The sinusoidal curve often used to denote electromagnetic radiation represents:

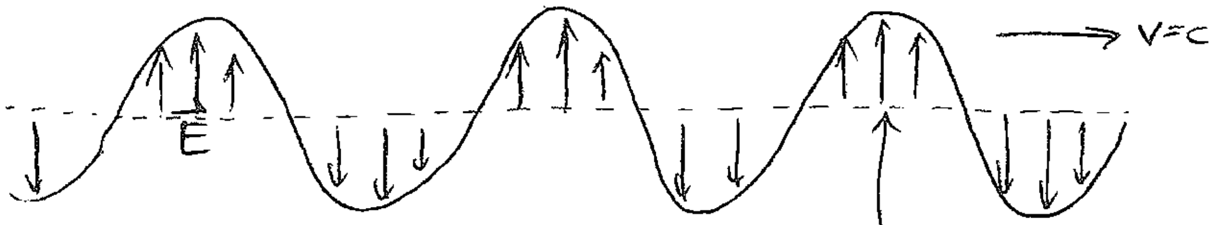
A) The path of a light ray

B) The boundary of the region in which the electric and magnetic fields are nonzero

C) The strength and direction of the electric field along a line in the direction of the wave

D) Photons which oscillate up and down in the presence of a light beam

E) A snake



path of light ray = straight line

The sinusoidal curve often used to denote electromagnetic radiation represents:

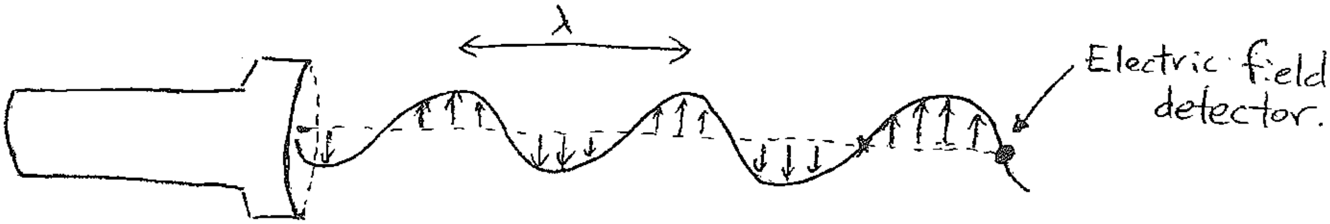
A) The path of a light ray

B) The boundary of the region in which the electric and magnetic fields are nonzero

C) The strength and direction of the electric field along a line in the direction of the wave

D) Photons which oscillate up and down in the presence of a light beam

E) A snake



time $t=0$

At what time will the electric field detector next read $\vec{E}=0$?

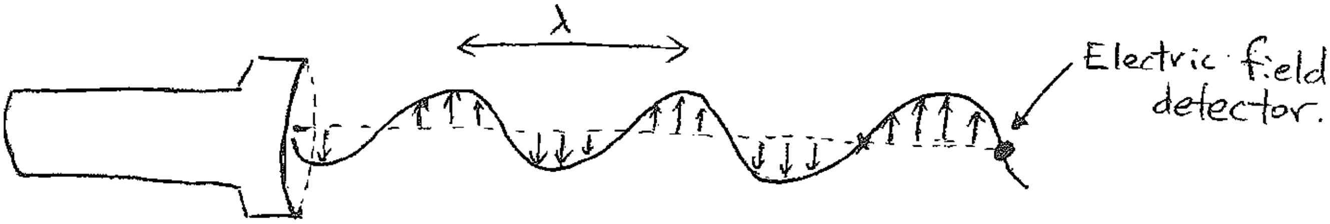
A) $\frac{1}{2}\lambda\cdot c$

B) λ/c

C) $\frac{\lambda}{2c}$

D) $\frac{2c}{\lambda}$

E) $\cos(2\pi\lambda)$



time $t=0$

At what time will the electric field detector next read $\vec{E}=0$?

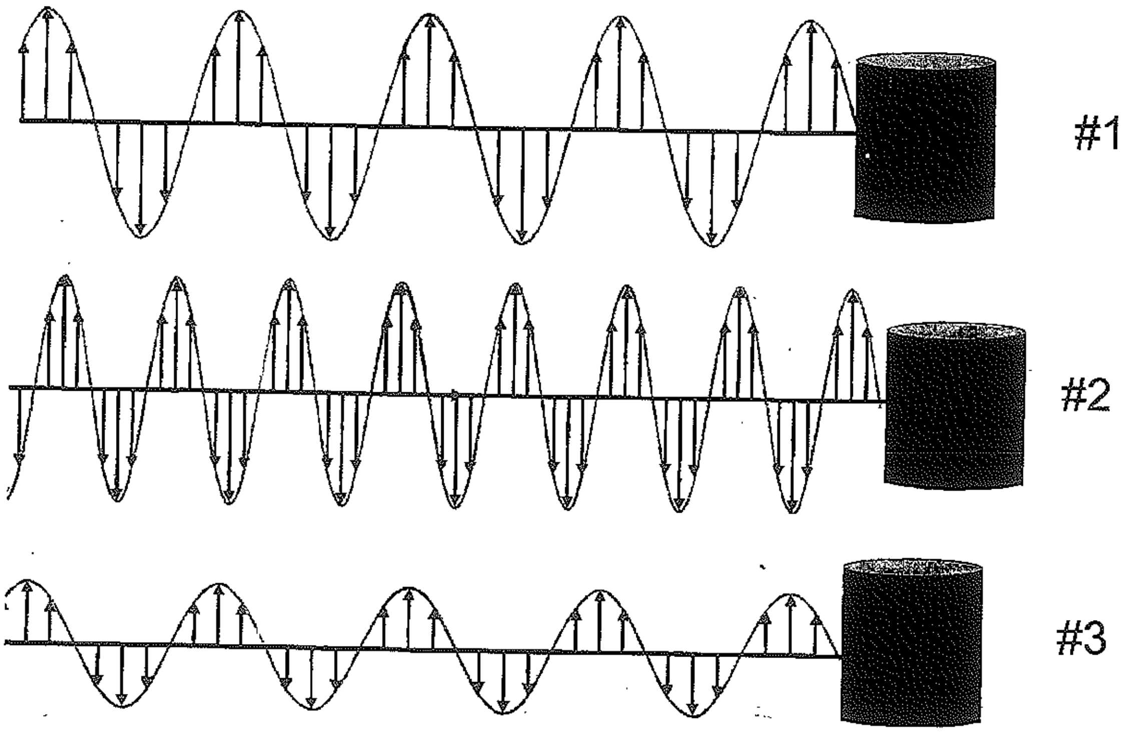
A) $\frac{1}{2}\lambda \cdot c$

B) λ / c

C) $\frac{\lambda}{2c}$ ⟶ needs to travel distance $\frac{\lambda}{2}$
- speed c
time $\frac{\lambda}{2c}$

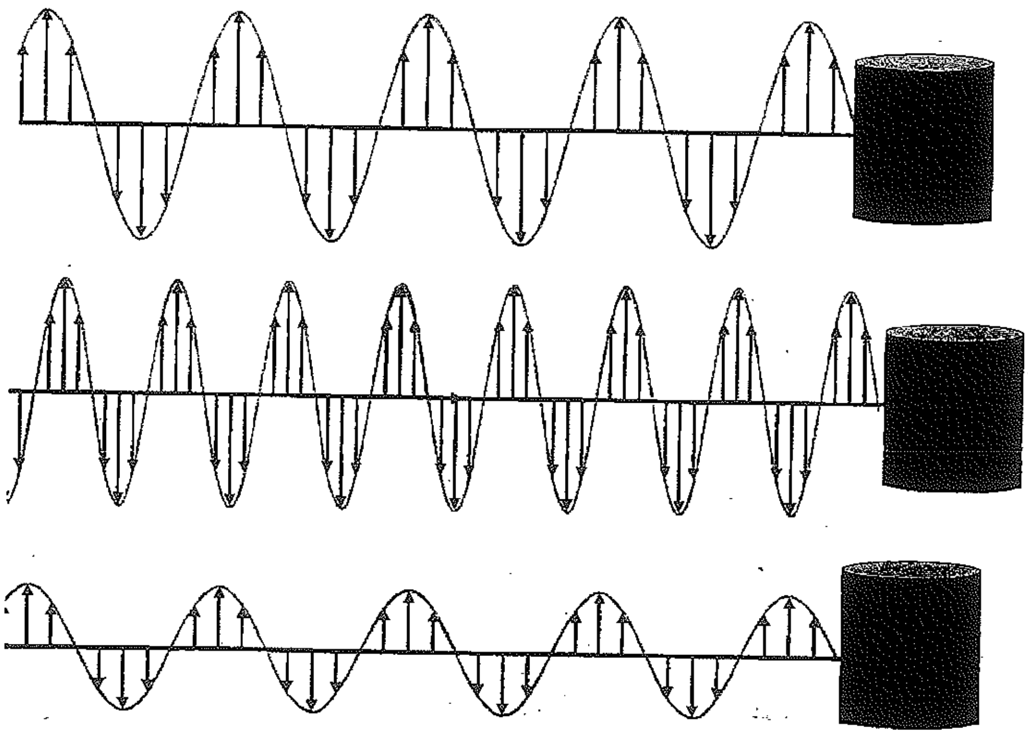
D) $\frac{2c}{\lambda}$

E) $\cos(2\pi\lambda)$



Which barrel will heat up the fastest? $E_{1max}=E_{2max}>E_{3max}$

a. 2>1>3
b. 1>2>3
c. 1=2>3
d. 1=3>2
e. 2>1=3



#1

#2

#3

Which barrel will heat up the fastest? $E_{1max}=E_{2max}>E_{3max}$

a. 2>1>3
b. 1>2>3
c. 1=2>3
d. 1=3>2
e. 2>1=3

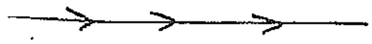
Energy density same for #1 and #2, less for #3
(prop to (amplitude)^2)

Velocity same for all

∴ Amount of energy per time
greatest for #1 and #2.

energy per photon is more for #2
but there are less photons here.

Which of these produce electromagnetic radiation?

A)  A current in a wire

B)  A single charge moving around a circular path

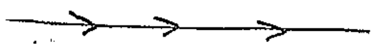
C) 

Two charges that deflect off each other.

D) Both B and C

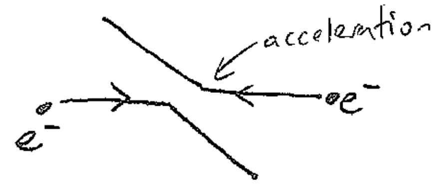
E) All of the above.

Which of these produce electromagnetic radiation?

A)  A current in a wire

B) 

A single charge moving around a circular path

C) 

Two charges that deflect off each other.

D) Both B and C

E) All of the above.

According to classical mechanics and electromagnetism, what will happen to an electron orbiting a nucleus?

A) It orbits at a constant speed; no radiation is emitted.

B) It continuously emits radiation at a constant wavelength.

C) It emits radiation and spirals into the nucleus.

D) It emits radiation and flies away from the nucleus.

According to classical mechanics and electromagnetism, what will happen to an electron orbiting a nucleus?

A) It orbits at a constant speed; no radiation is emitted.

B) It continuously emits radiation at a constant wavelength.

C) It emits radation and spirals into the nucleus.

D) It emits radiation and flies away from the nucleus.

circular motion ⇒ inward acceleration

⇓

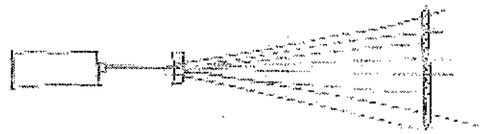
radiation

⇓

atom loses energy

⇓

electron spirals in



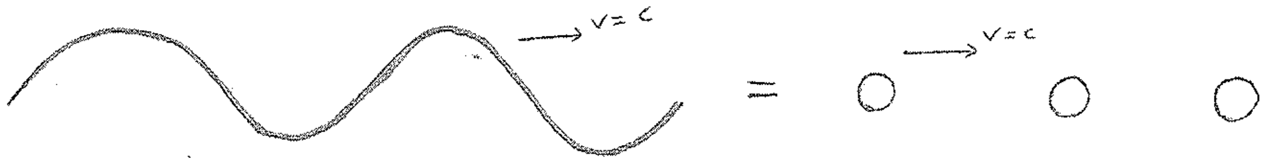
According to classical electricity and magnetism, what will happen if we illuminate a metal wire with light from a laser pointer?

A) Nothing
B) A uniform current will flow in the wire
C) Some electrons in the wire will oscillate up and down
D) Some electrons will fly out of the wire

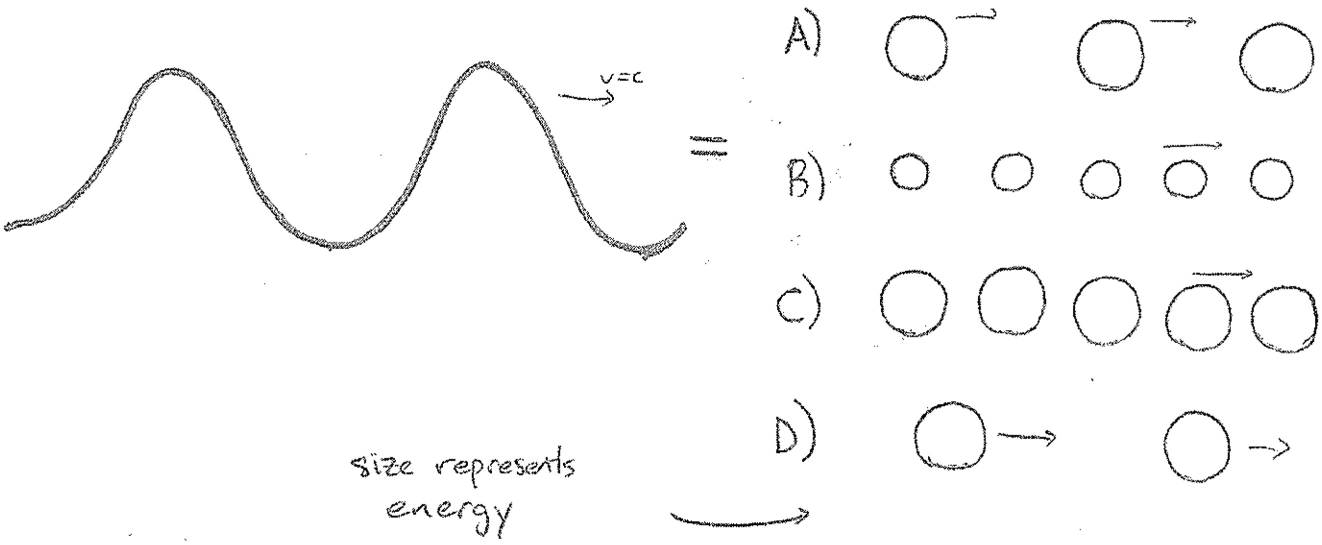
According to classical electricity and magnetism, what will happen if we illuminate a metal wire with light from a laser pointer?

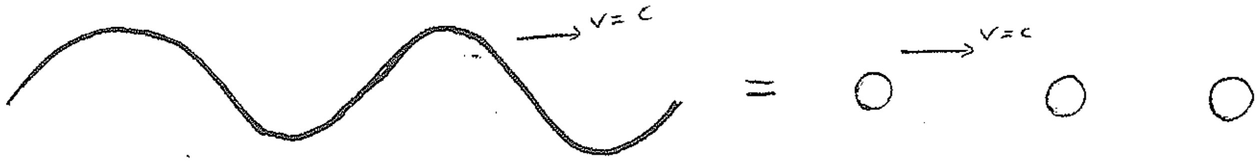
A) Nothing
B) A uniform current will flow in the wire
C) Some electrons in the wire will oscillate up and down
D) Some electrons will fly out of the wire

light: oscillating $\vec{E}$ field
$\Rightarrow$ oscillating force on electrons

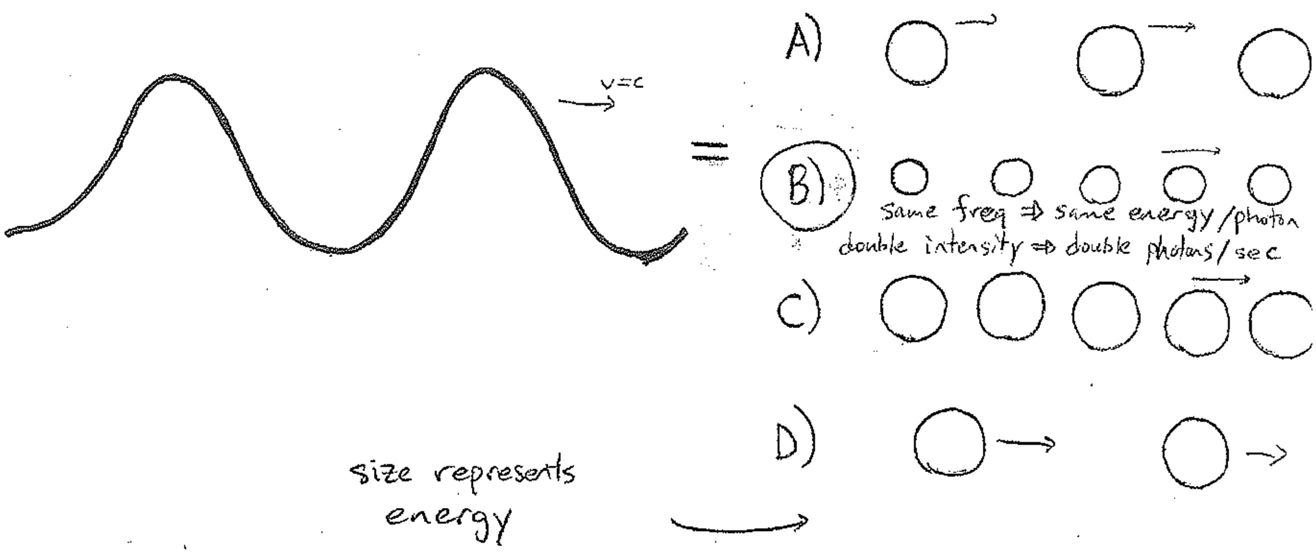


The picture on the right above represents the photons making up a beam of red light. Which of the pictures below represents the photons making up a beam of red light with double the intensity?

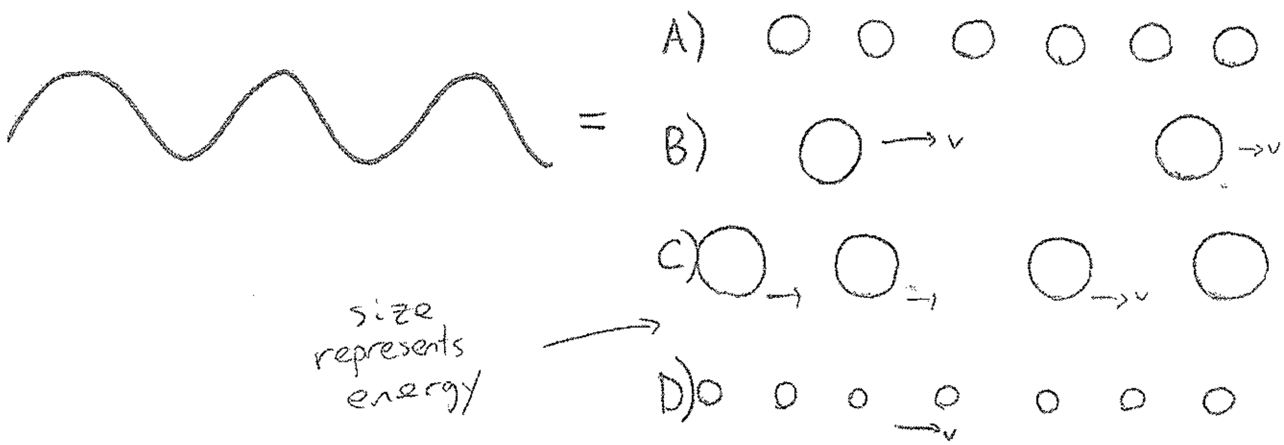




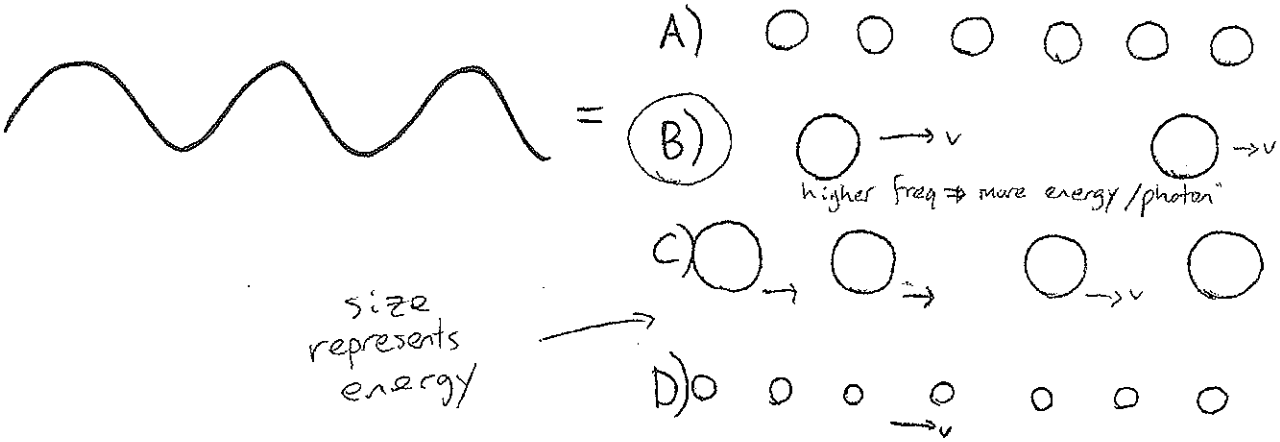
The picture on the right above represents the photons making up a beam of red light. Which of the pictures below represents the photons making up a beam of red light with double the intensity?



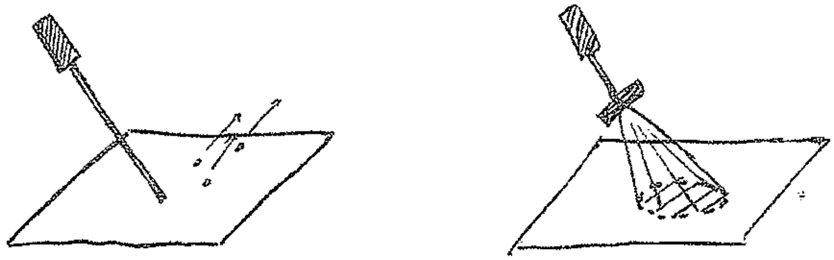
The picture on the right above represents the photons making up a beam of red light. Which of the pictures below represents the photons making up a beam of blue light with the same intensity?



The picture on the right above represents the photons making up a beam of red light. Which of the pictures below represents the photons making up a beam of blue light with the same intensity?



Same intensity ∴ same energy/sec ⇒ less photons/sec since each has more energy

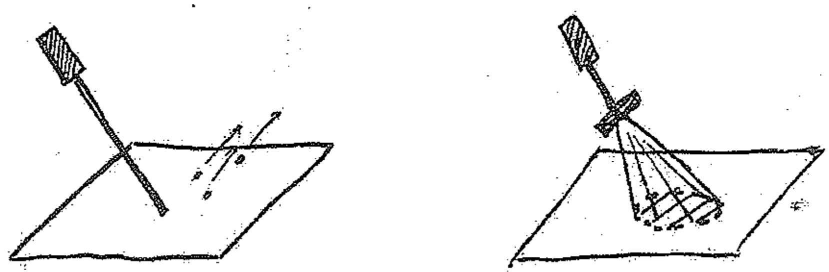


A narrow beam of light is incident on a metal. The wavelength is short enough to produce photoelectrons. If we adjust the beam to make it more diffuse (keeping the total power fixed), what happens to the current of photoelectrons?

A) It increases

B) It decreases

C) It stays the same



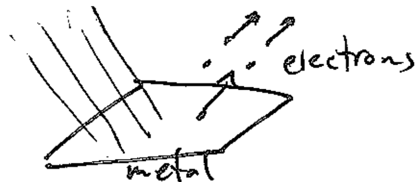
A narrow beam of light is incident on a metal. The wavelength is short enough to produce photoelectrons. If we adjust the beam to make it more diffuse (keeping the total power fixed), what happens to the current of photoelectrons?

A) It increases

B) It decreases

C) It stays the same

photon's per second hitting metal doesn't change.
- electrons are ejected by single photons



What will happen if we double the intensity of the light source (with a fixed beam area)?

A) The current of electrons will double
B) The energy of the electrons will increase
C) Both A and B
D) The current and energy will stay the same

What will happen if we double the intensity of the light source (with a fixed beam area)?

A) The current of electrons will double
B) The energy of the electrons will increase
C) Both A and B
D) The current and energy will stay the same

twice as many photons hitting per second
∴ twice as many electrons ~~el~~ ejected per second

BUT: each photon same energy as before
∴ electrons ejected don't have more energy than before.

In a photoelectric effect experiment:

Why are some of the electrons moving faster than others? (assume light is a single wavelength)

A) Because they absorbed photons that had a larger energy

B) Because some electrons are lighter than others

C) Some other reason (prepare to explain)

Why are some of the electrons moving faster than others? (assume light is a single wavelength)

A) Because they absorbed photons that had a larger energy

B) Because some electrons are lighter than others

C) Some other reason (prepare to explain)

- Some electrons are bound more tightly to metal.

- ~~electron can absorb~~
- photon can spread its energy between more than one electron.

Light incident on a polarizer is polarized at 45 degrees relative to the polarizer. The transmitted intensity will be:

A) Zero

B) The same as the original intensity

C) Half the original intensity

D) $\frac{1}{\sqrt{2}}$ times the original intensity

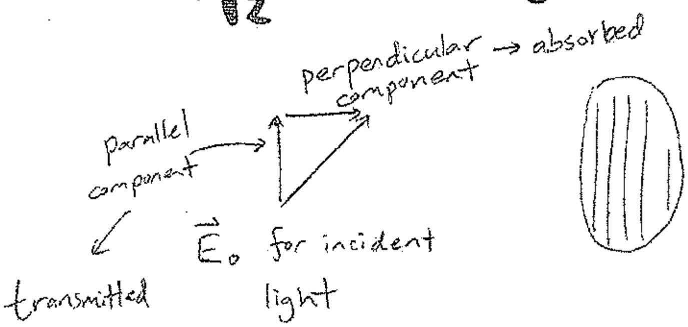
Light incident on a polarizer is polarized at 45 degrees relative to the polarizer. The transmitted intensity will be:

A) Zero

B) The same as the original intensity

C) Half the original intensity

D) $\frac{1}{\sqrt{2}}$ times the original intensity



transmitted amplitude $\sim \frac{1}{\sqrt{2}} \times$ original

transmitted intensity $\sim \frac{1}{2} \times$ original.

A stream of photons with the same polarization is incident on a polarizer oriented at 45 degrees relative to the polarization direction of the photons. What happens?

A) All the photons go through, but each have half as much energy as before.

B) All the photons go through, with unchanged energy.

C) None of the photons go through.

D) Half of the photons pass through.

A stream of photons with the same polarization is incident on a polarizer oriented at 45 degrees relative to the polarization direction of the photons. What happens?

A) All the photons go through, but each have half as much energy as before.

B) All the photons go through, with unchanged energy.

C) None of the photons go through.

D) Half of the photons pass through.

same wavelength ∴ same energy/photon

half intensity ⟹ half as many photons

A beam of polarized photons is incident on a polarizer whose orientation is chosen so that the photons are either absorbed (with probability 1/3) or transmitted (with probability 2/3). What is the intensity of the transmitted light as a fraction of the intensity of the incident light?

A) 1/3

B) 1/9

C) 2/3

D) 4/9

E) I don't understand what probability means.

A beam of polarized photons is incident on a polarizer whose orientation is chosen so that the photons are either absorbed (with probability 1/3) or transmitted (with probability 2/3). What is the intensity of the transmitted light as a fraction of the intensity of the incident light?

A) 1/3

B) 1/9

C) 2/3

D) 4/9

E) I don't understand what probability means.

$\frac{2}{3}$ of photons pass through

$\therefore$ $\frac{2}{3}$ intensity since

intensity $\propto$ # photons/sec.

Four photons with a vertical polarization are sent into a polarizer oriented at 45 degrees to the vertical. Which of the following is correct?

A) The photons will all be absorbed.

B) Two of the photons will pass through.

C) The photons will all be transmitted.

D) None of the above

Four photons with a vertical polarization are sent into a polarizer oriented at 45 degrees to the vertical. Which of the following is correct?

A) The photons will all be absorbed.

B) Two of the photons will pass through.

C) The photons will all be transmitted.

D) None of the above

this is the most likely, but all of these outcomes are possible, with some probability

→ same as flipping coin 4 times - could get 4 heads.

A beam of light polarized at 45 degrees is incident on a vertically (i.e. 0 degrees) oriented polarizer. If the first photon is observed to pass through the polarizer, the probability that the second will pass through is

A) 50 percent

B) greater than 50 percent

C) less than 50 percent

D) we can't predict the probability since it's completely random

A beam of light polarized at 45 degrees is incident on a vertically (i.e. 0 degrees) oriented polarizer. If the first photon is observed to pass through the polarizer, the probability that the second will pass through is

A) 50 percent → prob. for each one completely indep. of previous ones.

B) greater than 50 percent

→ can predict probability exactly.

C) less than 50 percent

→ can't predict what will happen each time.

D) we can't predict the probability since it's completely random

For a double slit experiment:

Which explains the result that we get the same interference pattern even if we send the photons in one at a time?

A) Each photon interferes with other photons that have already passed through.

B) Each photon spreads its energy over the screen with the characteristic interference pattern.

C) Each photon hits the screen at a specific location, but the probability for each location is related to the classical intensity distribution.

D) The photons hit the screen at different places because they each go through the slits at a slightly different place

E) More than one of the above models works

Which explains the result that we get the same interference pattern even if we send the photons in one at a time?

A) Each photon interferes with other photons that have already passed through.

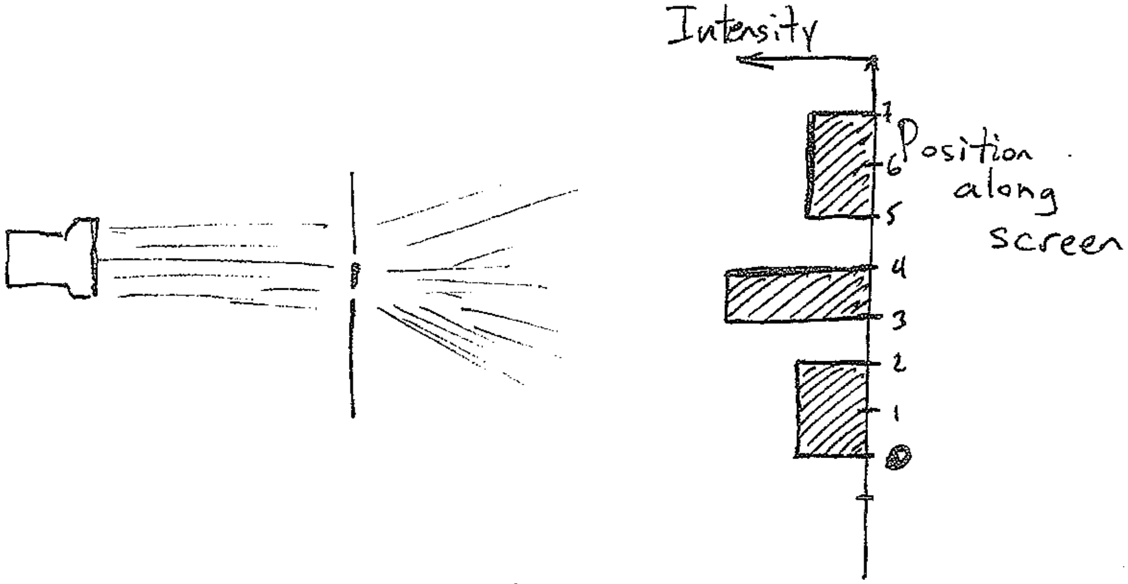
B) Each photon spreads its energy over the screen with the characteristic interference pattern.

C) Each photon hits the screen at a specific location, but the probability for each location is related to the classical intensity distribution.

D) The photons hit the screen at different places because they each go through the slits at a slightly different place

E) More than one of the above models works

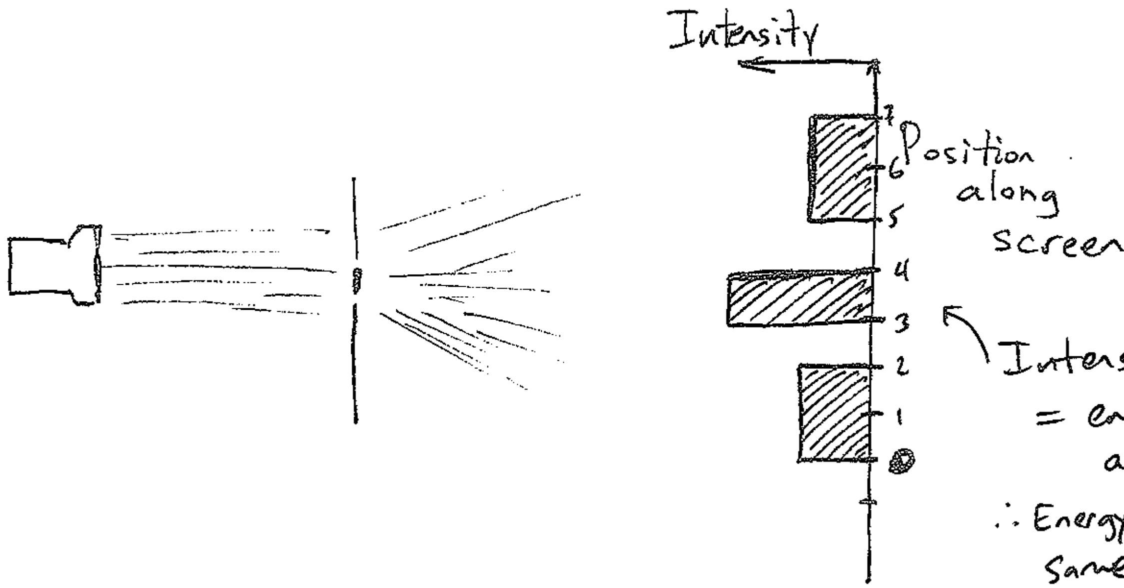
In a diffraction experiment the following pattern of intensity is observed on a screen:



We can conclude that the probability for a single photon to hit the screen between 0 and 2 is

A) Equal to the probability to hit between 3 and 4
B) Half the probability to hit between 3 and 4
C) Double the probability to hit between 3 and 4
D) Not related to the classical intensity pattern.

In a diffraction experiment the following pattern of intensity is observed on a screen:



Intensity = energy per area per time.

∴ Energy per time same for [3,4] as [0,2]

We can conclude that the probability for a single photon to hit the screen between 0 and 2 is

∴ photons per time same.

∴ probability for each photon same.

A) Equal to the probability to hit between 3 and 4

B) Half the probability to hit between 3 and 4

C) Double the probability to hit between 3 and 4

D) Not related to the classical intensity pattern.

~~Probability of hitting point x ∝ classical intensity at x~~

What happens to the interference pattern if we double the momentum of the photons in a double slit experiment?

A) Nothing.

B) It gets brighter but the pattern doesn't change.

C) The bright parts get further apart.

D) The bright parts get closer together.

What happens to the interference pattern if we double the momentum of the photons in a double slit experiment?

A) Nothing.

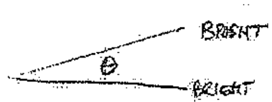
B) It gets brighter but the pattern doesn't change.

C) The bright parts get further apart.

D) The bright parts get closer together.

have : $\lambda = \frac{c}{f} = \frac{hc}{E} = \frac{h}{|\vec{p}|}$

$\therefore$ double momentum $\Rightarrow$ half wavelength



$\sin\theta = \frac{\lambda}{d}$ $\therefore \theta \downarrow$ bright areas closer together.

According to the quantum superposition model, what will happen if we remove the middle screen with the two slits?

A) Nothing, the pattern of hits will remain the same
B) The photons will now all hit the screen at the same place
C) The photons will still hit at various locations, but the pattern of hits will be different.
D) The photons will no longer hit at specific locations, but will be absorbed in a more diffuse way, distributing their energy over a larger region.

According to the quantum superposition model, what will happen if we remove the middle screen with the two slits?

A) Nothing, the pattern of hits will remain the same
B) The photons will now all hit the screen at the same place
C) **The photons will still hit at various locations, but the pattern of hits will be different.**
D) The photons will no longer hit at specific locations, but will be absorbed in a more diffuse way, distributing their energy over a larger region.

We know that each photon is spread out enough to go through both slits. The slits change how these spread out photons move, so if the slits aren't there, the photons will still be spread out, but in a different way. Thus, we expect that the photons will still hit the screen at various specific locations (this is part of the quantum superposition model), but in a different pattern.

A photon is in a state:

$$\frac{1}{\sqrt{2}}|x_1\rangle + \frac{1}{\sqrt{2}}|x_2\rangle,$$

a quantum superposition of two position eigenstates. This state describes:

A) one photon at x_1 and another at x_2.

B) a single photon at a position somewhere in between x_1 and x_2.

C) a single photon at a specific location, but we don't know the location since we haven't measured it yet.

D) a single photon that does not have a definite location.

A photon is in a state:

$$\frac{1}{\sqrt{2}}|x_1\rangle + \frac{1}{\sqrt{2}}|x_2\rangle,$$

a quantum superposition of two position eigenstates. This state describes:

A) one photon at x_1 and another at x_2.

B) a single photon at a position somewhere in between x_1 and x_2.

C) a single photon at a specific location, but we don't know the location since we haven't measured it yet.

D) a single photon that does not have a definite location.

if we measure, we will either find it at ~~two~~ x_1 or x_2.

$\cdot x_2$

$\cdot x_1$

An electron is in a state

$$\frac{1}{2}|x_1\rangle - \frac{\sqrt{3}}{2}|x_2\rangle$$

If we measure the electron's position, the result that we are most likely to find is

A) x_1

B) x_2

C) $\frac{1}{2}x_1 - \frac{\sqrt{3}}{2}x_2$

D) $\frac{1}{4}x_1 + \frac{3}{4}x_2$

E) None of the above

x_2

x_1

An electron is in a state

$$\frac{1}{2}|x_1\rangle - \frac{\sqrt{3}}{2}|x_2\rangle$$

If we measure the electron's position, the result that we are most likely to find is

A) x_1 ⟶ Prob. $\frac{1}{4} = \left|\frac{1}{2}\right|^2$

B) x_2 ⟶ Prob. $\frac{3}{4} = \left|-\frac{\sqrt{3}}{2}\right|^2$

C) $\frac{1}{2}x_1 - \frac{\sqrt{3}}{2}x_2$

D) $\frac{1}{4}x_1 + \frac{3}{4}x_2$ ⟶ this is the average value if we did the experiment a large # of times.

E) None of the above

Immediately repeated measurements of an electron's position give the same result. This implies that

A) The electron's wavefunction generally stays the same when we do a measurement.

B) The electron's wavefunction generally changes when we do a measurement.

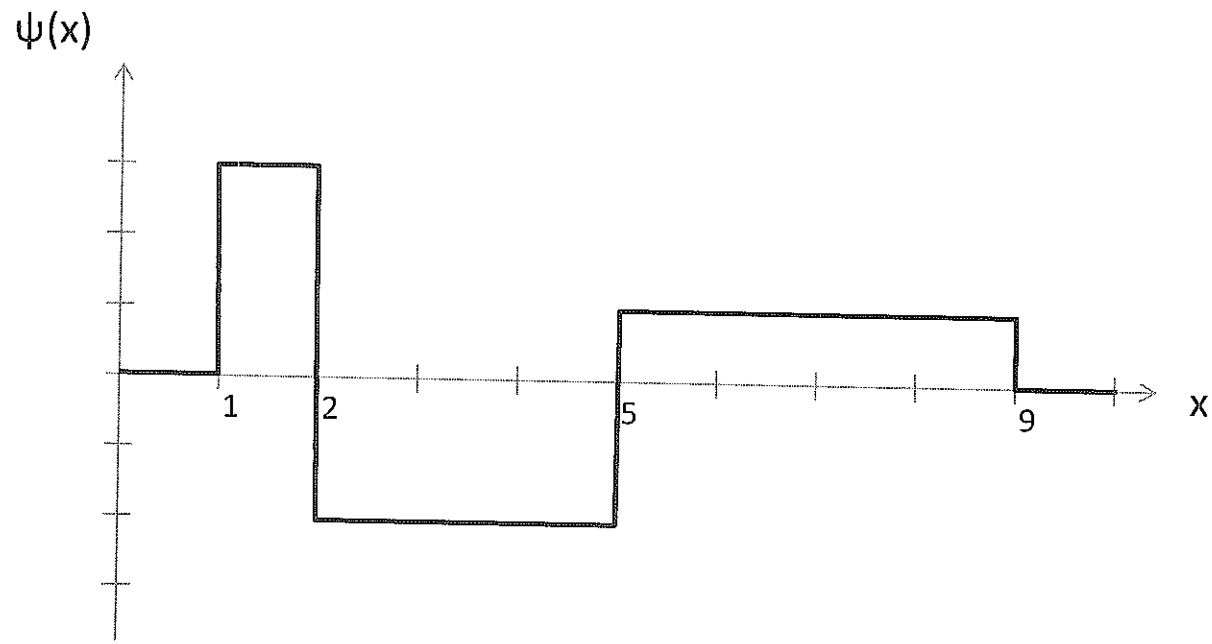
Immediately repeated measurements of an electron's position give the same result. This implies that

A) The electron's wavefunction generally stays the same when we do a measurement.

B) The electron's wavefunction generally changes when we do a measurement.

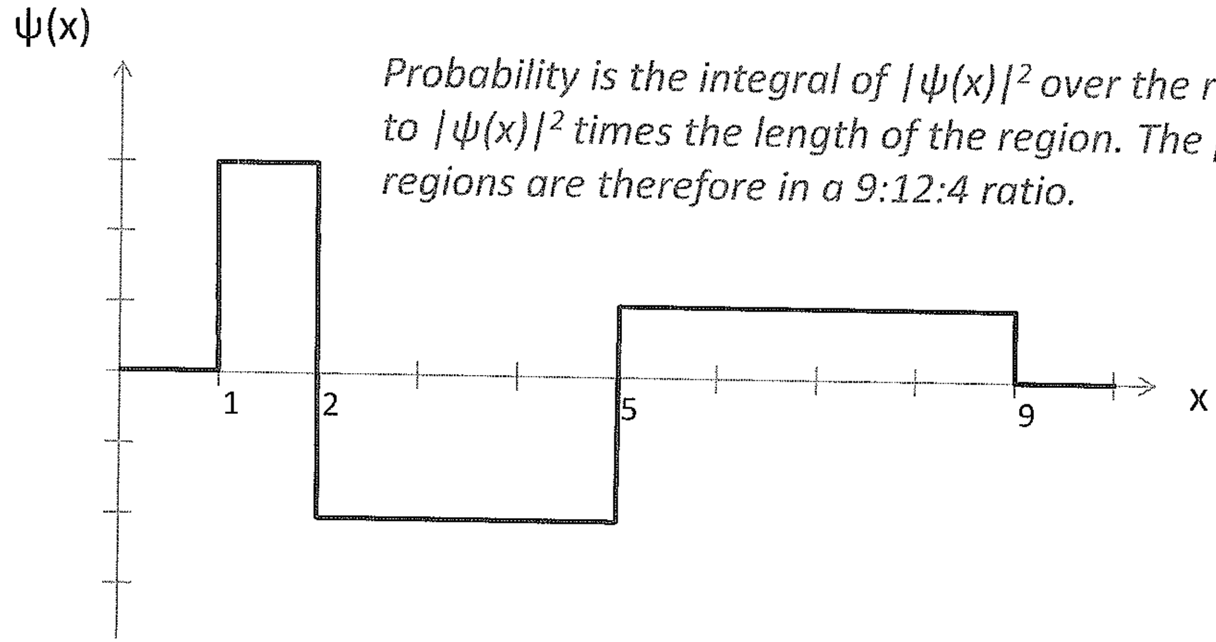
Original wavefunction → superposition of position eigenstates.
→ position not predetermined

After measurement: know position
→ state = position eigenstate
∴ wavefunction has changed



The wavefunction for an electron in a one-dimensional wire is shown. If we measure the position, the electron is most likely to be found:

A) Between 1 and 2
B) Between 2 and 5
C) Between 5 and 9
D) All are equally likely
E) The answer cannot be determined from the information given



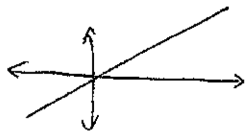
Probability is the integral of $|\psi(x)|^2$ over the region, so is proportional to $|\psi(x)|^2$ times the length of the region. The probabilities for the three regions are therefore in a 9:12:4 ratio.

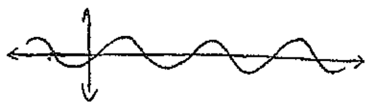
The wavefunction for an electron in a one-dimensional wire is shown. If we measure the position, the electron is most likely to be found:

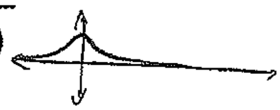
A) Between 1 and 2
B) Between 2 and 5
C) Between 5 and 9
D) All are equally likely
E) The answer cannot be determined from the information given

An electron is confined to an infinitely long thin wire (along the x direction). Which of the following is possible for the function ψ describing the electron's state?

A) $\psi(x) = 0$ 

B) $\psi(x) = x$ 

C) $\psi(x) = \cos(x)$ 

D) $\psi(x) = 1/\sqrt{\pi(1+x^2)}$ 

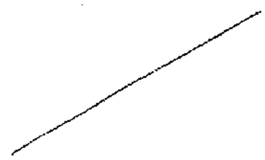
E) All of the above

An electron is confined to an infinitely long thin wire (along the x direction). Which of the following is possible for the function ψ describing the electron's state?

A) $\psi(x) = 0$

$\int |\psi(x)|^2 dx = 0$ ×

B) $\psi(x) = x$



$\int |\psi(x)|^2 dx = \infty$ ×

C) $\psi(x) = \cos(x)$

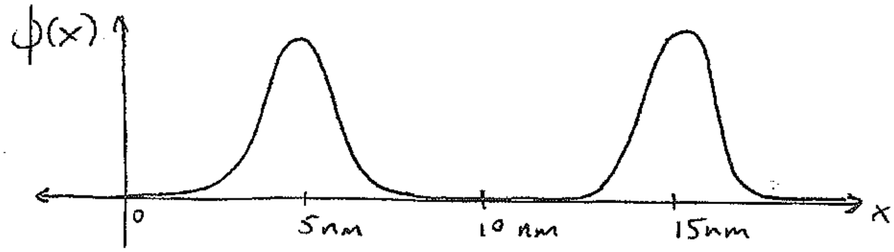
$\int |\psi(x)|^2 dx = \infty$ ×

D) $\psi(x) = 1/\sqrt{\pi(1+x^2)}$

$\int |\psi(x)|^2 dx = 1$ ✓

E) All of the above

total probability for finding electron must be $= 1$.



wavefn. for electron(s) in a wire extended along x direction.

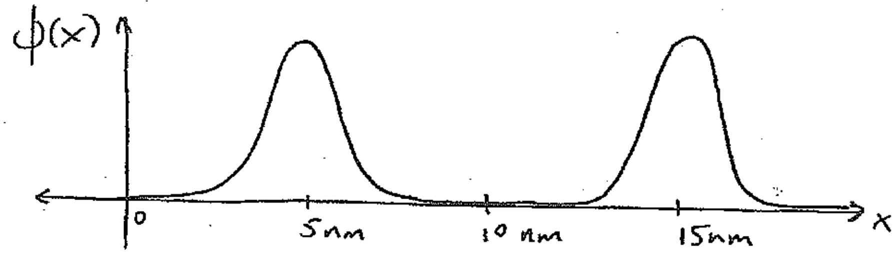
The wavefunction shown represents:

A) An electron near 5nm and an electron near 15nm.

B) A single electron with its charge split into two locations

C) A single electron which does not have a definite location.

D) This is not an allowable wavefunction.



wavefn. for electron(s) in a wire extended along x direction.

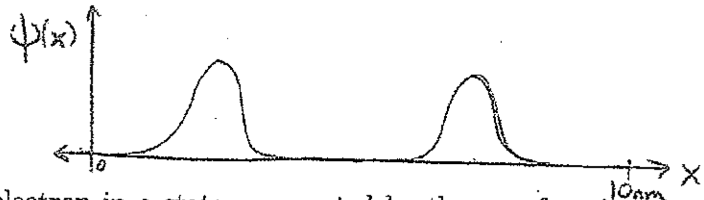
The wavefunction shown represents:

A) An electron near 5nm and an electron near 15nm.

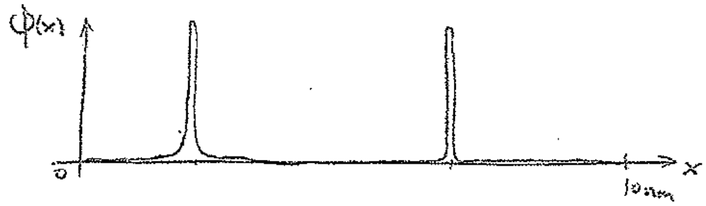
B) A single electron with its charge split into two locations

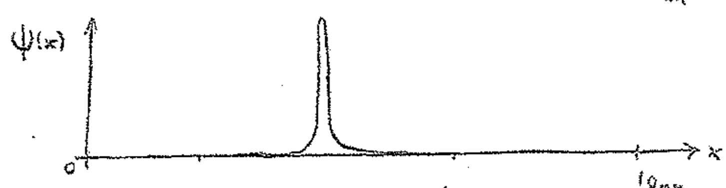
C) A single electron which does not have a definite location.

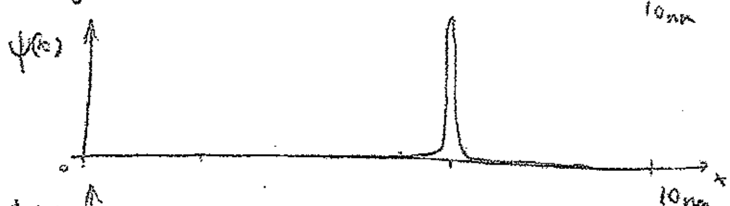
D) This is not an allowable wavefunction.

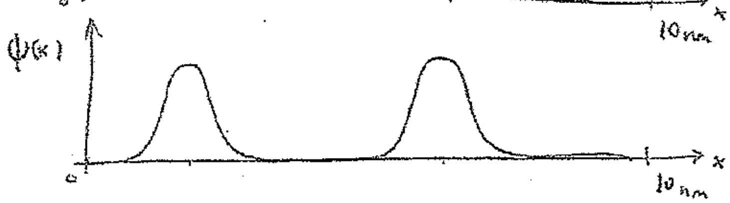


For an electron in a state represented by the wavefunction shown, a measurement of position is performed. Which of the following best represents a possible wavefunction immediately after the measurement?

A) 

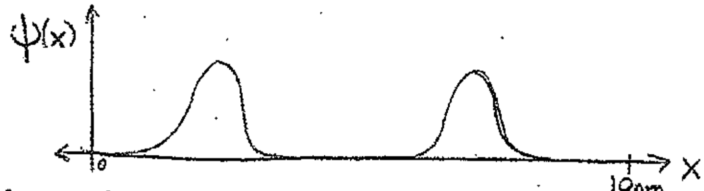
B) 

C) 

D) 

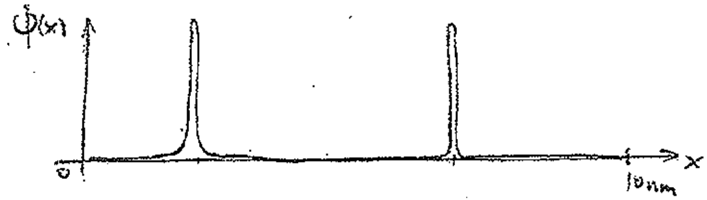
assume all wavefunctions are normalized.

E) Either B or C



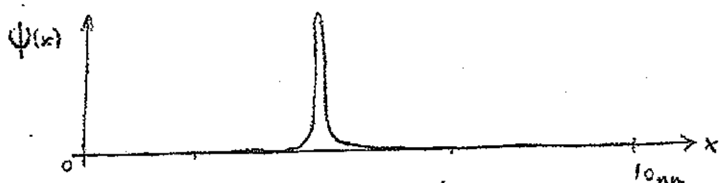
For an electron in a state represented by the wavefunction shown, a measurement of position is performed. Which of the following best represents a possible wavefunction immediately after the measurement?

A)

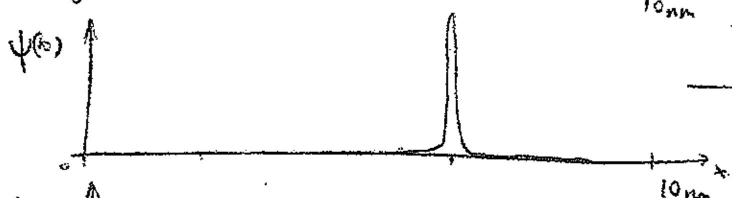


assume all wavefunctions are normalized.

B)

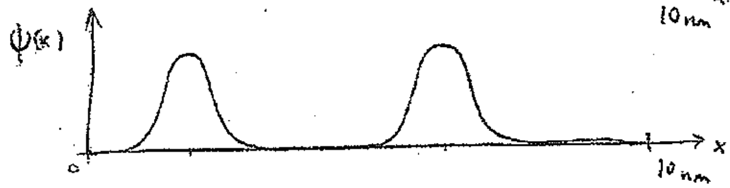


C)



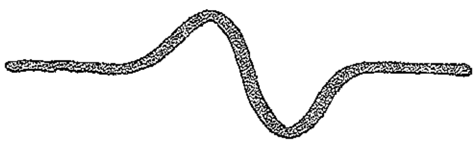
→ becomes position eigenstate
- original $\psi(x)$ determines possible results & probabilities.

D)

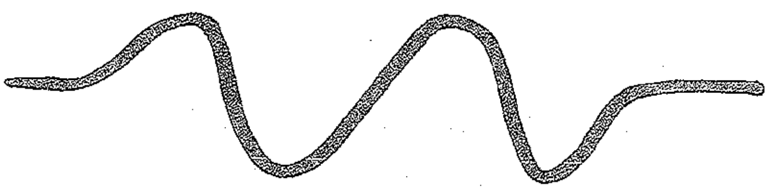


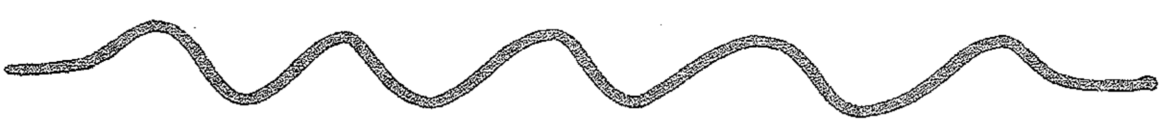
E) Either B or C

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

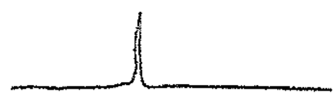
A) Will be the same as the first one.

B) Will generally be different than the first one.

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.

measure position $\psi \rightarrow$ 

measure momentum $\psi \rightarrow$ 

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

$\therefore$ generally different.

For which of these wave packets will Δx increase the fastest?

A) 

B) 

C) 

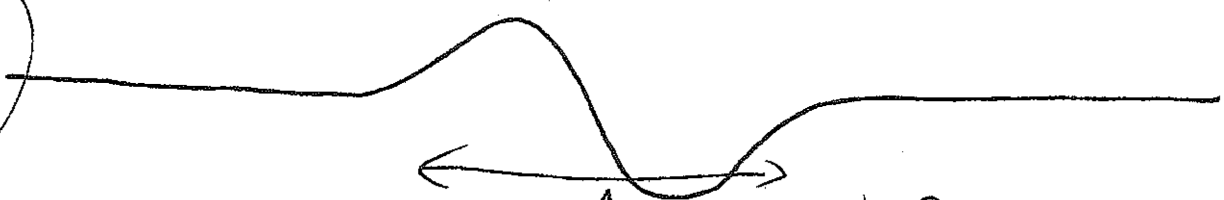
D) Both A and B

E) Both A and C

For which of these wave packets will Δx increase the fastest?

A) 

B) 

C) 

Δx smallest for this one

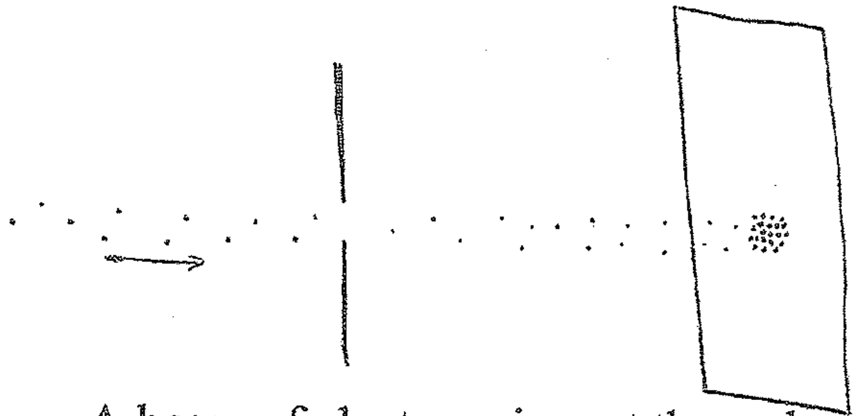
$\therefore \Delta p$ largest

$\therefore$ greatest range of velocities making up wavepacket.

$\therefore$ fastest spread.

D) Both A and B

E) Both A and C

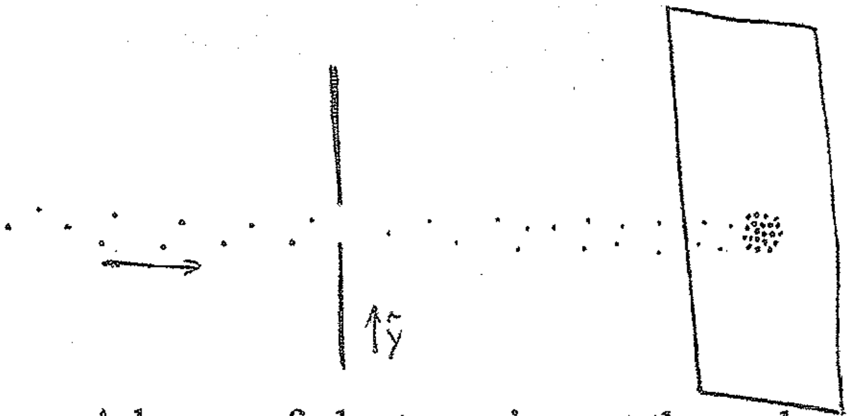


A beam of electrons is sent through a narrow hole in a piece of foil, and the places where these electrons hit a distant screen are recorded. If we make the hole in the screen smaller, the region where the electrons are hitting the screen will

A) become smaller.

B) become larger.

C) stay the same.



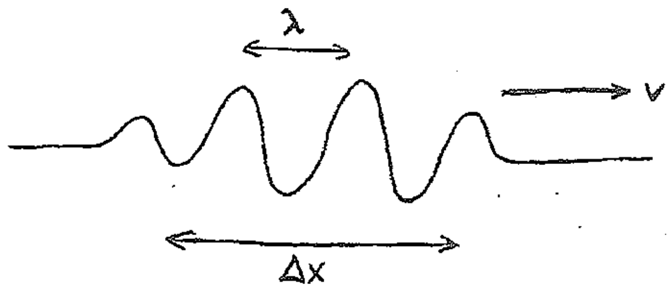
A beam of electrons is sent through a narrow hole in a piece of foil, and the places where these electrons hit a distant screen are recorded. If we make the hole in the screen smaller, the region where the electrons are hitting the screen will

A) become smaller.

B) become larger.

C) stay the same.

smaller hole:
$\Rightarrow$ less uncertainty in y position
$\Rightarrow$ more uncertain y momentum/velocity
$\therefore$ pattern spreads out



The speed of a wavepacket describing a traveling electron should be

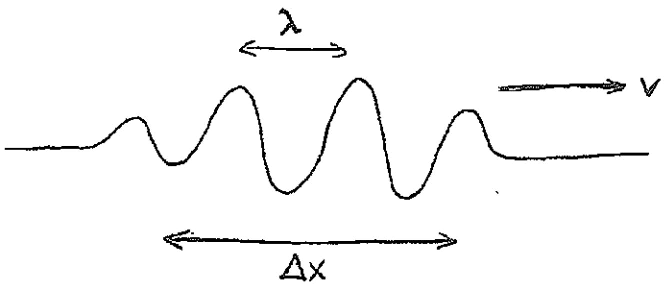
A) proportional to λ

B) inversely proportional to λ

C) proportional to Δx

D) inversely proportional to Δx

E) the same regardless of λ or Δx



The speed of a wavepacket describing a traveling electron should be

$v = \frac{p}{m} = \frac{h}{m\lambda}$

A) proportional to λ

B) inversely proportional to λ

C) proportional to Δx

D) inversely proportional to Δx

E) the same regardless of λ or Δx

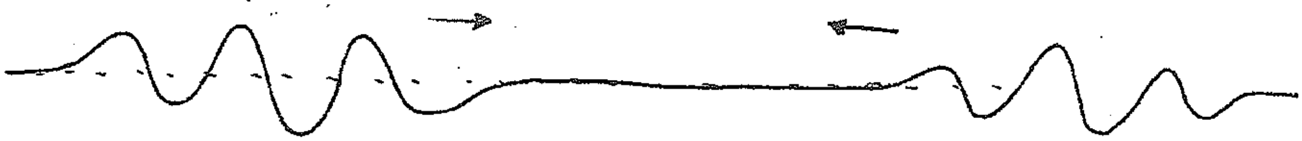
The wavefunction for an electron involves two wavepackets traveling in opposite directions. When they meet, the wavepackets will

A) Pass right through each other

B) Repel each other and reverse directions

C) Attract each other and form a bound state.

$Re(\psi(x))$



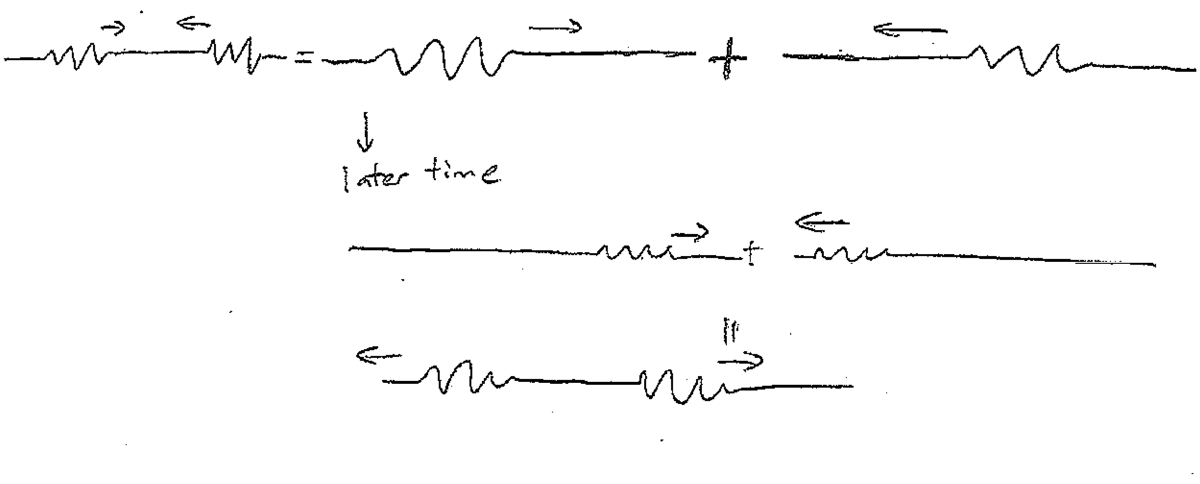
The wavefunction for an electron involves two wavepackets traveling in opposite directions. When they meet, the wavepackets will

A) Pass right through each other

B) Repel each other and reverse directions

C) Attract each other and form a bound state.

Schrodinger eqn $\rightarrow$ sum of any 2 solns is a solution.



An electron with momentum p travels in a region where it has a constant positive potential energy V. Compared to an electron with the same momentum p in a region with zero potential energy, we expect that this electron's wavefunction will have

A) a larger wavelength

B) a smaller wavelength

C) a larger frequency

D) a smaller frequency

E) both B and C

An electron with momentum p travels in a region where it has a constant positive potential energy V. Compared to an electron with the same momentum p in a region with zero potential energy, we expect that this electron's wavefunction will have

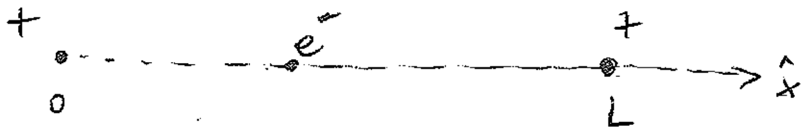
A) a larger wavelength

B) a smaller wavelength

C) a larger frequency *frequency = energy/h =* $(p^2/(2m) + V)/h$

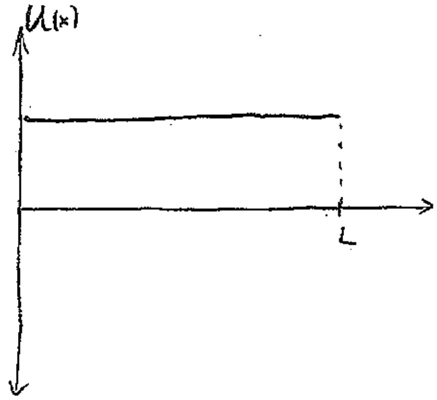
D) a smaller frequency

E) both B and C

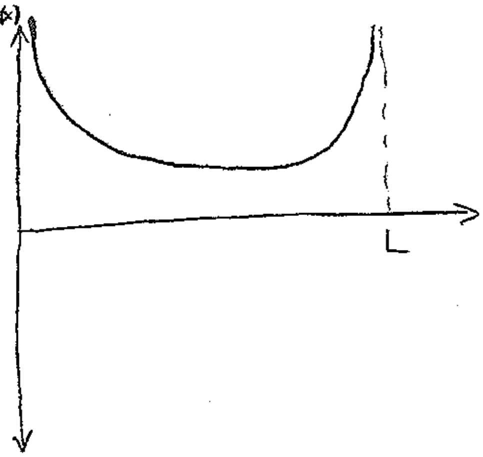


Which of the following diagrams best represents the potential energy function for an electron moving along the x-axis between two positive charges?

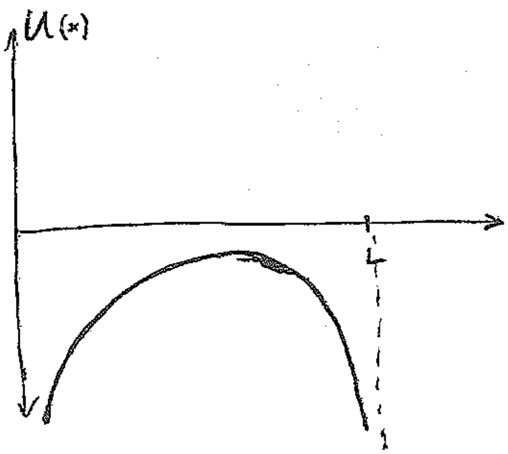
A)



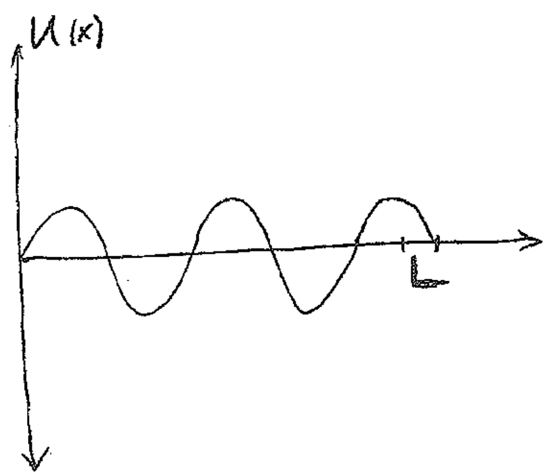
B)

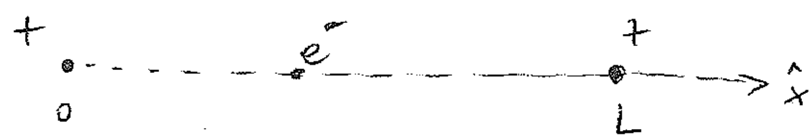


C)



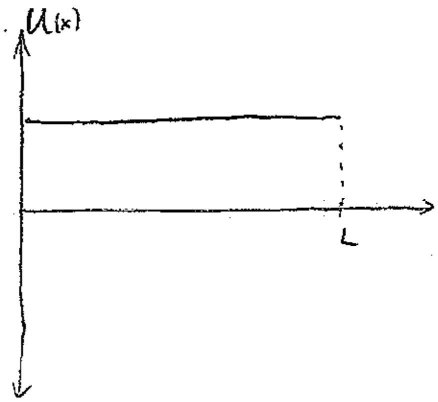
D)



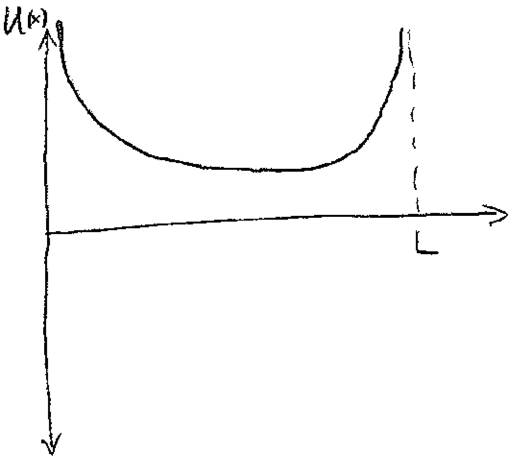


Which of the following diagrams best represents the potential energy function for an electron moving along the x-axis between two positive charges?

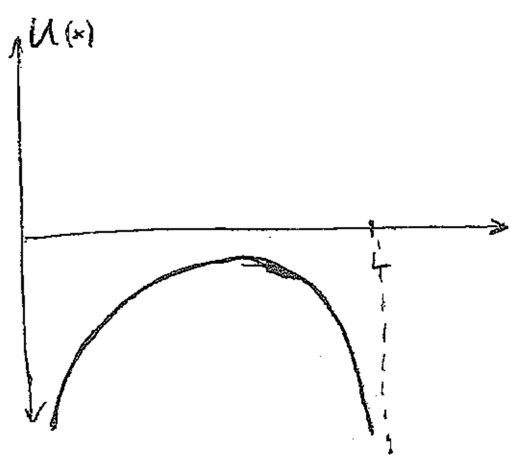
A)



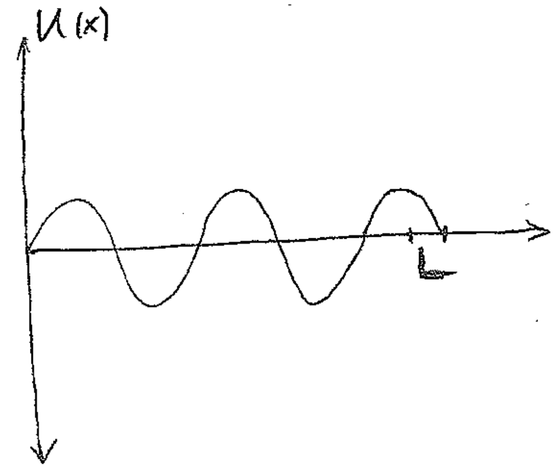
B)



C)

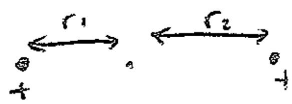


D)



Each charge has Coulomb potential:

$$U_1(x) = -\frac{e}{r_1} \qquad U_2(x) = -\frac{e}{r_2}$$



$$U(x) = U_1(x) + U_2(x)$$

The quantum picture explains the stability of atoms because:
(choose the best answer)

A) The energy levels are discrete.

B) There is a finite minimum energy that the electron can have

C) There is no definite value for the electron's position.

The quantum picture explains the stability of atoms because:
(choose the best answer)

A) The energy levels are discrete.

B) There is a finite minimum energy that the electron can have $\longrightarrow$ no other state for electron to go to. ground state completely stable

C) There is no definite value for the electron's position.

$\psi_1(x)$ and $\psi_2(x)$ are ~~energy eig~~ wave functions for an electron corresponding to definite energies E_1 and E_2.

$$\psi(x) = \frac{1}{\sqrt{2}}\psi_1(x) + \frac{1}{\sqrt{2}}\psi_2(x)$$

For the electron state ~~in the previous question~~, a measurement of energy is performed. The result we will find is:

A) $E_1 + E_2$

B) something between E_1 and E_2, but the result is not predetermined

C) either E_1 or E_2, with equal probability

D) most likely the lowest energy value, E_1

For the electron state in the previous question, a measurement of energy is performed. The result we will find is:

A) $E_1 + E_2$

B) something between E_1 and E_2, but the result is not predetermined

C) either E_1 or E_2, with equal probability

D) most likely the lowest energy value, E_1

$\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$: probability of finding E_1

$\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$: probability of finding E_2

With respect to visible light, an interstellar cloud of atomic hydrogen gas is

A) opaque

B) transparent

C) opaque for most wavelengths but transparent for a some wavelengths

D) transparent for most wavelengths but opaque for some wavelengths

E) I haven't the faintest idea

With respect to visible light, an interstellar cloud of atomic hydrogen gas is

A) opaque

B) transparent

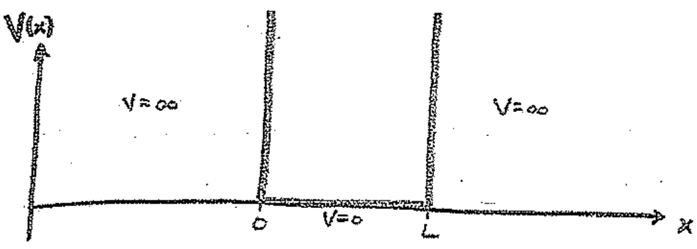
C) opaque for most wavelengths but transparent for a some wavelengths

D) transparent for most wavelengths but opaque for some wavelengths → will absorb light (i.e. be opaque) only if $hf = E_a - E_b$ for 2 energy levels of hydrogen.

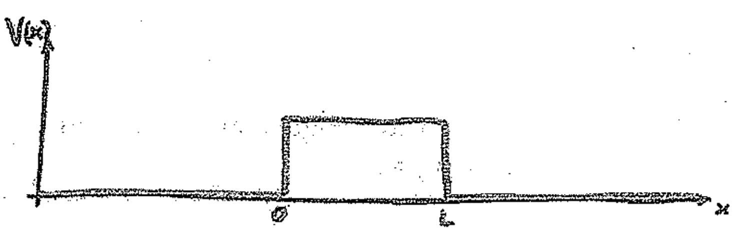
E) I haven't the faintest idea

Which of the pictures best represents the potential energy function for an electron in a thin one-dimensional wire of length L?

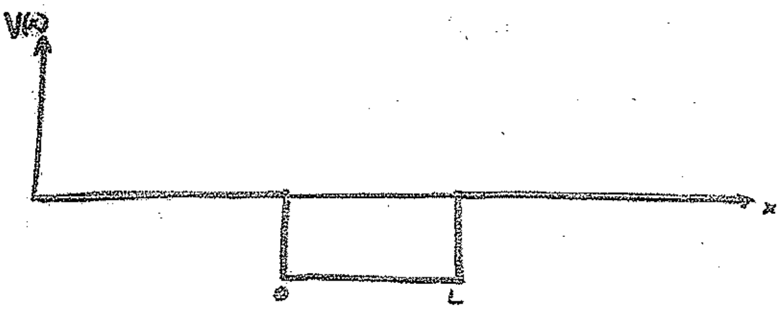
A



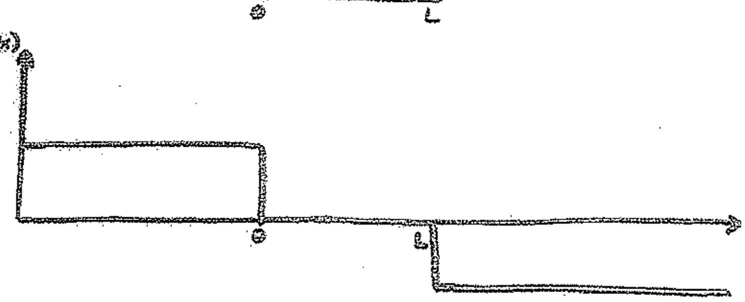
B



C

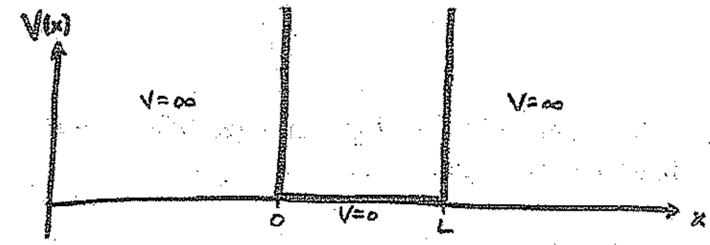


D

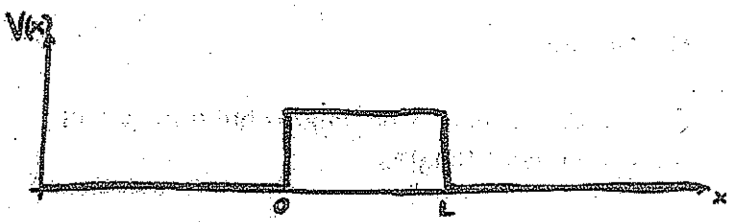


Which of the pictures best represents the potential energy function for an electron in a thin one-dimensional wire of length L?

A

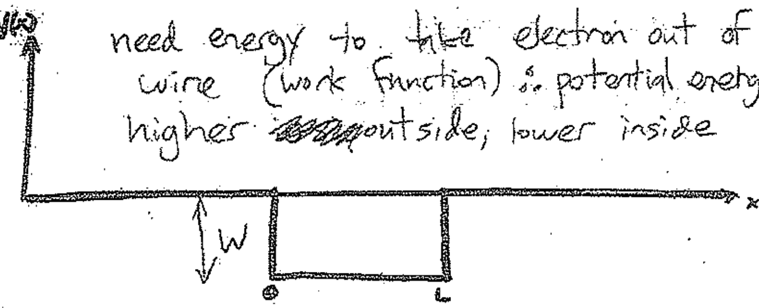


B



C

need energy to take electron out of wire (work function) ∴ potential energy higher ~~in~~ outside, lower inside



D