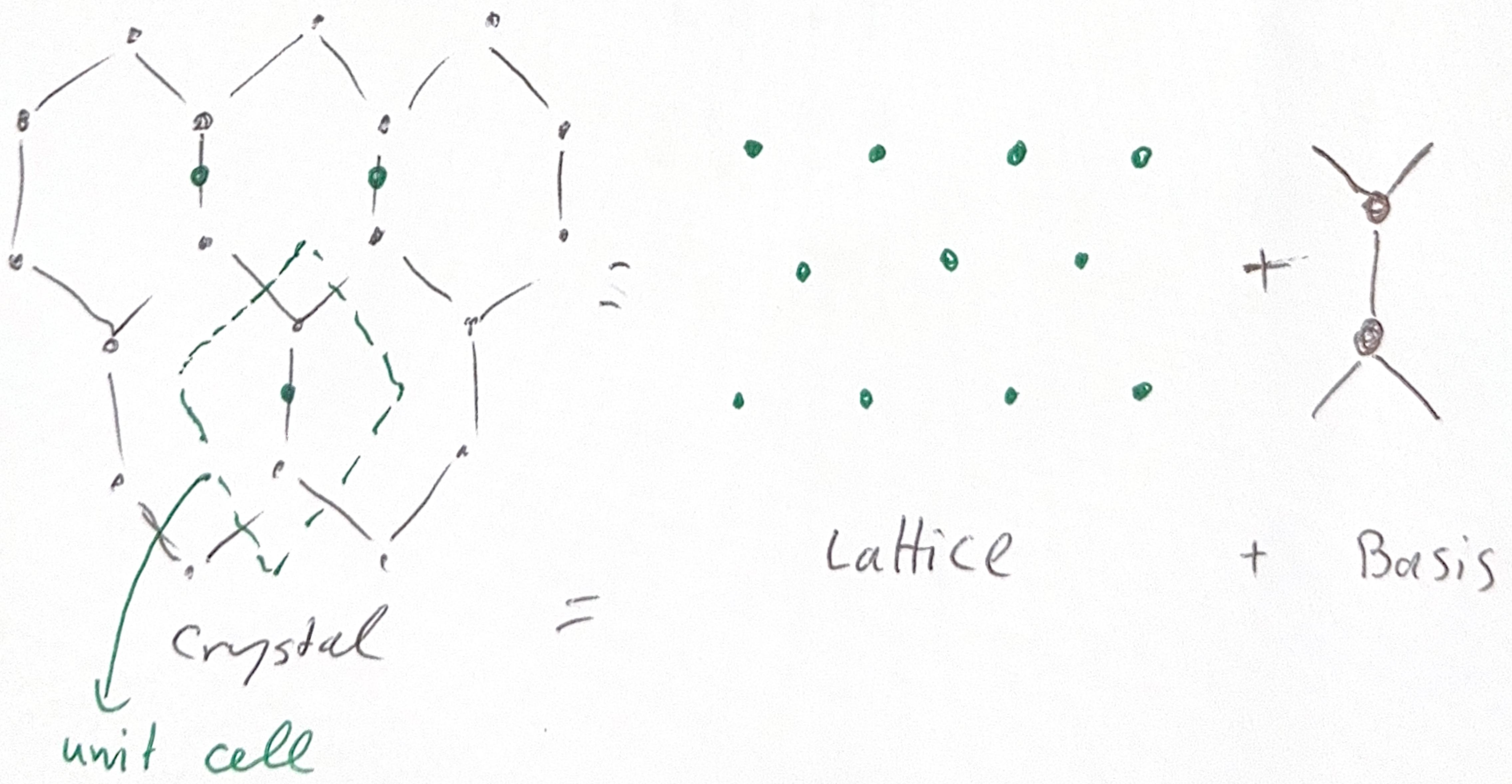
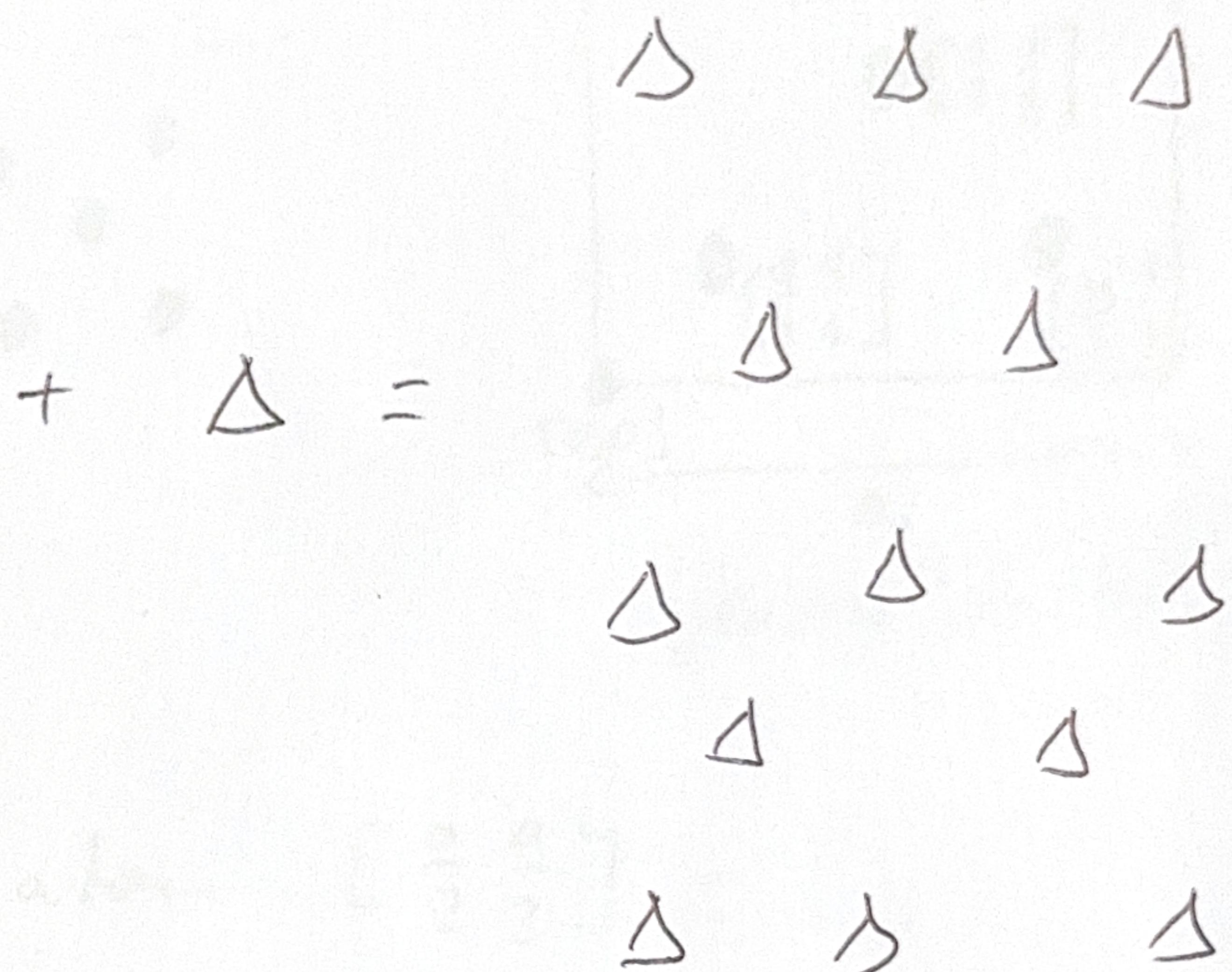
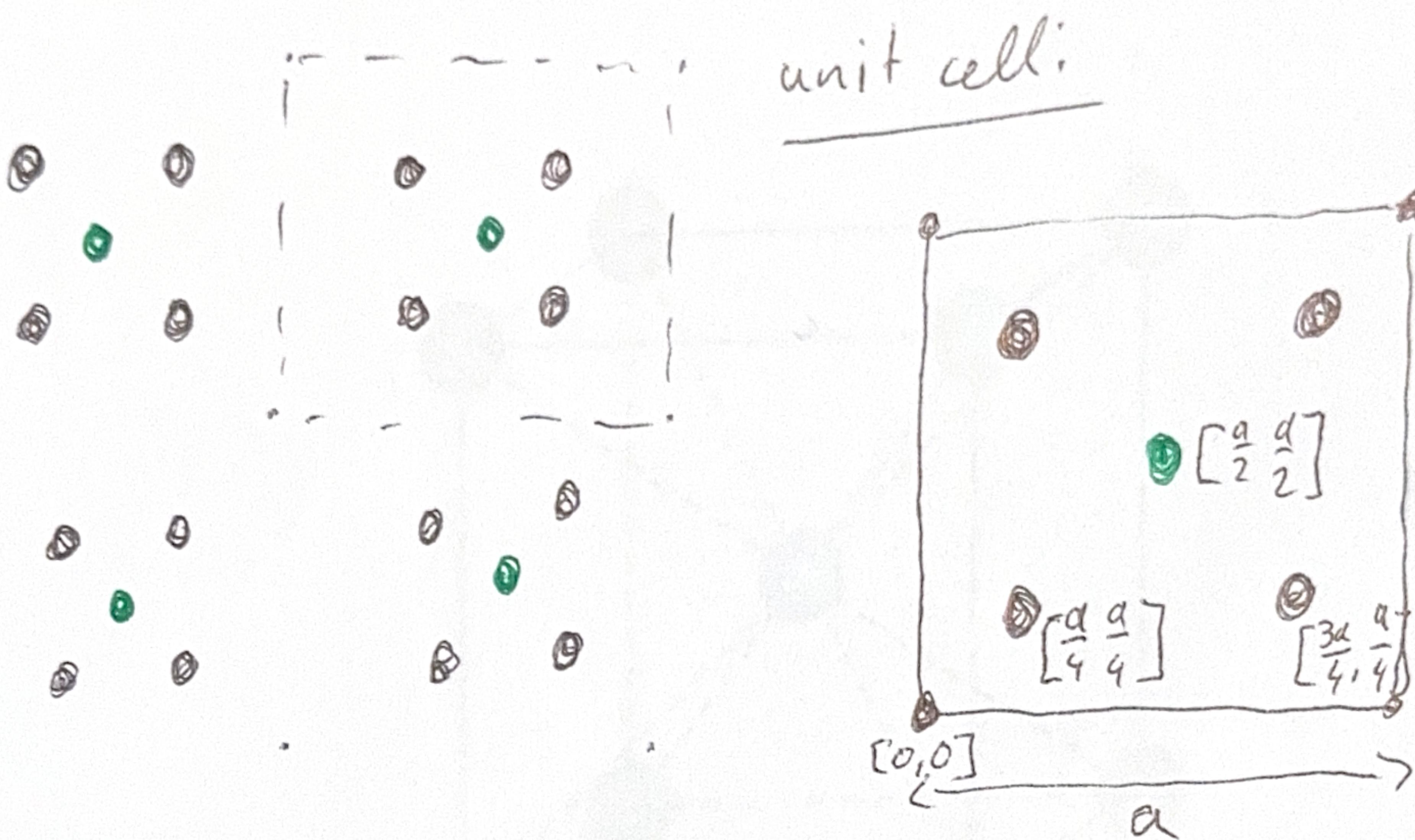


→ any periodic arrangement (structure) is a lattice of repeating motifs



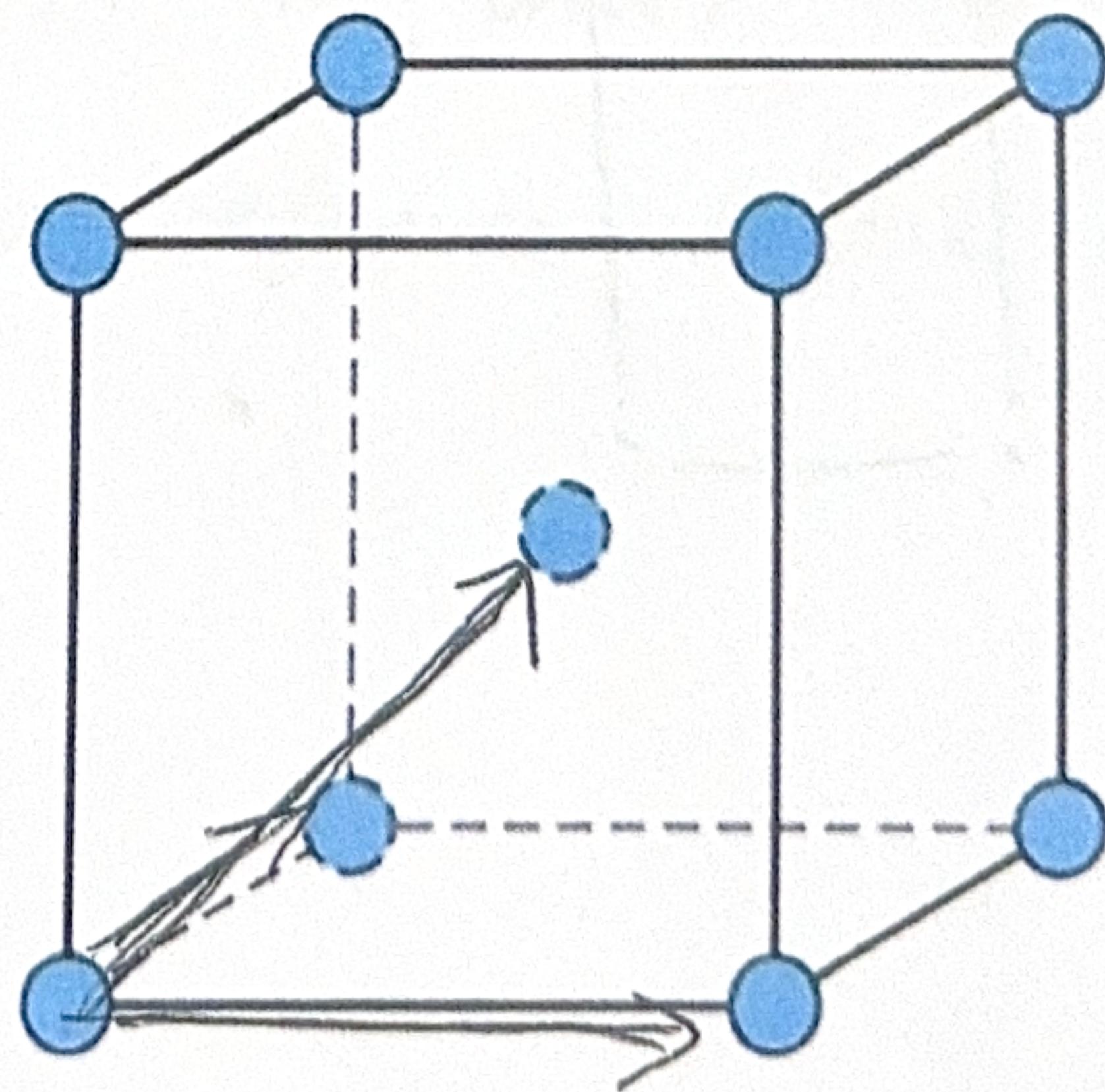
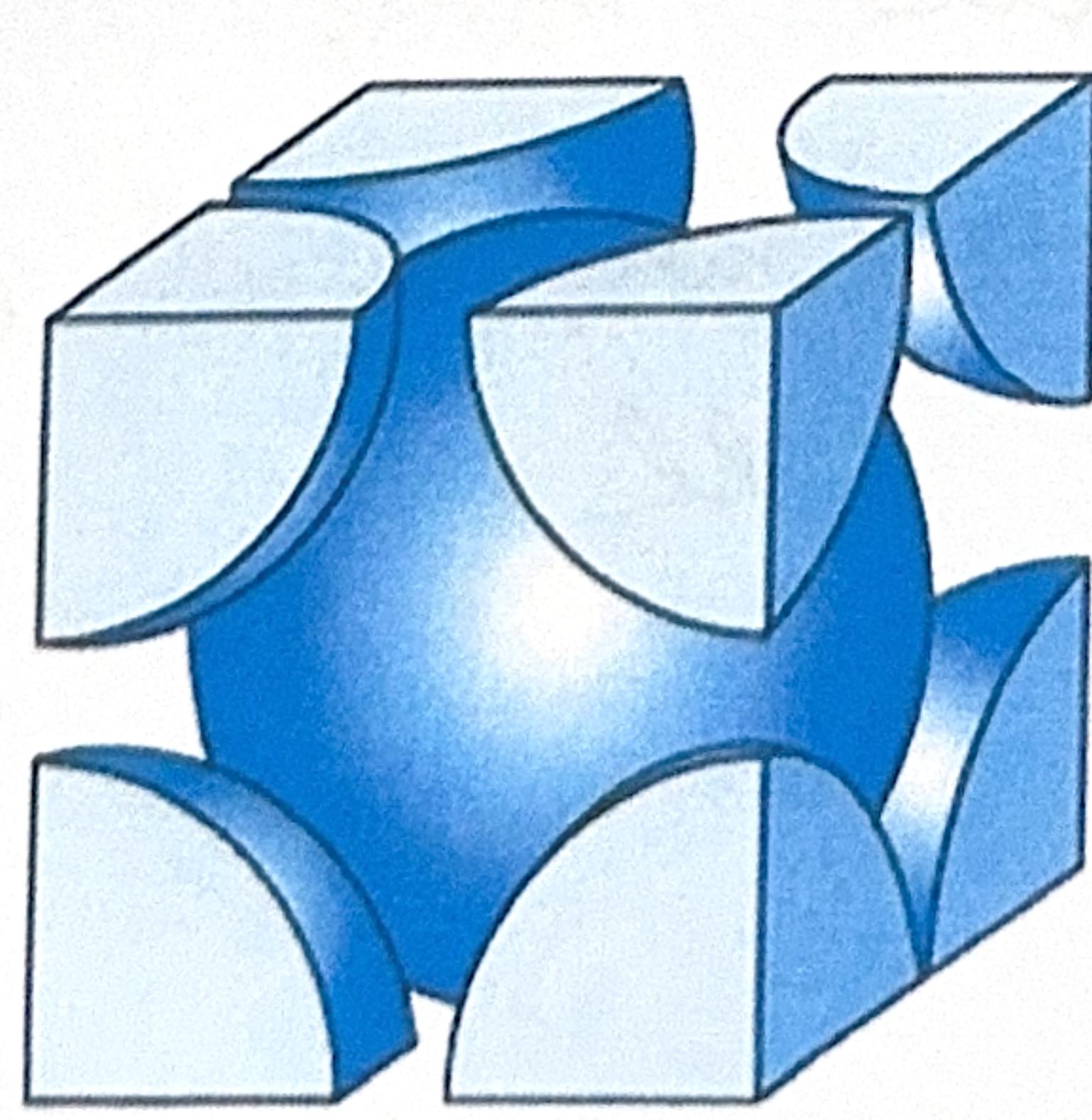
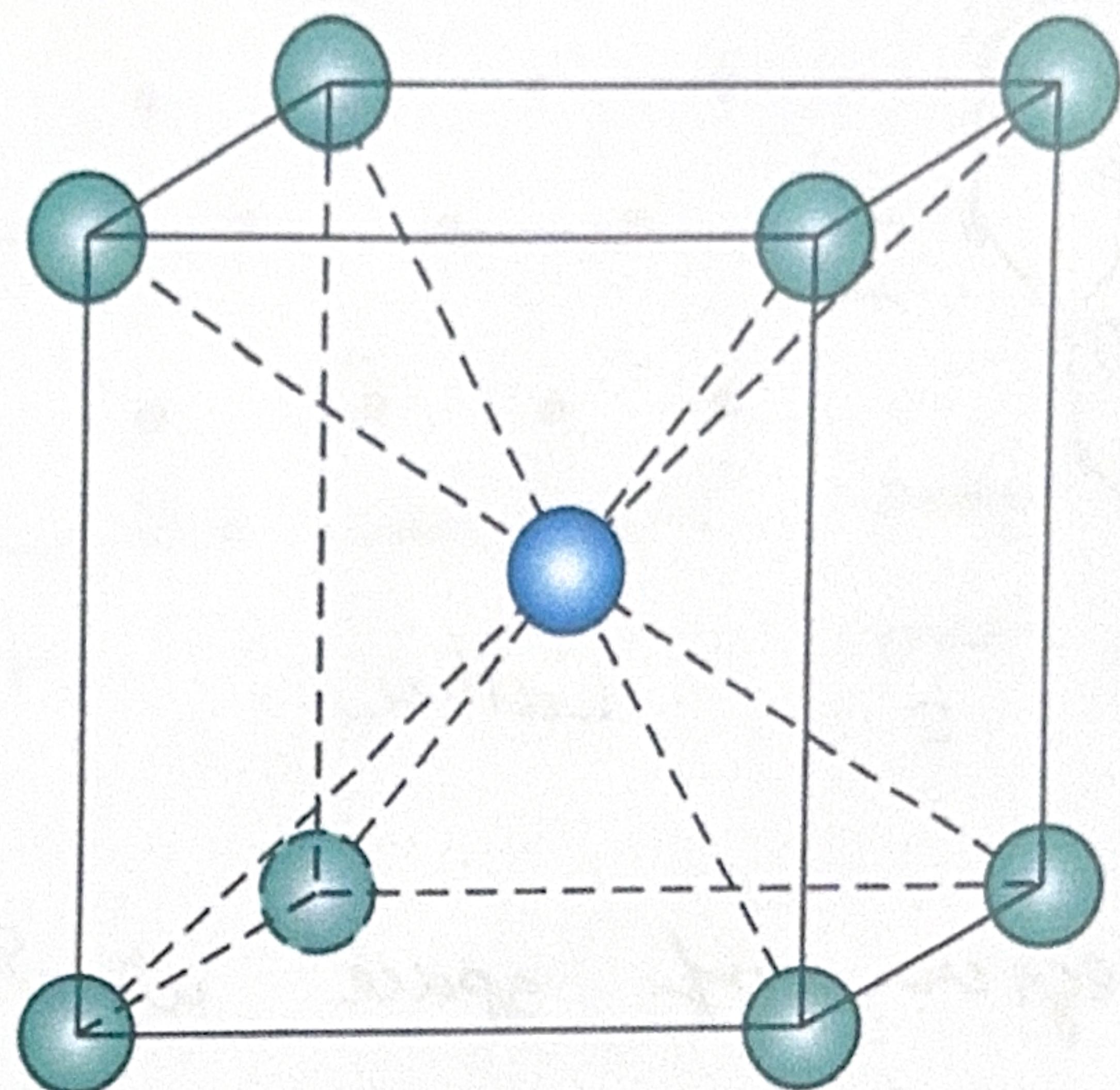


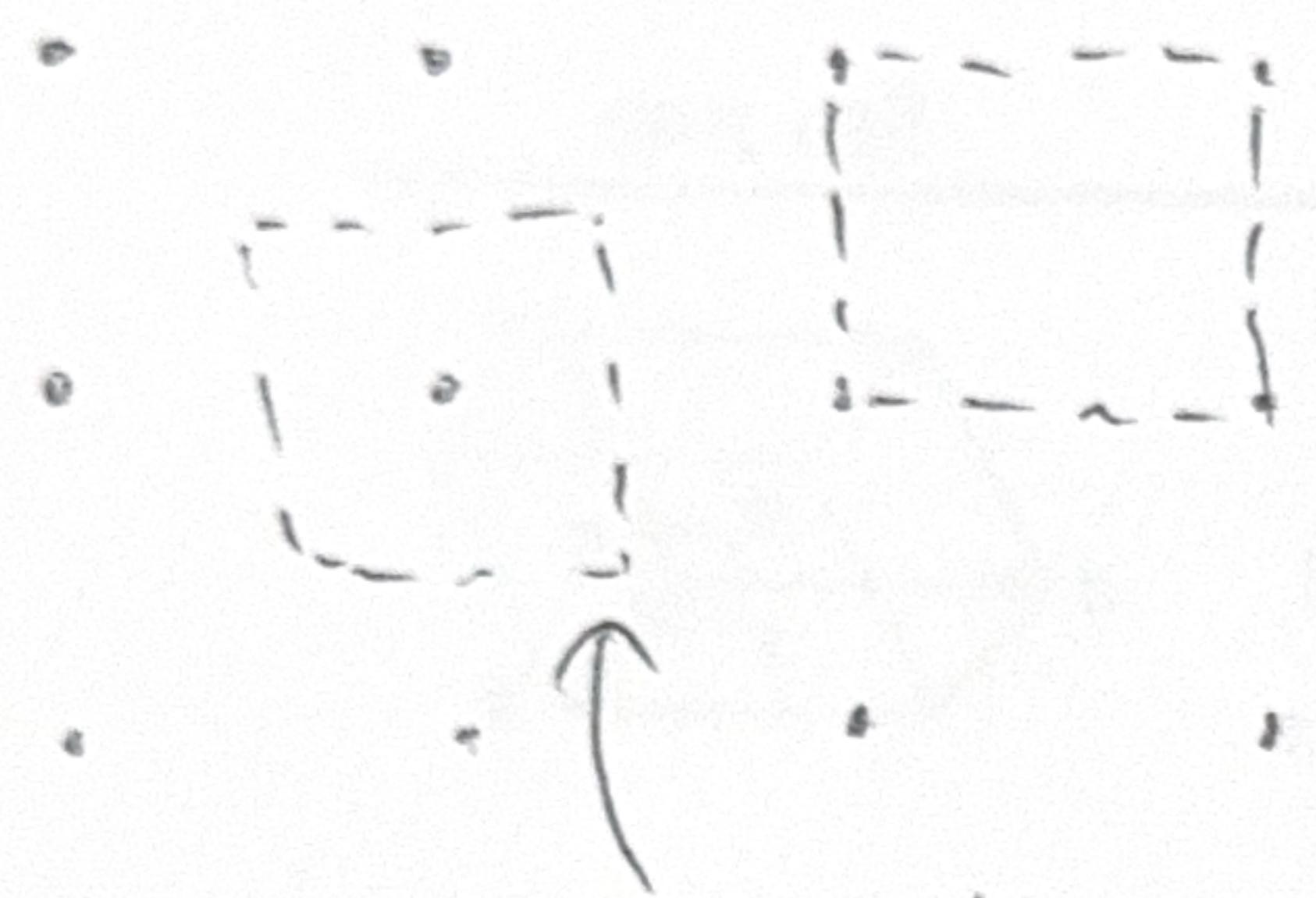
Basis: green atom $\begin{bmatrix} \frac{a}{2} & \frac{a}{2} \\ \frac{a}{2} & \frac{a}{2} \end{bmatrix} = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$

black atoms $\begin{bmatrix} \frac{a}{4} & \frac{1}{4} \\ \frac{3a}{4} & \frac{1}{4} \end{bmatrix}$

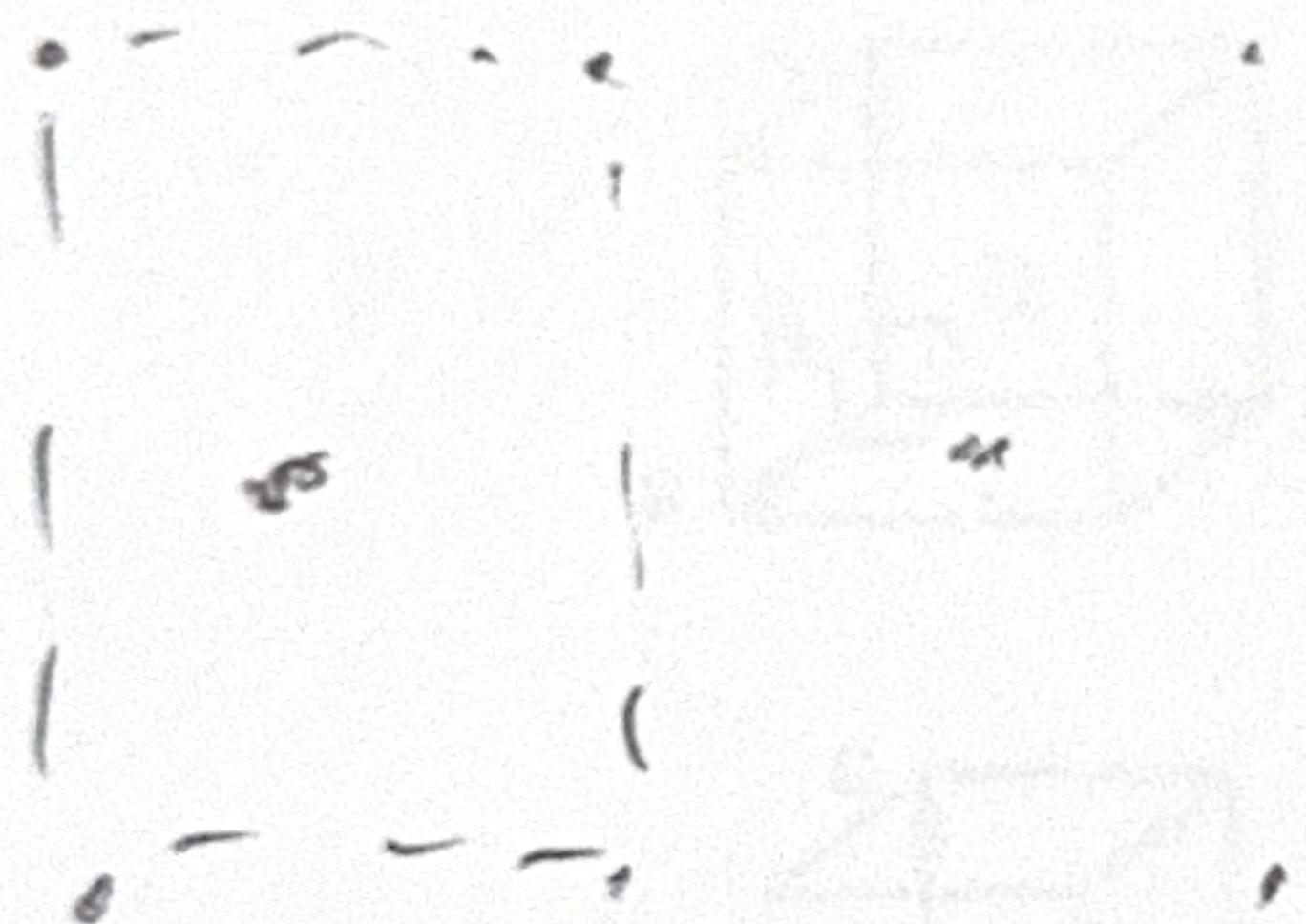
$\begin{bmatrix} \frac{a}{4} & \frac{3a}{4} \\ \frac{3a}{4} & \frac{3a}{4} \end{bmatrix}$

$\begin{bmatrix} \frac{3a}{4} & \frac{3a}{4} \\ \frac{3a}{4} & \frac{3a}{4} \end{bmatrix}$





primitive unit cell: only contains
one lattice point



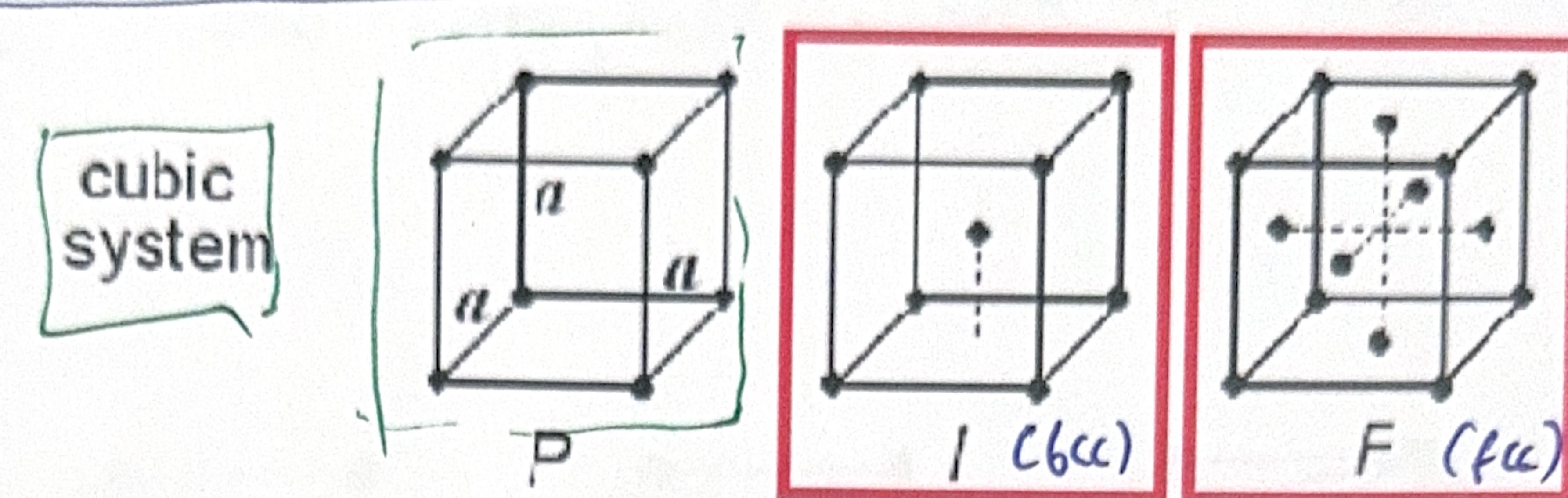
conventional unit cell: contains more
than one lattice point

Basis: Description of objects in unit cell
with respect to a reference lattice point:

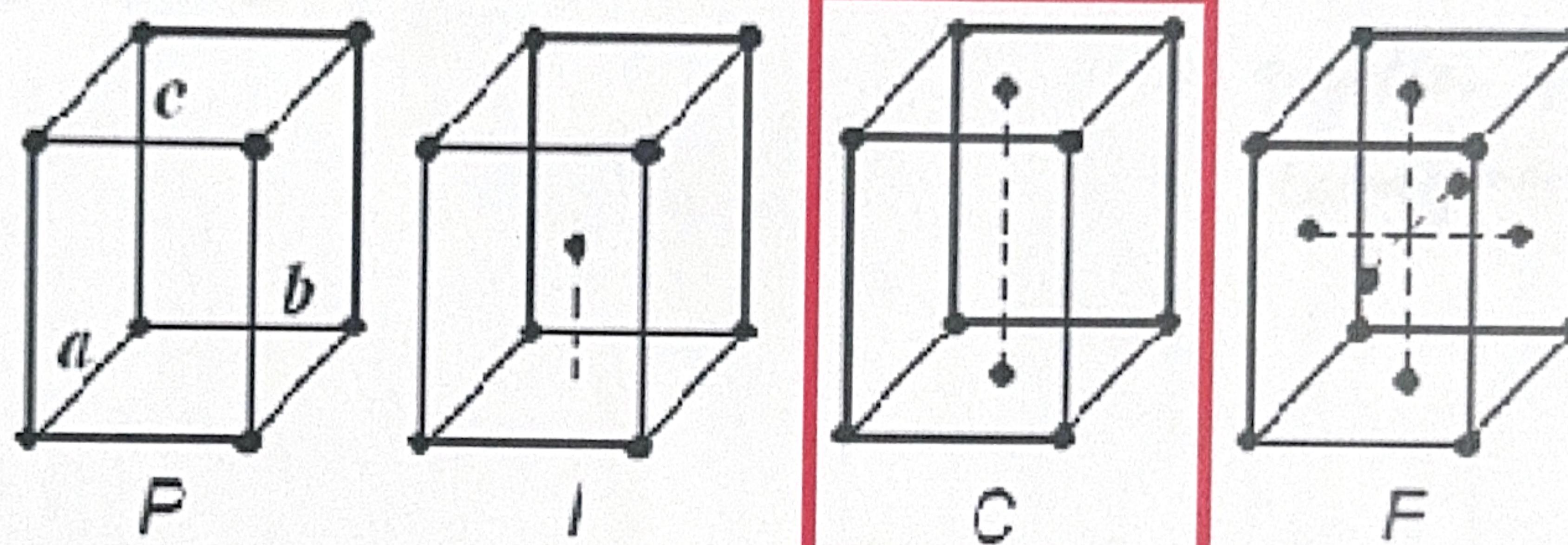
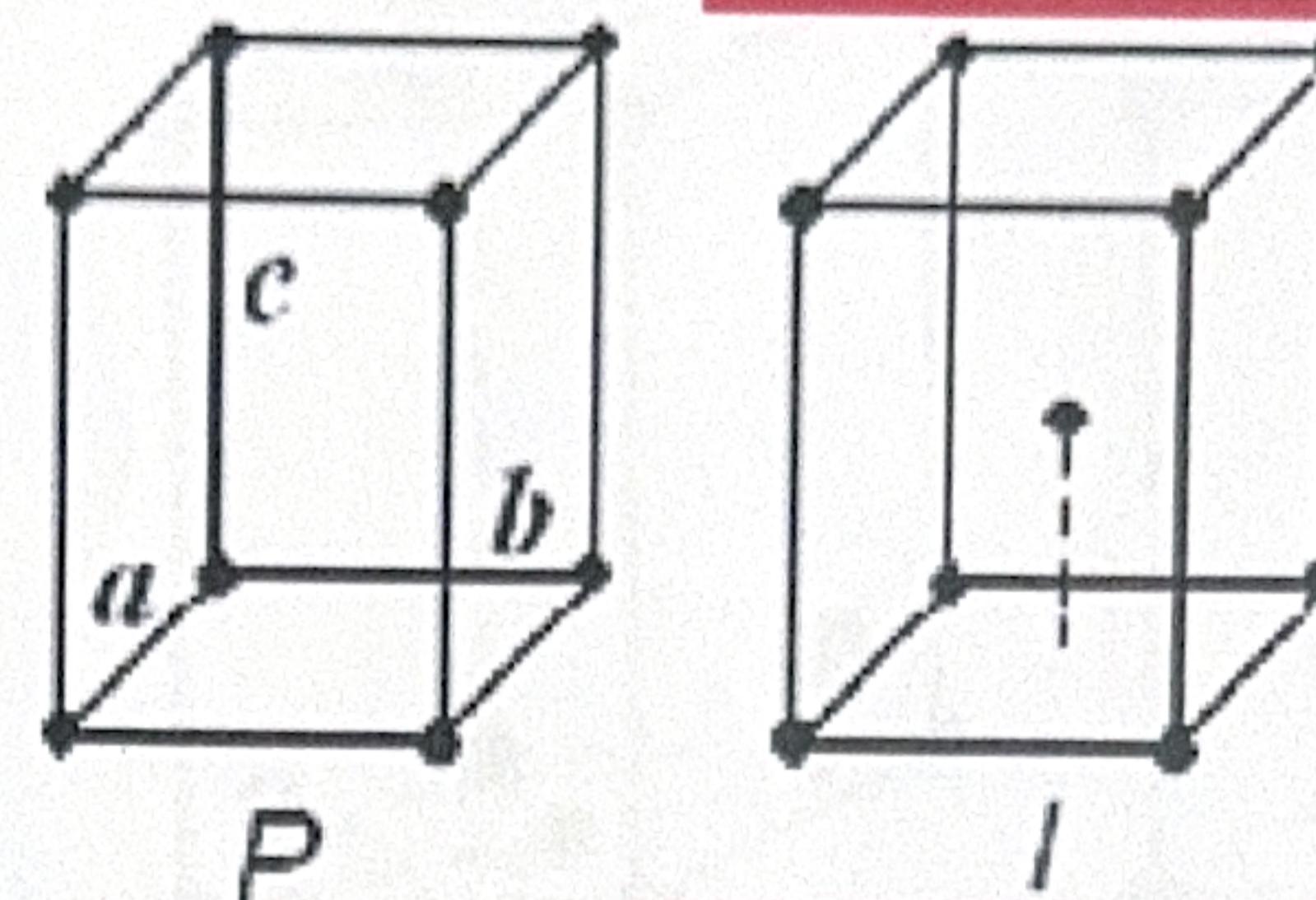
7 crystal systems needed to describe all crystals in nature

unit cell	name	geometry
	triclinic (anorthic)	$a \neq b \neq c \neq a$ $\alpha \neq \beta \neq \gamma \neq \alpha$
	monoclinic	$a \neq b \neq c \neq a$ $\alpha = \gamma = 90^\circ$ $\beta \neq 90^\circ$
	orthorhombic	$a \neq b \neq c \neq a$ $\alpha = \beta = \gamma = 90^\circ$
	tetragonal	$a = b \neq c$ $\alpha = \beta = \gamma = 90^\circ$
	trigonal hexagonal	$a = b \neq c$ $\alpha = \beta = 90^\circ$ $\gamma = 120^\circ$
	rhombohedral	$a = b = c$ $\alpha = \beta = \gamma \neq 90^\circ$
	cubic	$a = b = c$ $\alpha = \beta = \gamma = 90^\circ$

centering types and Bravais lattices (14)

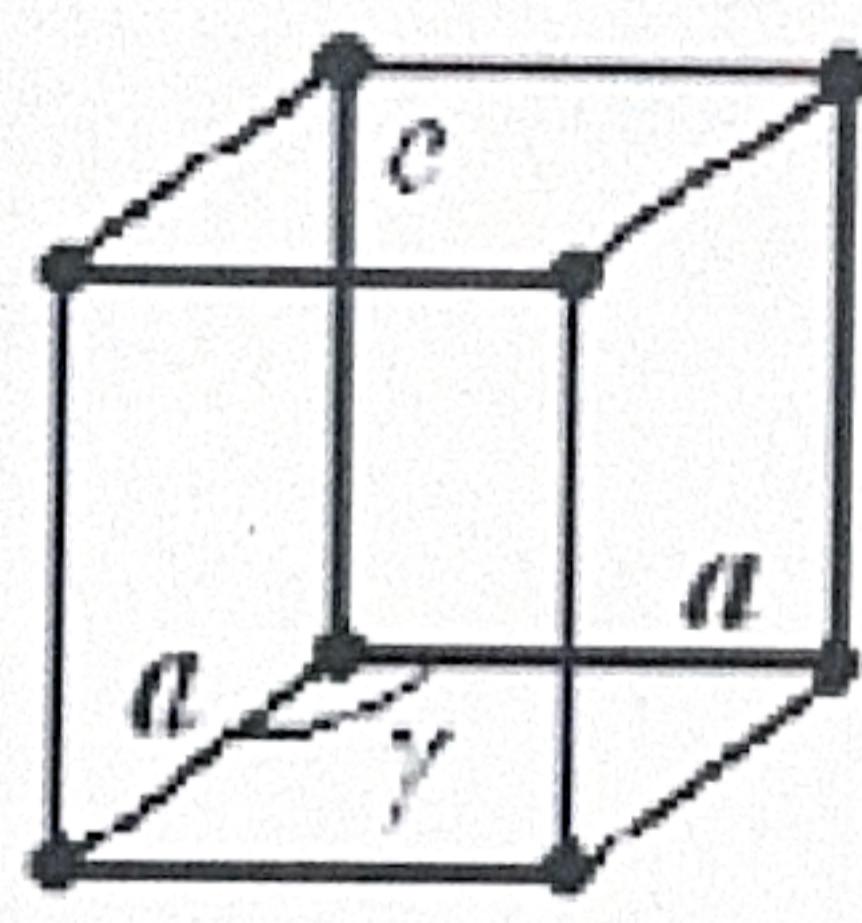


tetragonal system

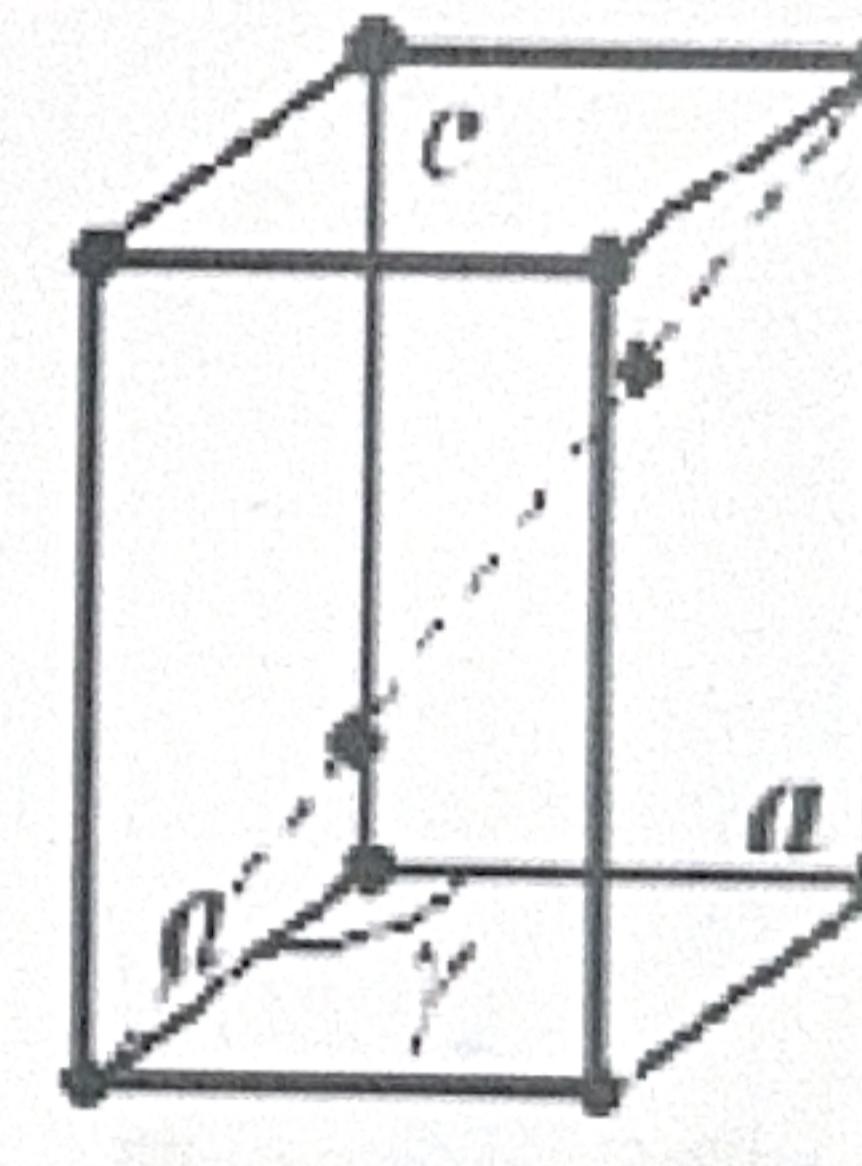


orthorhombic system

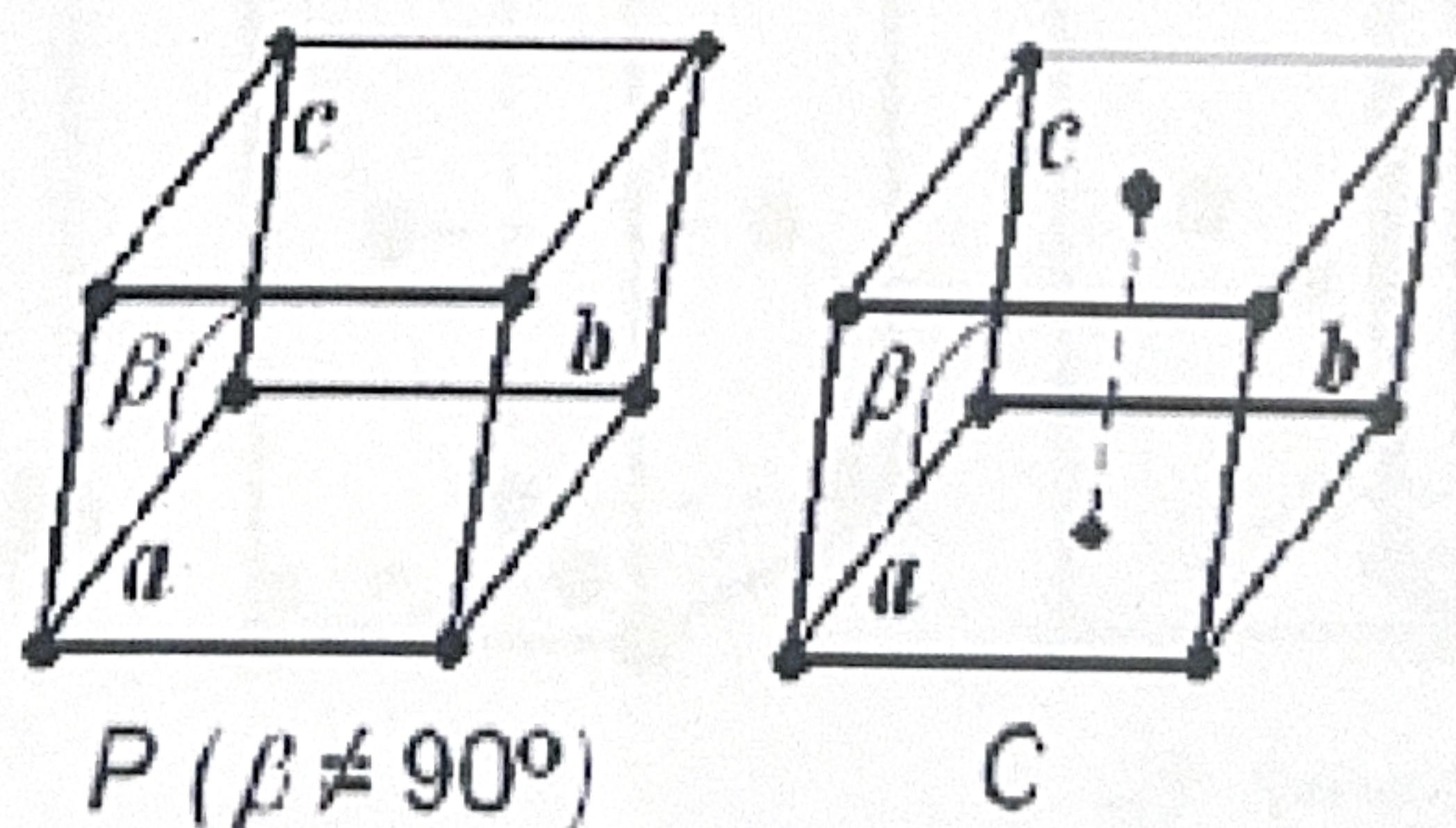
hexagonal & trigonal systems



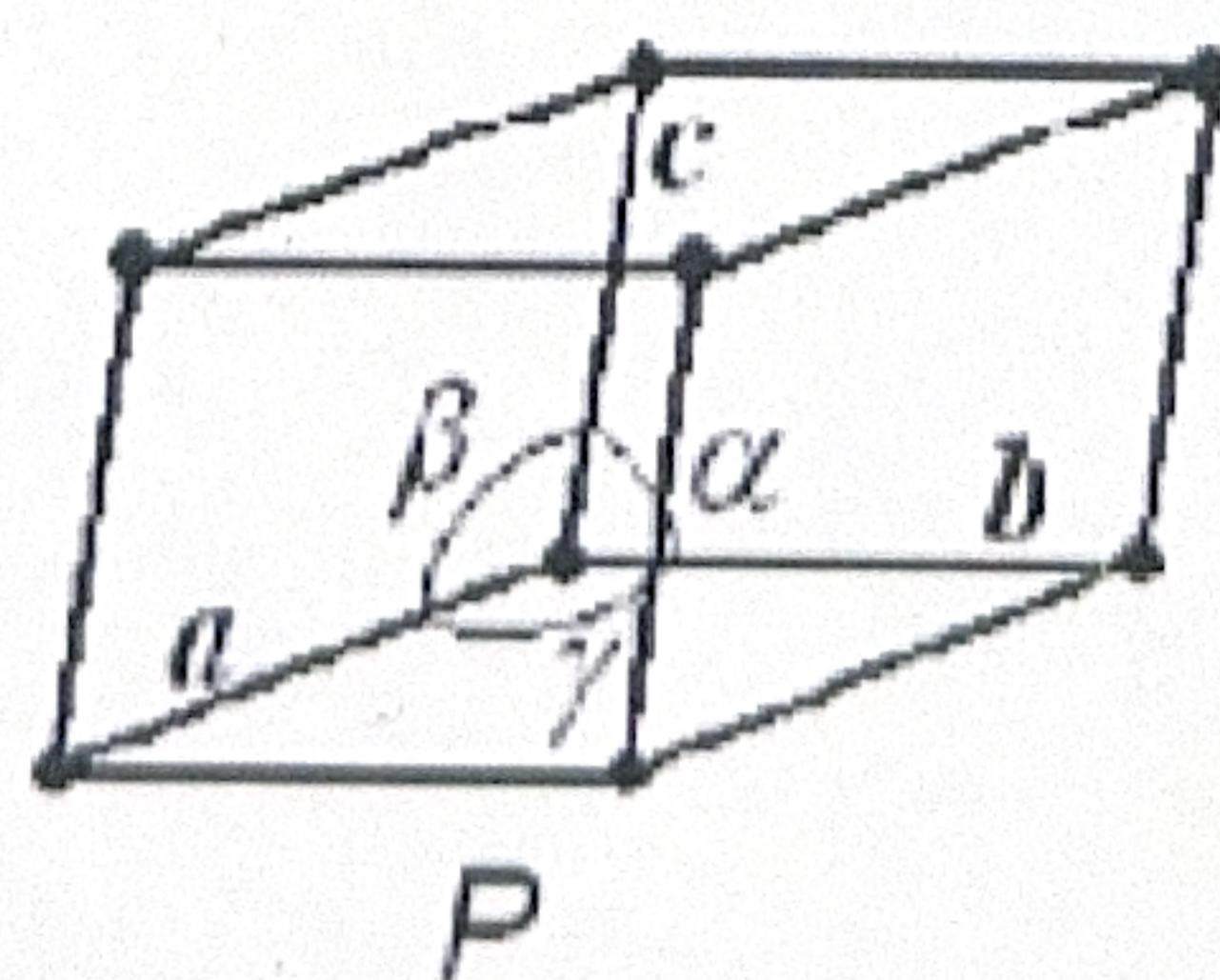
trigonal system



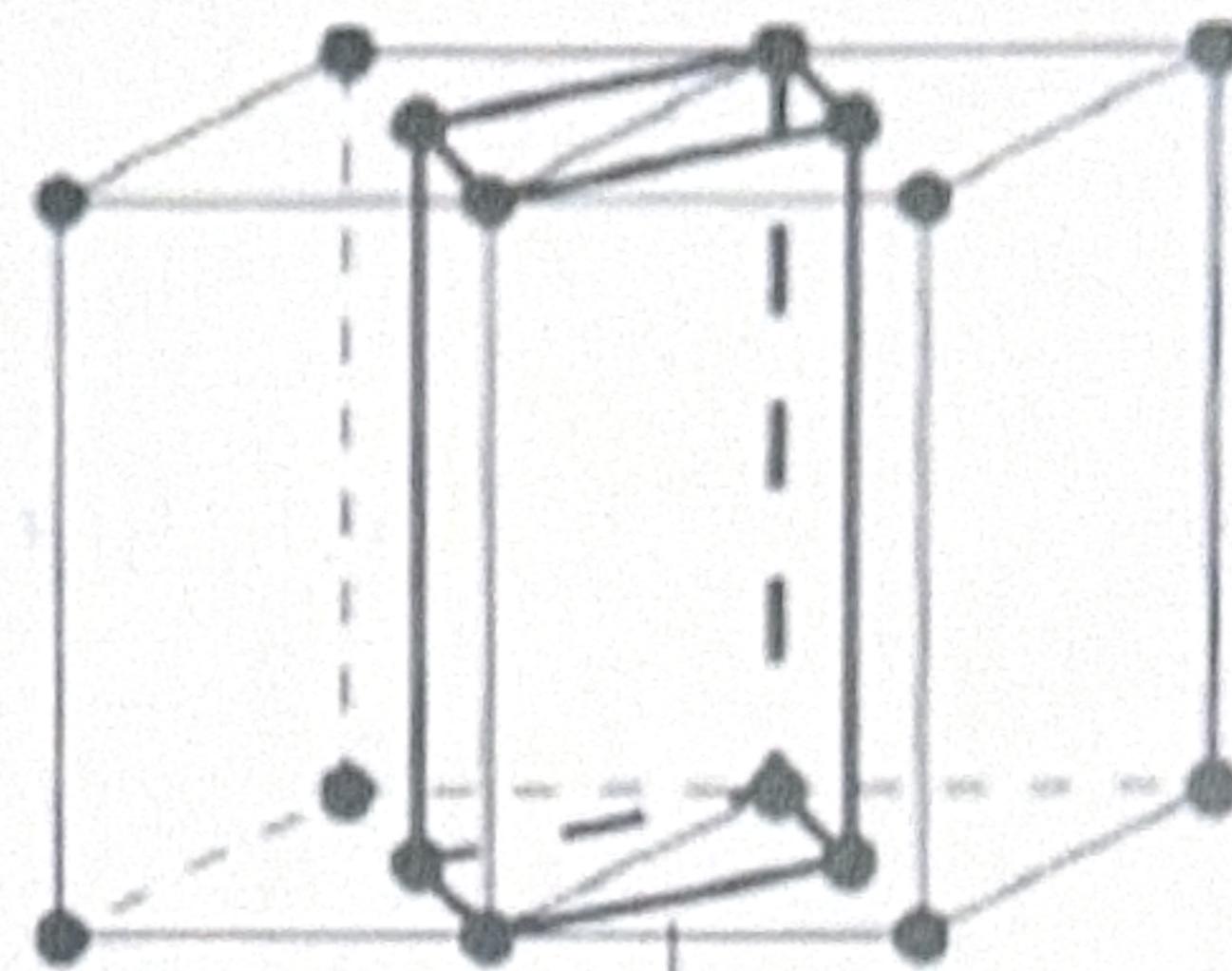
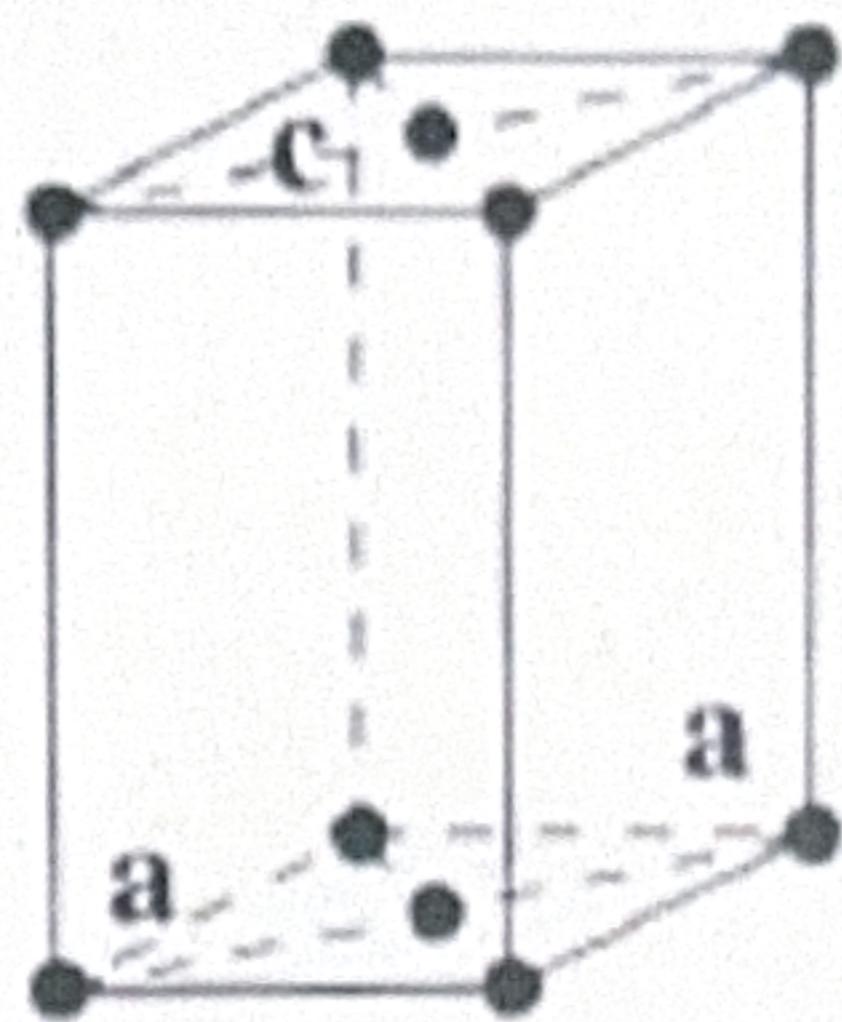
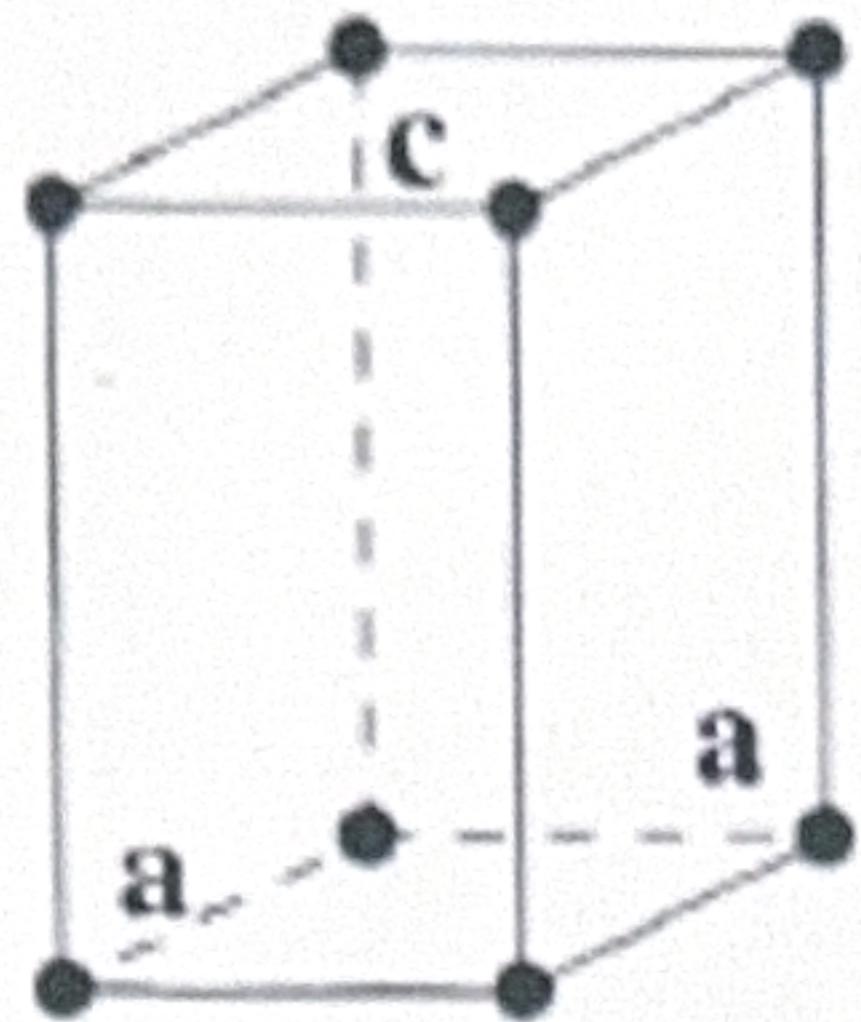
monoclinic system



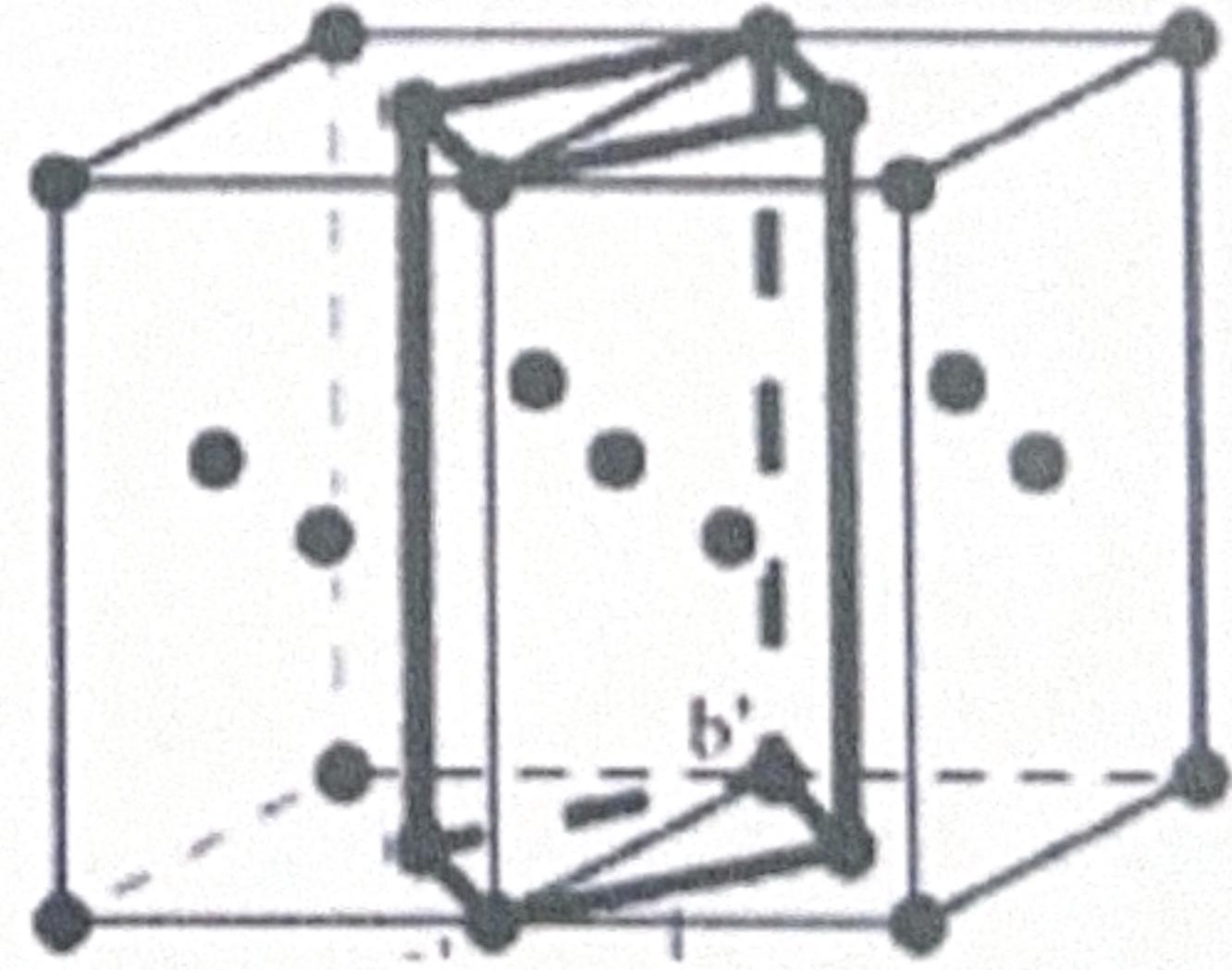
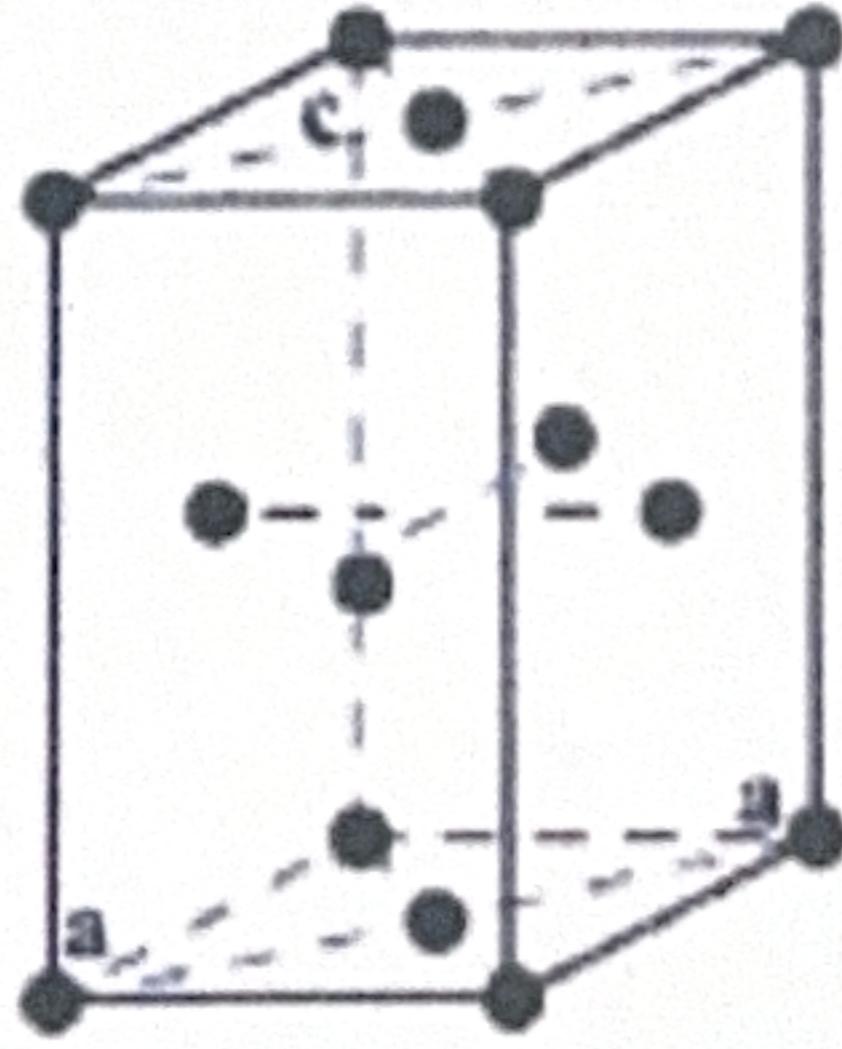
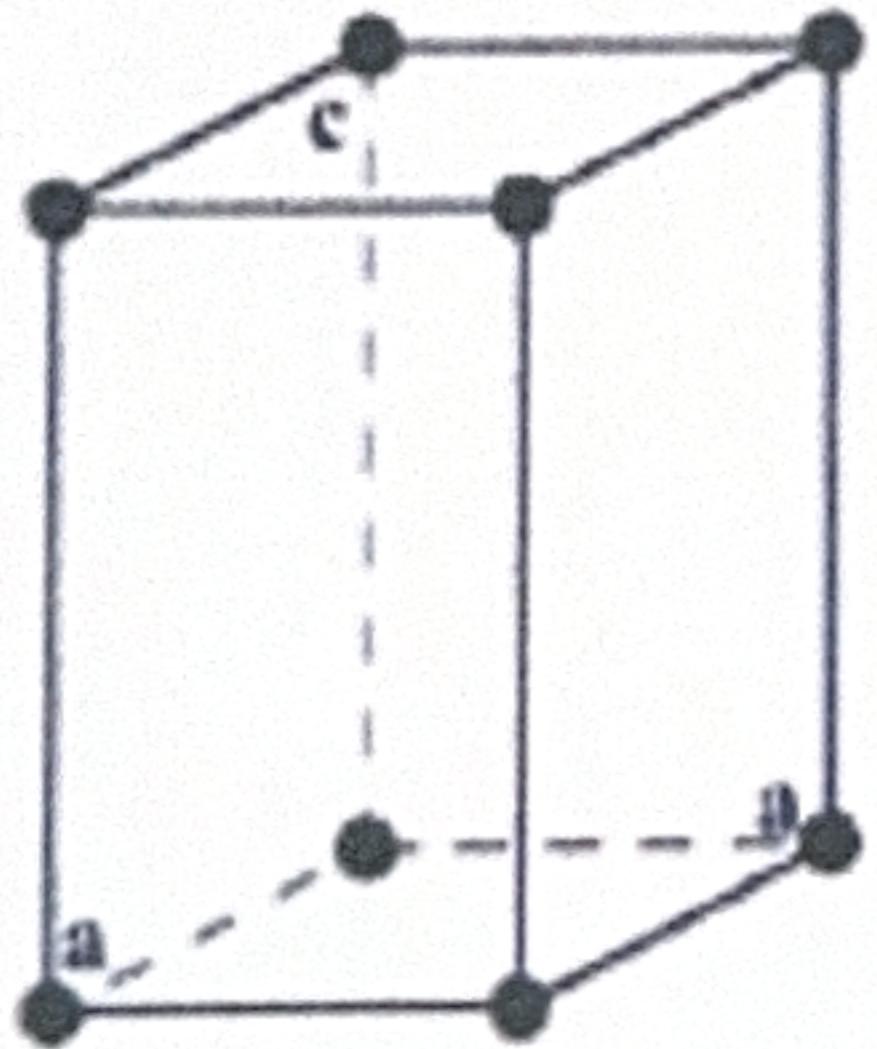
triclinic system



Example: Why tetragonal- C and - F impossible?



→ smaller primitive
tetragonal cell



→ smaller tetragonal-I
cell