

WHY SHOULD I TAKE A  
BATH? I'M JUST GOING  
TO GET DIRTY AGAIN.



WHY SHOULD I BRUSH  
MY TEETH? I'M JUST  
GOING TO EAT AGAIN.



WHY SHOULD I COMB MY  
HAIR? IT'S JUST GOING  
TO GET MESSED UP AGAIN.



I'D RATHER BE  
EFFICIENT THAN  
HYGIENIC.



SO YOUR TEACHER DIDN'T  
KNOW YOU'D RIPPED YOUR  
PANTS, AND SHE MADE YOU  
DO A PROBLEM AT THE CHALK-  
BOARD?



THAT  
SUMS  
IT UP.  
HOW AWFUL!  
WHAT DID YOU DO??



I DIDN'T HAVE A CHOICE.  
I MOONED THE WHOLE CLASS.



THAT'S WHY  
YOU'RE HOME  
EARLY?  
THREE TEACHERS  
AND THE  
PRINCIPAL  
COULDNT RESTORE  
ORDER.



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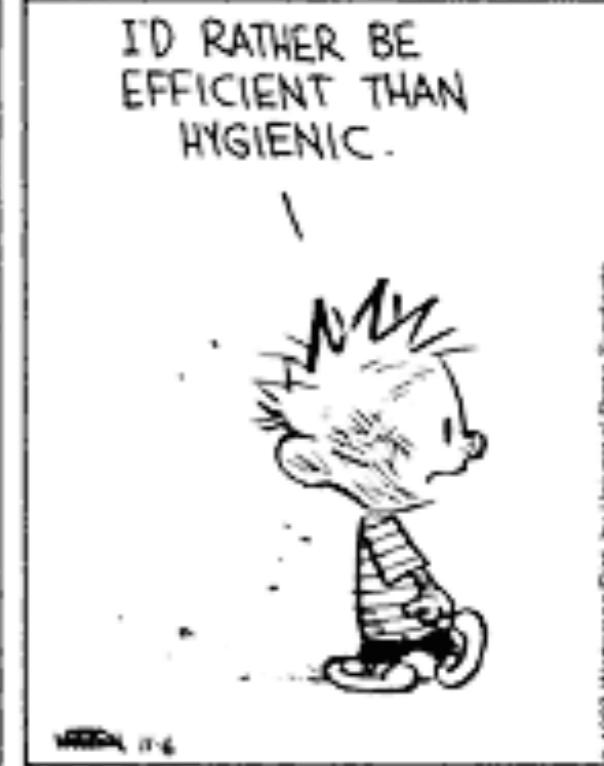
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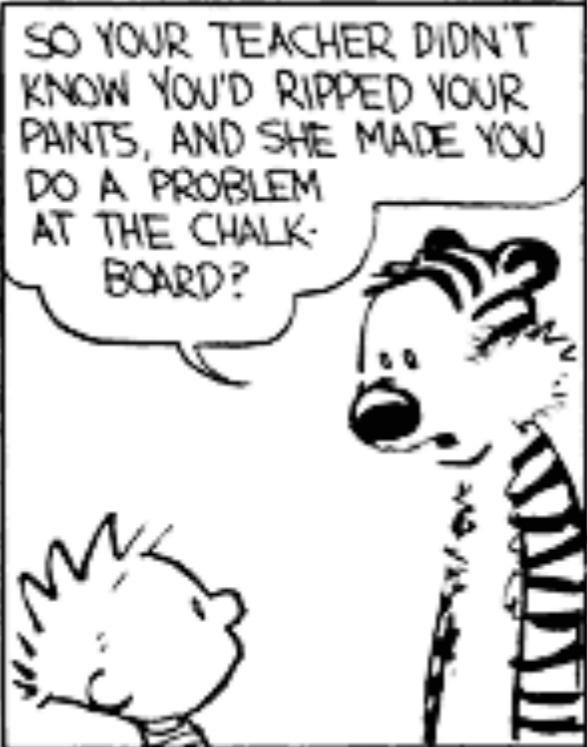
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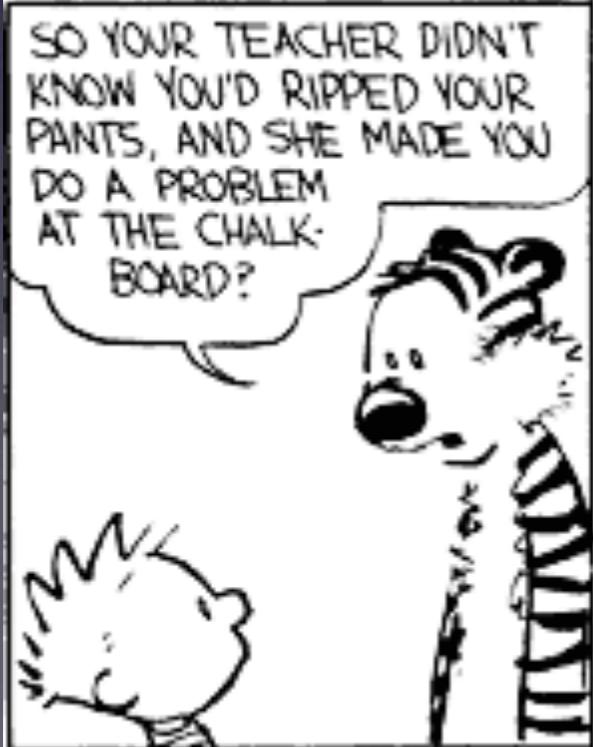
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# One dimensional metal

$$\psi = A \exp(\pm i\pi x/a - i\omega t)$$



What are the differences between  
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$$\psi_1 = 2A \cos(\pi x/a) \exp(-i\omega t)$$

$$\psi_2 = 2iA \sin(\pi x/a) \exp(-i\omega t)$$

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Traveling wave versus stationary

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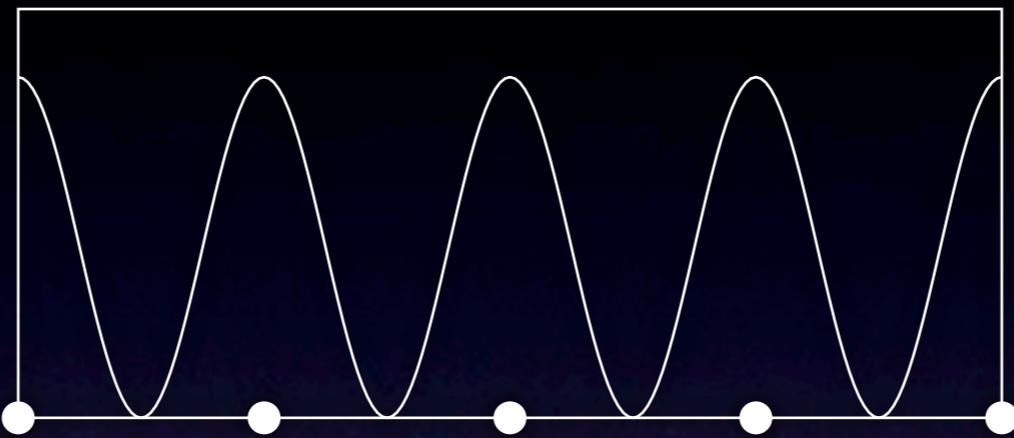
$$\psi_2 = 2iA \sin(\pi x/a) \exp(-i\omega t)$$

$$|\psi_1|^2 = 4A^2 \cos^2(\pi x/a)$$

$$|\psi_2|^2 = 4A^2 \sin^2(\pi x/a)$$

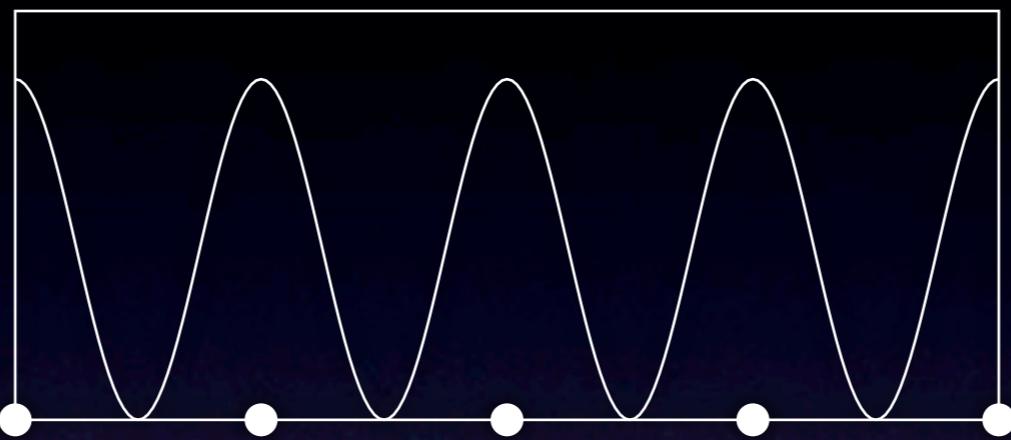
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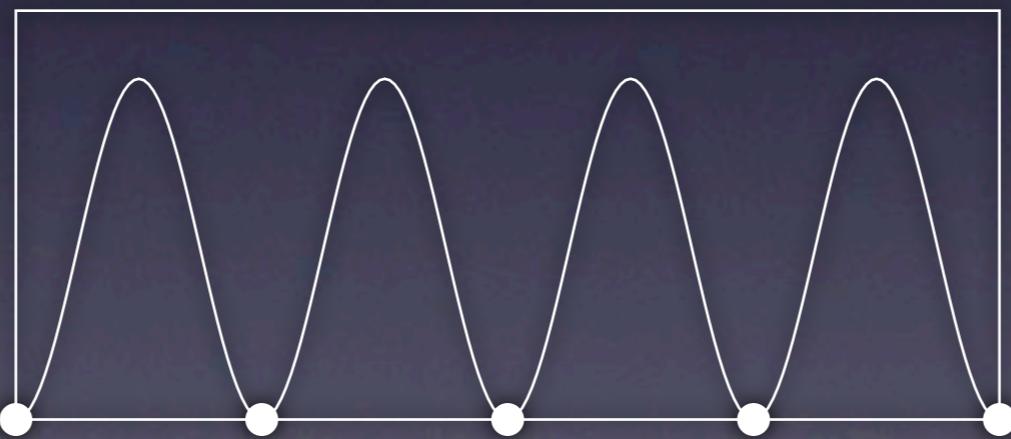


# Probability density

$$|\psi_1|^2 = 4A^2 \cos^2(\pi x/a)$$



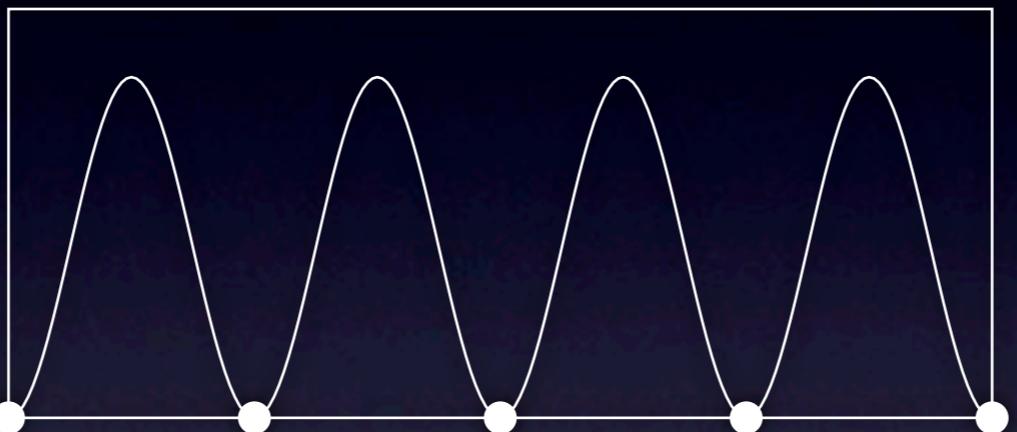
$$|\psi_2|^2 = 4A^2 \sin^2(\pi x/a)$$



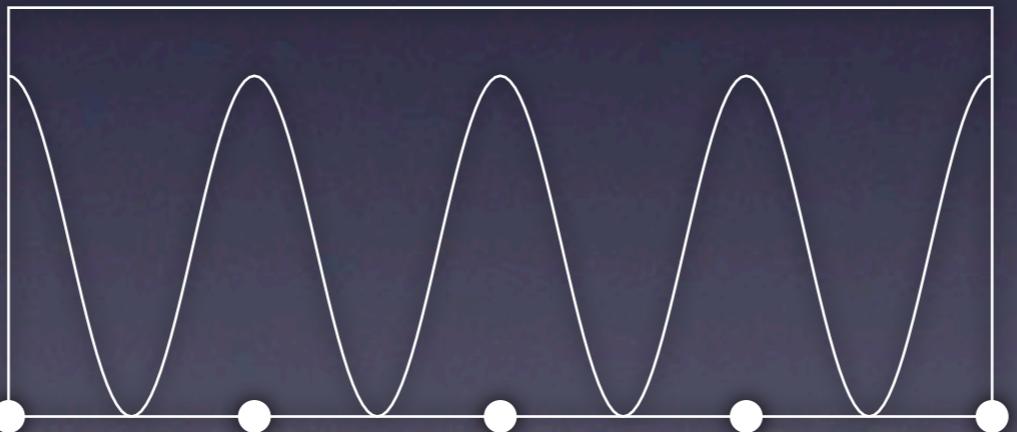
# Which state has the highest energy?

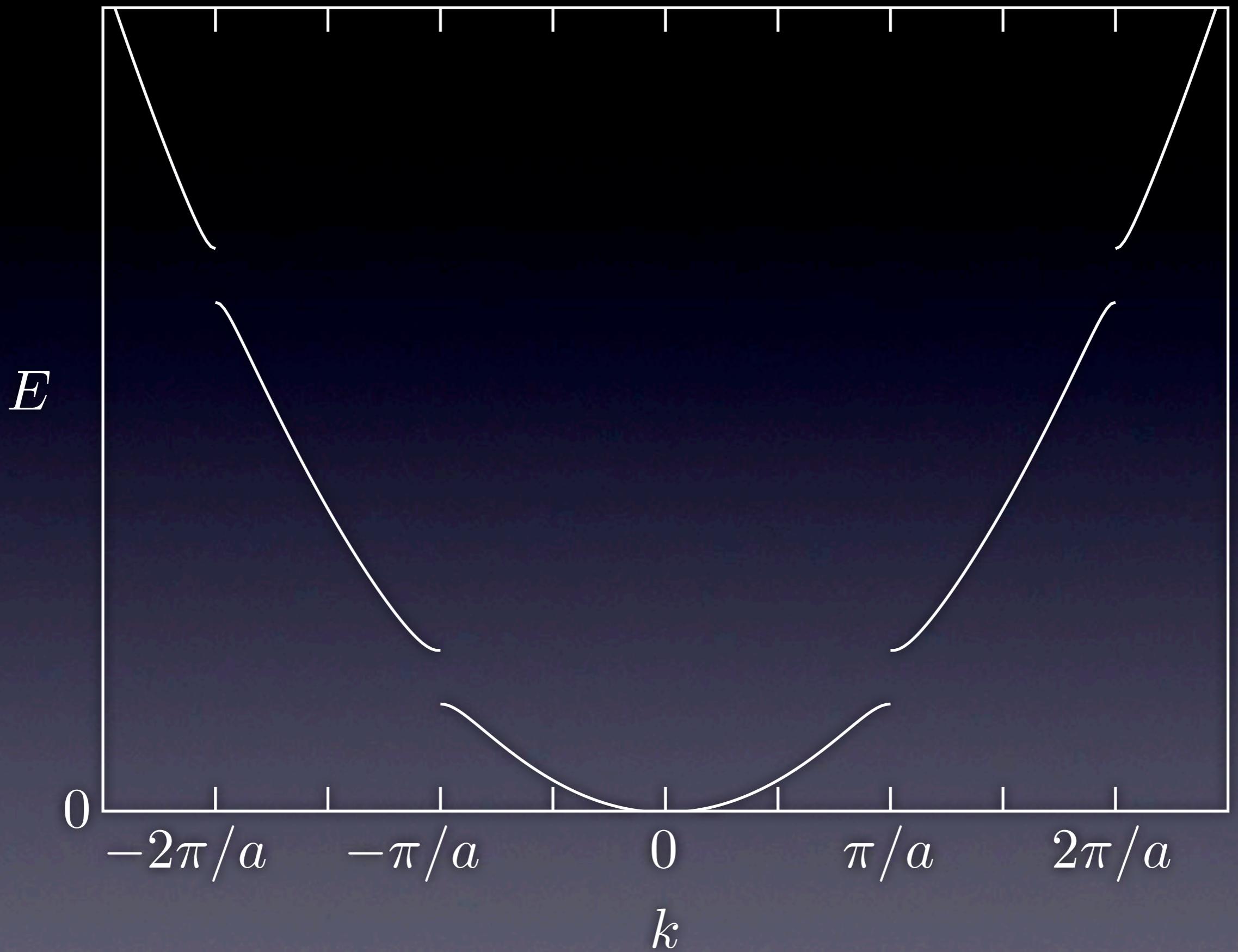
Question #14

(D)



(E)





# Bloch function

Question #15

True or False:

The Bloch function is periodic. That is,  
it has the same form in every unit cell.

(D) True

(E) False

# Bloch functions

$$\psi = u(x) \exp(ikx - i\omega t)$$

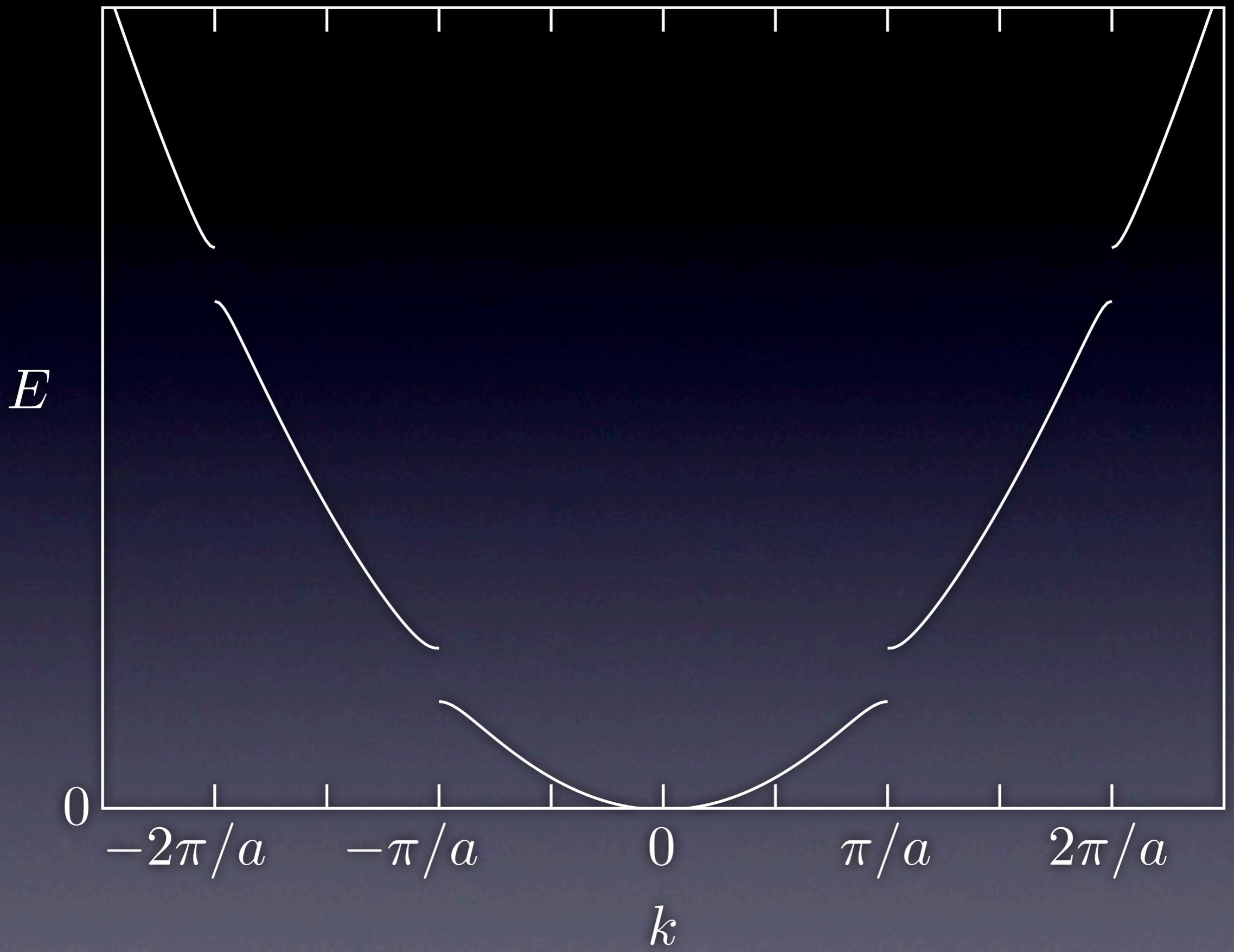
periodicity of  $u(x)$  matches lattice

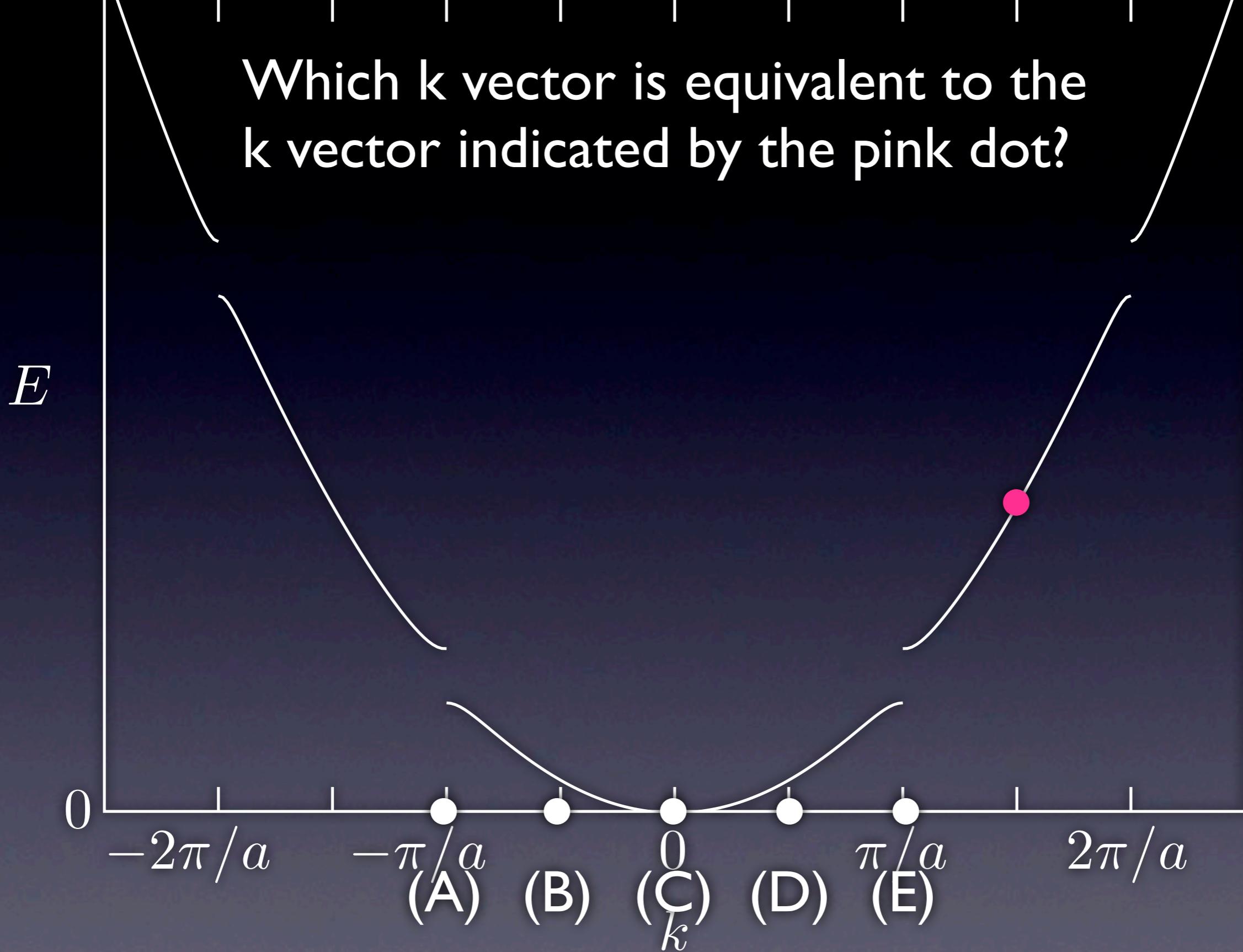
$\psi$  does *not* have periodicity of the lattice

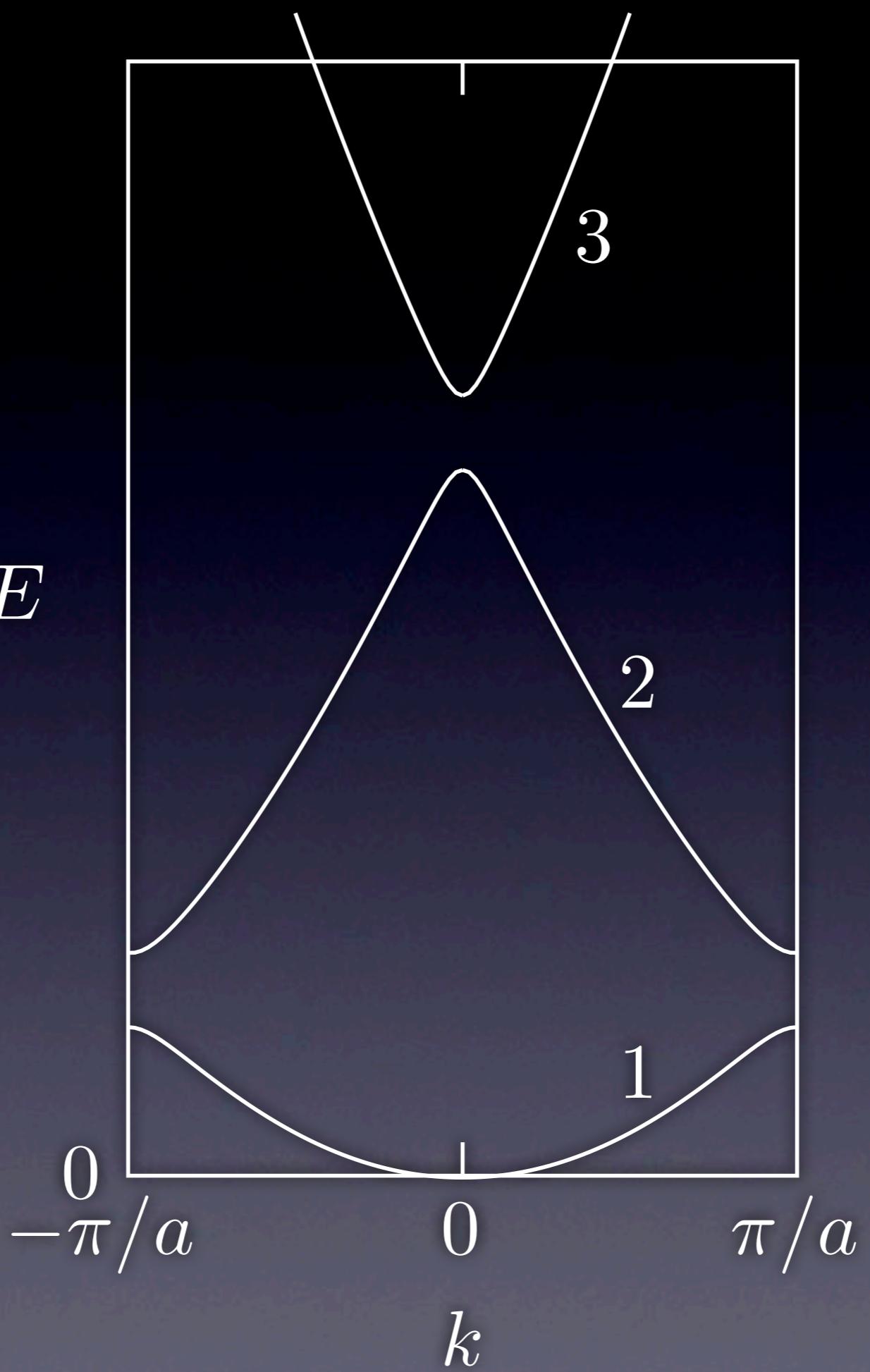
(but  $\psi^2$  does!)

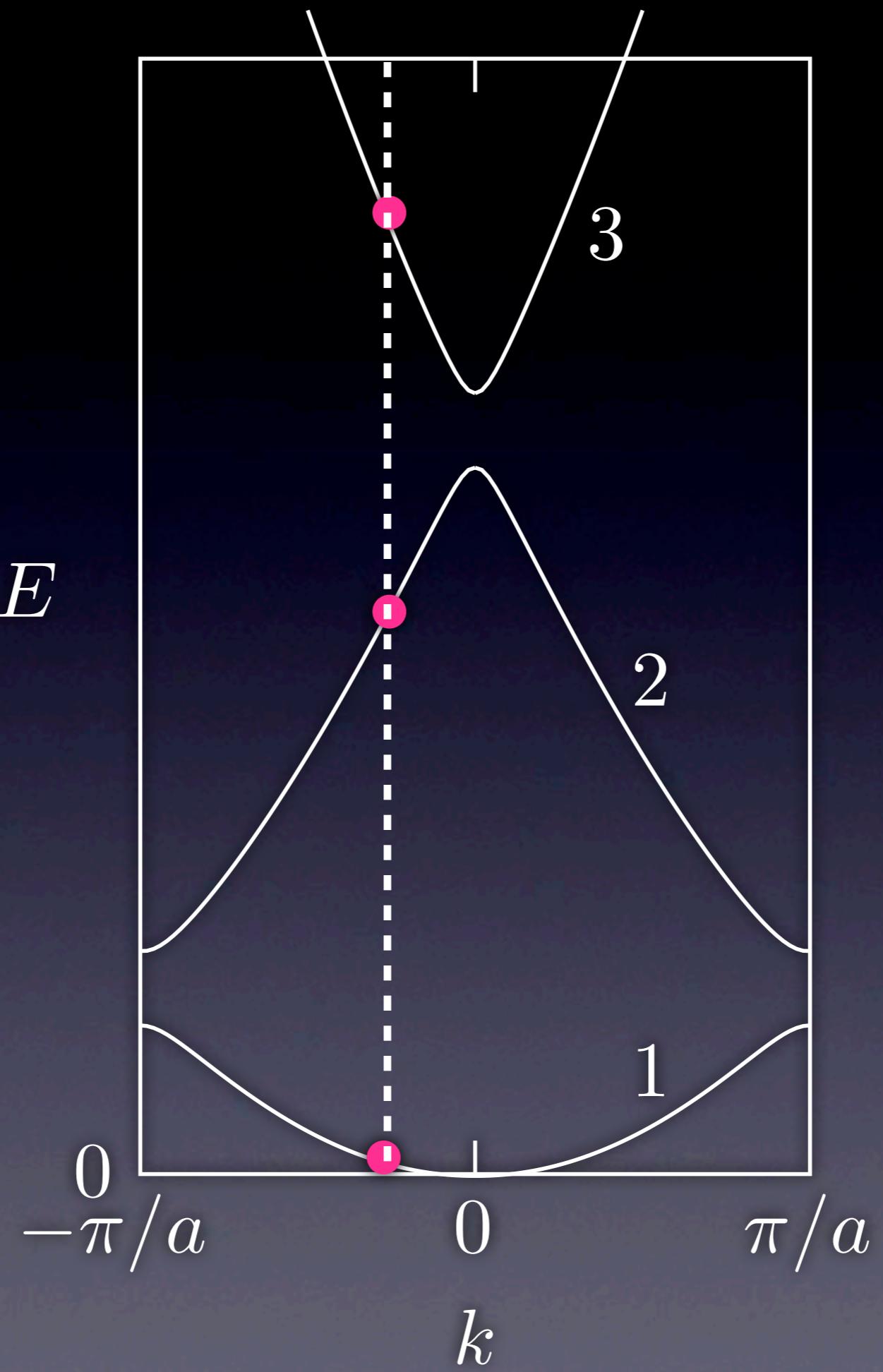
# Bloch functions

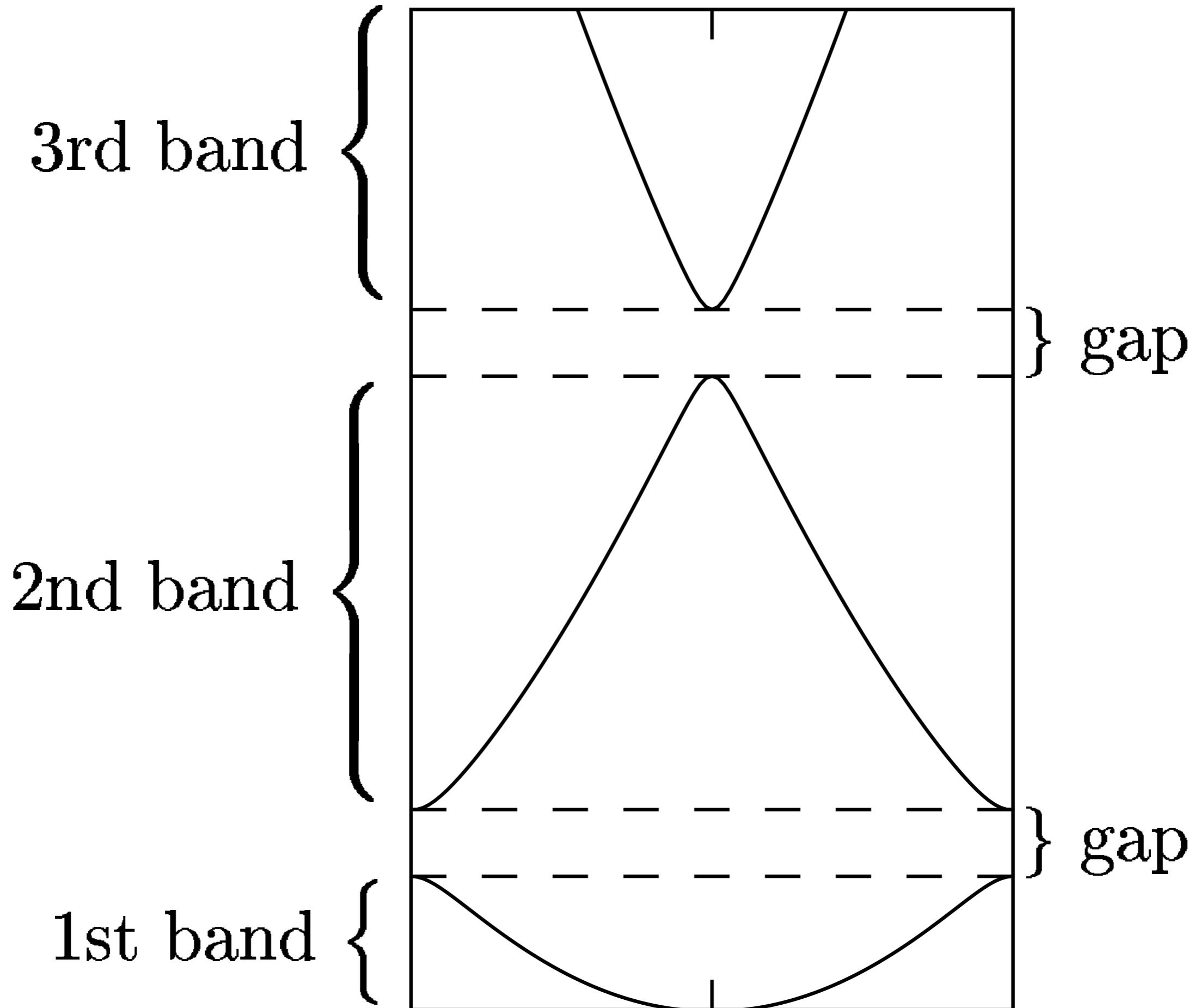
- label  $\psi$  with  $k$
- Bring  $k$  into the first BZ:  $k' = k - G$

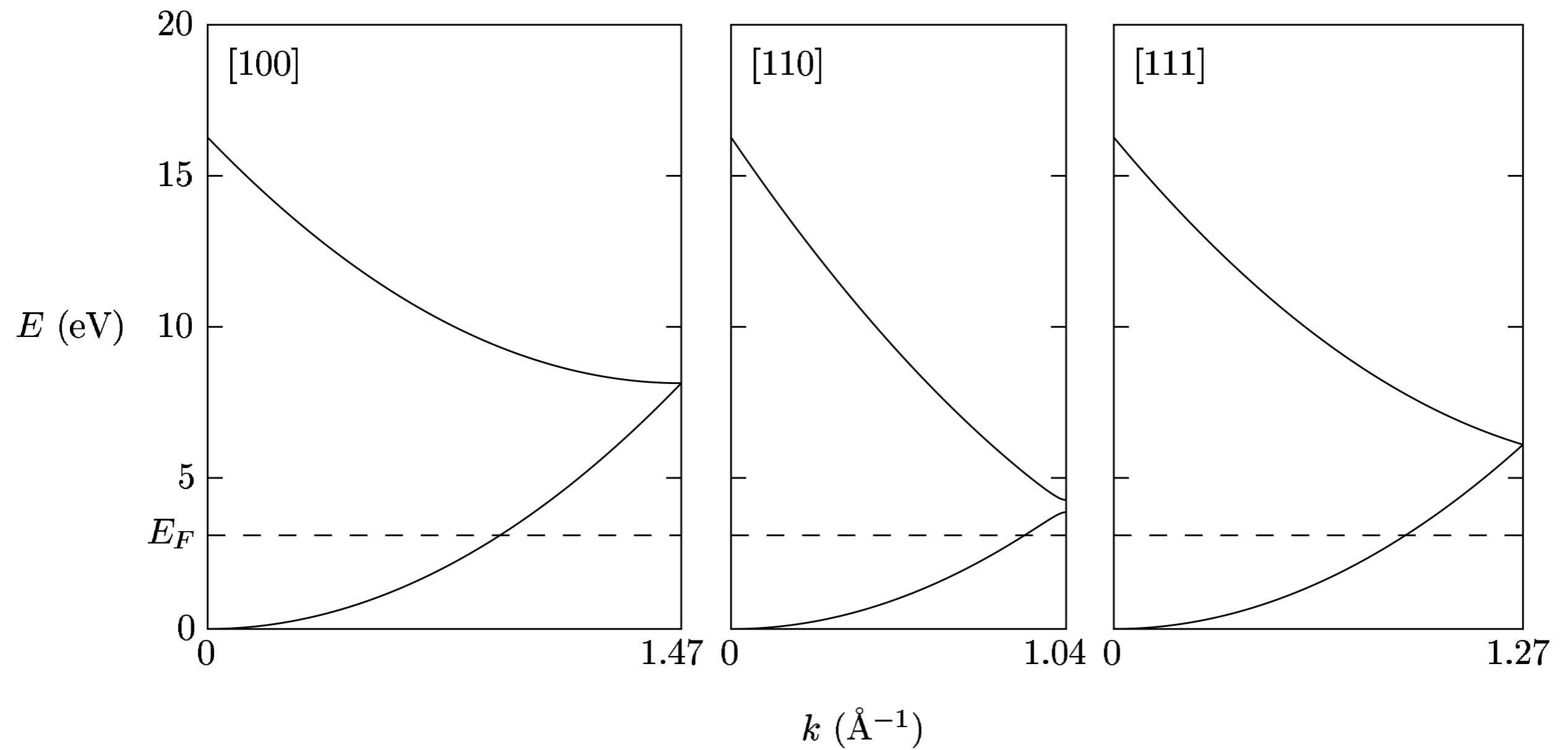


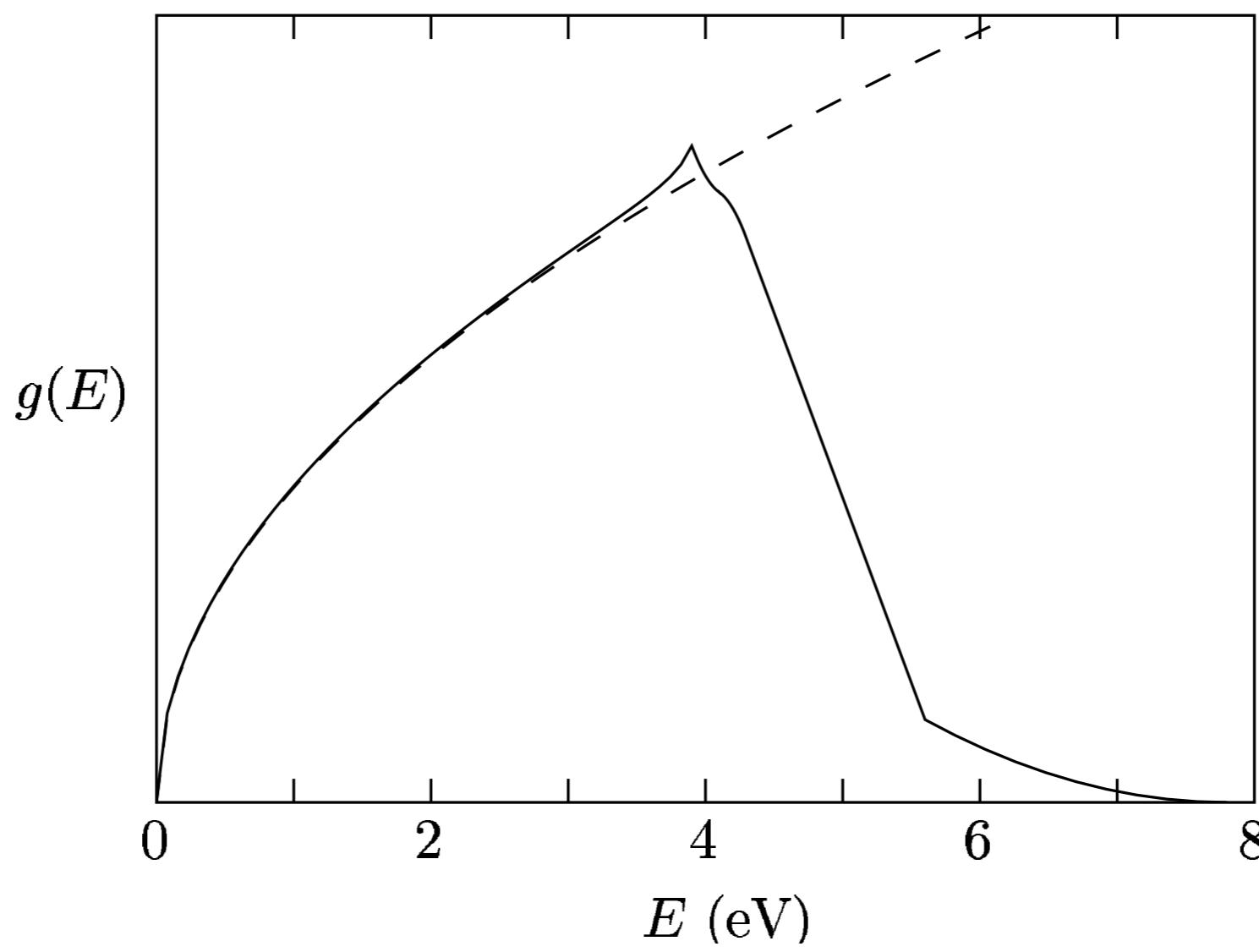
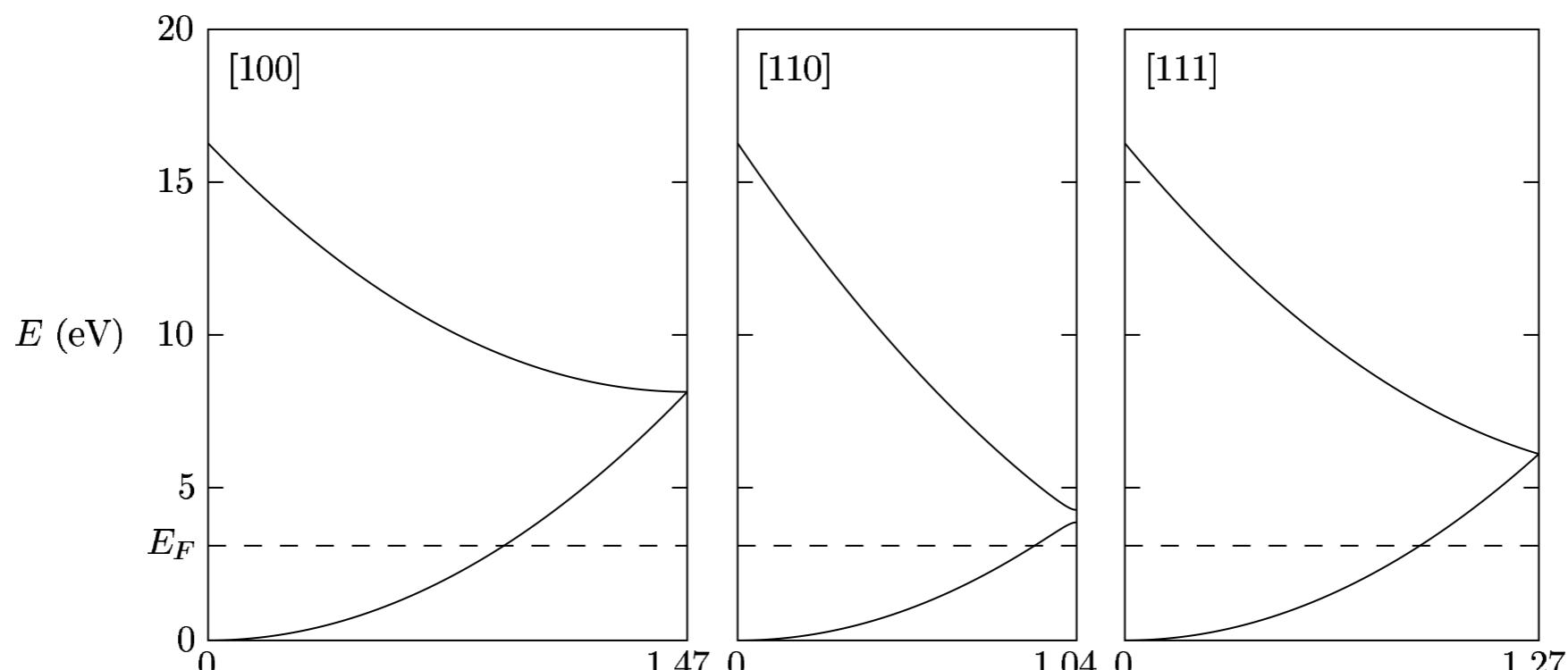


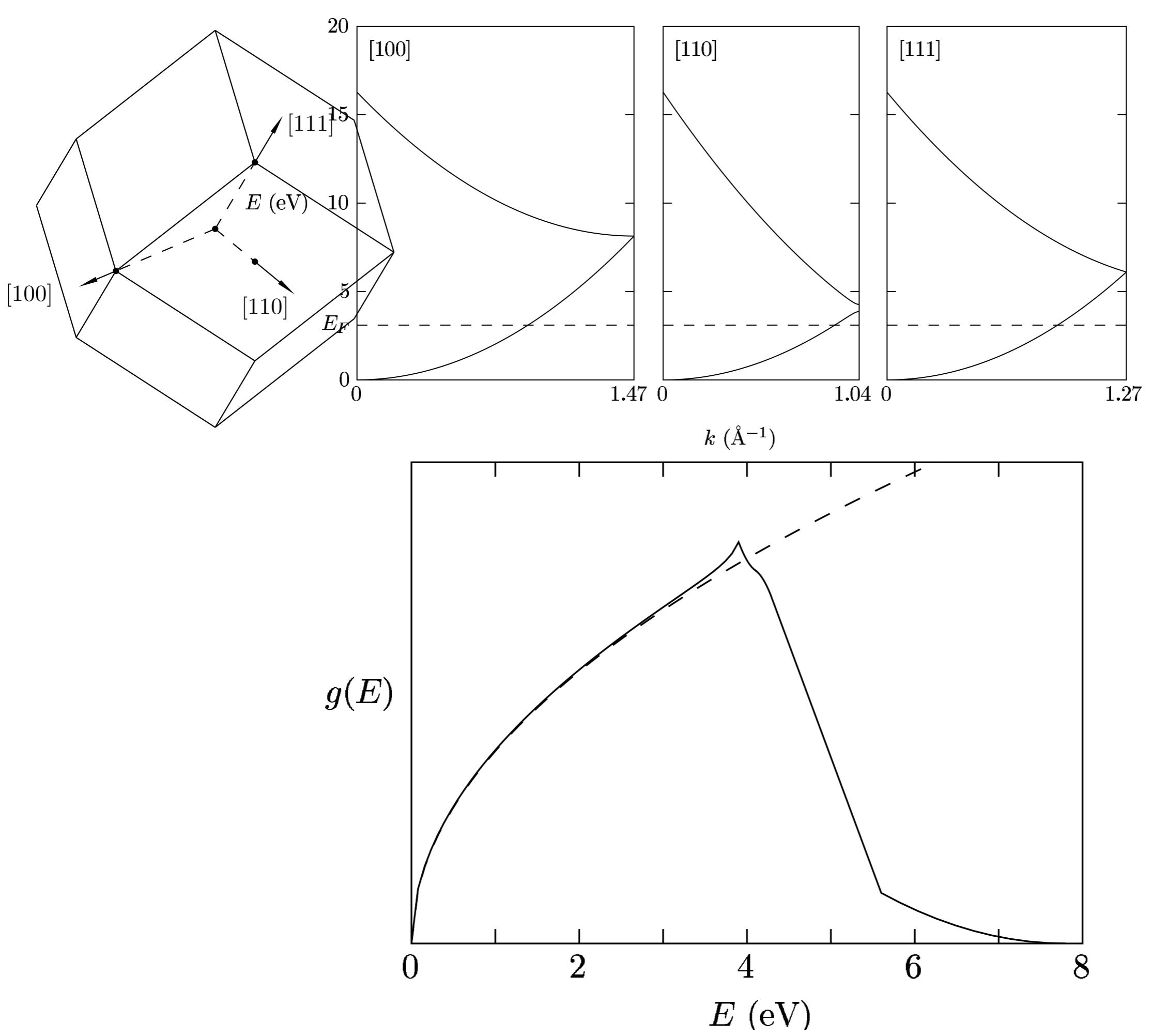






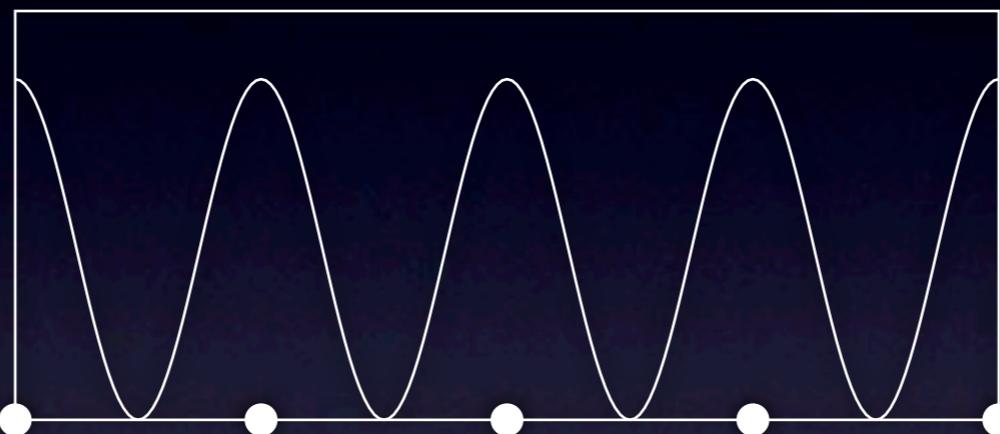




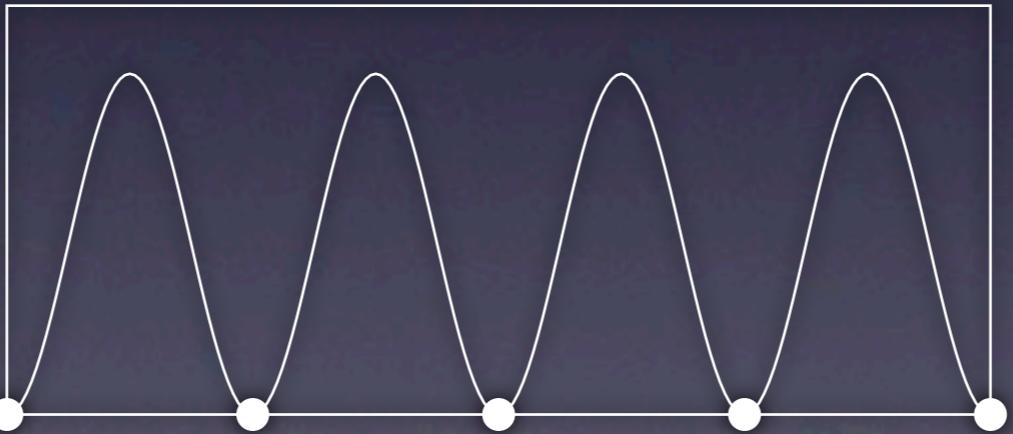


Write the k-vector for each of these wavefunctions.

(A)



(B)



Class is over  
and I'm still here

Push any button on your iclicker

Lots of stuff connected today. What can I do to help the students connect?

We looked at a single band as a jump-in to the next day but it was stilted (and I forgot why we were going there...)

