

phi: $2A_5 \rightarrow R^8$
 $(a+b\sqrt{5})+(c+d\sqrt{5})i+(e+f\sqrt{5})j+(g+h\sqrt{5})k$
 $2((a+b\sqrt{5})+(c+d\sqrt{5})i+(e+f\sqrt{5})j+(g+h\sqrt{5})k) \rightarrow (a,b,c,d,e,f,g,h)$

psi: $2A_5 \rightarrow R^8$
 $(a+b\sqrt{5})+(c+d\sqrt{5})i+(e+f\sqrt{5})j+(g+h\sqrt{5})k$
 $\rightarrow 2\sigma((a+b\sqrt{5})+(c+d\sqrt{5})i+(e+f\sqrt{5})j+(g+h\sqrt{5})k)$
 $\rightarrow (p,q,r,s,t,u,v,w)$

where $\sigma = (1-\sqrt{5})/2$

f:
 $(a+b\sqrt{5})+(c+d\sqrt{5})i+(e+f\sqrt{5})j+(g+h\sqrt{5})k \rightarrow (a+b, c+d, e+f, g+h, p+q, r+s, t+u, v+w)$

Then the elements all belong to the lattice generated by following

$$\begin{pmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \end{pmatrix}$$

which is isomorphic to E_8

120 vectors

[0, 2, 0, 0, 0, 0, 0, 0],
[0, 0, 2, 0, 0, 0, 0, 0],
[0, 0, 0, 2, 0, 0, 0, 0],
[1, 1, 1, 1, 0, 0, 0, 0],
[0, 1, 0, 1, 0, 0, 1, -1],
[0, 0, -2, 0, 0, 0, 0, 0],
[2, 0, 0, 0, 0, 0, 0, 0],
[1, 1, -1, -1, 0, 0, 0, 0],
[1, 0, -1, 0, -1, 1, 0, 0],
[0, 0, 0, -2, 0, 0, 0, 0],
[-2, 0, 0, 0, 0, 0, 0, 0],
[-1, 1, 1, -1, 0, 0, 0, 0],
[0, 1, 0, -1, -1, -1, 0, 0],
[1, 1, 1, -1, 0, 0, 0, 0],
[1, 1, 0, 0, -1, 0, 0, -1],
[0, 1, 0, -1, 0, 0, -1, 1],
[-1, 0, 1, 0, 1, 1, 0, 0],
[0, 1, 0, 1, 1, -1, 0, 0],
[0, 1, 1, 0, 1, 0, -1, 0],
[0, -2, 0, 0, 0, 0, 0, 0],
[-1, -1, 1, 1, 0, 0, 0, 0],
[-1, 0, 1, 0, 1, -1, 0, 0],
[1, -1, 1, -1, 0, 0, 0, 0],
[1, 0, 1, 0, 0, 0, -1, -1],
[1, -1, 1, 1, 0, 0, 0, 0],
[0, 0, 1, 1, 1, 0, 0, -1],
[1, 0, 1, 0, -1, 1, 0, 0],
[0, -1, 0, -1, 0, 0, 1, 1],
[-1, 0, 1, 0, 0, 0, -1, 1],
[0, -1, 1, 0, 0, 1, 0, 1],

[1, -1, -1, 1, 0, 0, 0, 0],
[0, -1, 0, 1, 1, 1, 0, 0],
[-1, 1, -1, 1, 0, 0, 0, 0],
[-1, 0, -1, 0, 0, 0, 1, 1],
[1, 1, -1, 1, 0, 0, 0, 0],
[0, 0, -1, 1, 0, 1, 1, 0],
[0, 1, 0, 1, -1, -1, 0, 0],
[1, 0, 1, 0, 0, 0, -1, 1],
[0, -1, 0, 1, 0, 0, -1, -1],
[1, 0, 0, 1, -1, 0, -1, 0],
[1, 0, 0, 1, 0, 1, 0, -1],
[1, 1, 0, 0, -1, 0, 0, 1],
[0, 0, 1, -1, 1, 0, 0, 1],
[0, 0, 1, 1, 0, -1, -1, 0],
[1, 0, 1, 0, -1, -1, 0, 0],
[0, -1, 0, 1, -1, 1, 0, 0],
[1, 0, 0, 1, -1, 0, 1, 0],
[0, -1, 0, 1, 0, 0, 1, -1],
[-1, 0, -1, 0, 1, 1, 0, 0],
[1, 0, -1, 0, 0, 0, 1, 1],
[0, 1, -1, 0, 1, 0, 1, 0],
[0, 0, -1, -1, 0, 1, 1, 0],
[0, 1, 0, -1, 1, -1, 0, 0],
[-1, 0, 1, 0, 0, 0, -1, -1],
[0, 1, 1, 0, 0, -1, 0, -1],
[0, 1, -1, 0, 0, -1, 0, -1],
[1, 1, 0, 0, 0, -1, 1, 0],
[1, 0, -1, 0, 0, 0, 1, -1],
[-1, -1, -1, -1, 0, 0, 0, 0],
[0, -1, 0, -1, 0, 0, -1, 1],
[-1, 1, -1, -1, 0, 0, 0, 0],
[0, 0, -1, -1, -1, 0, 0, 1],
[-1, 0, -1, 0, 1, -1, 0, 0],
[0, 1, 0, 1, 0, 0, -1, -1],
[1, -1, -1, -1, 0, 0, 0, 0],
[1, -1, 0, 0, 0, 1, -1, 0],
[1, 0, 0, -1, 0, -1, 0, 1],
[1, 0, 0, -1, -1, 0, -1, 0],
[0, 0, -1, -1, 1, 0, 0, 1],
[-1, 1, 0, 0, 1, 0, 0, -1],
[0, 1, 0, -1, 0, 0, 1, 1],
[1, 0, 0, -1, 0, 1, 0, 1],
[0, -1, 0, -1, 1, 1, 0, 0],
[0, -1, -1, 0, 0, 1, 0, -1],
[-1, -1, 0, 0, 0, 1, -1, 0],
[-1, 0, -1, 0, 0, 0, 1, -1],
[0, 1, -1, 0, -1, 0, 1, 0],
[0, -1, -1, 0, -1, 0, 1, 0],
[0, -1, 0, -1, -1, 1, 0, 0],
[-1, -1, 1, -1, 0, 0, 0, 0],
[0, 0, 1, -1, 0, -1, -1, 0],
[-1, 0, 0, -1, 1, 0, 1, 0],
[-1, 1, 1, 1, 0, 0, 0, 0],
[-1, 1, 0, 0, 0, -1, 1, 0],
[-1, 0, 0, 1, 0, 1, 0, -1],
[0, 0, 1, -1, 0, 1, -1, 0],
[-1, -1, 0, 0, 0, 1, 1, 0],
[-1, 1, 0, 0, 1, 0, 0, 1],
[0, 1, 1, 0, -1, 0, -1, 0],
[1, 0, 0, -1, -1, 0, 1, 0],
[1, -1, 0, 0, -1, 0, 0, -1],
[-1, 0, 0, -1, 0, -1, 0, 1],
[0, 0, 1, -1, -1, 0, 0, 1],
[0, 1, 1, 0, 0, -1, 0, 1],
[0, 0, 1, 1, 0, 1, -1, 0],
[0, 0, 1, 1, -1, 0, 0, -1],
[0, 0, -1, 1, 1, 0, 0, -1],
[1, -1, 0, 0, 0, 1, 1, 0],
[0, 0, -1, -1, 0, -1, 1, 0],
[-1, 1, 0, 0, 0, -1, -1, 0],
[1, 0, -1, 0, -1, -1, 0, 0]

```
[-1, 0, 0, -1, 0, 1, 0, 1],
[-1, 0, 0, -1, 1, 0, -1, 0],
[-1, 0, 0, 1, 1, 0, 1, 0],
[0, -1, 1, 0, 0, 1, 0, -1],
[-1, -1, 0, 0, 1, 0, 0, 1],
[1, 0, 0, 1, 0, -1, 0, -1],
[0, 1, -1, 0, 0, -1, 0, 1],
[1, 1, 0, 0, 0, -1, -1, 0],
[0, -1, 1, 0, 1, 0, -1, 0],
[-1, 0, 0, 1, 0, -1, 0, -1],
[-1, -1, -1, 1, 0, 0, 0, 0],
[1, -1, 0, 0, -1, 0, 0, 1],
[0, -1, 1, 0, -1, 0, -1, 0],
[-1, -1, 0, 0, 1, 0, 0, -1],
[0, 0, -1, 1, 0, -1, 1, 0],
[0, -1, -1, 0, 1, 0, 1, 0],
[-1, 0, 0, 1, 1, 0, -1, 0],
[0, -1, -1, 0, 0, 1, 0, 1],
[0, 0, -1, 1, -1, 0, 0, -1]]
```