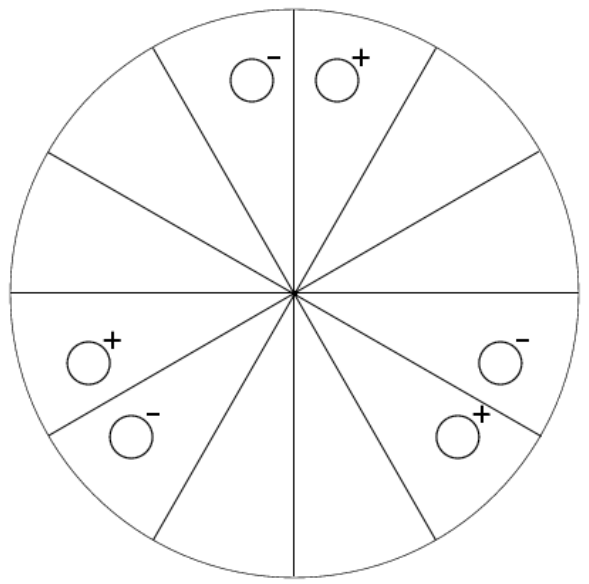
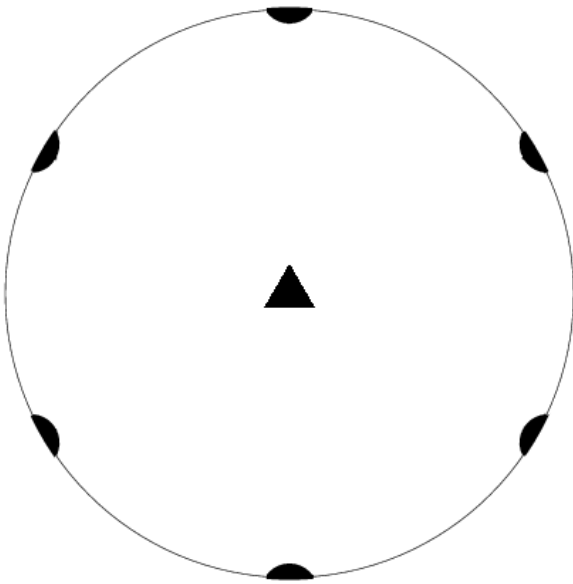
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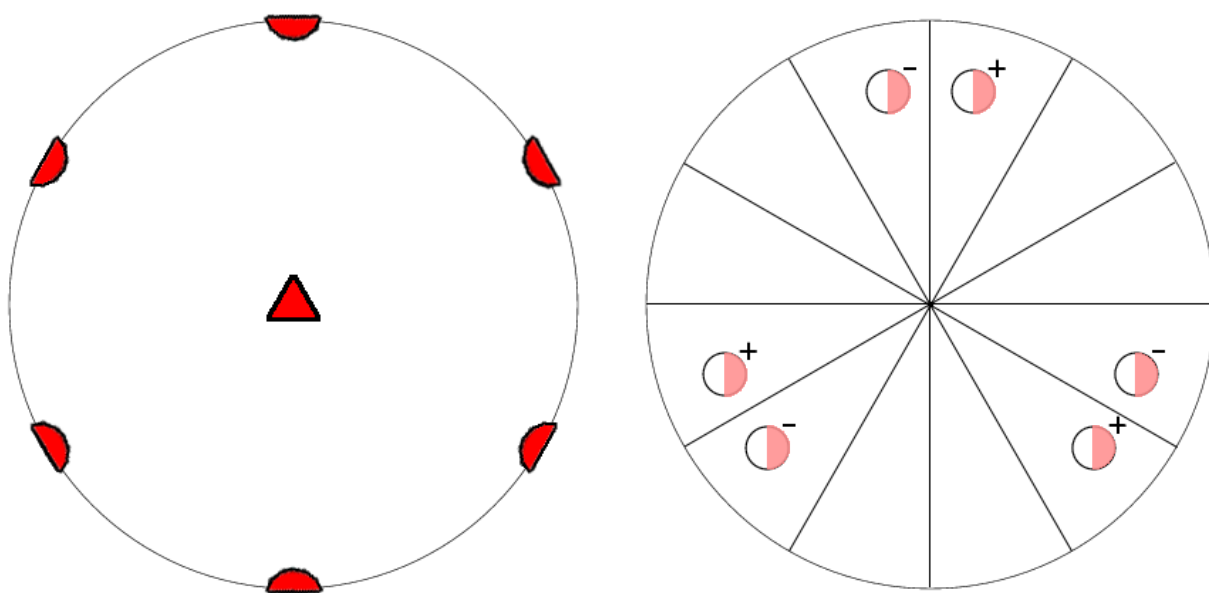
17.4.1.182



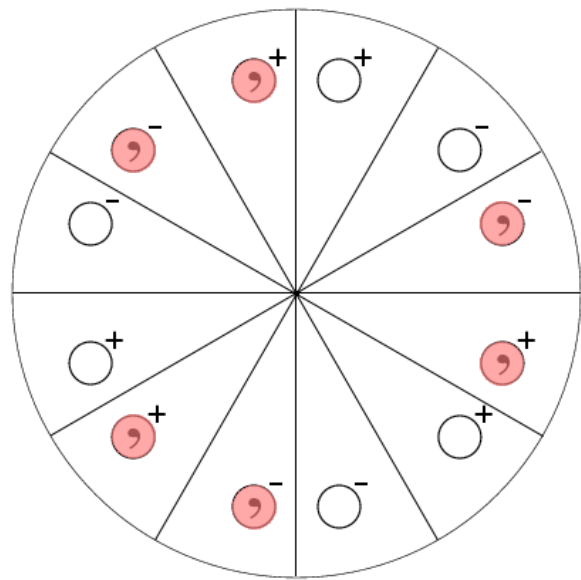
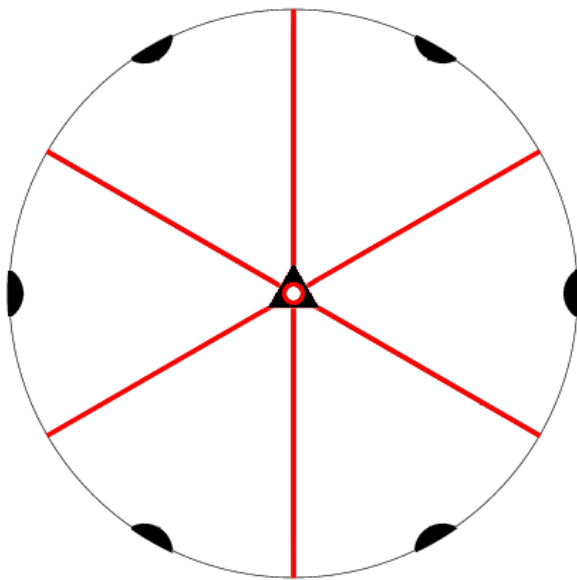
17.4.2.183



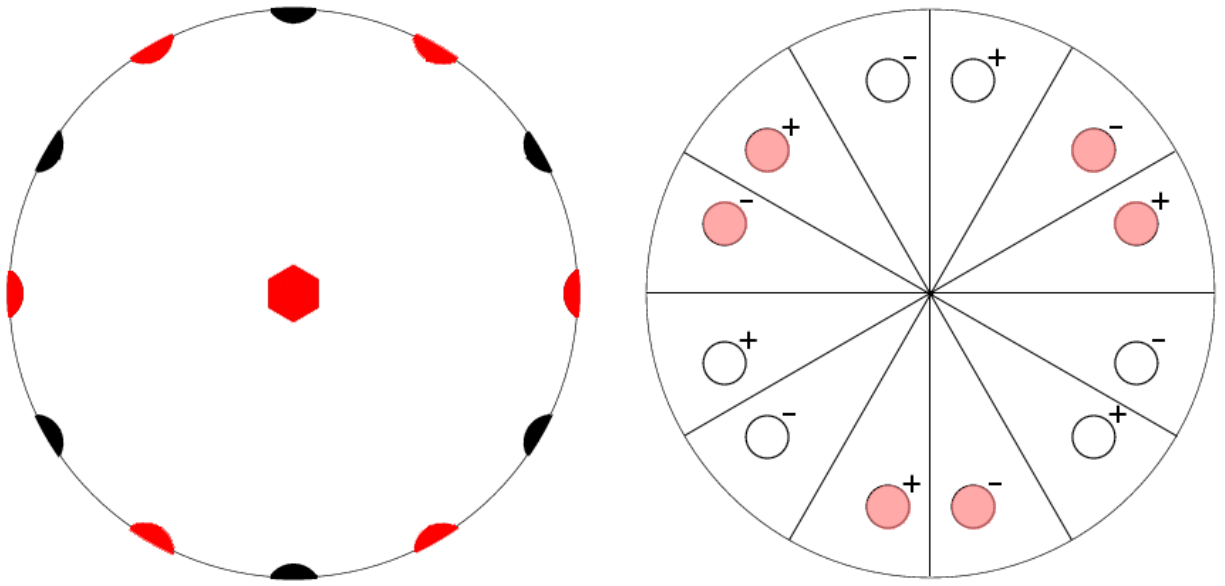
18.1.1.184



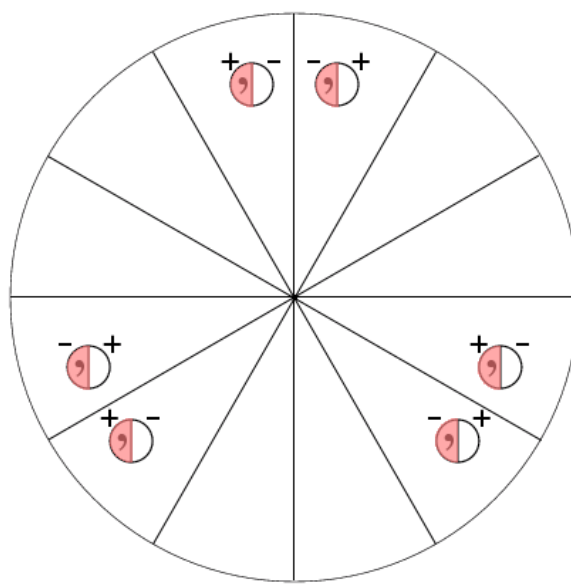
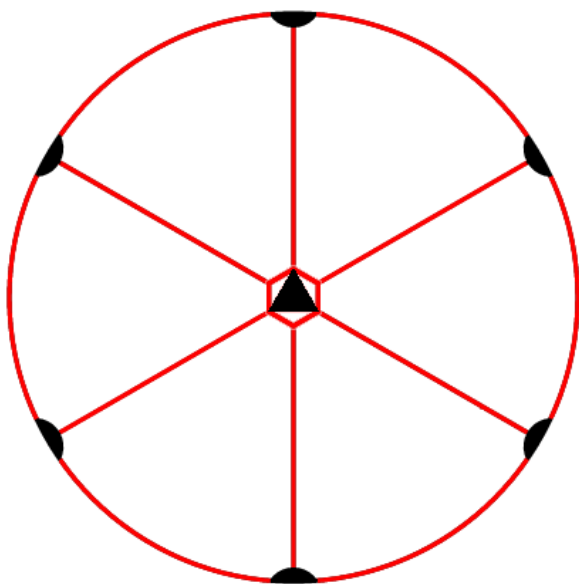
18.1.2.185



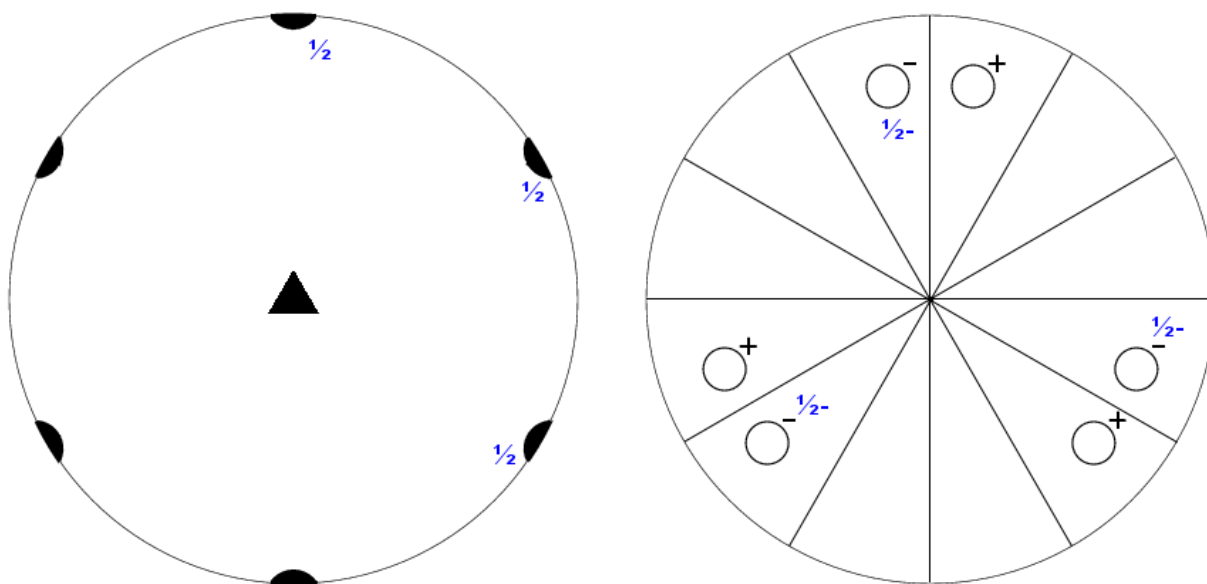
18.1.3.186



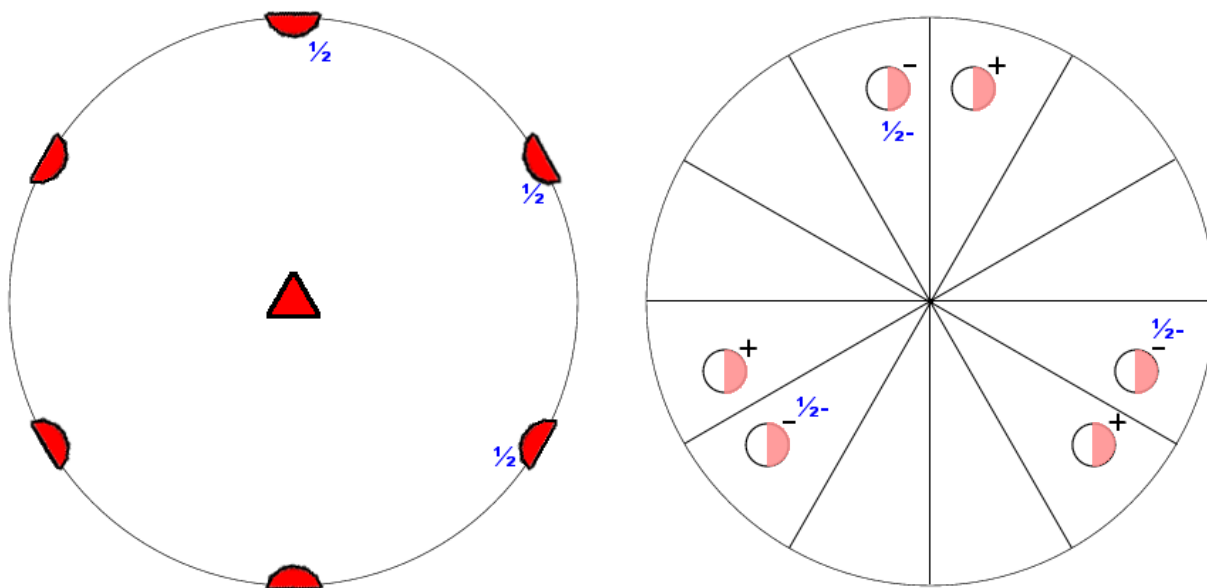
18.1.4.187



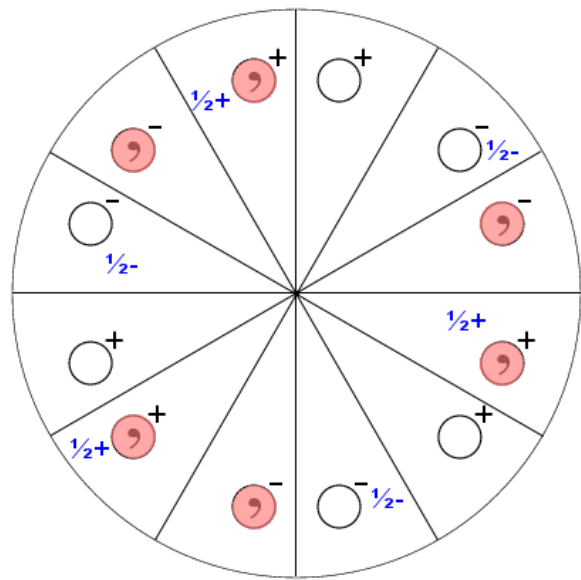
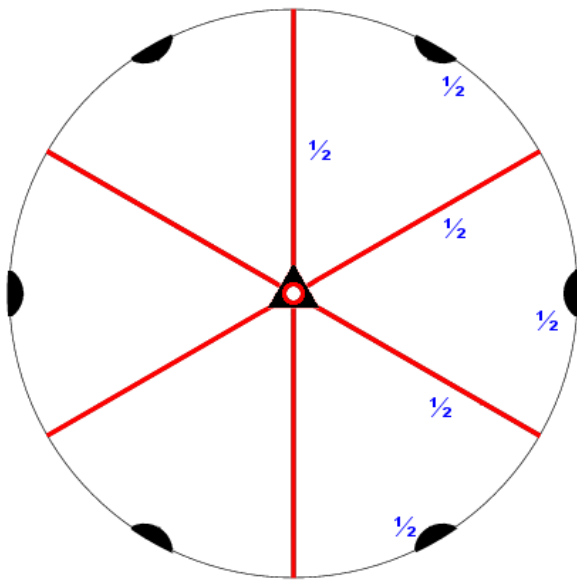
18.1.5.188



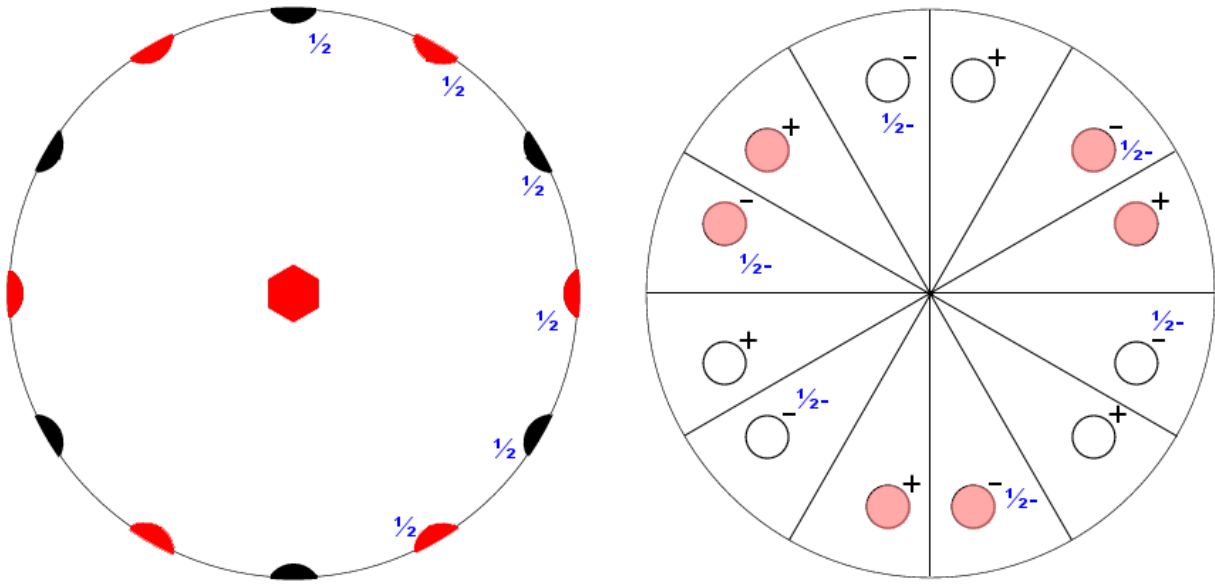
18.2.1.189



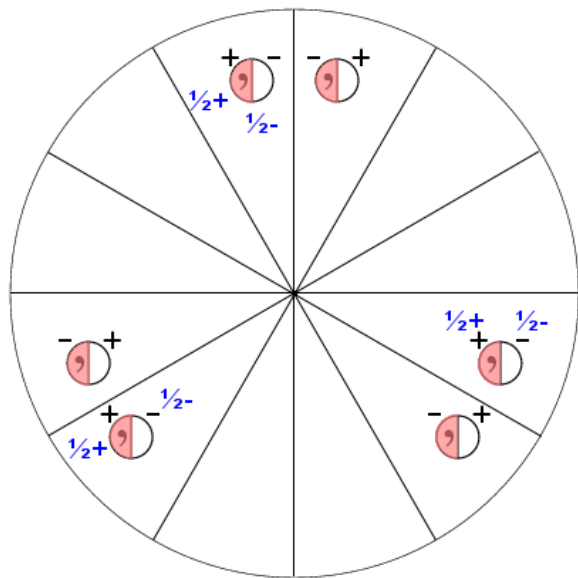
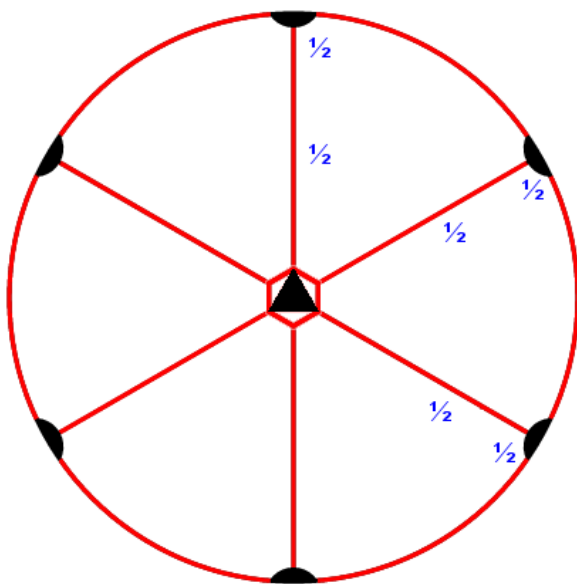
18.2.2.190



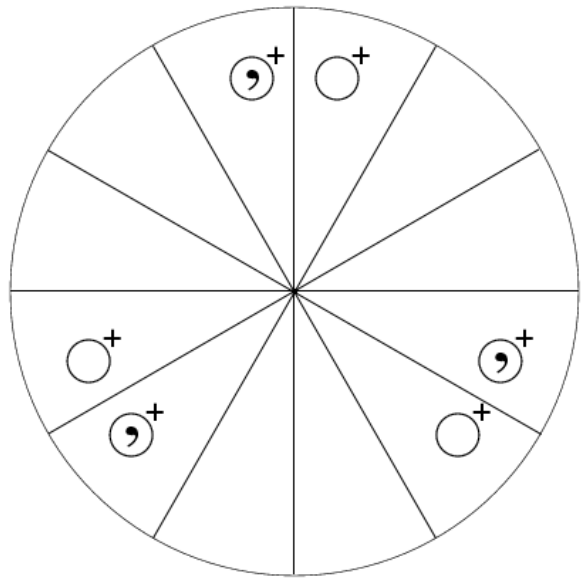
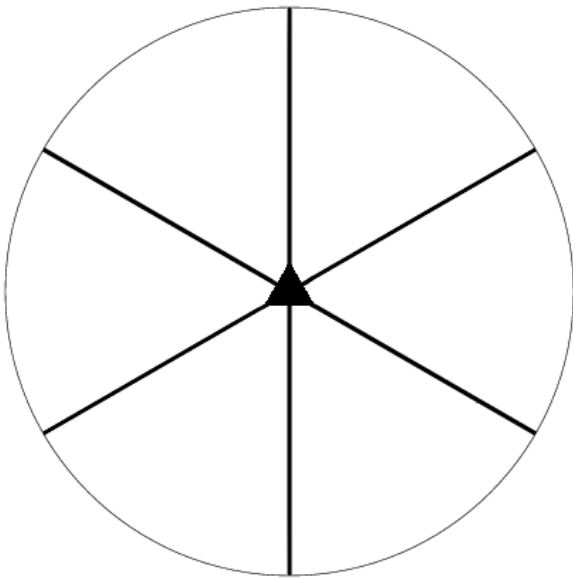
18.2.3.191



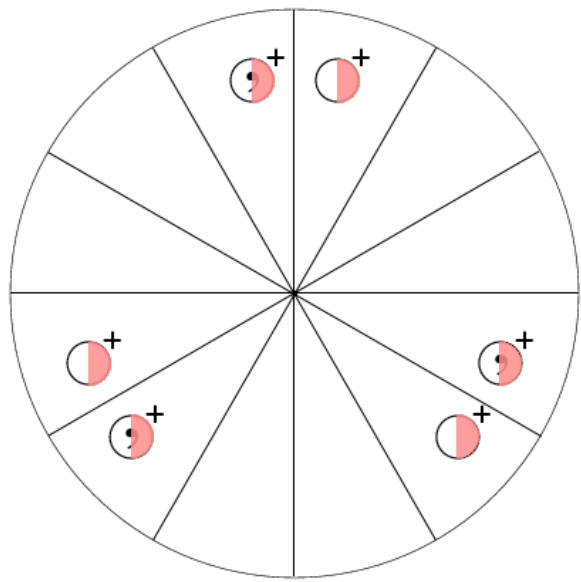
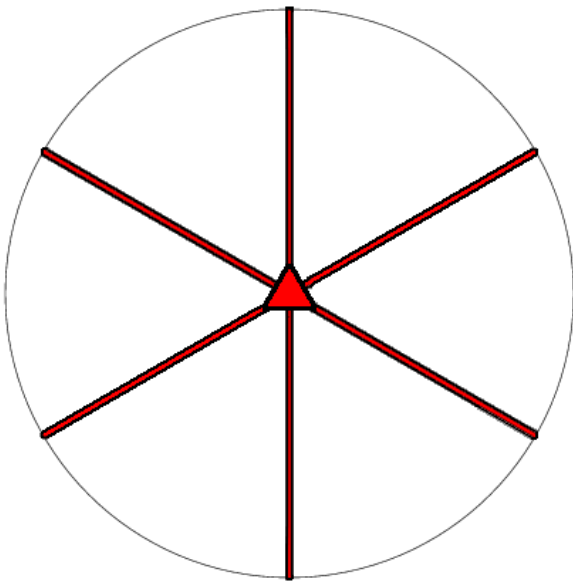
18.2.4.192



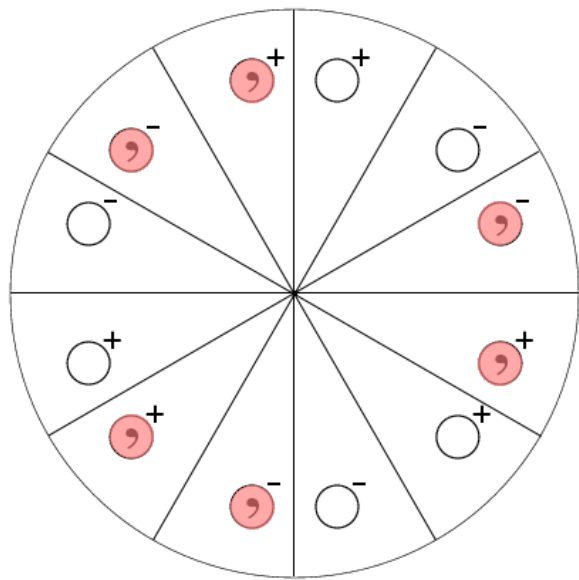
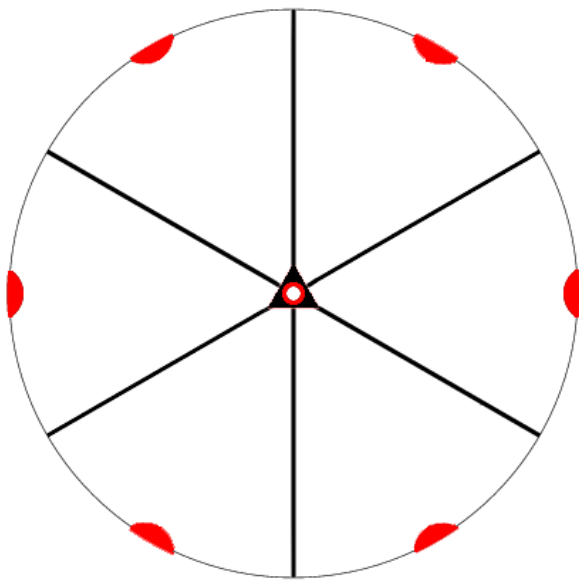
18.2.5.193



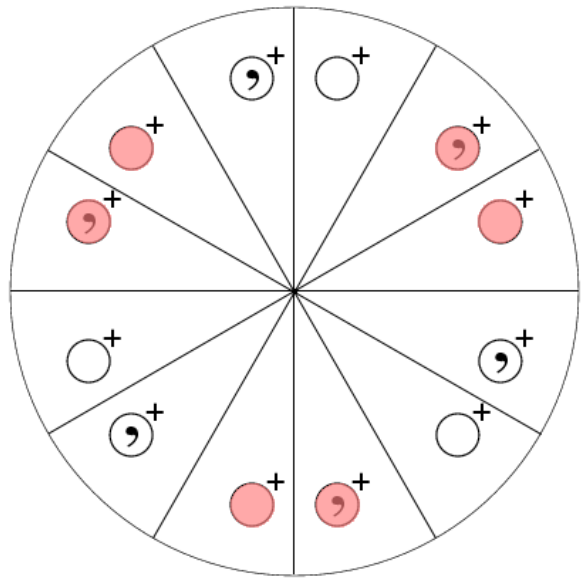
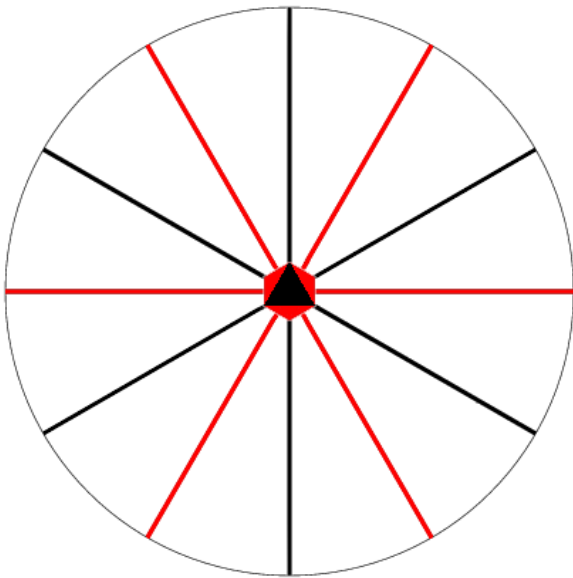
19.1.1.194



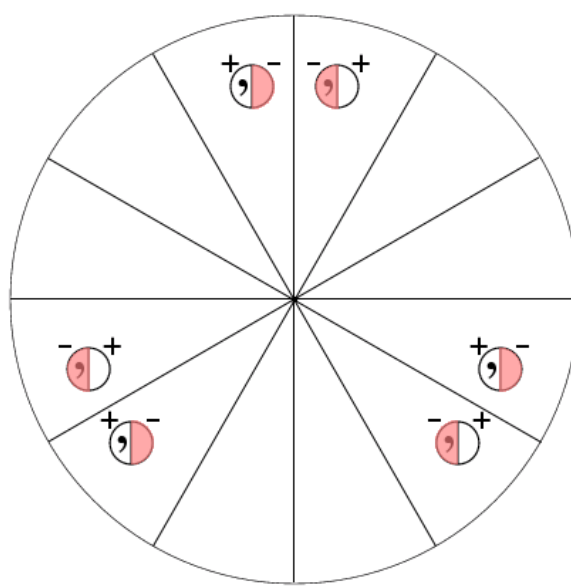
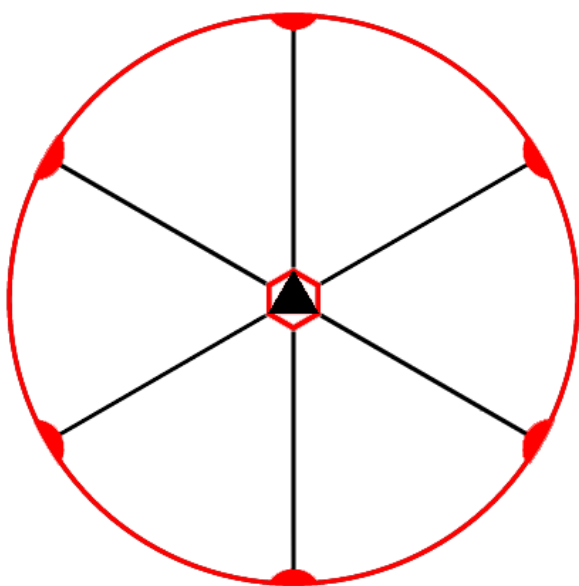
19.1.2.195



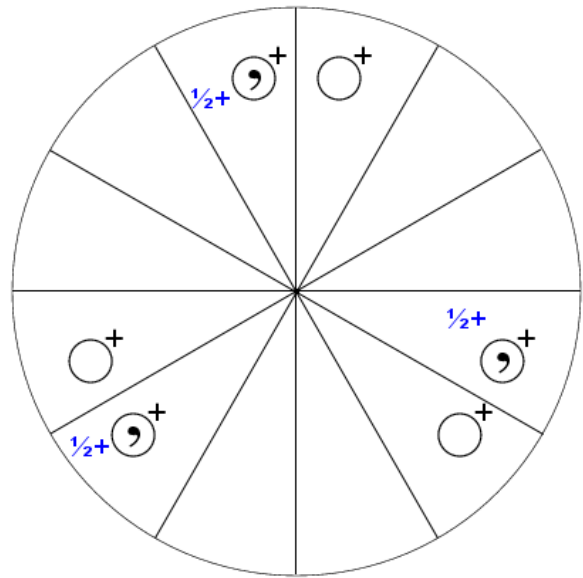
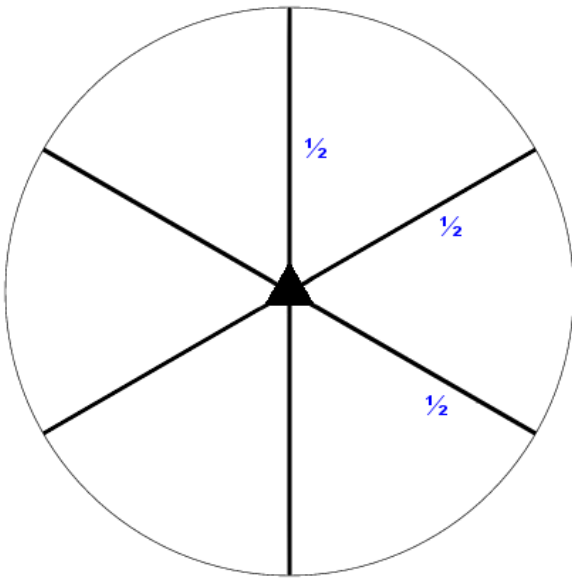
19.1.3.196



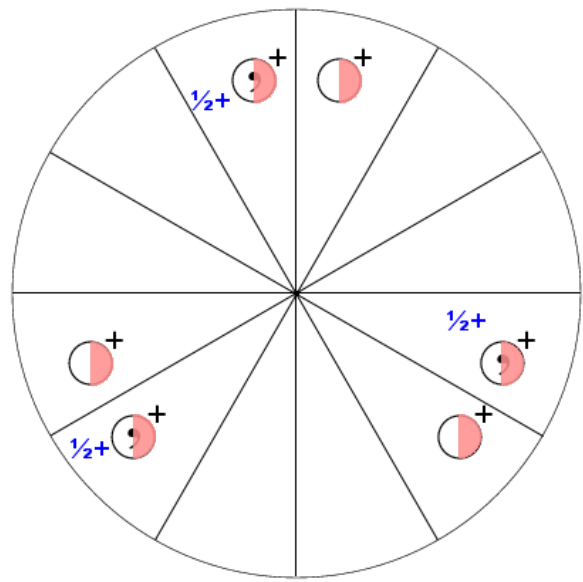
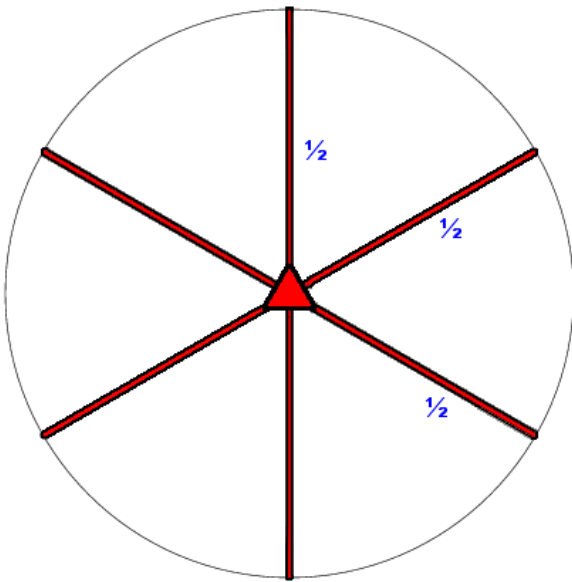
19.1.4.197



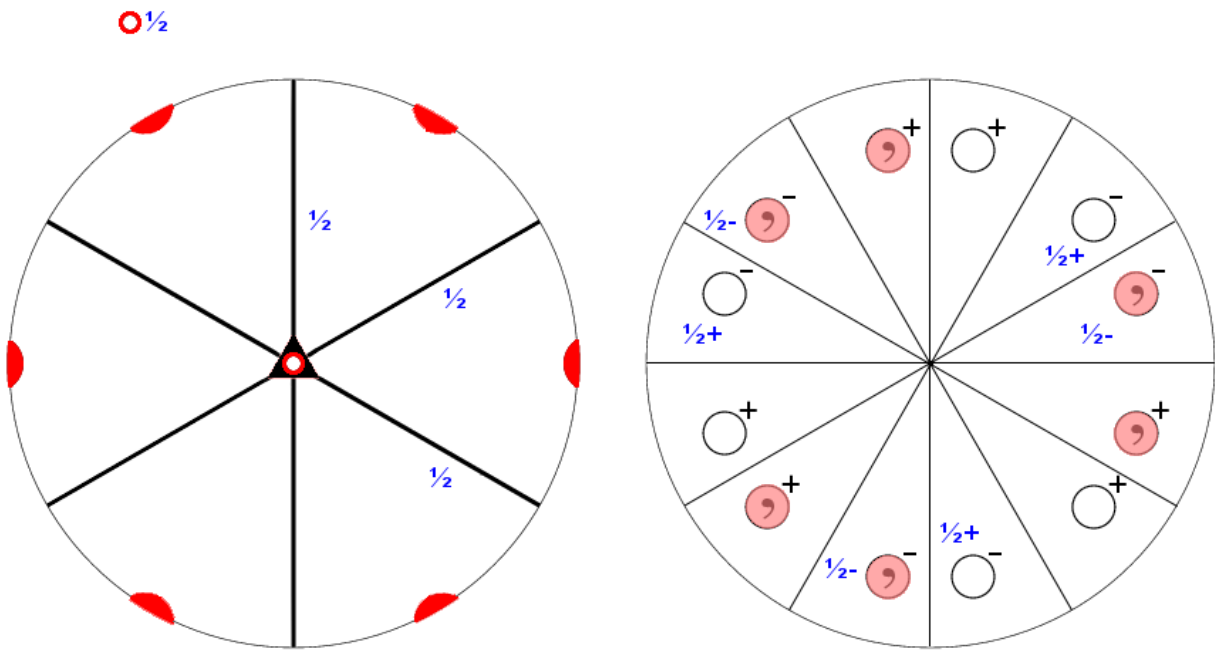
19.1.5.198



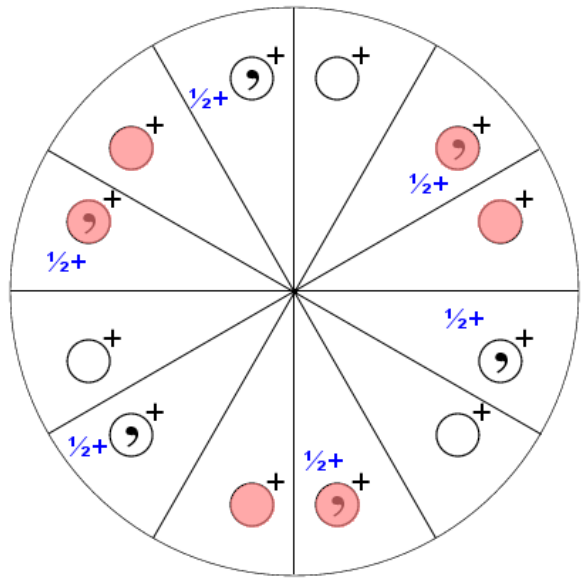
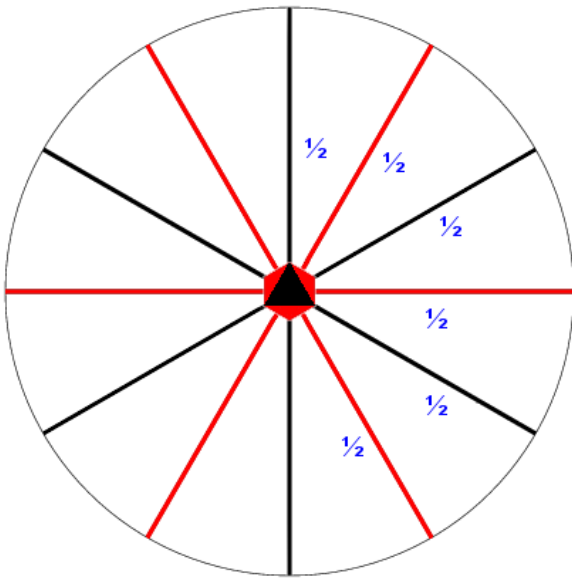
19.2.1.199



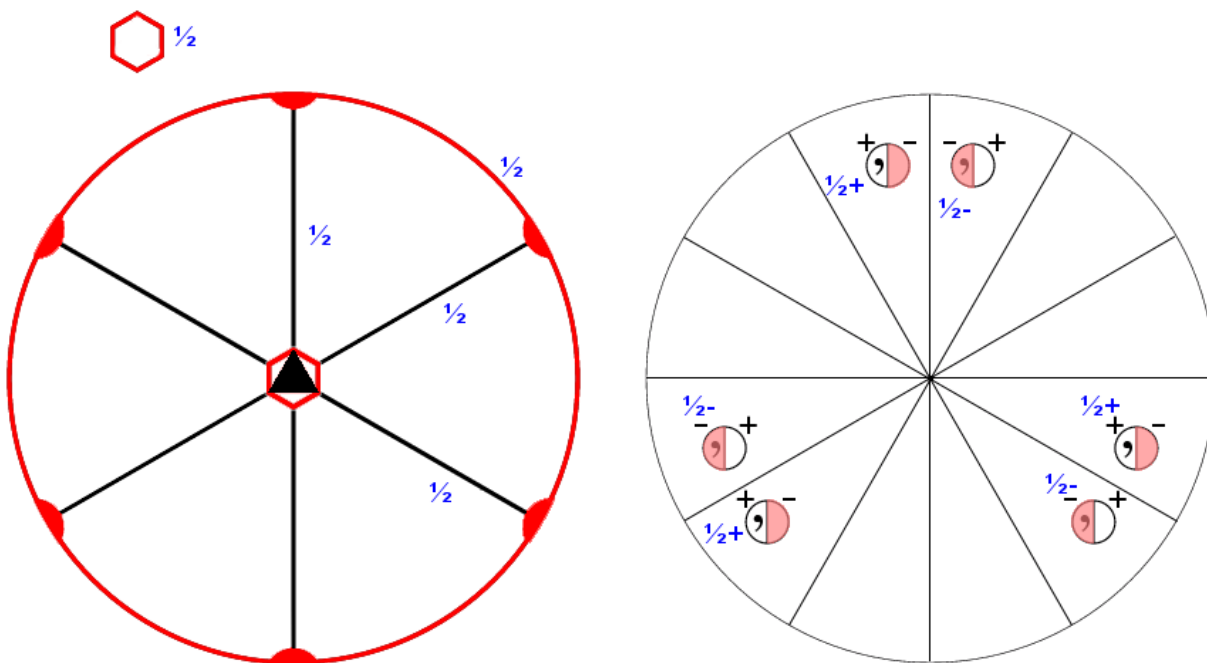
19.2.2.200



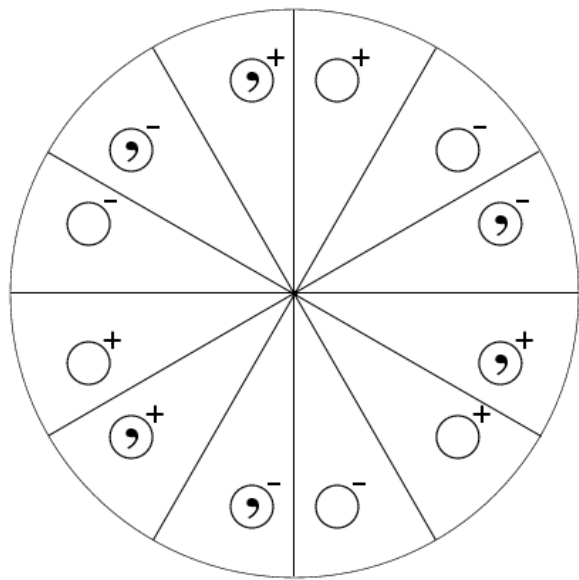
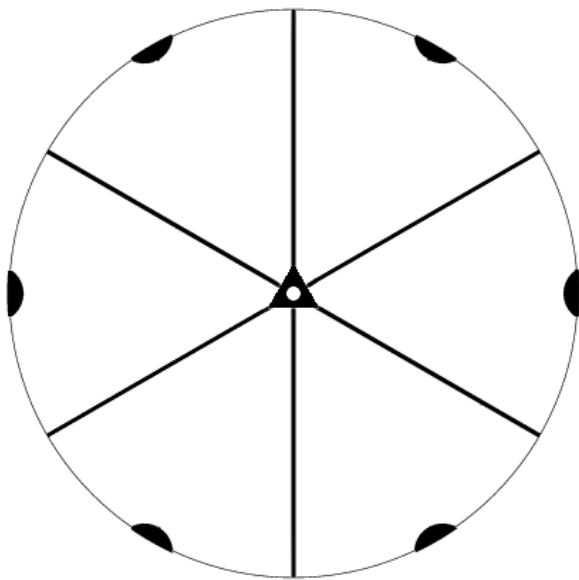
19.2.3.201



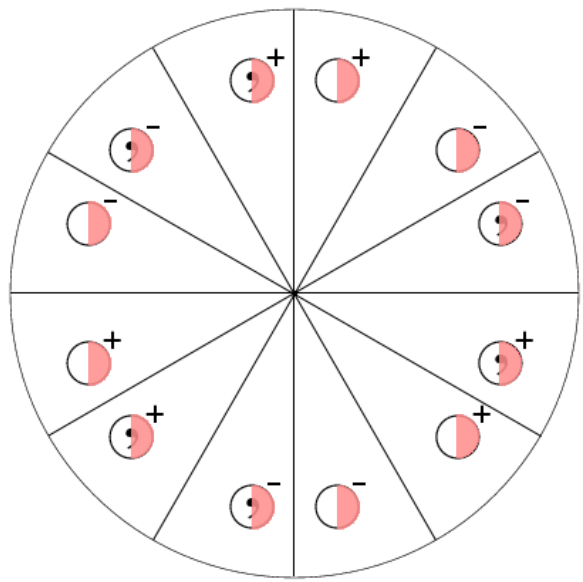
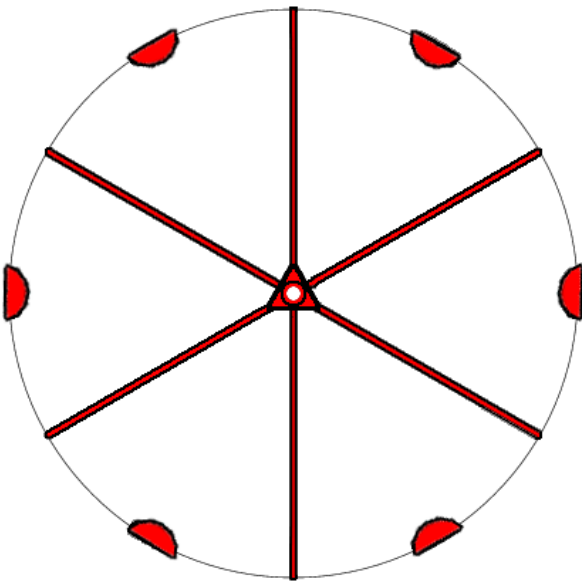
19.2.4.202



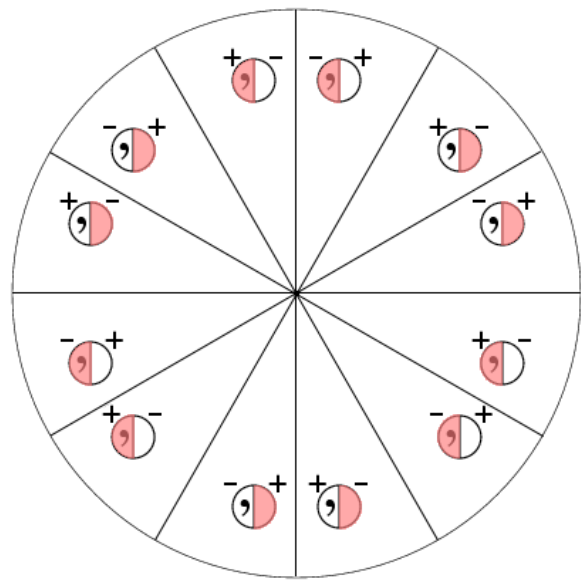
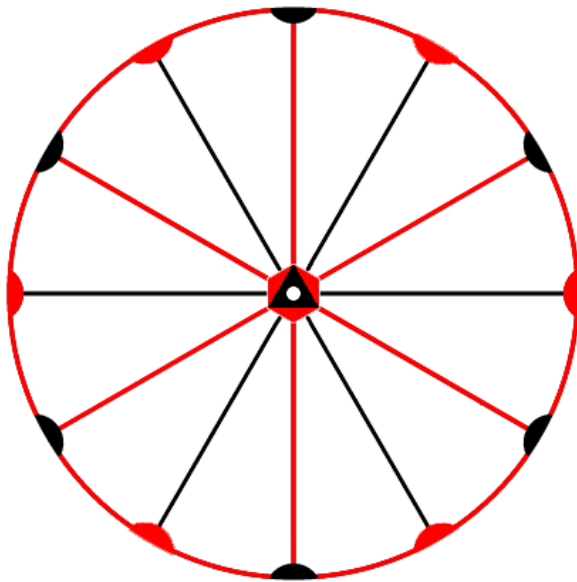
19.2.5.203



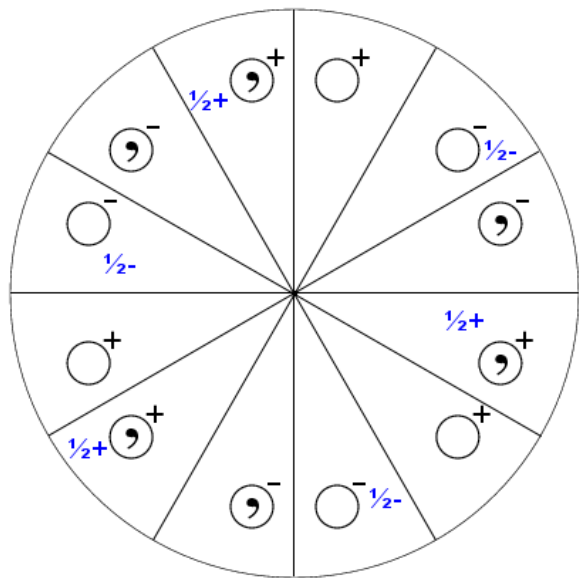
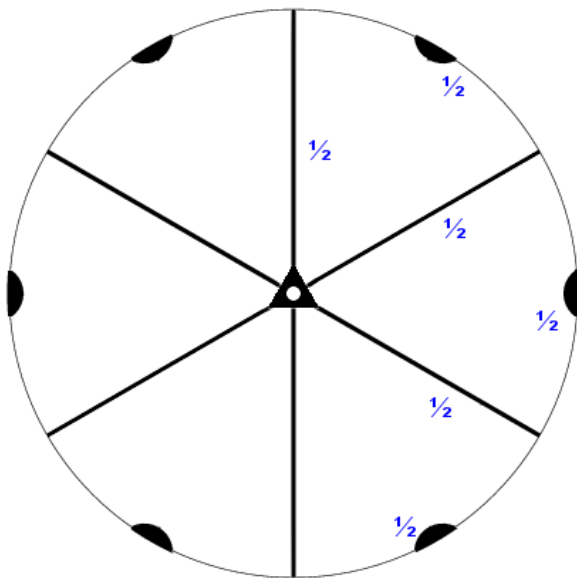
20.1.1.204



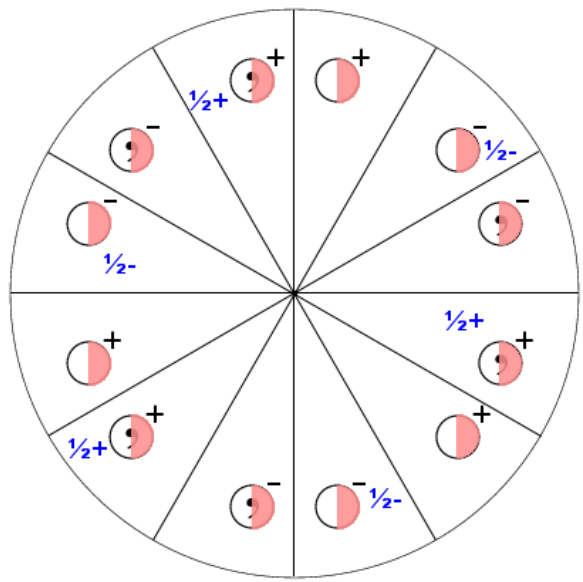
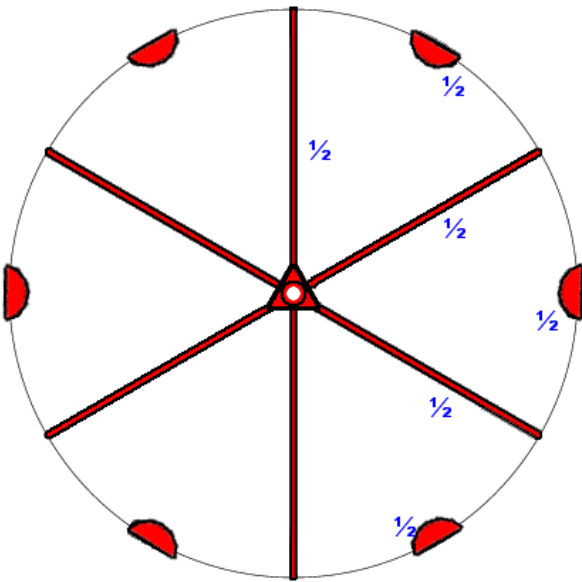
20.1.2.205



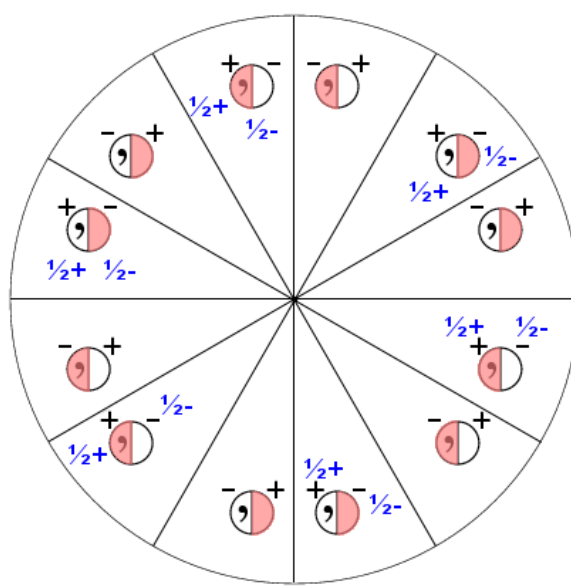
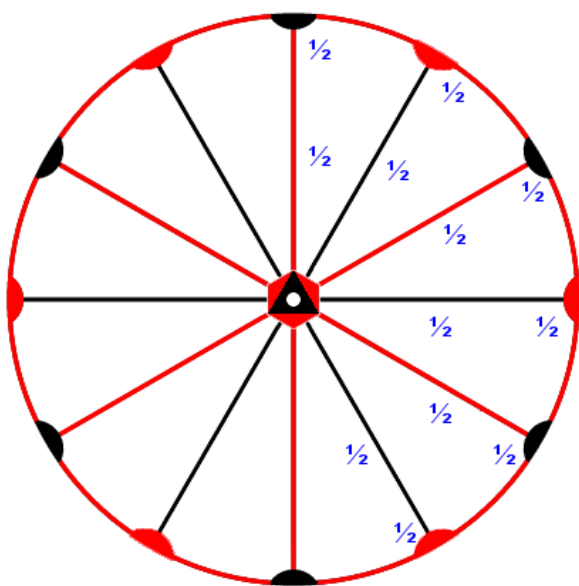
20.1.3.206



20.2.1.207

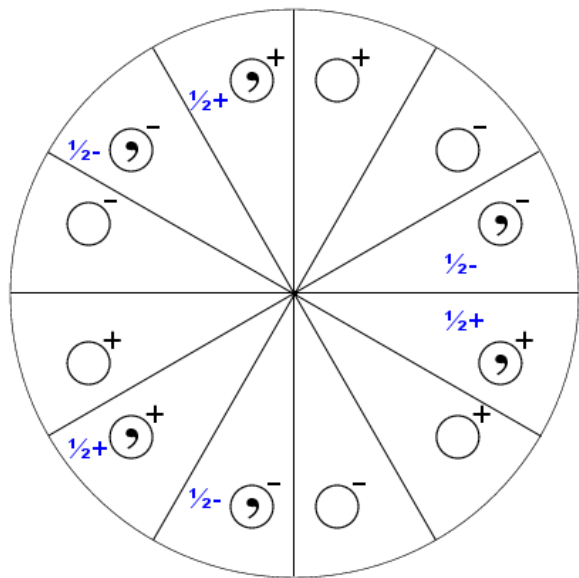
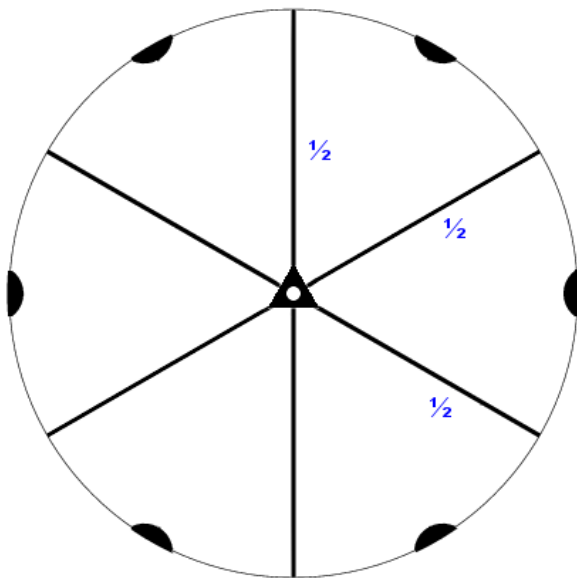


20.2.2.208

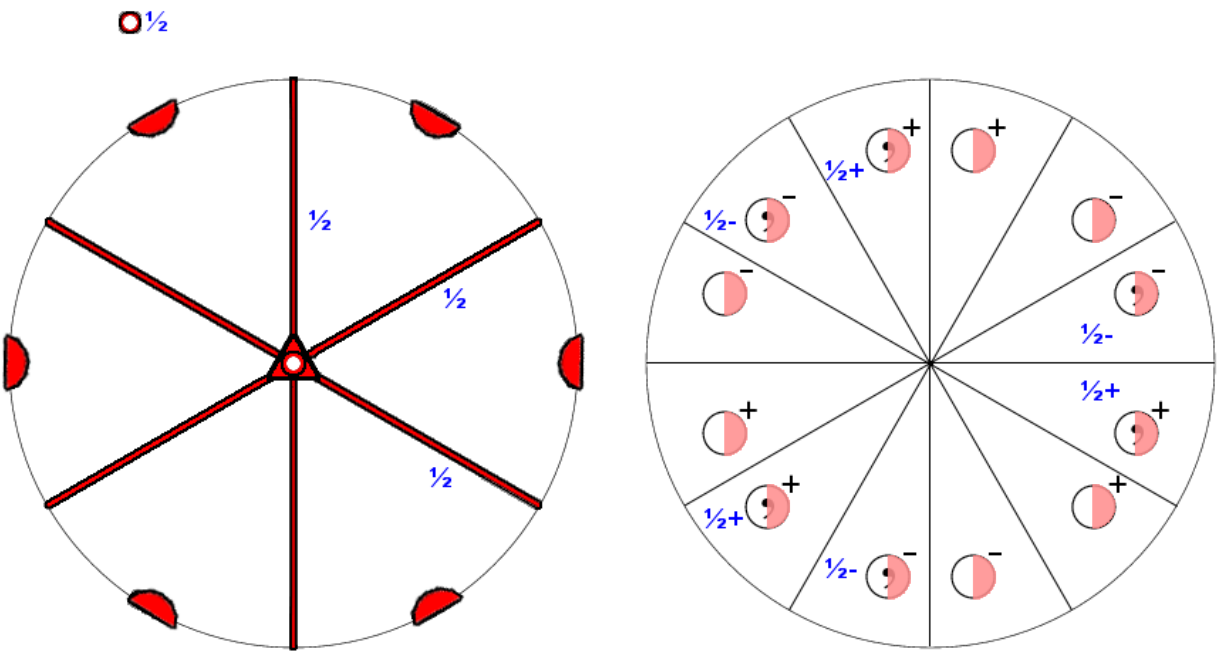


20.2.3.209

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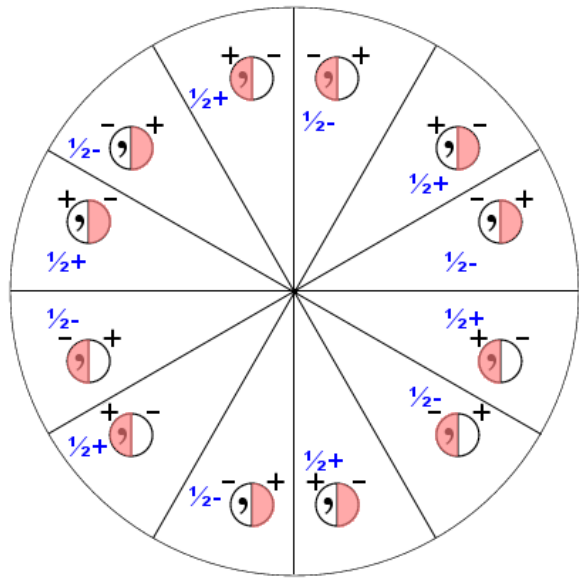
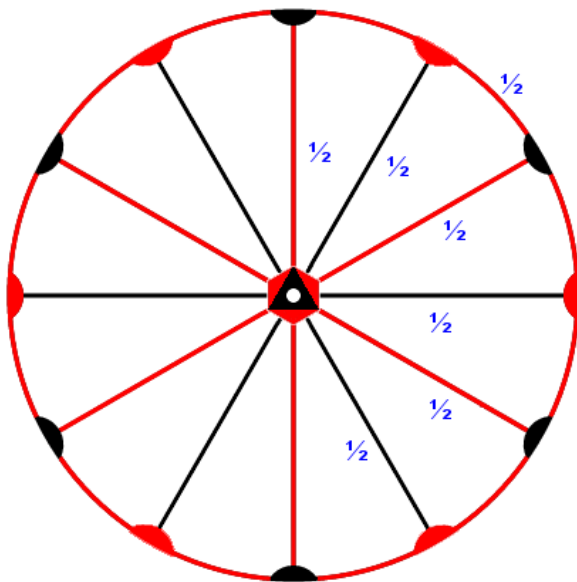


20.3.1.210



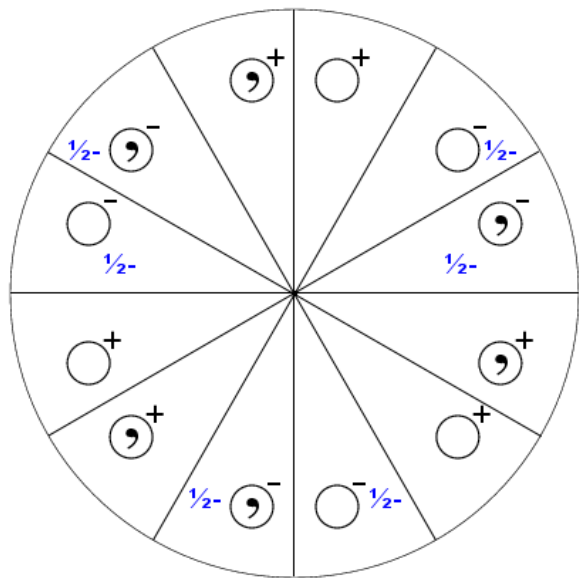
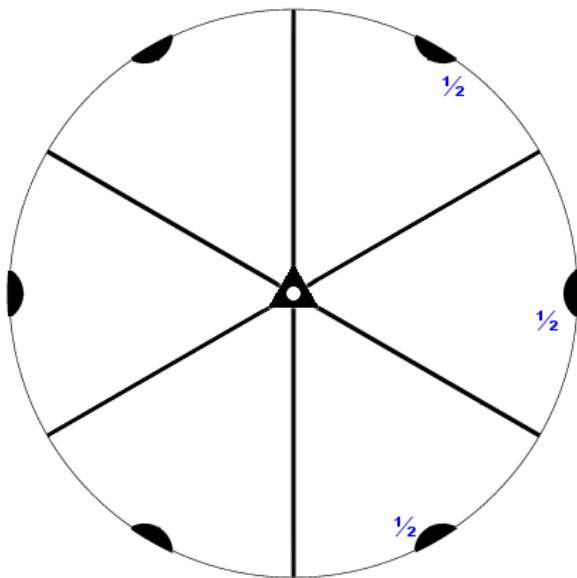
20.3.2.211

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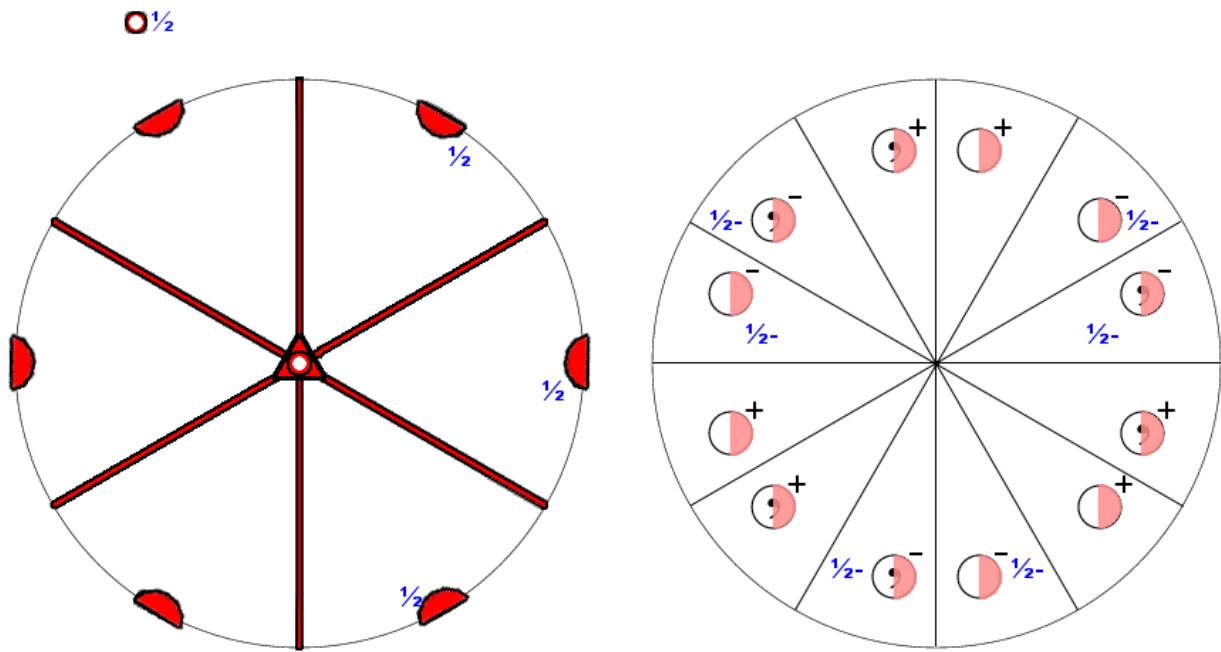


20.3.3.212

$\circ \frac{1}{2}$

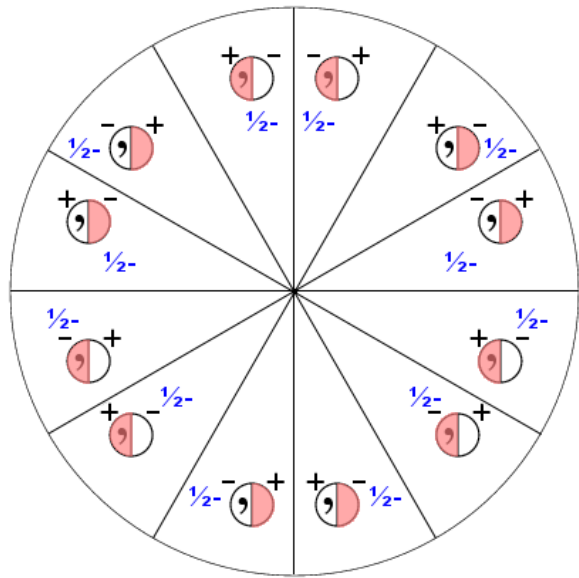
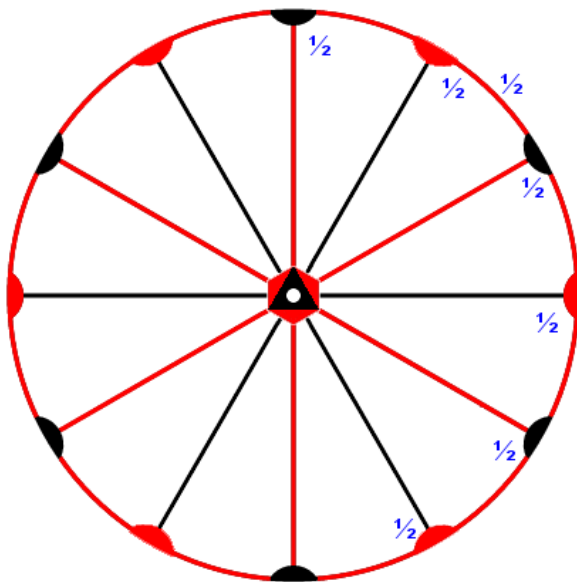


20.4.1.213

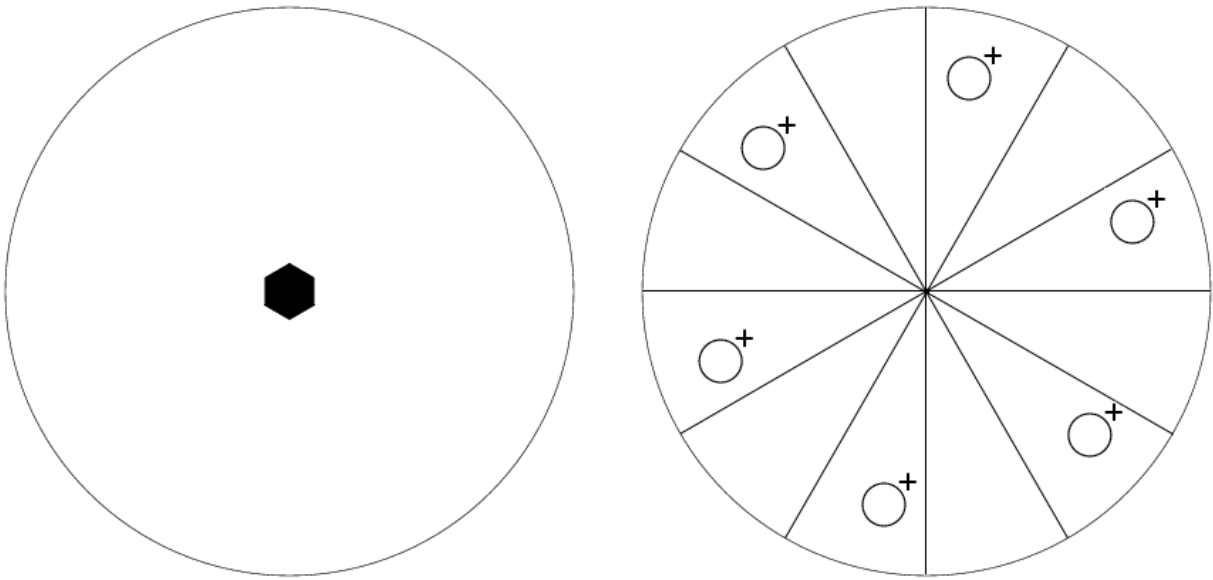


20.4.2.214

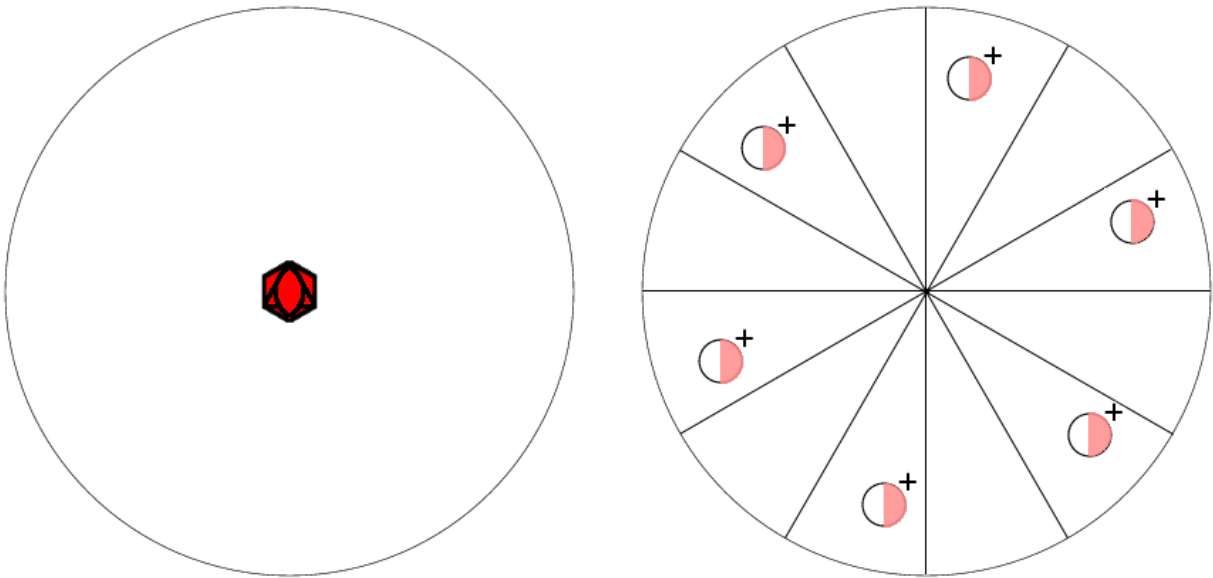
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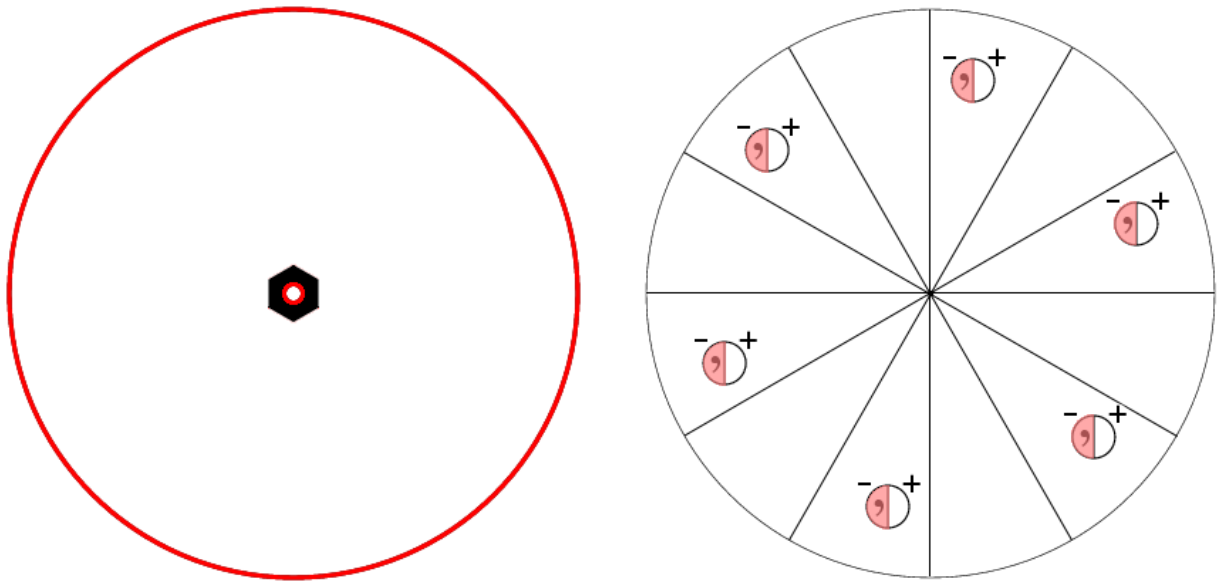
20.4.3.215



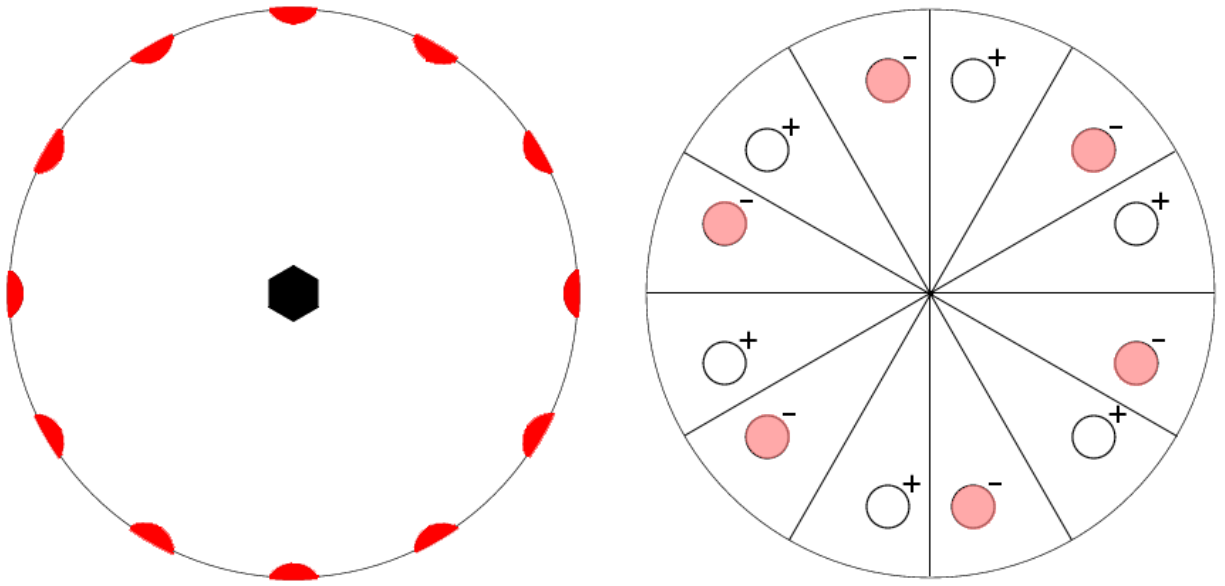
21.1.1.216



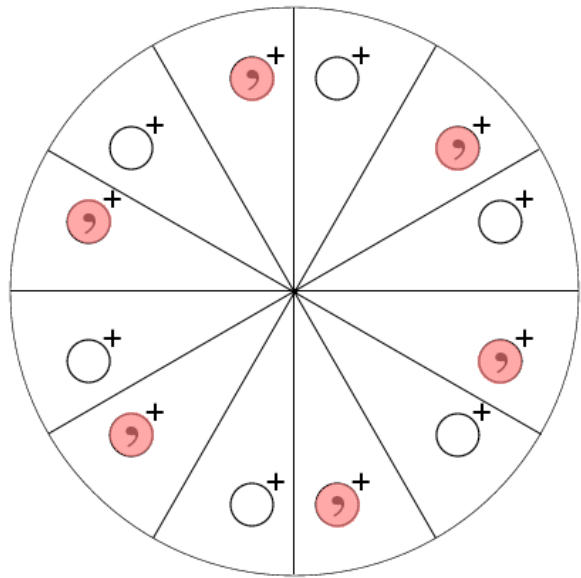
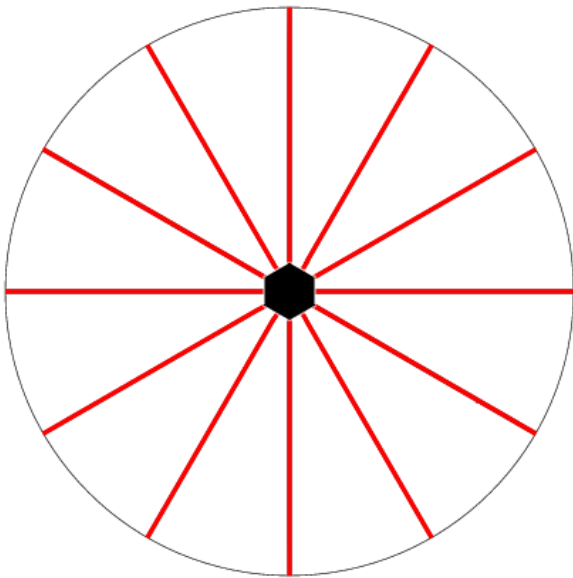
21.1.2.217



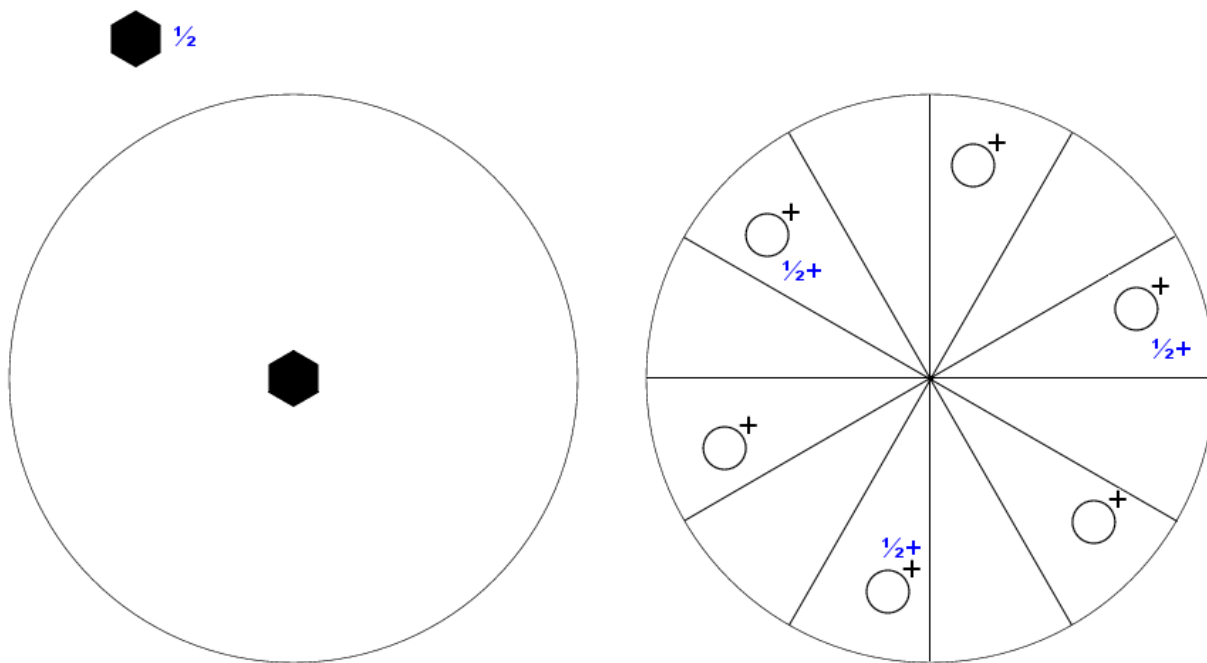
21.1.3.218



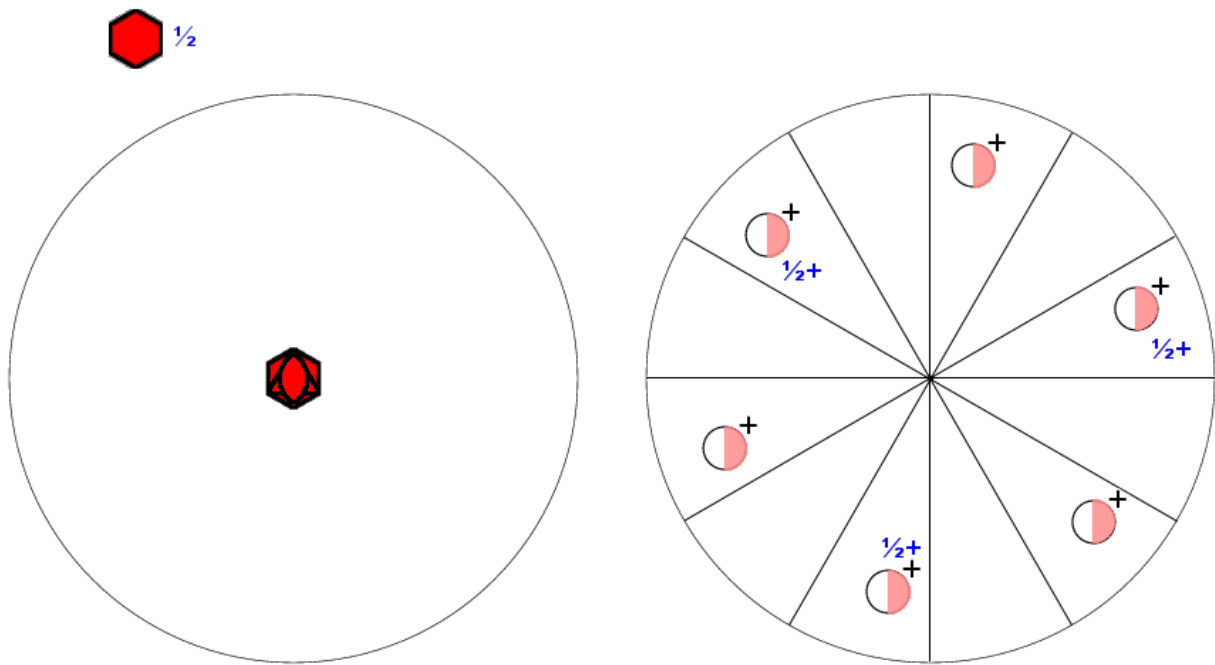
21.1.4.219



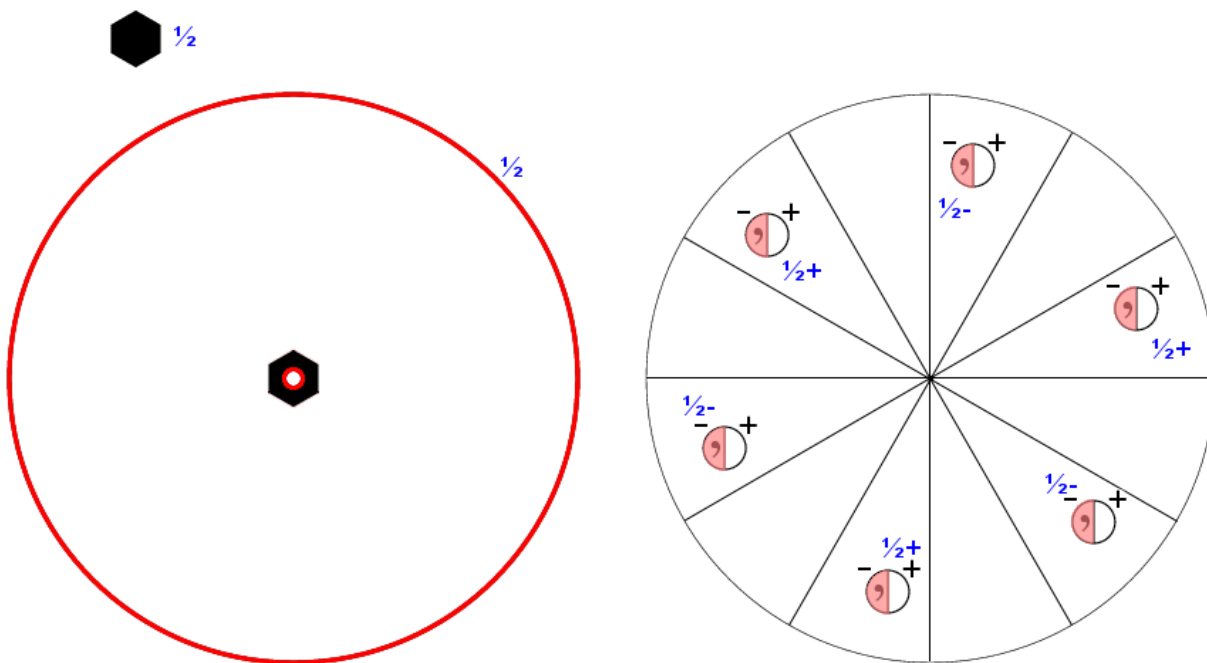
21.1.5.220



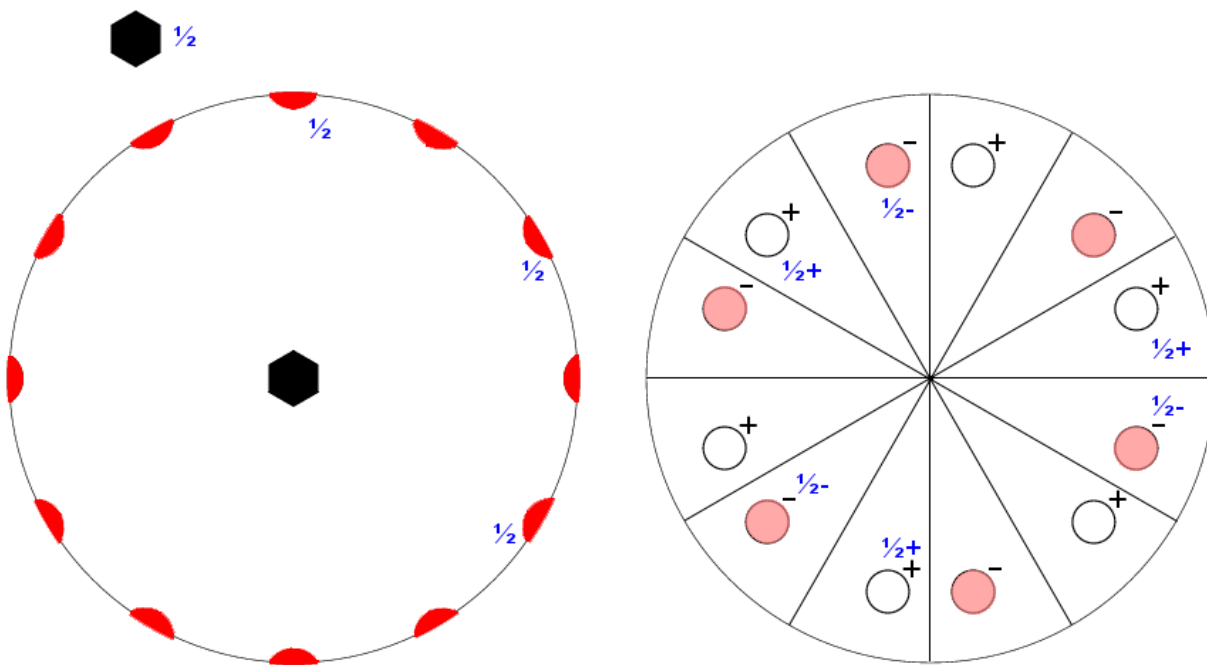
21.2.1.221



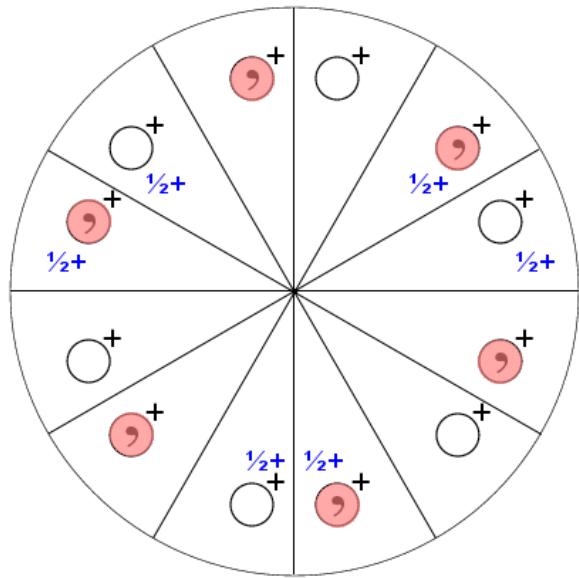
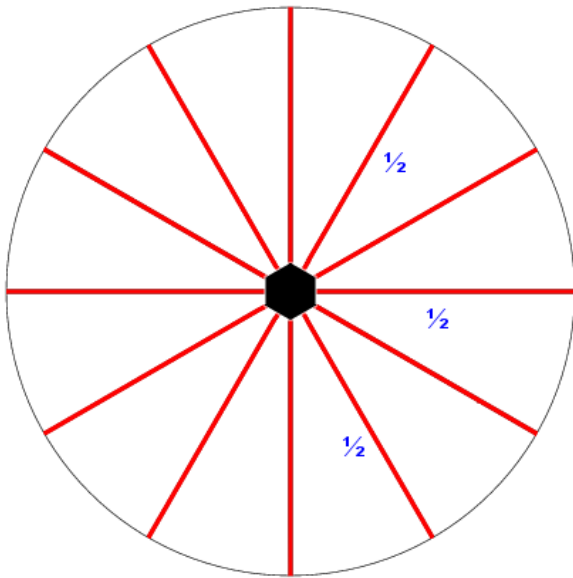
21.2.2.222



21.2.3.223

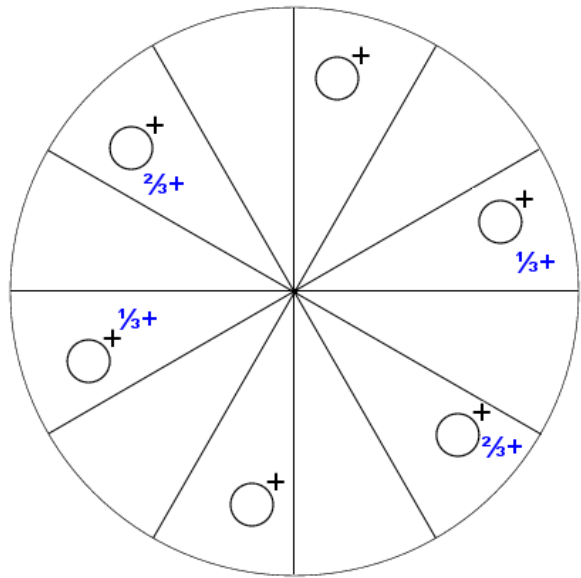
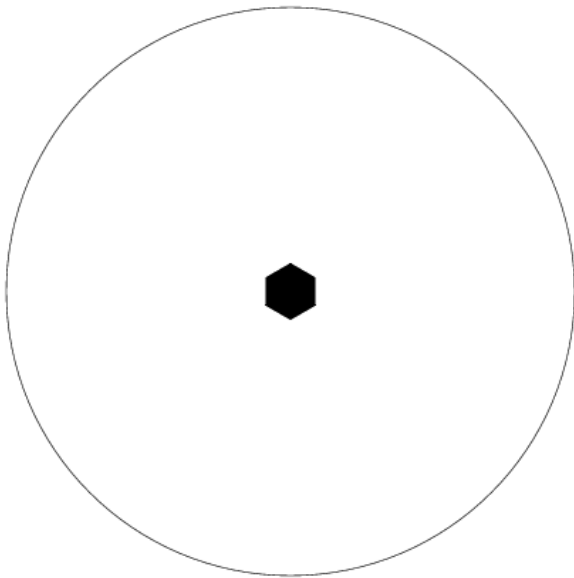


21.2.4.224

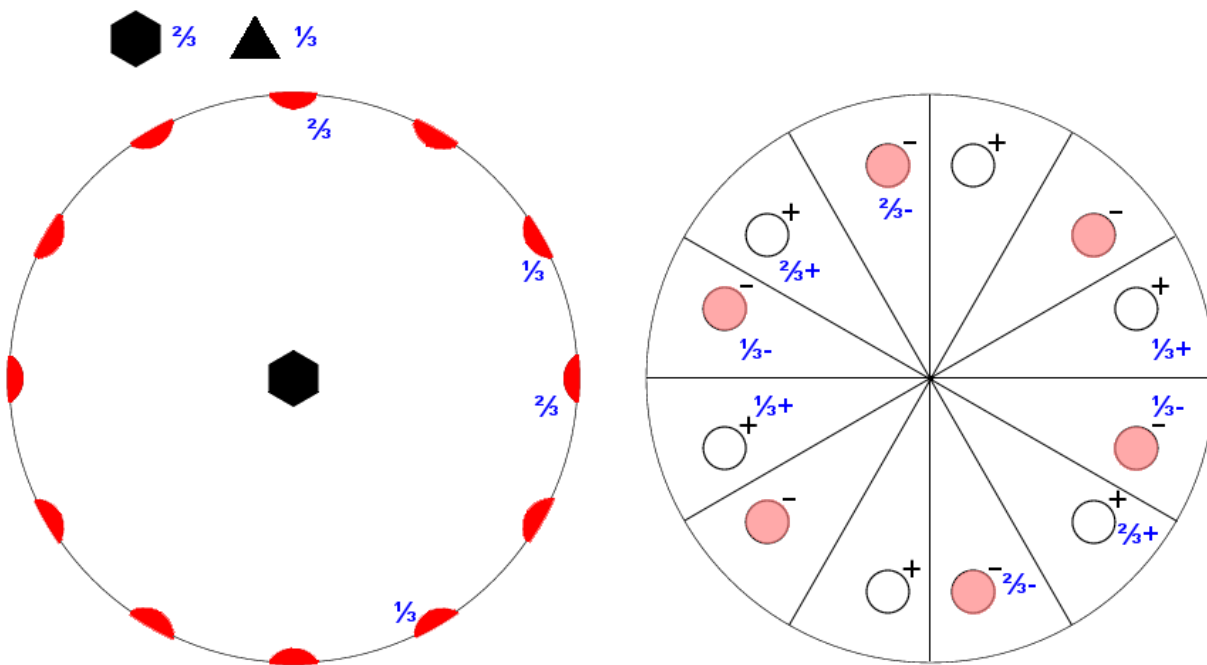


21.2.5.225

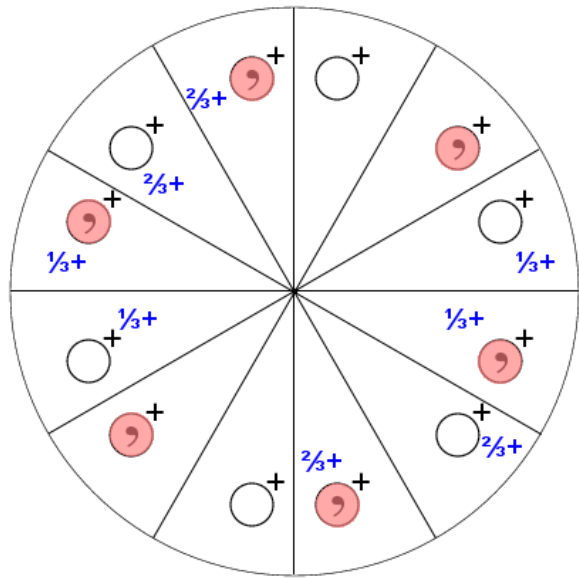
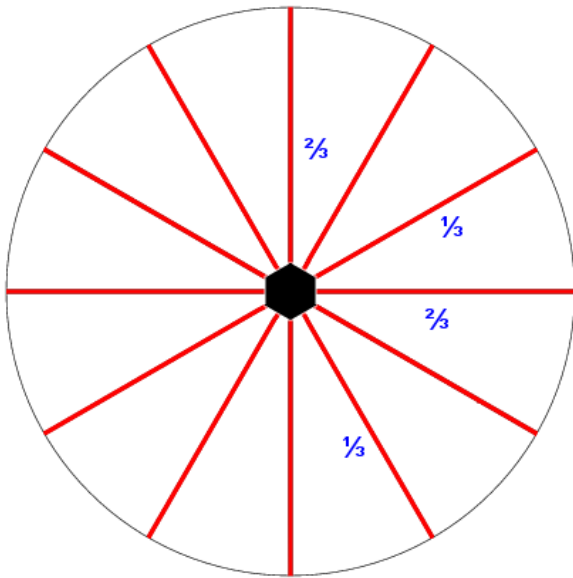
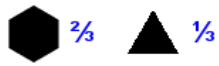
⬛ $\frac{2}{3}$ ⬛ $\frac{1}{3}$



21.3.1.226

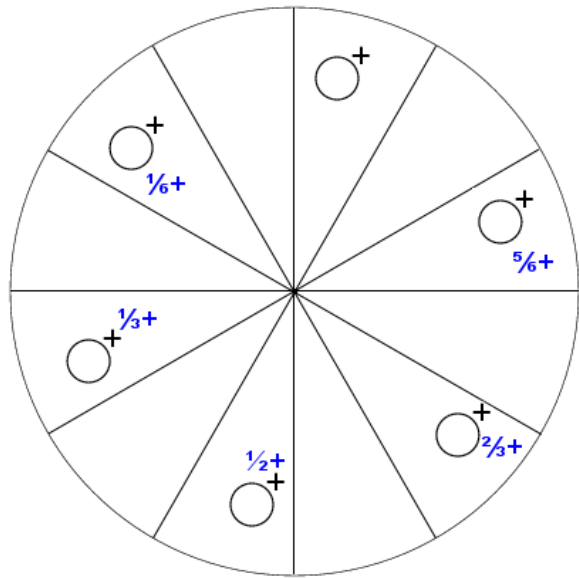
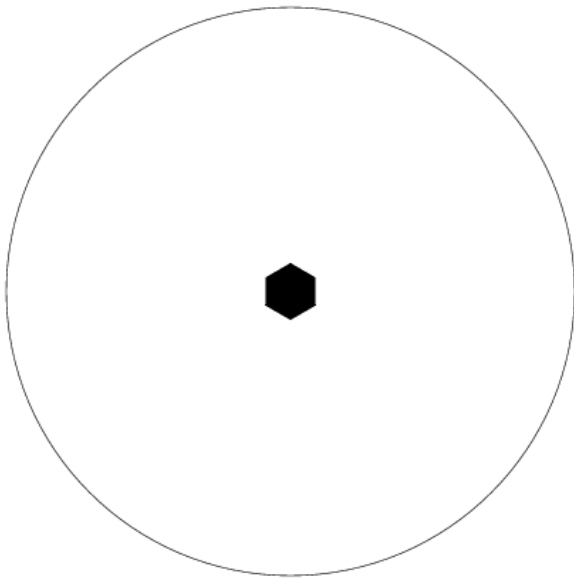


21.3.2.227

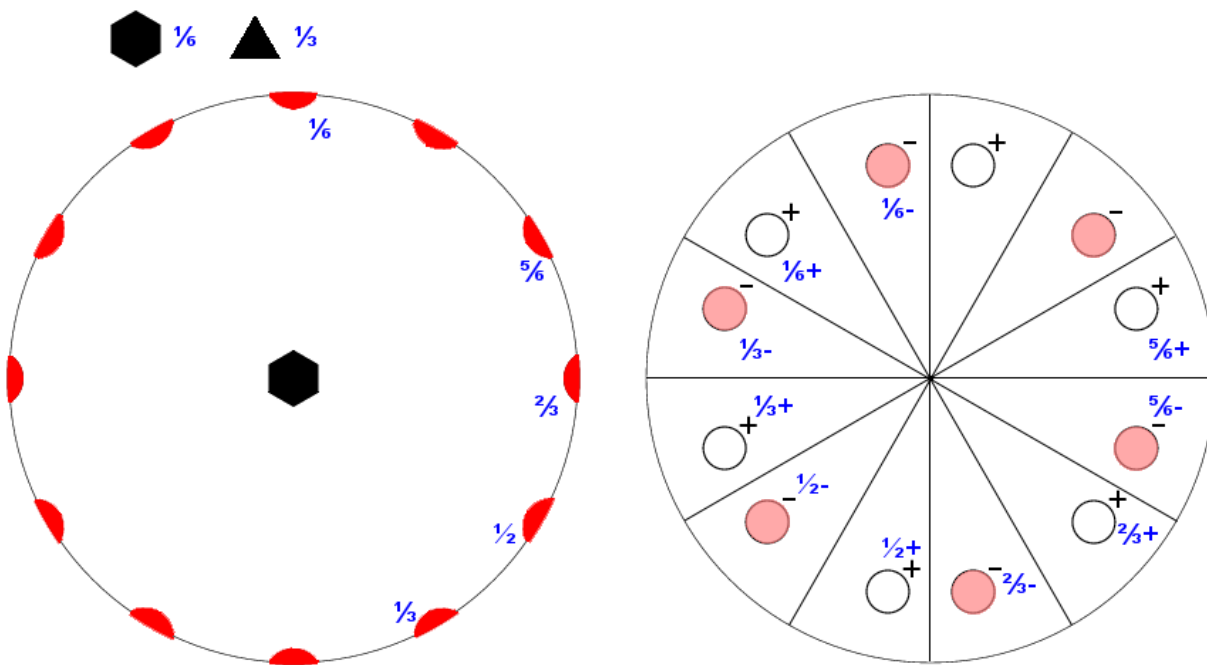


21.3.3.228



● $\frac{1}{6}$ ▲ $\frac{1}{3}$

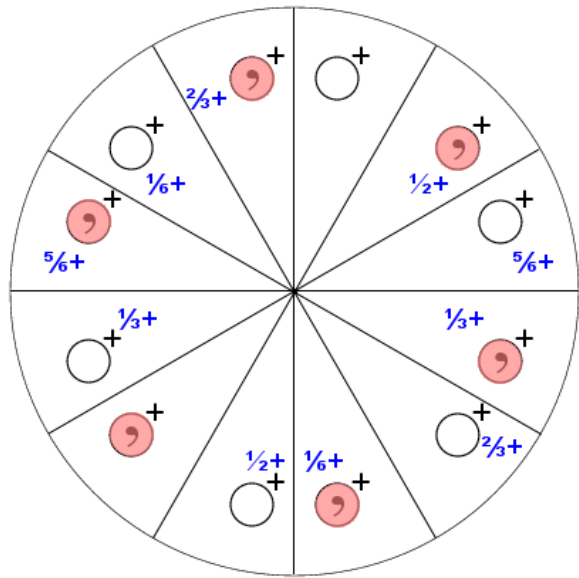
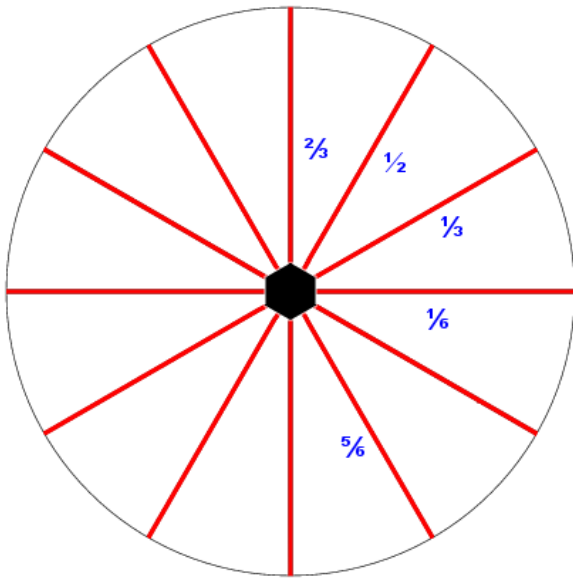


21.4.1.229

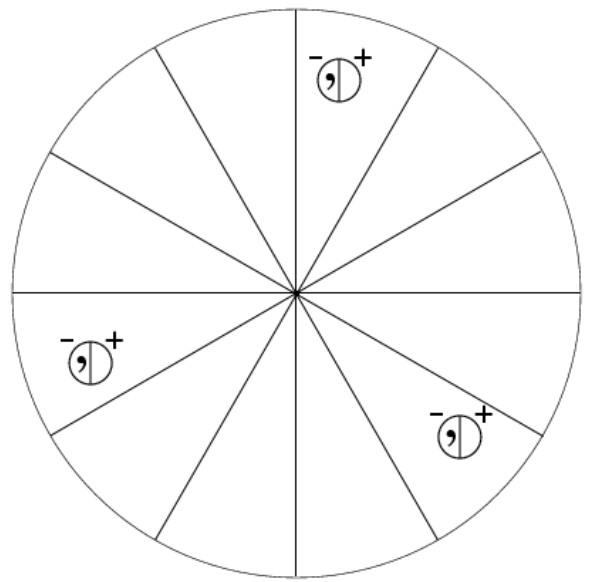
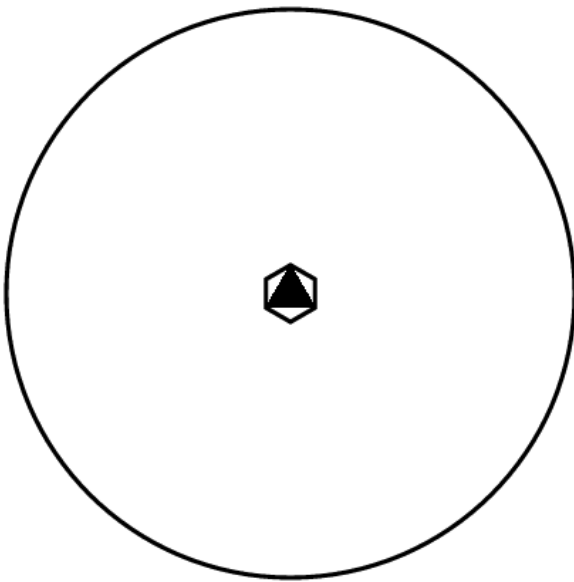


21.4.2.230

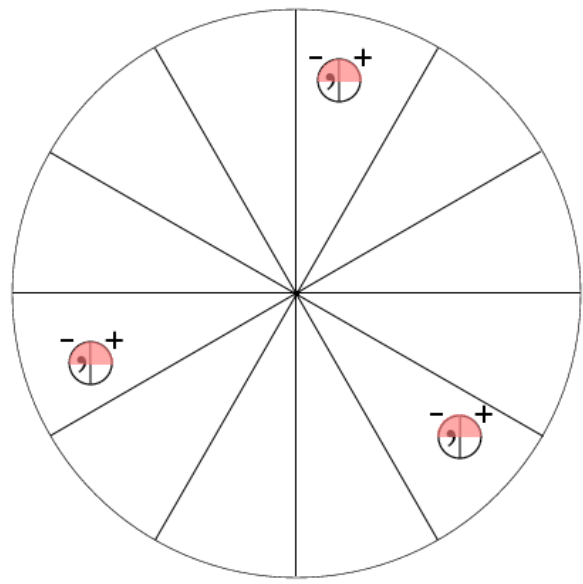
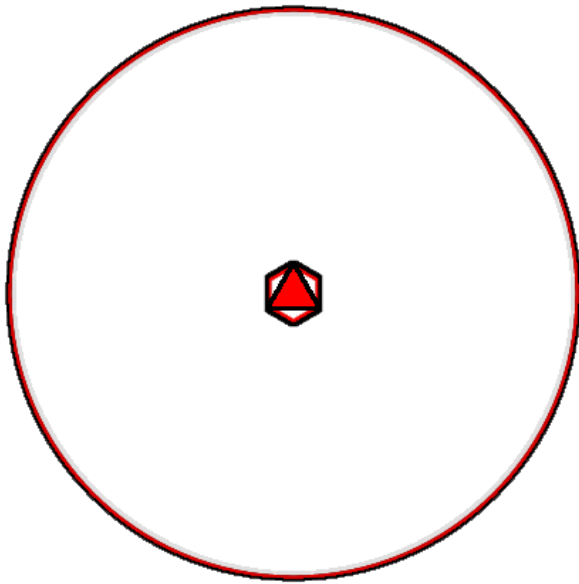
 $\frac{1}{6}$
 $\frac{1}{3}$



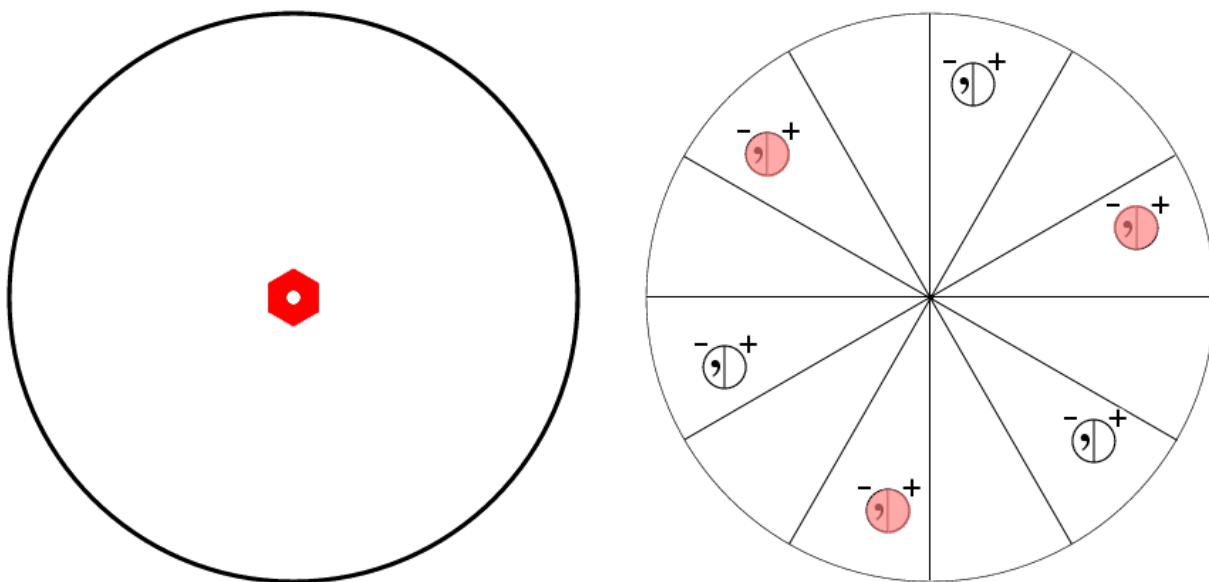
21.4.3.231



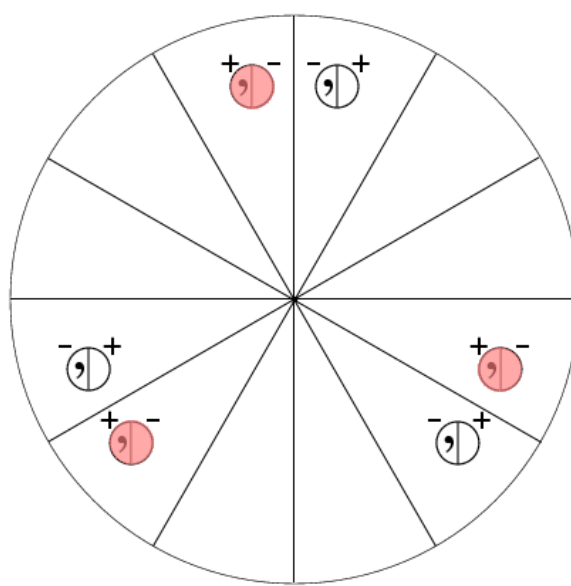
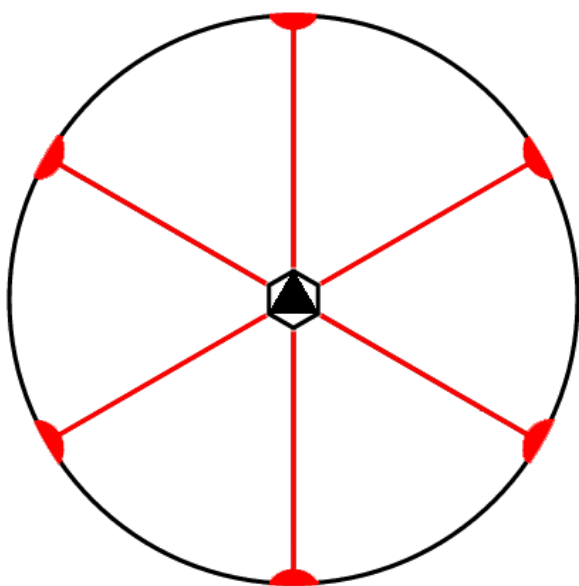
22.1.1.232



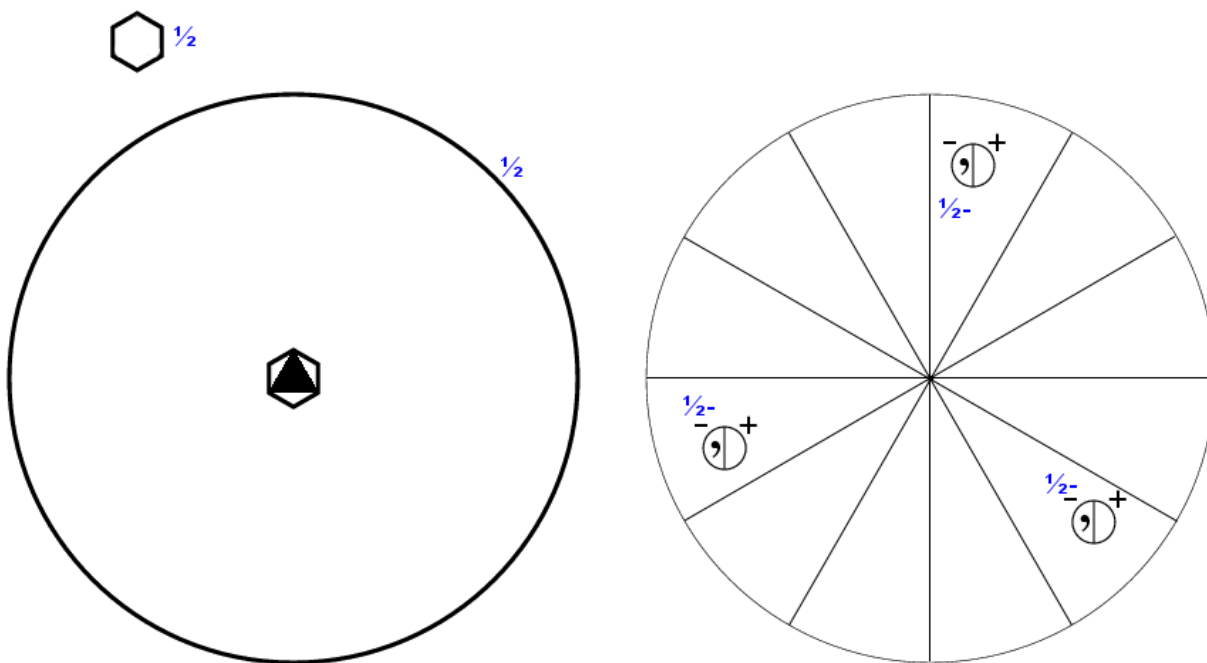
22.1.2.233



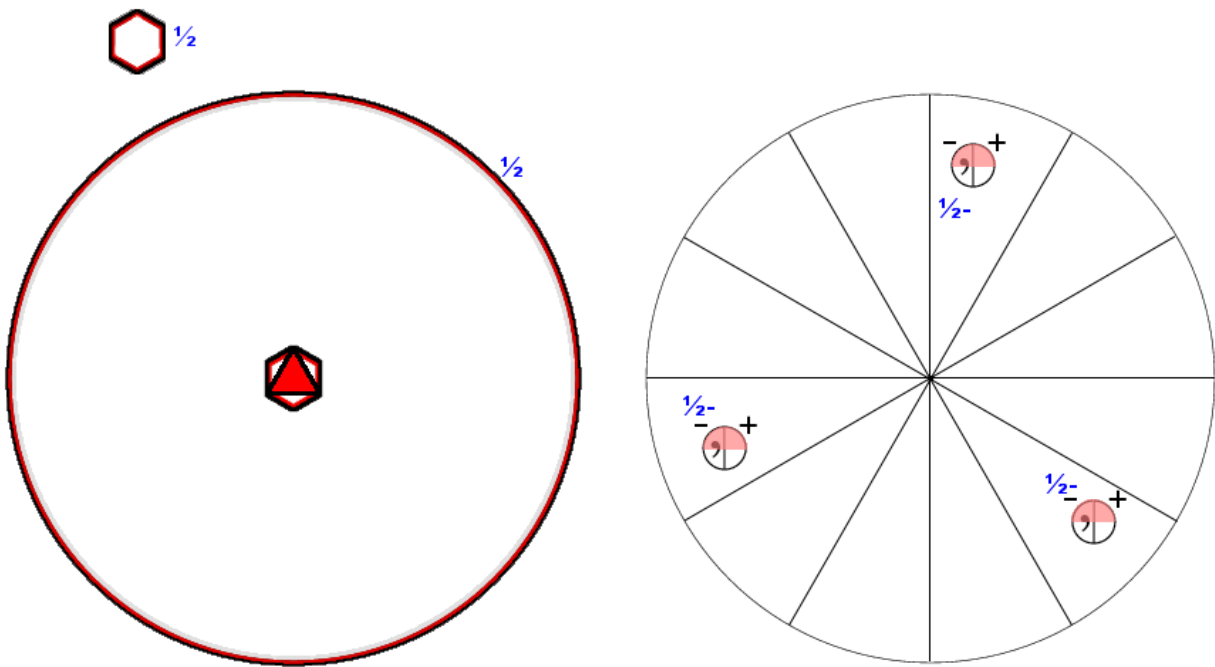
22.1.3.234



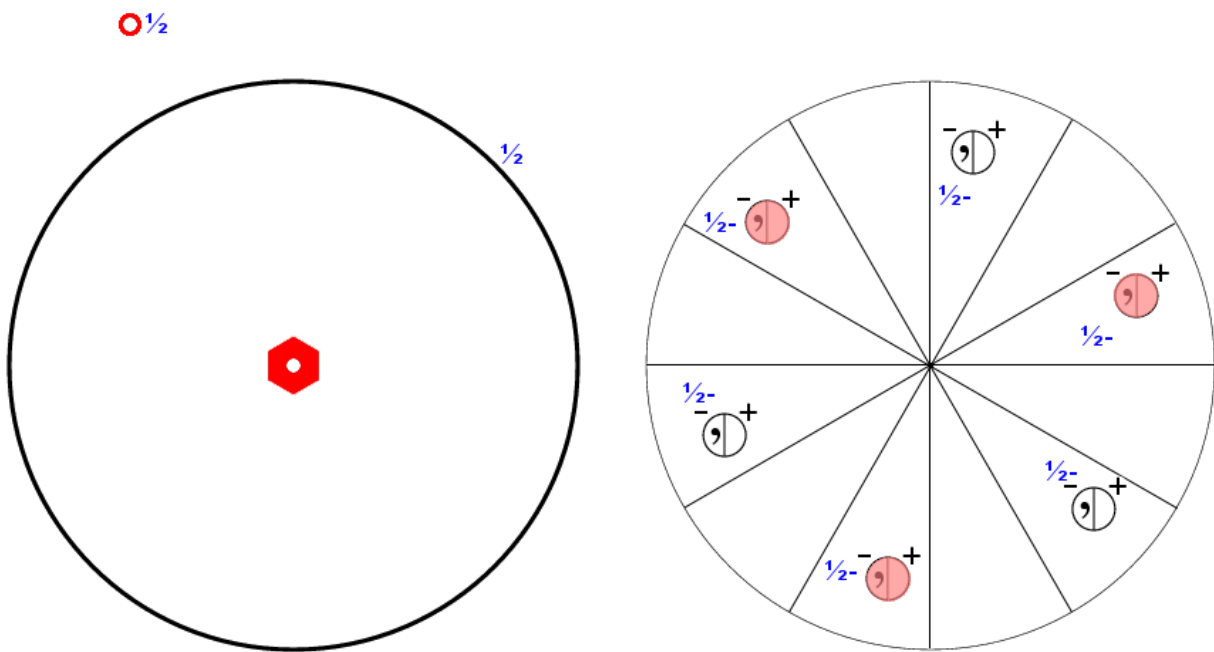
22.1.4.235



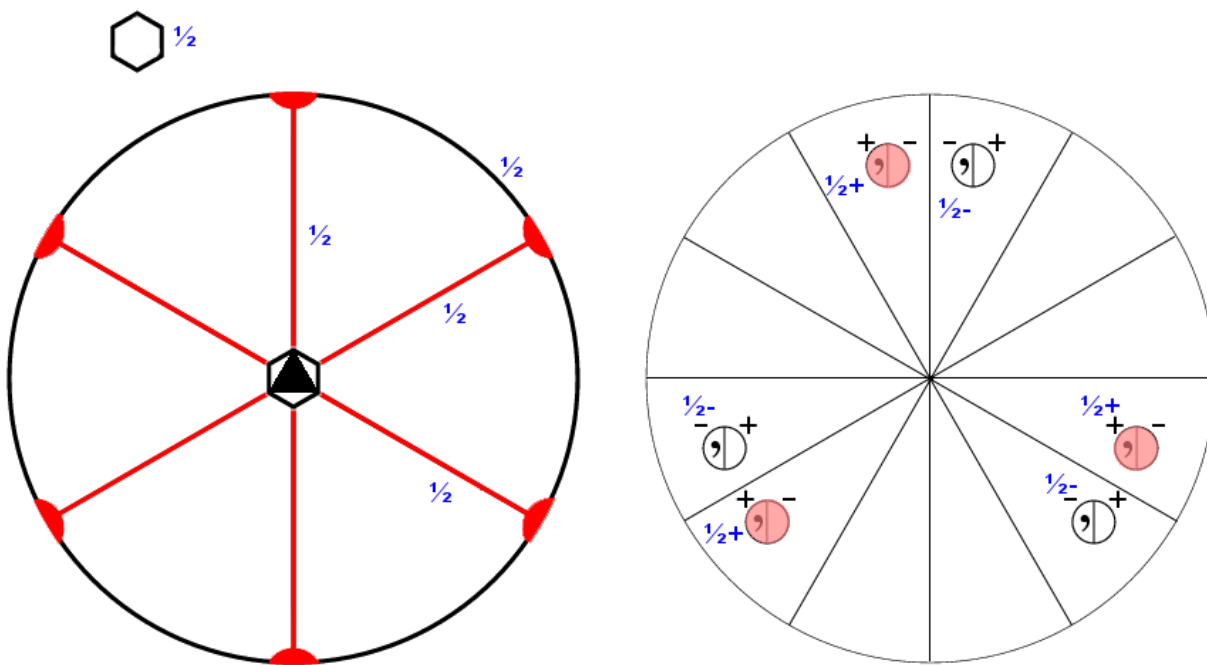
22.2.1.236



22.2.2.237

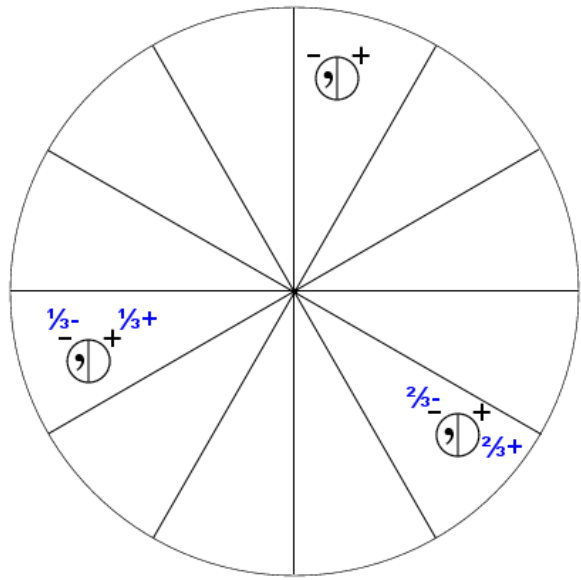
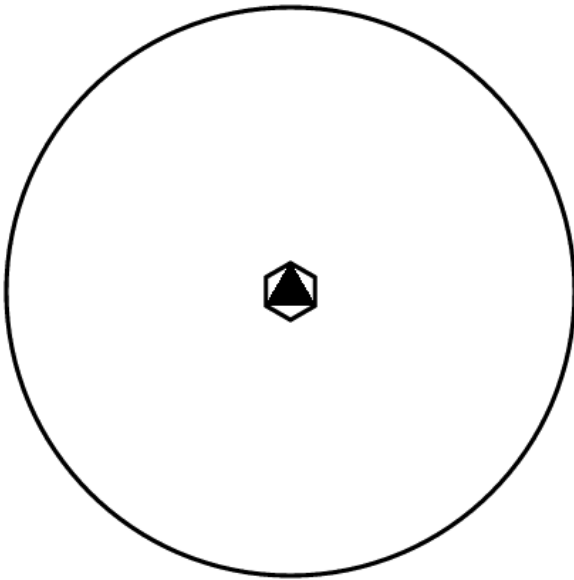


22.2.3.238

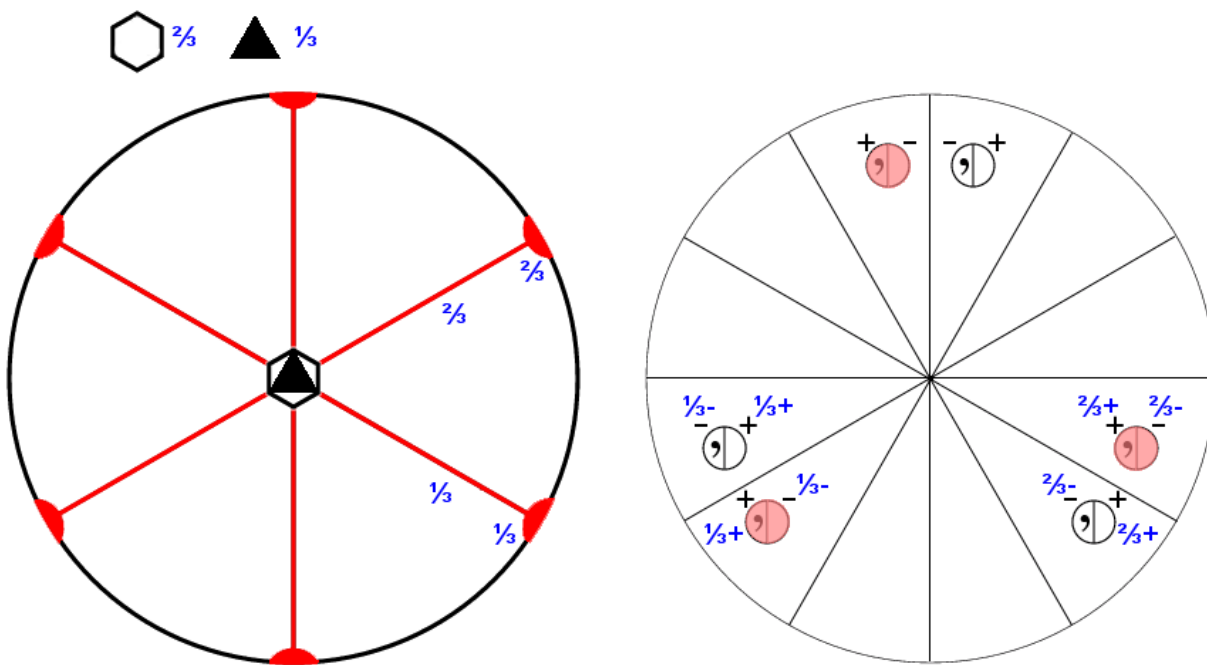


22.2.4.239

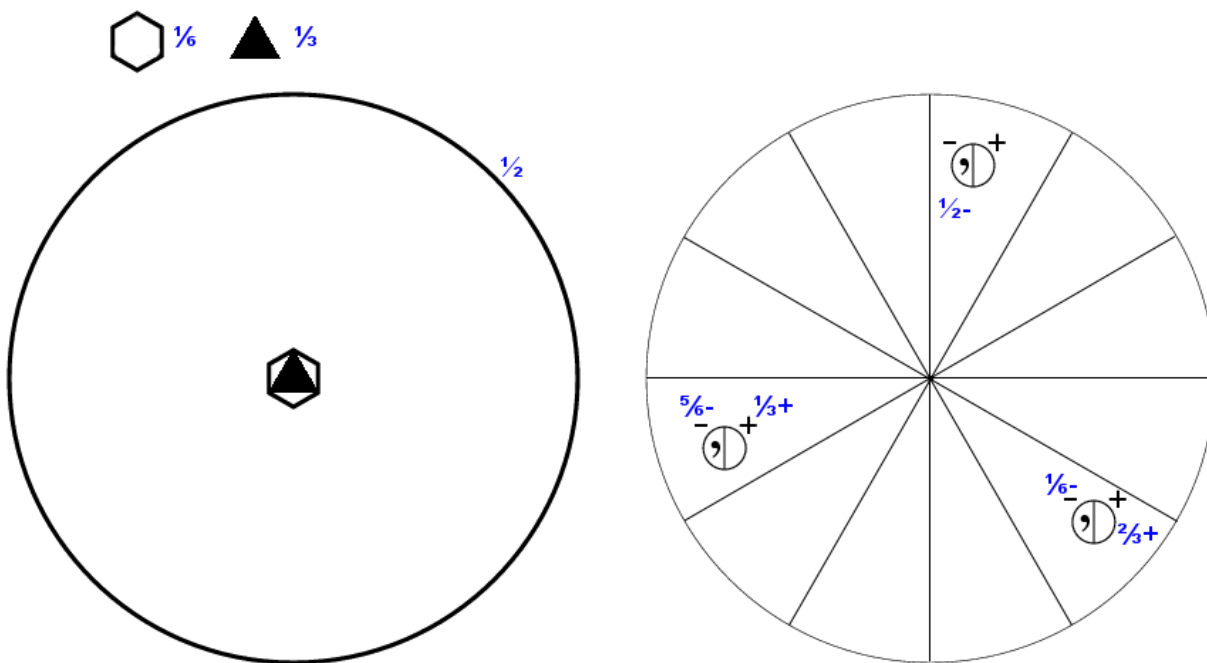
⬡ $\frac{2}{3}$ ▲ $\frac{1}{3}$



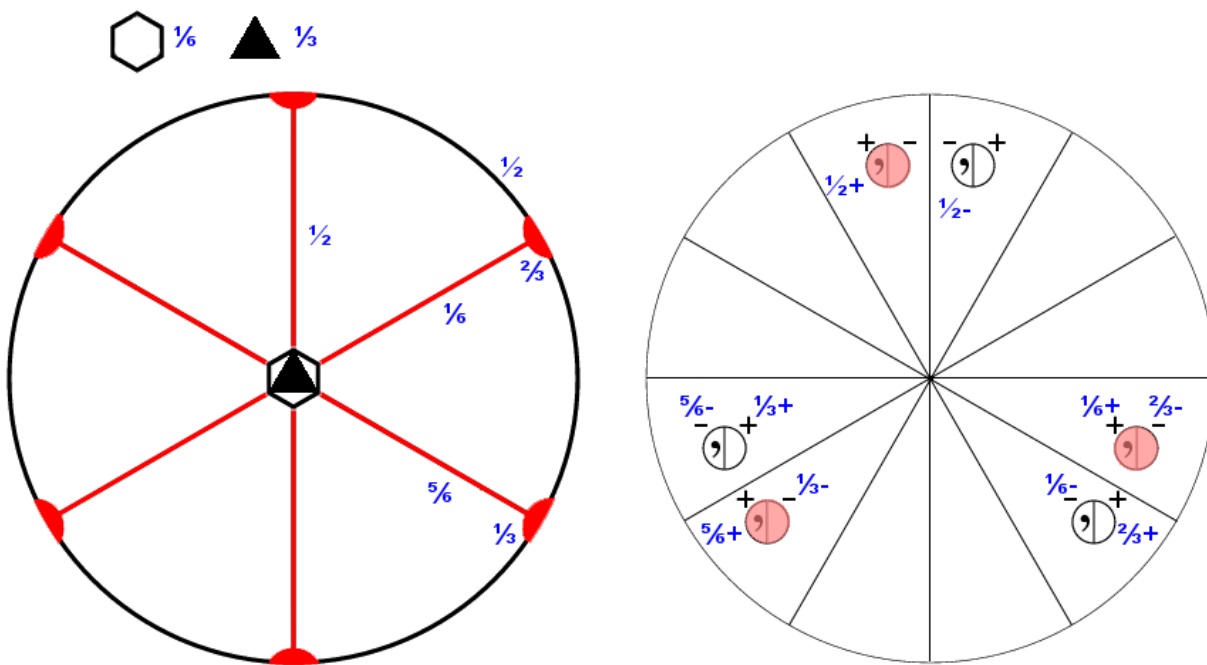
22.3.1.240



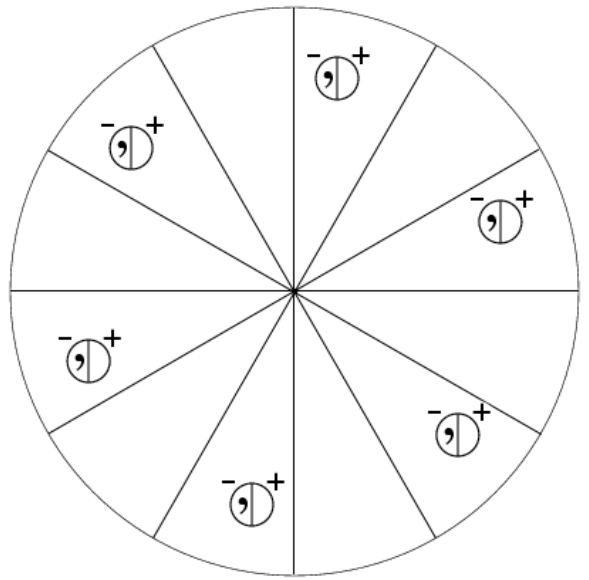
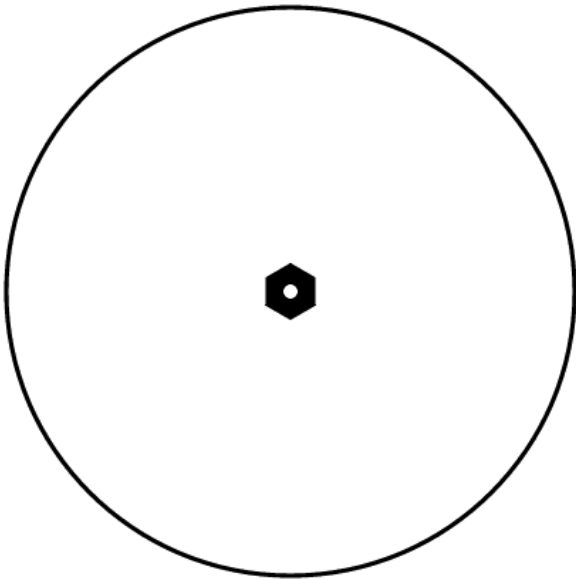
22.3.2.241



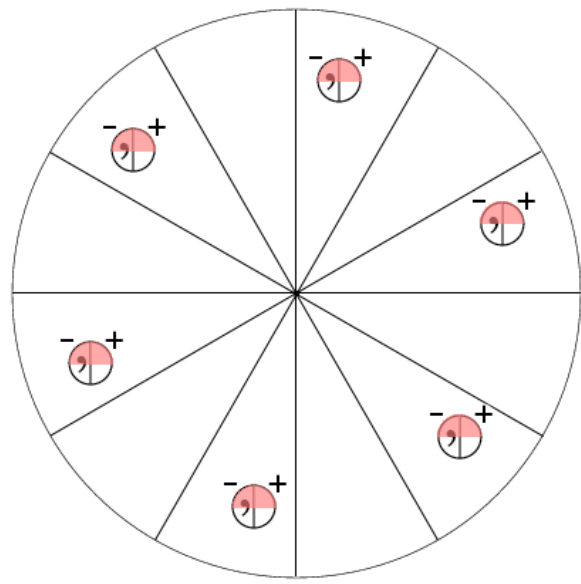
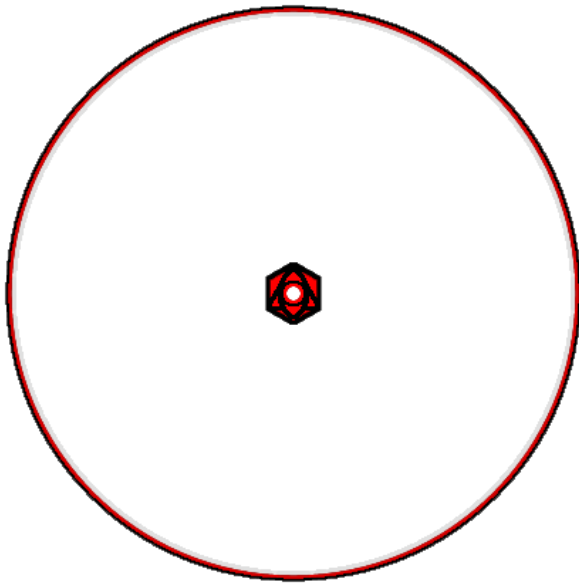
22.4.1.242



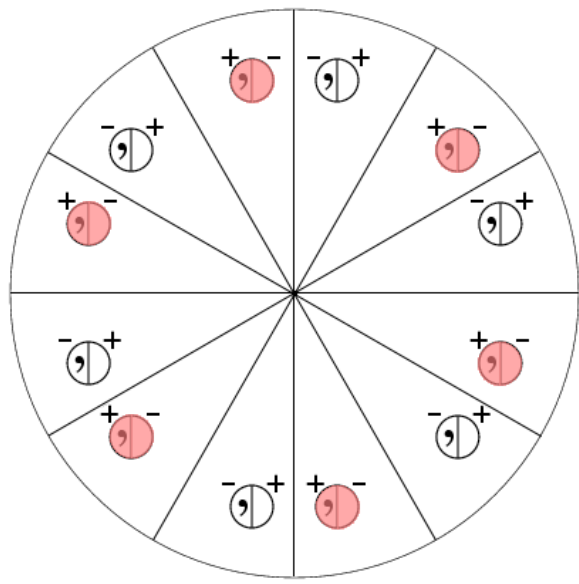
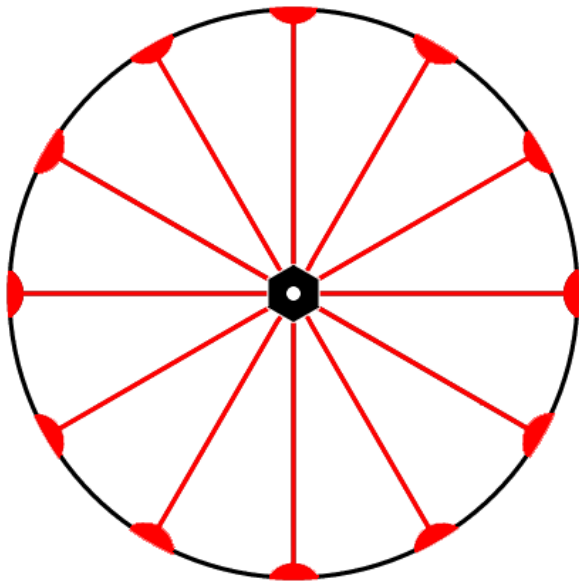
22.4.2.243



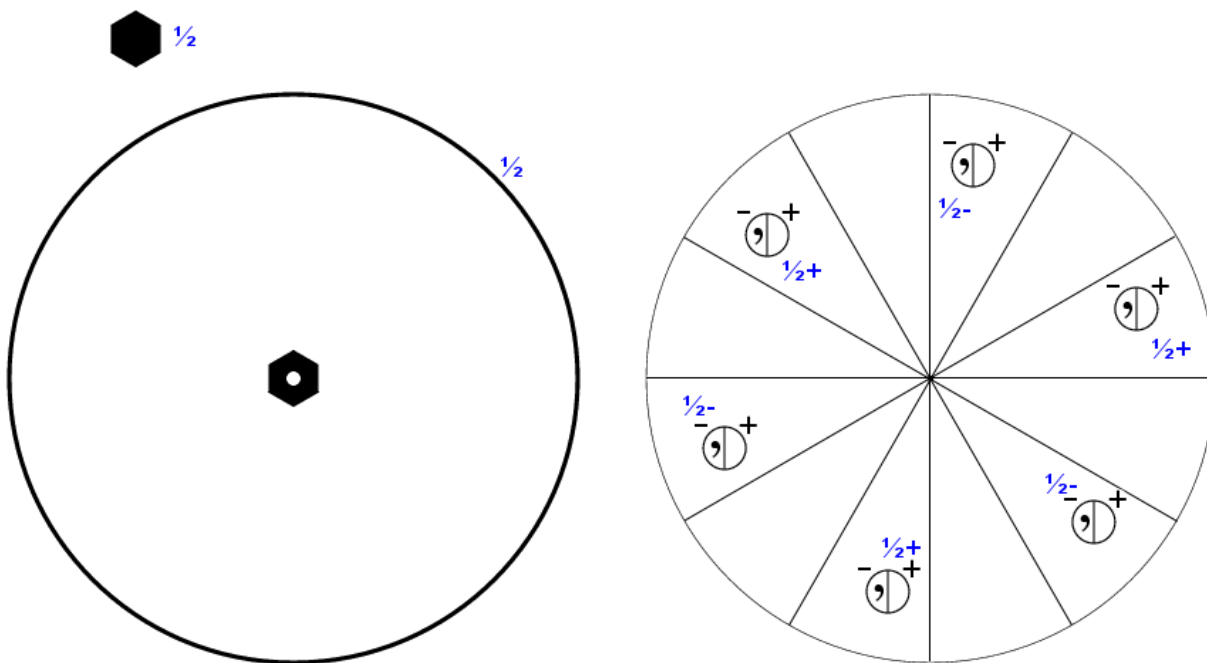
23.1.1.244



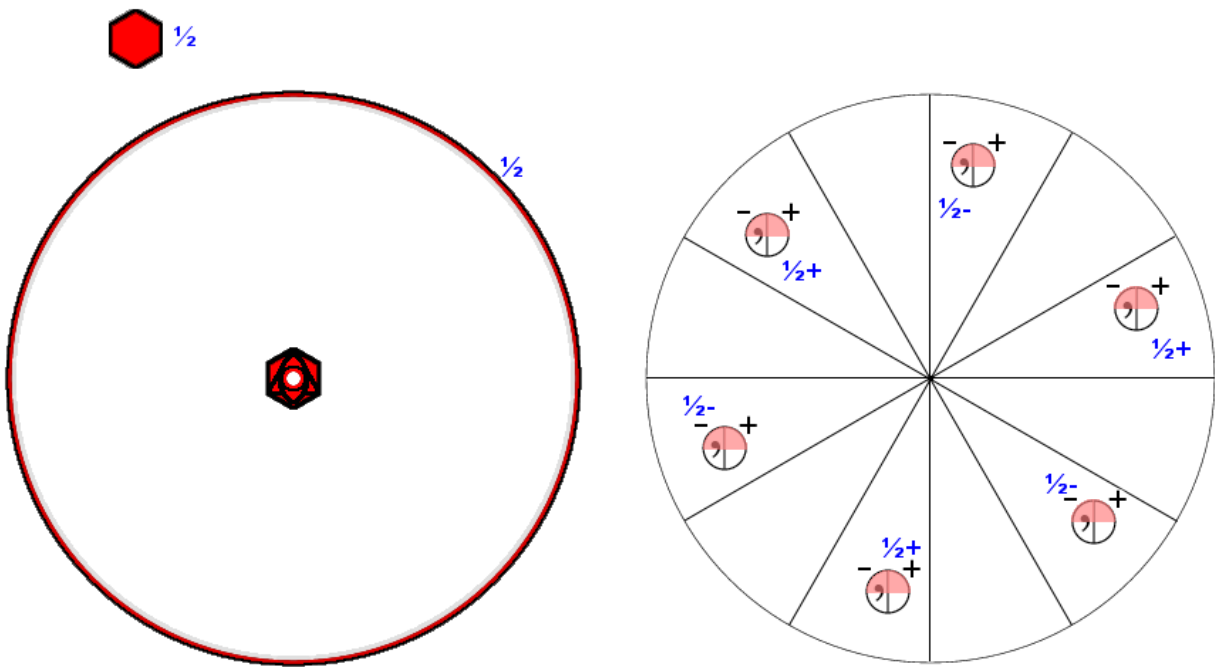
23.1.2.245



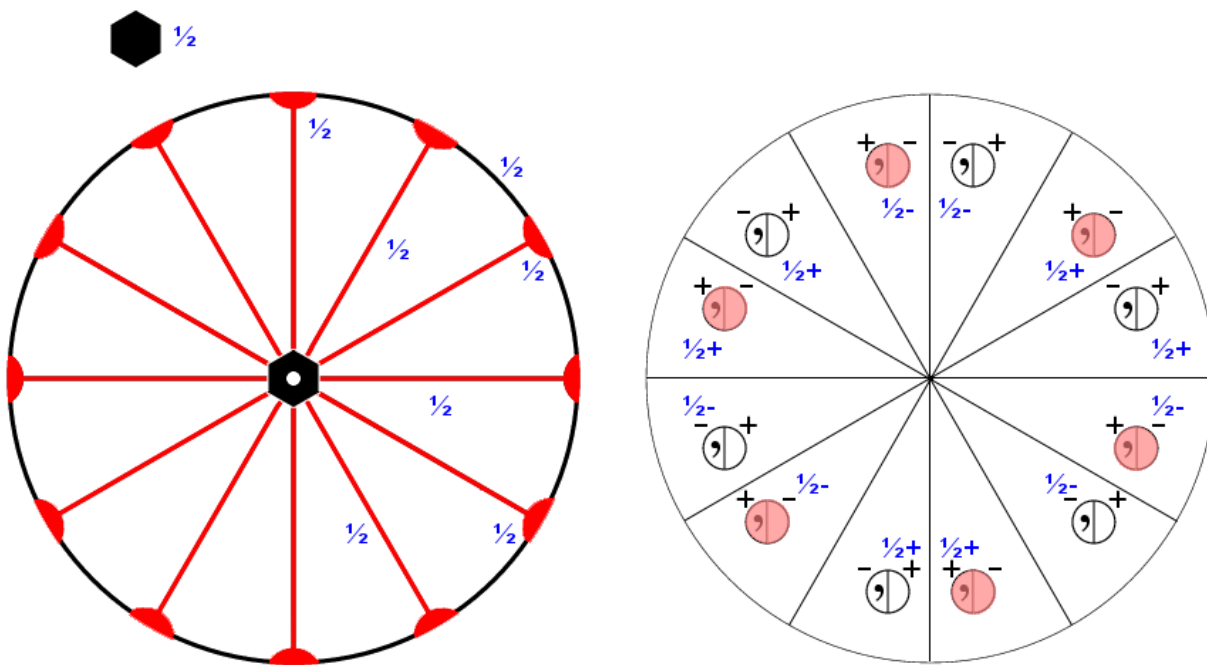
23.1.3.246



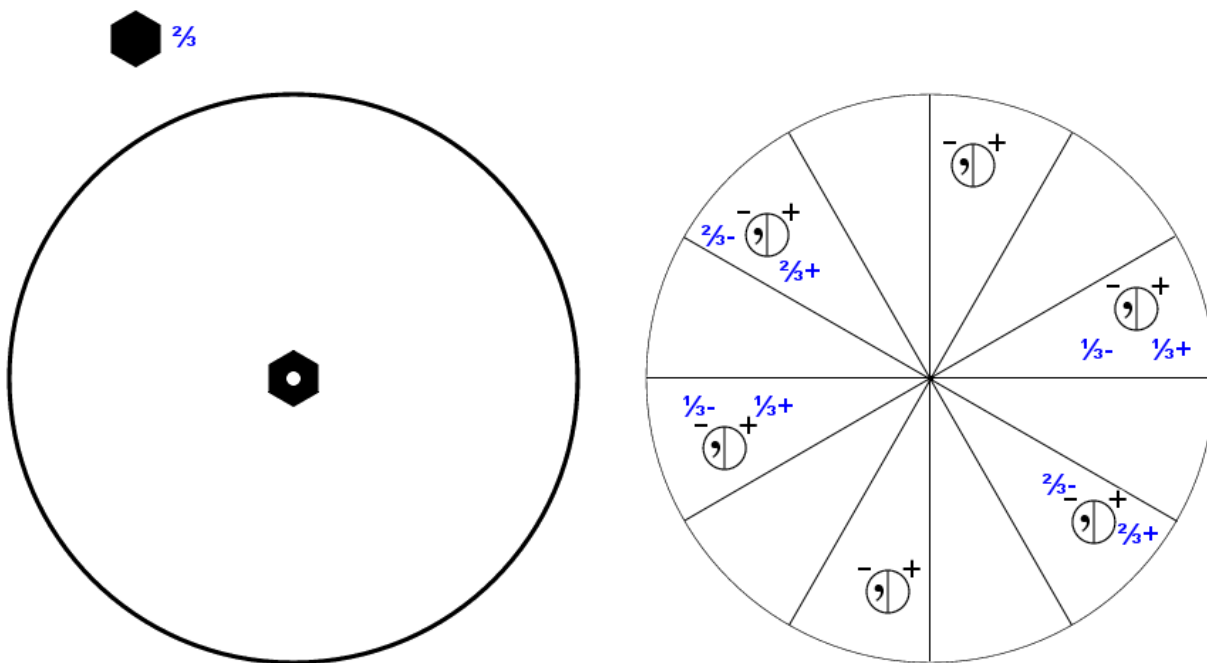
23.2.1.247



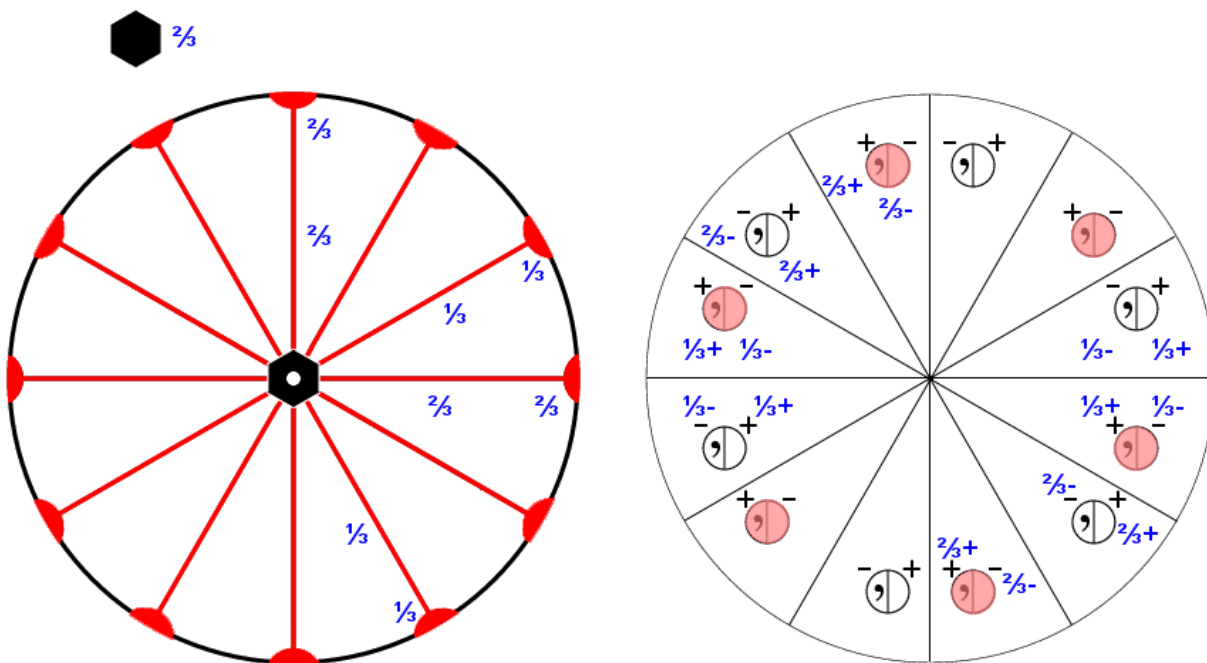
23.2.2.248



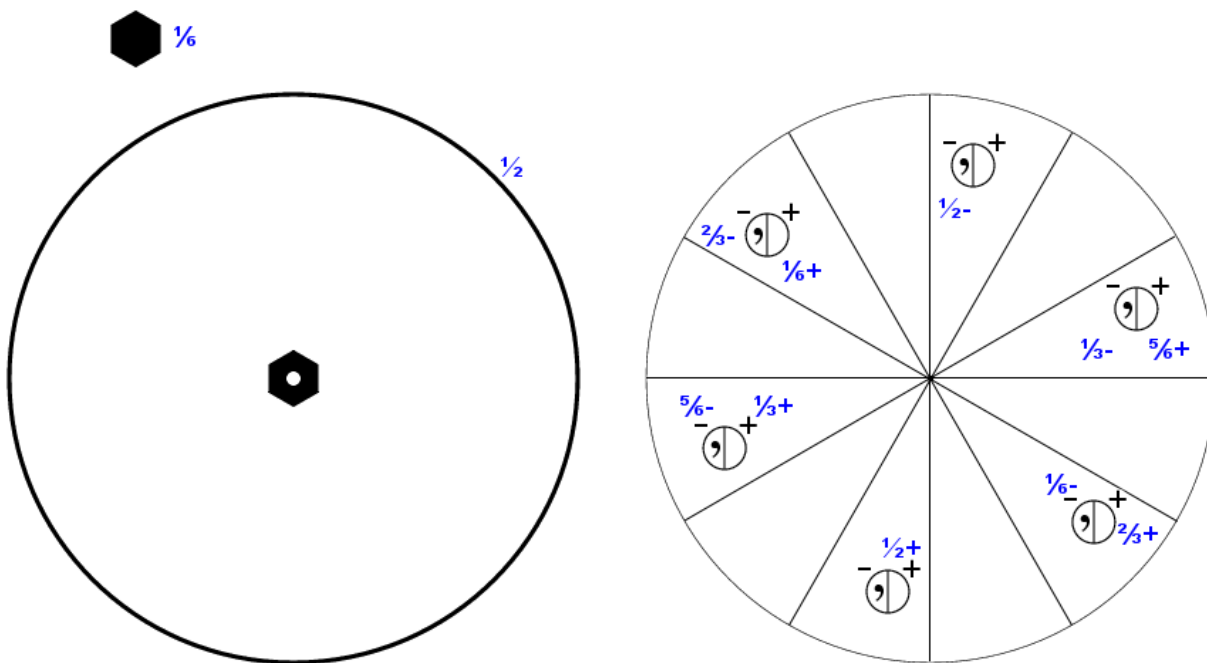
23.2.3.249



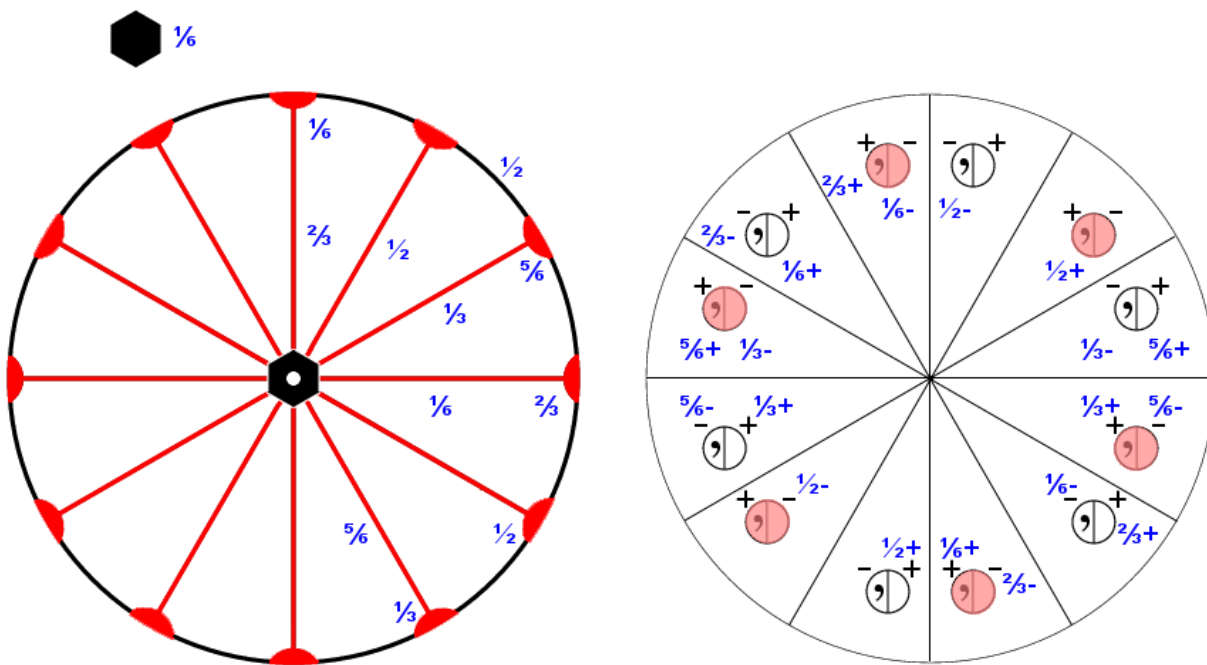
23.3.1.250



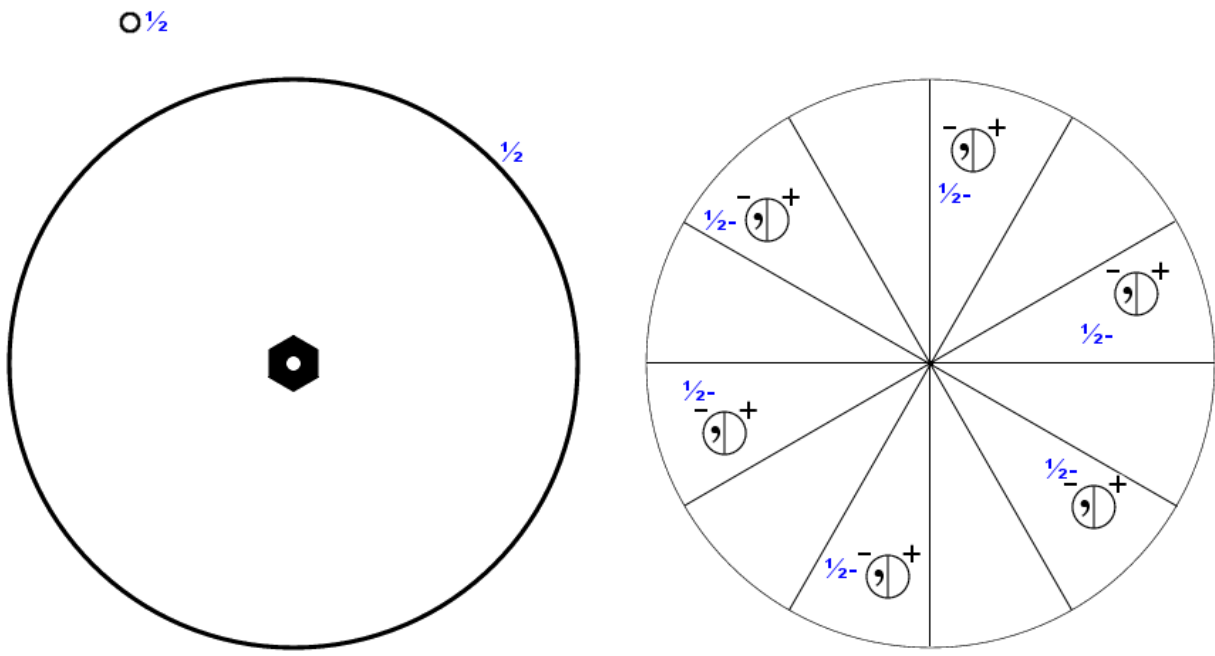
23.3.2.251



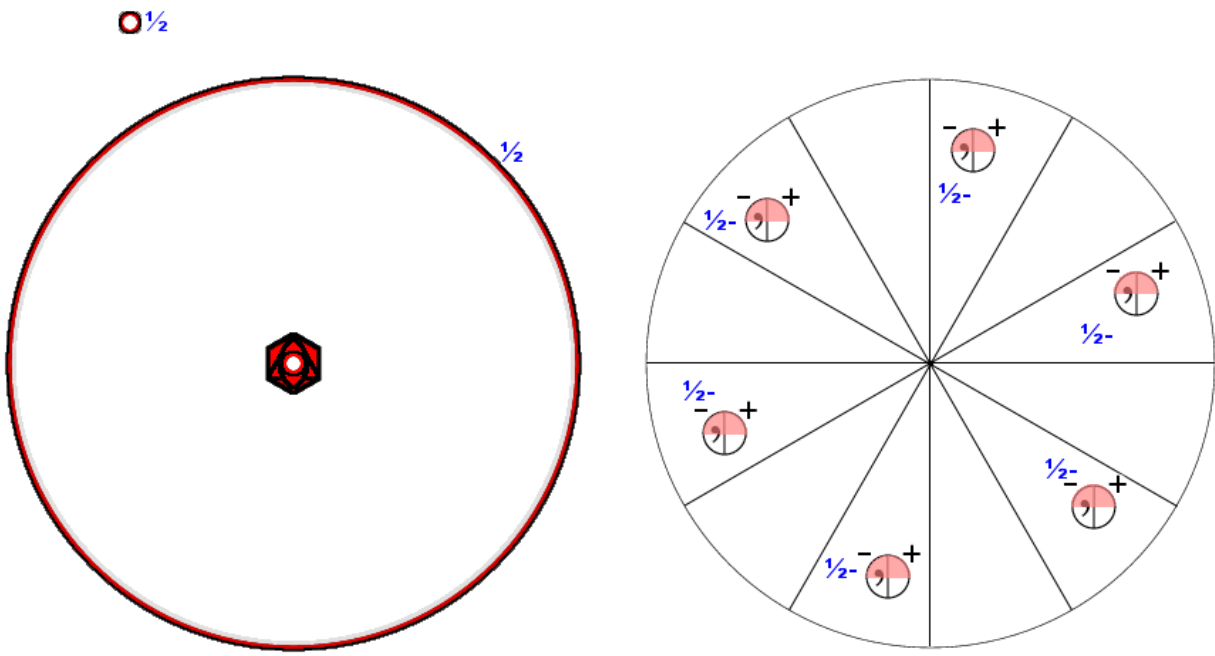
23.4.1.252



23.4.2.253

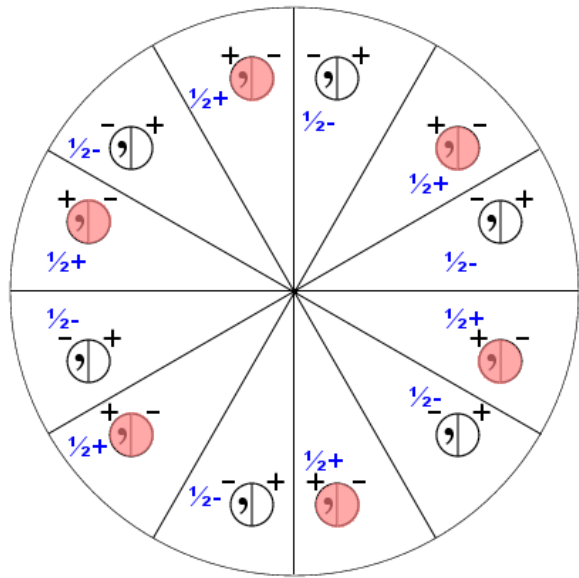
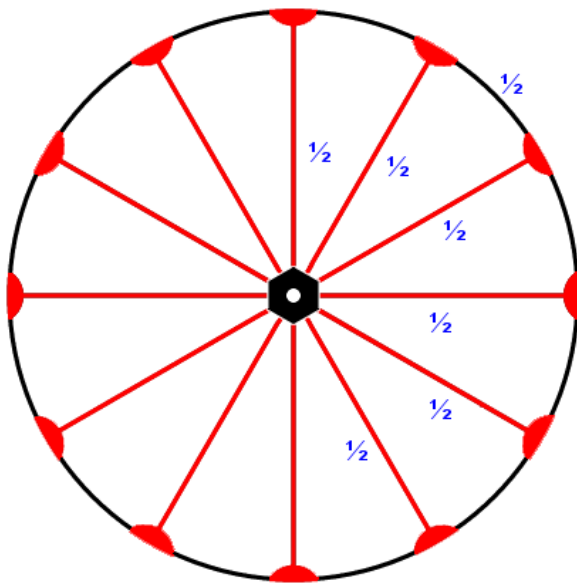


23.5.1.254

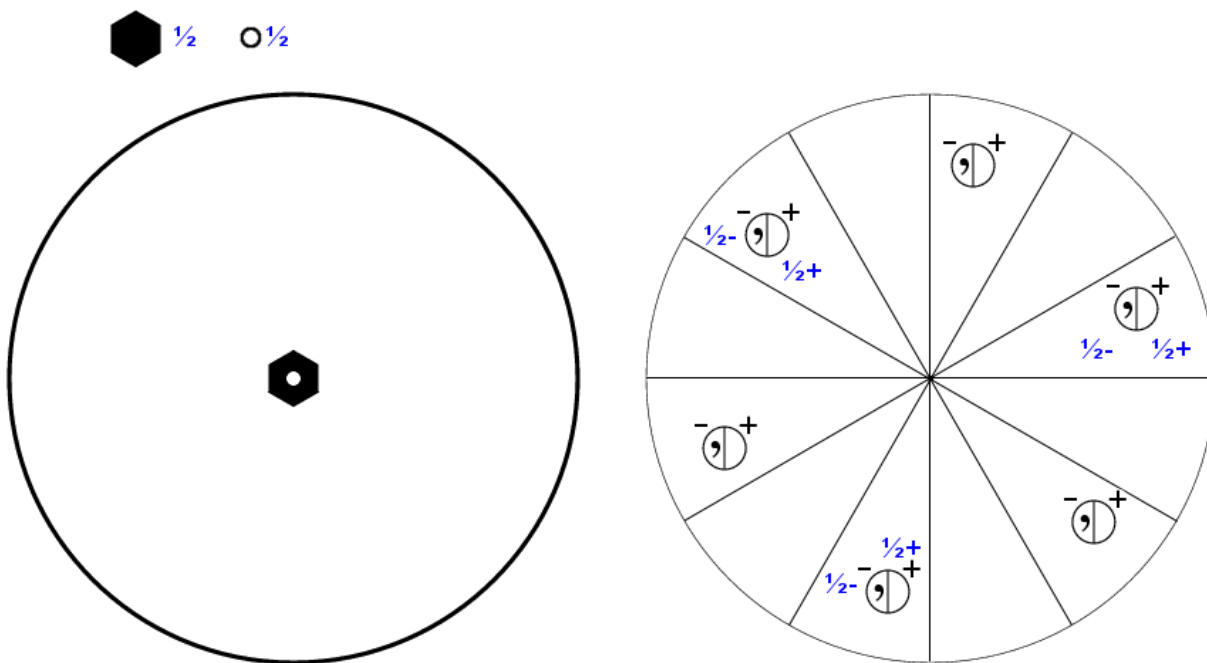


23.5.2.255

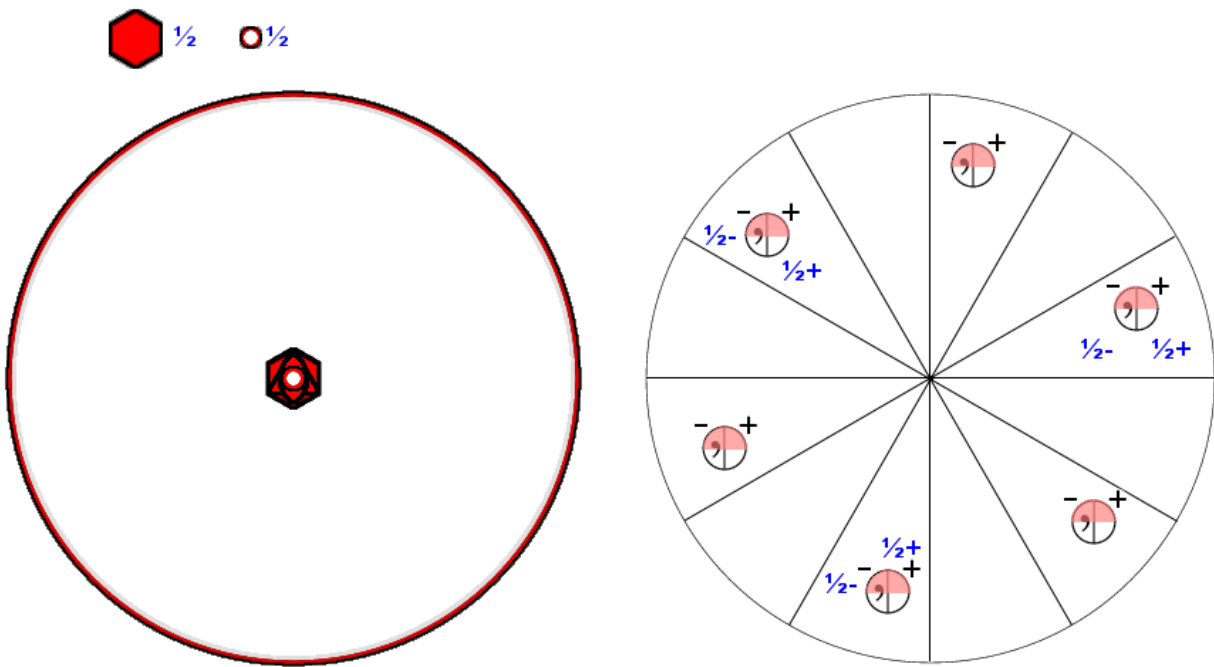
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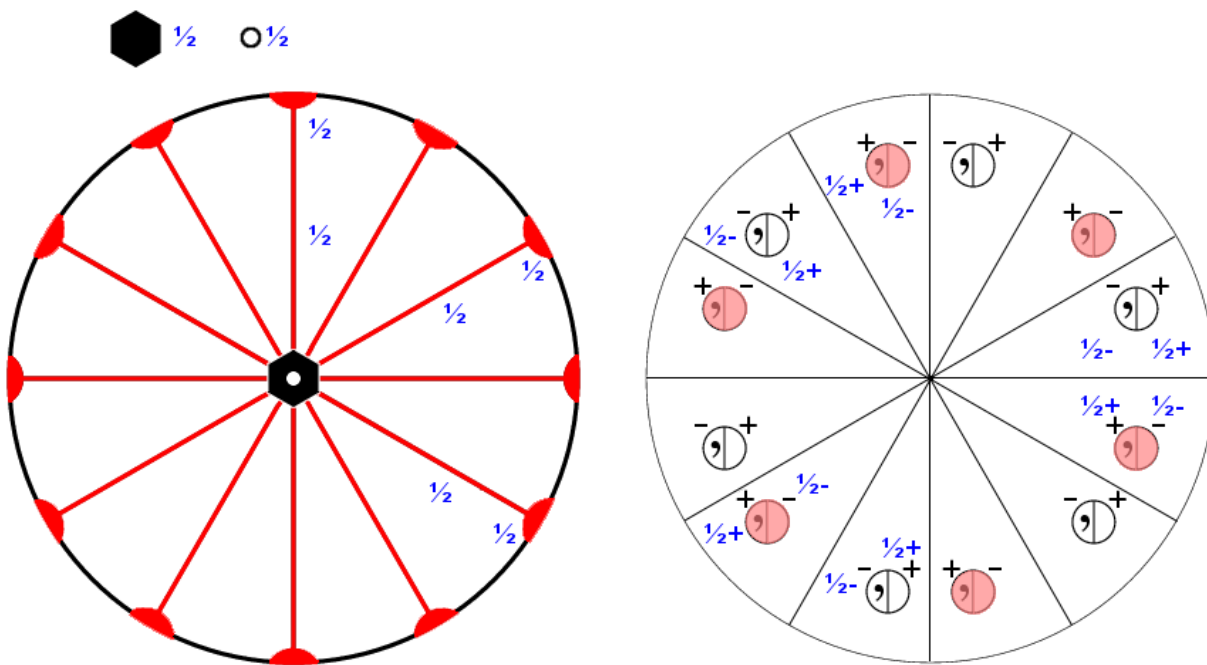
23.5.3.256



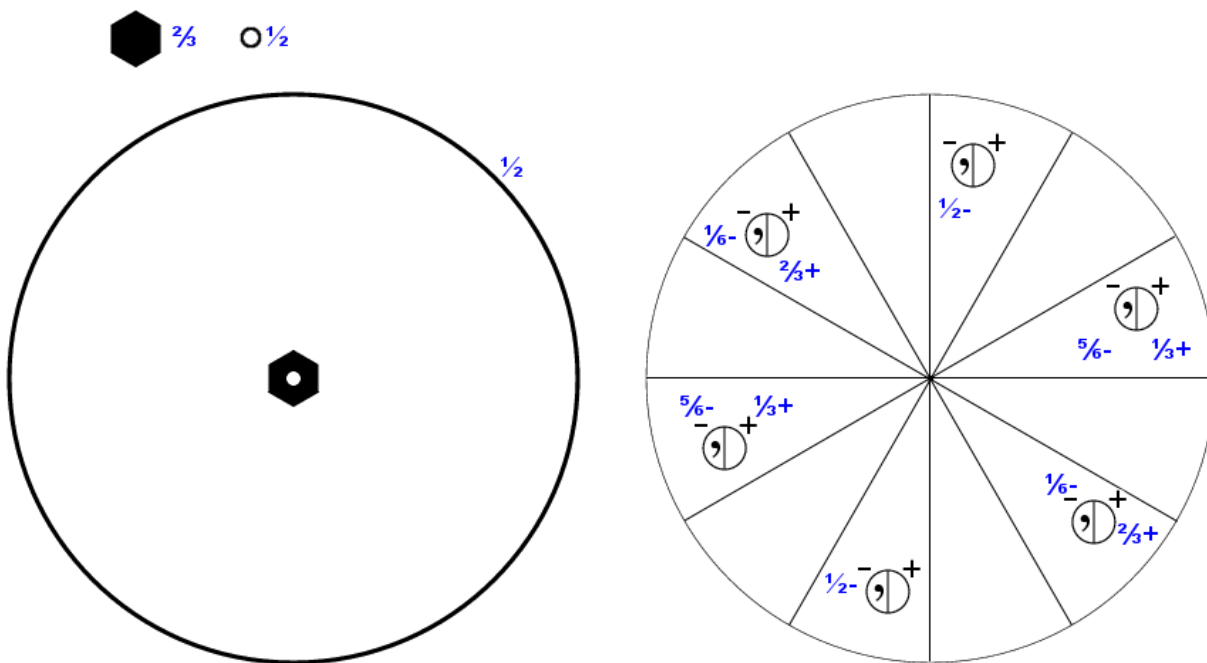
23.6.1.257



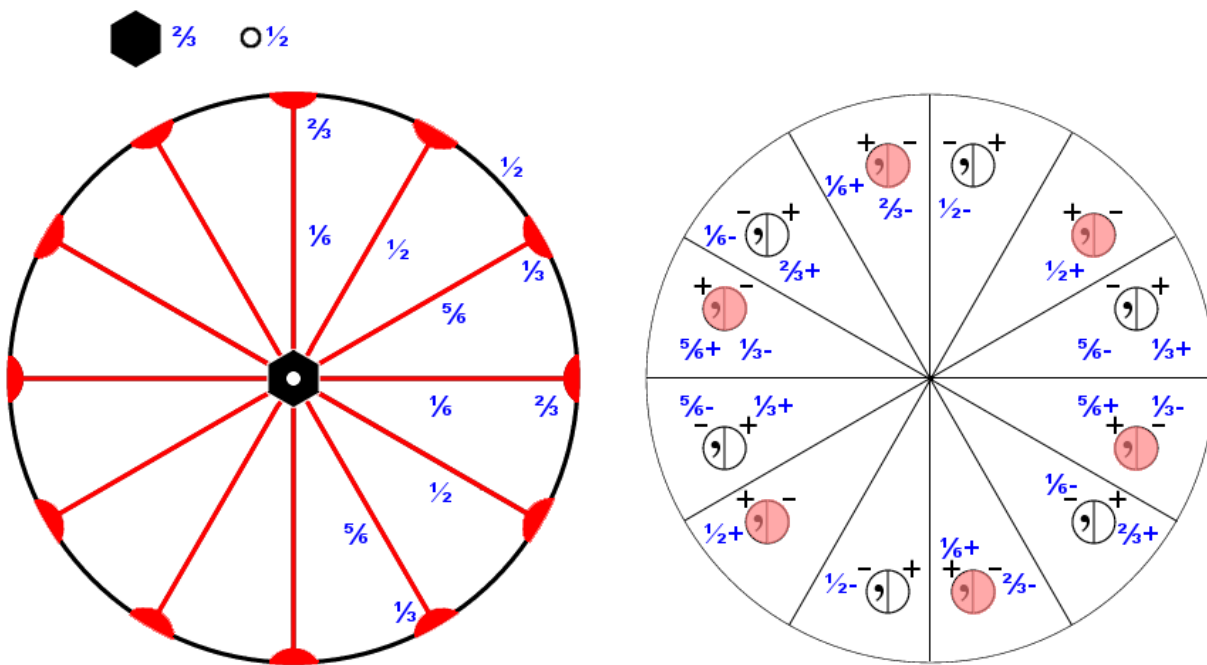
23.6.2.258



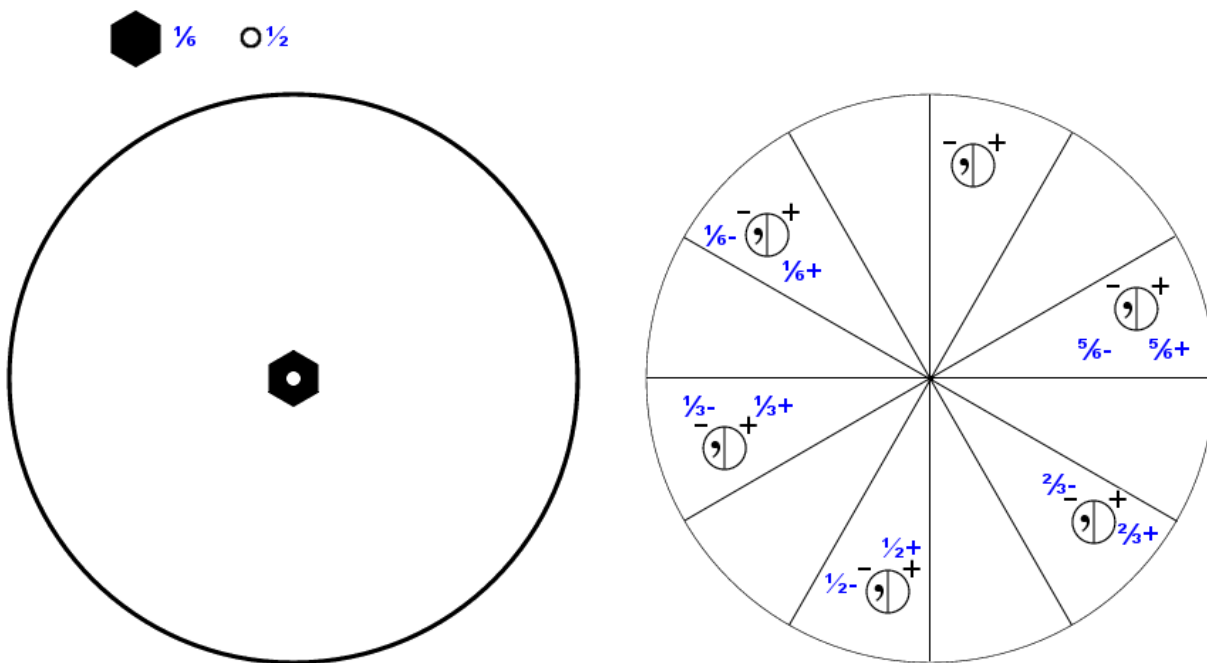
23.6.3.259



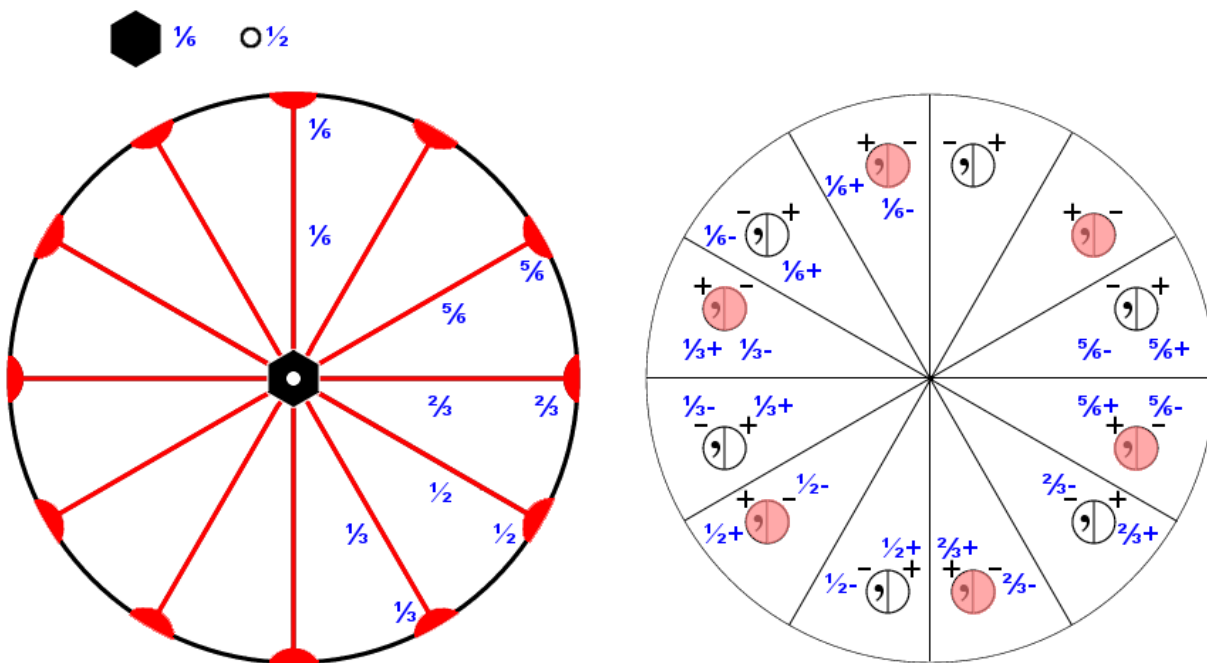
23.7.1.260



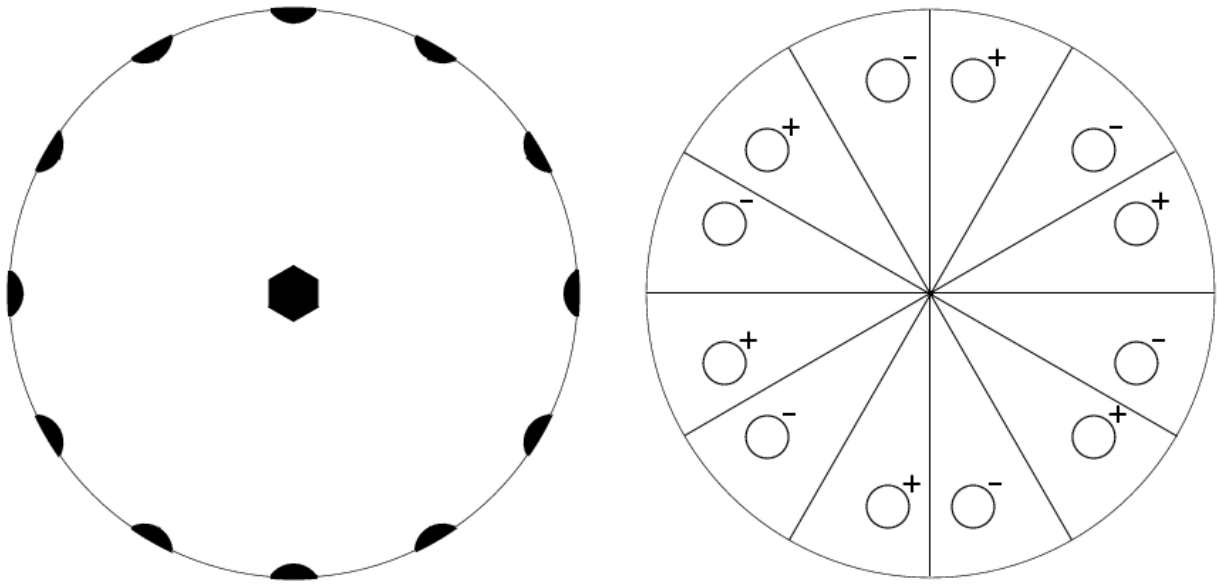
23.7.2.261



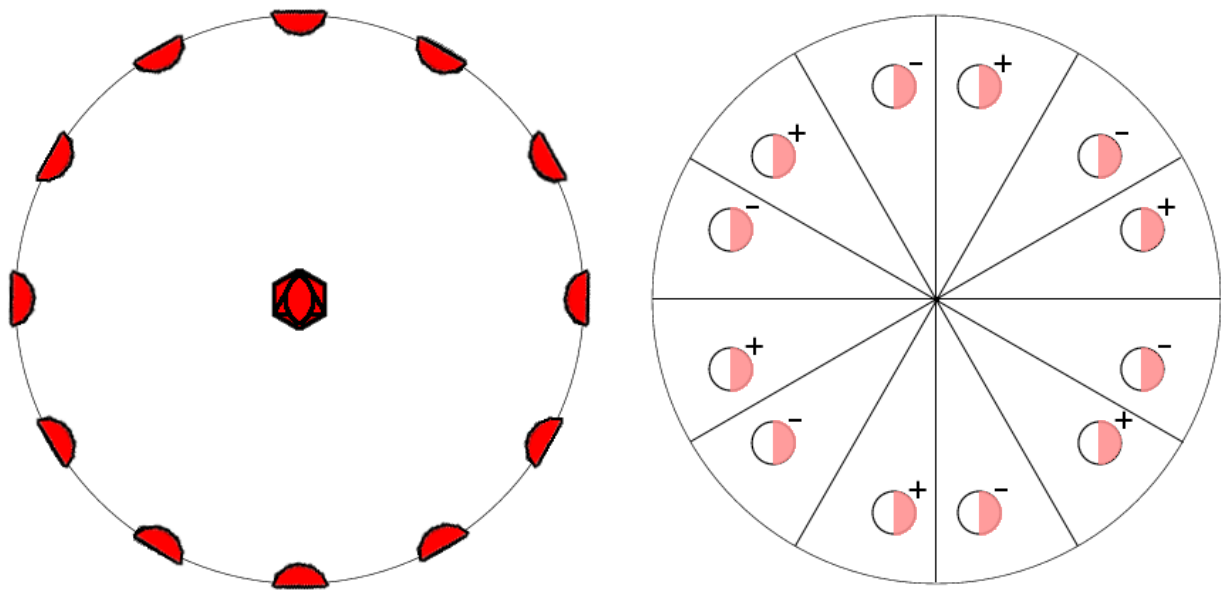
23.8.1.262



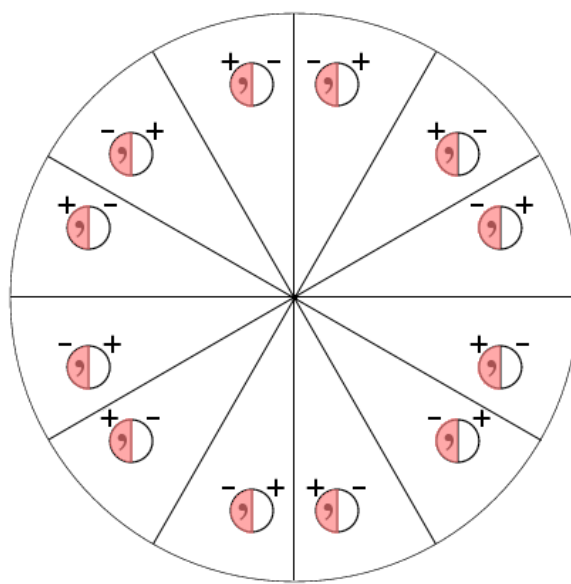
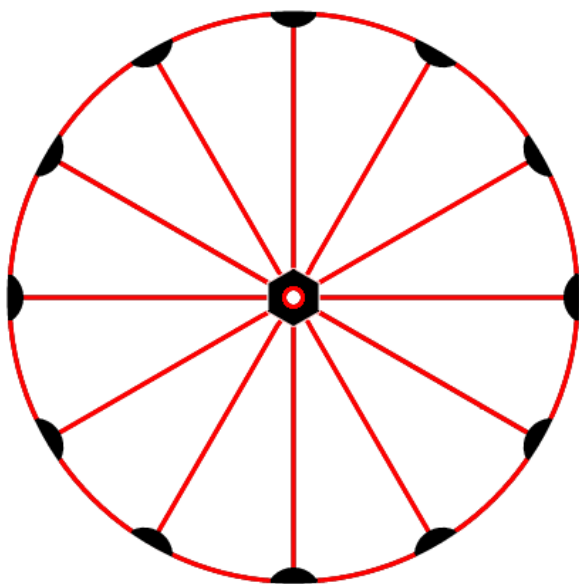
23.8.2.263



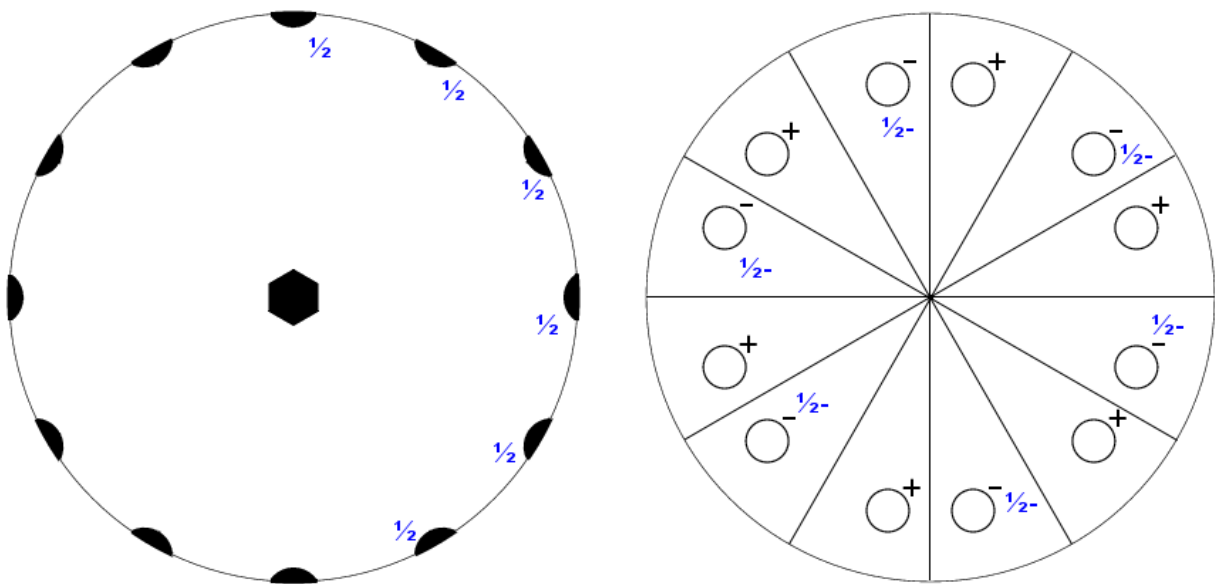
24.1.1.264



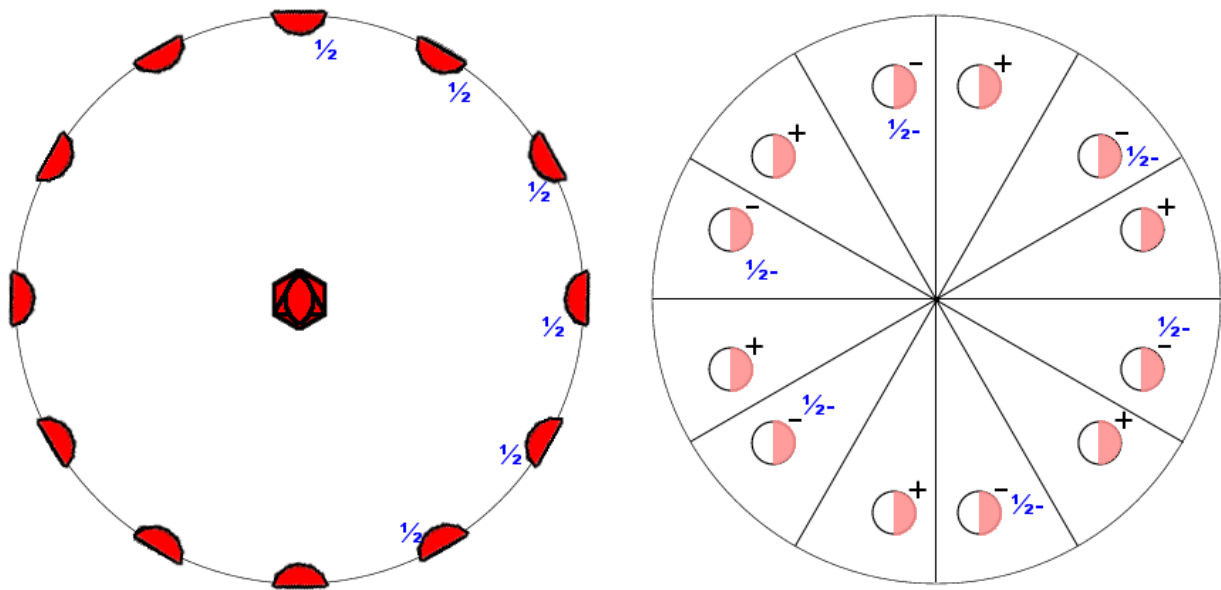
24.1.2.265



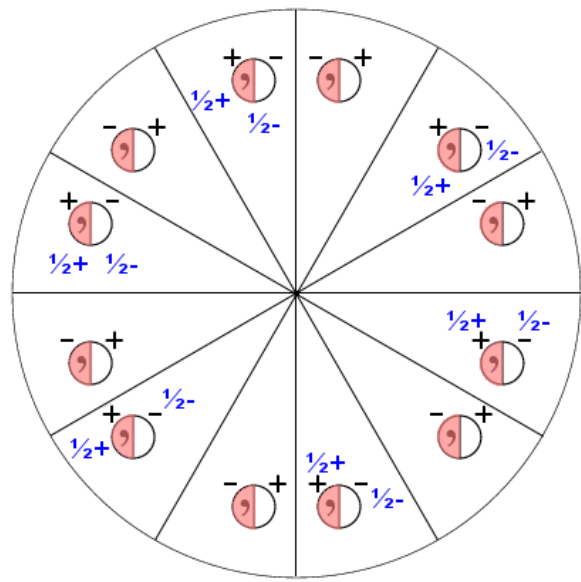
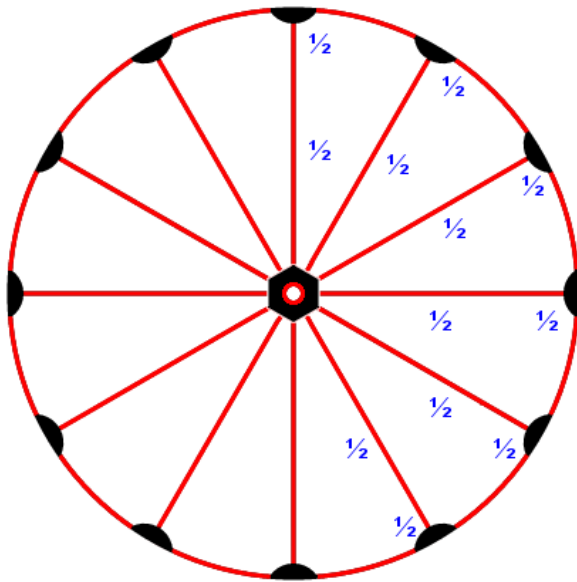
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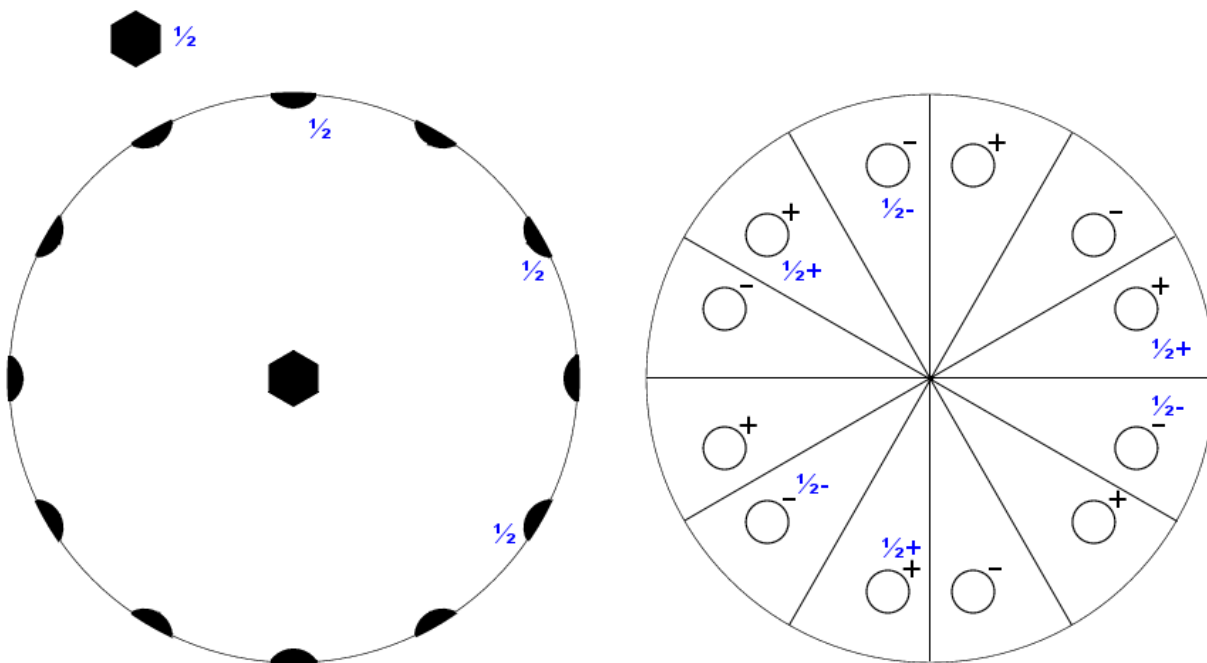
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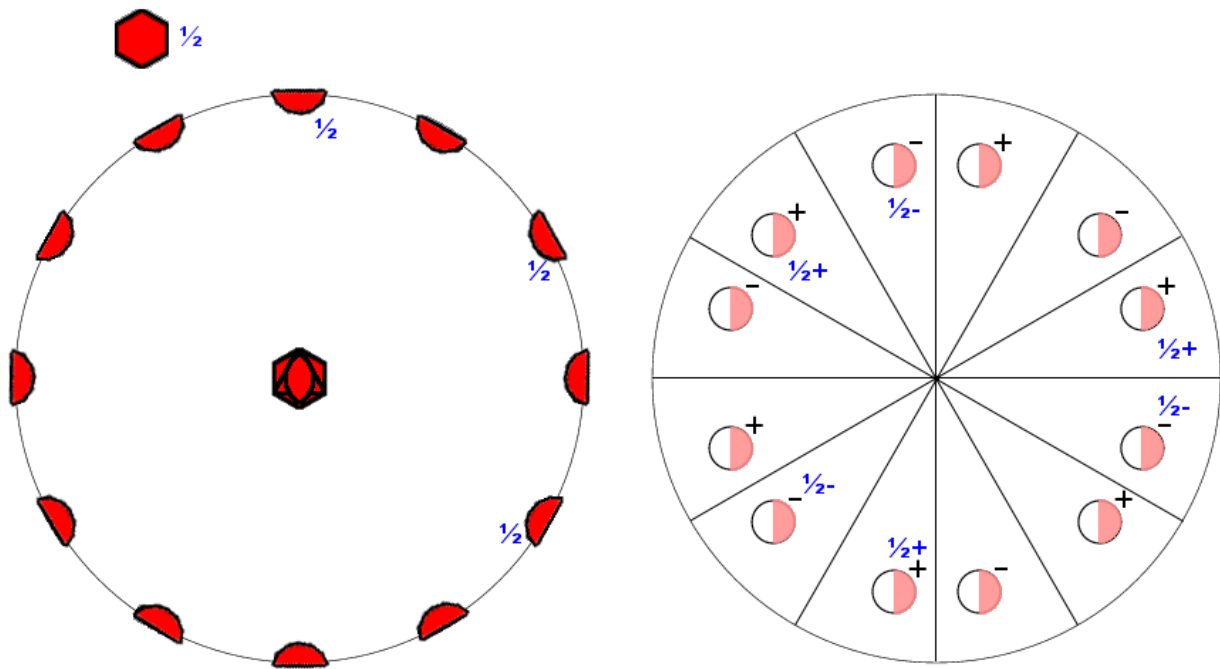
24.2.2.268



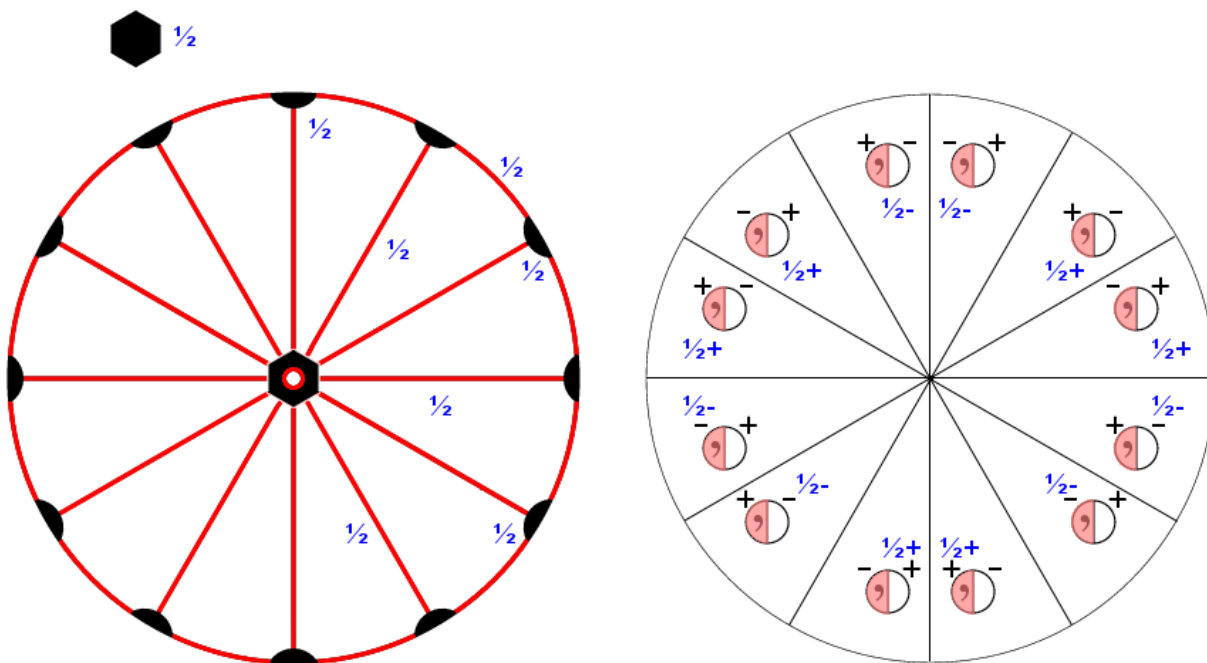
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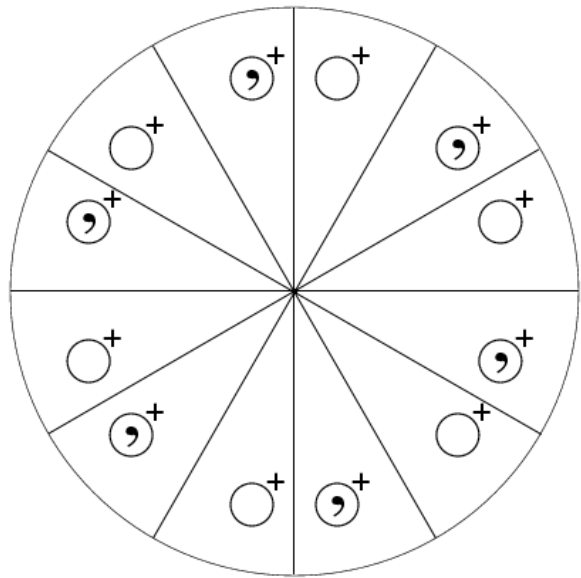
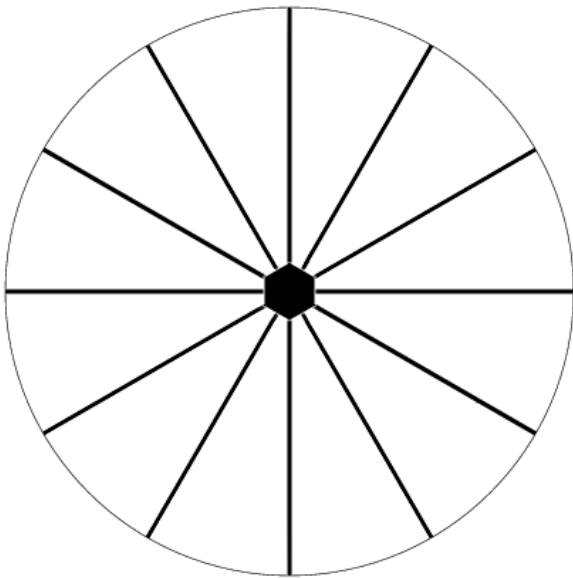
24.3.1.270



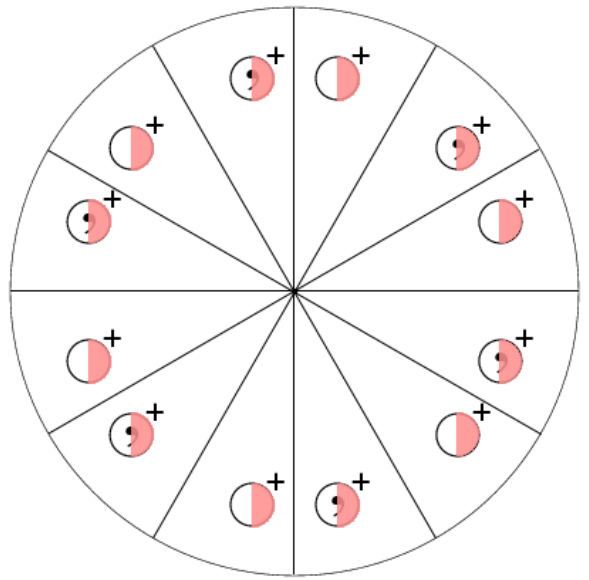
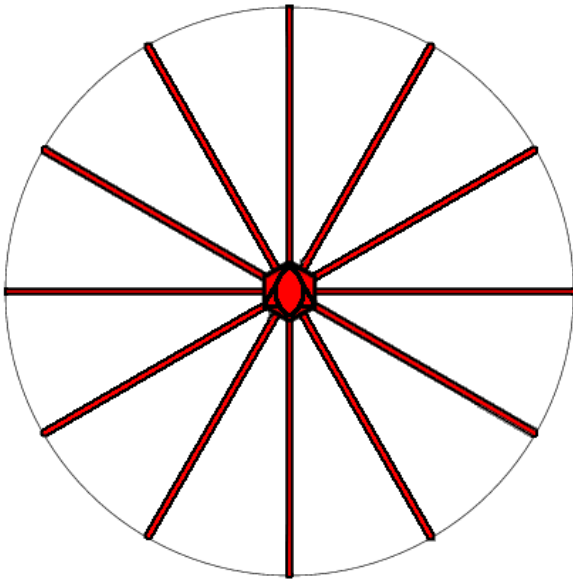
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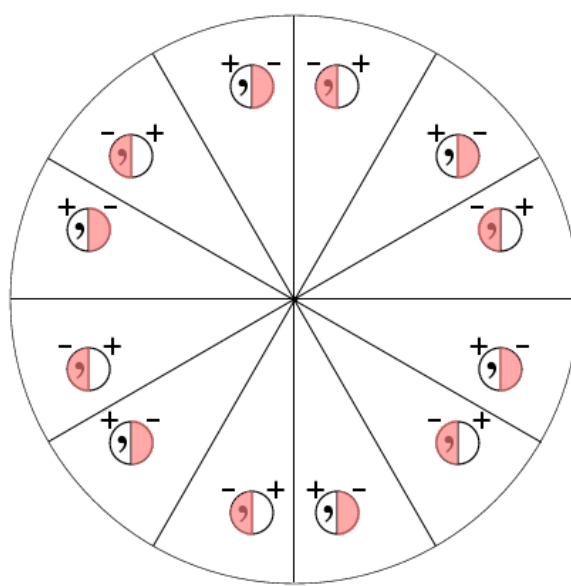
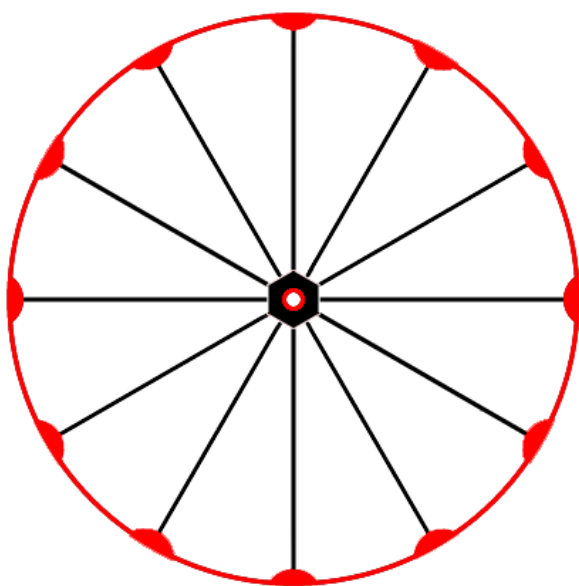
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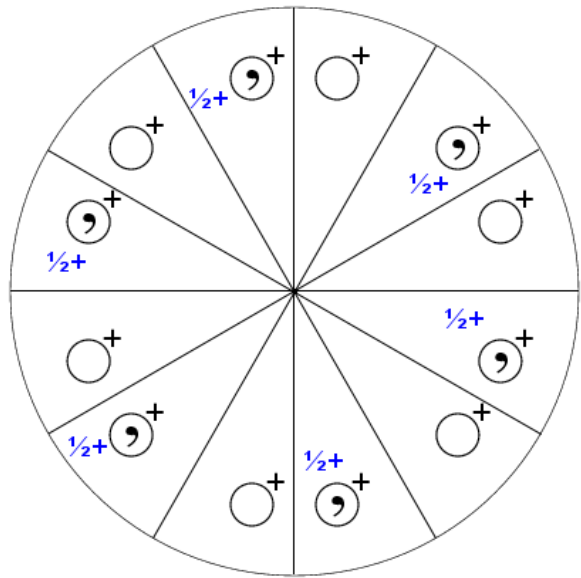
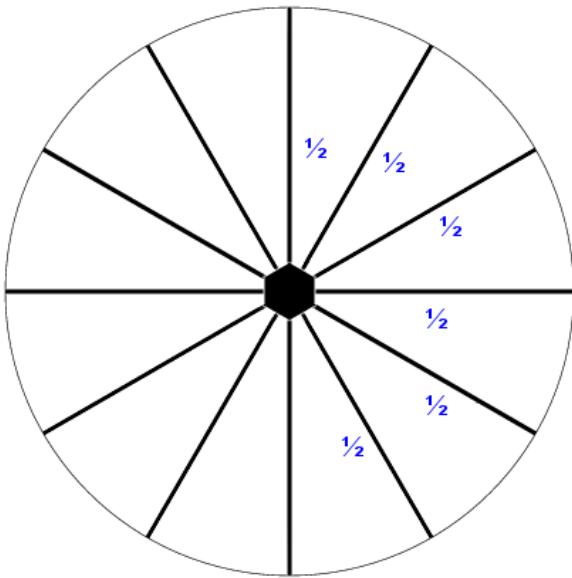
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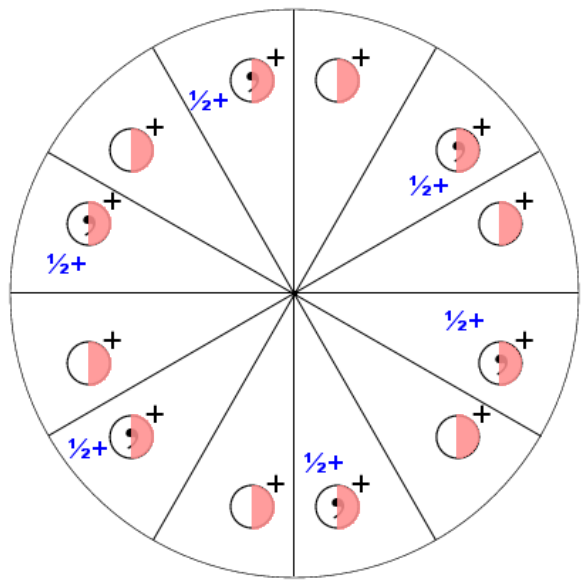
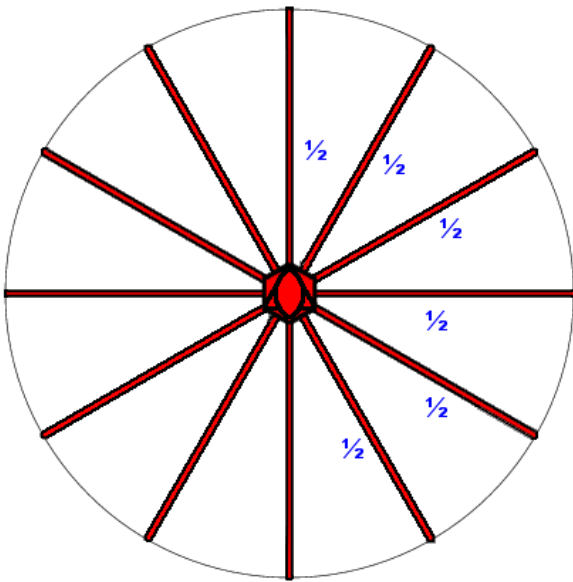
25.1.2.274



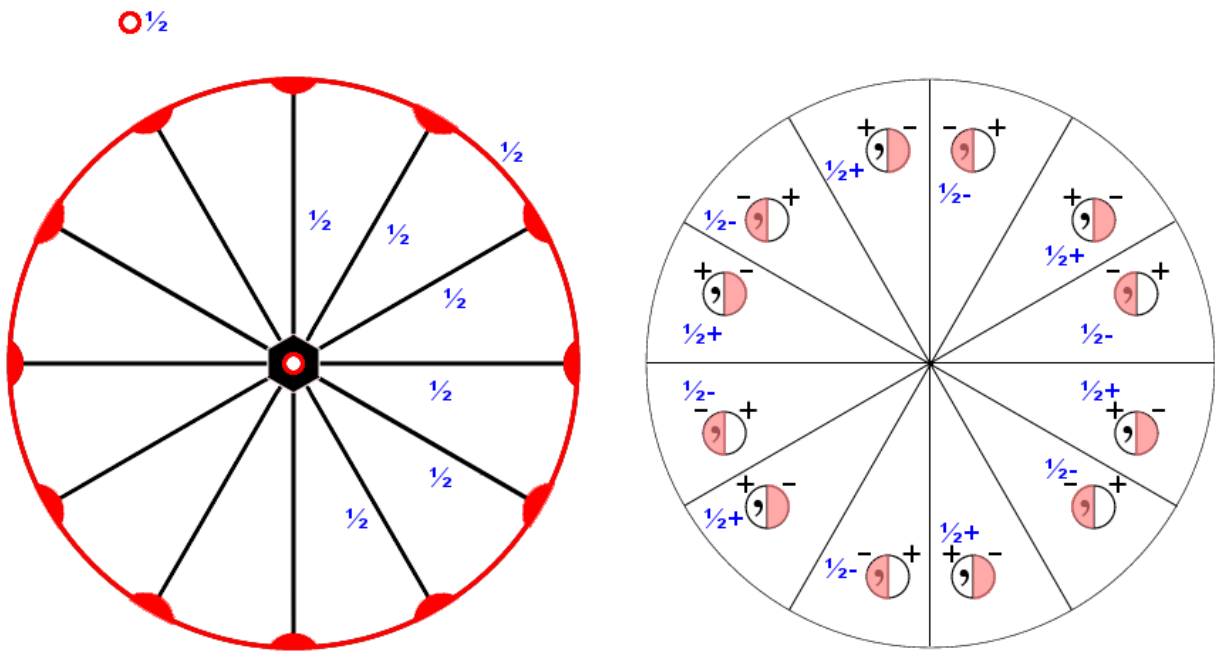
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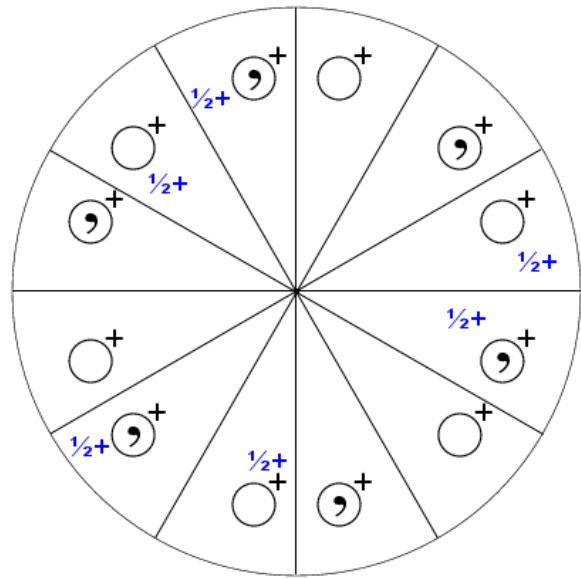
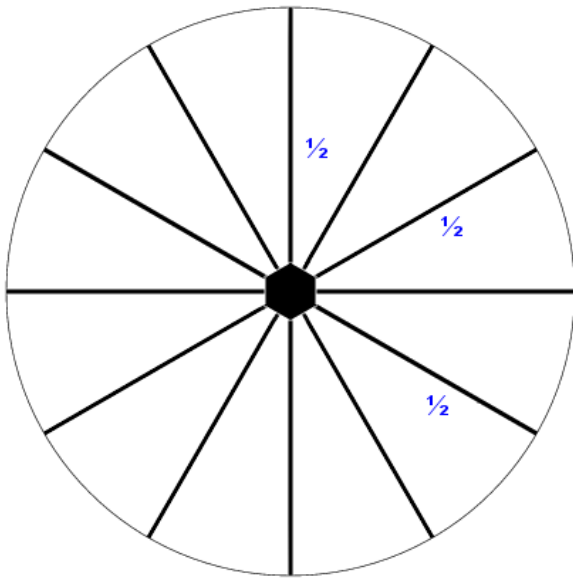
25.2.1.276



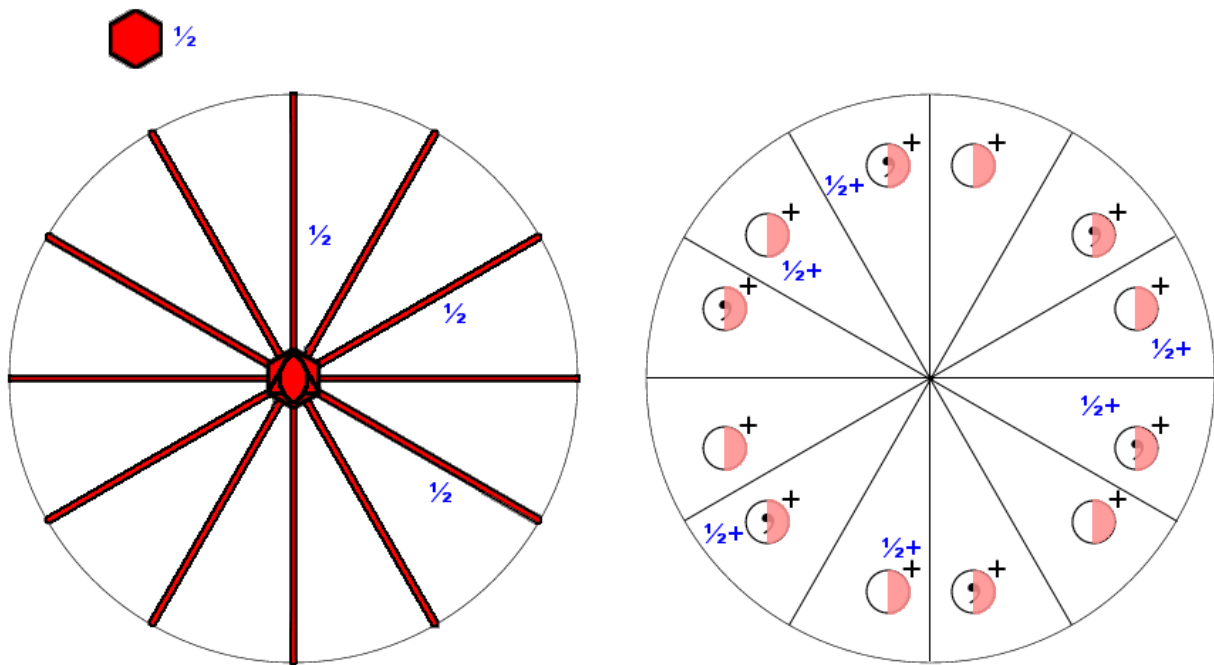
25.2.2.277



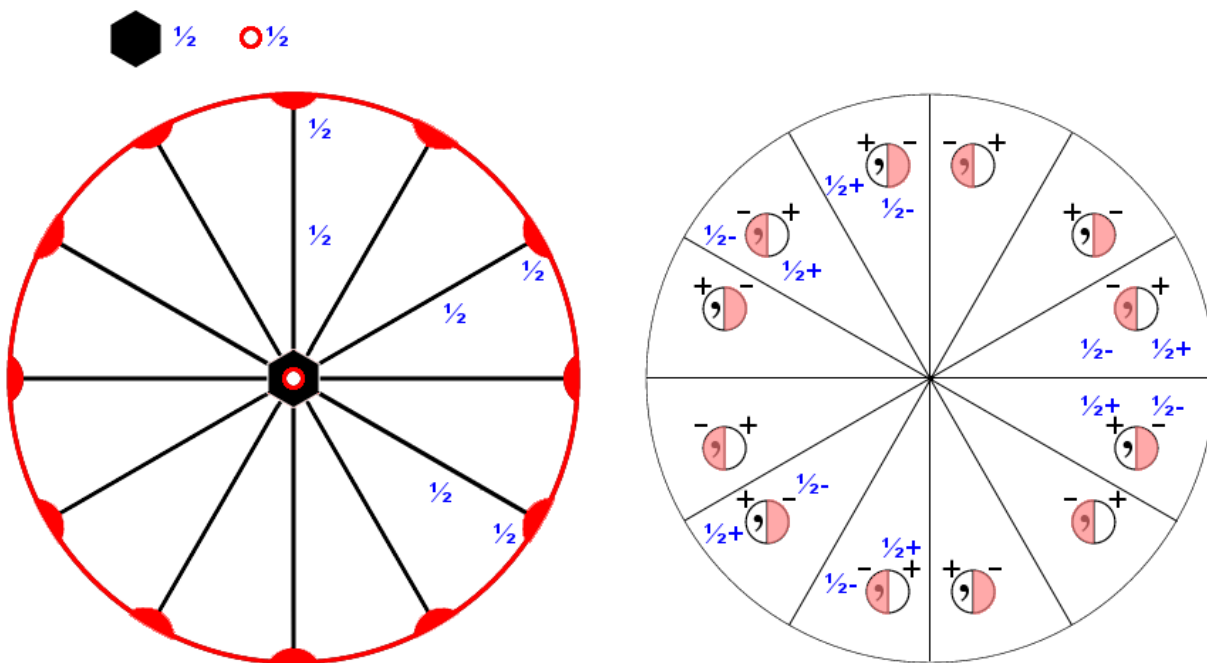
25.2.3.278



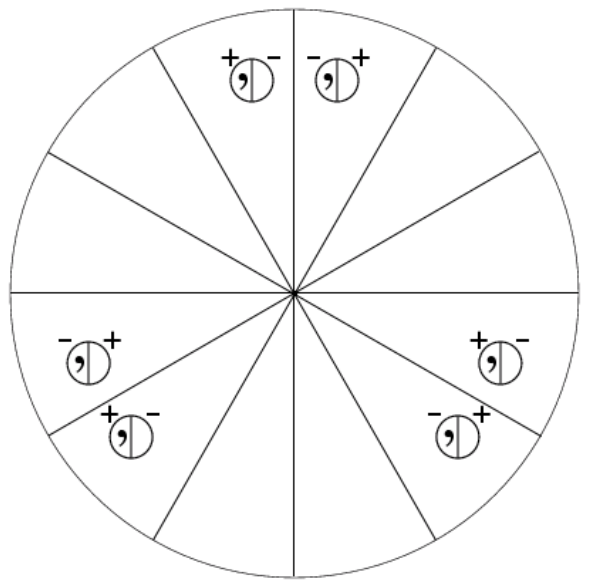
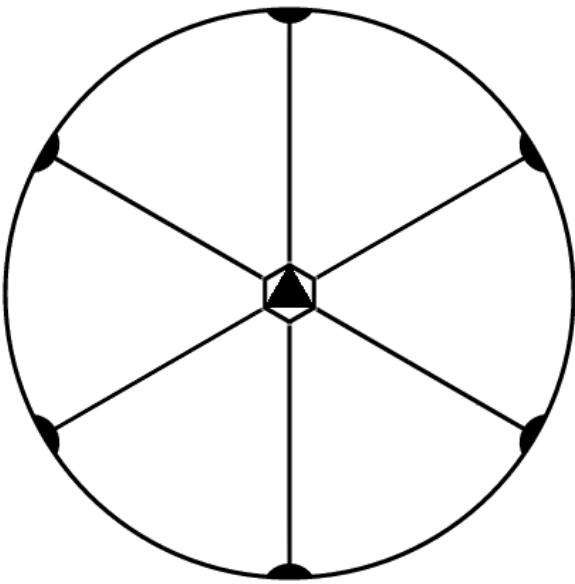
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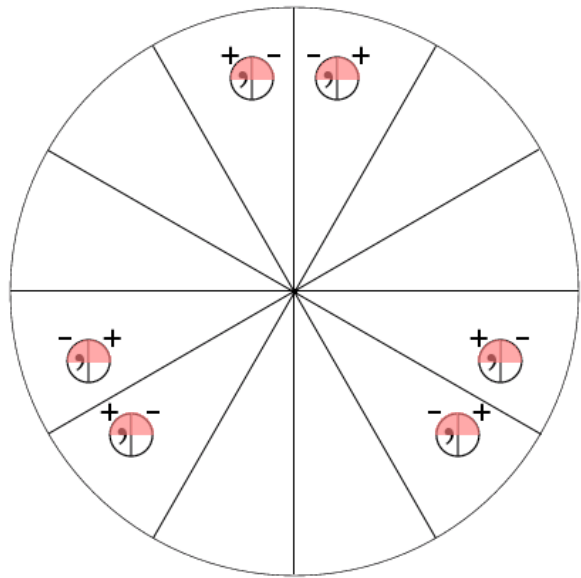
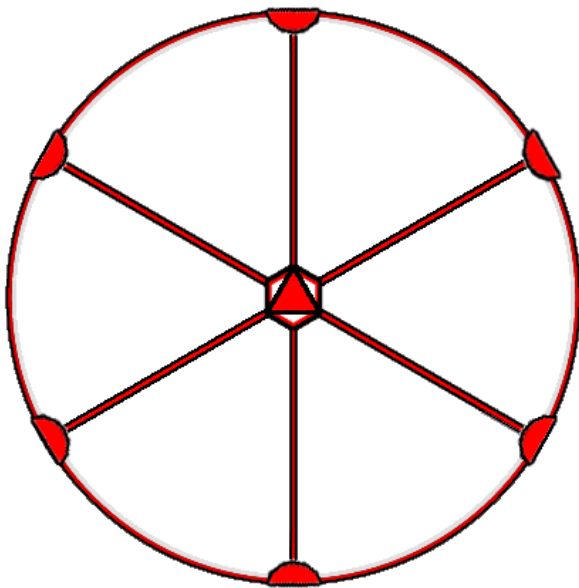
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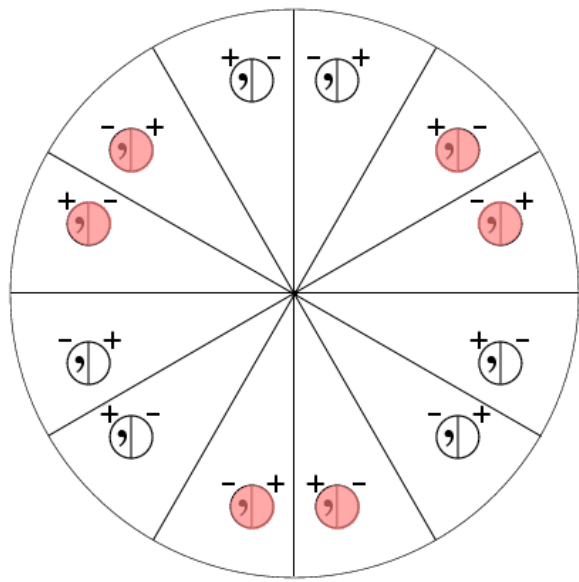
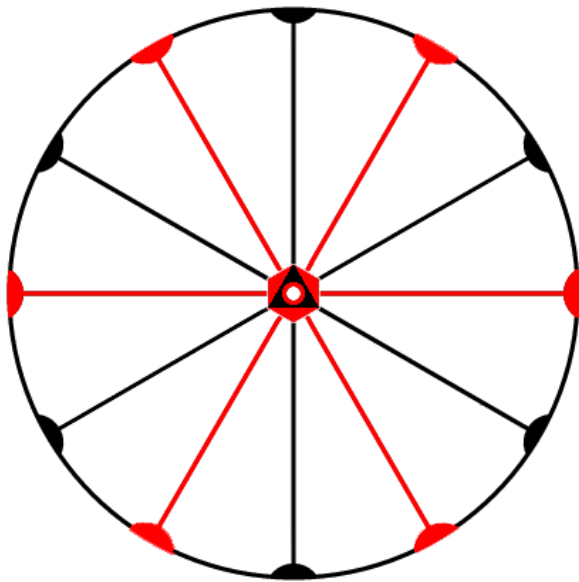
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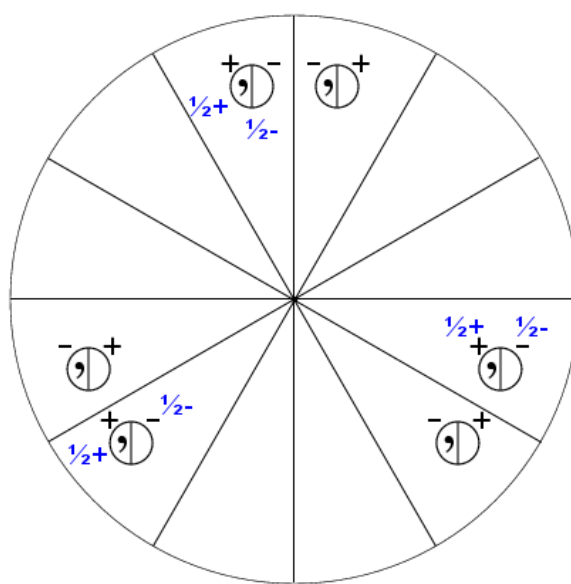
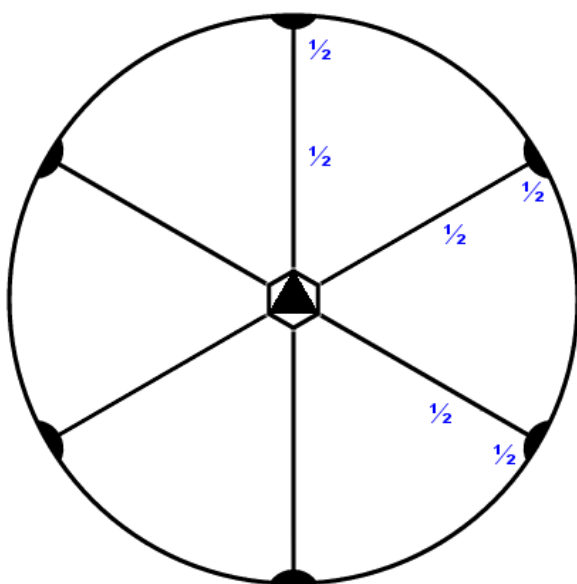
26.1.1.282



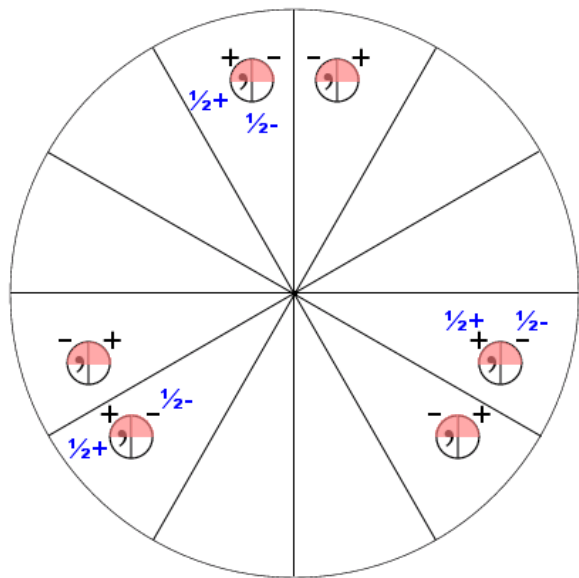
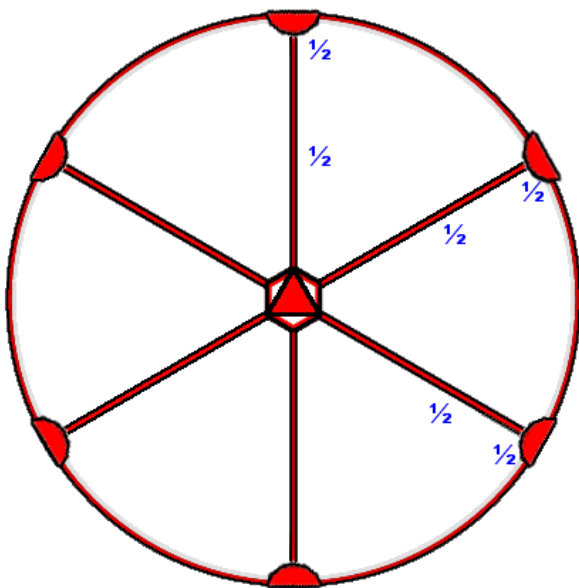
26.1.2.283



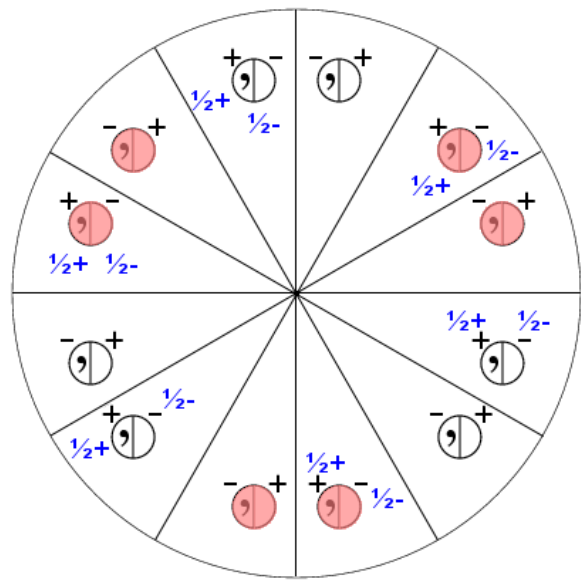
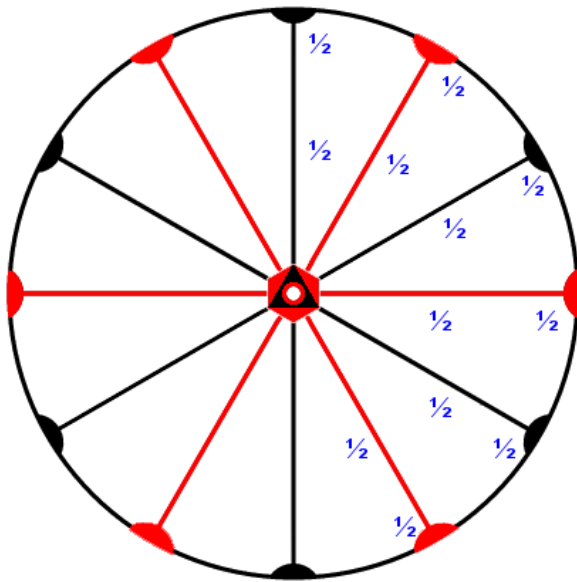
26.1.3.284



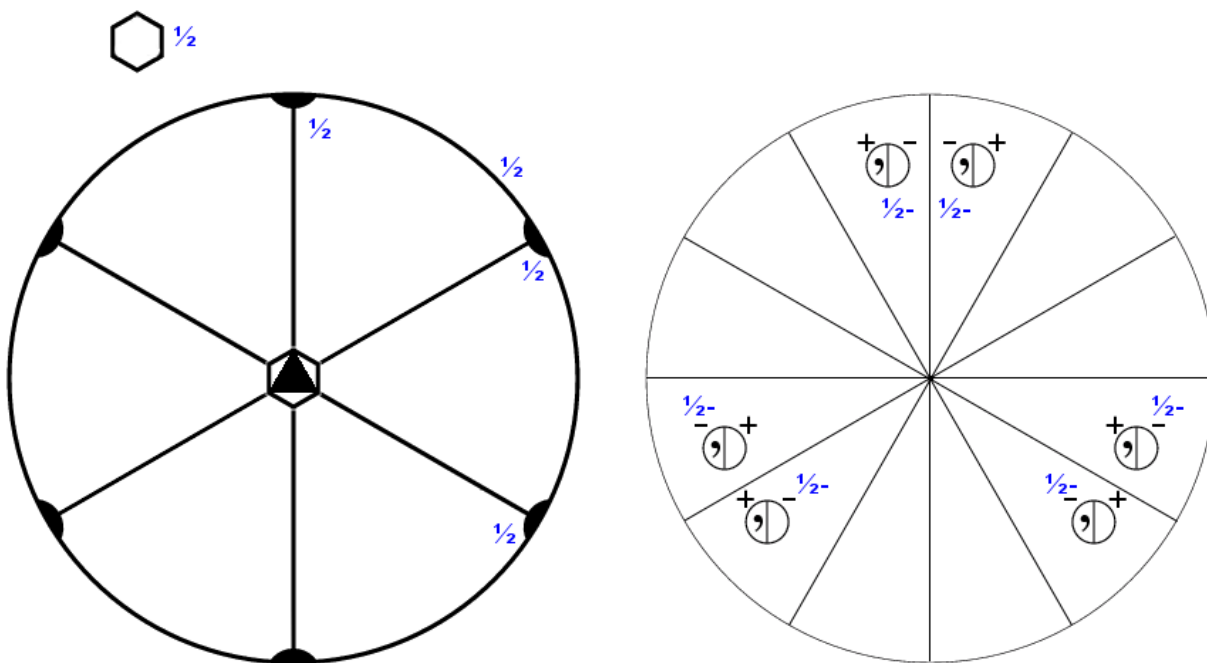
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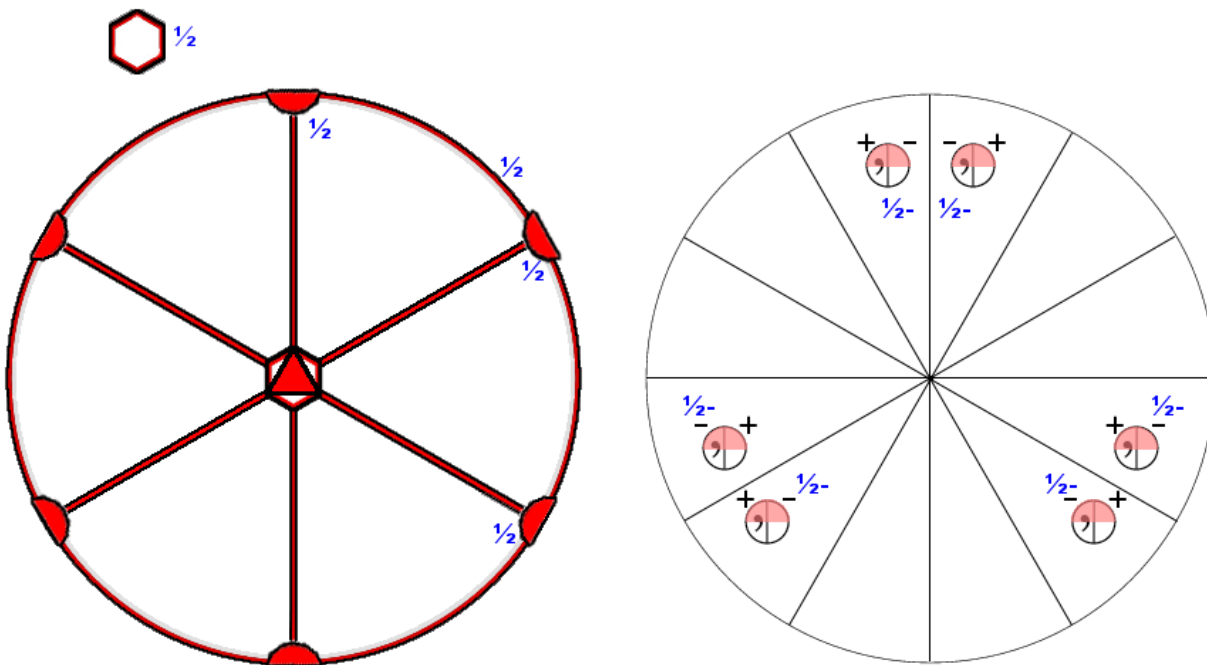
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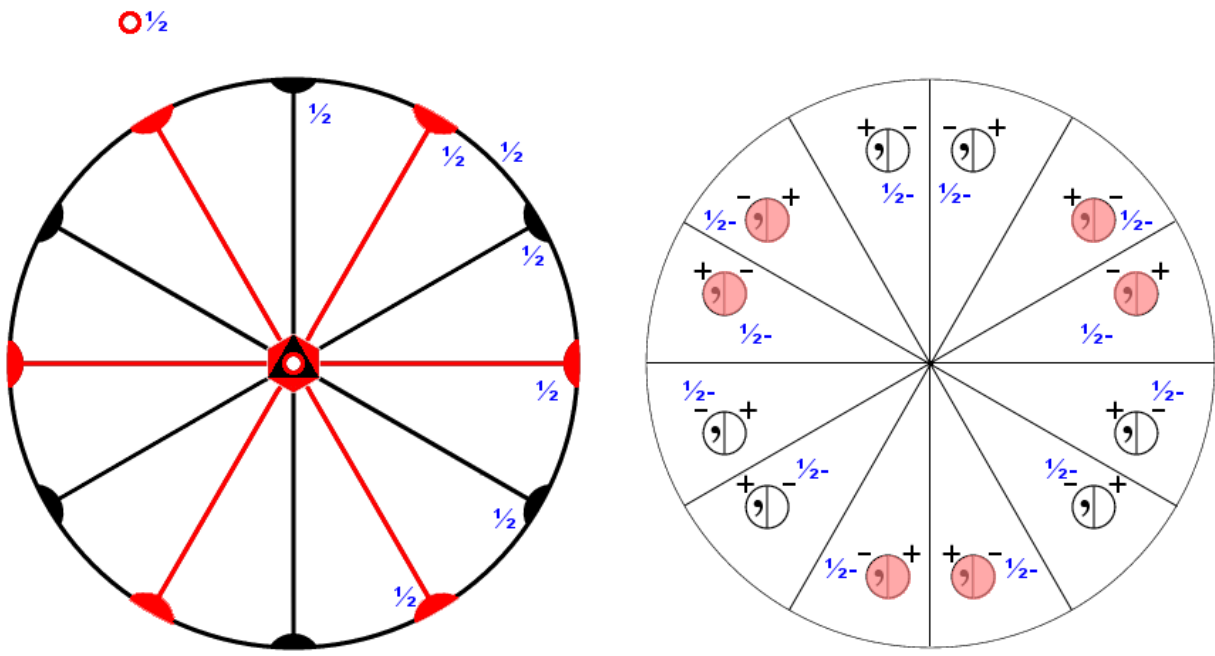
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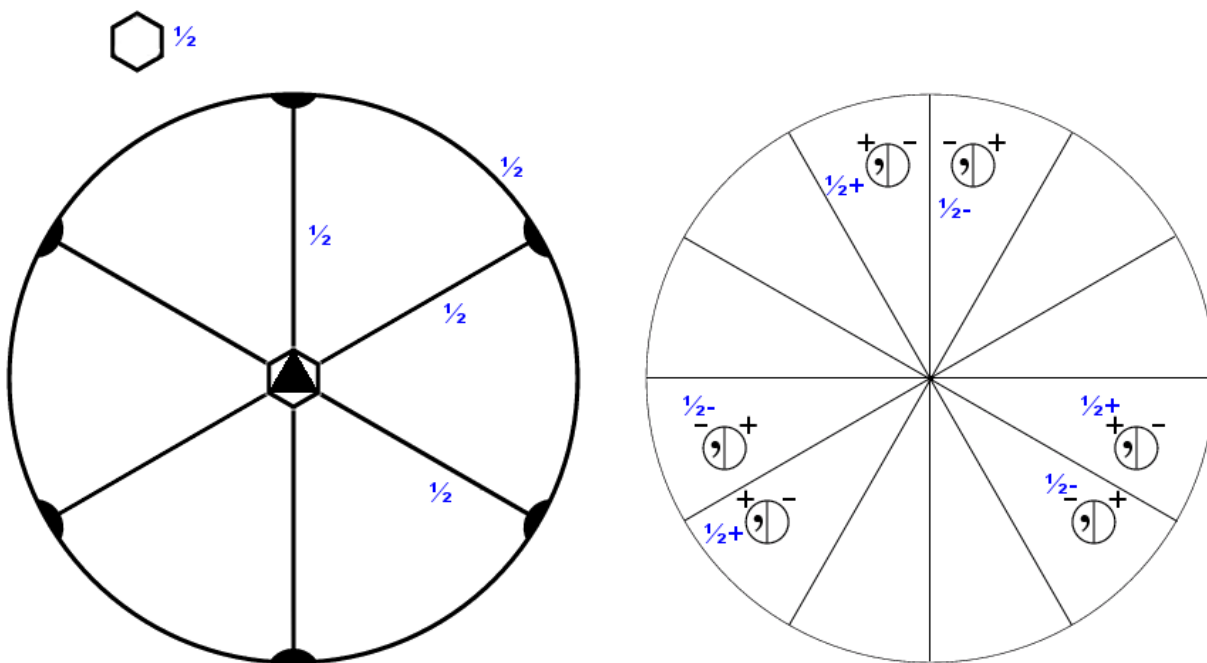
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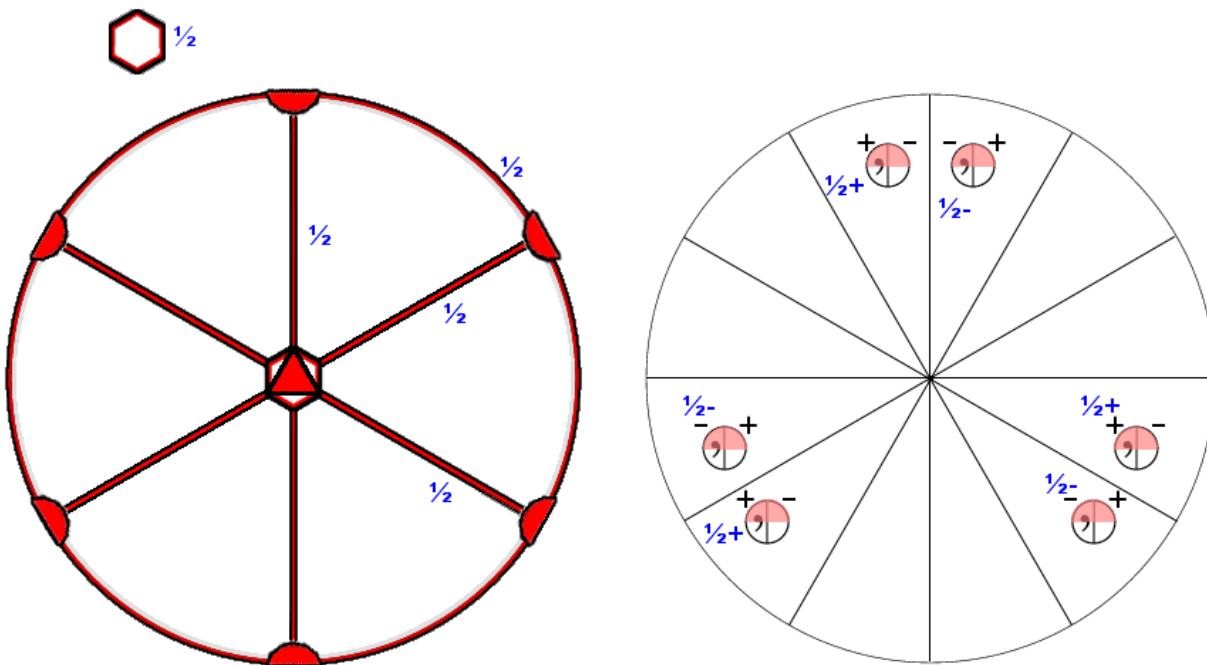
26.3.2.289



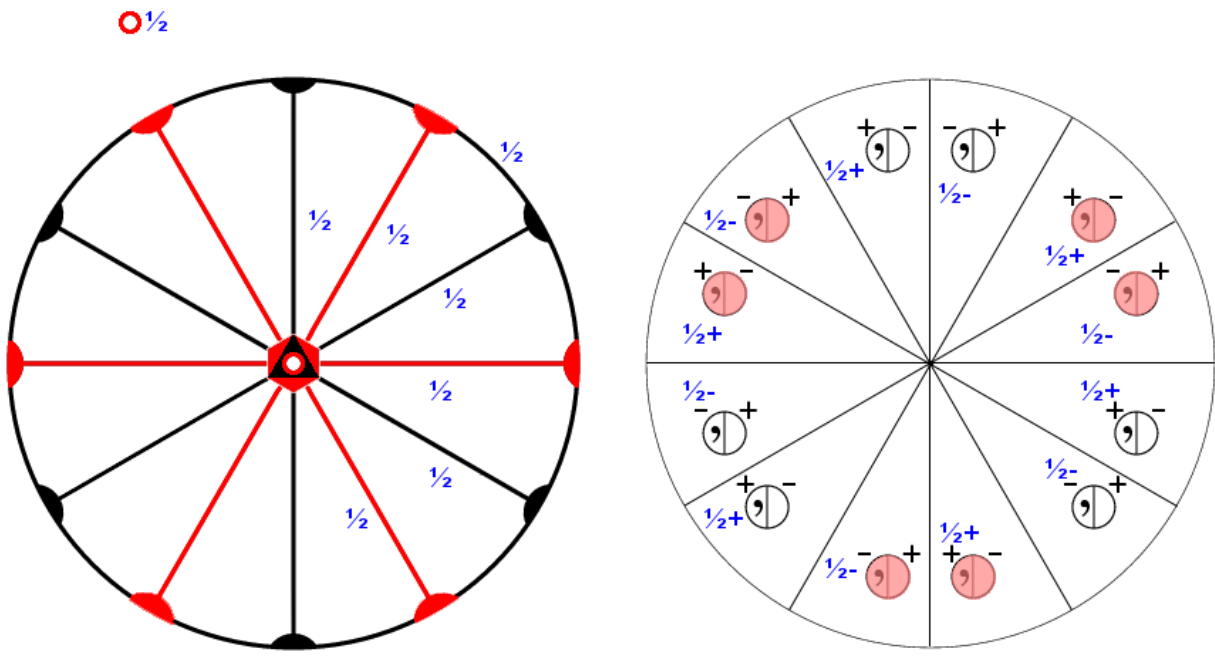
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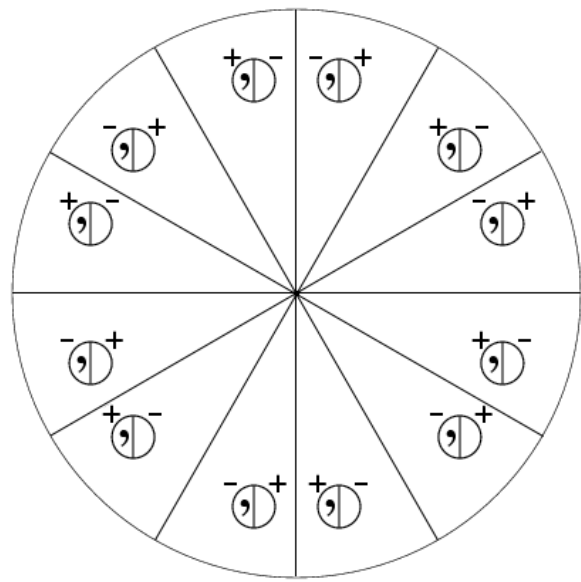
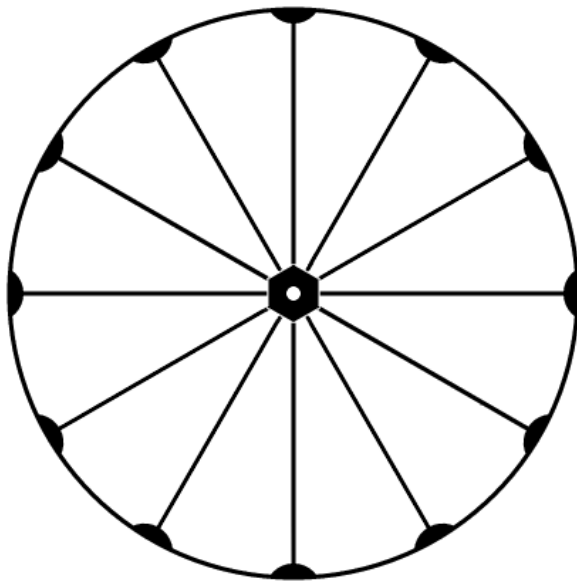
26.4.1.291



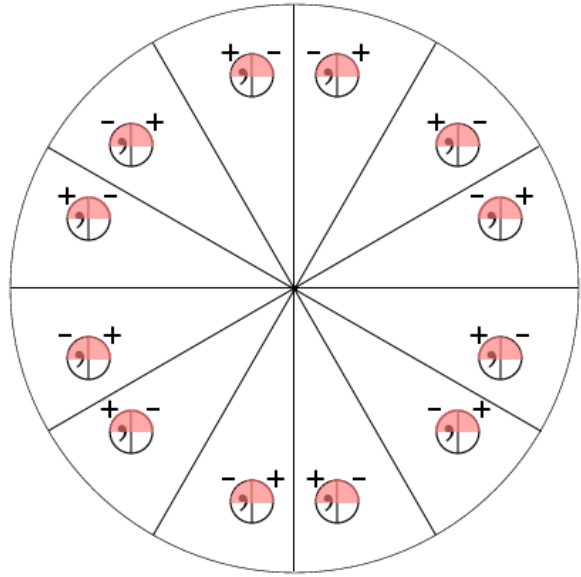
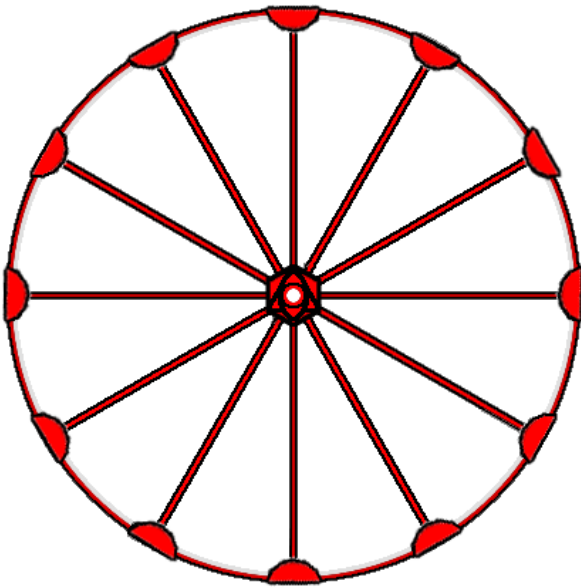
26.4.2.292



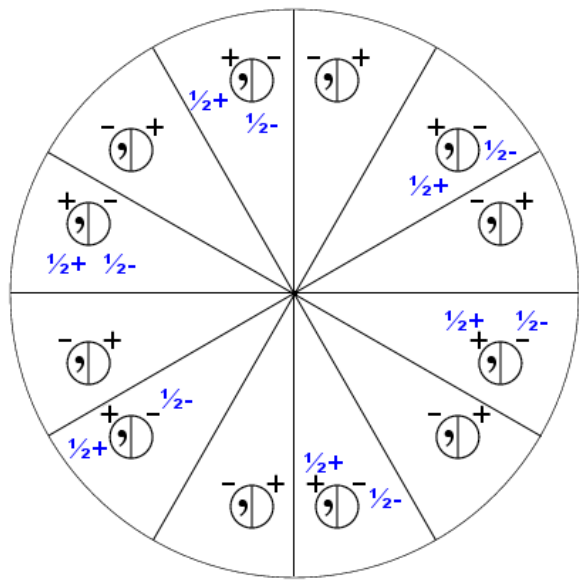
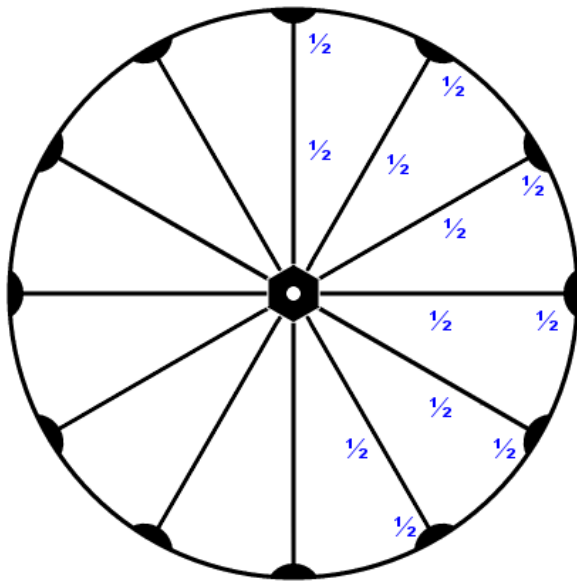
26.4.3.293



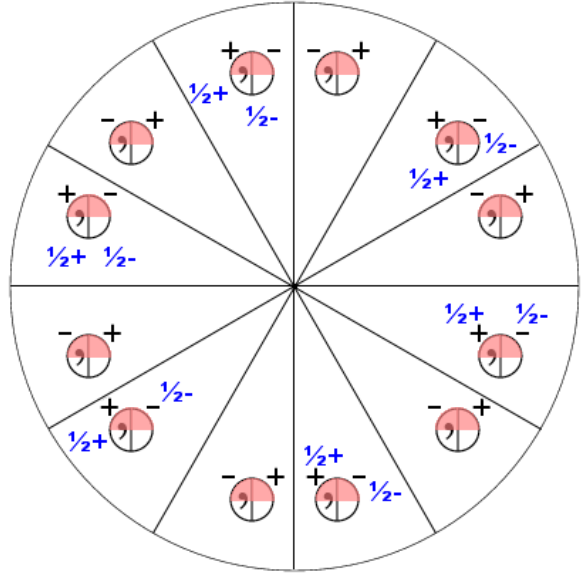
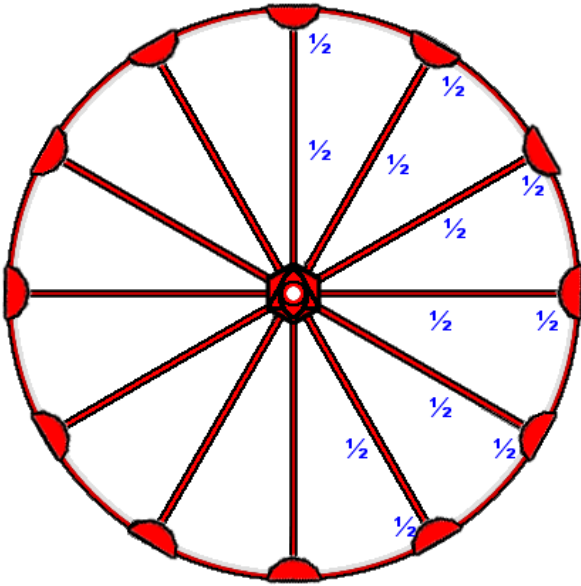
27.1.1.294



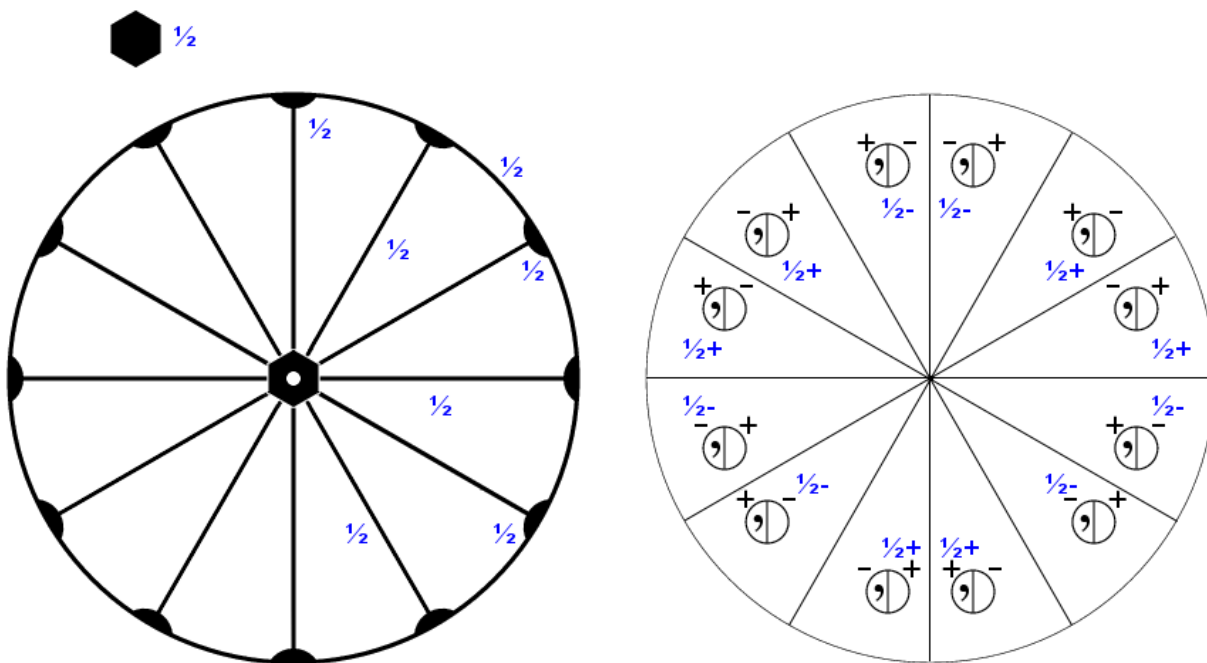
27.1.2.295



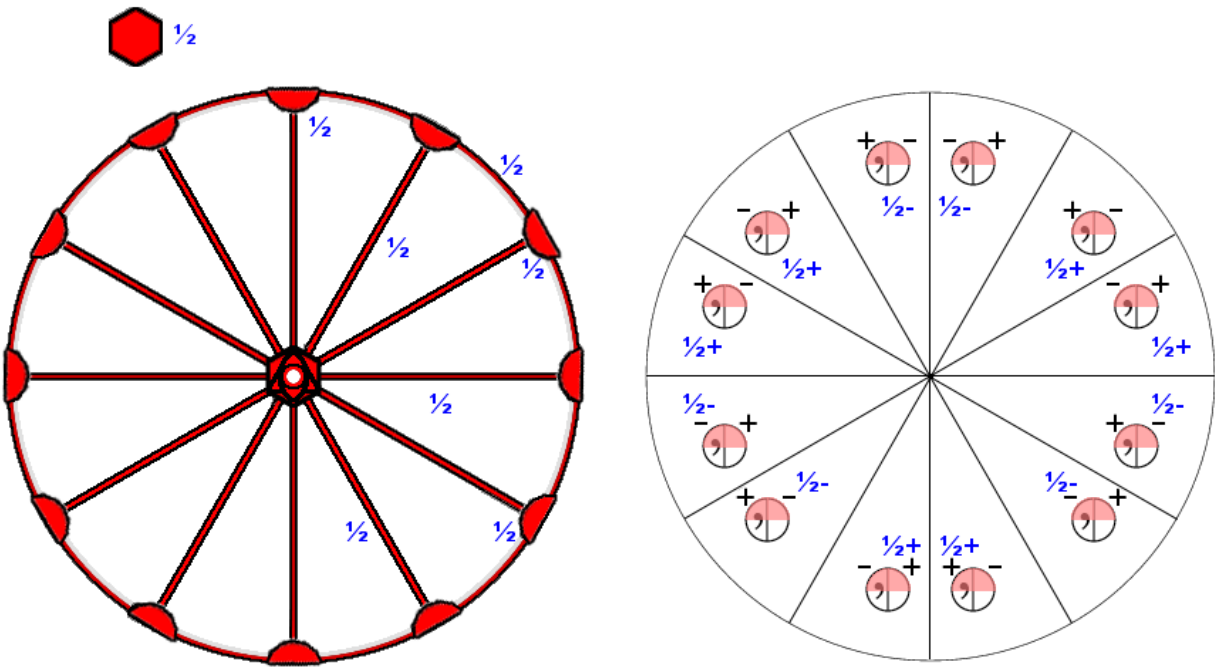
27.2.1.296



27.2.2.297

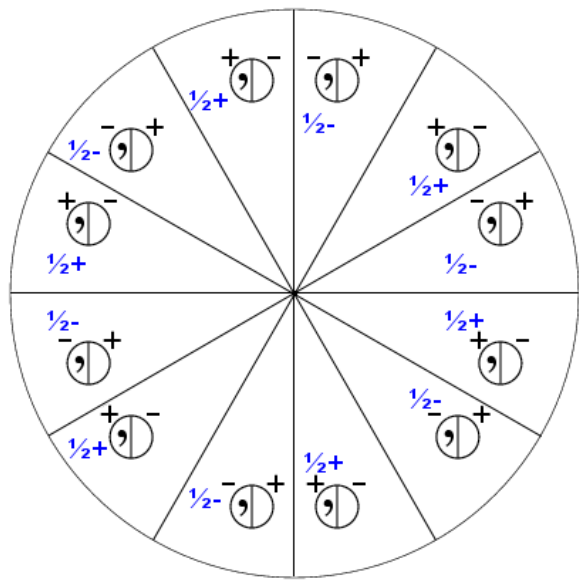
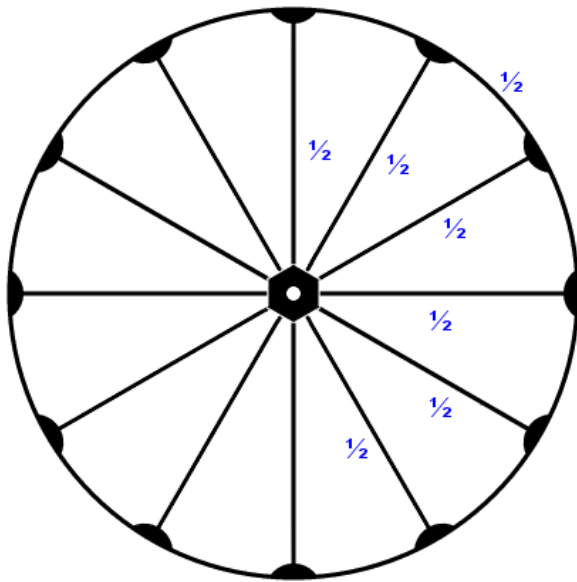


27.3.1.298



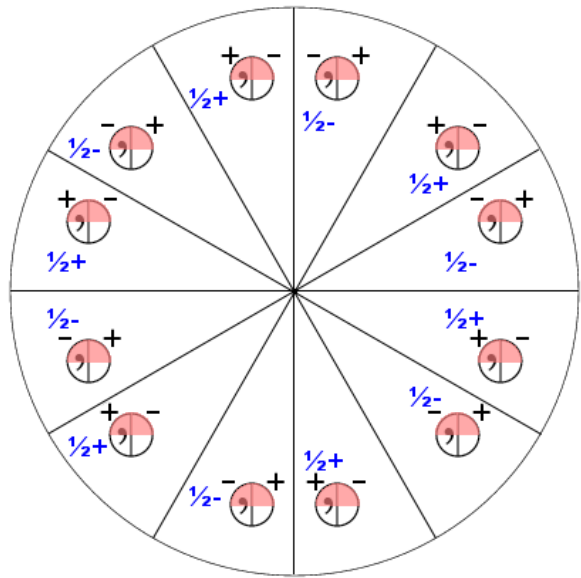
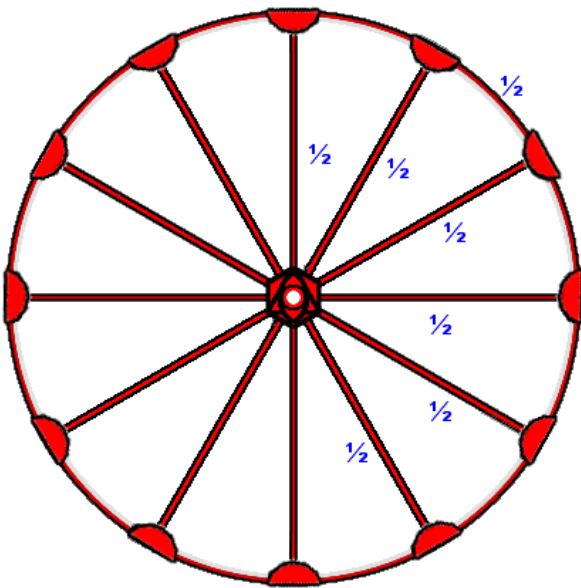
27.3.2.299

$\circ \frac{1}{2}$



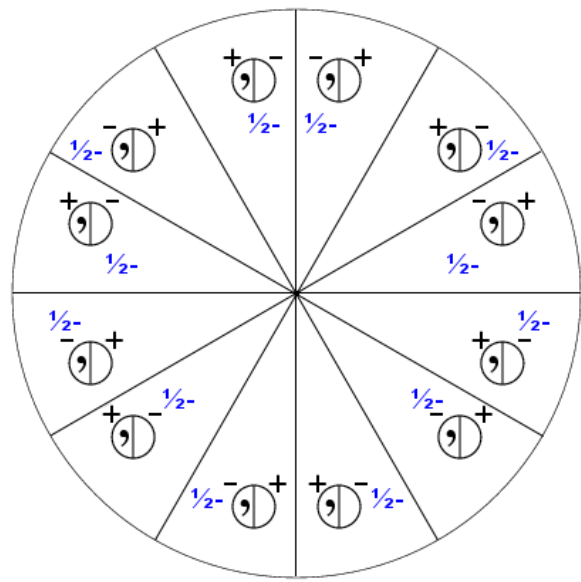
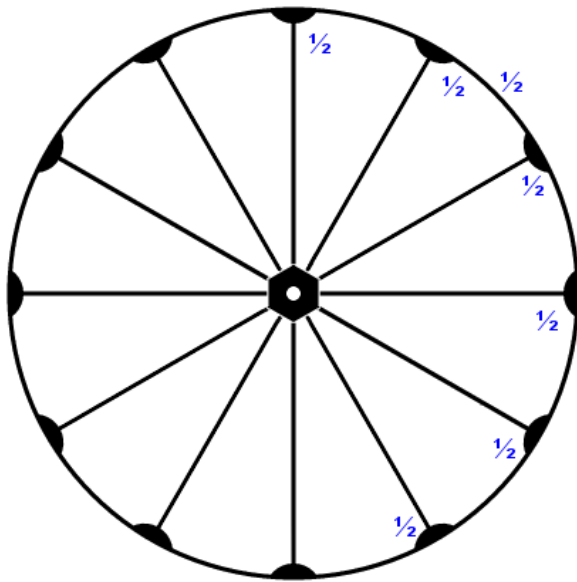
27.4.1.300

$\odot \frac{1}{2}$



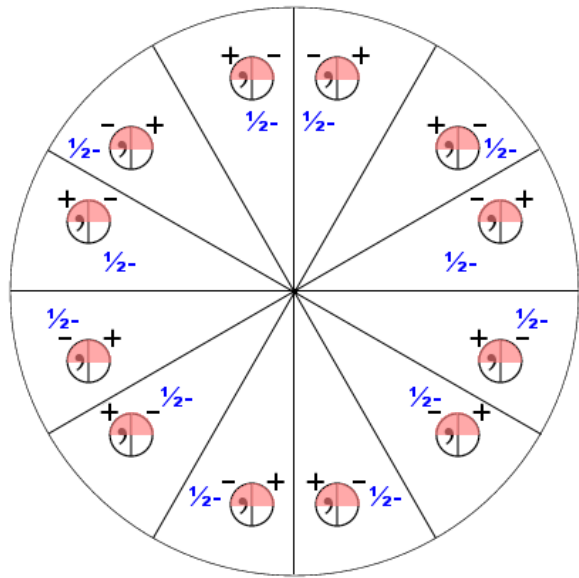
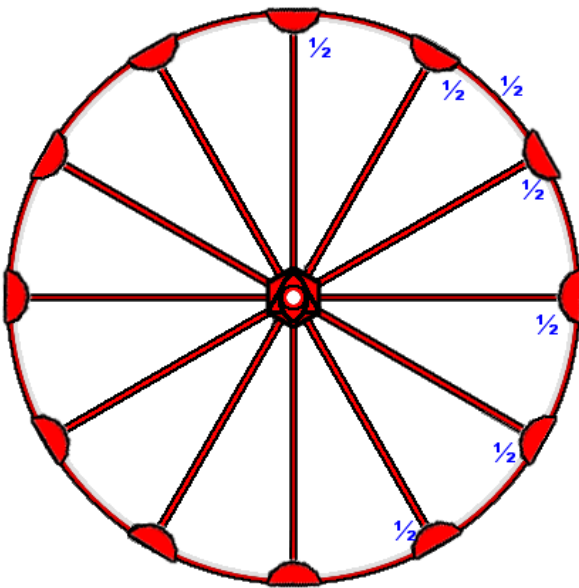
27.4.2.301

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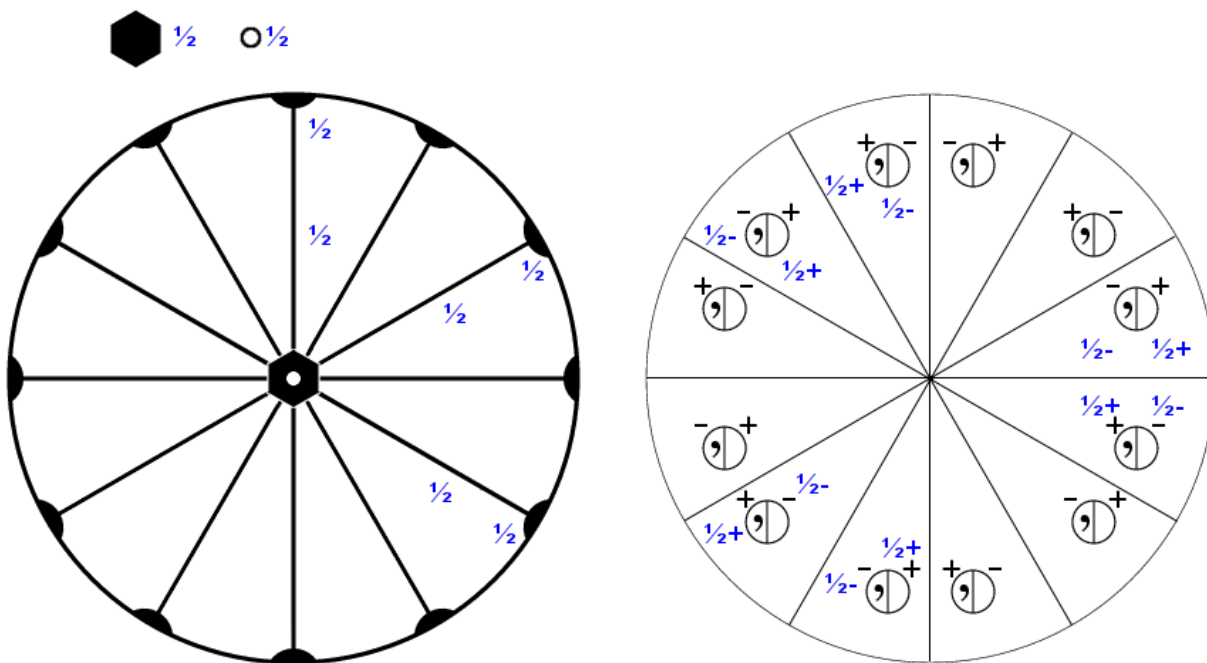


27.5.1.302

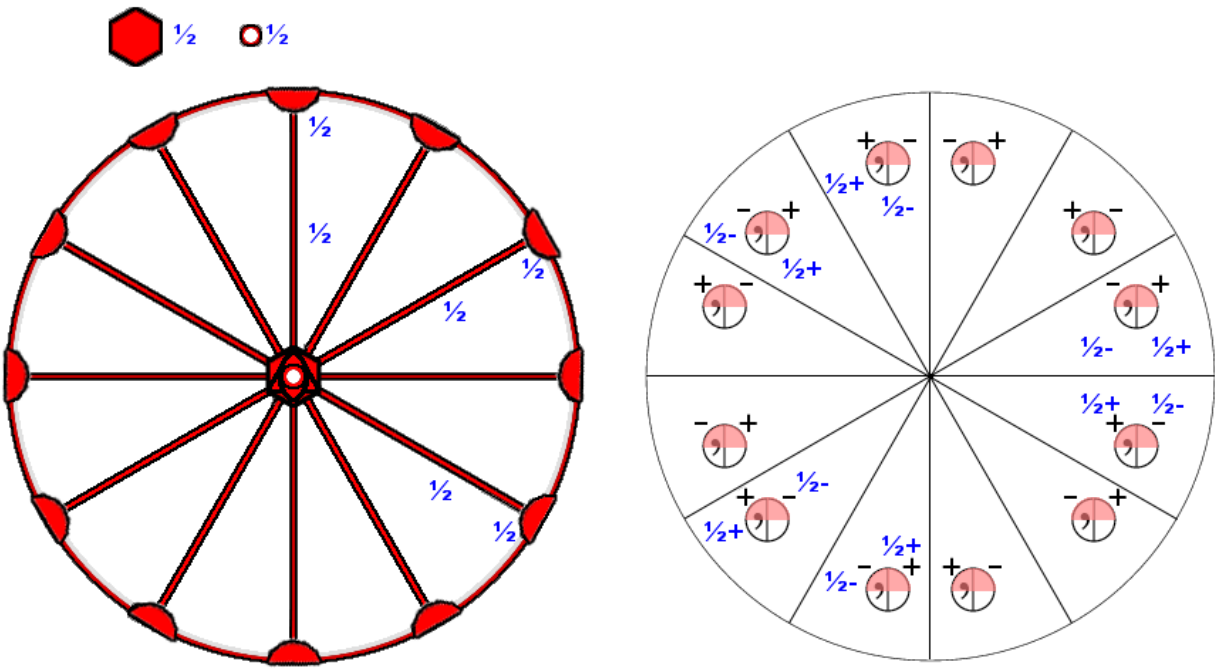
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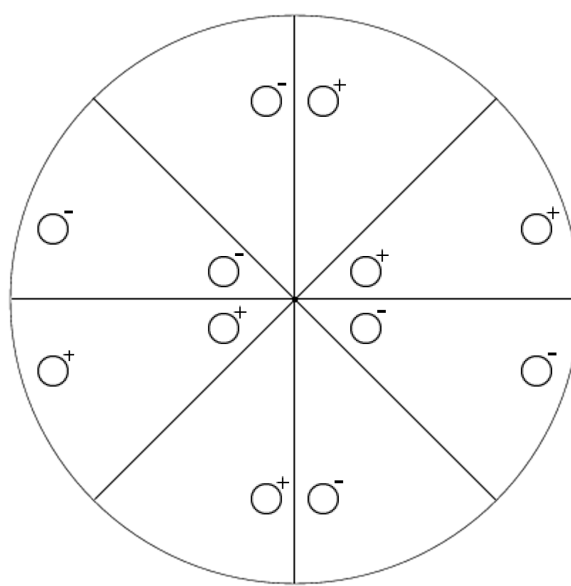
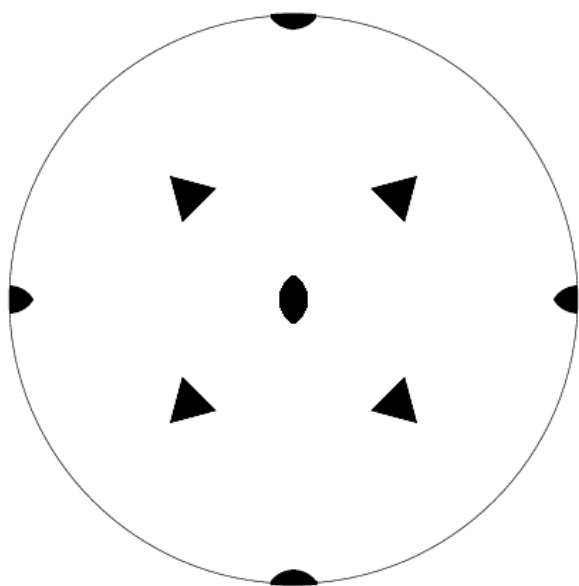
27.5.2.303



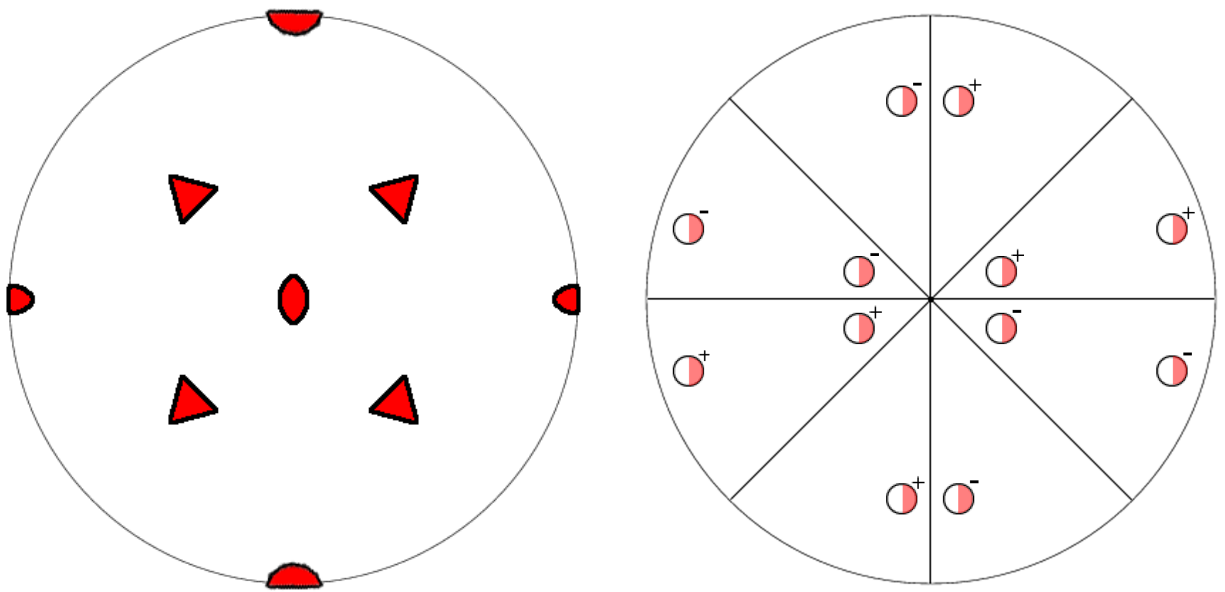
27.6.1.304



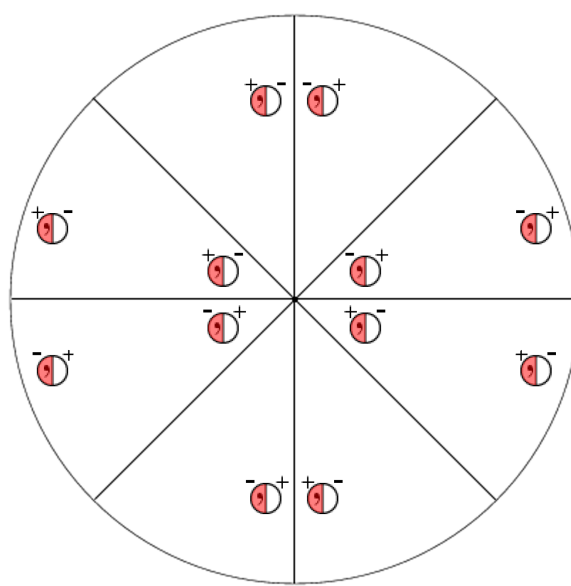
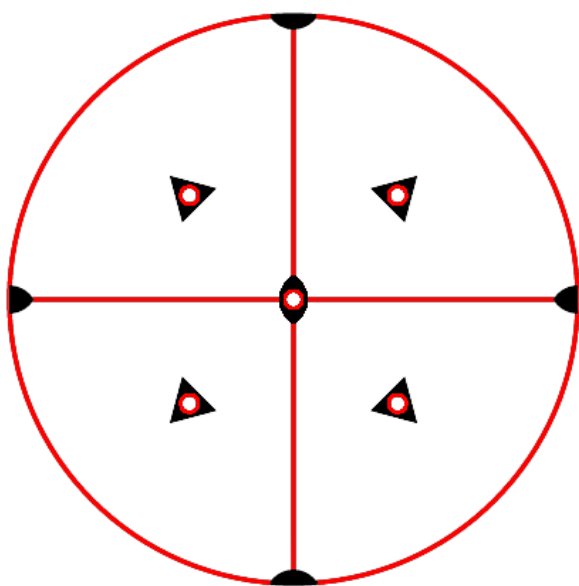
27.6.2.305



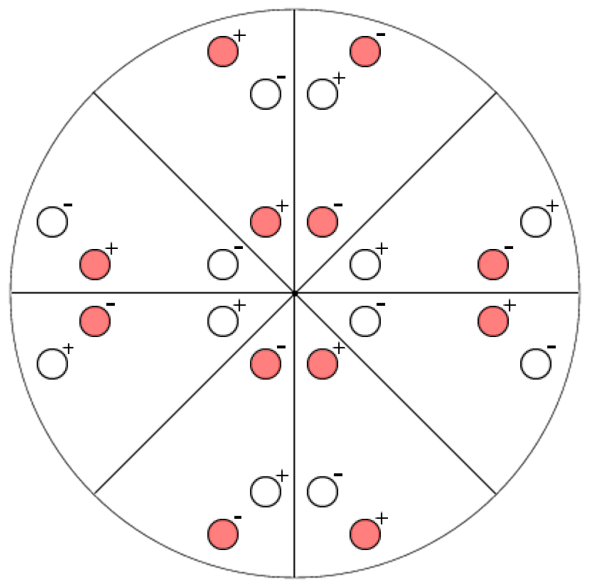
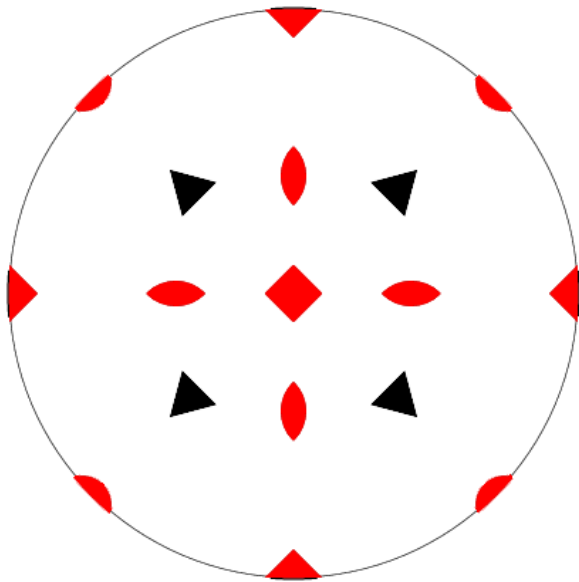
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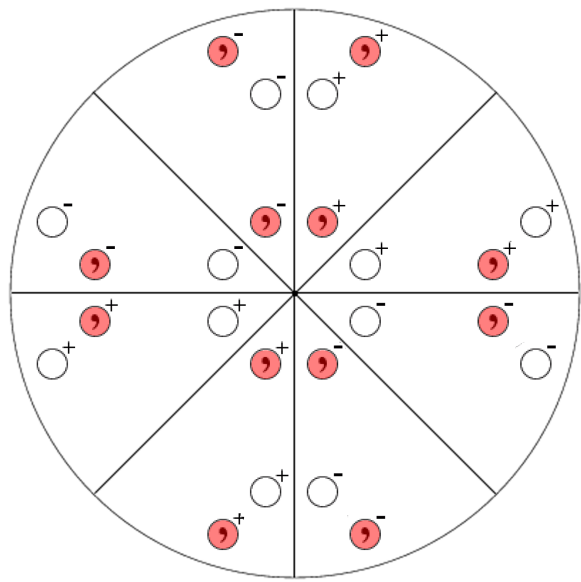
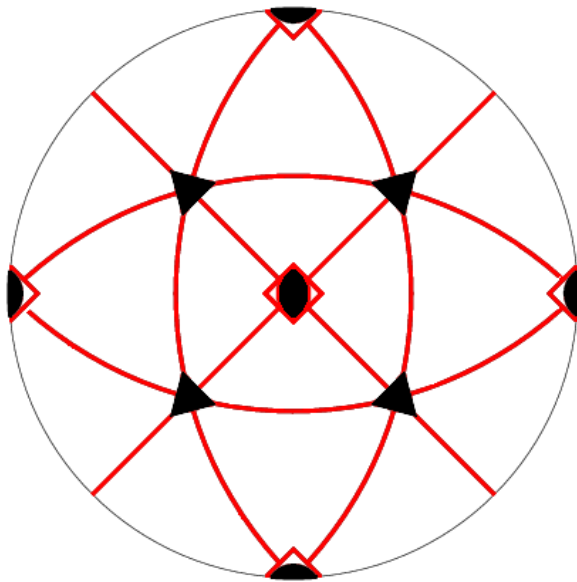
28.1.2.307



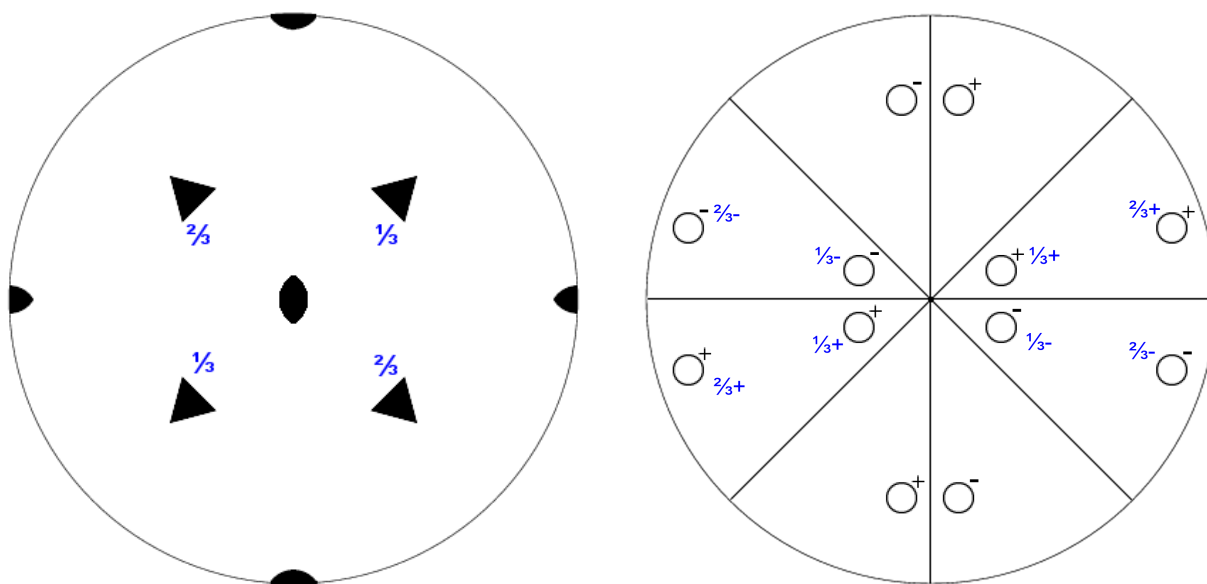
28.1.3.308



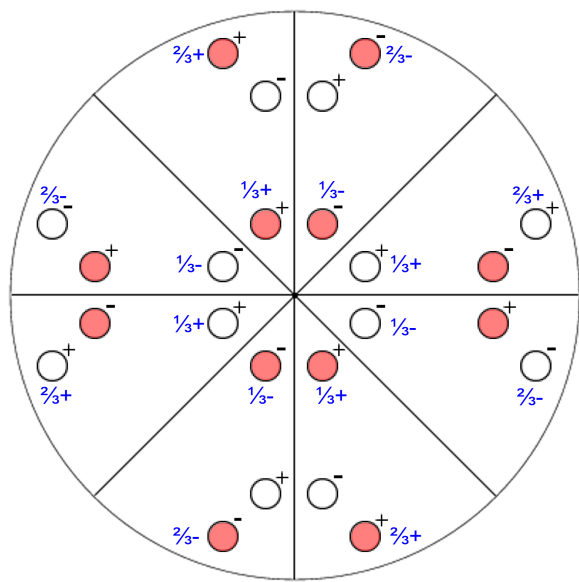
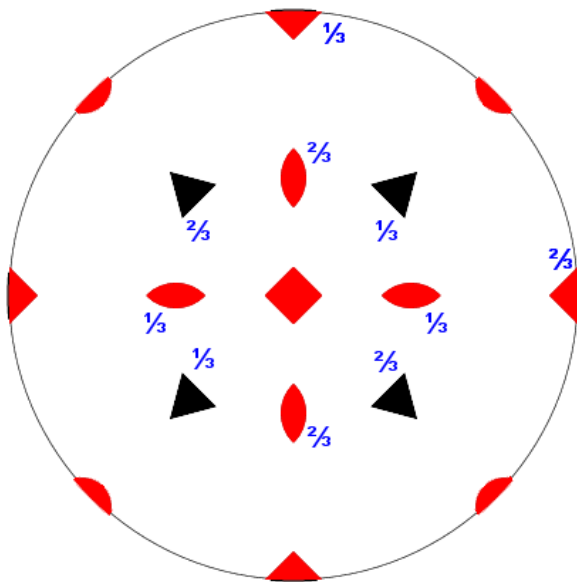
28.1.4.309



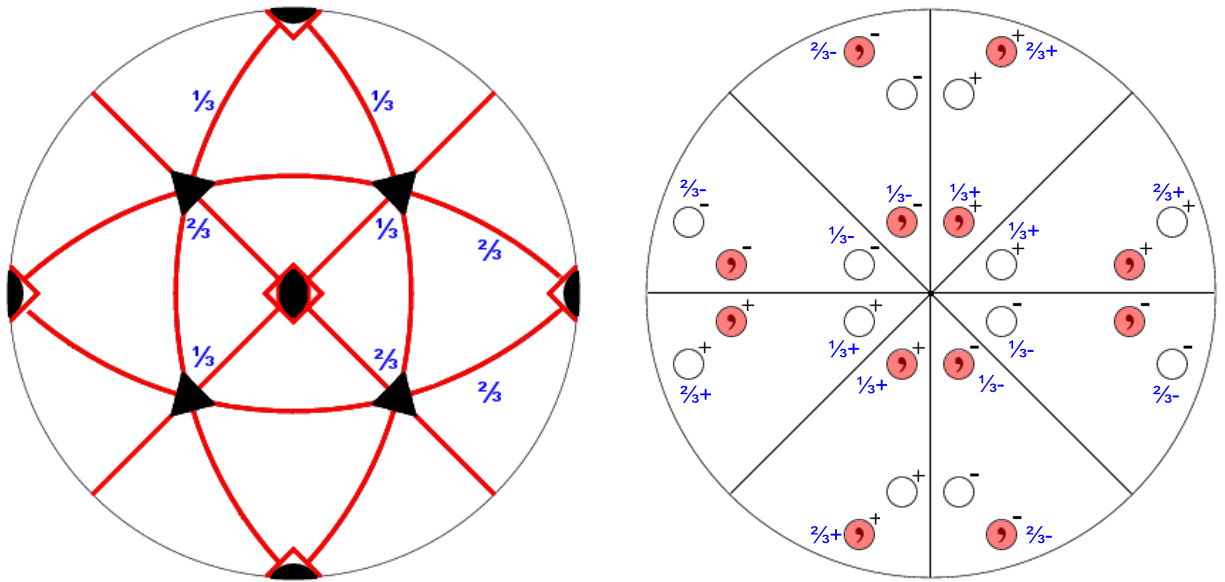
28.1.5.310



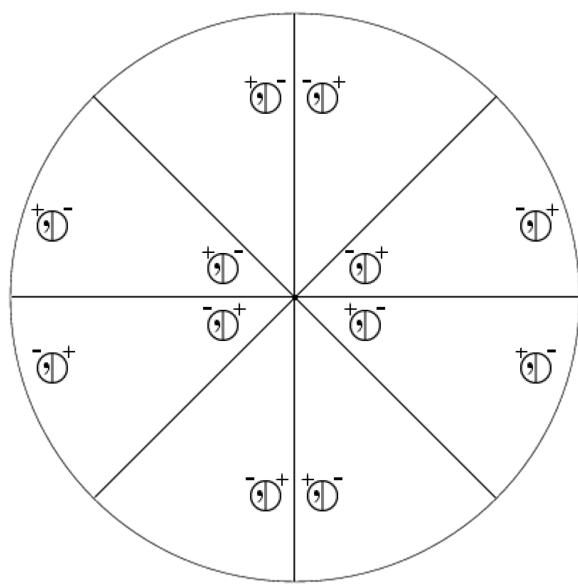
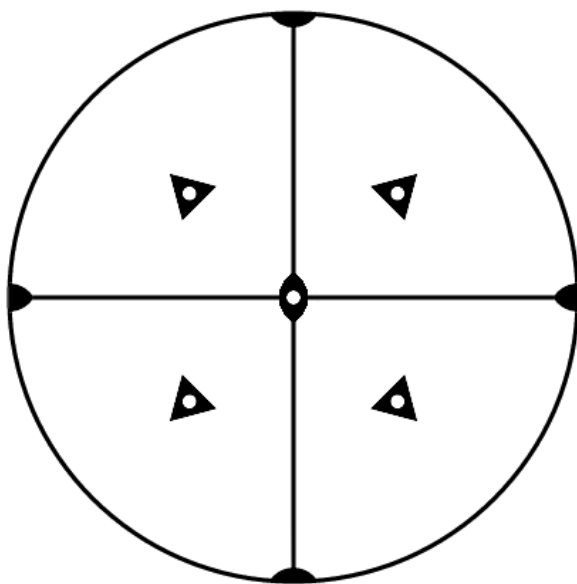
28.2.1.311



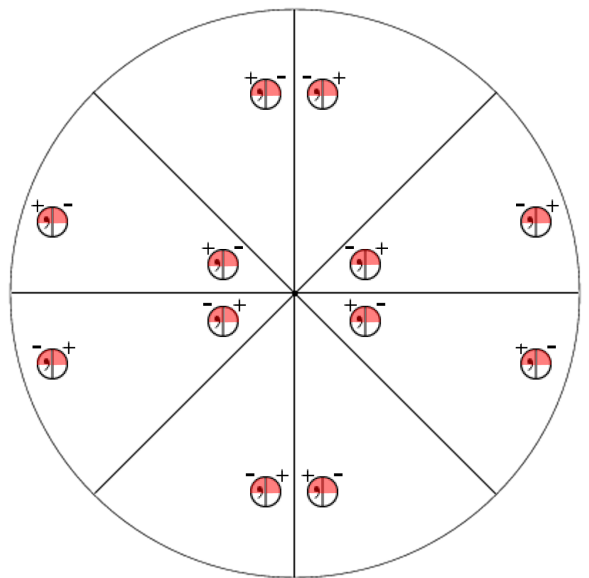
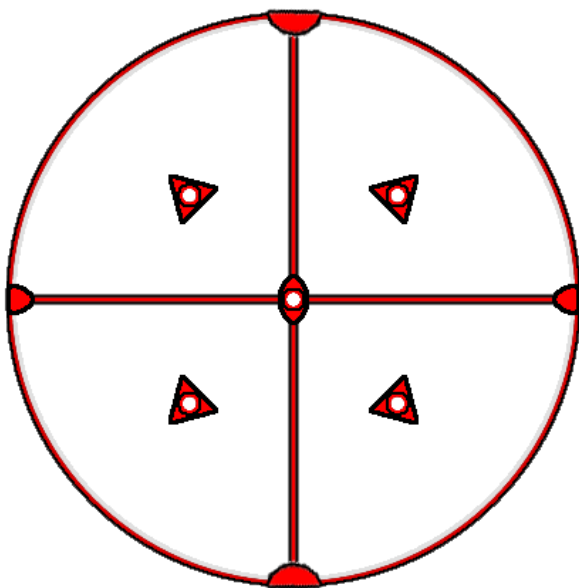
28.2.2.312



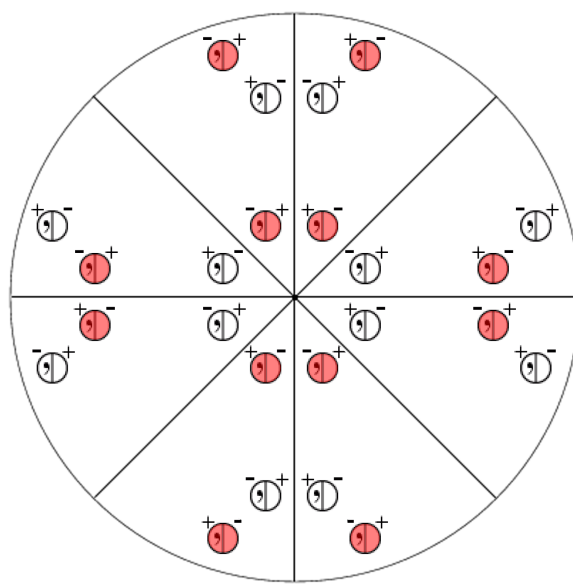
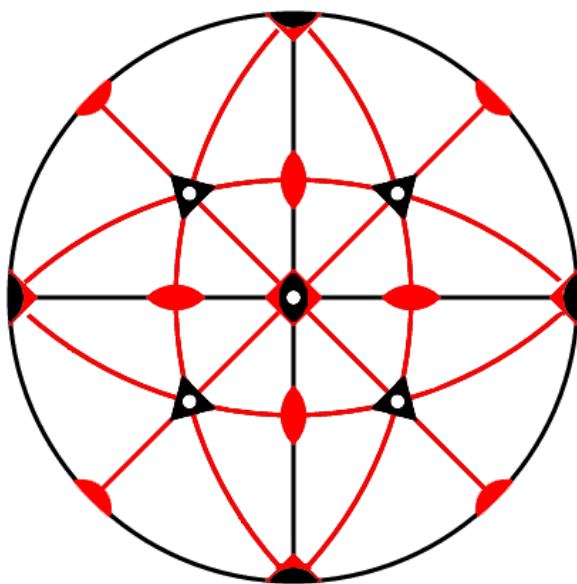
28.2.3.313



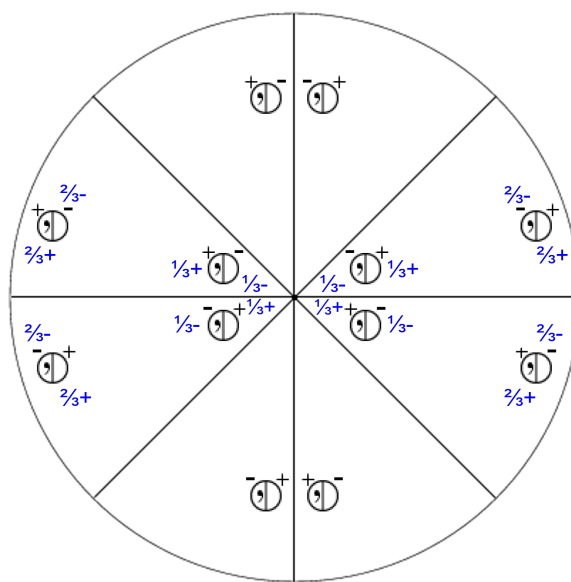
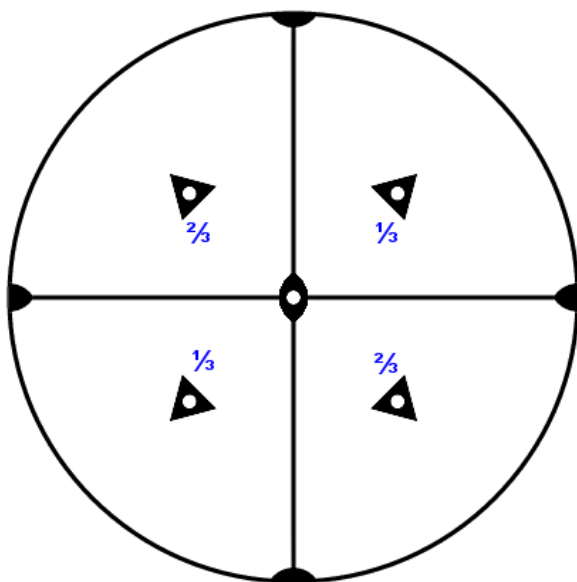
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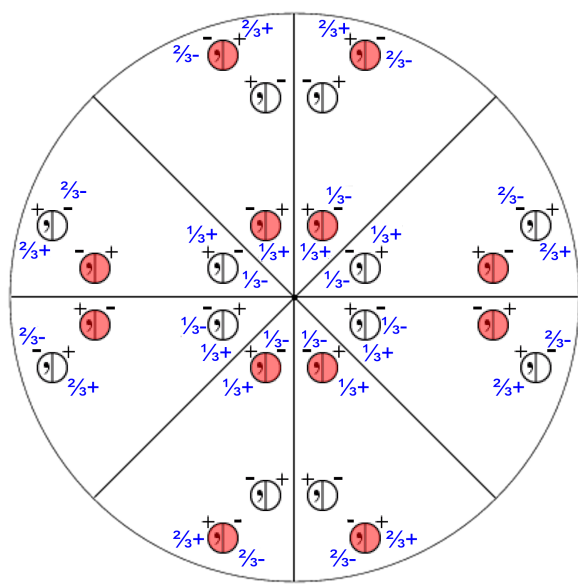
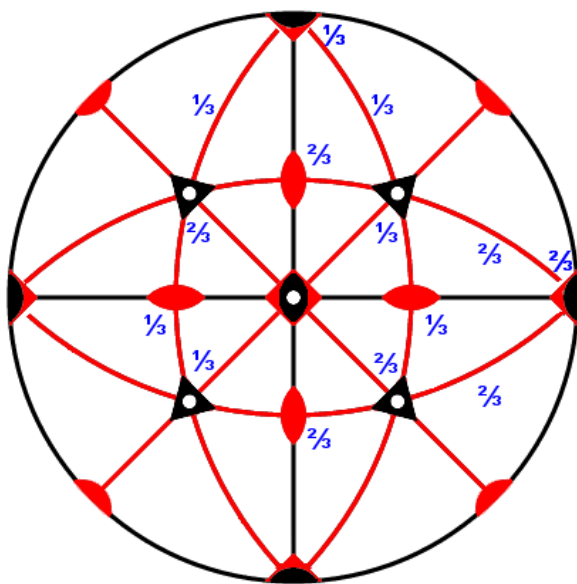
29.1.2.315



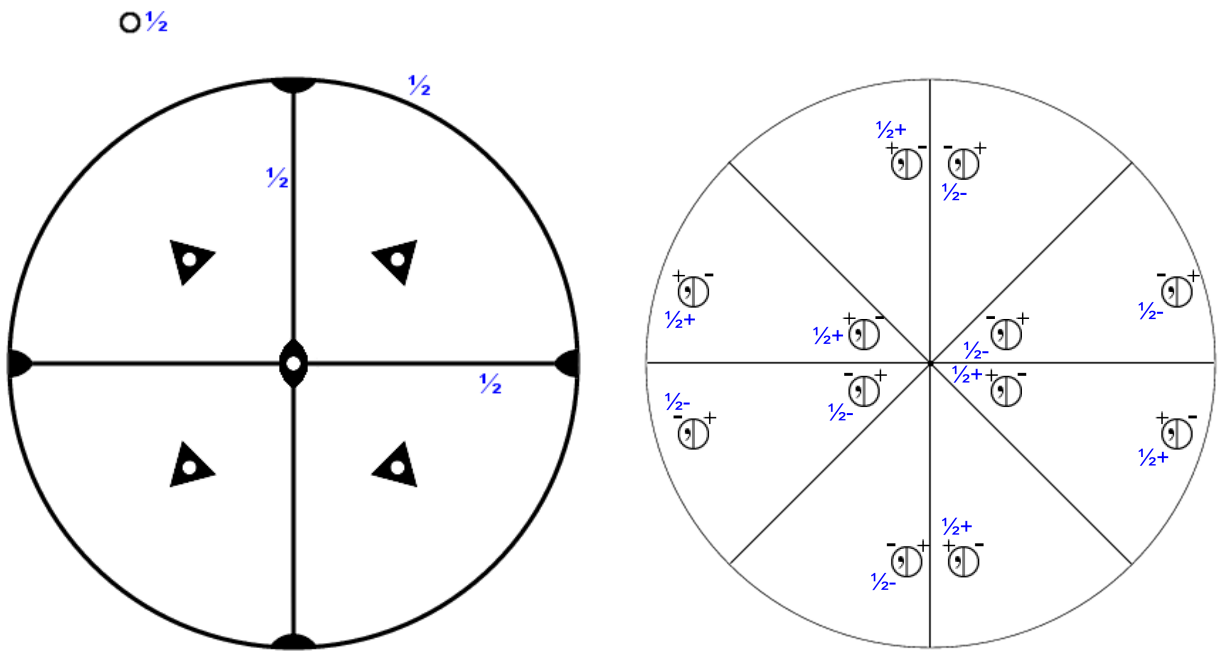
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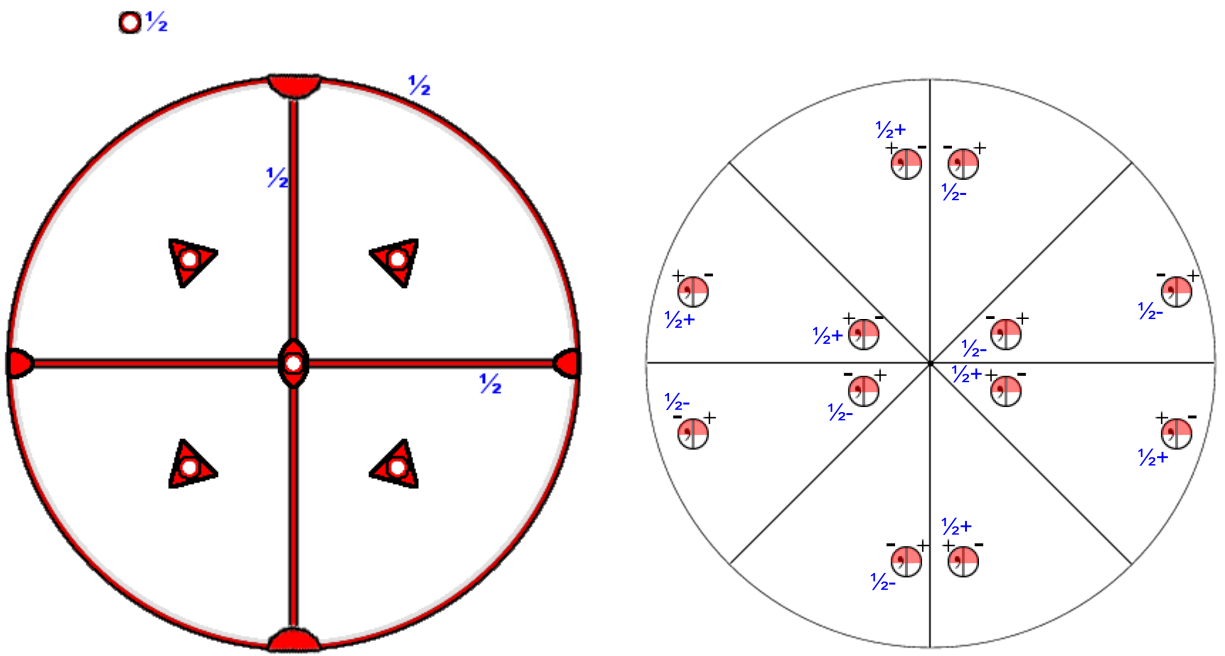
29.2.1.317



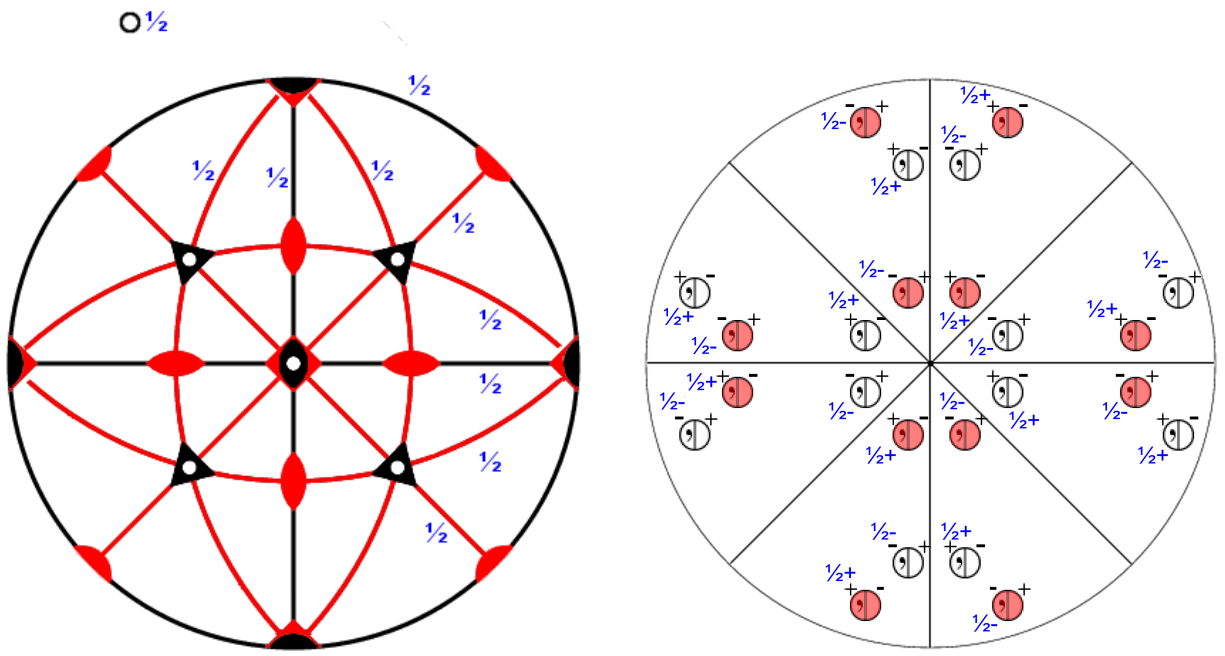
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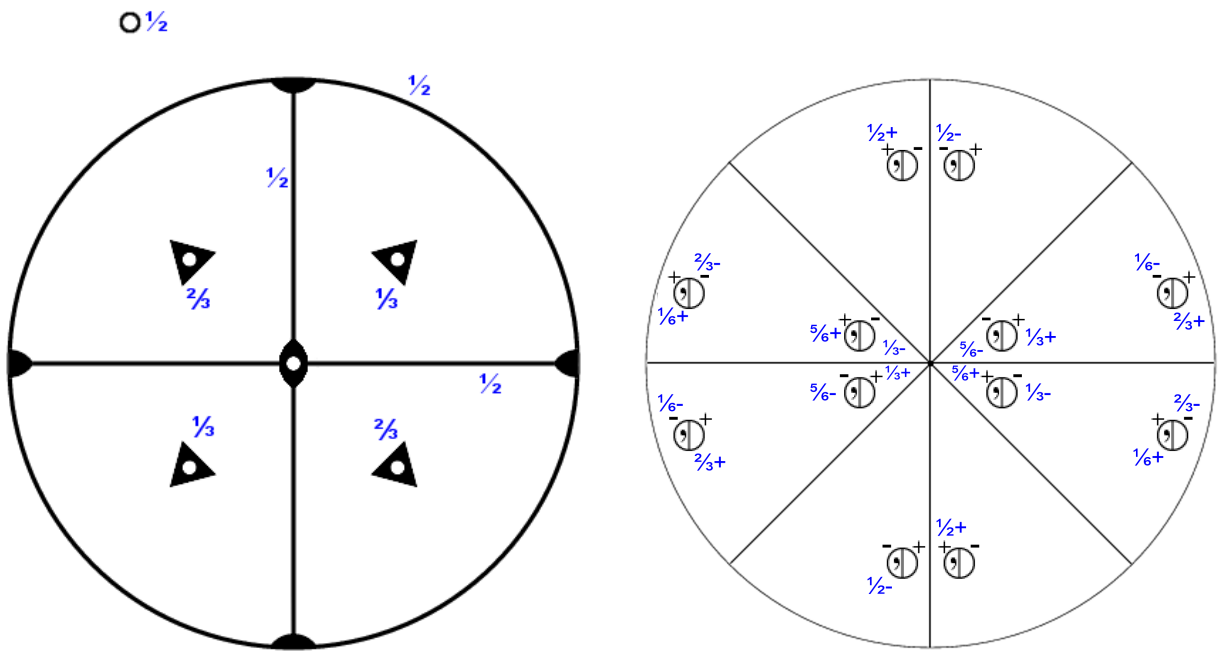
29.3.1.319



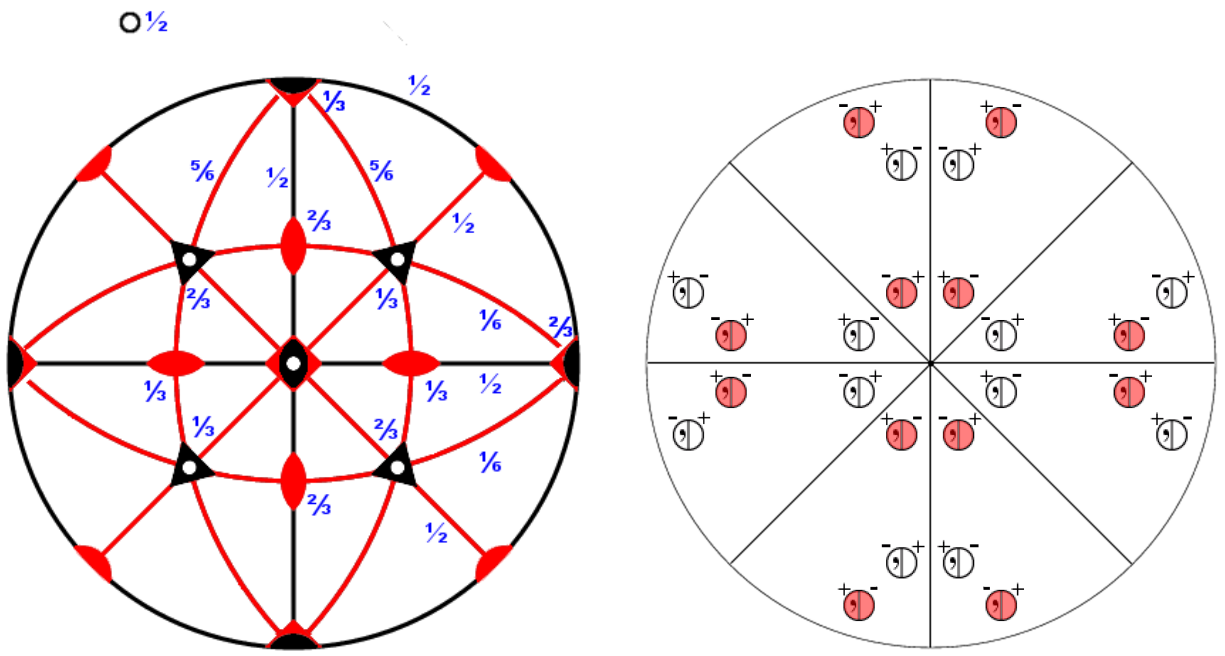
29.3.2.320



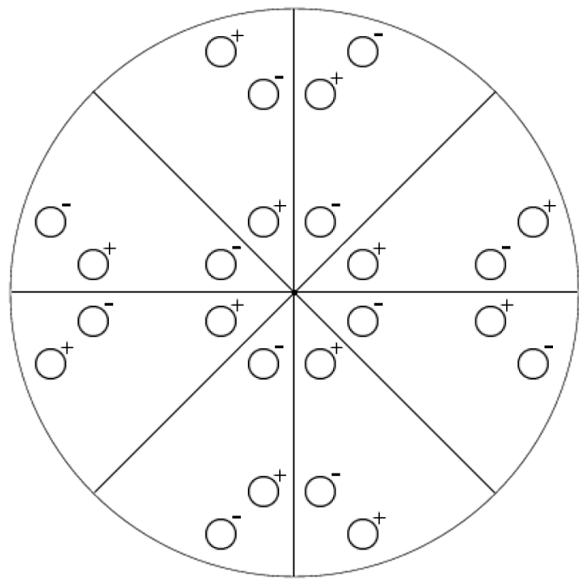
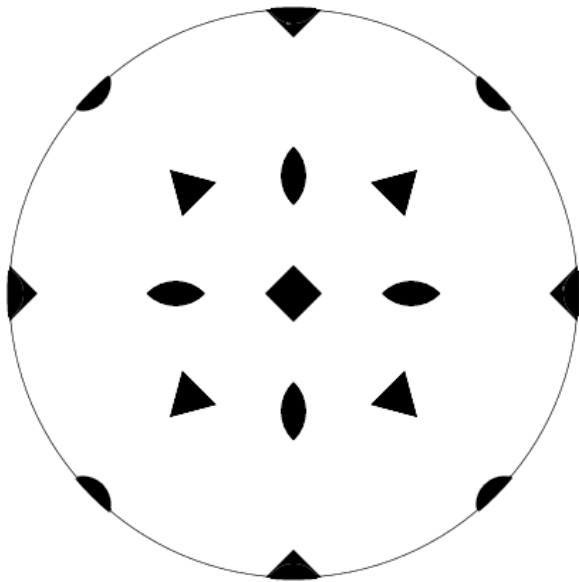
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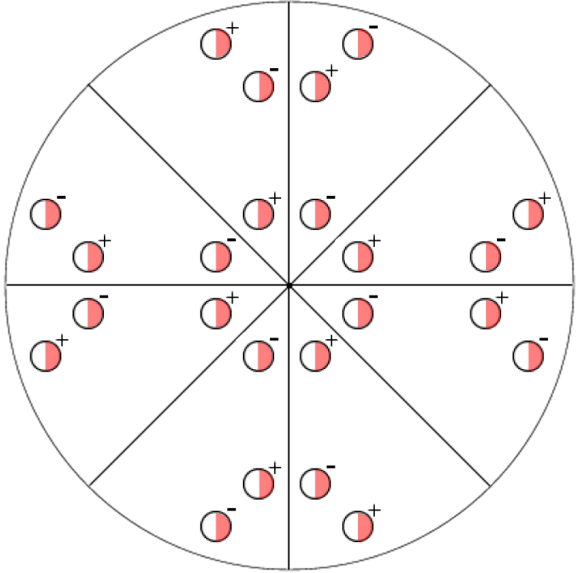
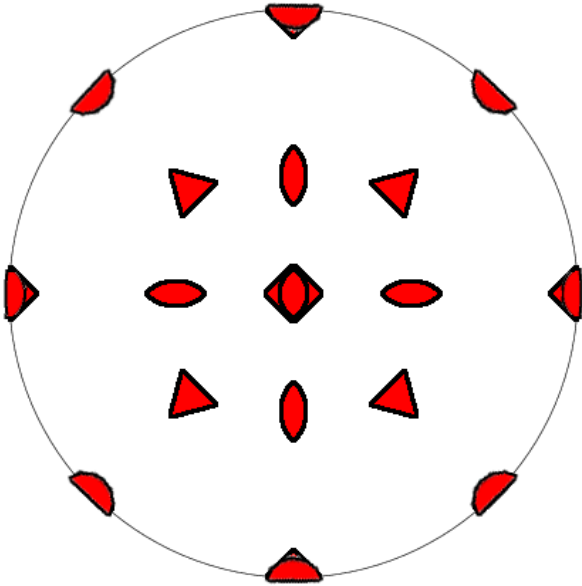
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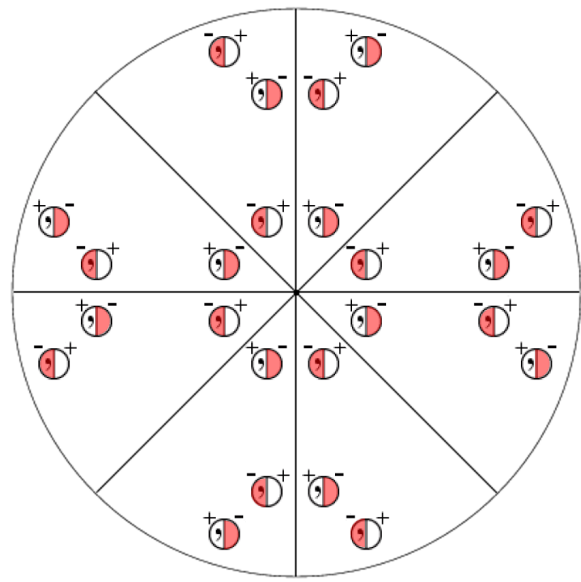
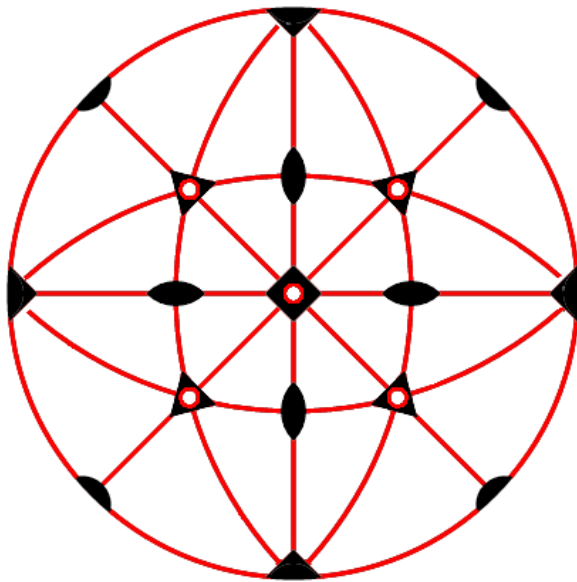
29.4.2.323



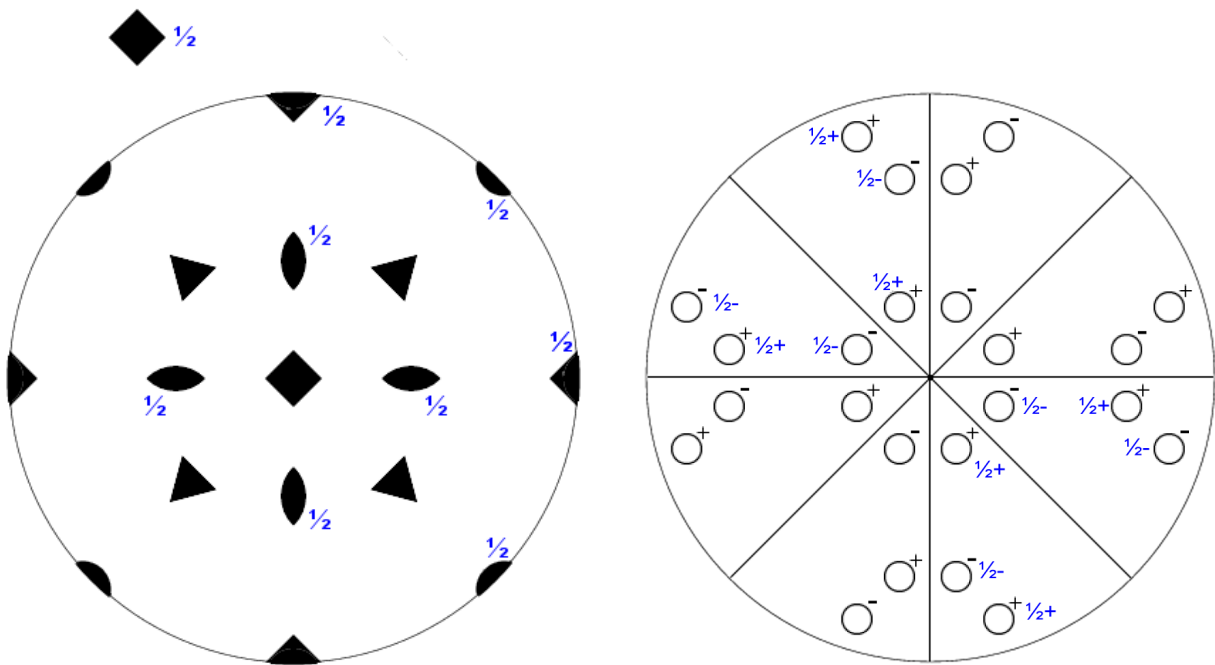
30.1.1.324



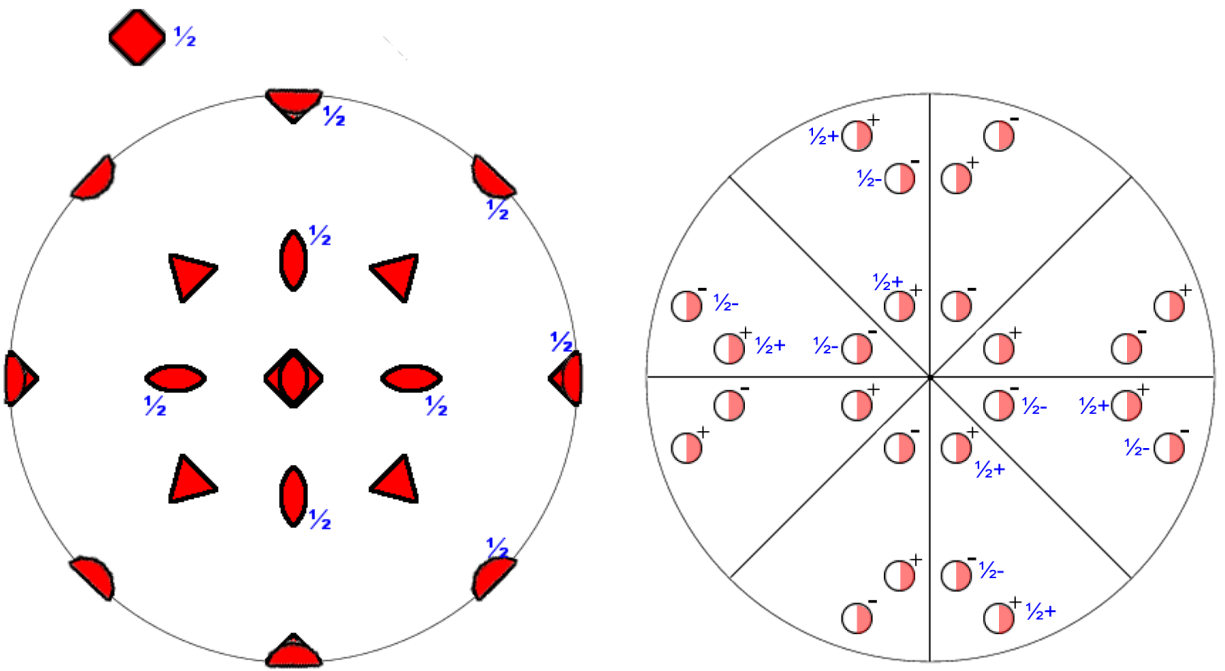
30.1.2.325



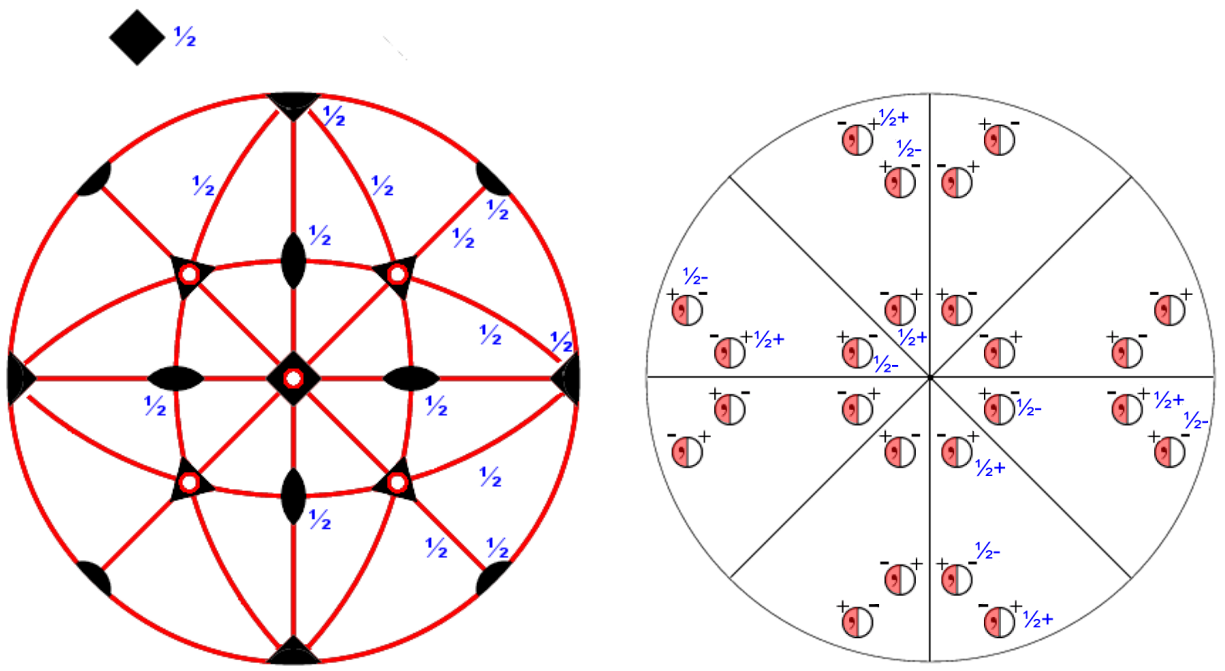
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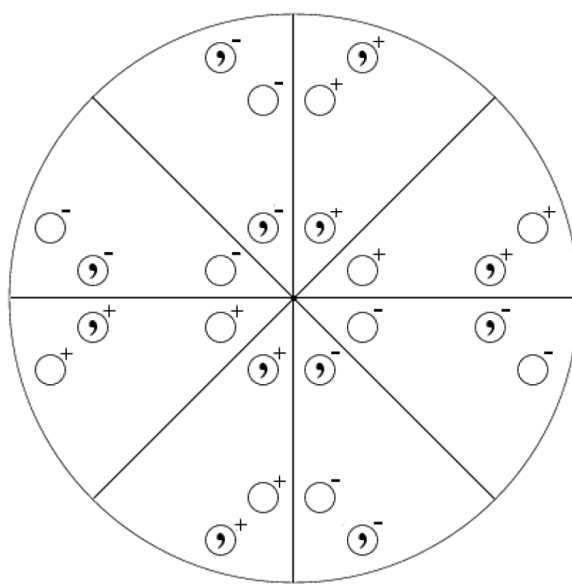
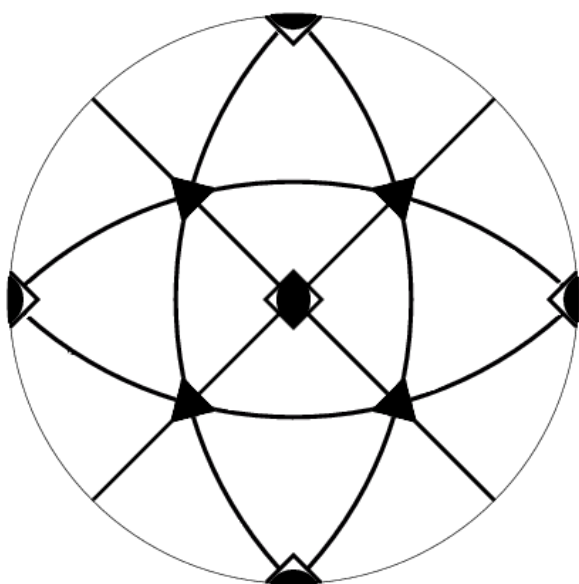
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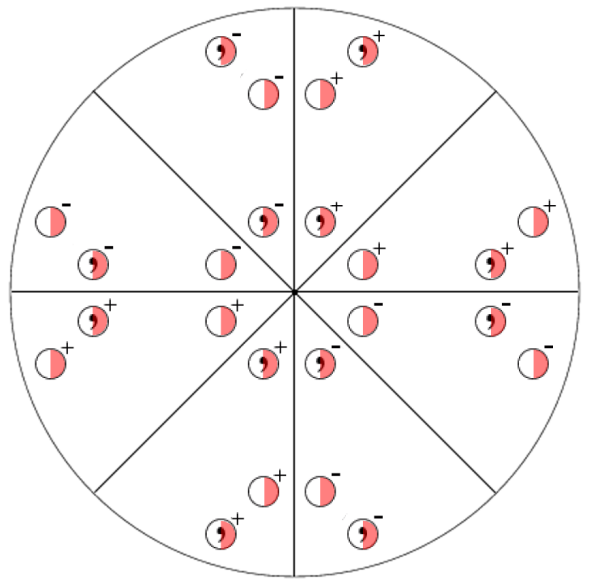
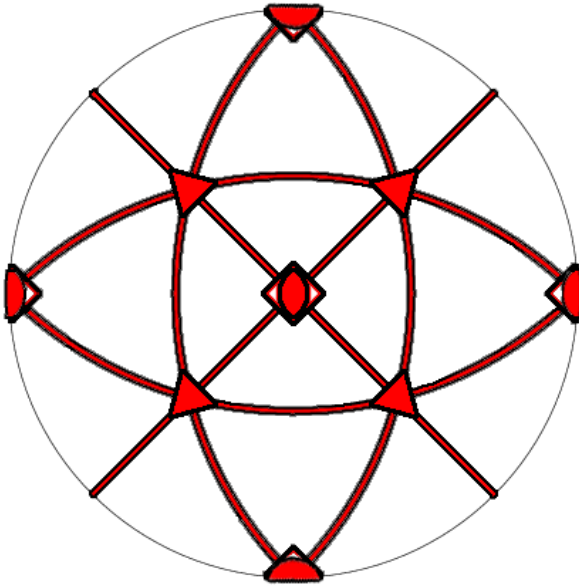
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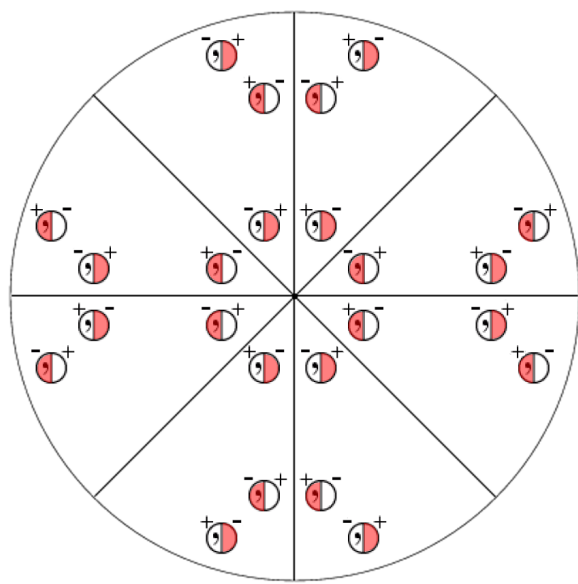
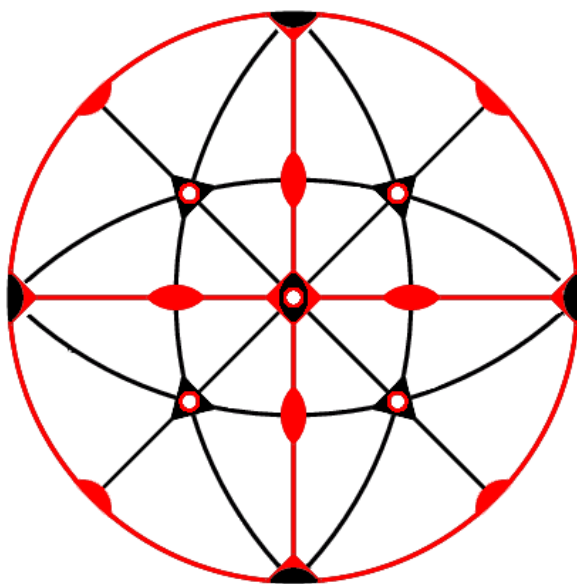
30.2.3.329



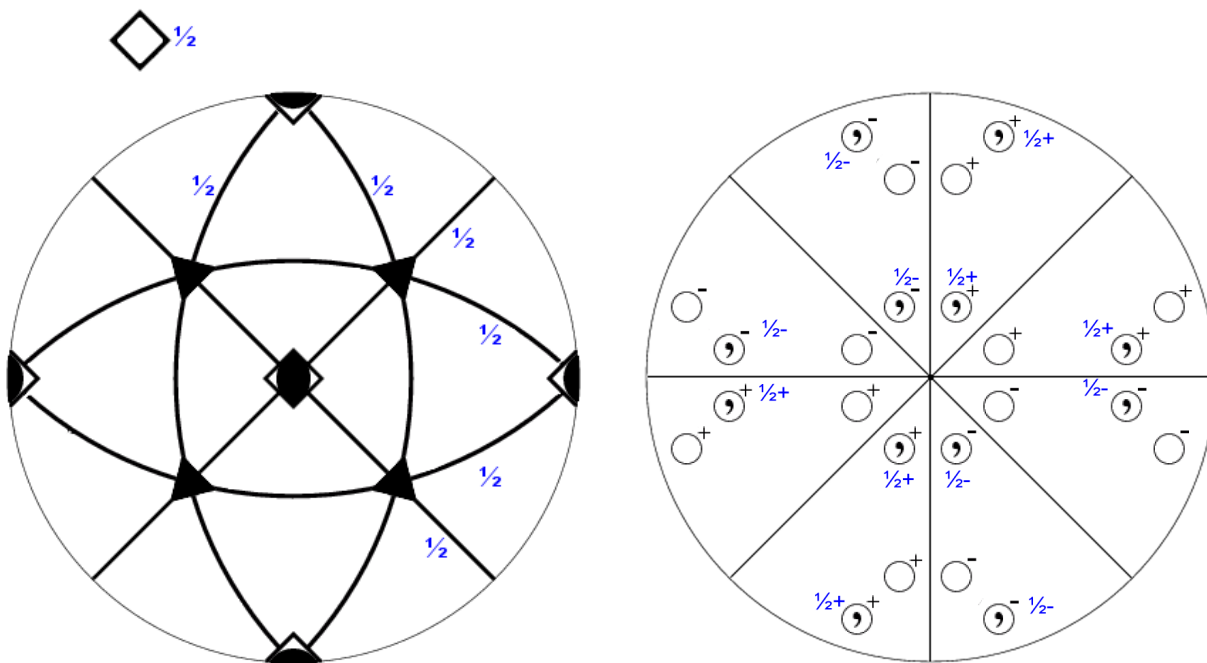
31.1.1.330



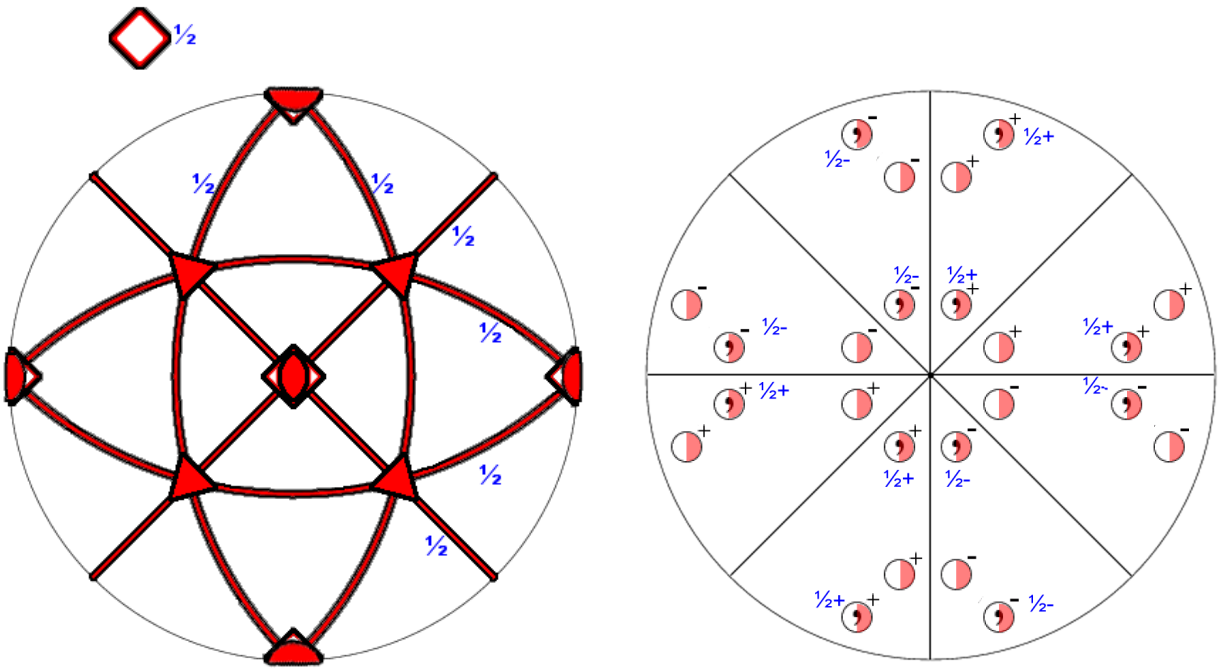
31.1.2.331



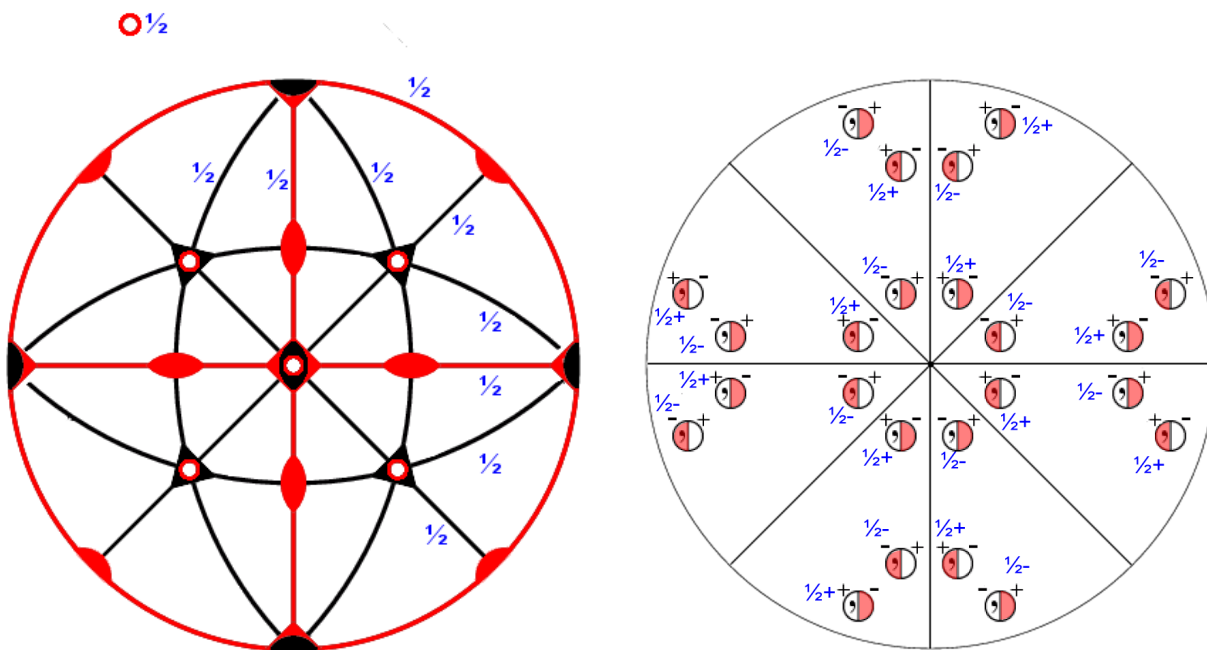
31.1.3.332



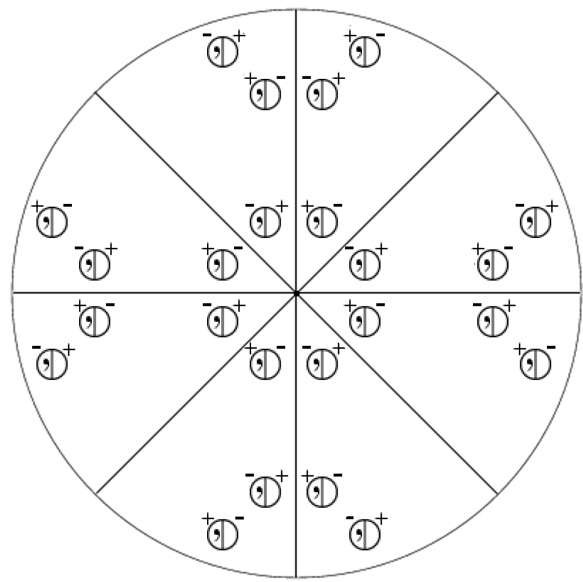
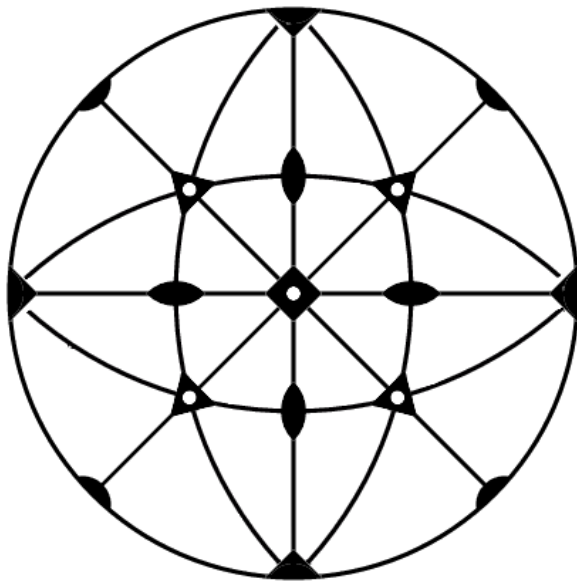
31.2.1.333



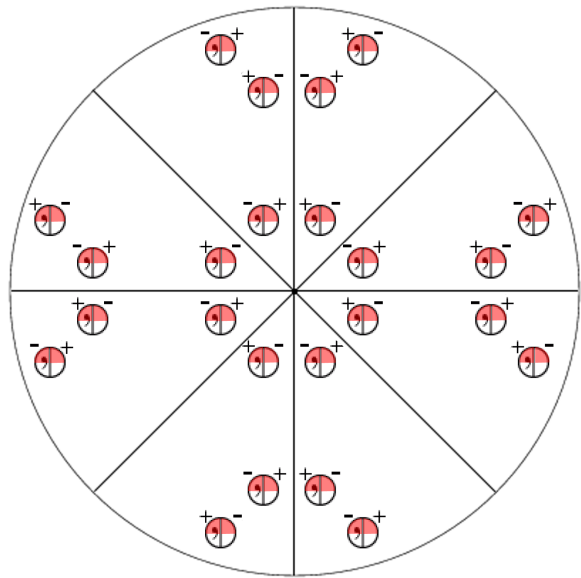
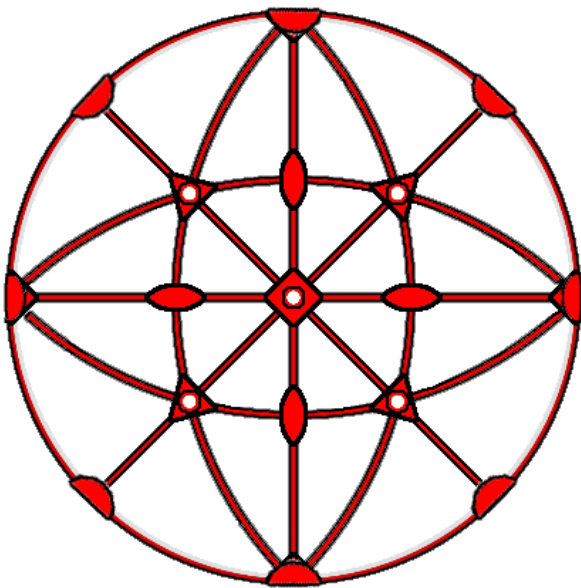
31.2.2.334



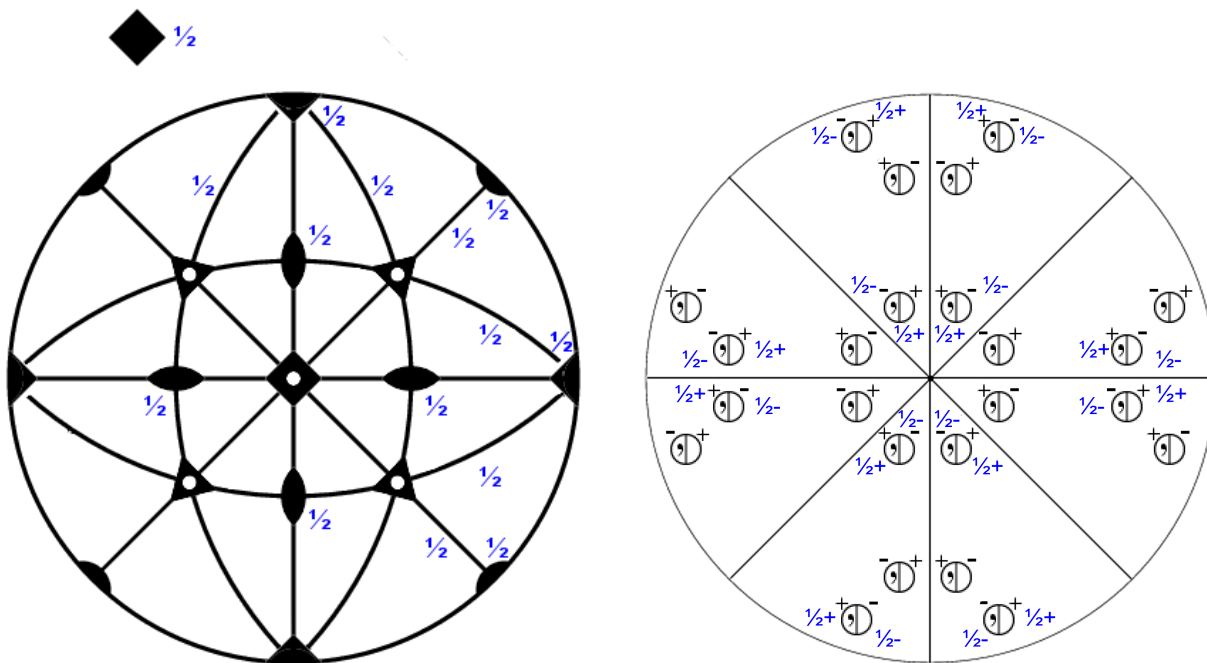
31.2.3.335



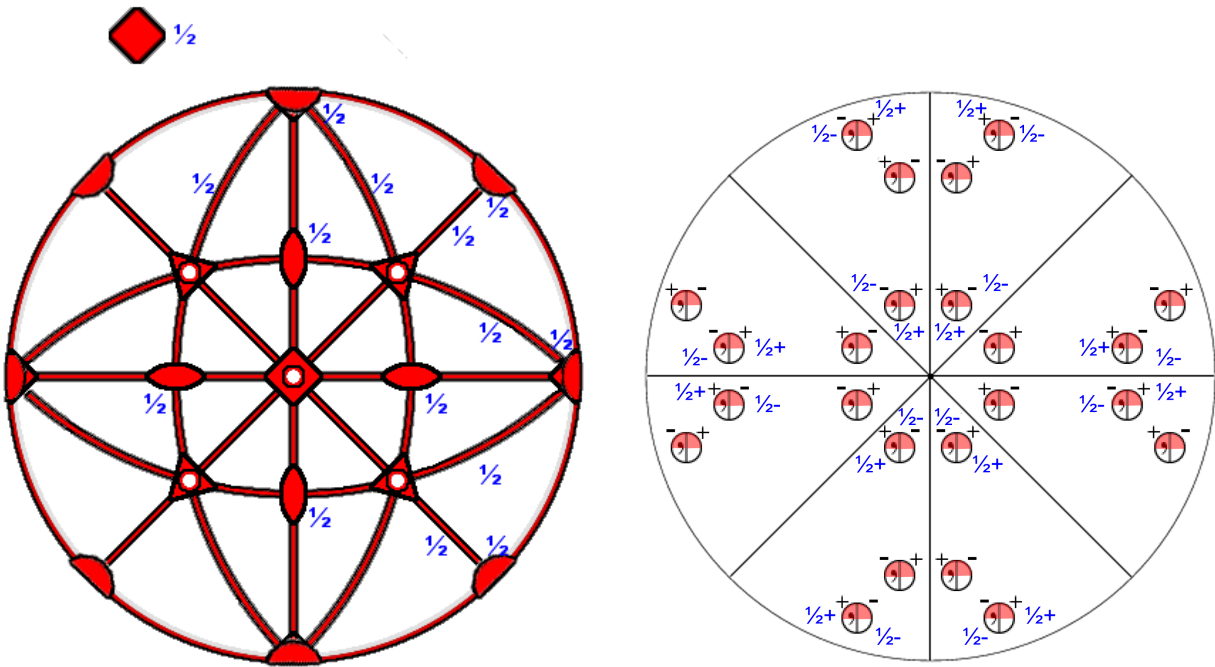
32.1.1.336



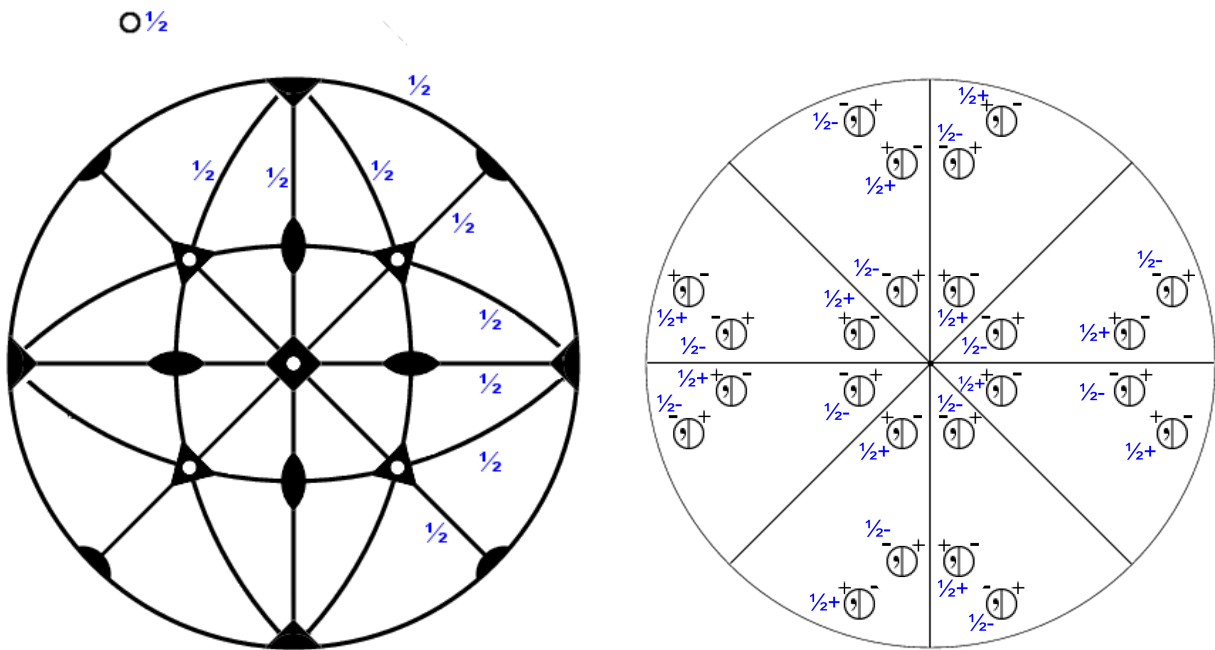
32.1.2.337



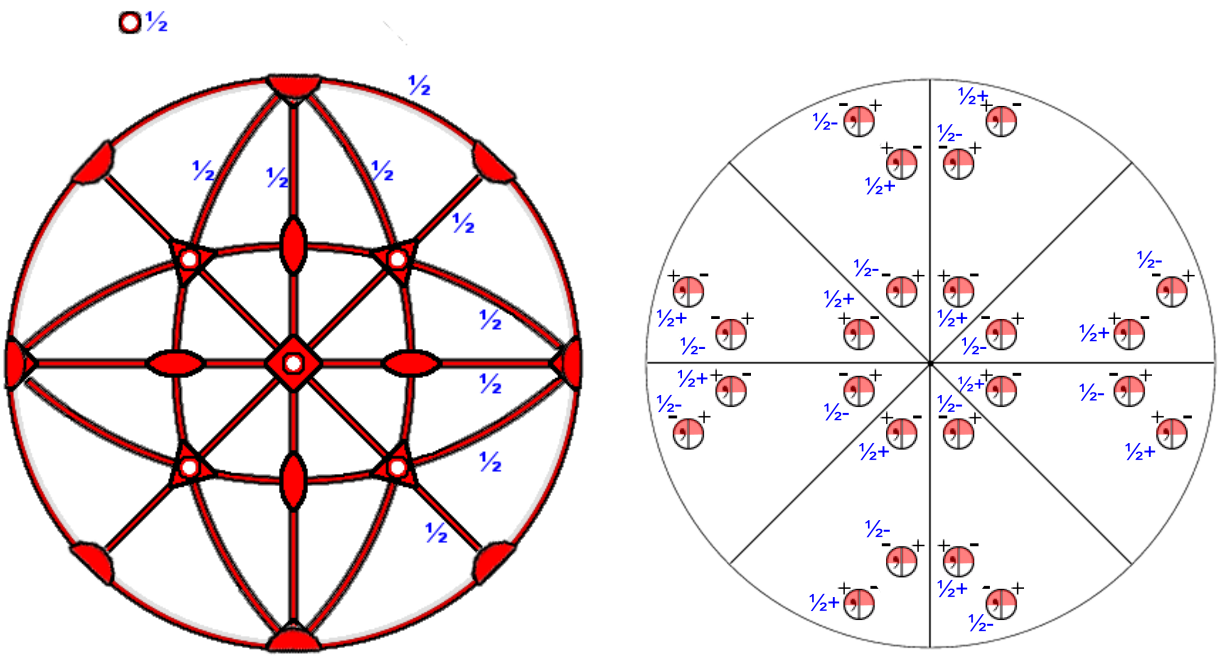
32.2.1.338



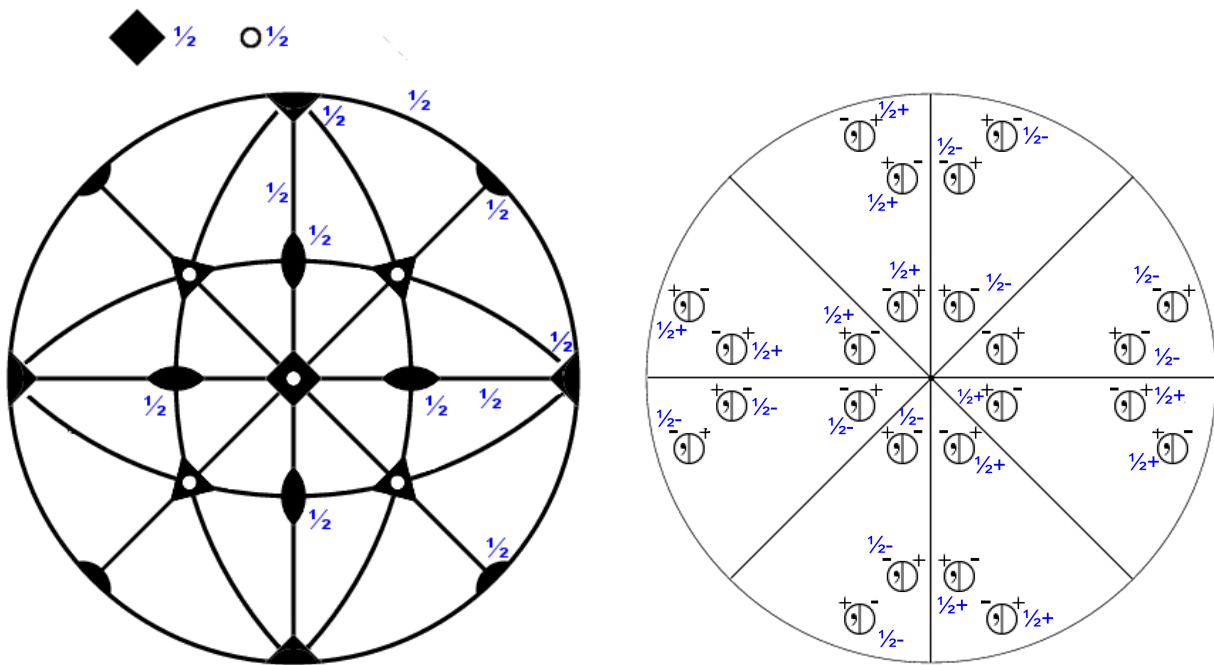
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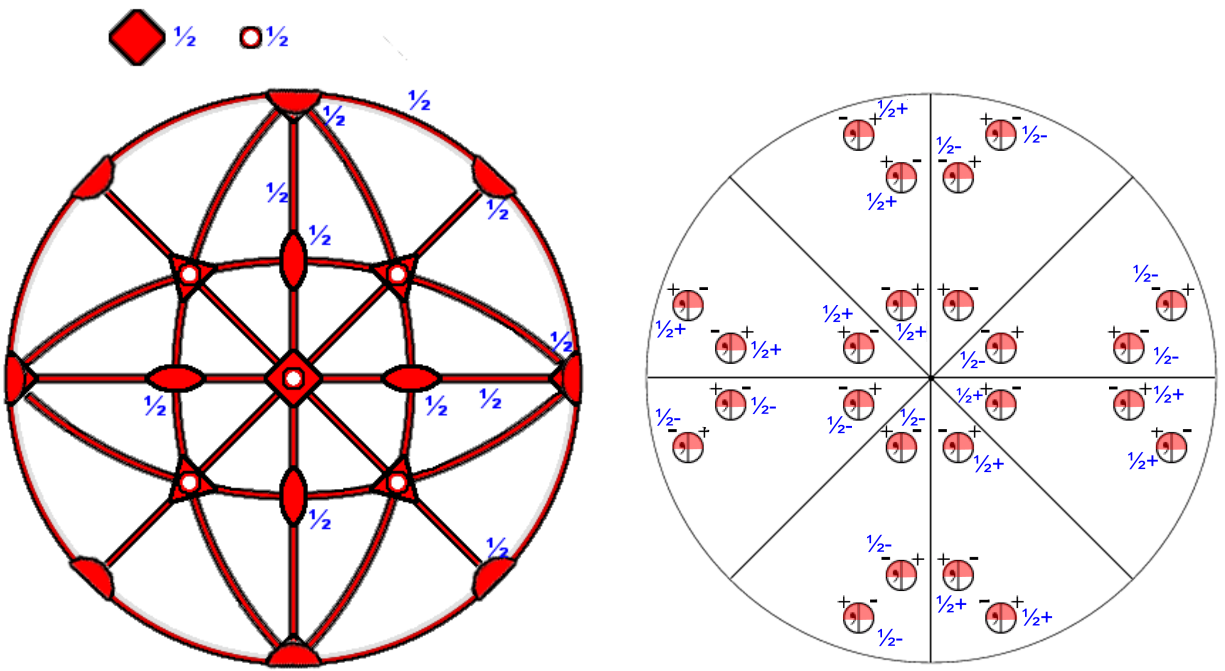
32.3.1.340



32.3.2.341



32.4.1.342



32.4.2.343