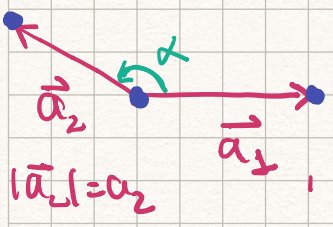
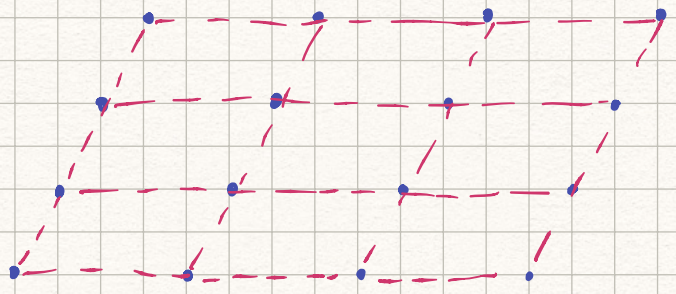
Bravais Lattices

Set of lattices with particular symmetries

2D

Oblique lattice





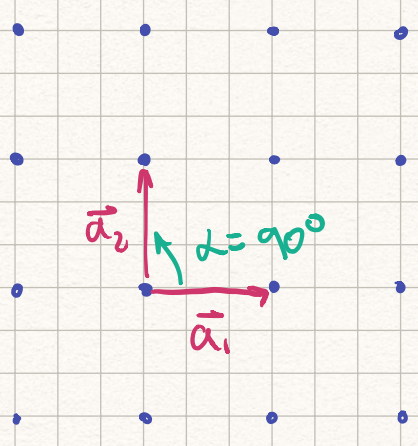
$a_1 \neq a_2$ $\quad \alpha \neq 90°, 60°$

Make a rotation of 2π, which is trivial

Least symmetry that a lattice can have

↳ Rotation of $2\pi \Rightarrow 2\pi$-symmetry

Square lattice

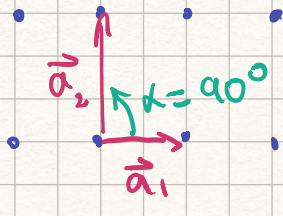


$a_1 = a_2$ $\quad \alpha = 90°$

$90°, 180°, 270°, 360°$

$\frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$ - symmetry

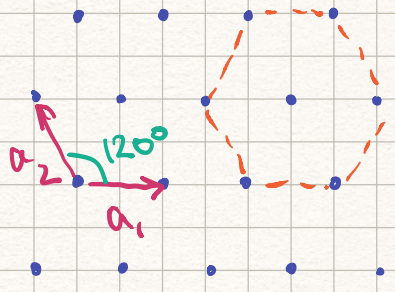
Rectangular lattice



$a_1 \neq a_2$ $\quad \alpha = 90°$

$\pi, 2\pi$ - symmetry

Hexagonal lattice



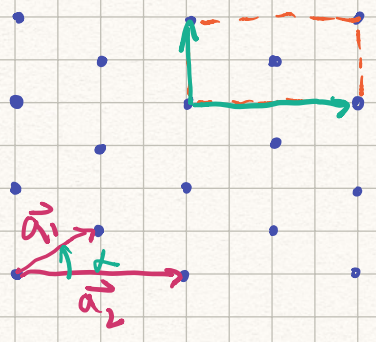
Why isn't this area a primitive cell?

$\alpha = \frac{2\pi}{3}$ $\quad a_1 = a_2$

$\frac{\pi}{3}$, $\frac{2\pi}{3} - 2\pi$, $\frac{4\pi}{3}$

Are these symmetries of the hex. lattice?

Centered rectangular lattice



Not a primitive cell!
Not primitive trans. vectors

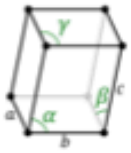
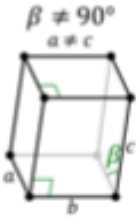
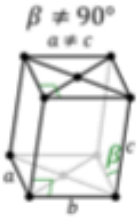
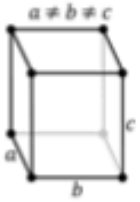
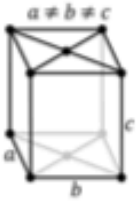
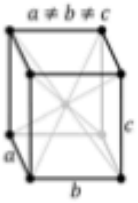
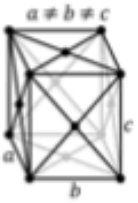
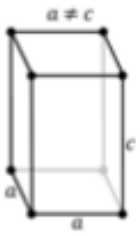
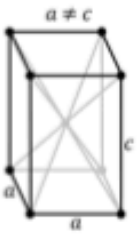
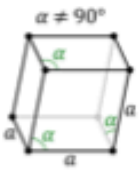
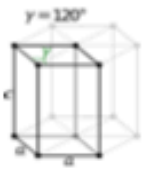
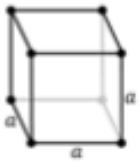
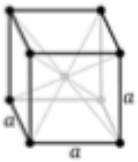
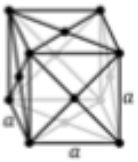
$a_1 = a_2$ $\quad \alpha \neq 90°, 120°$

What are the symmetries?

π, 2π - symmetries $\quad$ Are there more?

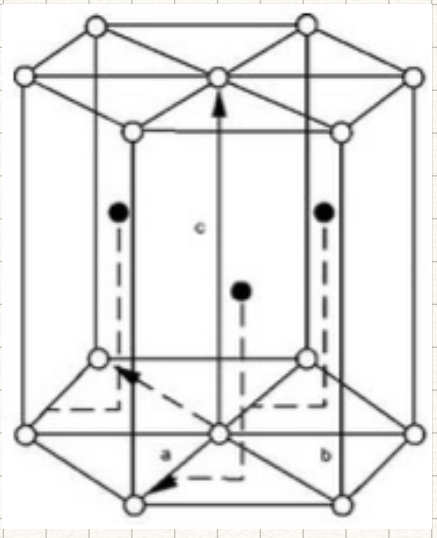
3D

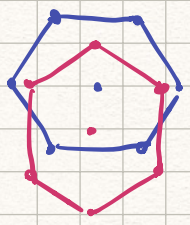
14. Bravais lattices

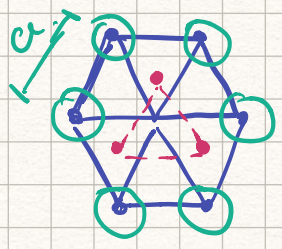
Lattice type	Primitive	Base-centered	Body-centered	Face-centered
Triclinic				
Monoclinic				
Orthorombic				
Tetragonal				
Rhombohedral				
Hexagonal				
Cubic				

How many lattice points are enclosed by the monoclinic base-centered lattice?

Hexagonal close packed (hcp) lattice







1. Rotate the red lattice
2. Displace it

How tightly packed can the atoms be?

$\frac{c}{a} = 1.633$