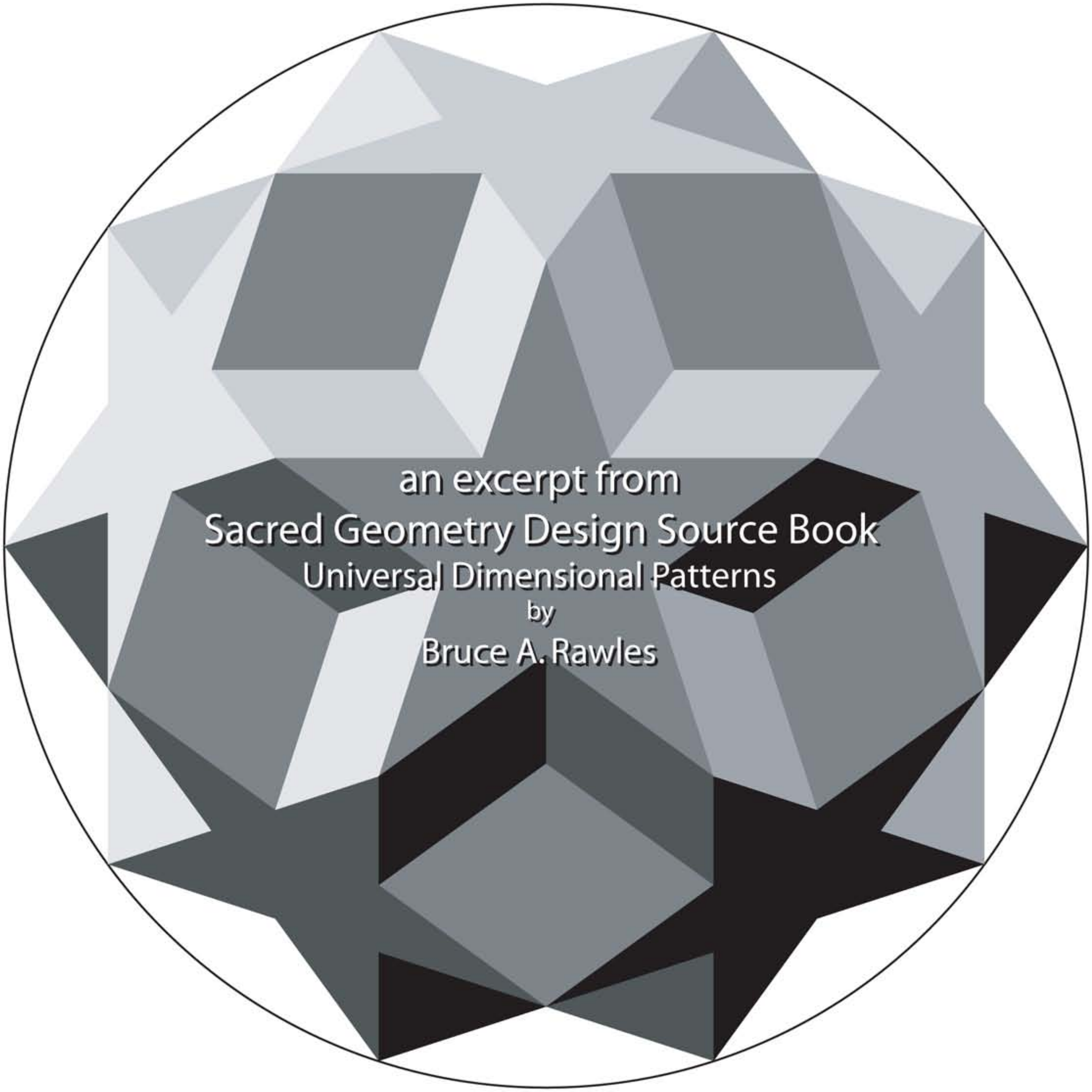
SACRED GEOMETRY DESIGN SOURCEBOOK

Archimedean Solid
Fold Up Patterns

by

Bruce A. Rawles



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Platonic Solids & Archimedean Solids - Construction Suggestions:

To make the fold-up patterns for these polyhedra (the general name for these objects), cut out the large image in the center of the page along the heavy outer lines. Fold along the lighter, inner lines and tape together. To make polyhedra with a given edge size, or to fit inside or outside spheres, scale the images using the side length, circumsphere, or insphere radii, respectively. For example, scale the tetrahedron pattern (3.69" sides) by (4"(2√2)/√3)/3.69" = 1.77 or 177% to fit inside a 4" radius sphere.

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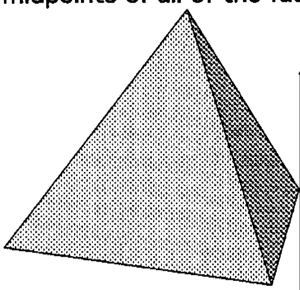
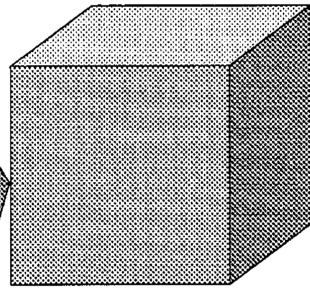
The 5 Platonic Solids

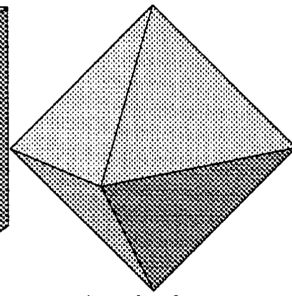
Each of these solids are composed of identical regular polygons. The elements Plato ascribed to each of these are listed underneath the name of each solid. Hedron means surface (or in this context, polygon, and tetra means 4, hexa means 6, octa means 8, dodeca means 12 and icosa means 20; so these are 4, 6, 8, 12 and 20 polygon-sided objects, respectively. The cube and octahedron are duals, meaning that one can be created from the other by connecting the midpoints of all of the faces. The dodecahedron and icosahedron are also duals. The tetrahedron is a dual to itself.



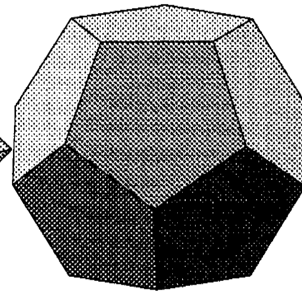
Tetrahedron
fire



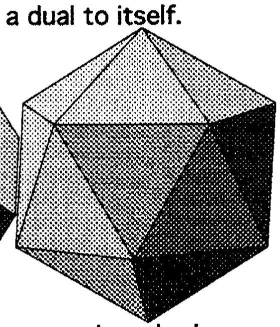
Cube
(Hexahedron)
earth



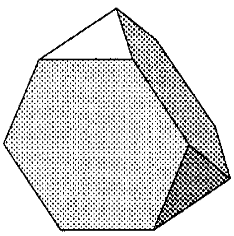
Octahedron
air



Dodecahedron
spirit or ether



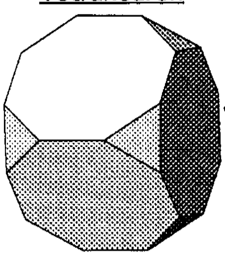
Icosahedron
water



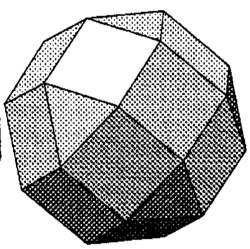
Truncated Tetrahedron

The 13 Archimedean Solids

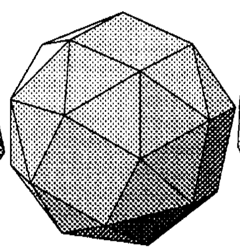
These all have 2 or more types of regular polygons (e.g. triangles & squares).
The truncated tetrahedron shows the "progression" from a tetrahedron to another tetrahedron, since the tetrahedron is a dual to itself, i.e., connecting the midpoints of the faces yields another tetrahedron pointing in the opposite direction from the original.
The row below shows the progression from a hexahedron (cube) to an octahedron.
The bottom row shows the progression from a dodecahedron to an icosahedron, as corners are trimmed off and turned into other regular polygons.



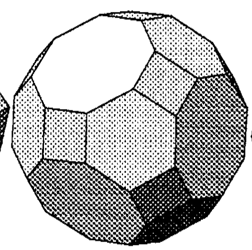
Truncated Cube



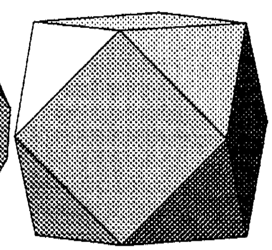
Rhombicub-octahedron



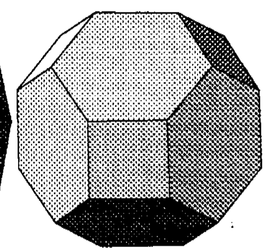
Snub Cube



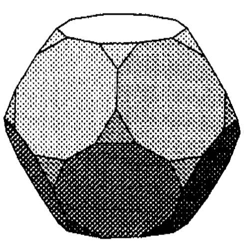
(Rhombi)truncated Cuboctahedron



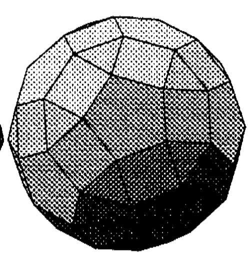
Cuboctahedron (Dymaxion)



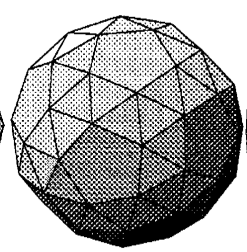
Truncated Octahedron (Mecon)



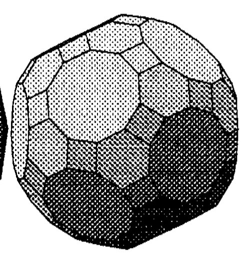
Truncated Dodecahedron



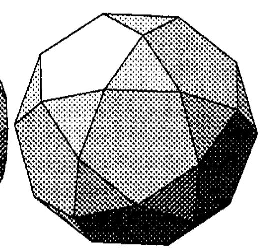
Rhombicosi-dodecahedron



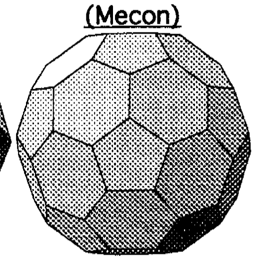
Snub Dodecahedron



(Rhombi)truncated Icosidodecahedron



Icosidodecahedron

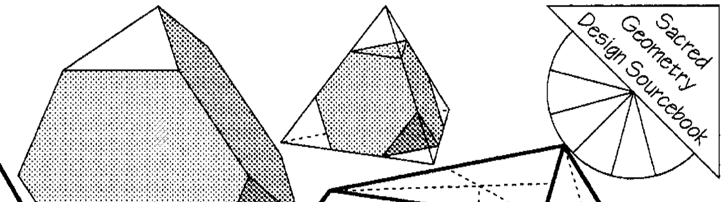


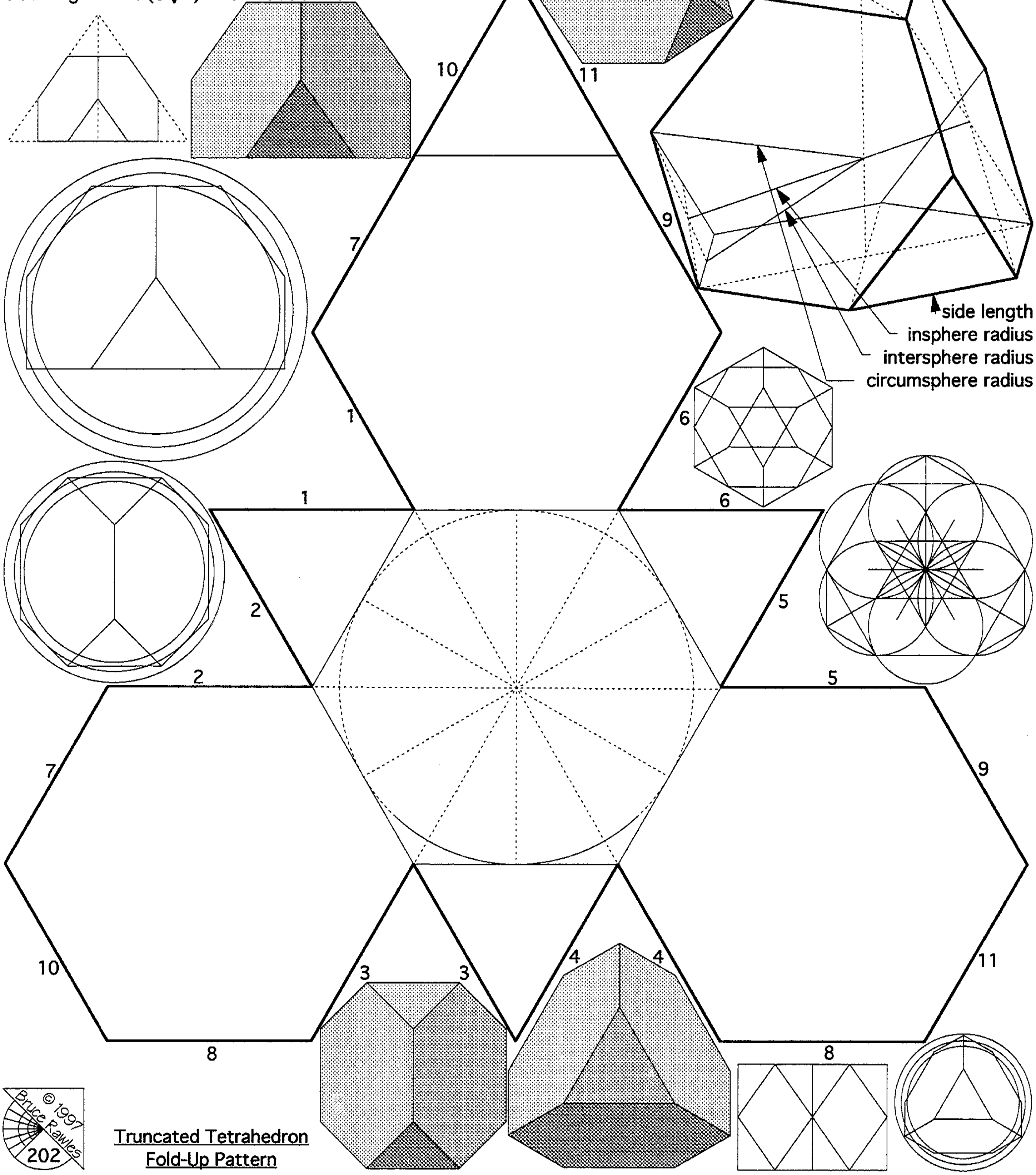
Truncated Icosahedron

The 5 Platonic Solids & 13 Archimedean Solids

These are also known as convex polyhedra, as there are no hollow (concave) places on these shapes.

The truncated tetrahedron has the following relative dimensions (this allows scaling to any size):
circumsphere radius $(\sqrt{11})/3 \approx 1.1055415968$
intersphere radius = 1
insphere radius $3/(\sqrt{11}) \approx .9045340337$
side length = $4/(3\sqrt{2}) \approx .9428090416$





Truncated Tetrahedron
Fold-Up Pattern

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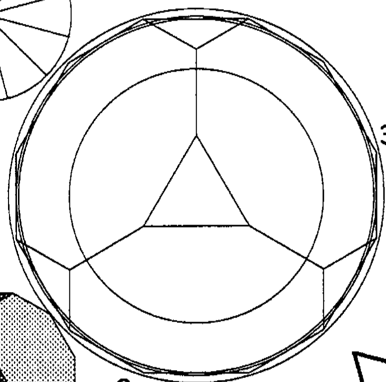
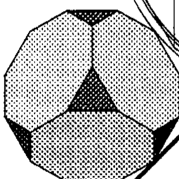
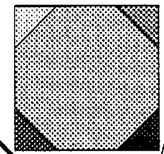
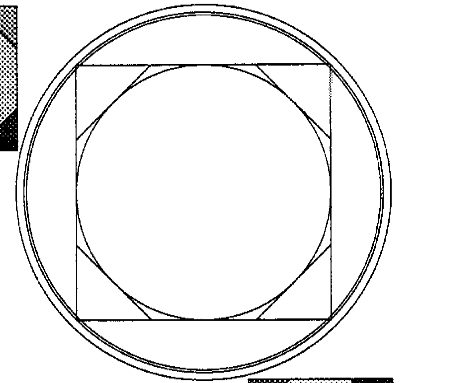
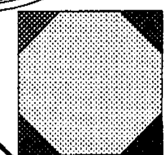
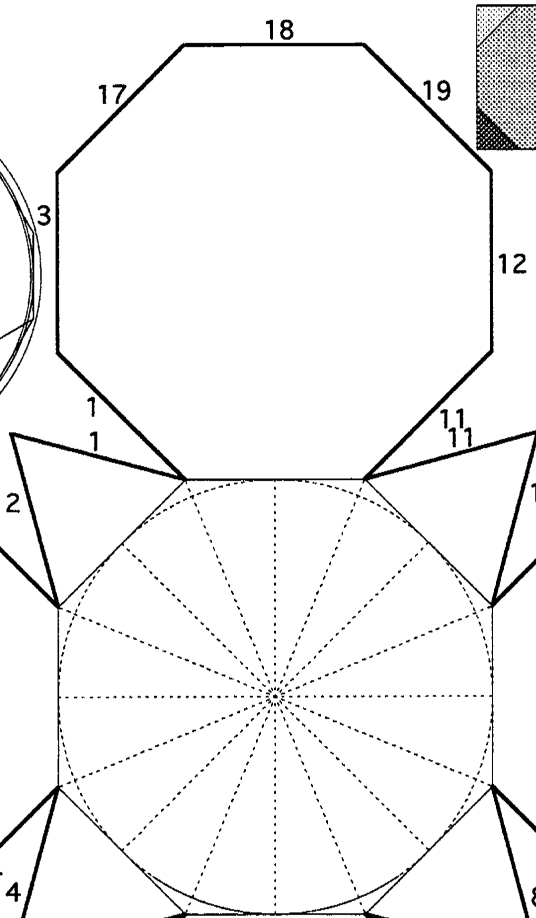


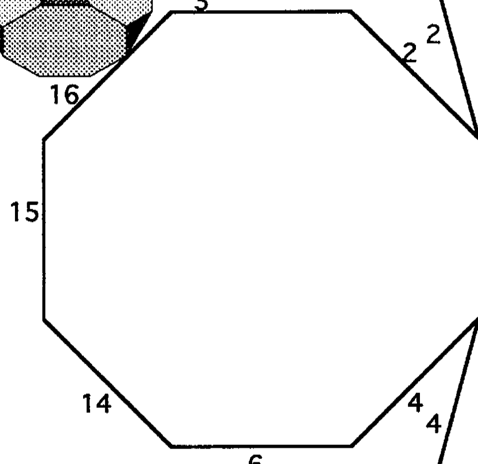


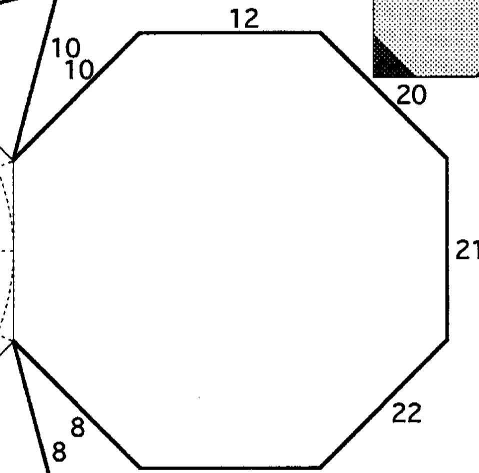












The truncated cube has the following relative dimensions (this allows scaling to any size):

circumsphere radius = (√(7+4√2)) - √((7/2)+2√2)

≈ 1.0420107666

intersphere radius = 1

enclosed sphere radius= √2)/2

≈ .7071067812

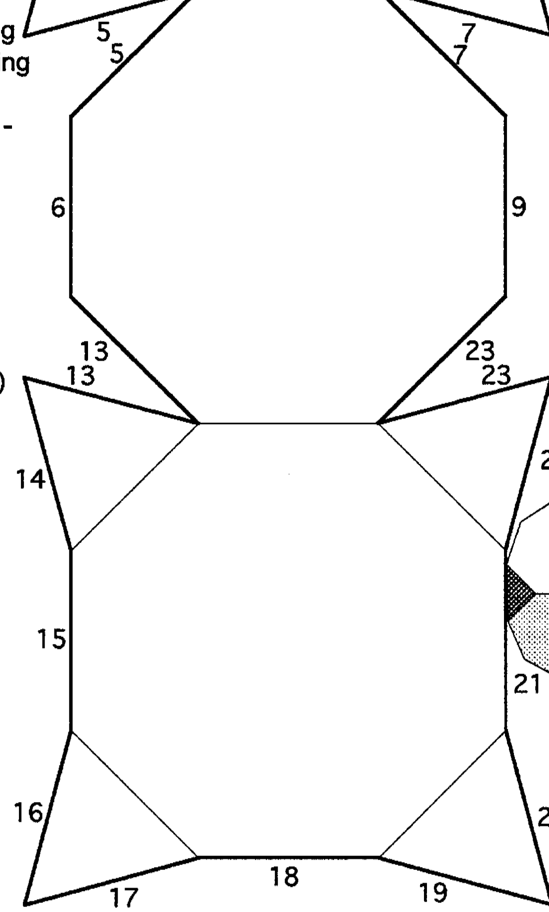
insphere radius =

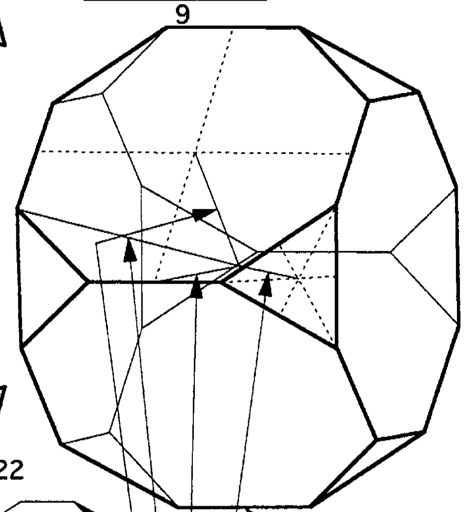
=2(5+2√2)√(7+4√2)/(17(2+√2))

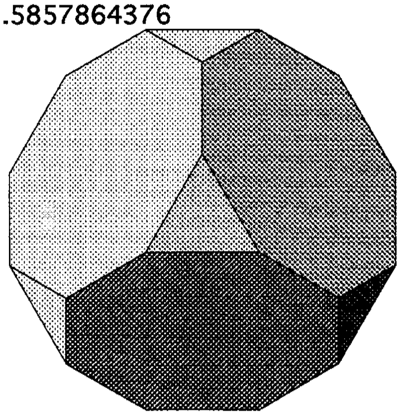
≈ .9596829823

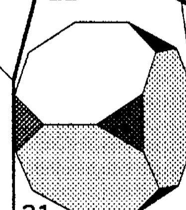
side length = 2-√2

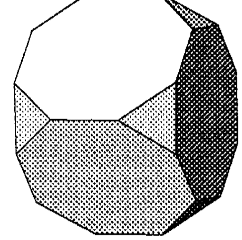
≈ .5857864376



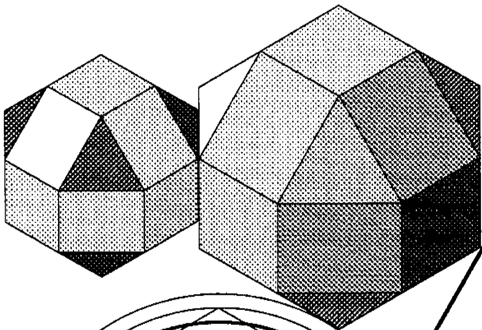


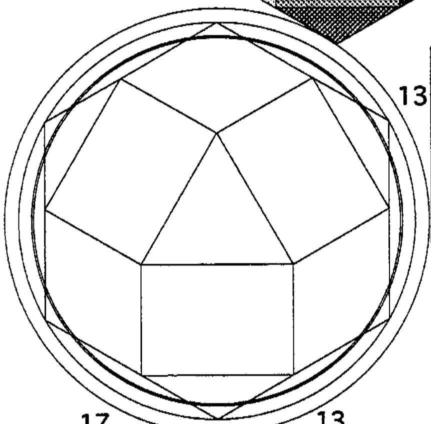


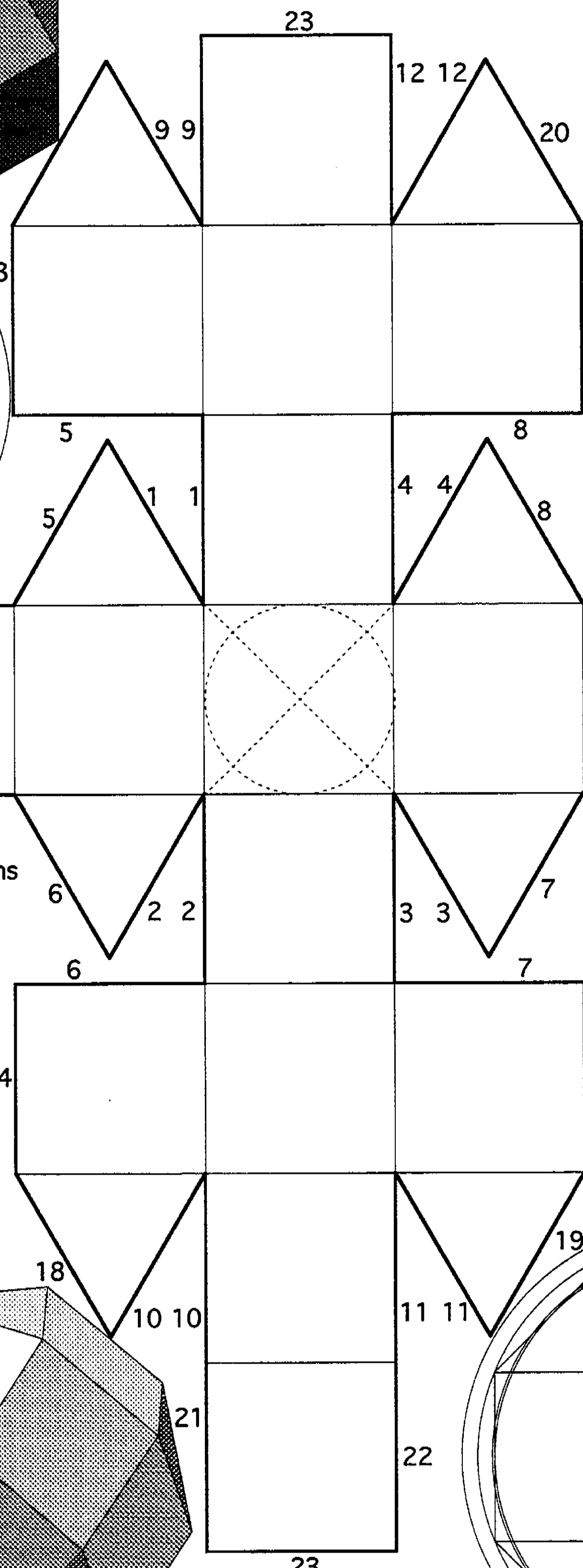


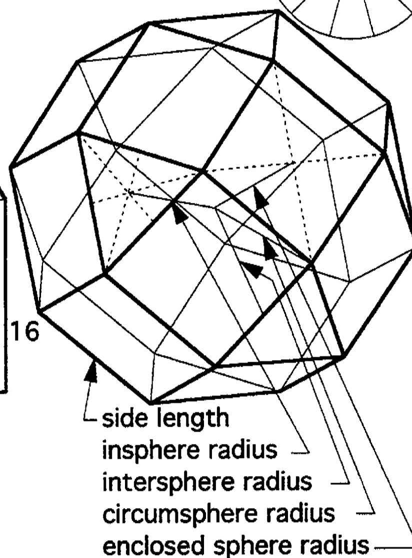


Truncated Cube Fold-Up Pattern









The (small) rhombicuboctahedron has the following relative dimensions (this allows scaling to any size):

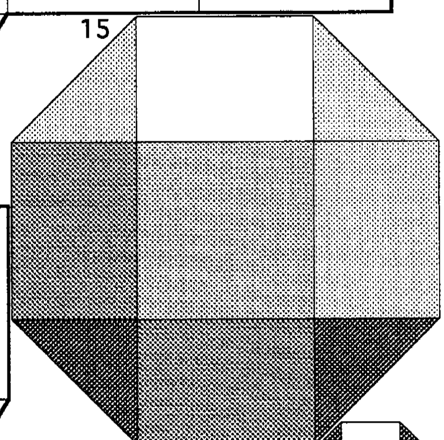
circumsphere radius =
$= \sqrt{((5/2)+\sqrt{2})}/\sqrt{(2+\sqrt{2})}$
≈ 1.0707224707

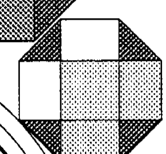
intersphere radius = 1

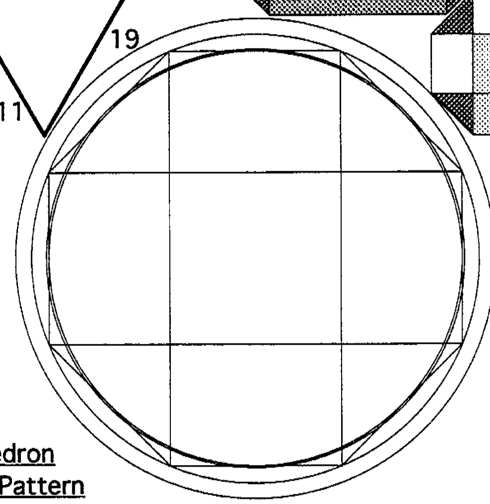
enclosed sphere radius
$= (1+(\sqrt{2})/2)/\sqrt{(2+\sqrt{2})}$
$\approx .9238795325$

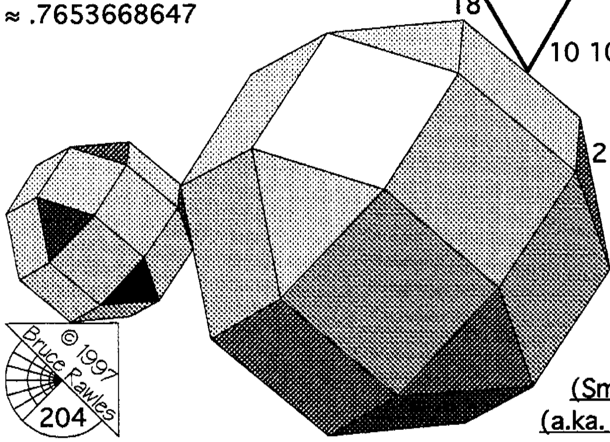
insphere radius
$= \sqrt{(2+\sqrt{2})}/\sqrt{((5/2)+\sqrt{2})}$
$\approx .9339488311$

side length $= (2\sqrt{2})/(2\sqrt{(2+\sqrt{2})})$
$\approx .7653668647$





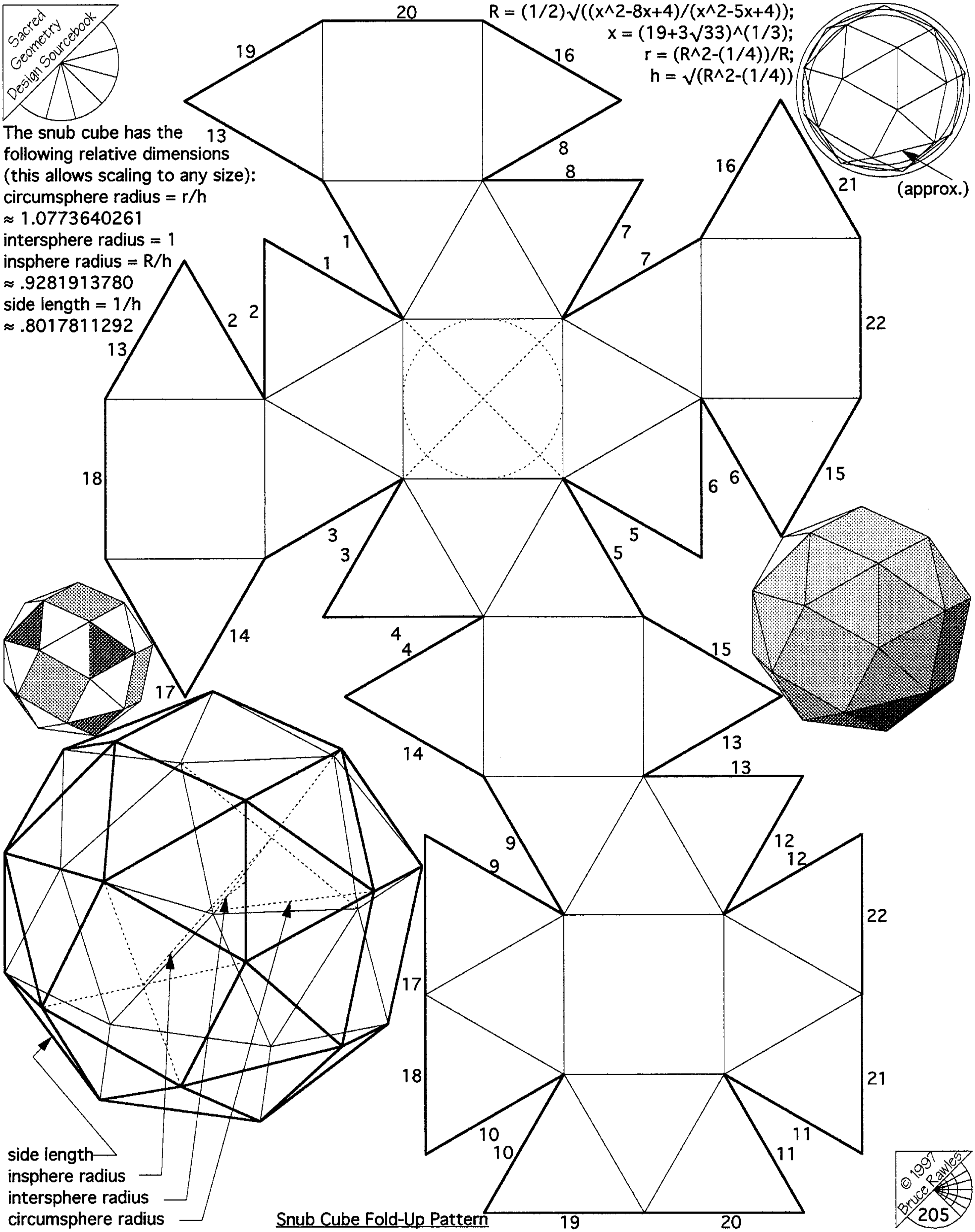




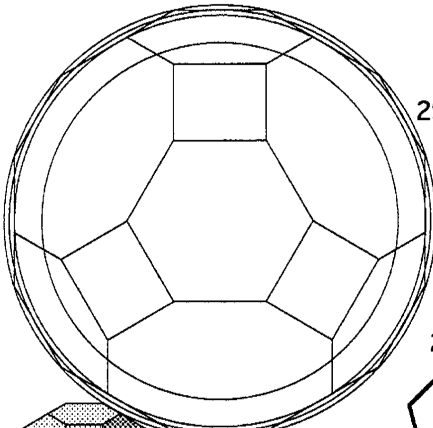
(Small) Rhombicuboctahedron
(a.ka. Square Spin) Fold-Up Pattern

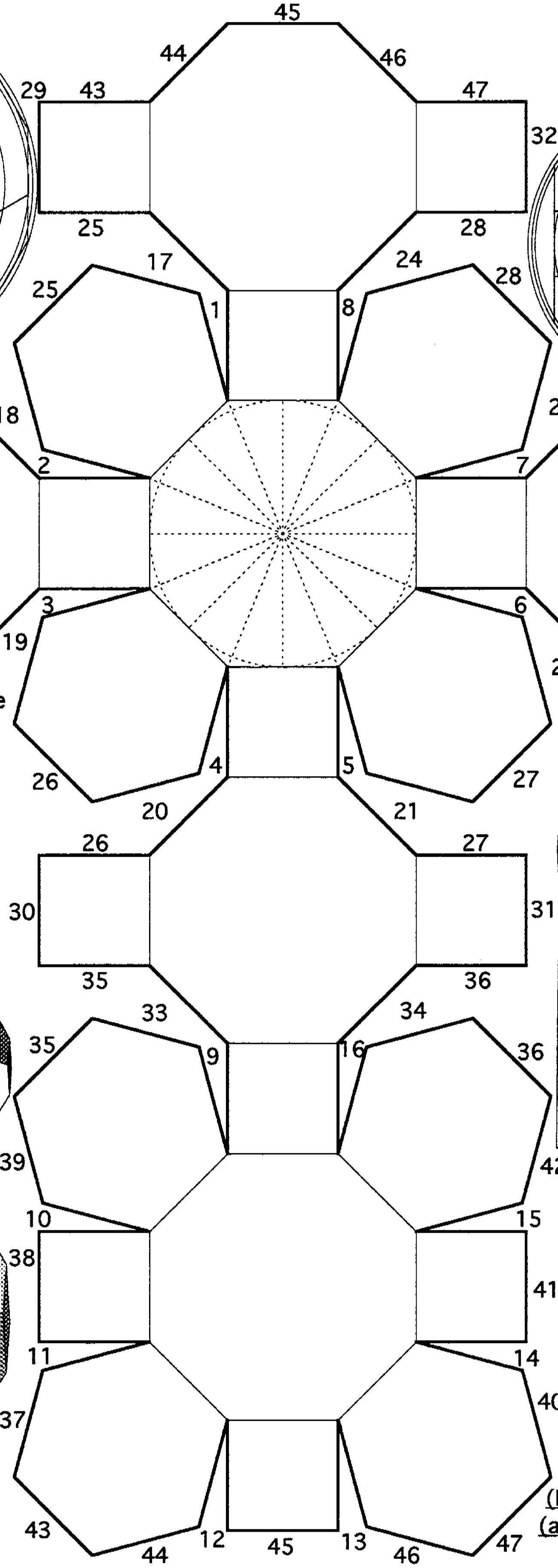
$R = (1/2)\sqrt{(x^2-8x+4)/(x^2-5x+4)}$;
$x = (19+3\sqrt{33})^{(1/3)}$;
$r = (R^2-(1/4))/R$;
$h = \sqrt{R^2-(1/4)}$

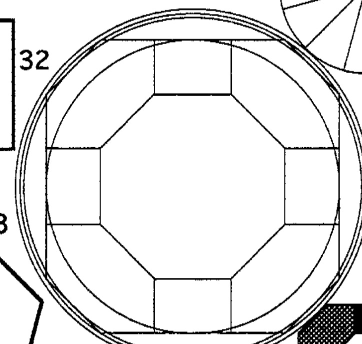
The snub cube has the following relative dimensions (this allows scaling to any size):
circumsphere radius = r/h
≈ 1.0773640261
intersphere radius = 1
insphere radius = R/h
≈ .9281913780
side length = 1/h
≈ .8017811292

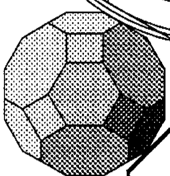


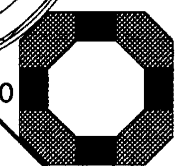
Snub Cube Fold-Up Pattern

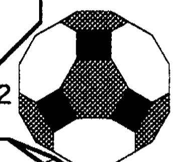












The (rhombi) truncated cuboctahedron has the following relative dimensions (this allows scaling to any size):

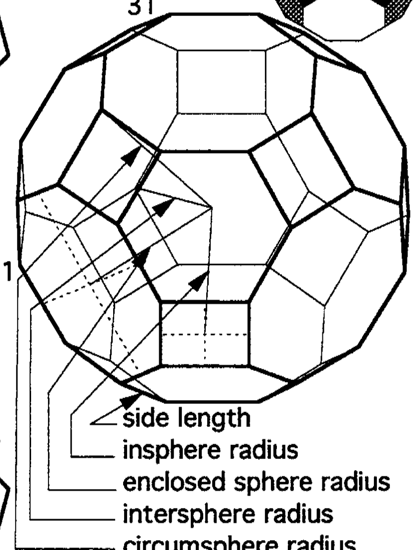
circumsphere radius
$= \sqrt{((13/2)+3\sqrt{2})} / \sqrt{(6 + 3\sqrt{2})}$
≈ 1.0241169545

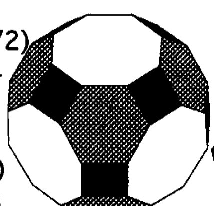
intersphere radius = 1

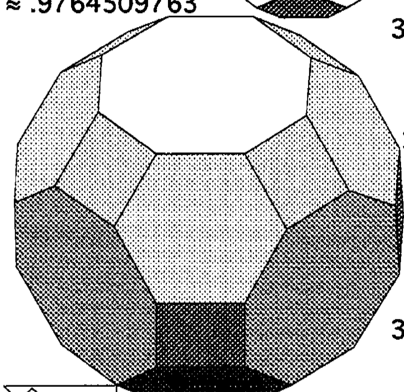
enclosed sphere radius
$= (2+(\sqrt{2})/2) / \sqrt{(6 + 3\sqrt{2})}$
$\approx .8458618109$

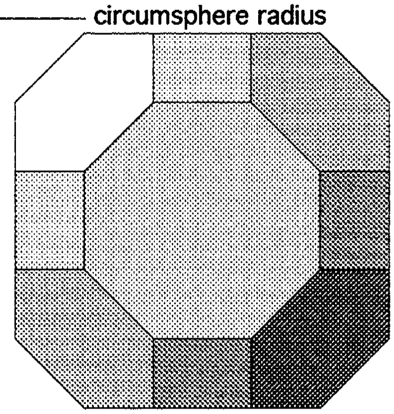
side length
$= \sqrt{2} / \sqrt{(6 + 3\sqrt{2})}$
$\approx .4418847654$

insphere radius
$= \sqrt{(6 + 3\sqrt{2})} / \sqrt{((13/2)+3\sqrt{2})}$
$\approx .9764509763$

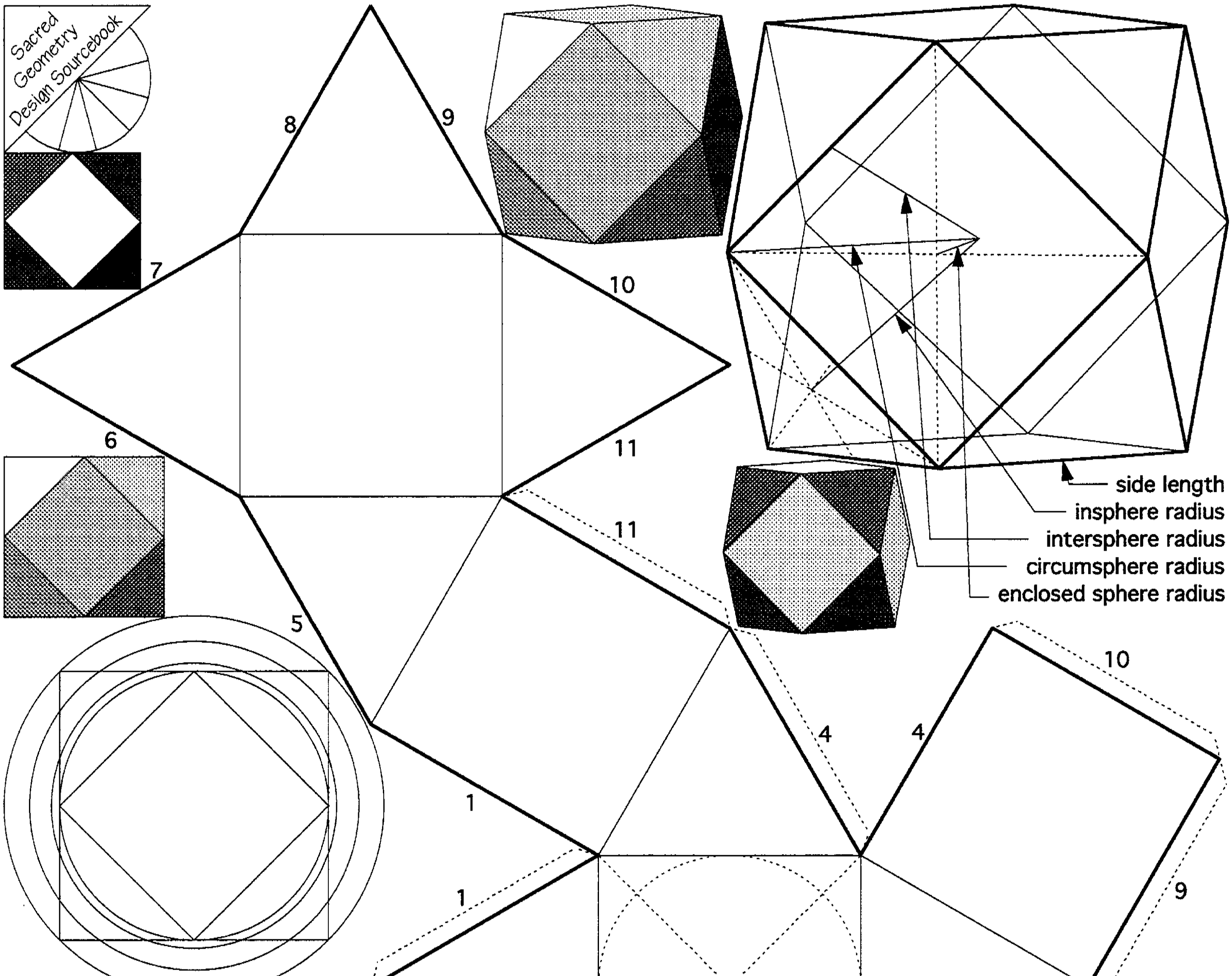




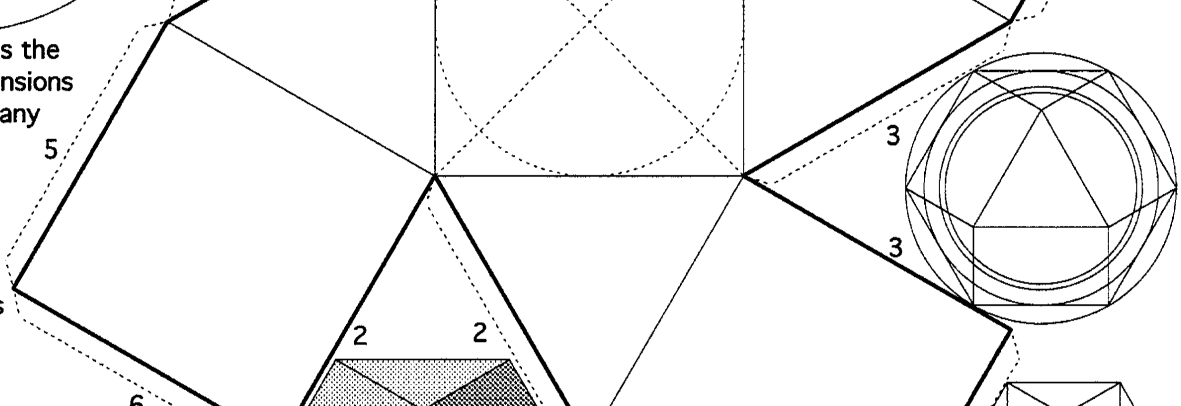


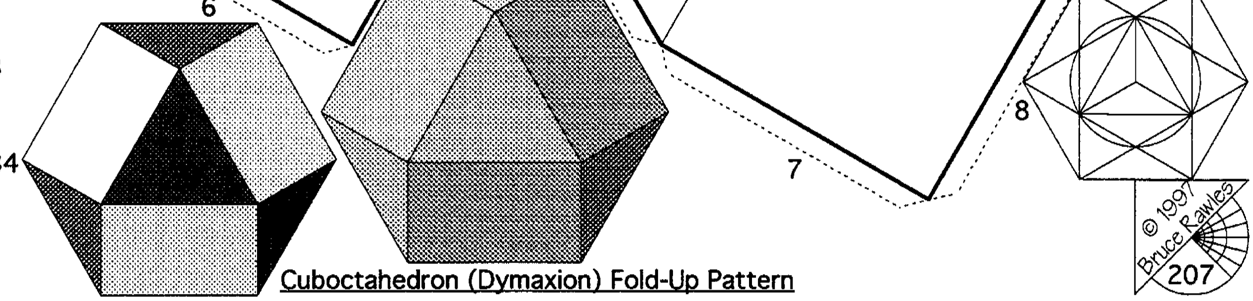


(Rhombi)truncated Cuboctahedron
(a.k.a. Great Rhombicuboctahedron)
Fold-Up Pattern

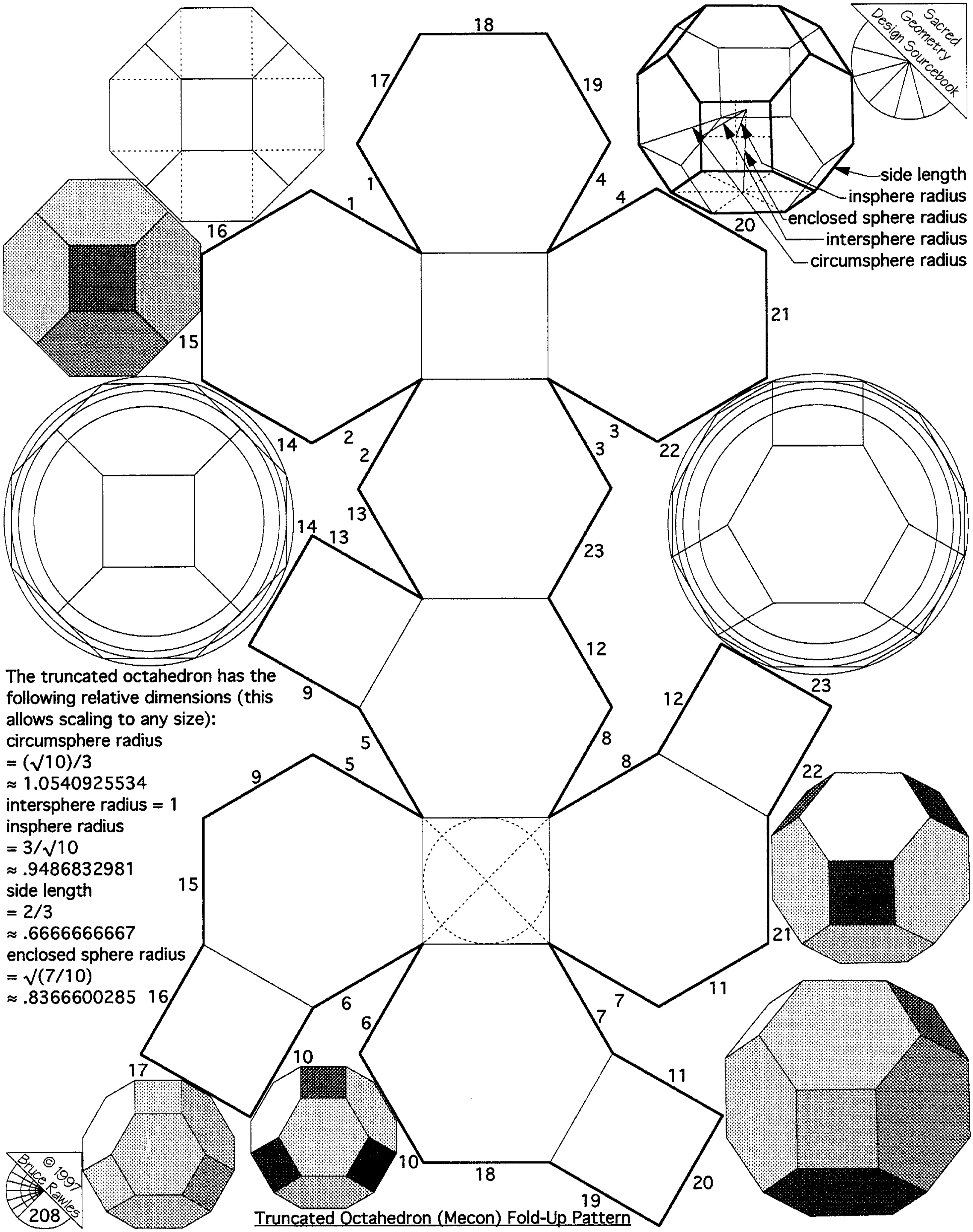


The cuboctahedron has the following relative dimensions (this allows scaling to any size):
circumsphere radius
= 2/(√3)
≈ 1.1547005384
intersphere radius = 1
enclosed sphere radius
= √(2/3)
≈ .8164965809
insphere radius
= (√3)/2
≈ .8660254038
side length
= 2/(√3)
≈ 1.1547005384





Cuboctahedron (Dymaxion) Fold-Up Pattern



The truncated octahedron has the following relative dimensions (this allows scaling to any size):

circumsphere radius
$= (\sqrt{10})/3$
≈ 1.0540925534

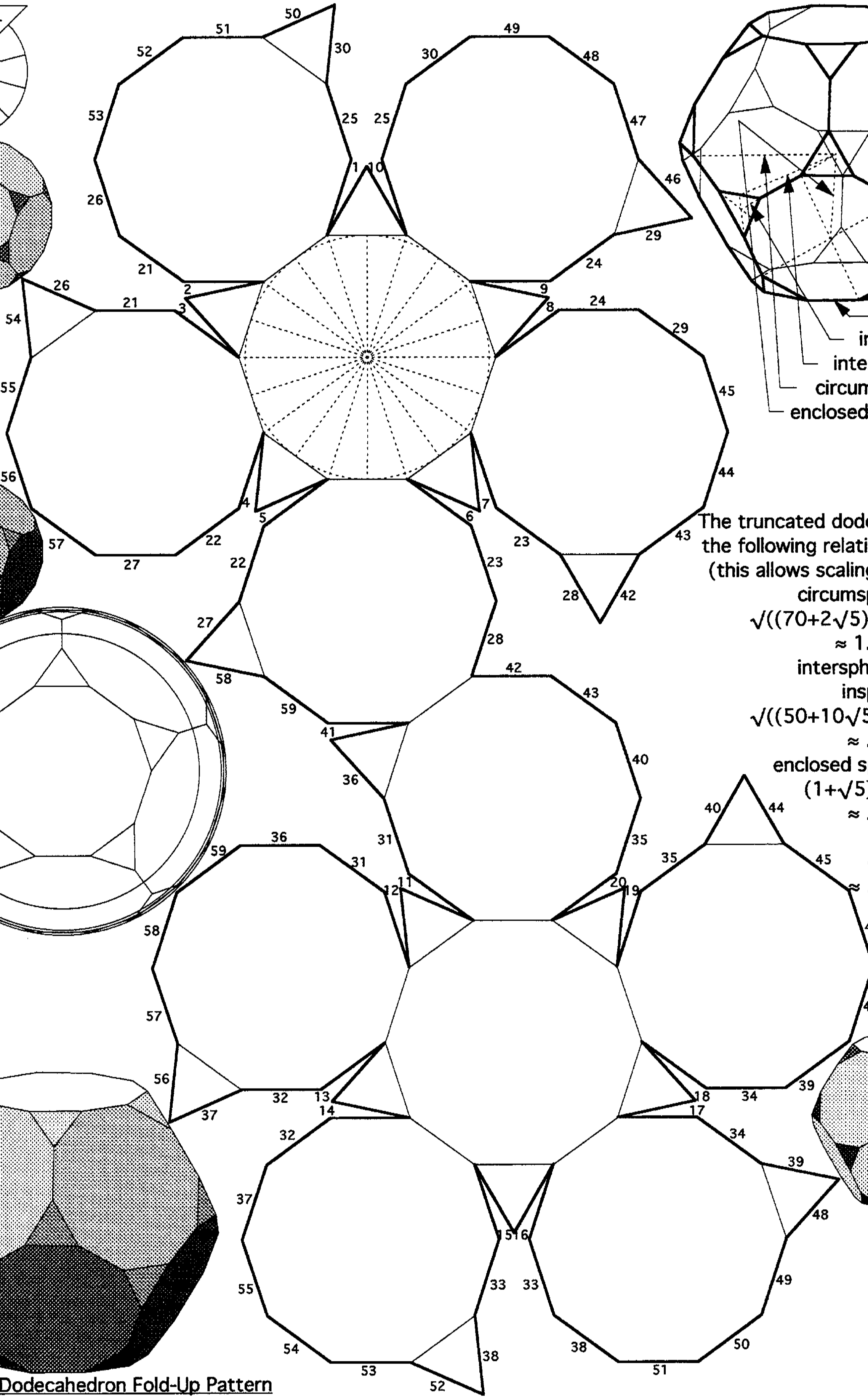
intersphere radius = 1

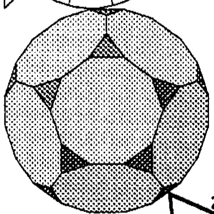
insphere radius
$= 3/\sqrt{10}$
$\approx .9486832981$

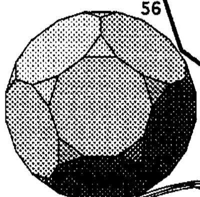
side length
$= 2/3$
$\approx .6666666667$

enclosed sphere radius
$= \sqrt{(7/10)}$
$\approx .8366600285$

Truncated Octahedron (Mecon) Fold-Up Pattern







The truncated dodecahedron has the following relative dimensions (this allows scaling to any size):

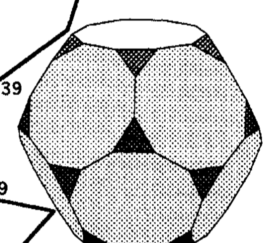
circumsphere radius = $\sqrt{((70+2\sqrt{5})/(50+10\sqrt{5}))}$
≈ 1.0144848973

intersphere radius = 1

insphere radius = $\sqrt{((50+10\sqrt{5})/(70+2\sqrt{5}))}$
$\approx .9857219193$

enclosed sphere radius = $(1+\sqrt{5})/\sqrt{(10+2\sqrt{5})}$
$\approx .8506508084$

side length = $(3(\sqrt{5})/5) - 1$
$\approx .3416407865$



Truncated Dodecahedron Fold-Up Pattern

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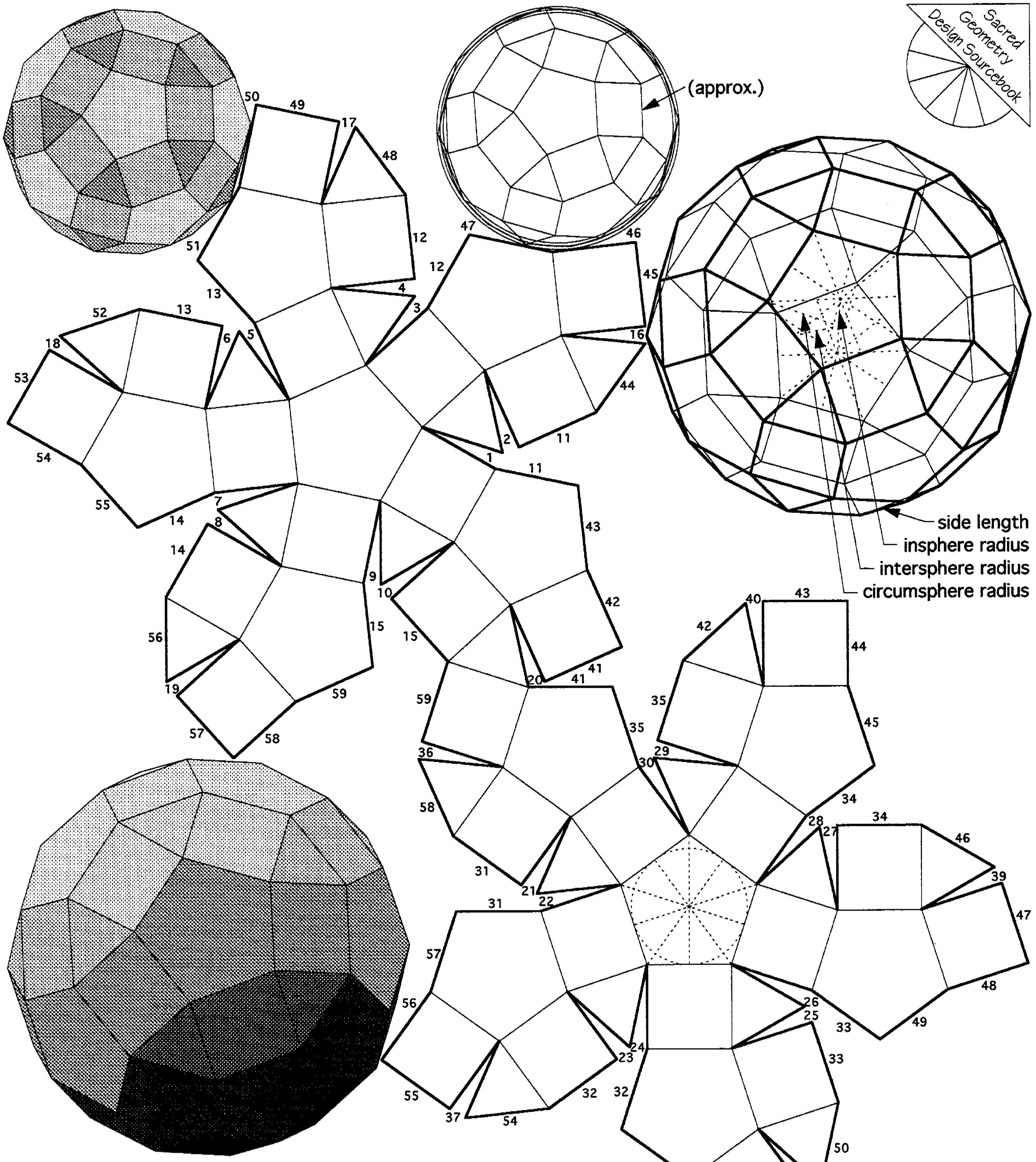
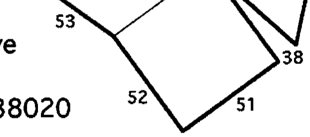




The (small) rhombicosidodecahedron has the following relative dimensions (this allows scaling to any size):

circumsphere radius = $\sqrt{((11+4\sqrt{5})/(10+4\sqrt{5}))} \approx 1.0260538020$

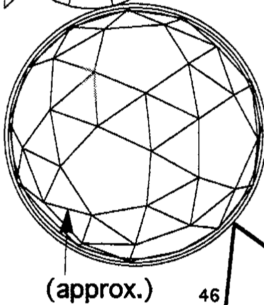
intersphere radius = 1

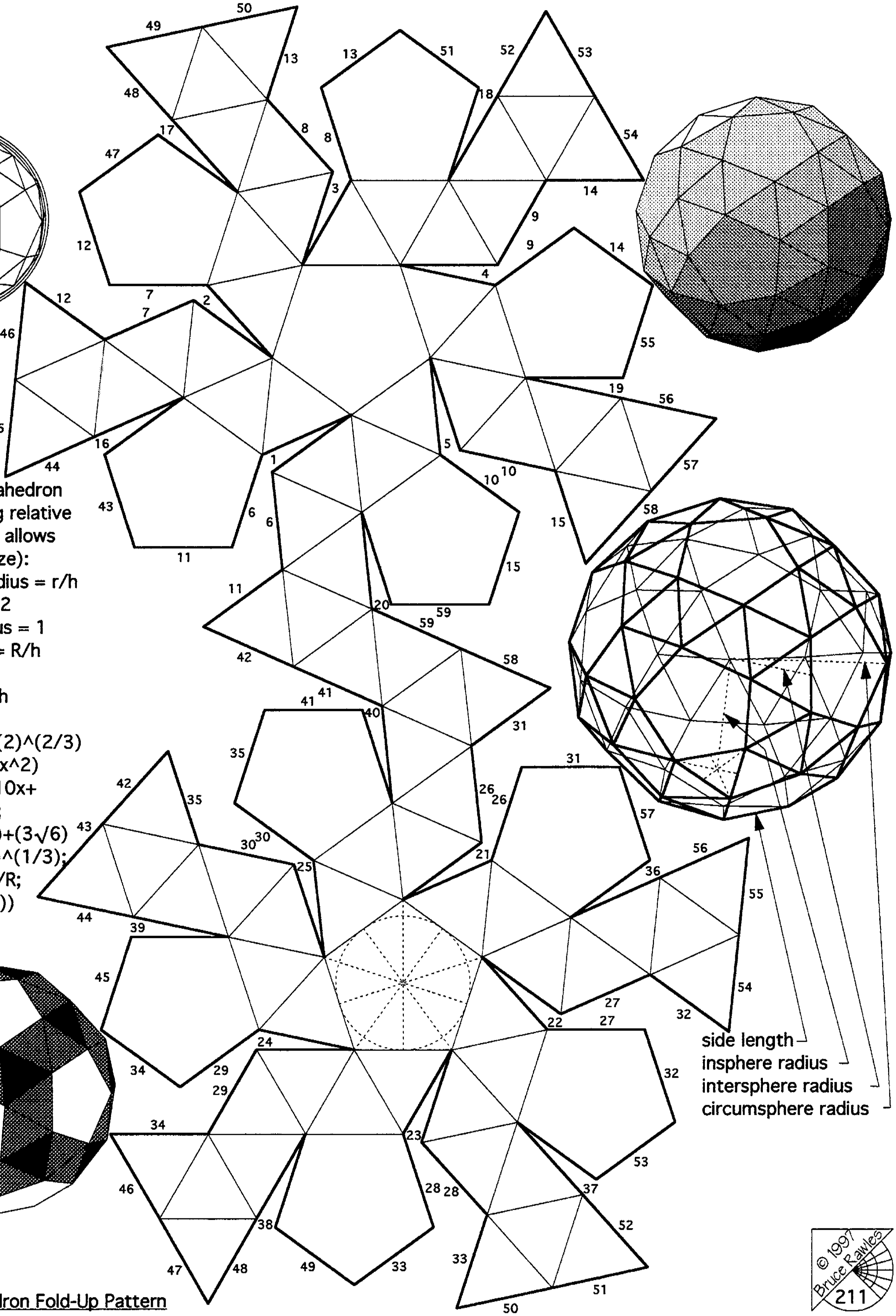
insphere radius = $\sqrt{((10+4\sqrt{5})/(11+4\sqrt{5}))} \approx .9746077624$

side length = $2/\sqrt{(10+4\sqrt{5})} \approx .4595058411$

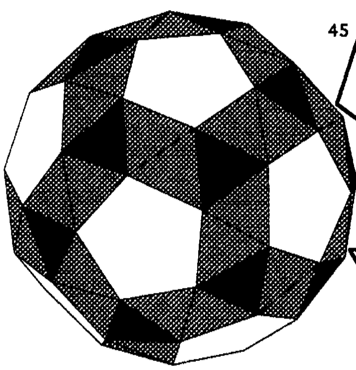
(Small) Rhombicosidodecahedron

Fold-Up Pattern

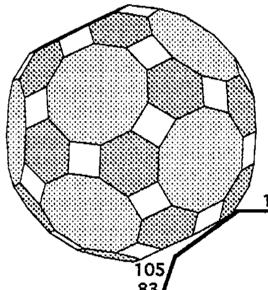


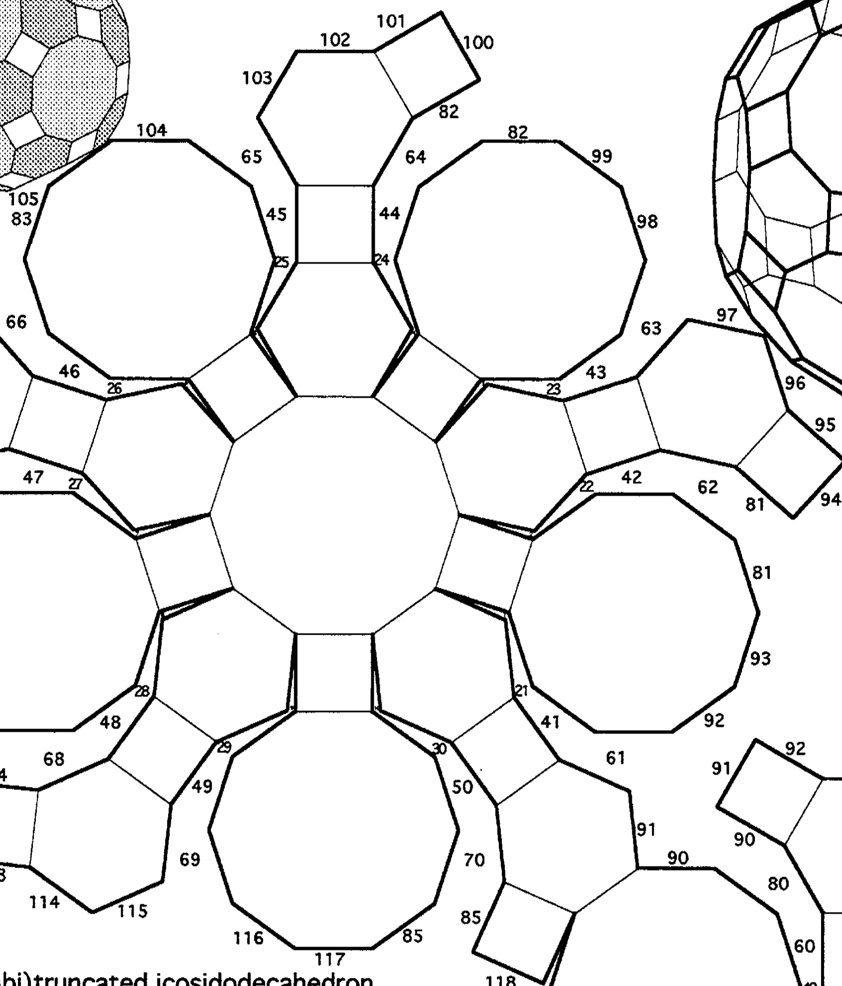


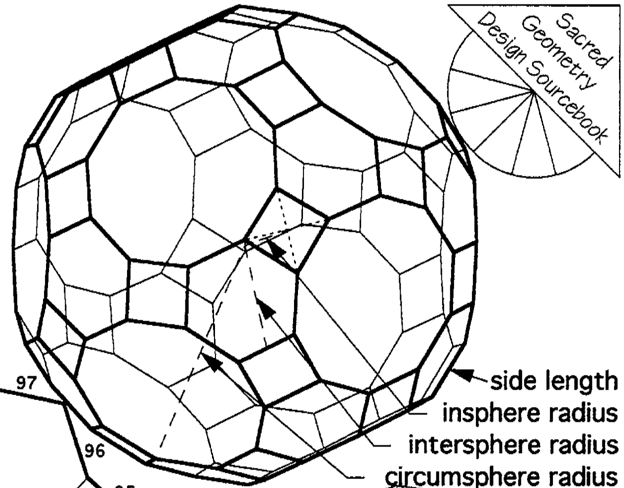
The snub dodecahedron has the following relative dimensions (this allows scaling to any size):
circumsphere radius = r/h
≈ 1.0280314882
intersphere radius = 1
insphere radius = R/h
≈ .9727328506
side length = 1/h
≈ .4768594793
R = (1/2)√((8*(2)^(2/3)
-16x+(2)^(1/3)x^2)
/(8*(2)^(2/3)-10x+
(2)^(1/3)x^2));
x = (49+(27√5)+(3√6)
√(93+(49√5)))^(1/3);
r = (R^2-(1/4))/R;
h = √(R^2-(1/4))



Snub Dodecahedron Fold-Up Pattern







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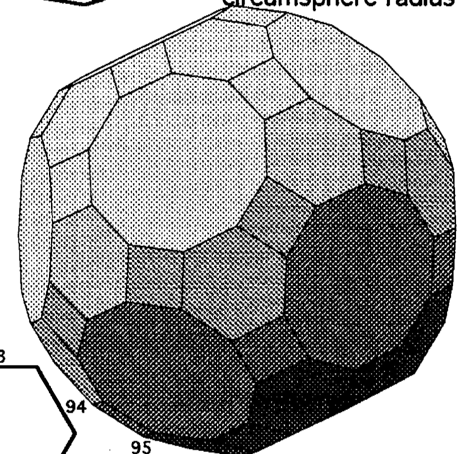
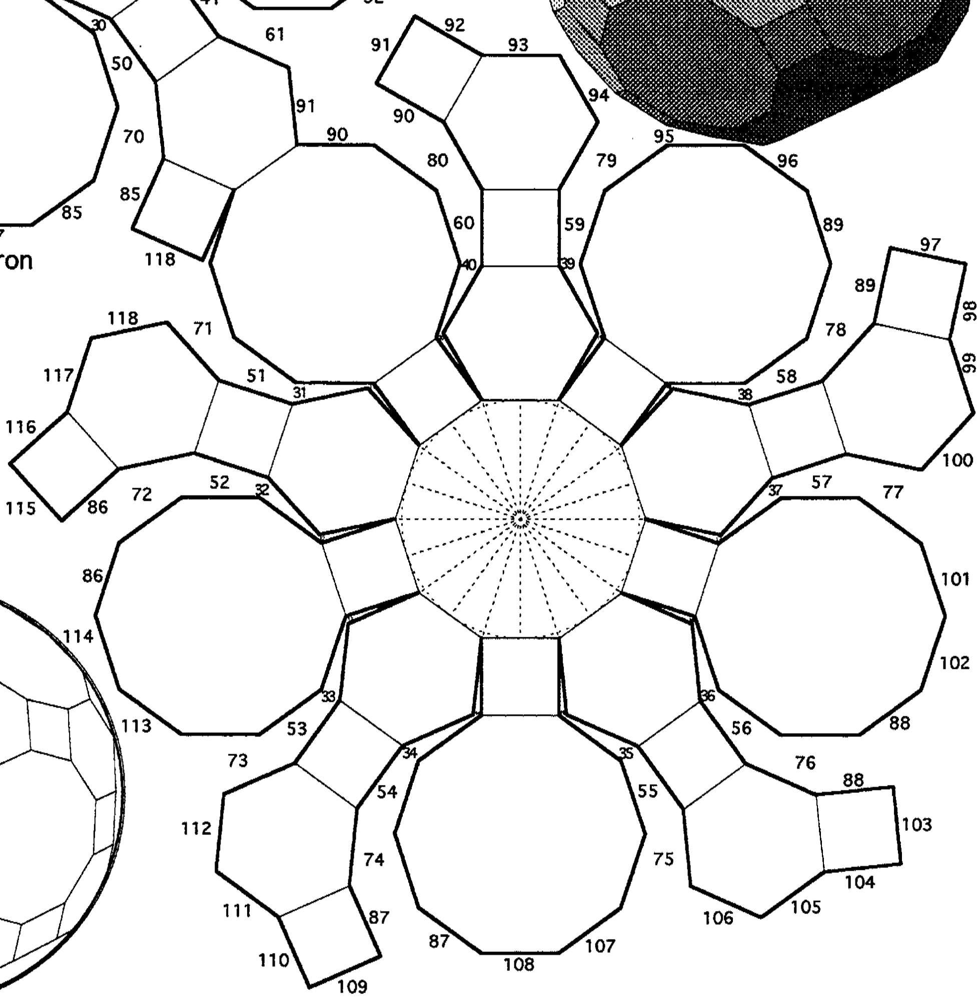




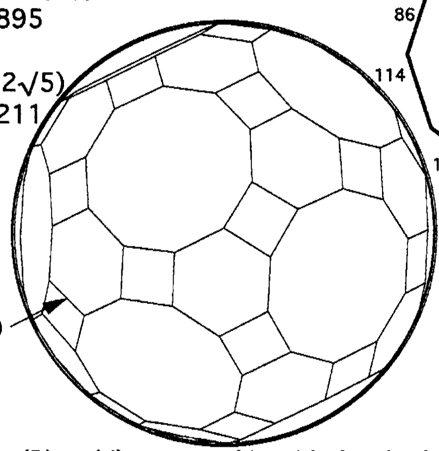
The (rhombi)truncated icosidodecahedron has the following relative dimensions (this allows scaling to any size):

circumsphere radius
$= \sqrt{(31+12\sqrt{5})/(30+12\sqrt{5})}$
≈ 1.0087593708

intersphere radius = 1

insphere radius
$= 2(105+6\sqrt{5})\sqrt{(31+12\sqrt{5})}$
$/(241\sqrt{(30+12\sqrt{5})})$
$\approx .9913166895$

side length
$= 2/\sqrt{(30+12\sqrt{5})}$
$\approx .2652958211$



(Rhombi)truncated Icosidodecahedron (a.k.a. Great Rhombicosidodecahedron) Fold-Up Pattern

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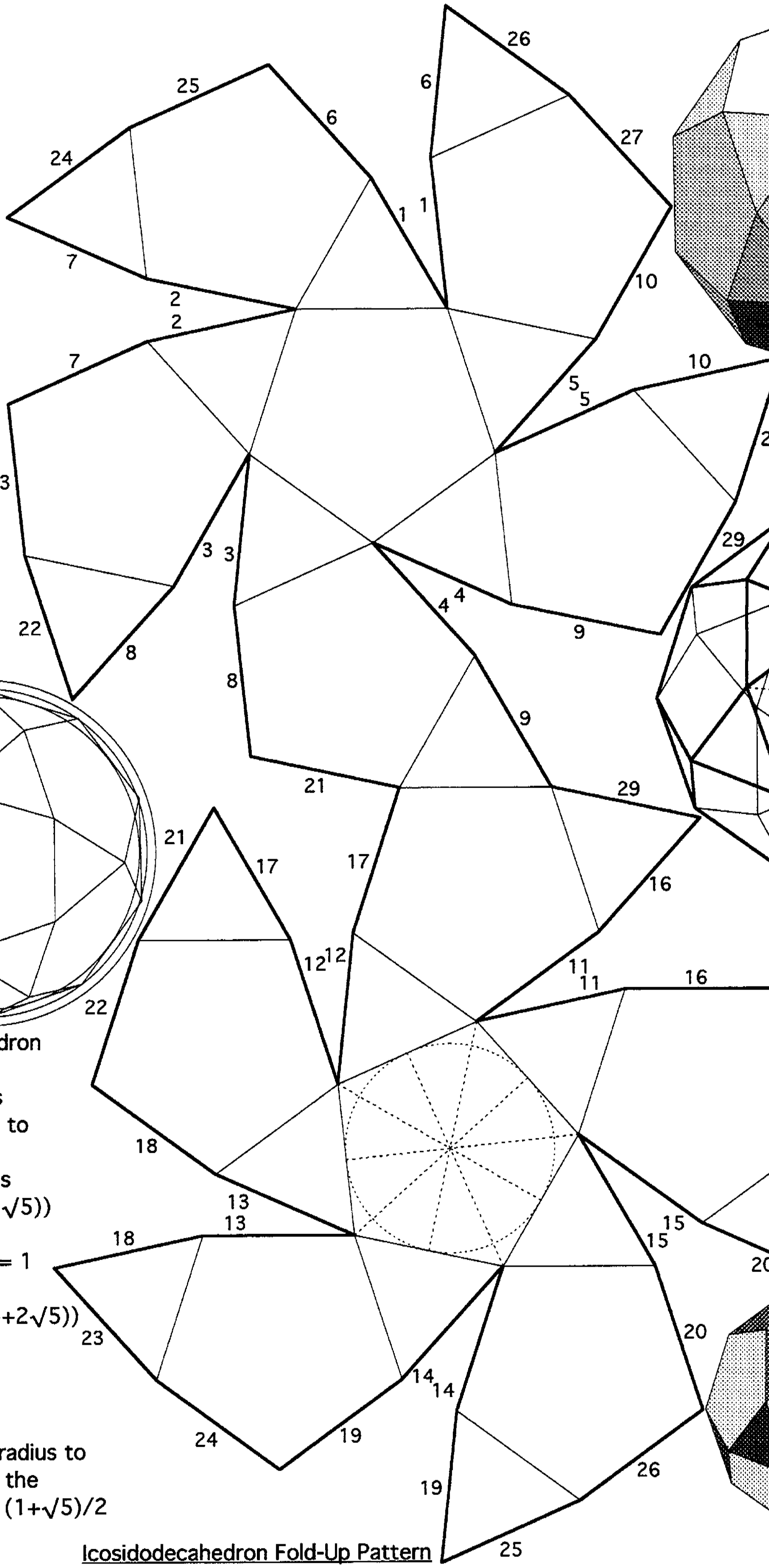
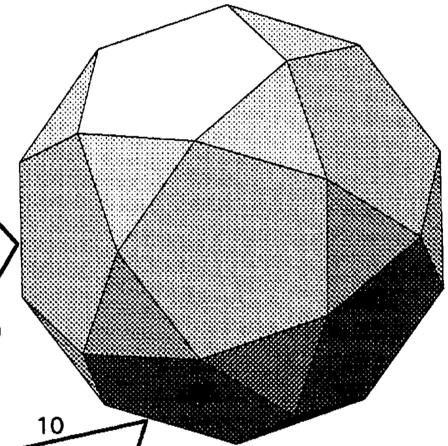
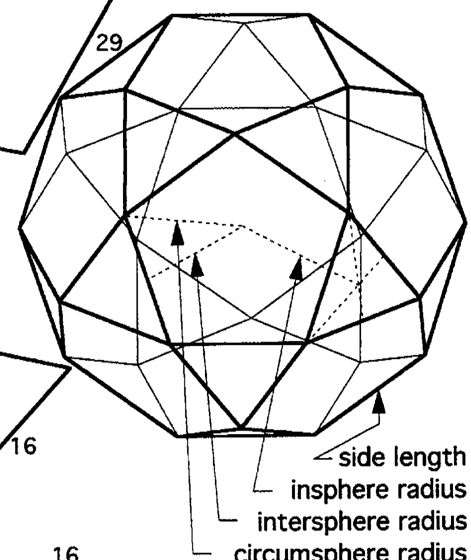
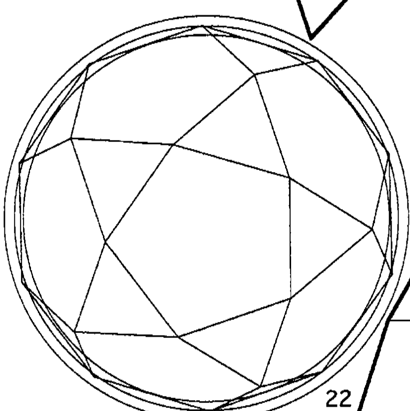








The icosidodecahedron has the following relative dimensions (this allows scaling to any size):

circumsphere radius
= (1+√5)/(√(5+2√5))
≈ 1.0514622242

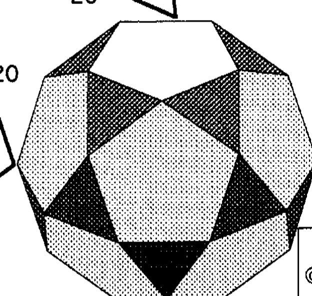
intersphere radius = 1

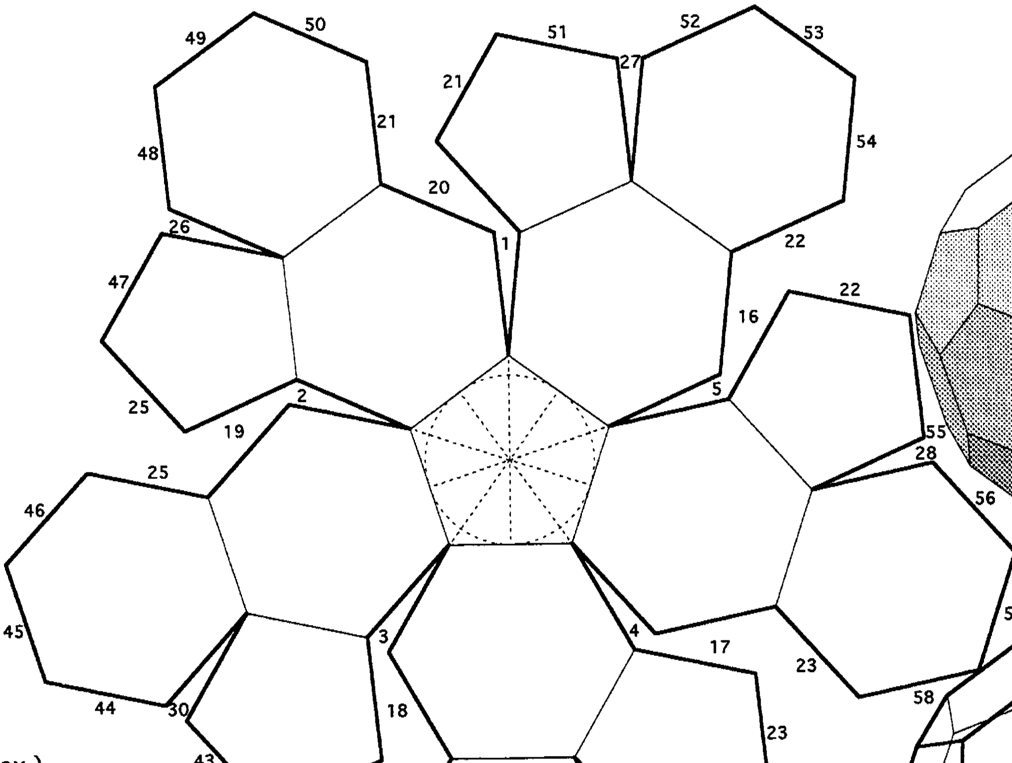
insphere radius
= (5+3√5)/(4√(5+2√5))
≈ .9510565163

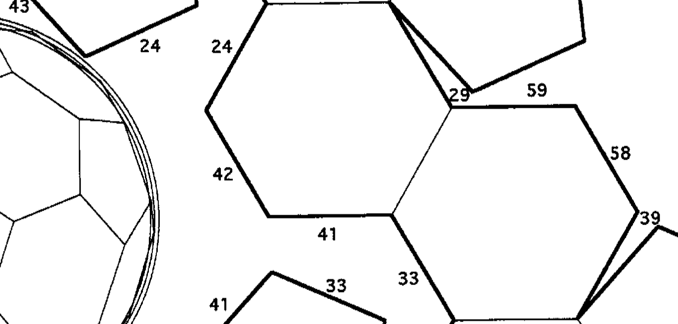
side length
= 2/(√(5+2√5))
≈ .6498393925

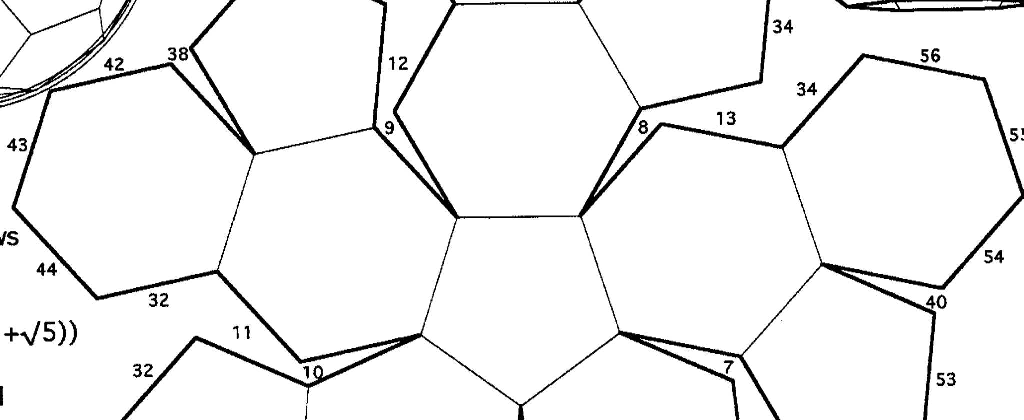
The circumsphere radius to side length ratio is the golden ratio = Ø = (1+√5)/2
≈ 1.6180339888

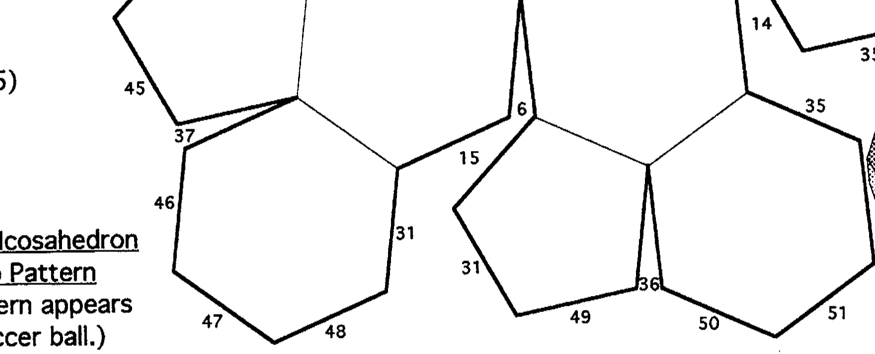
Icosidodecahedron Fold-Up Pattern

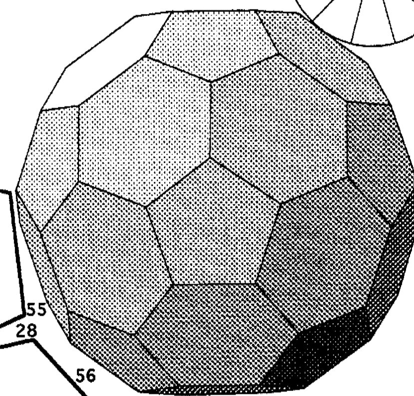


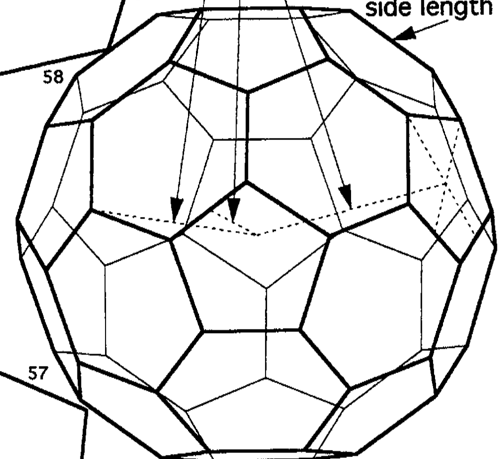


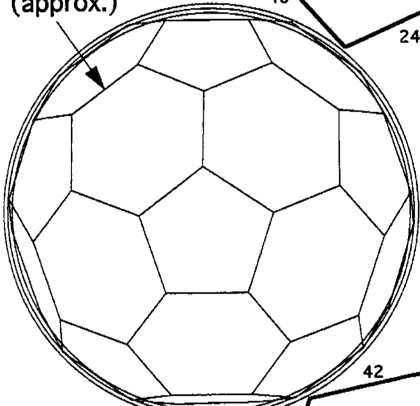












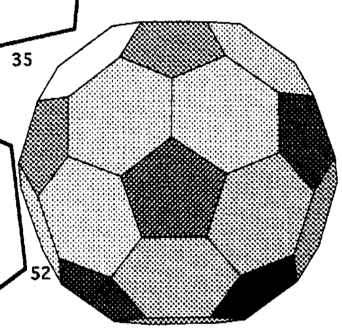
The truncated icosahedron has the following relative dimensions (this allows scaling to any size):

circumsphere radius
$= \sqrt{(58+18\sqrt{5})/(3(1+\sqrt{5}))}$
≈ 1.0209998374

intersphere radius = 1

insphere radius
$= (3/218)(21+\sqrt{5})\sqrt{(58+18\sqrt{5})/(1+\sqrt{5})}$
$\approx .9794320855$

side length
$= 4/(3(1+\sqrt{5}))$
$\approx .4120226592$



Truncated Icosahedron Fold-Up Pattern
(This pattern appears on a soccer ball.)

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