Universidad Industrial de Santander

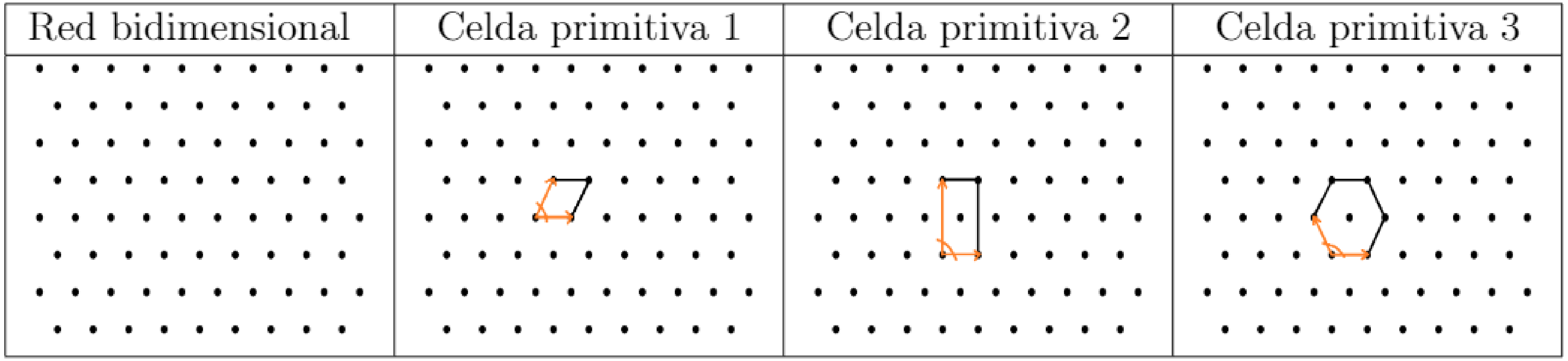
Redes de Bravais

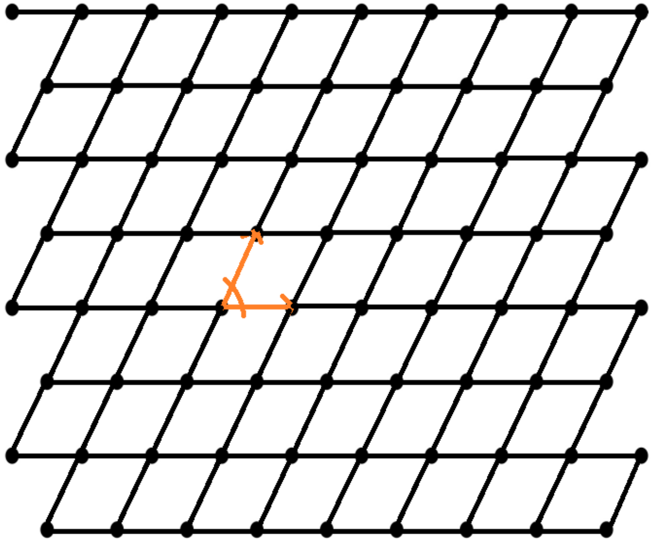
Métodos matemáticos para fisicos I
Profesor: Luis Nuñez

Gabriela Sánchez Ariza - 2200816
Nicolás Toledo - 2200017

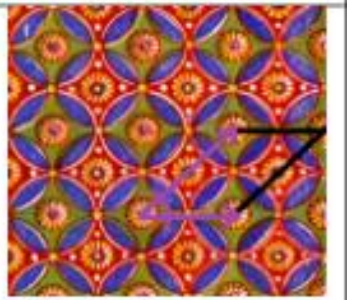
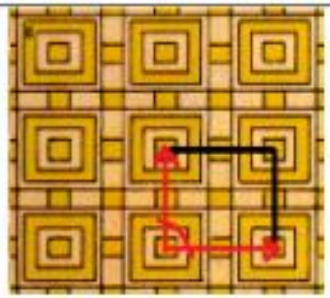
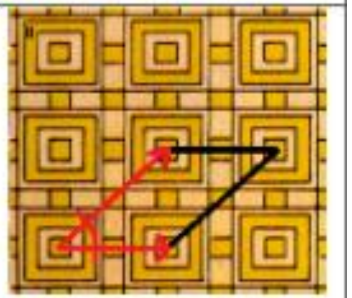
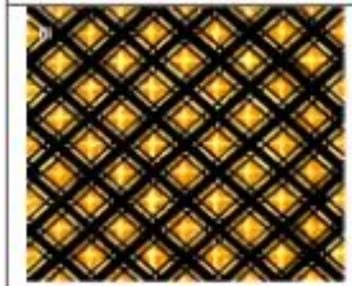
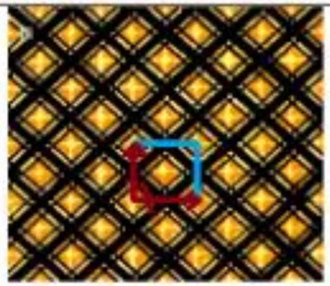
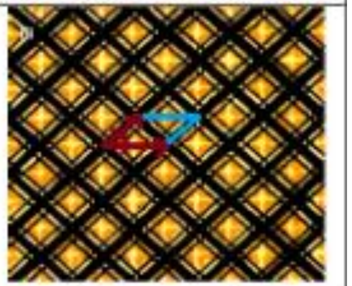
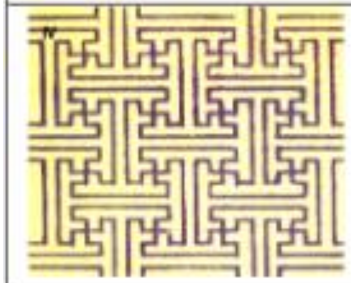
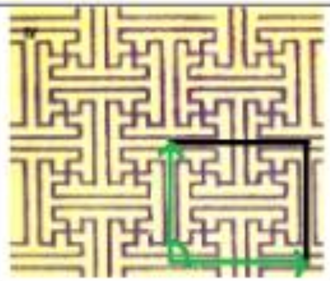
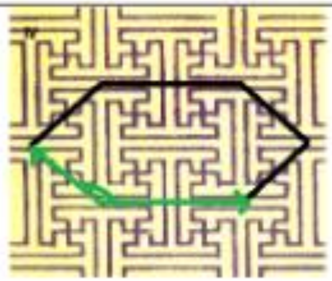
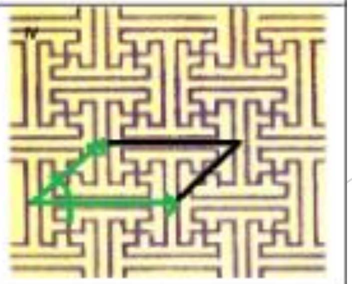
Inciso a

Parte I

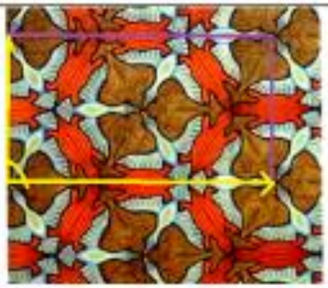
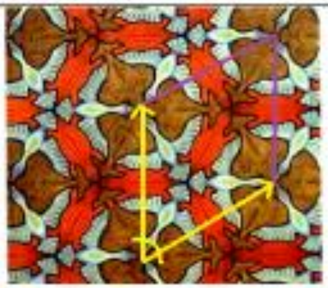
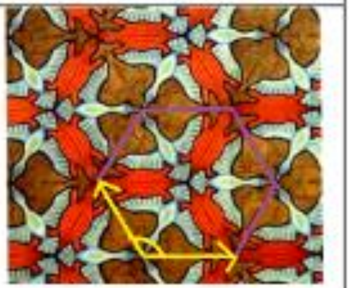
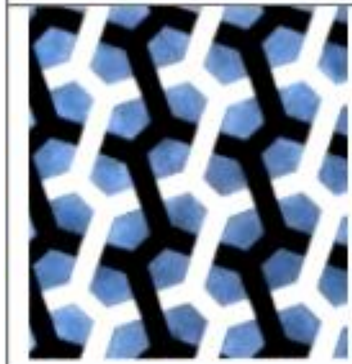
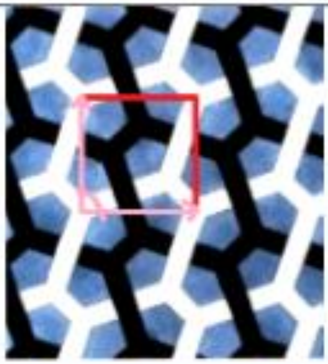
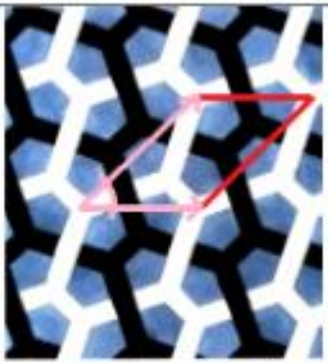
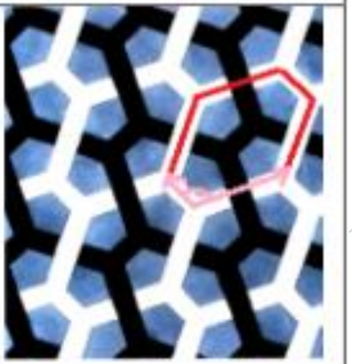




Parte II

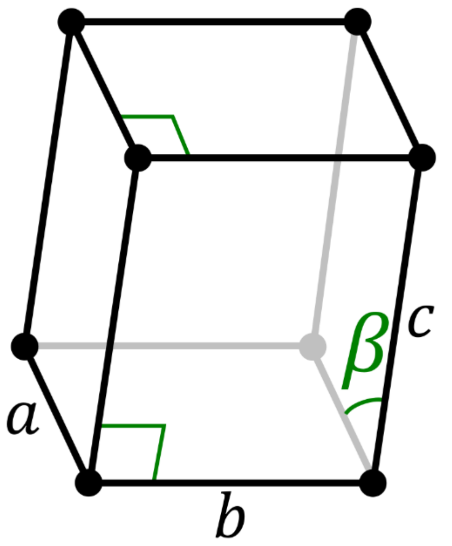
Detalles geométricos	Celda primitiva 1	Celda primitiva 2	Celda primitiva 3
			
			
			
			

Parte III

Teselados	Celda primitiva 1	Celda primitiva 2	Celda primitiva 3
			
			
			
			

Inciso b

Monoclínico



|a|≠|b|≠|c| y α=γ=90°
β< 90°

$$\boldsymbol{a} = (a1, a2, a3), \qquad \boldsymbol{b} = (b1, b2, b3), \qquad \boldsymbol{c} = (c1, c2, c3)$$

$$v = \boldsymbol{c} * (\boldsymbol{a}x\boldsymbol{b}) = \begin{vmatrix} c1 & c2 & c3 \\ a1 & a2 & a3 \\ b1 & b2 & b3 \end{vmatrix}$$

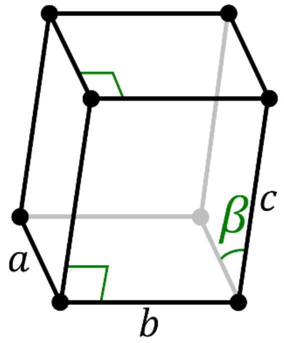
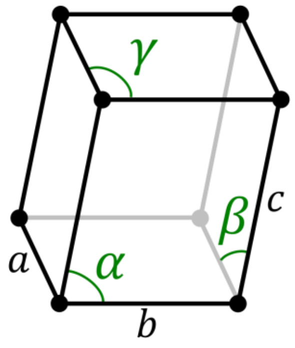
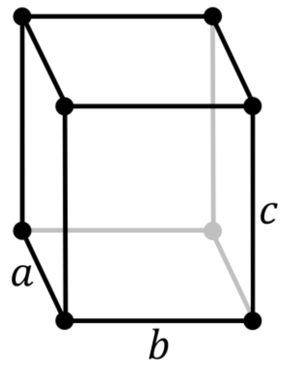
$$v^2 = Det(\boldsymbol{D}\boldsymbol{D}^T) = \begin{vmatrix} \boldsymbol{c}.\boldsymbol{c} & \boldsymbol{c}.\boldsymbol{a} & \boldsymbol{c}.\boldsymbol{b} \\ \boldsymbol{c}.\boldsymbol{a} & \boldsymbol{a}.\boldsymbol{a} & \boldsymbol{a}.\boldsymbol{b} \\ \boldsymbol{c}.\boldsymbol{b} & \boldsymbol{a}.\boldsymbol{b} & \boldsymbol{b}.\boldsymbol{b} \end{vmatrix}$$

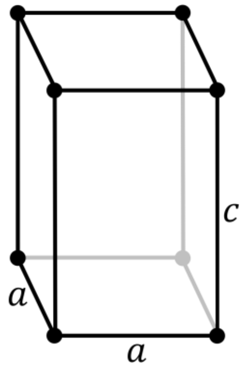
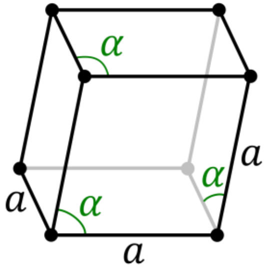
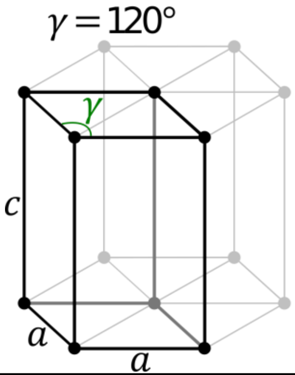
$$v^2 = Det(\boldsymbol{D}\boldsymbol{D}^T) = (\mathbf{c}.\mathbf{d})((\mathbf{a}.\mathbf{a})(\mathbf{b}.\mathbf{b}) - (\mathbf{a}.\mathbf{b})^2) - (\mathbf{c}.\mathbf{a})((\mathbf{c}.\mathbf{a})(\mathbf{b}.\mathbf{b}) - (\mathbf{a}.\mathbf{b})(\mathbf{c}.\mathbf{b})) + (\boldsymbol{c}.\boldsymbol{b})((\boldsymbol{c}.\boldsymbol{a})(\boldsymbol{a}.\boldsymbol{b}) - (\boldsymbol{a}.\boldsymbol{a})(\boldsymbol{c}.\boldsymbol{b}))$$

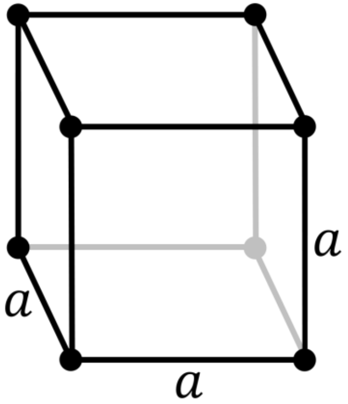
$$v = |\boldsymbol{a}||\boldsymbol{b}||\boldsymbol{c}|\sqrt{1 - \cos^2\gamma - \cos^2\beta - \cos^2\alpha + 2cos\gamma cos\beta cos\alpha}$$

$$v = |\boldsymbol{a}||\boldsymbol{b}||\boldsymbol{c}|\sqrt{1 - \cos^2\beta}$$

$$v = |\boldsymbol{a}||\boldsymbol{b}||\boldsymbol{c}|sin\beta$$

Monoclínica		$v = \|\boldsymbol{a}\|\|\boldsymbol{b}\|\|\boldsymbol{c}\| sin\beta$
Triclínica		$v = \|\boldsymbol{a}\|\|\boldsymbol{b}\|\|\boldsymbol{c}\| \sqrt{1 - \cos^2\alpha - \cos^2\beta - \cos^2\gamma + 2cos\alpha cos\gamma cos\beta}$
Ortorrómbica		$v = \|\boldsymbol{a}\|\|\boldsymbol{b}\|\|\boldsymbol{c}\|$

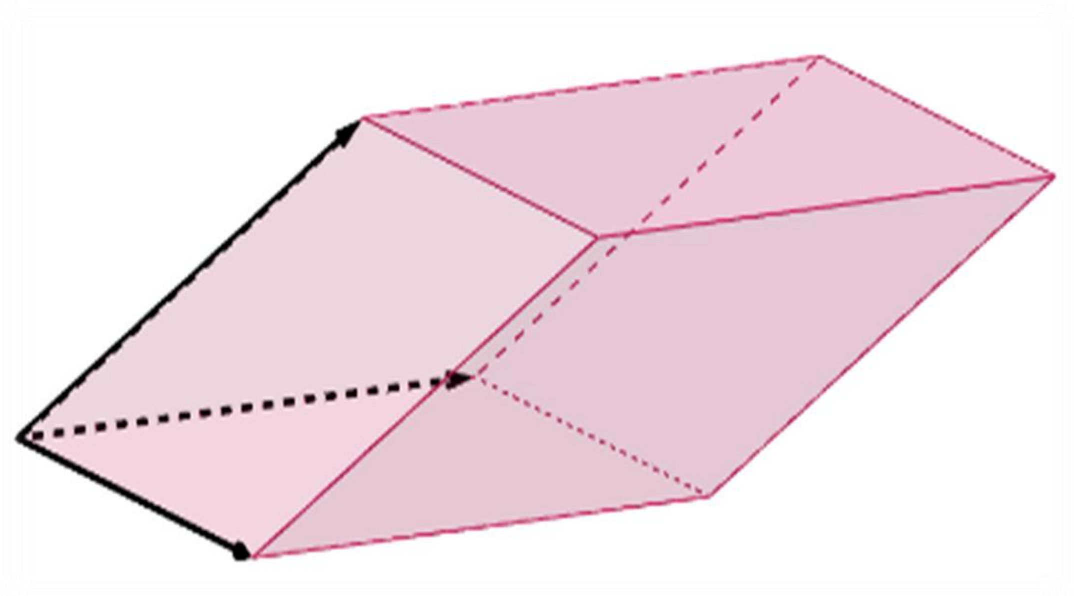
Tetragonal		$v = \|\boldsymbol{a}\|^2 \|\boldsymbol{c}\|$
Romboédrico		$v = \|\boldsymbol{a}\|^3 \sqrt{1 - 3\cos^2\alpha + 2\cos^3\alpha}$
Hexagonal		$v = \|\boldsymbol{a}\|^2 \|\boldsymbol{c}\| \frac{\sqrt{3}}{2}$

Cúbico		$v = \|\boldsymbol{a}\|^3$

Inciso c

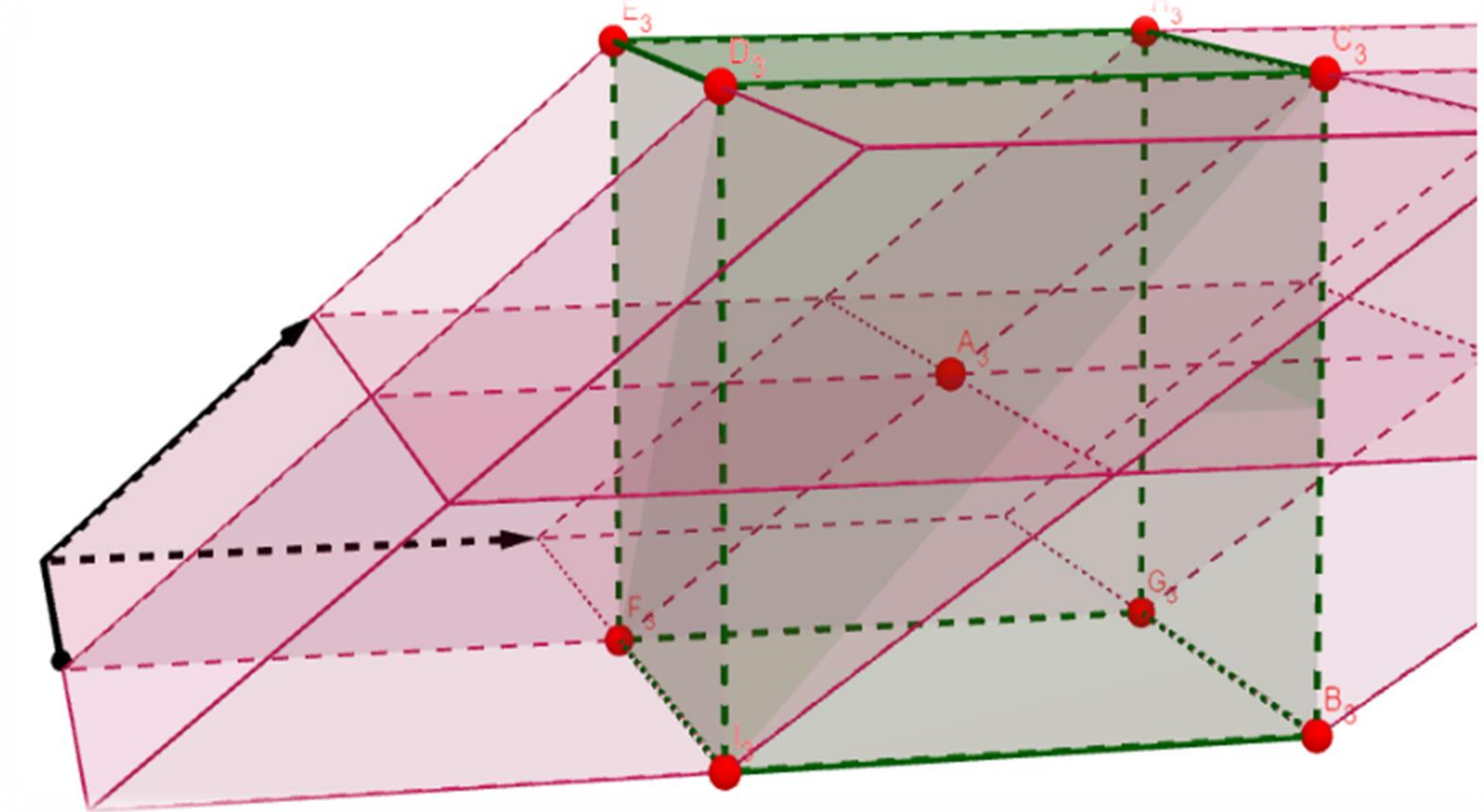
Parte I: BCC $\boldsymbol{a} = a\hat{\boldsymbol{\imath}}, \boldsymbol{b} = a\hat{\boldsymbol{\jmath}}, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{\jmath}} + \widehat{\boldsymbol{k}})/2$

$$\mathbf{c}\cdot(\mathbf{a}\times\mathbf{b}) = \begin{vmatrix} c_1 & c_2 & c_3 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} \frac{a}{2} & \frac{a}{2} & \frac{a}{2} \\ a & 0 & 0 \\ 0 & a & 0 \end{vmatrix} = \frac{a^3}{2}$$



Inciso c

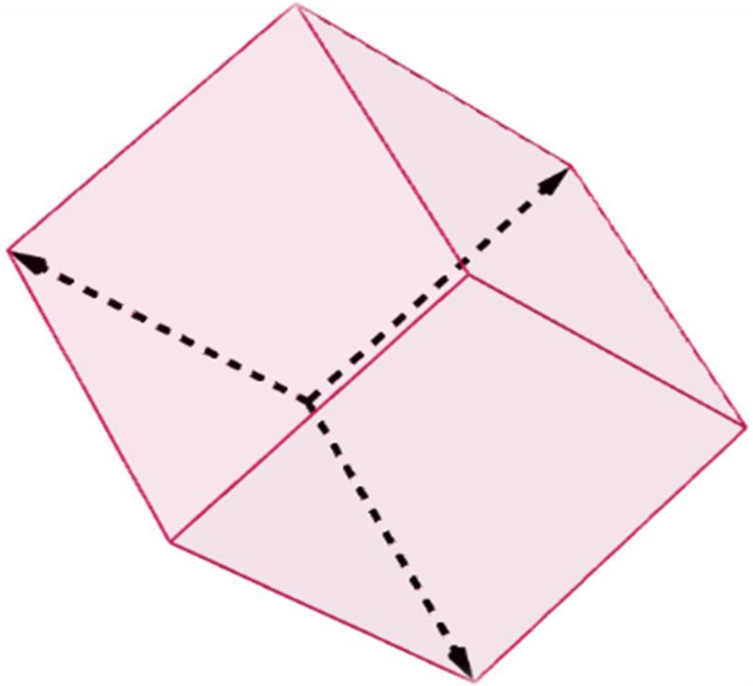
Parte I: BCC



Inciso c

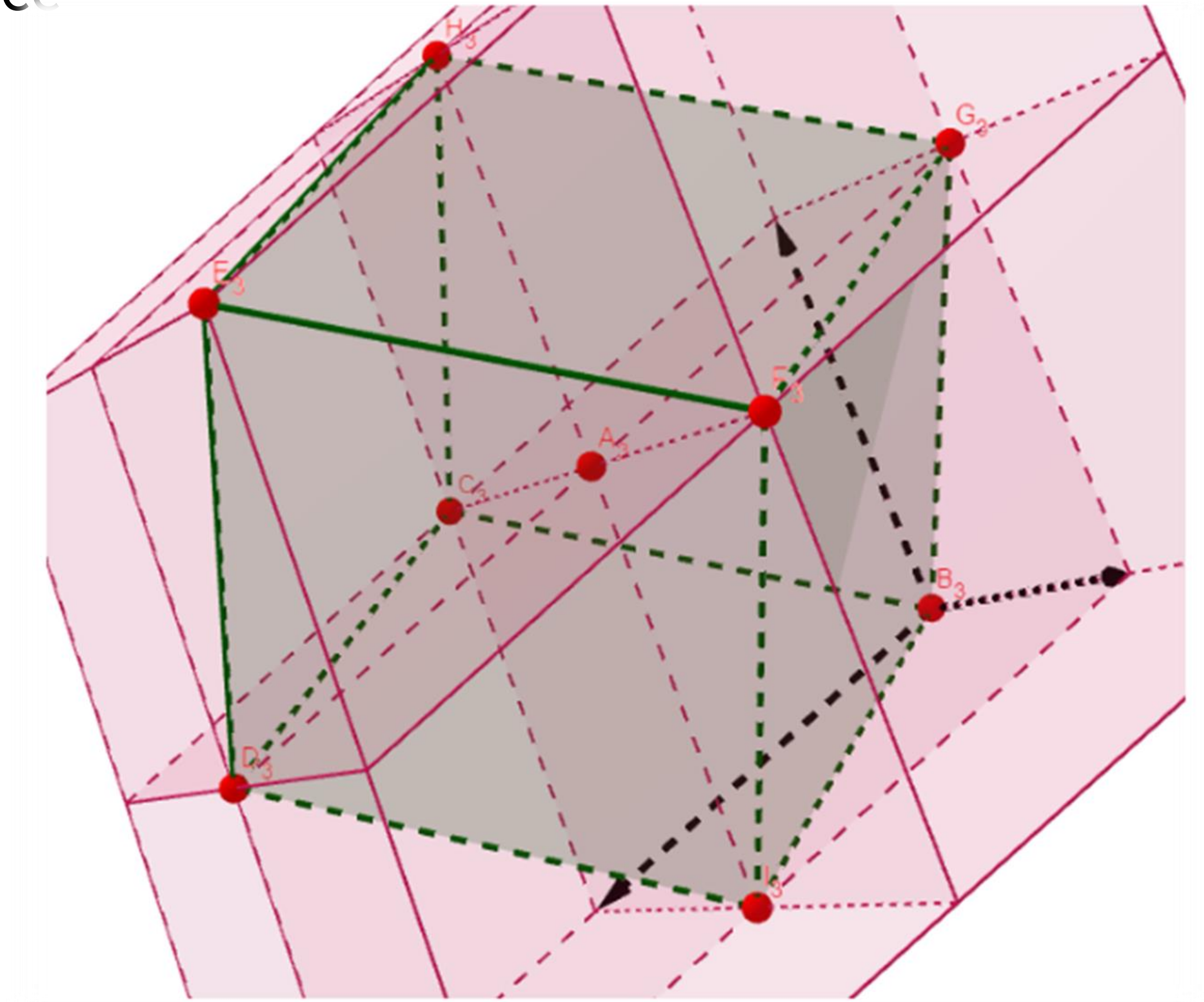
Parte II: BCC $\boldsymbol{a} = a(\hat{\boldsymbol{j}} + \widehat{\boldsymbol{k}} - \hat{\boldsymbol{\imath}})/\mathbf{2}, \boldsymbol{b} = a(\hat{\boldsymbol{\imath}} + \widehat{\boldsymbol{k}} - \hat{\boldsymbol{j}})/\mathbf{2}, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{j}} - \widehat{\boldsymbol{k}})/\mathbf{2}$

$$\mathbf{c} \cdot (\mathbf{a} \times \mathbf{b}) = \begin{vmatrix} c_1 & c_2 & c_3 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} \frac{a}{2} & \frac{a}{2} & -\frac{a}{2} \\ -\frac{a}{2} & \frac{a}{2} & \frac{a}{2} \\ \frac{a}{2} & -\frac{a}{2} & \frac{a}{2} \end{vmatrix} = \frac{a^3}{2}$$



Inciso c

Parte II: BCC

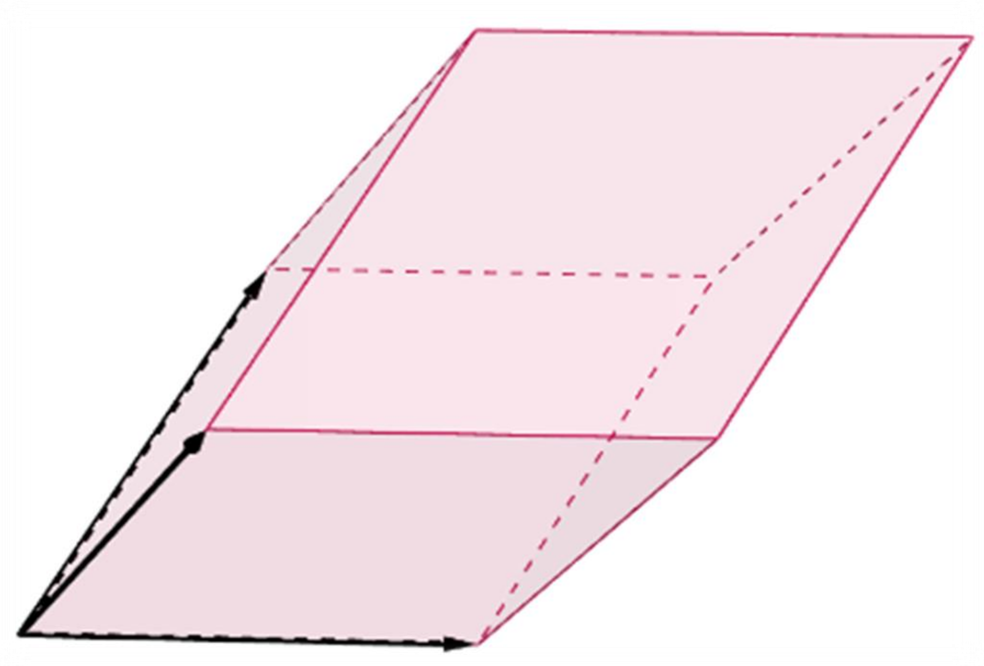


Inciso c

Parte III: FCC

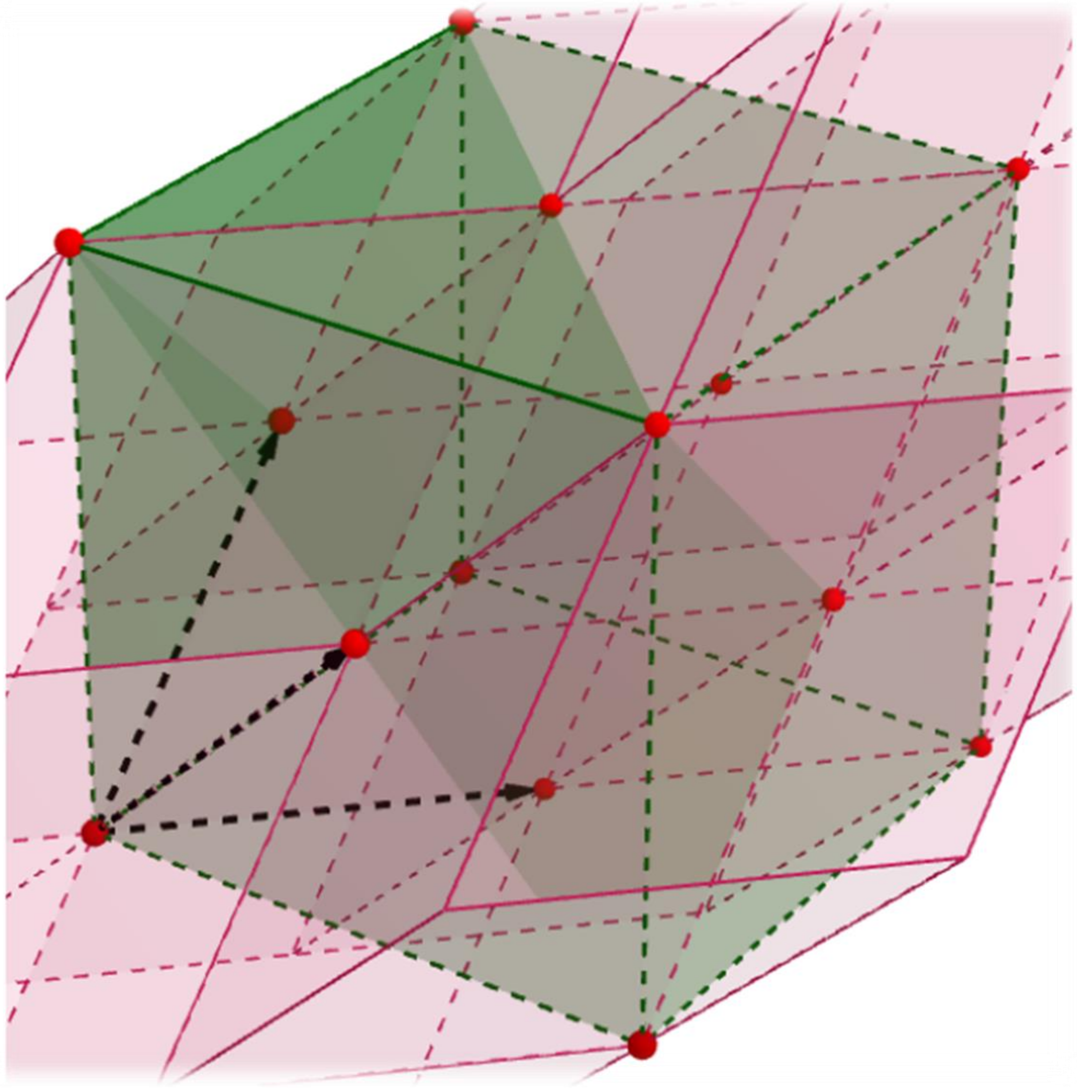
$$\boldsymbol{a} = a(\hat{\boldsymbol{j}} + \widehat{\boldsymbol{k}})/\mathbf{2}, \boldsymbol{b} = a(\hat{\boldsymbol{\imath}} + \widehat{\boldsymbol{k}})/\mathbf{2}, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{j}})/\mathbf{2}$$

$$\mathbf{c} \cdot (\mathbf{a} \times \mathbf{b}) = \begin{vmatrix} c_1 & c_2 & c_3 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} \frac{a}{2} & \frac{a}{2} & 0 \\ 0 & \frac{a}{2} & \frac{a}{2} \\ \frac{a}{2} & 0 & \frac{a}{2} \end{vmatrix} = \frac{a^3}{4}$$



Inciso c

Parte III: FCC



Inciso d

Caso cúbico simple: $\boldsymbol{a} = a\hat{\boldsymbol{\imath}}, \boldsymbol{b} = a\hat{\boldsymbol{\jmath}}, \boldsymbol{c} = a\hat{\boldsymbol{k}}$

$$\mathbf{a}' = \frac{\mathbf{b}\times\mathbf{c}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(a^2,0,0)}{a^3} = \frac{1}{a}\hat{\mathbf{i}} = (\frac{1}{a},0,0)$$

$$\mathbf{b}' = \frac{\mathbf{c}\times\mathbf{a}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(0,a^2,0)}{a^3} = \frac{1}{a}\hat{\mathbf{j}} = (0,\frac{1}{a},0)$$

$$\mathbf{c}'\cdot(\mathbf{a}'\times\mathbf{b}') = \mathrm{V} = \frac{1}{a^3}$$

$$\mathbf{c}' = \frac{\mathbf{a}\times\mathbf{b}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(0,0,a^2)}{a^3} = \frac{1}{a}\hat{\mathbf{k}} = (0,0,\frac{1}{a})$$

Inciso d

BCC inciso C-1: $\boldsymbol{a} = a\hat{\boldsymbol{\imath}}, \boldsymbol{b} = a\hat{\boldsymbol{\jmath}}, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{\jmath}} + \widehat{\boldsymbol{k}})/2$

$$\mathbf{a}' = \frac{\mathbf{b}\times\mathbf{c}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(\frac{a^2}{2}, 0, -\frac{a^2}{2})}{\frac{a^3}{2}} = (\frac{1}{a}, 0, -\frac{1}{a})$$

$$\mathbf{b}' = \frac{\mathbf{c}\times\mathbf{a}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(0, \frac{a^2}{2}, -\frac{a^2}{2})}{\frac{a^3}{2}} = (0, \frac{1}{a}, -\frac{1}{a})$$

$$\mathbf{c}'\cdot(\mathbf{a}'\times\mathbf{b}') = \mathrm{V} = \frac{2}{a^3}$$

$$\mathbf{c}' = \frac{\mathbf{a}\times\mathbf{b}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(0, 0, a^2)}{\frac{a^3}{2}} = (0, 0, \frac{2}{a})$$

Inciso d

BCC inciso C-2: $\boldsymbol{a} = a(\hat{\boldsymbol{j}} + \widehat{\boldsymbol{k}} - \hat{\boldsymbol{\imath}})/\mathbf{2}, \boldsymbol{b} = a(\hat{\boldsymbol{\imath}} + \widehat{\boldsymbol{k}} - \hat{\boldsymbol{j}})/\mathbf{2}, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{j}} - \widehat{\boldsymbol{k}})/\mathbf{2}$

$$\mathbf{a}' = \frac{\mathbf{b}\times\mathbf{c}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(0, \frac{a^2}{2}, \frac{a^2}{2})}{\frac{a^3}{2}} = (0, \frac{1}{a}, \frac{1}{a})$$

$$\mathbf{b}' = \frac{\mathbf{c}\times\mathbf{a}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(\frac{a^2}{2}, 0, \frac{a^2}{2})}{\frac{a^3}{2}} = (\frac{1}{a}, 0, \frac{1}{a})$$

$$\mathbf{c}'\cdot(\mathbf{a}'\times\mathbf{b}') = \mathrm{V} = \frac{2}{a^3}$$

$$\mathbf{c}' = \frac{\mathbf{a}\times\mathbf{b}}{\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})} = \frac{(\frac{a^2}{2}, \frac{a^2}{2}, 0)}{\frac{a^3}{2}} = (\frac{1}{a}, \frac{1}{a}, 0)$$

Inciso d

FCC inciso C-3: $\boldsymbol{a} = a(\hat{\boldsymbol{j}} + \widehat{\boldsymbol{k}})/2, \boldsymbol{b} = a(\hat{\boldsymbol{\imath}} + \widehat{\boldsymbol{k}})/2, \boldsymbol{c} = a(\hat{\boldsymbol{\imath}} + \hat{\boldsymbol{j}})/2$

$$\mathbf{a}' = \frac{\mathbf{b} \times \mathbf{c}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})} = \frac{(-\frac{a^2}{4}, \frac{a^2}{4}, \frac{a^2}{4})}{\frac{a^3}{4}} = (-\frac{1}{a}, \frac{1}{a}, \frac{1}{a})$$

$$\mathbf{b}' = \frac{\mathbf{c} \times \mathbf{a}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})} = \frac{(\frac{a^2}{4}, -\frac{a^2}{4}, \frac{a^2}{4})}{\frac{a^3}{4}} = (\frac{1}{a}, -\frac{1}{a}, \frac{1}{a})$$

$$\mathbf{c}' \cdot (\mathbf{a}' \times \mathbf{b}') = \mathrm{V} = \frac{4}{a^3}$$

$$\mathbf{c}' = \frac{\mathbf{a} \times \mathbf{b}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})} = \frac{(\frac{a^2}{4}, \frac{a^2}{4}, -\frac{a^2}{4})}{\frac{a^3}{4}} = (\frac{1}{a}, \frac{1}{a}, -\frac{1}{a})$$