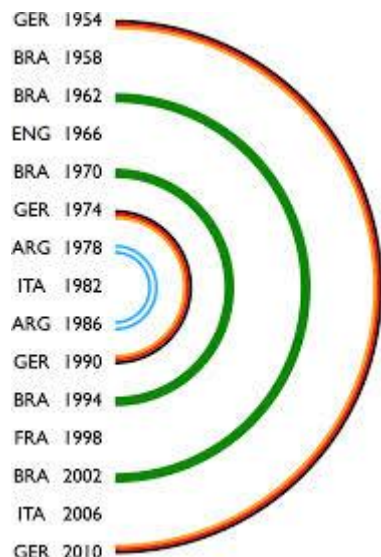




Seleção europeia, campeã pela primeira vez jogando em casa, com uma nação estreante terminando em terceiro e com o artilheiro da Copa, Eusébio de Portugal

Seleção europeia, campeã pela primeira vez jogando em casa, com uma nação estreante terminando em terceiro e com o artilheiro da Copa, Suker da Croácia



2006



2002



1998



1994



1990



1986



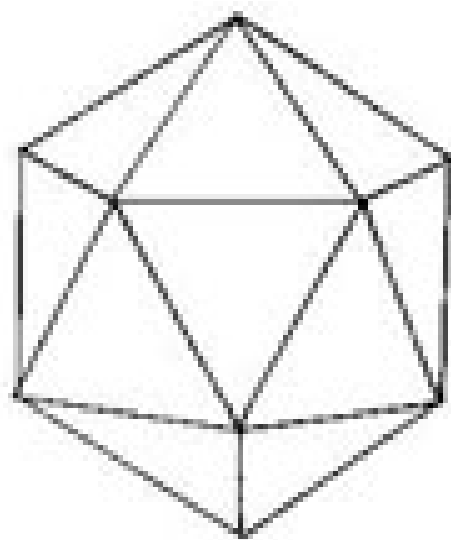
1982



1978



1974

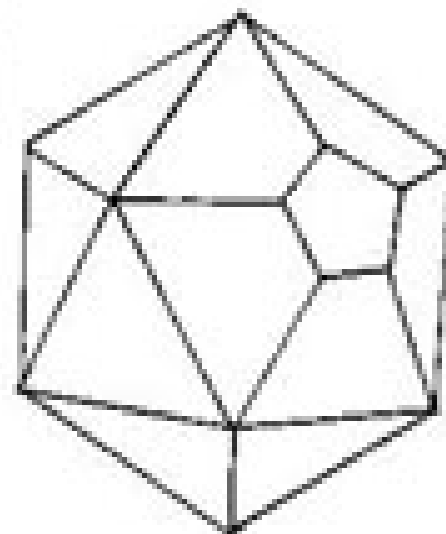
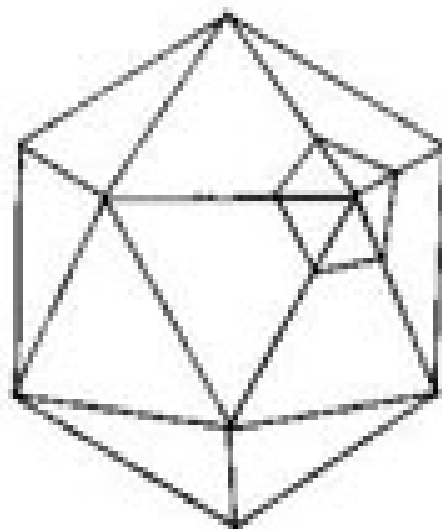


Icosaedro:

12 cantos

20 faces triangulares

30 bordas



**Icosaedro
Truncado:**

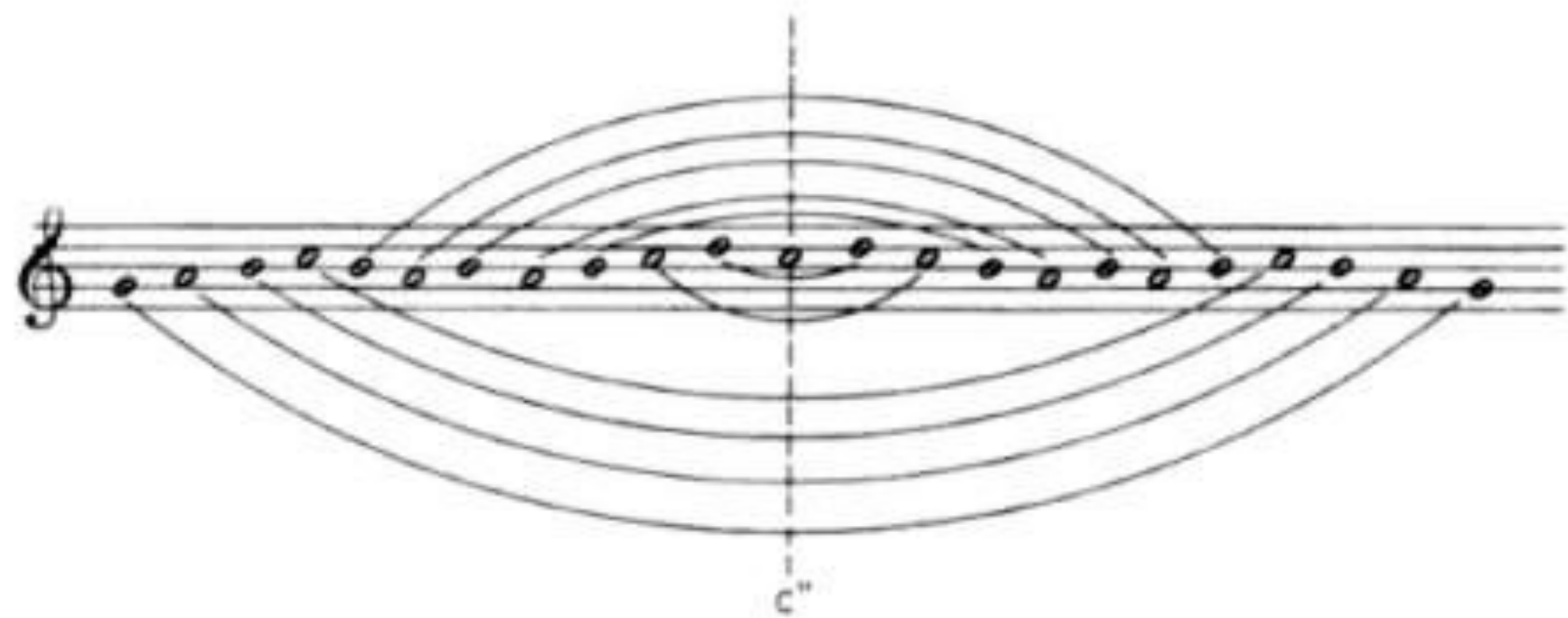
60 cantos

12 pentágonos

20 hexágonos

90 bordas



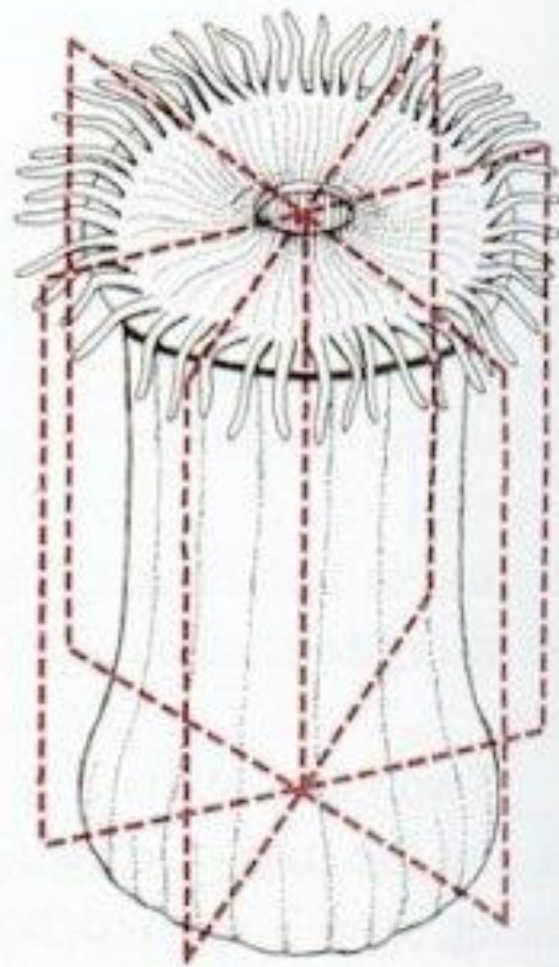




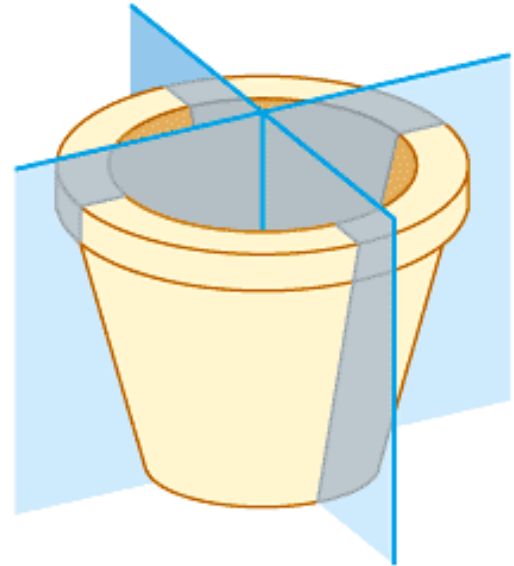
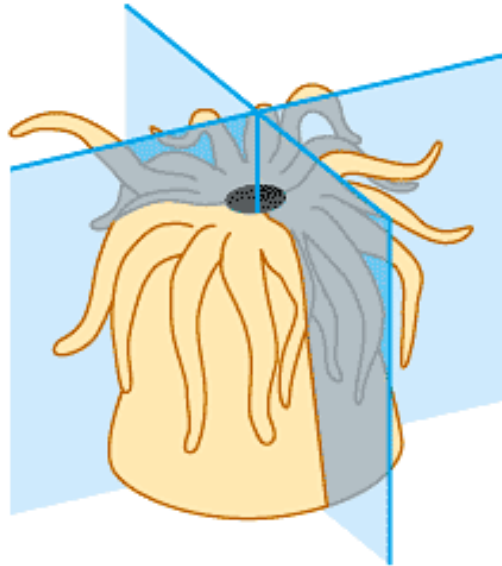




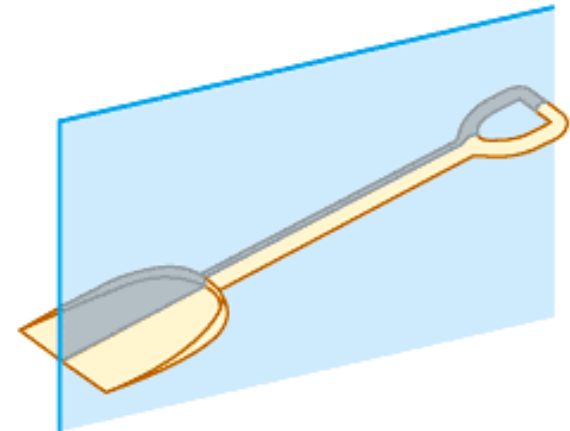
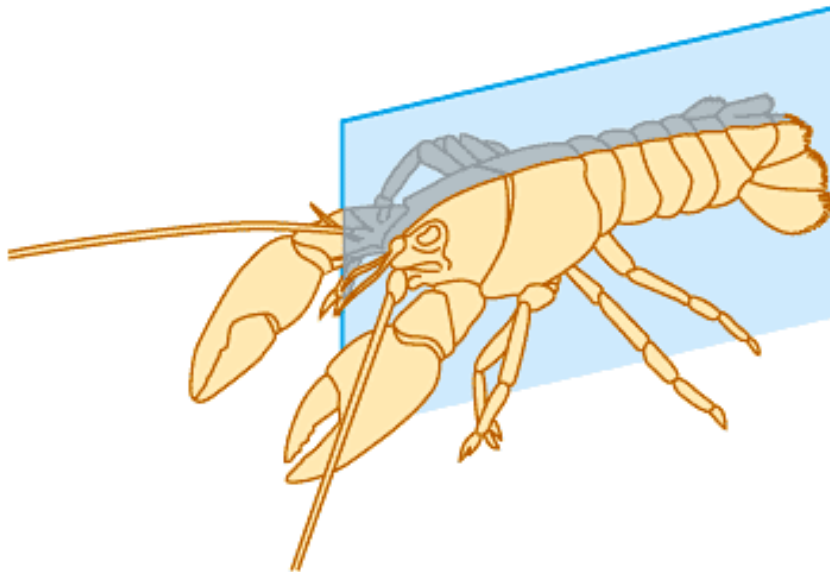
a. Bilateral symmetry



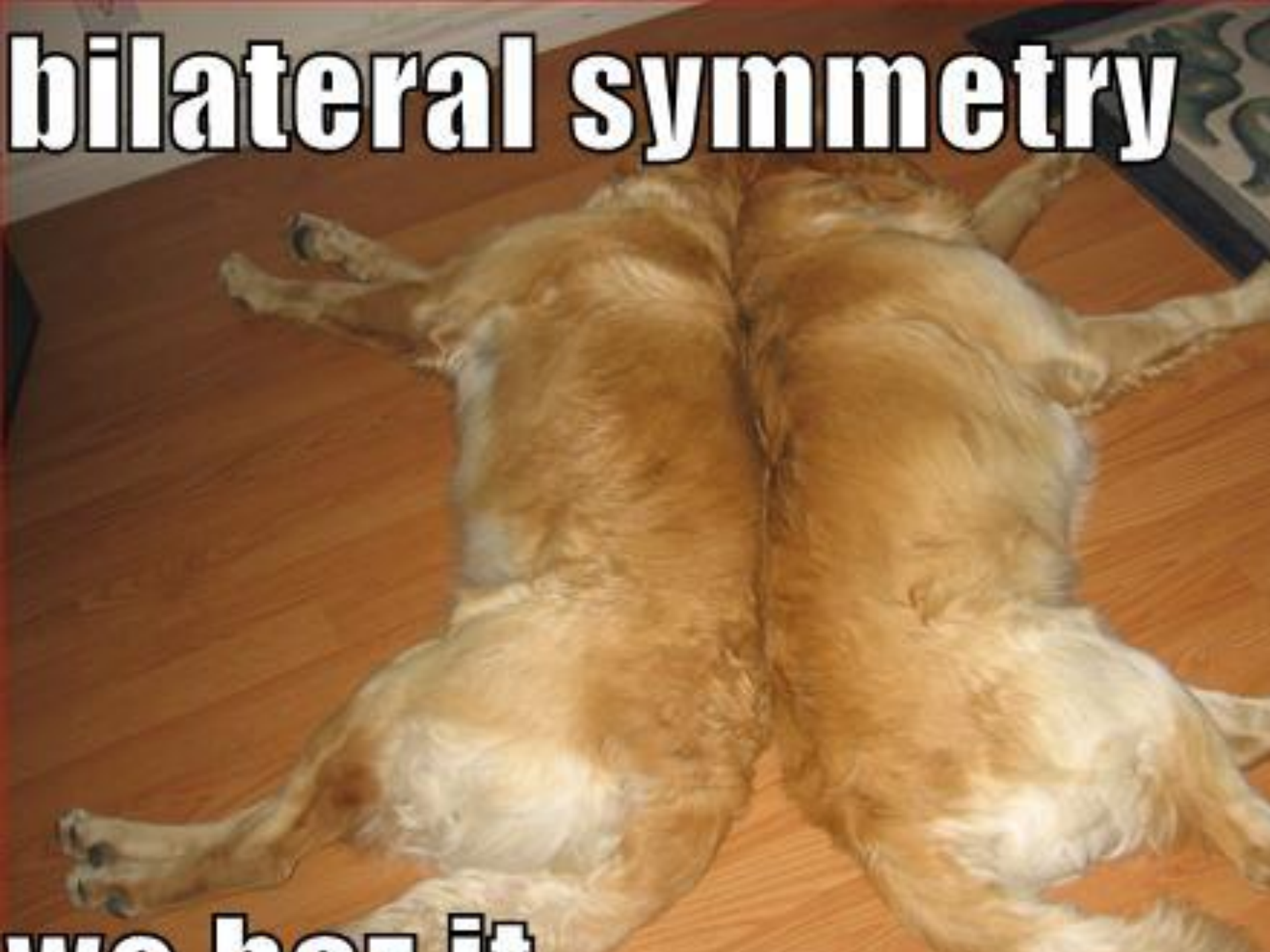
b. Radial symmetry



(a) Radial symmetry



(b) Bilateral symmetry



bilateral symmetry

we have it





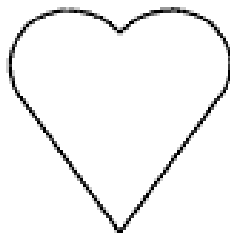
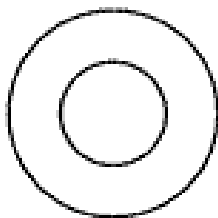
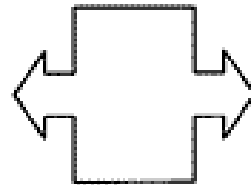
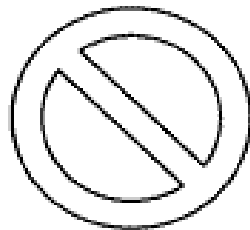
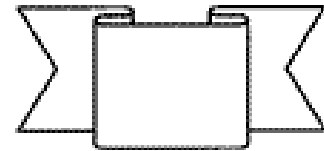
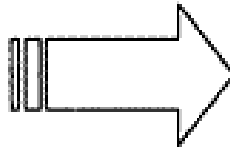
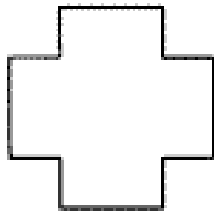
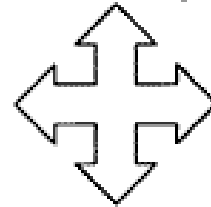
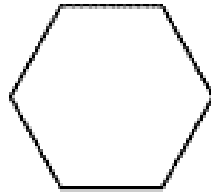
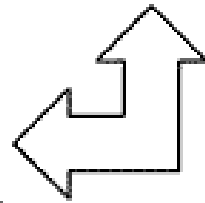
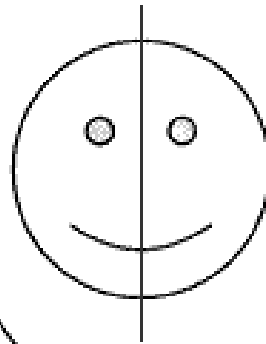
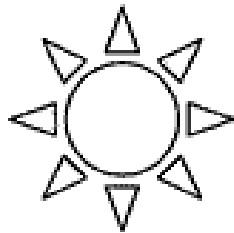
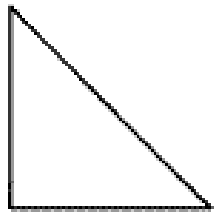






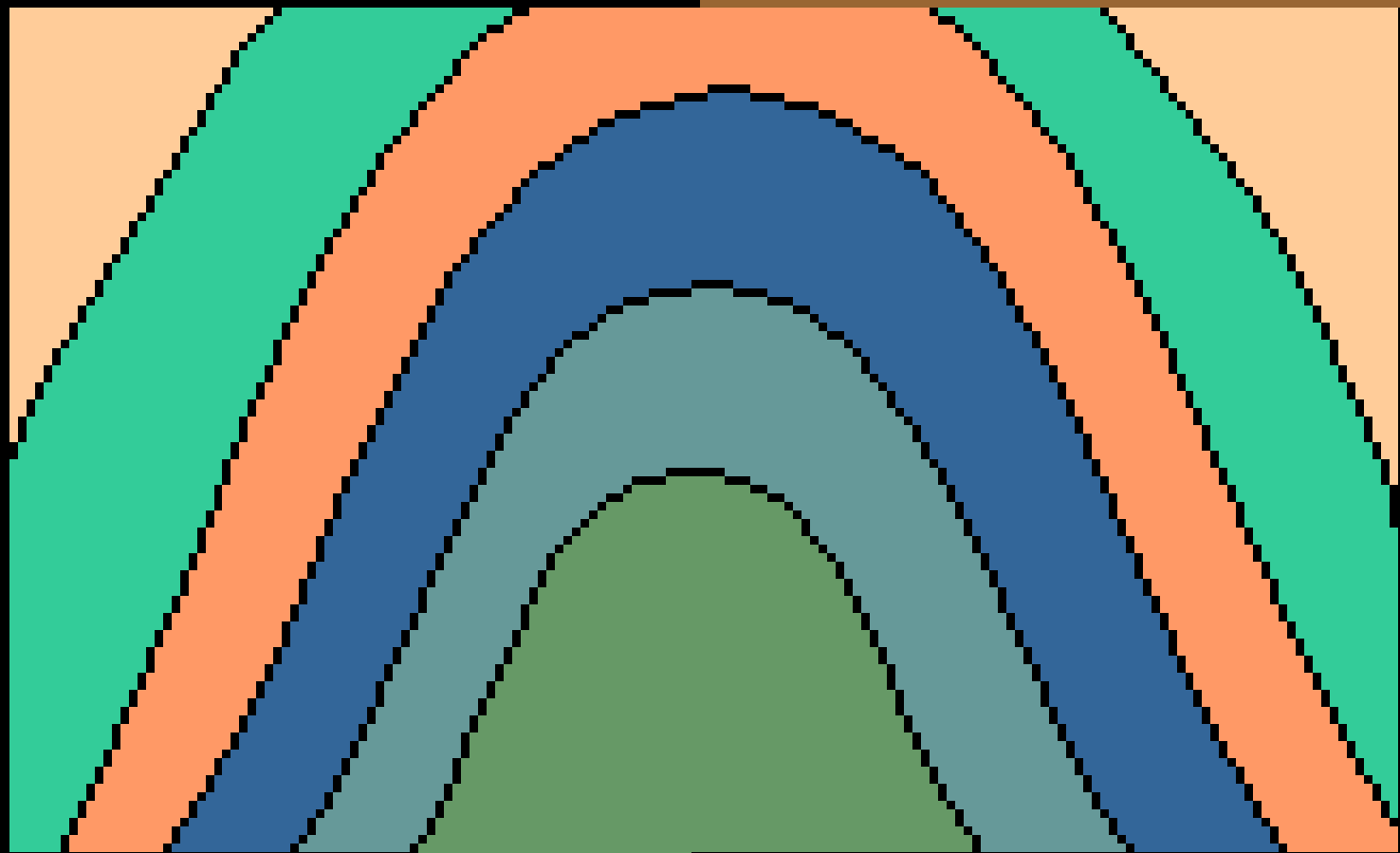
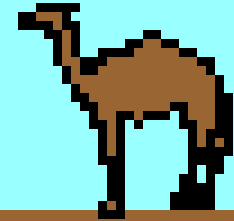
qualidade de vida !!!





***Dábale arroz a la zorra el
Abad***

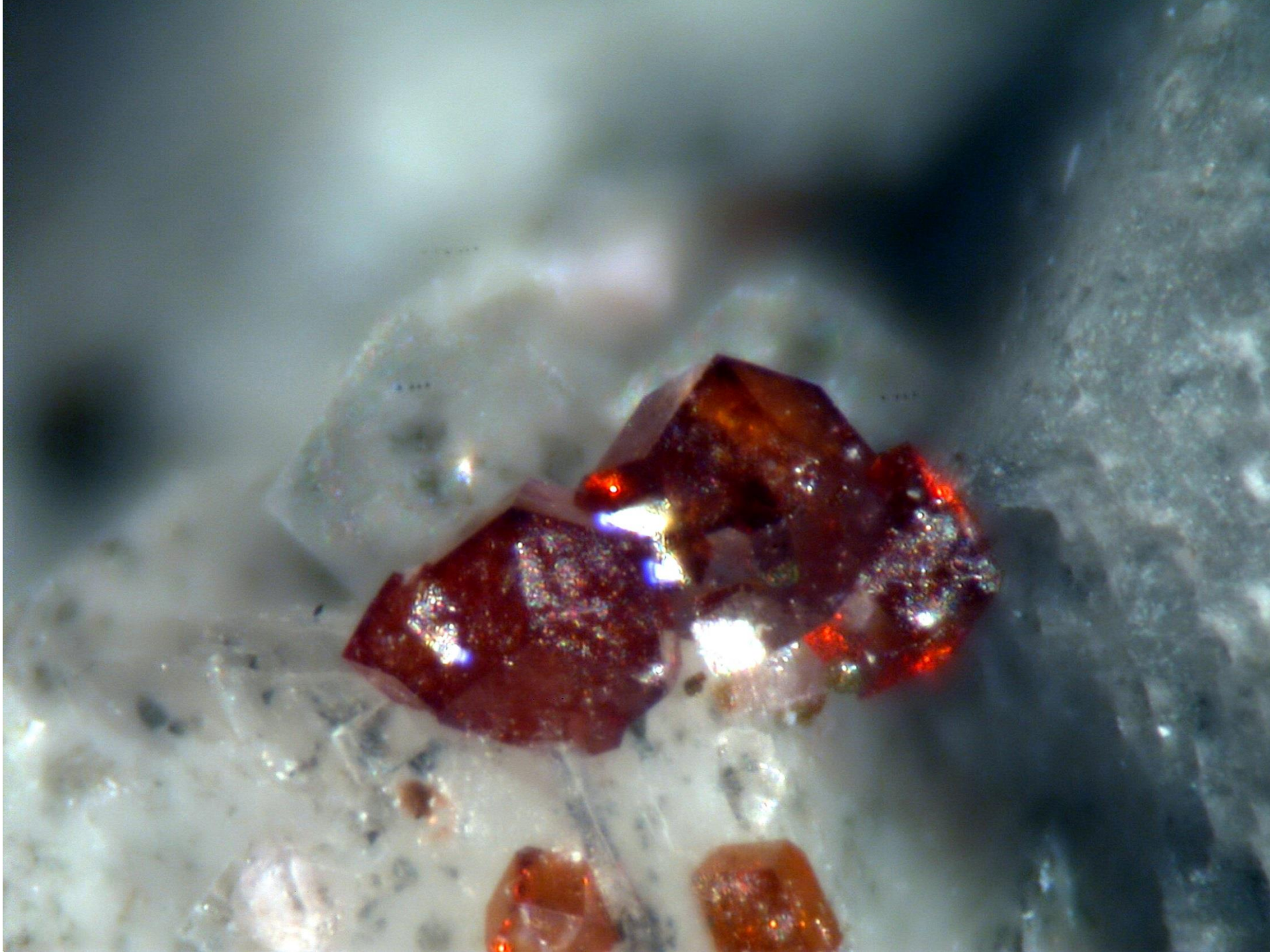
Perfil: Pliegue simétrico

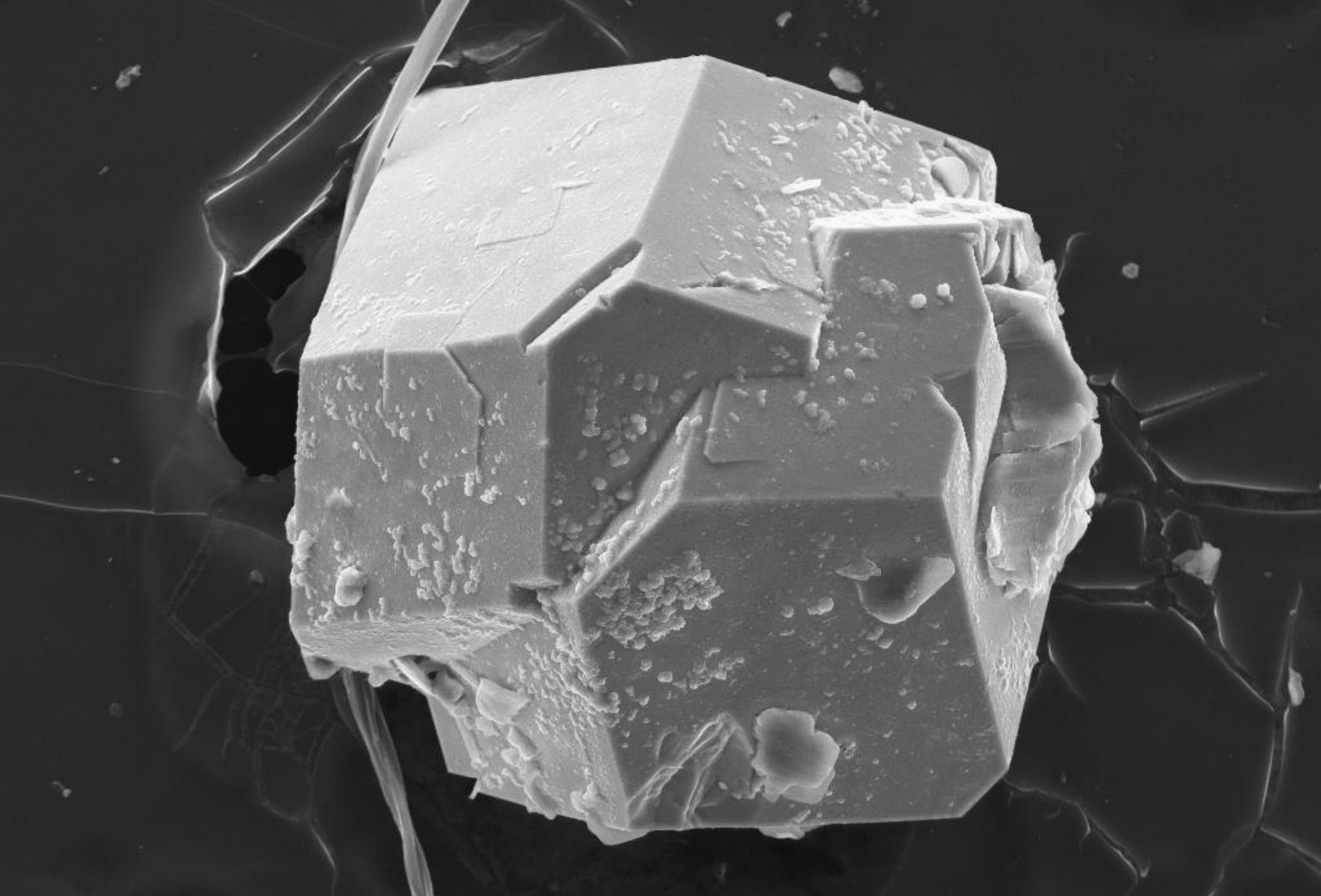




SIMETRIA EXTERNA DOS CRISTAIS

Daniel Atencio



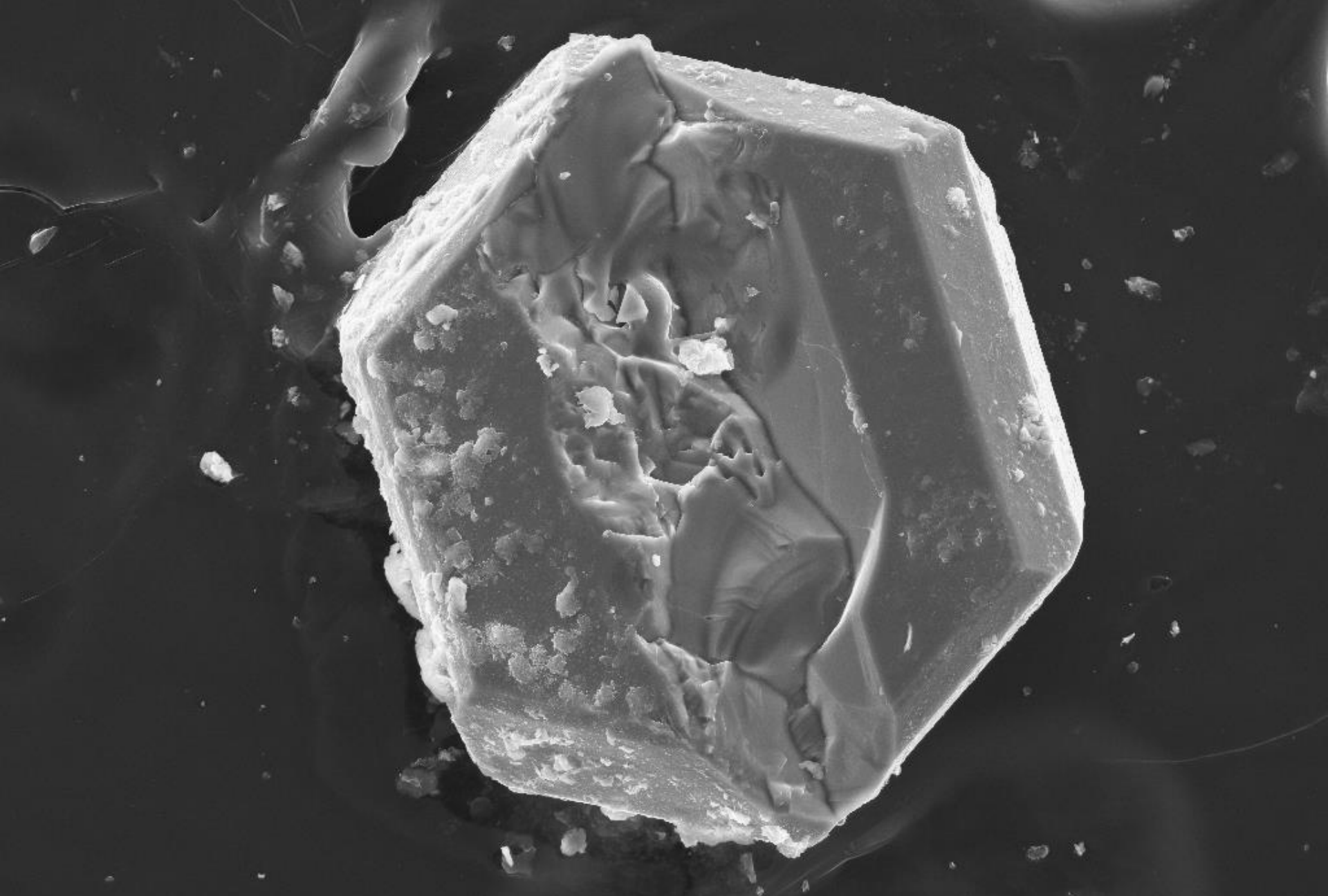


IGc-USP EHT=30.00 kV
30µm

WD= 25 mm
Photo No.=5

Mag= 700 X
Detector= SE1

14405



IGc-USP EHT=30.00 kV
100µm

WD= 25 mm
Photo No.=9

Mag= 600 X
Detector= SE1

3VID305

Elementos de Simetria

Plano de simetria – m – *reflexão*

Eixos de simetria

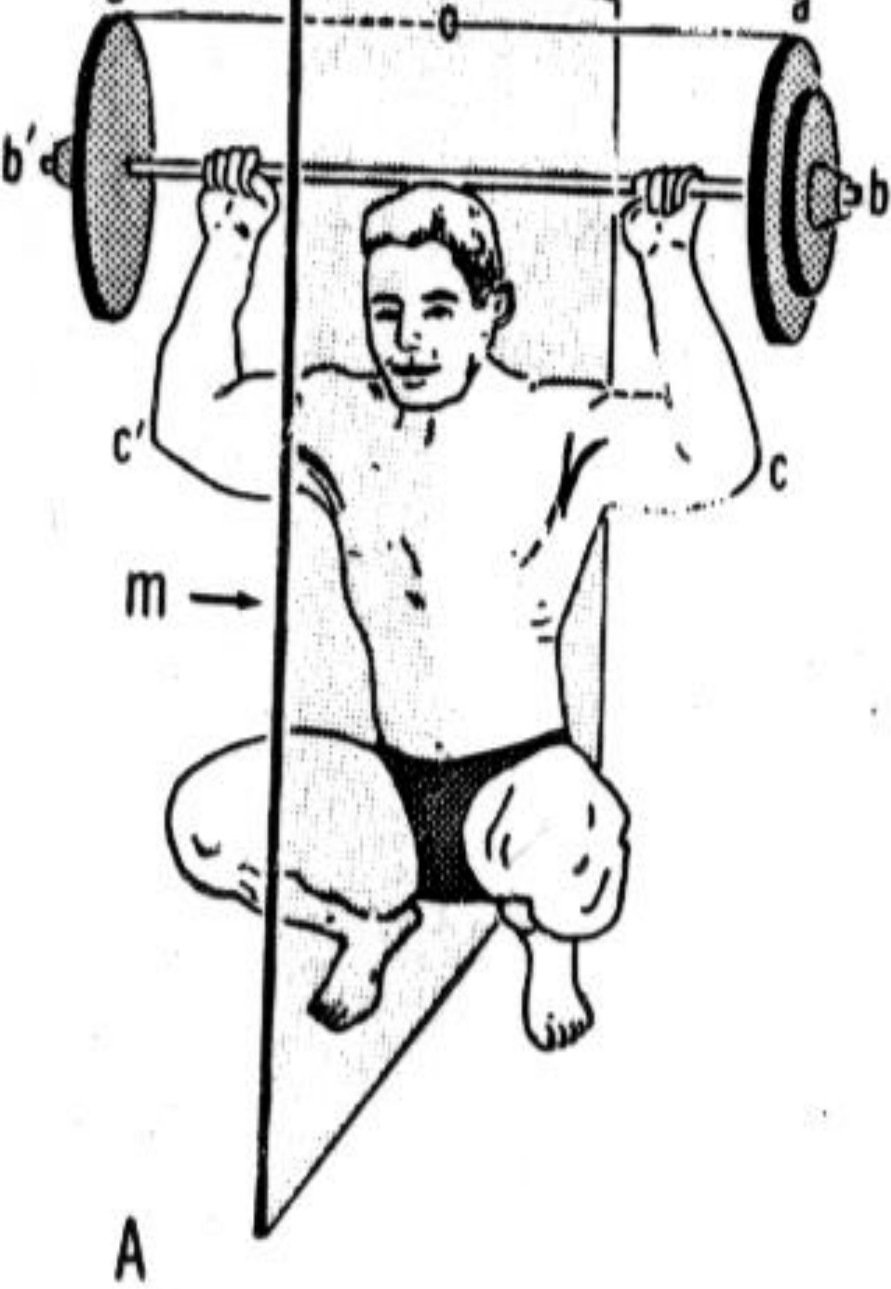
próprios: 1, 2, 3, 4, 6 – *rotação*

impróprios – *rotação + inversão*

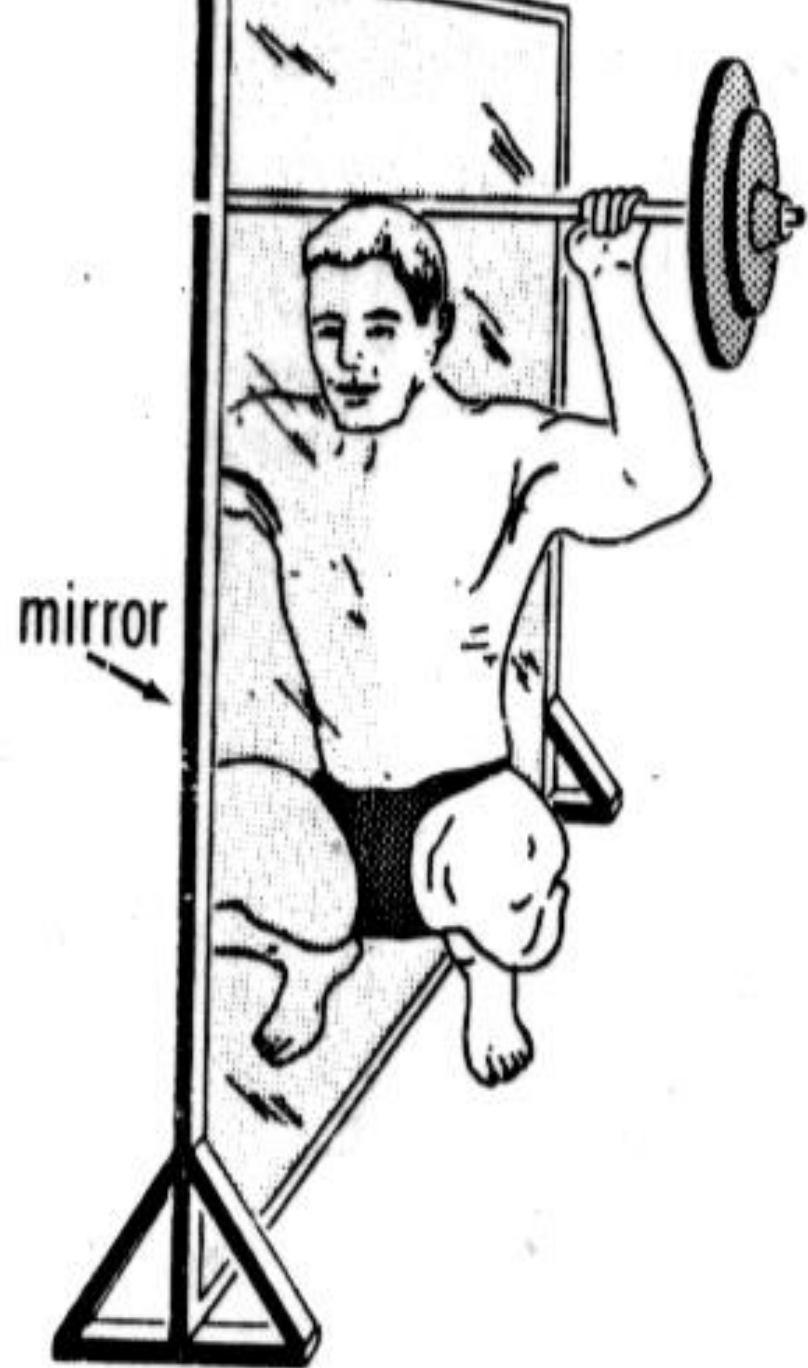
Centro de simetria – i - *inversão*

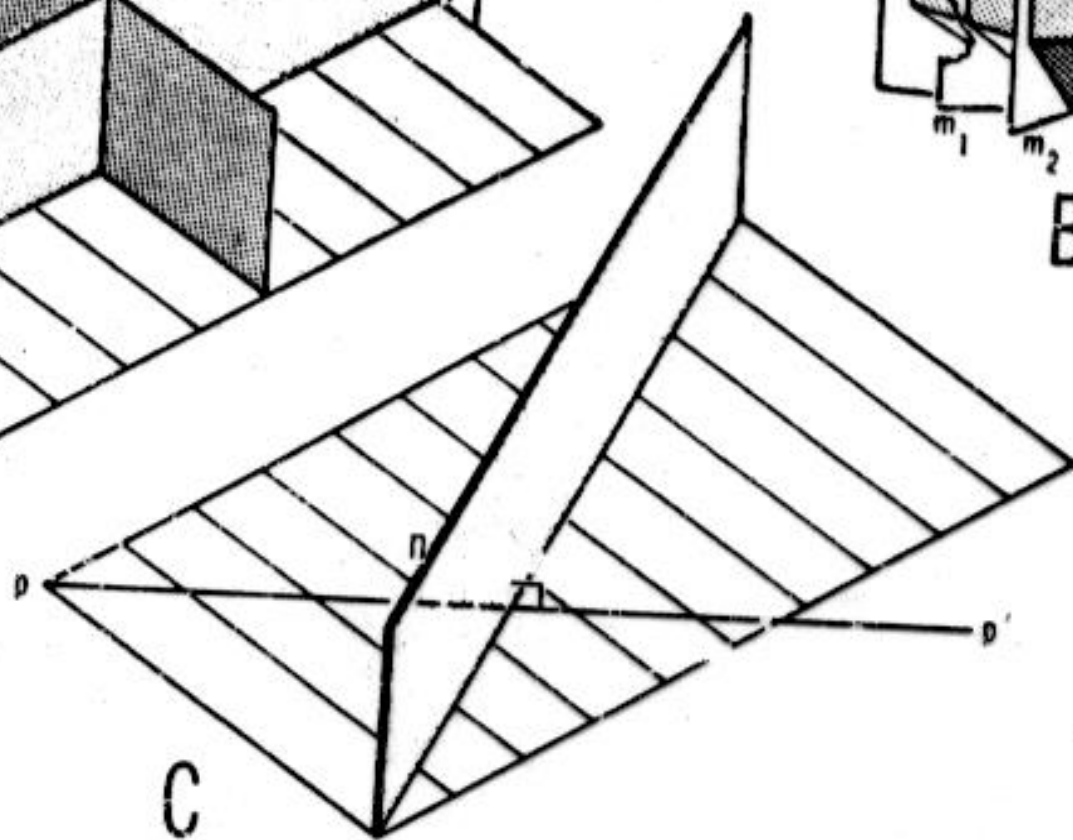
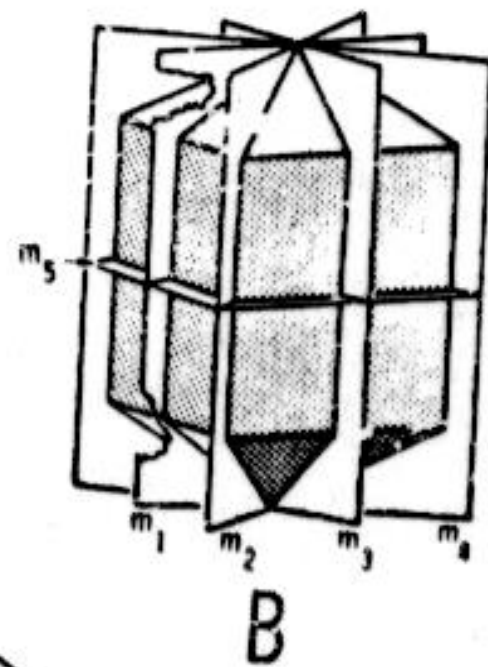
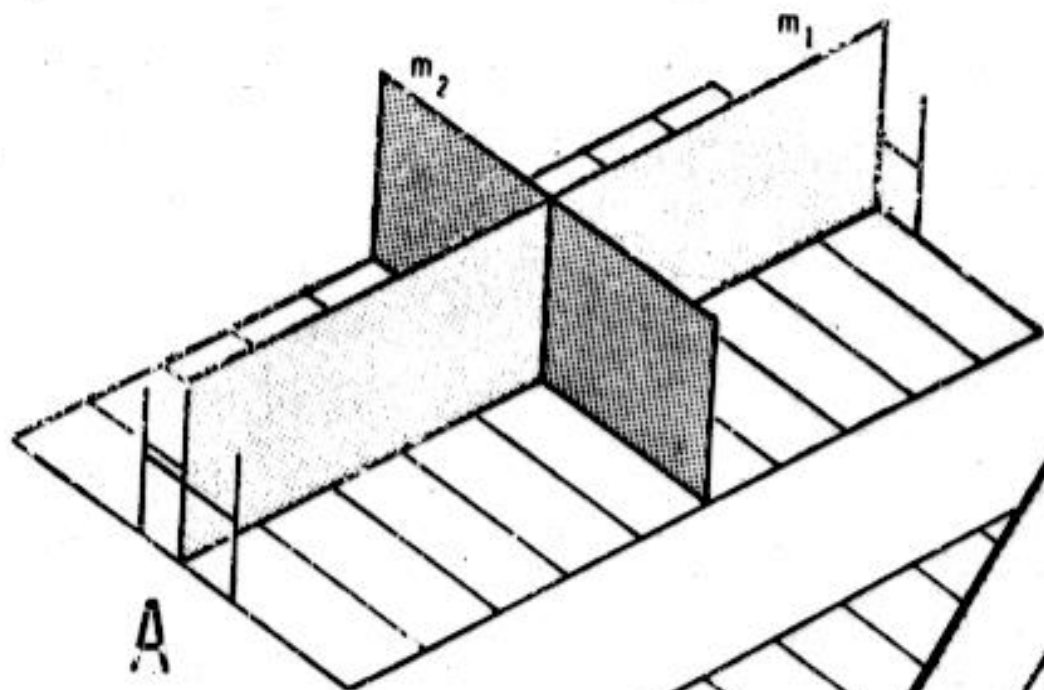
Plano de simetria – m – *reflexão*

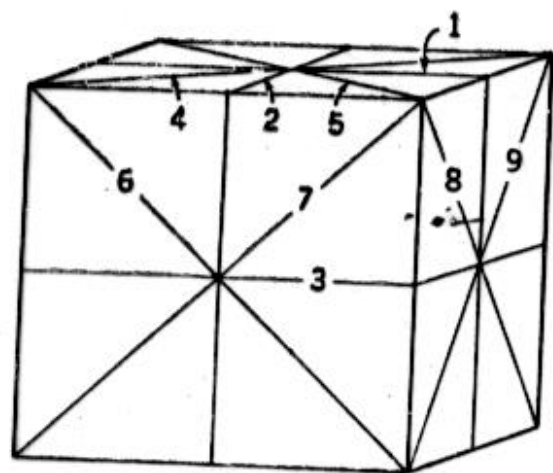




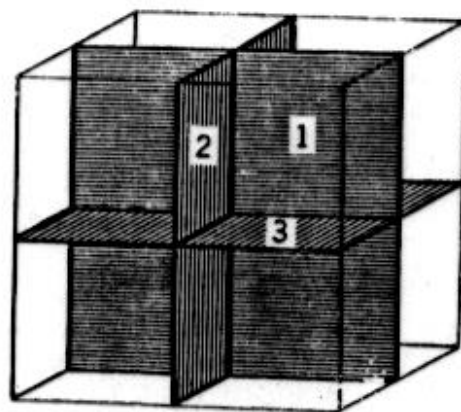
3



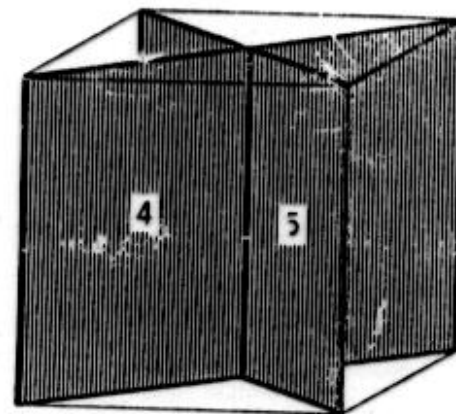




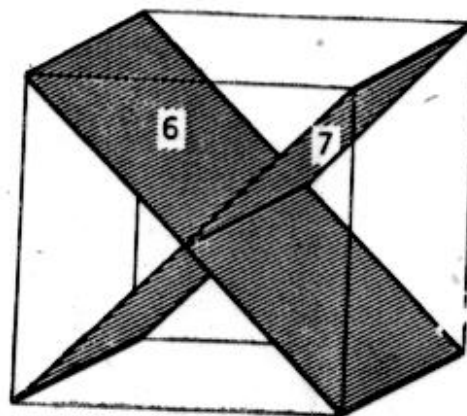
(a)



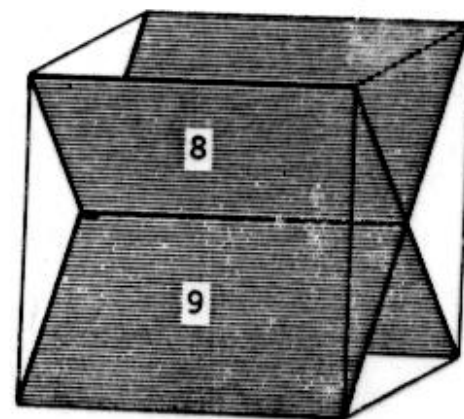
(b)



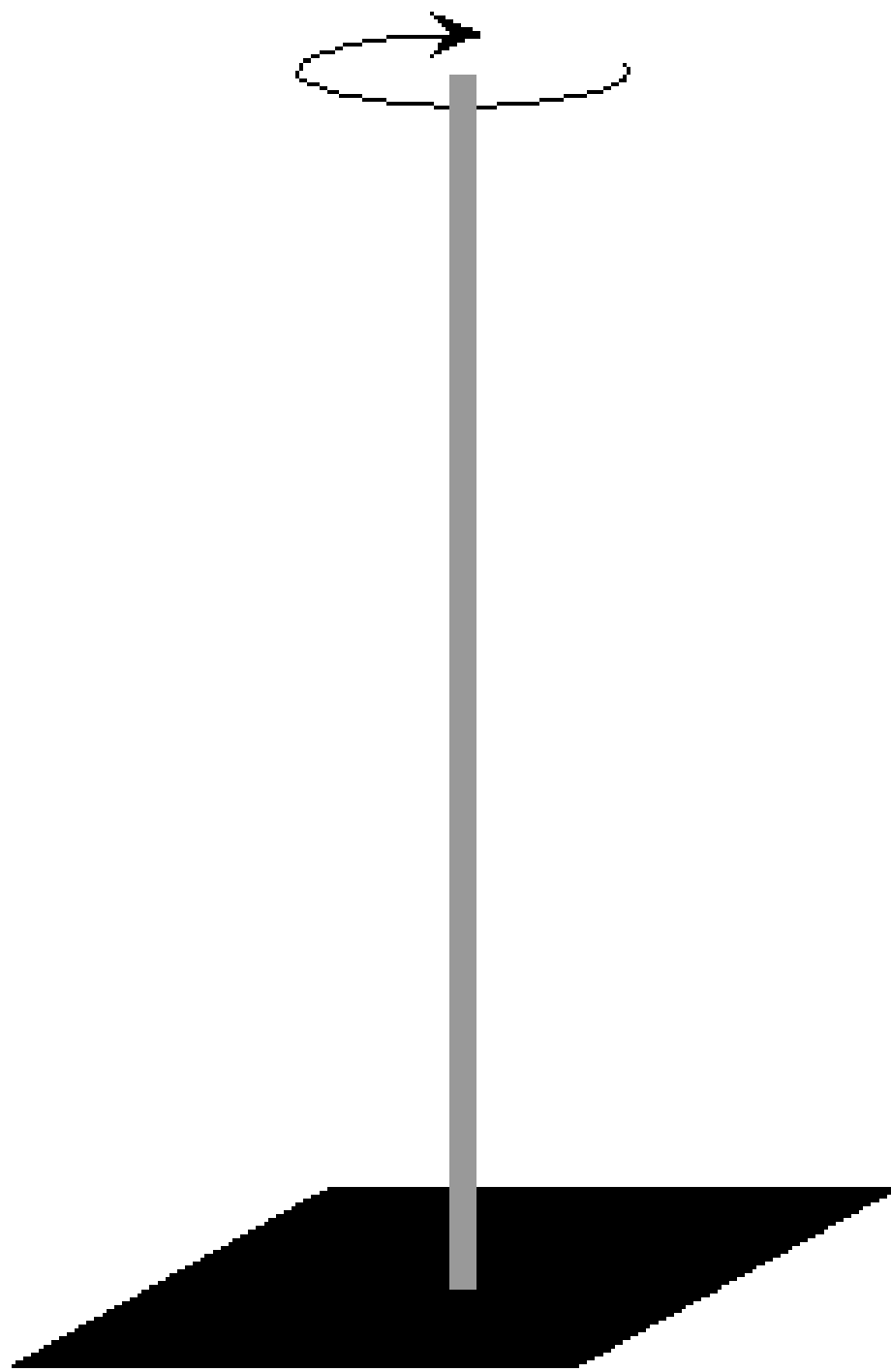
(c)

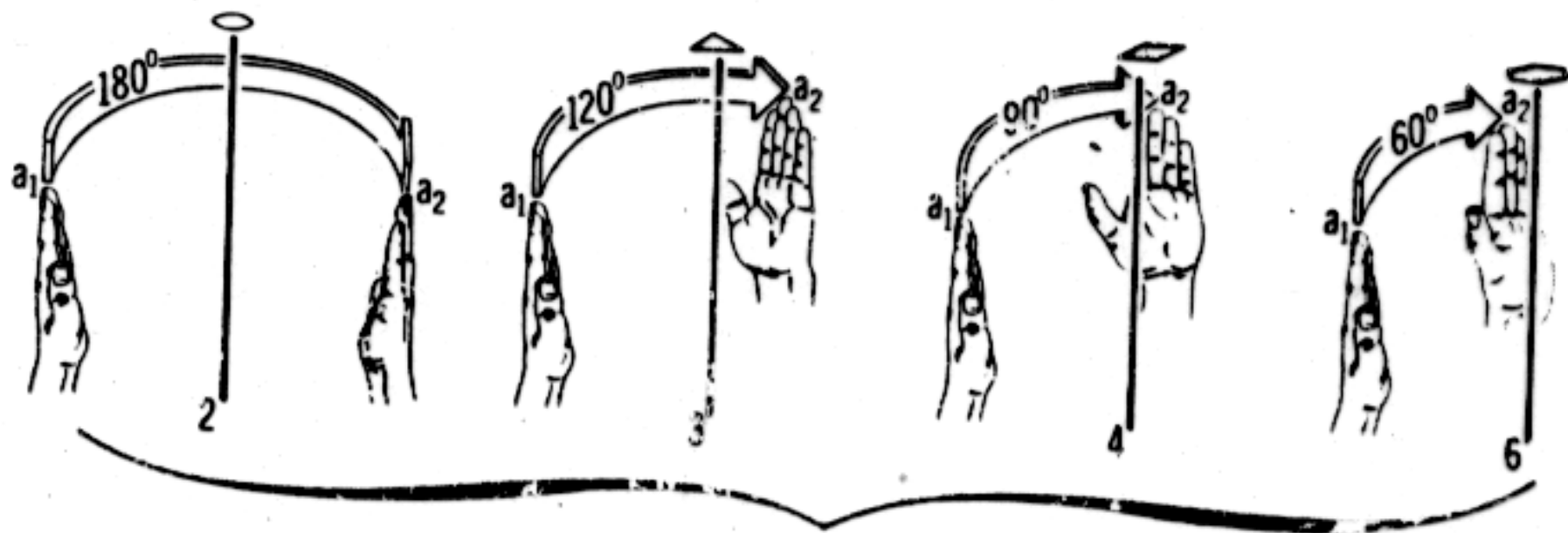


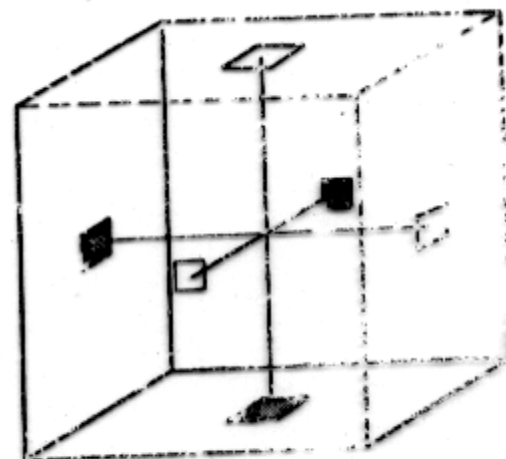
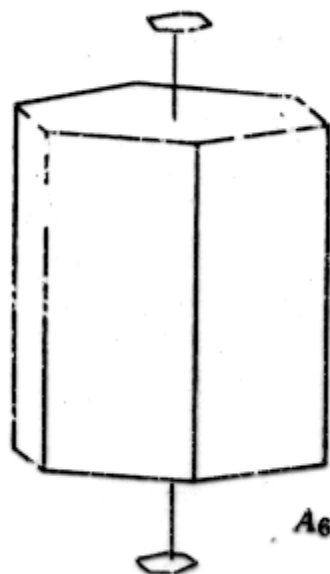
(d)

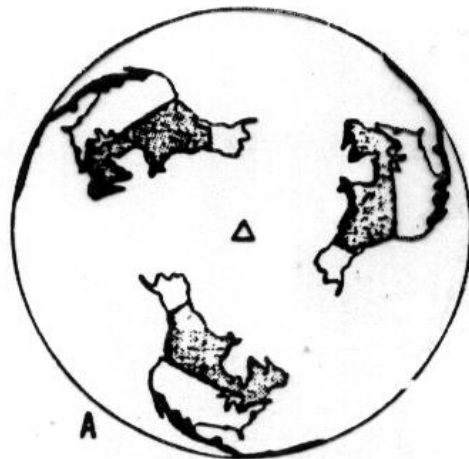


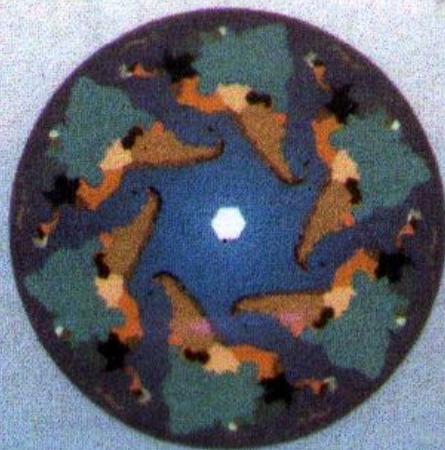
Eixos de simetria
próprios: 1, 2, 3, 4, 6
rotação



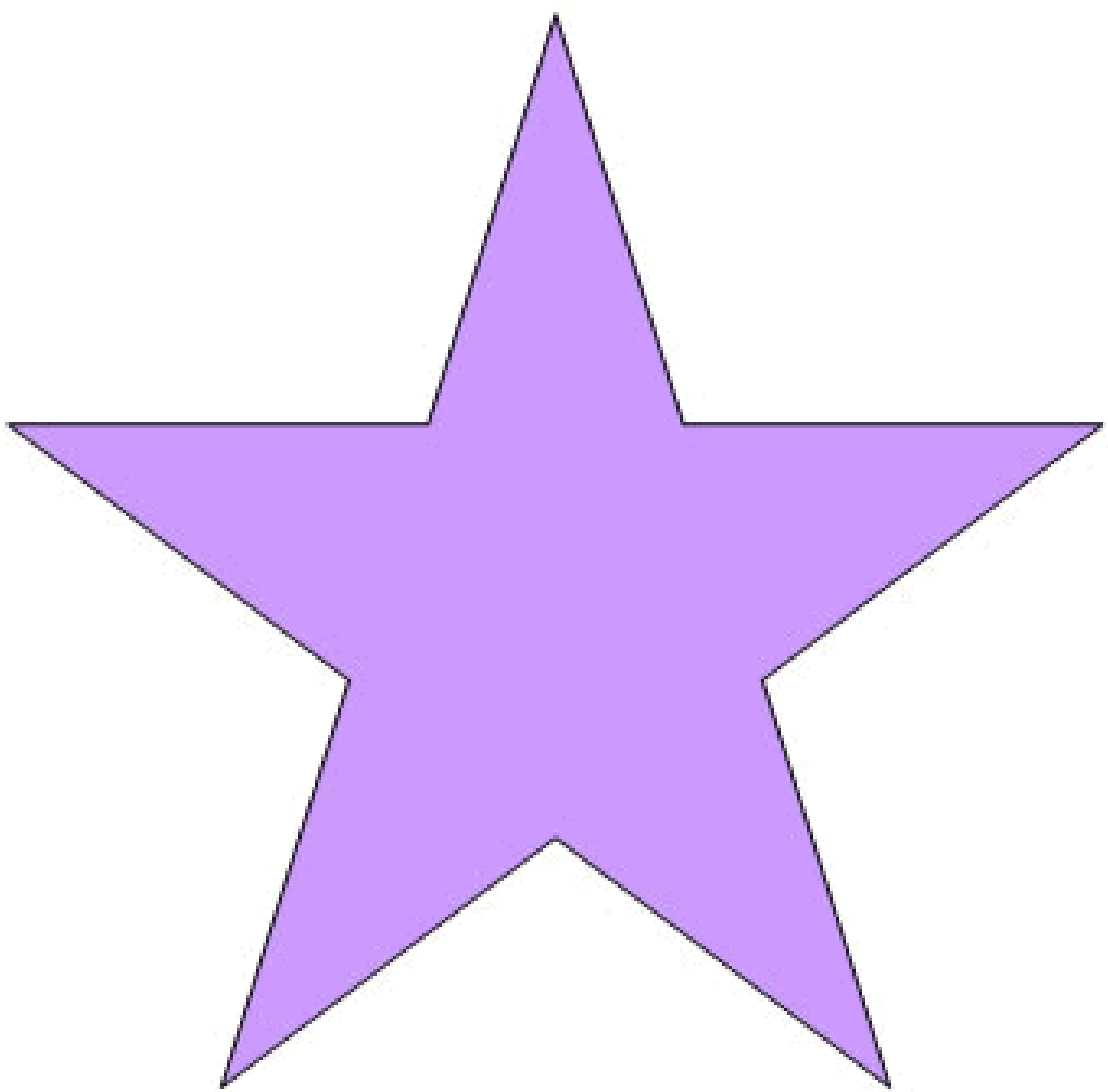


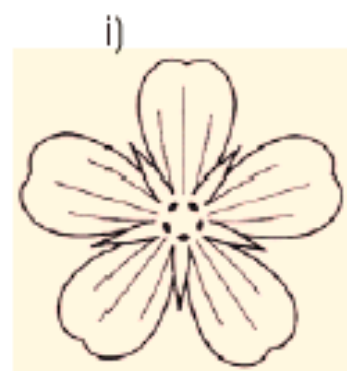
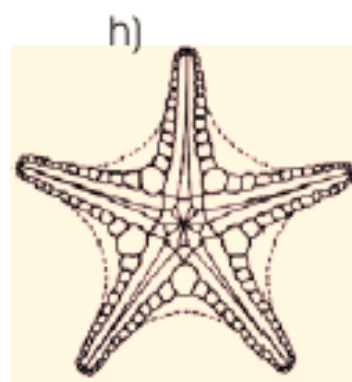
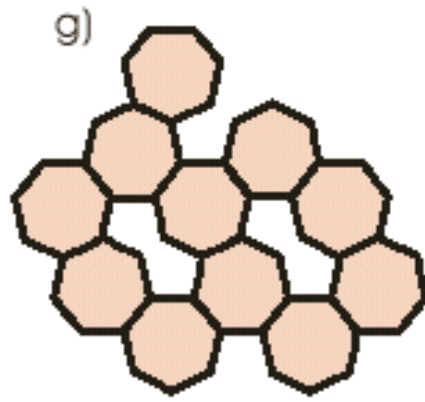
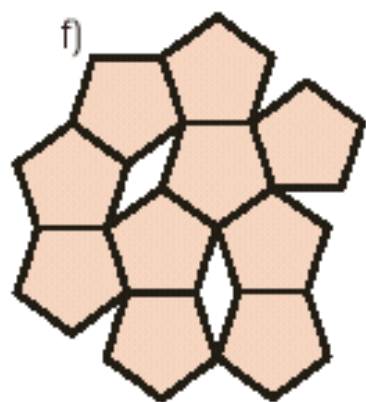
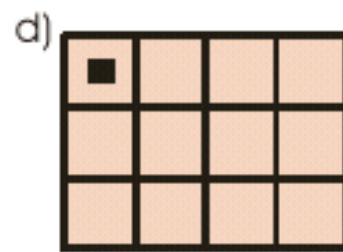
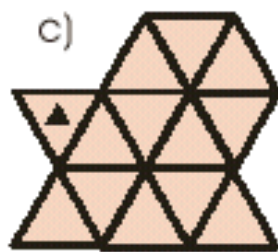
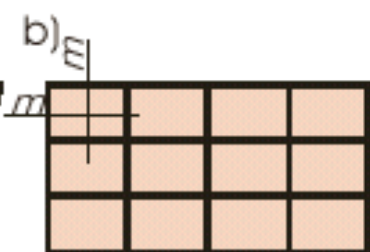
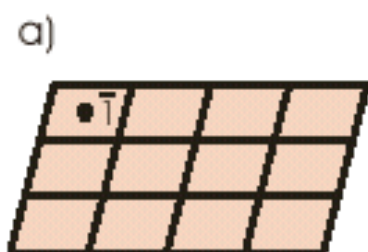




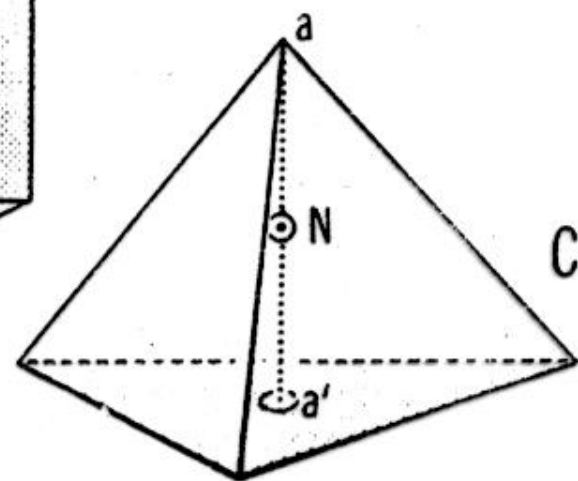
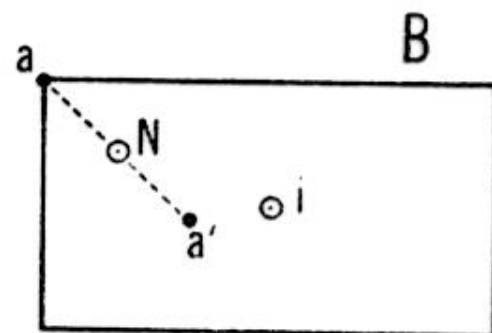
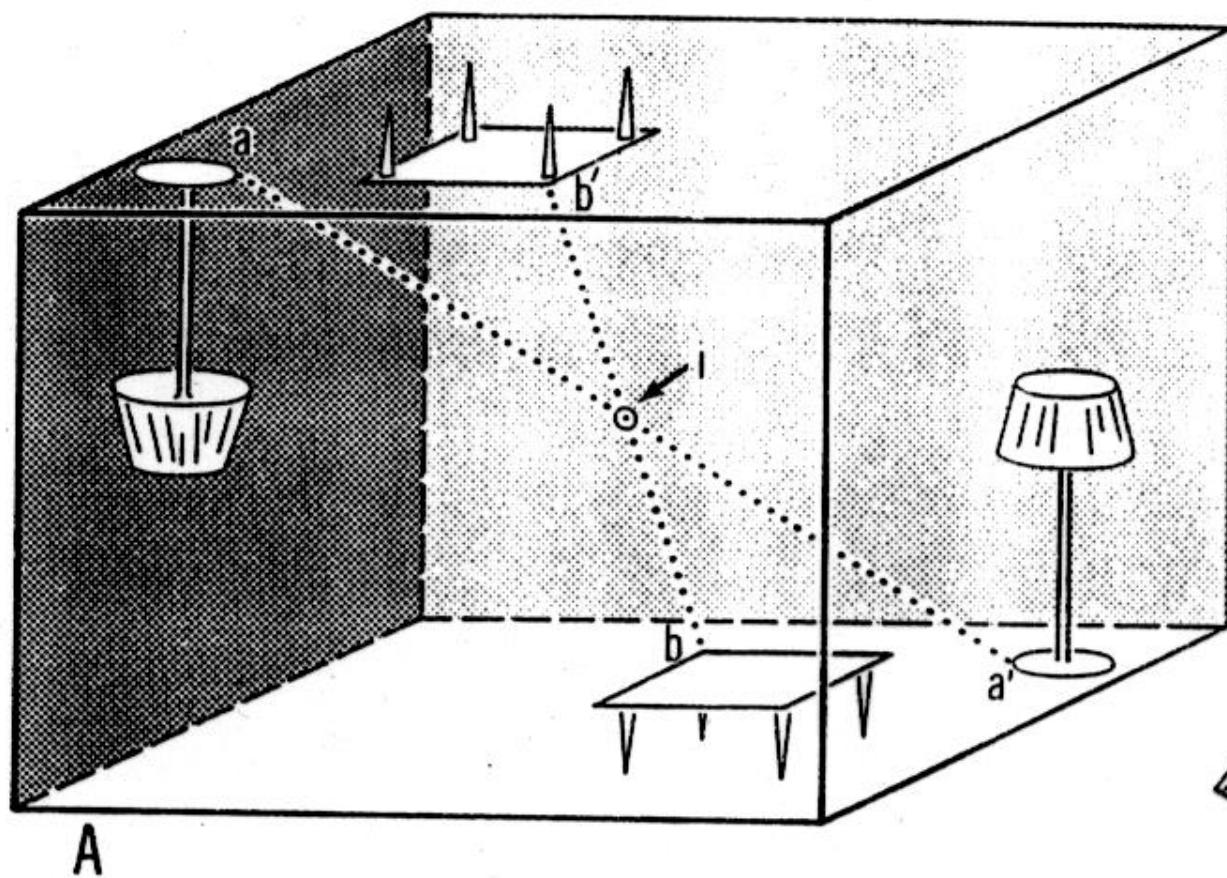


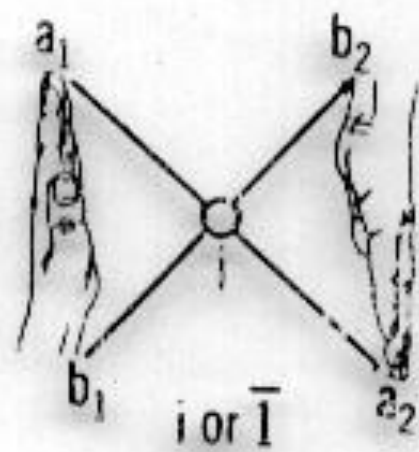
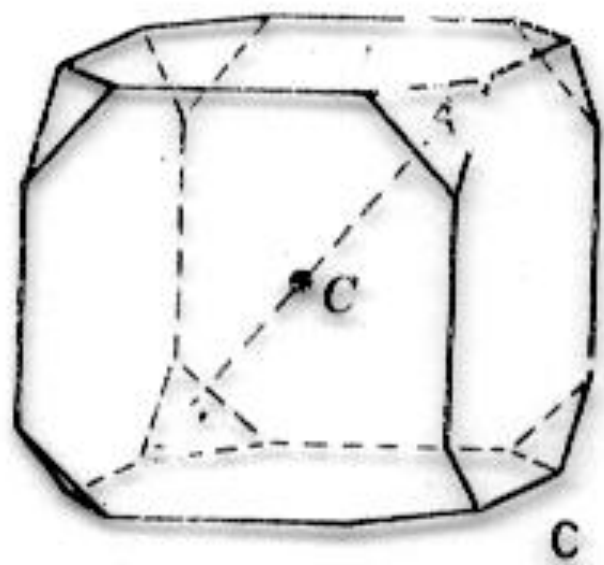
Eixos de simetria
próprios: 1, 2, 3, 4, 6
rotação



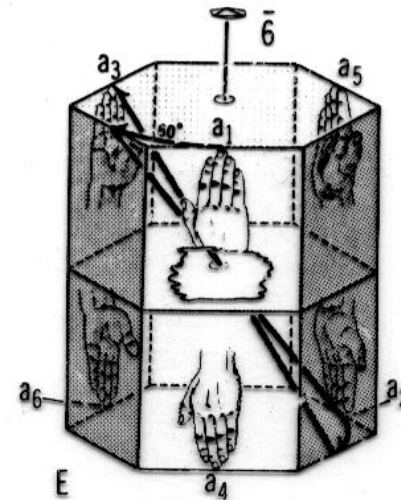
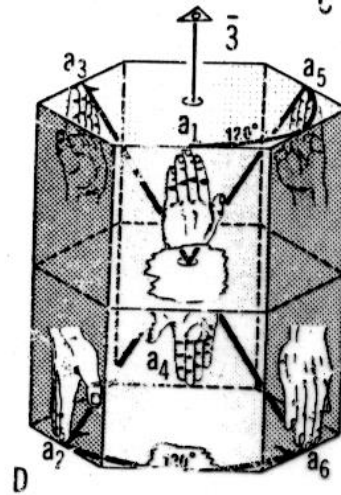
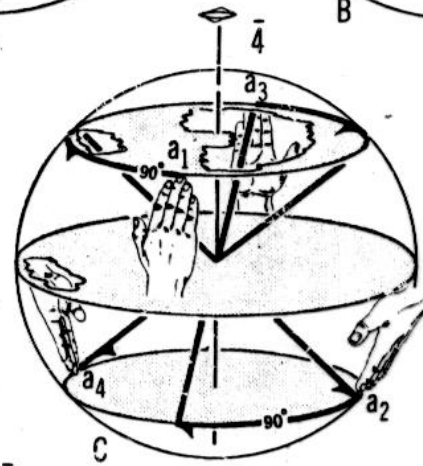
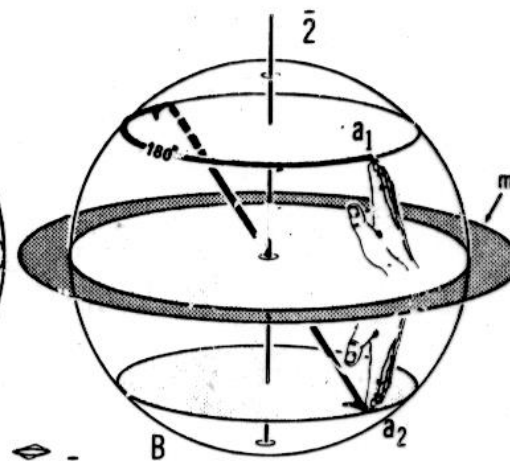
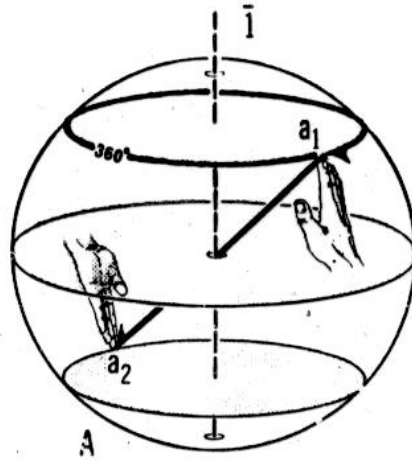


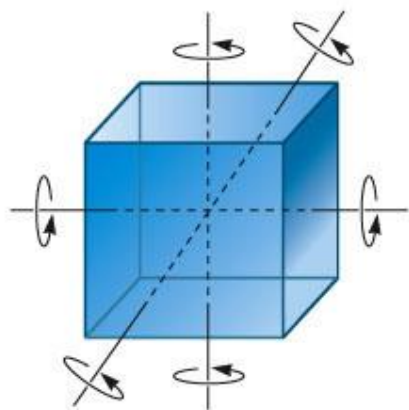
Centro de simetria – i - *inversão*



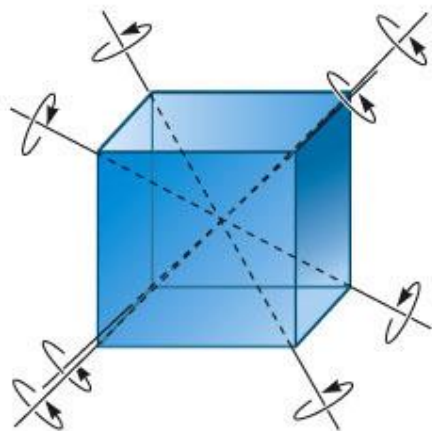


Eixos de simetria
impróprios
rotação + inversão

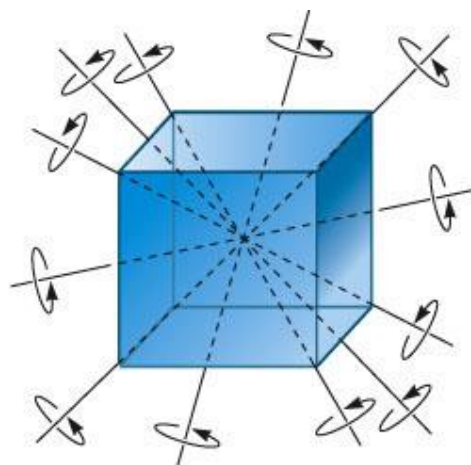




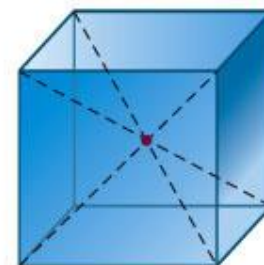
Three 4-fold axes



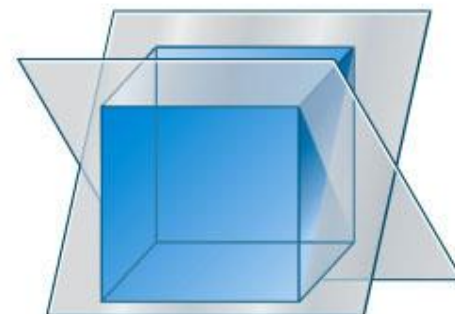
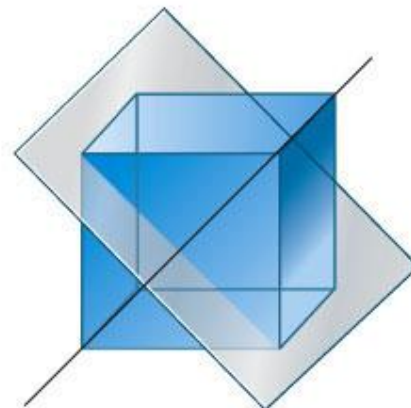
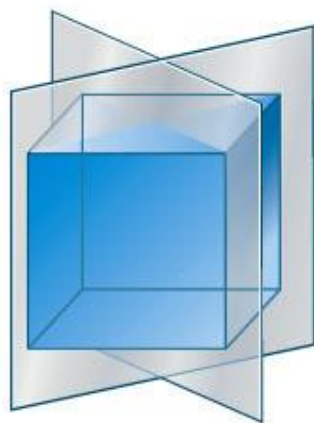
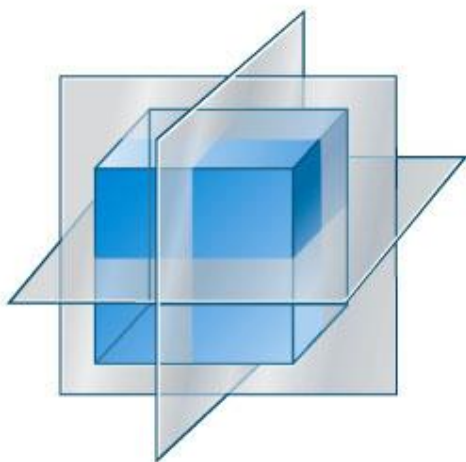
Four 3-fold axes



Six 2-fold axes



Center of inversion



Nine mirror planes

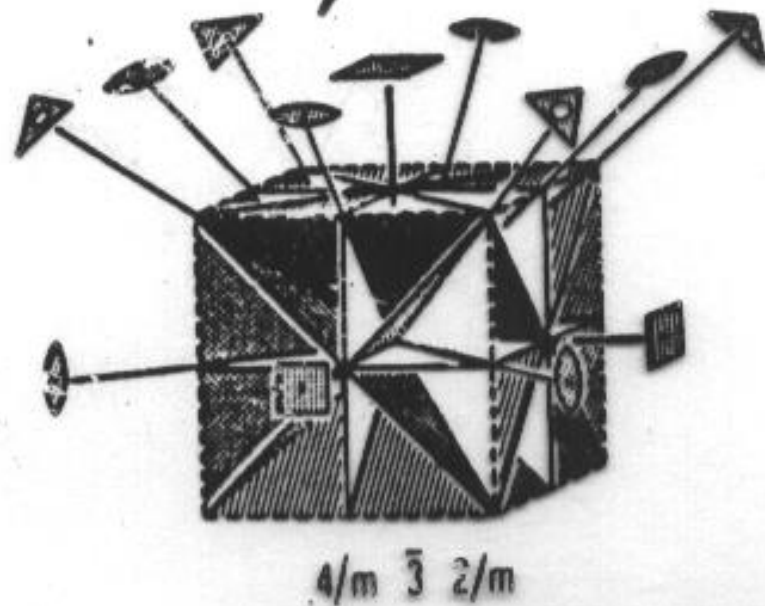
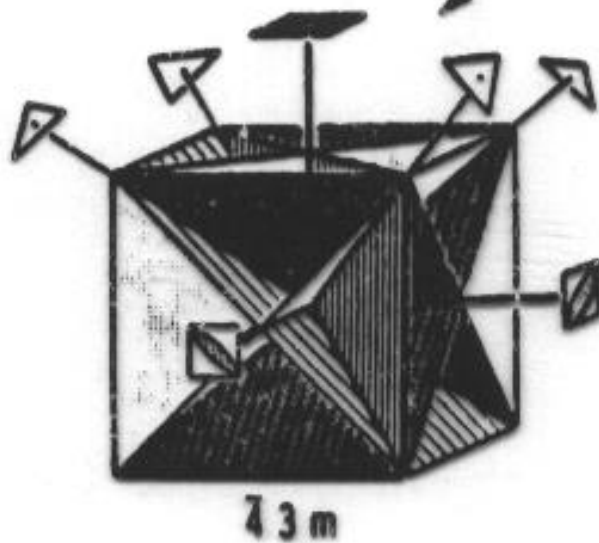
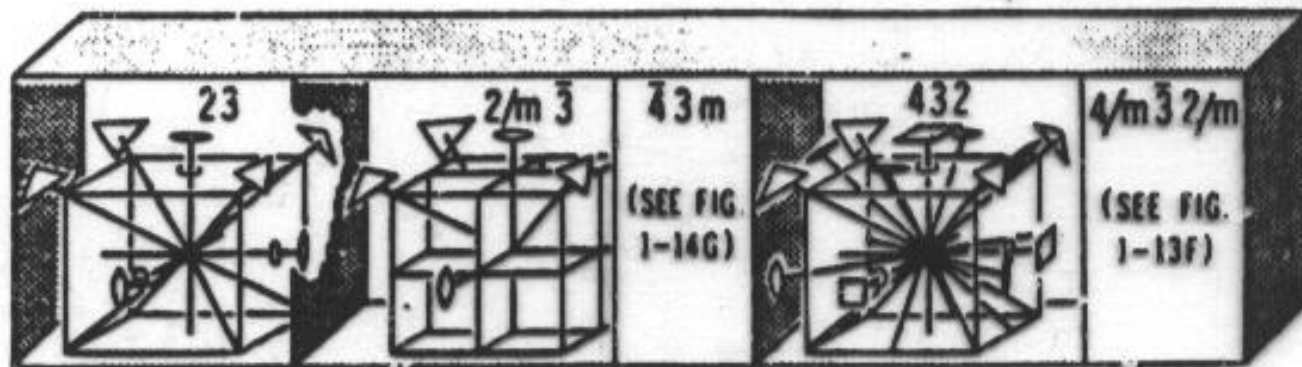
Associações de elementos de
simetria externa:
32 possibilidades
(Grupos Pontuais/Classes de
Simetria).

AS 32 CLASSES CRISTALINAS

Sistema Cristalino	Classe Cristalina	Grau de Simetria
Triclínico	1	Sem simetria
	$\bar{1}$	i
Monoclínico	2	1E2
	m	1m
	2/m	1E2, 1m, i
Ortorrômbico	222	3E2
	mm2	1E2, 2m
	2/m2/m2/m	3E2, 3m, i
Tetragonal	4	1E4
	$\bar{4}$	1E $\bar{4}$
	4/m	1E4, 1m, i
	422	1E4, 4E2
	4mm	1E4, 4m
	$\bar{4}2m$	1E $\bar{4}$, 2E2, 2m
	4/m2/m2/m	1E4, 4E2, 5m, i
Trigonal	3	1E3
	$\bar{3}$	1E $\bar{3}$
	32	1E3, 3E2
	3m	1E3, 3m
	$\bar{3}2/m$	1E $\bar{3}$, 3E2, 3m, i
Hexagonal	6	1E6
	$\bar{6}$	1E $\bar{6}$
	6/m	1E6, 1m, i
	622	1E6, 6E2
	6mm	1E6, 6m
	$\bar{6}m2$	1E $\bar{6}$, 3E2, 3m
	6/m2/m2/m	1E6, 6E2, 7m, i
Isométrico (Cúbico)	23	4E3, 3E2
	2/m $\bar{3}$	4E $\bar{3}$, 3E2, 3m, i
	432	4E3, 3E4, 6E2
	$\bar{4}3m$	4E3, 3E $\bar{4}$, 6m
	4/m $\bar{3}2/m$	4E $\bar{3}$, 3E4, 6E2, 9m, i

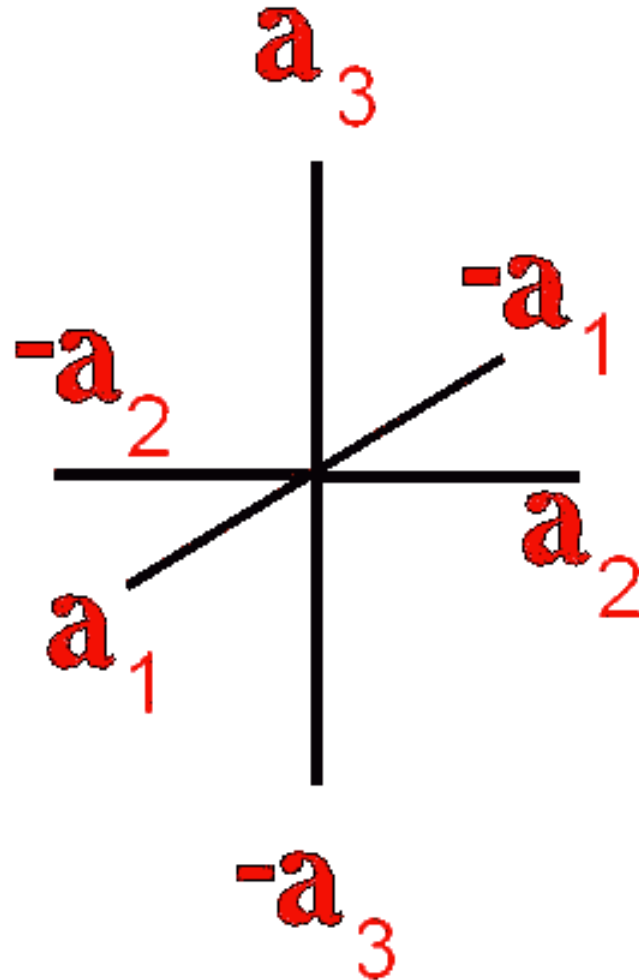
X					
$\bar{X}$					
X/m	$1/m = m = \bar{2}$		$3/m = \bar{6}$		
$Xm(m)$	$1m = m = \bar{2}$				
$X2(2)$	$12 = 2$				
$\bar{X}2, \bar{X}m$	$\bar{1}2 = 2/m$ $\bar{1}m = 2/m$	$\bar{2}2 = 2mm$ $\bar{2}m = 2mm$			
$X/m2/m2/m$	$1/m 2/m 2/m$ $=$ $2/m 2/m 2/m$		$3/m 2/m 2/m$ $=$ $6/m 2/m 2/m$		

Combinações referíveis ao cubo - guia

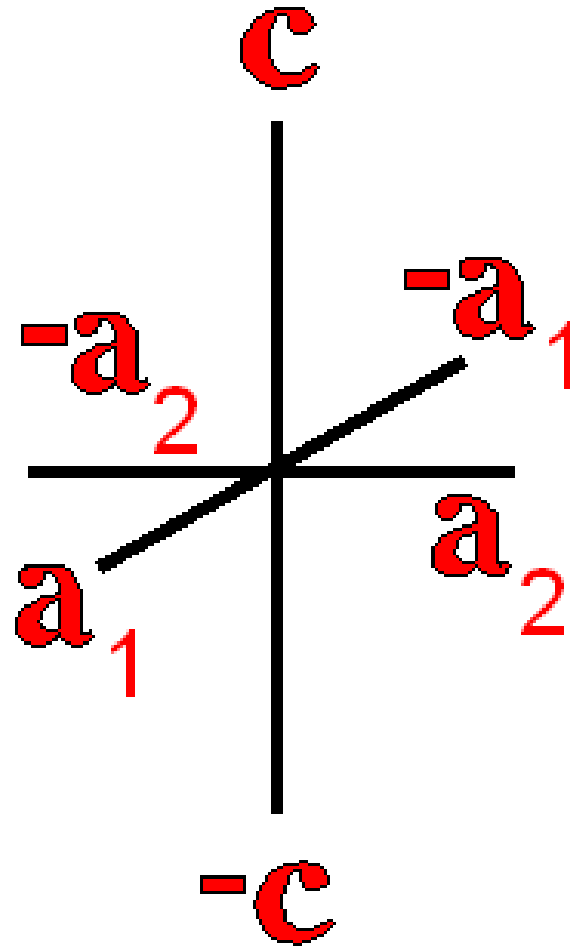


Eixos cristalográficos: orientação espacial

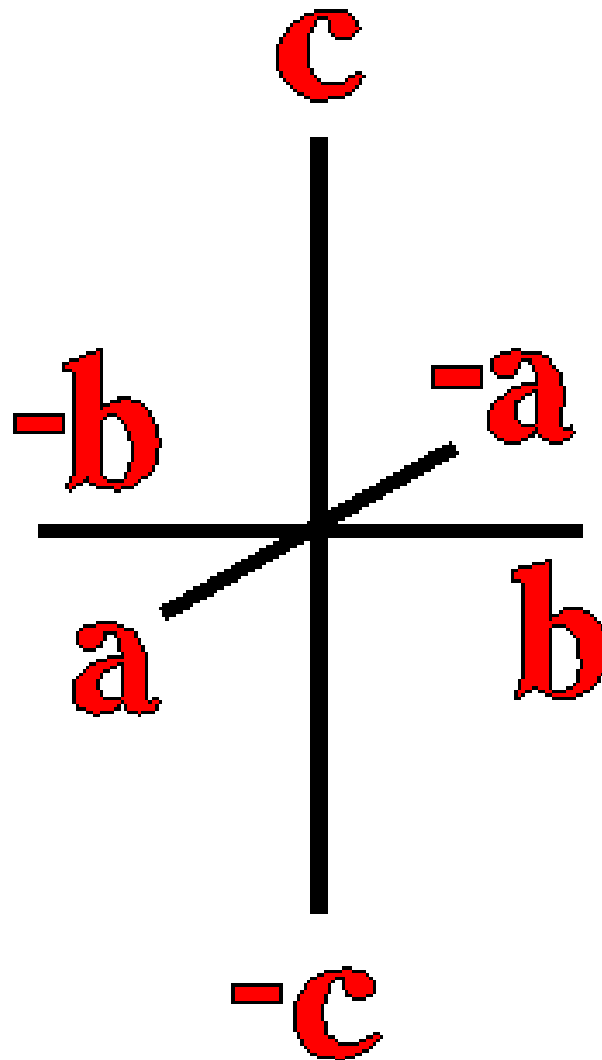
Isométrico



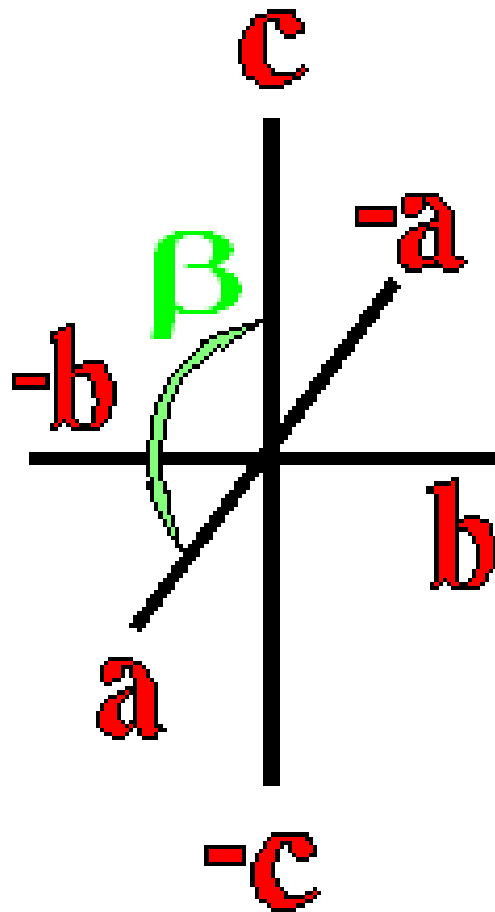
Tetragonal



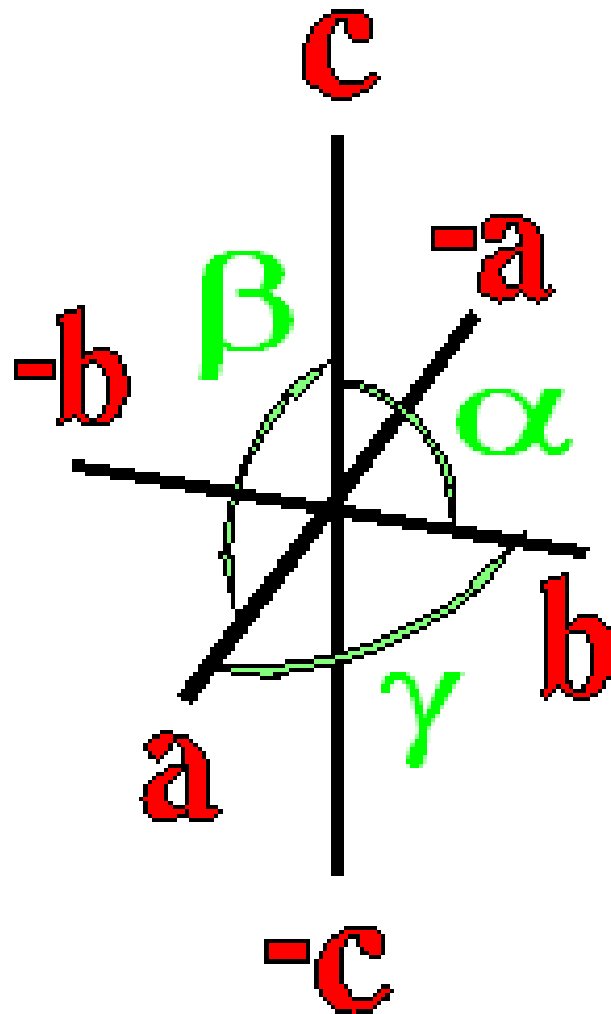
Ortorrômbico



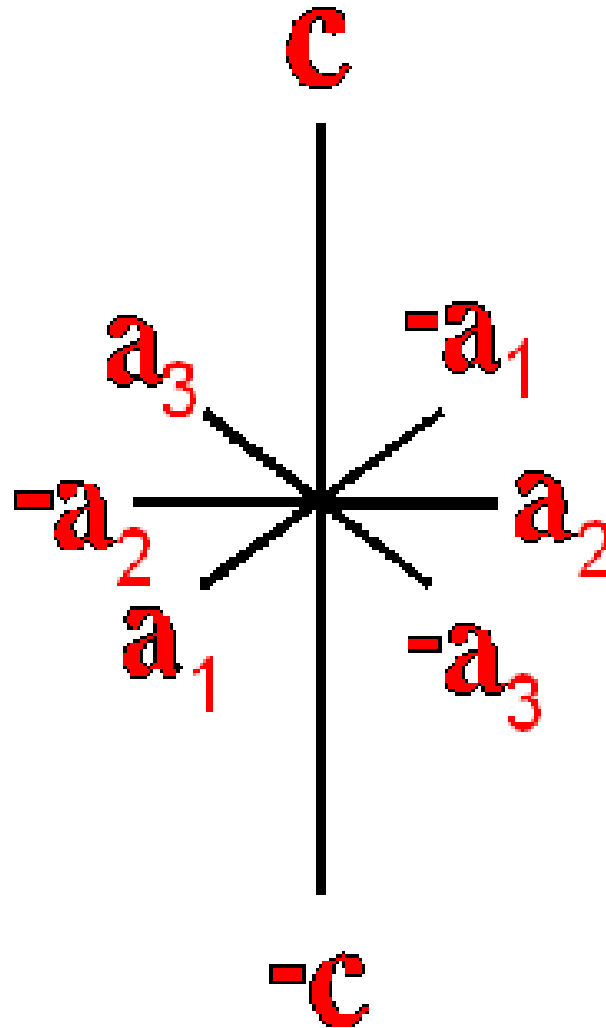
Monoclínico



Triclínico



Trigonal e hexagonal



AS 32 CLASSES CRISTALINAS

Sistema Cristalino	Classe Cristalina	Grau de Simetria
Triclínico	1	Sem simetria
	$\bar{1}$	i
Monoclínico	2	1E2
	m	1m
	2/m	1E2, 1m, i
Ortorrômbico	222	3E2
	mm2	1E2, 2m
	2/m2/m2/m	3E2, 3m, i
Tetragonal	4	1E4
	$\bar{4}$	1E $\bar{4}$
	4/m	1E4, 1m, i
	422	1E4, 4E2
	4mm	1E4, 4m
	$\bar{4}2m$	1E $\bar{4}$, 2E2, 2m
	4/m2/m2/m	1E4, 4E2, 5m, i
Trigonal	3	1E3
	$\bar{3}$	1E $\bar{3}$
	32	1E3, 3E2
	3m	1E3, 3m
	$\bar{3}2/m$	1E $\bar{3}$, 3E2, 3m, i
Hexagonal	6	1E6
	$\bar{6}$	1E $\bar{6}$
	6/m	1E6, 1m, i
	622	1E6, 6E2
	6mm	1E6, 6m
	$\bar{6}m2$	1E $\bar{6}$, 3E2, 3m
	6/m2/m2/m	1E6, 6E2, 7m, i
Isométrico (Cúbico)	23	4E3, 3E2
	2/m $\bar{3}$	4E $\bar{3}$, 3E2, 3m, i
	432	4E3, 3E4, 6E2
	$\bar{4}3m$	4E3, 3E $\bar{4}$, 6m
	4/m $\bar{3}2/m$	4E $\bar{3}$, 3E4, 6E2, 9m, i

Símbolos para classes cristalinas

Hermann-
Mauguin

	1º.	2º.	3º.
cúbico	a_1, a_2, a_3	vértices do cubo-guia	centro das arestas do cubo-guia
tetragonal	c	a_1, a_2	bissetrizes de a_1 e a_2
ortorrômbico	a	b	c
monoclínico	b	-	-
triclínico	-	-	-
hexagonal	c	a_1, a_2, a_3	bissetrizes de a_1, a_2 e a_3
trigonal	c	a_1, a_2, a_3	

AS 32 CLASSES CRISTALINAS

Sistema Cristalino	Classe Cristalina	Grau de Simetria
Triclínico	1	Sem simetria
	$\bar{1}$	i
Monoclínico	2	1E2
	m	1m
	2/m	1E2, 1m, i
Ortorrômbico	222	3E2
	mm2	1E2, 2m
	2/m2/m2/m	3E2, 3m, i
Tetragonal	4	1E4
	$\bar{4}$	1E $\bar{4}$
	4/m	1E4, 1m, i
	422	1E4, 4E2
	4mm	1E4, 4m
	$\bar{4}2m$	1E $\bar{4}$, 2E2, 2m
	4/m2/m2/m	1E4, 4E2, 5m, i
Trigonal	3	1E3
	$\bar{3}$	1E $\bar{3}$
	32	1E3, 3E2
	3m	1E3, 3m
	$\bar{3}2/m$	1E $\bar{3}$, 3E2, 3m, i
Hexagonal	6	1E6
	$\bar{6}$	1E $\bar{6}$
	6/m	1E6, 1m, i
	622	1E6, 6E2
	6mm	1E6, 6m
	$\bar{6}m2$	1E $\bar{6}$, 3E2, 3m
	6/m2/m2/m	1E6, 6E2, 7m, i
Isométrico (Cúbico)	23	4E3, 3E2
	2/m $\bar{3}$	4E $\bar{3}$, 3E2, 3m, i
	432	4E3, 3E4, 6E2
	$\bar{4}3m$	4E3, 3E $\bar{4}$, 6m
	4/m $\bar{3}2/m$	4E $\bar{3}$, 3E4, 6E2, 9m, i

TABELA A3.1 Formas dos sistemas triclinico, monoclinico e ortorrômbico

Número de faces	Nome da forma	Grupos pontuais (classe cristalina)								Forma exclusiva para
		1	$\bar{1}$	2	m	$2/m$	222	$mm2$	$2/m2/m2/m$	
1	Péδιο	+		+	+			+		
2	Pinacoide		+	+	+	+	+	+	+	
2	Domo			+	+			+		
2	Esfenoide									
4	Prisma					+	+	+	+	
4	Disfenoide						+			222
4	Pirâmide							+		$mm2$
8	Bipirâmide								+	$2/m2/m2/m$

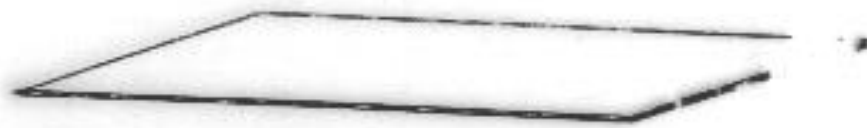


Fig. 2. Pediton (or monohedron, a form consisting of a single plane surface).



Fig. 3. Pinacoid (a form consisting of a pair of parallel plane surfaces).

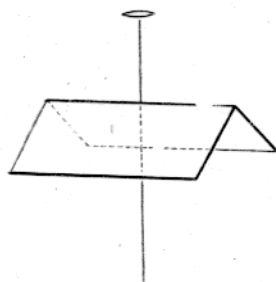


Fig. 4i. Sphenoid (or dihedron) of class 2.

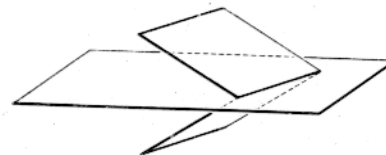


Fig. 4ii. Sphenoid (or dihedron) of class m .

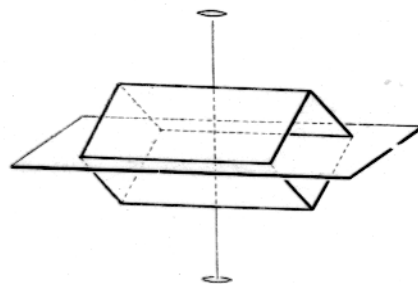


Fig. 5. Prism.

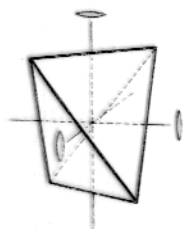


Fig. 6. Rhombic disphenoid.

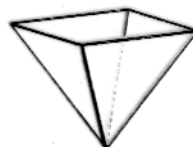


Fig. 7. Rhombic pyramid.

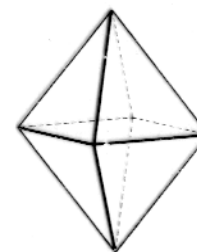


Fig. 8. Rhombic dipyramid.

TABELA A3.2 Formas do sistema tetragonal

Número de faces	Nome da forma	Grupos pontuais (classe cristalina)							Forma exclusiva para
		4	$\bar{4}$	$4m$	422	$4mm$	$\bar{4}2m$	$4/m2/m2/m$	
1	Pédio	+				+			
2	Pinacoide		+	+	+		+	+	
4	Prisma tetragonal	+	+	+	+	+	+	+	
4	Pirâmide tetragonal	+				+			
4	Disfenoide tetragonal		+				+		
8	Prisma ditetragonal				+	+	+	+	
8	Bipirâmide tetragonal			+	+		+	+	
8	Trapezoedro tetragonal				+				422
8	Escalenoedro tetragonal						+		$\bar{4}2m$
8	Pirâmide ditetragonal					+			$4mm$
16	Bipirâmide tetragonal							+	$4/m2/m2/m$

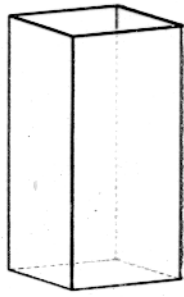


Fig. 9. Tetragonal prism.

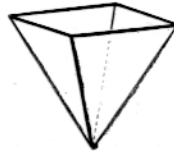


Fig. 10. Tetragonal pyramid.



Fig. 11. Tetragonal disphenoid.

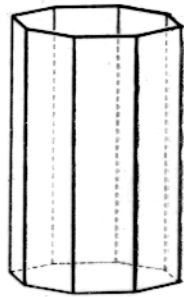


Fig. 12. Ditetragonal prism.

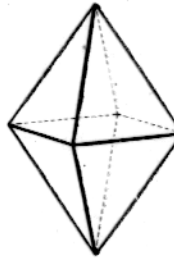


Fig. 13. Tetragonal dipyramid.



Fig. 14. Tetragonal trapezohedron.

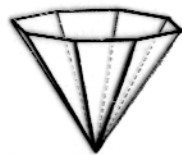


Fig. 15. Ditetragonal pyramid.



Fig. 16. Tetragonal scalenohedron.

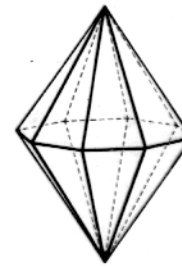


Fig. 17. Ditetragonal dipyramid.

TABELA A3.3 Formas do sistema hexagonal

Número de faces	Nome da forma	Grupos pontuais (classe cristalina)												Forma exclusiva para
		3	$\bar{3}$	32	3m	$\bar{3}2/m$	6	$\bar{6}$	6/m	622	6mm	$\bar{6}m2$	6/m ² /m ² /m	
1	Péδιο	+			+		+				+			
2	Pinacoide		+	+		+		+	+	+		+	+	
3	Prisma trigonal	+		+	+			+				+		
3	Pirâmide trigonal	+			+									
6	Prisma ditrigonal			+	+							+		
6	Prisma hexagonal		+	+	+	+	+		+	+	+	+	+	
6	Bipirâmide trigonal			+				+				+		
6	Romboedro		+	+		+								
6	Trapezoedro trigonal			+										
6	Pirâmide ditetragonal				+									32
6	Pirâmide hexagonal				+		+				+			3m
12	Bipirâmide hexagonal					+			+	+		+	+	
12	Escalenoedro hexagonal					+							+	
12	Prisma dihexagonal					+				+	+			$\bar{3}2/m$
12	Bipirâmide ditrigonal											+		
12	Trapezoedro hexagonal									+				$\bar{6}/m2$
12	Pirâmide dihexagonal										+			6mm
24	Bipirâmide dihexagonal												+	6/m ² /m ² /m

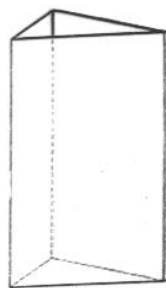


Fig. 18. Trigonal prism.

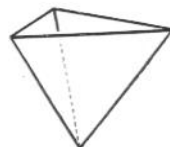


Fig. 19. Trigonal pyramid.

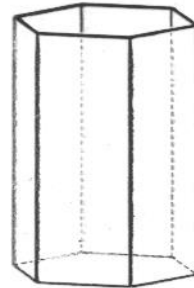


Fig. 20. Hexagonal prism.

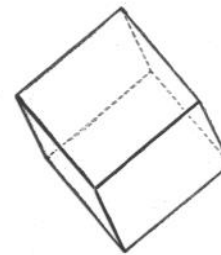


Fig. 21. Rhombohedron.

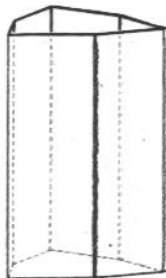


Fig. 22. Ditrigonal prism.

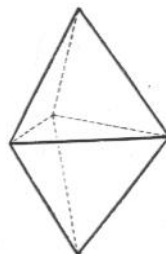


Fig. 23. Trigonal dipyramid.

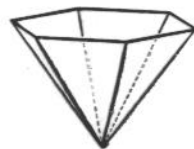


Fig. 24. Hexagonal pyramid.

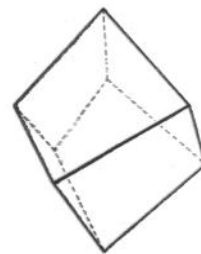


Fig. 25. Trigonal trapezohedron.

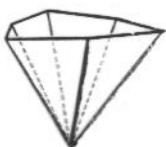


Fig. 26. Ditrigonal pyramid.

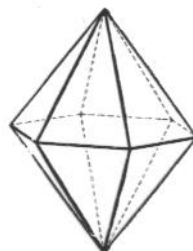


Fig. 27. Hexagonal dipyramid.

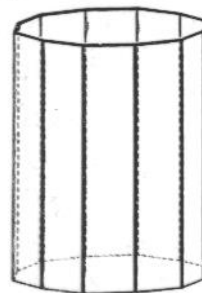


Fig. 28. Dihexagonal prism.

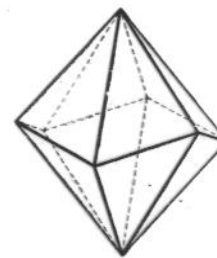


Fig. 29. Hexagonal scalenohedron.

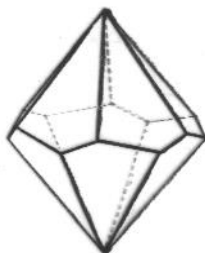


Fig. 30. Hexagonal trapezohedron.

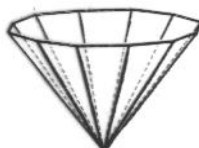


Fig. 31. Dihexagonal pyramid.

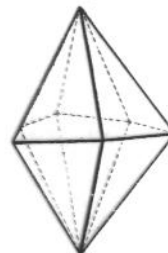


Fig. 32. Ditrigonal dipyramid.

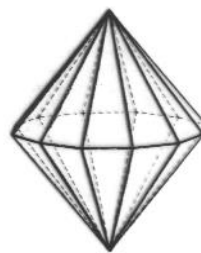


Fig. 33. Dihexagon dipyramid.

TABELA A3.4 Formas do sistema isométrico

Número de faces	Nome da forma	Grupos pontuais (classe cristalina)					Forma exclusiva para
		23	432	$2/m\bar{3}$	$\bar{4}3m$	$4m\bar{3}2/m$	
4	Tetraedro	+			+		
6	Cubo	+	+	+	+	+	
8	Octaedro		+	+		+	
12	Dodecaedro	+	+	+	+	+	
	Piritoedro	+		+			
	Tristetraedro	+			+		
	Dodecaedro deltoide	+			+		
	Tetartoide	+					23
24	Tetrahexaedro		+		+	+	
	Trapezoedro		+	+		+	
	Trisoctaedro		+	+		+	
	Hexatetraedro				+		$\bar{4}3m$
	Diploide			+			$2/m\bar{3}$
	Giroide		+				432
48	Hexaoctaedro					+	$4/m\bar{3}2/m$

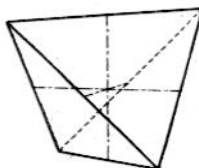


Fig. 34. Tetrahedron.

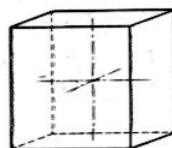


Fig. 35. Cube.

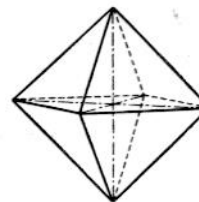


Fig. 36. Octahedron.

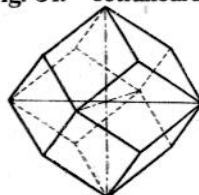


Fig. 37. Dodecahedron.

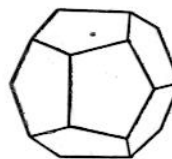


Fig. 38. Pyritohedron.

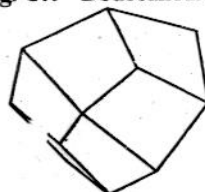


Fig. 39. Deltohedron.

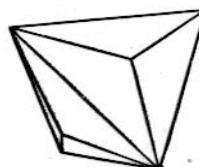


Fig. 40. Tristetrahedron.

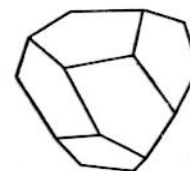


Fig. 41. Tetartoid.

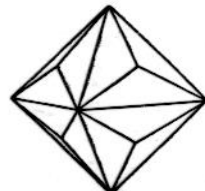


Fig. 42. Trisoctahedron.

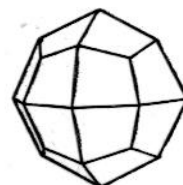


Fig. 43. Trapezohedron.

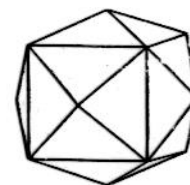


Fig. 44. Tetrahexahedron.

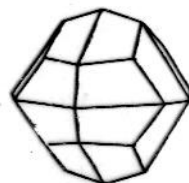


Fig. 45. Diploid.

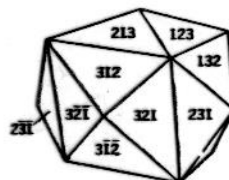


Fig. 46. Hextetrahedron.



Fig. 47. Gyroid.



Fig. 48. Hexoctahedron.