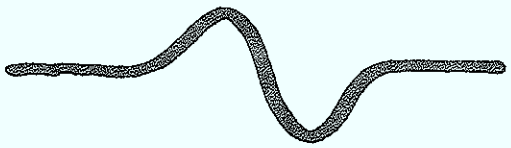
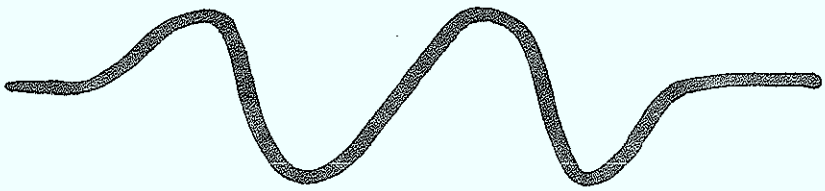
If we make a measurement of momentum, for which of the following electron states are we likely to find the largest value?

A) 

B) 

C) 

D) 

EXTRA: after the measurement, does the wavefunction tend to become more spread out, more localized, or stay the same?

Answer: B

Momentum is related to wavelength by h/p. The wave packet with the smallest apparent wavelength (distance between ripples) is the one for which we expect the measured momentum to be largest.

None of these wavepackets have an exactly-defined momentum, since they are not infinite pure waves, so in each case, there is a range of values that we might find. This range is larger for the narrower wavepackets and smaller for the larger wavepackets. But in this question, we care about the average (or expected) value that we'll find, so the size of the wavepacket isn't relevant.

Extra part: if we measure momentum, the state will become an (approximate) momentum eigenstates, so it should become more like a pure wave and therefore more spread out.

An electron is measured to be at some position x. Immediately afterwards, the electron's momentum is measured, and immediately after that, its position is measured again. The second measurement of position

A) Will be the same as the first one.

B) Will generally be different than the first one.

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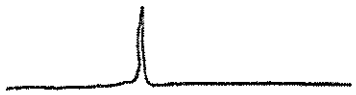
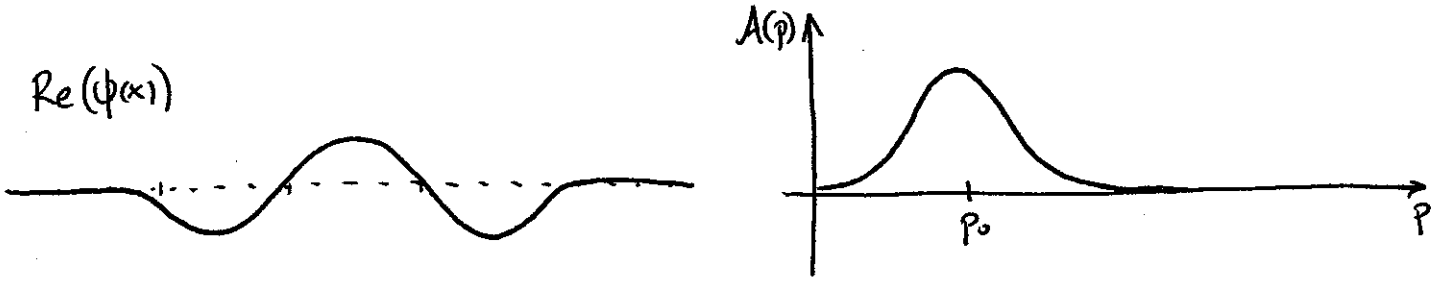
measure position $\psi \rightarrow$ 

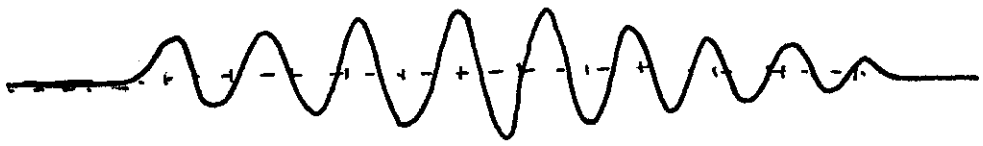
measure momentum $\psi \rightarrow$ 

measure position again : could be found anywhere in large range of x

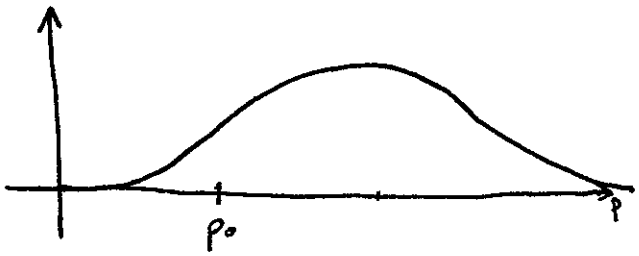
$\therefore$ generally different.



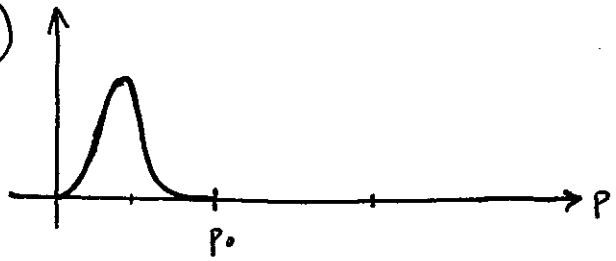
The wavepacket above can be written as a superposition of pure waves with relative amplitude $A(p)$. Which amplitude function will give the wavepacket shown below?



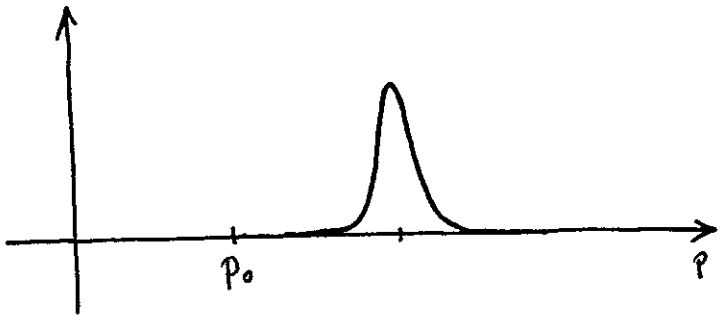
A)



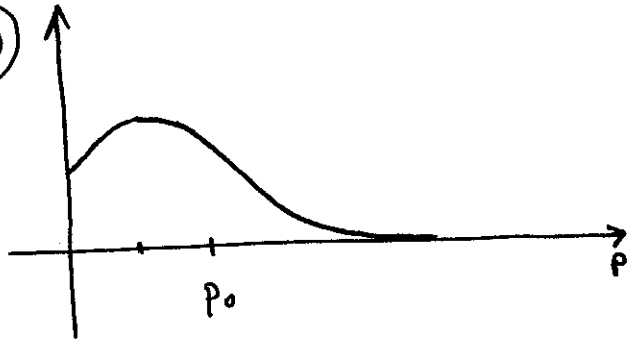
B)

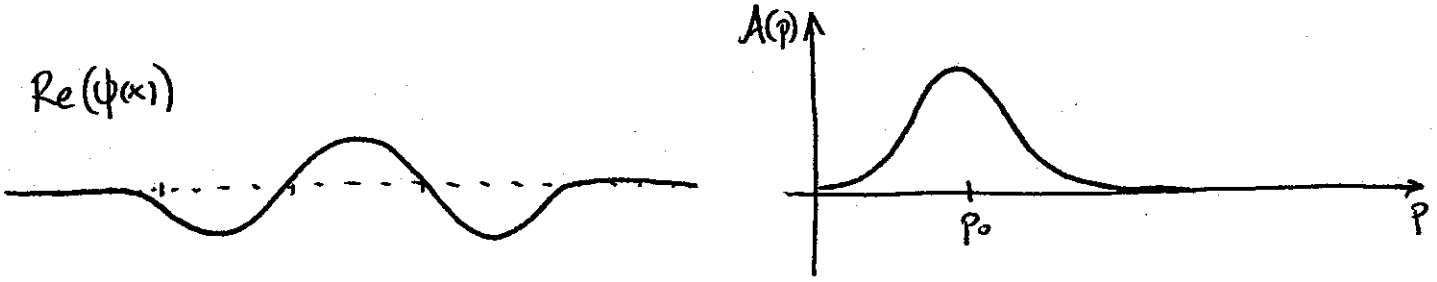


C)



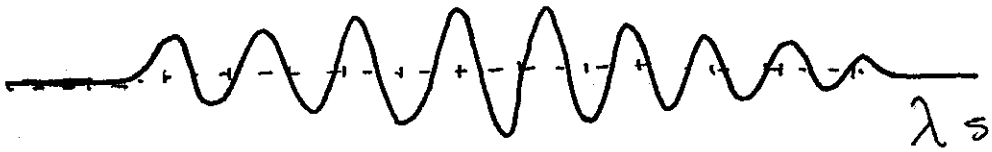
D)





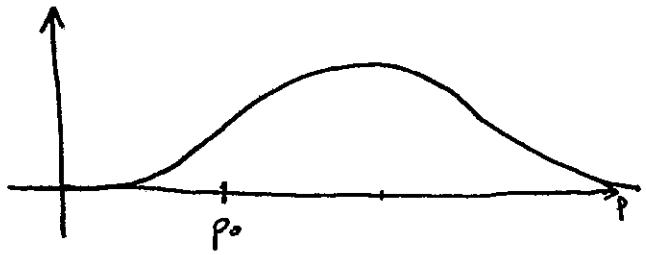
The wavepacket above can be written as a superposition of pure waves with relative amplitude $A(p)$. Which amplitude function will give the wavepacket shown below?

Δx larger
$\rightsquigarrow \Delta p$ should be smaller

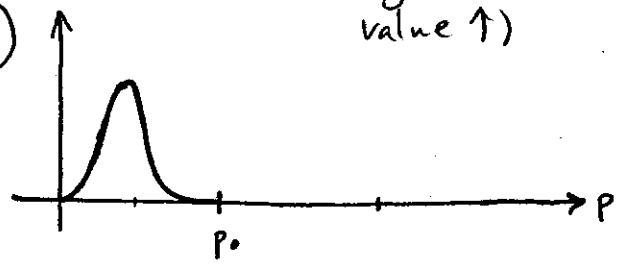


λ smaller
$\Rightarrow p$ should be larger (i.e. central value ↑)

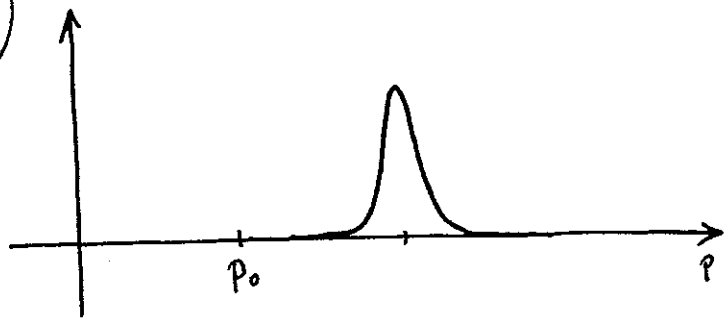
A)



B)



C)



D)