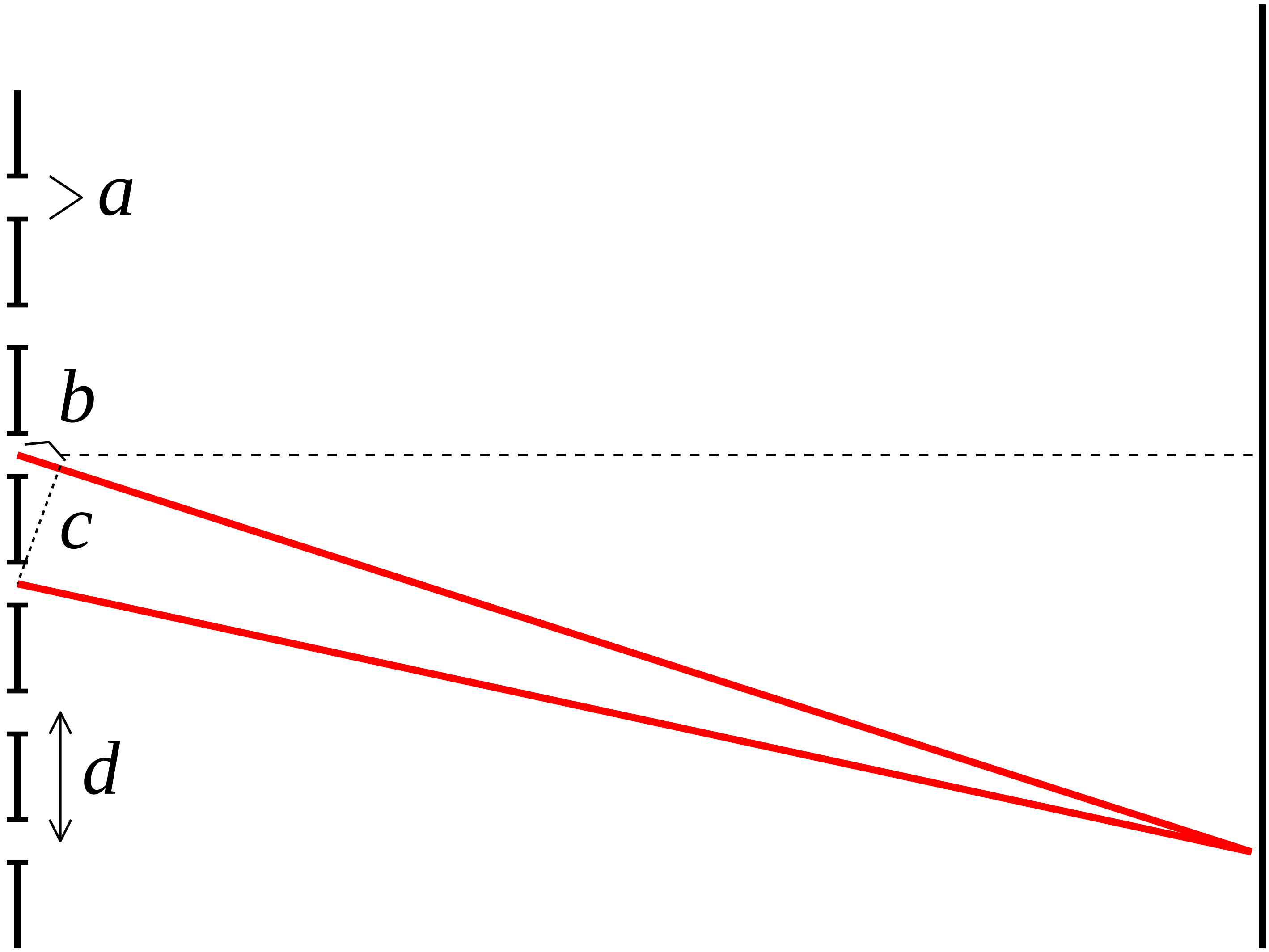
We had many equations for constructive interference of the form:

[ ] $\sin(\theta)=m\lambda$

Below find suggestions for what fills the box in what situation. How many of these suggestions are correct?

box contains	**situation**
d=slit separation	Young's experiment
2d=plane separation	Bragg diffraction
a=slit width	single slit diffraction
d=1/slits/m	diffraction grating
1.22 D = diameter	resolution of lens

A. 2
B. 3
C. 4
D. None of the above



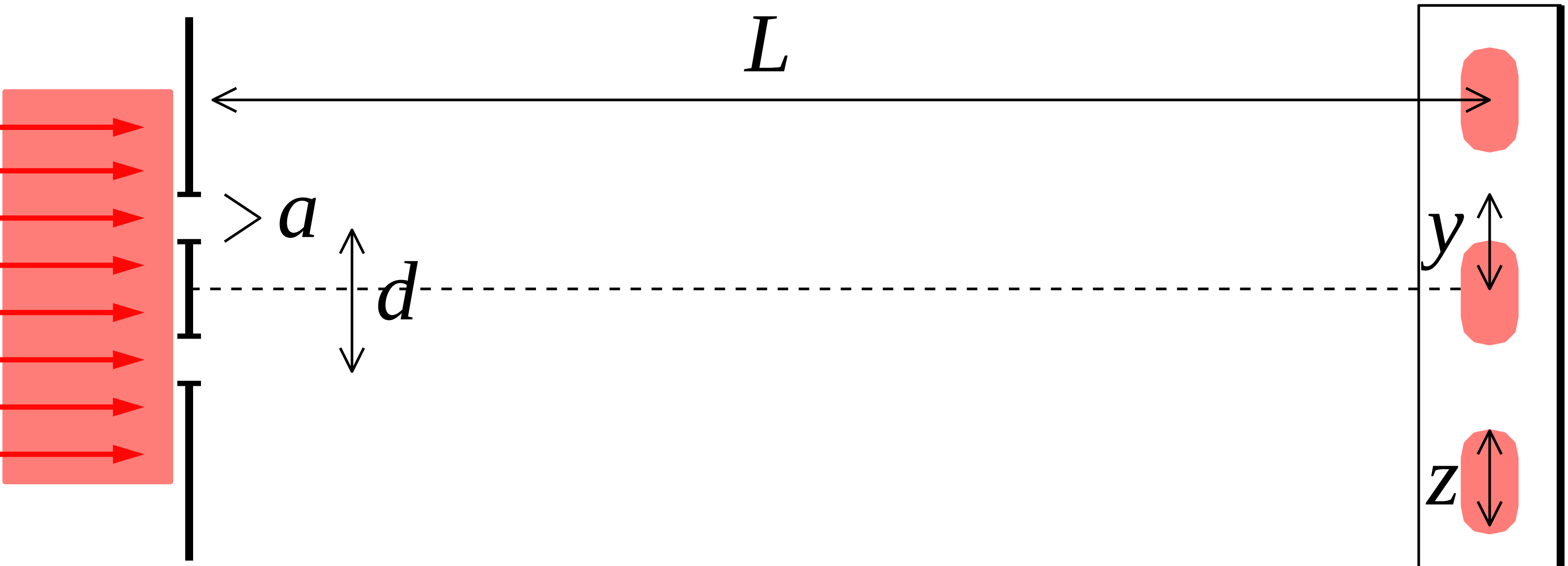
The parallel rays of a distant coherent light source pass through a diffraction grating producing a series of bright fringes on a distant wall. The rays displayed below go to make a first order bright fringe. Which of the distances denoted in the figure is equal to a wavelength of the light?

a the width of a slit.

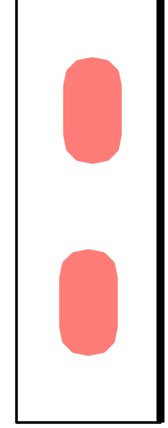
b the extra distance each diffracted ray must travel when compared to the distance between the grating and wall.

c the distance between the rays as they leave the slits.

d the distance between the slits.



A coherent light source shines on two holes; on a distant strip of paper we see blobs of light separated by unilluminated areas. This question asks how that pattern of blobs would change under different circumstances.



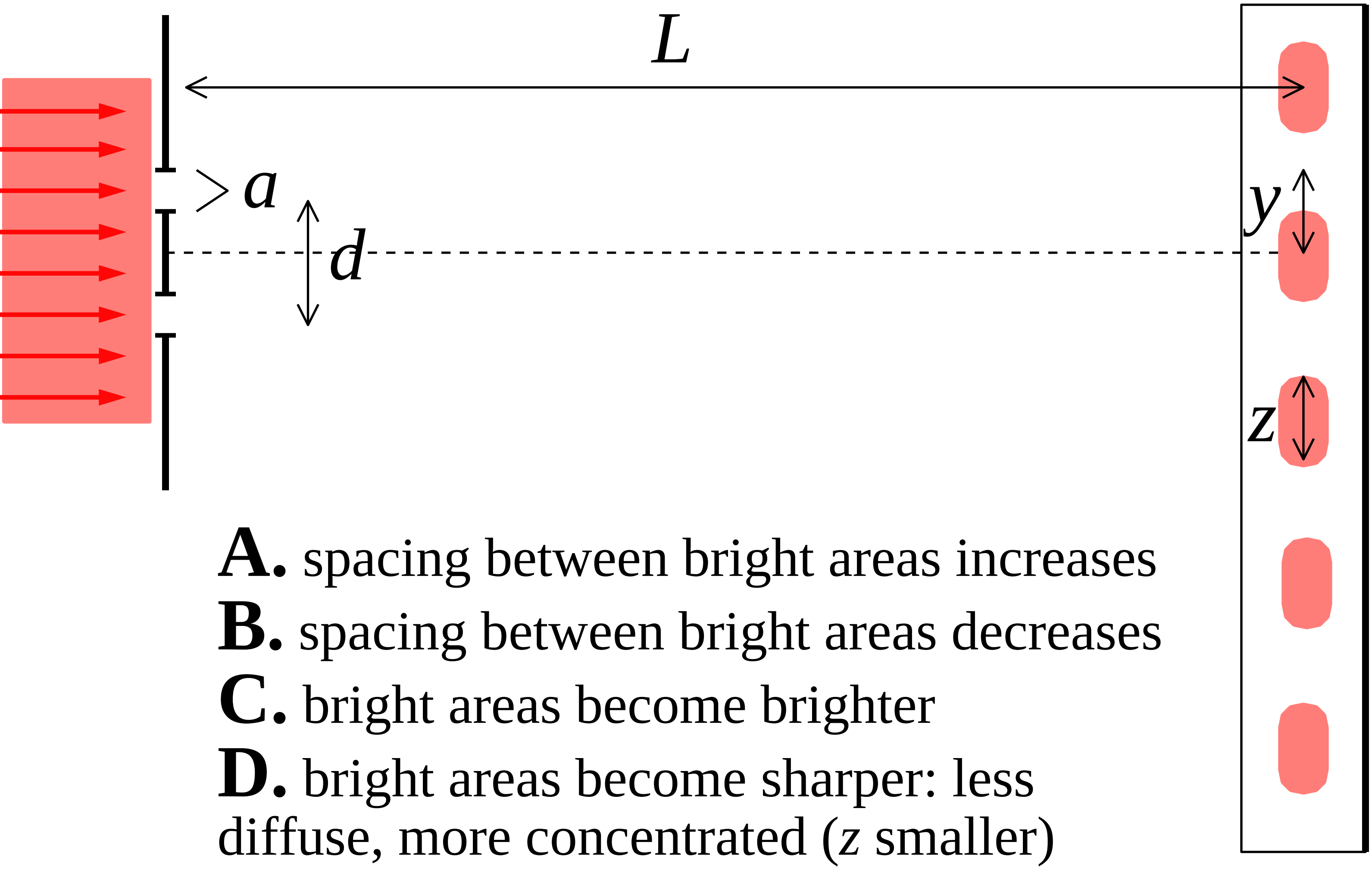
a the width of a slit.

d the distance between the slits.

y the distance to the center of the first unilluminated area

L the distance between the paper strip and the slits.

z the size of an illuminated area



A. spacing between bright areas increases
B. spacing between bright areas decreases
C. bright areas become brighter
D. bright areas become sharper: less diffuse, more concentrated (*z* smaller)

1. Use blue light rather than red light

2. Increase the slit-spacing *d*

3. Increase the number of slits

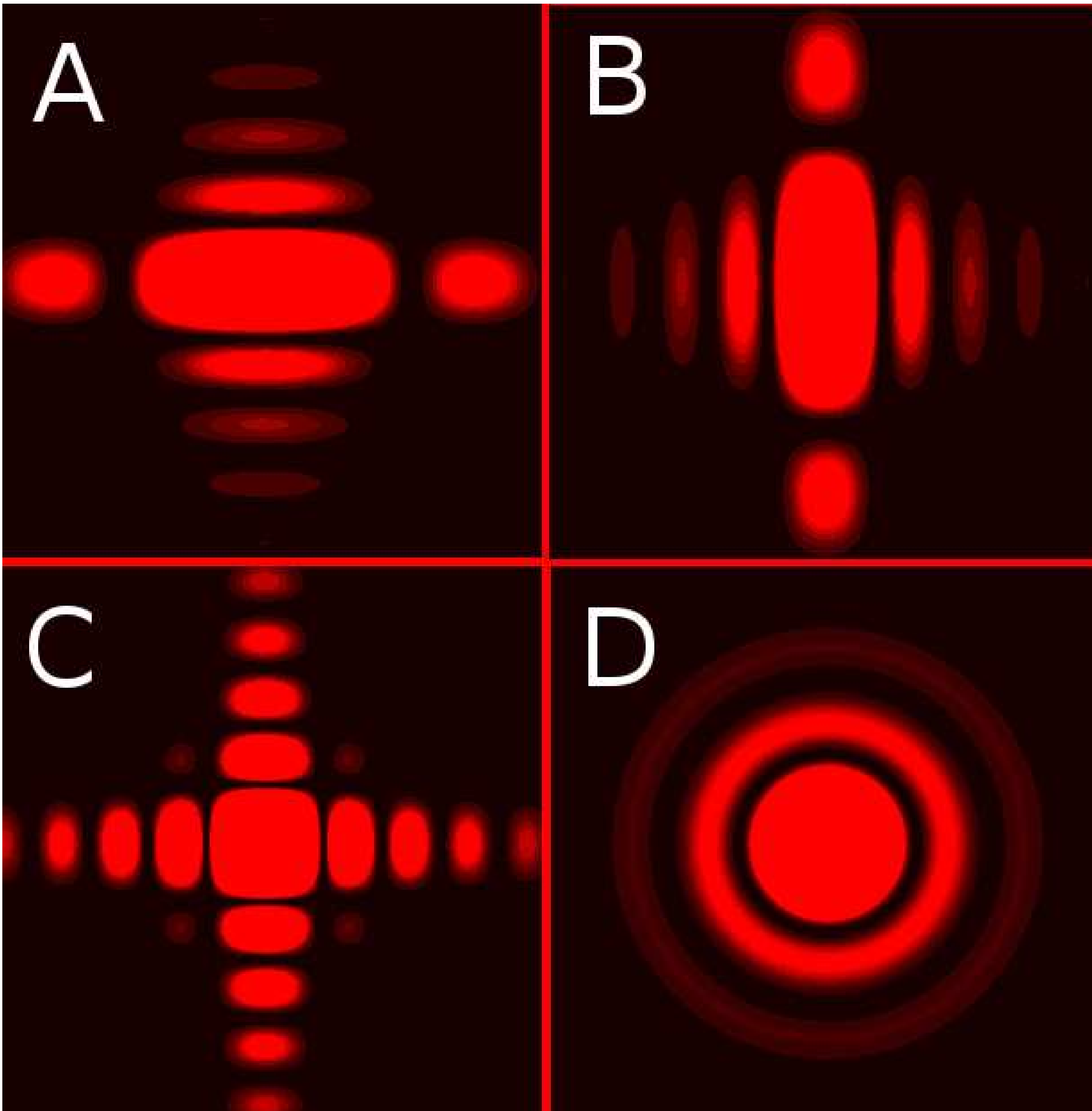
4. Increase the distance *L*

5. Increase the slit size *a*

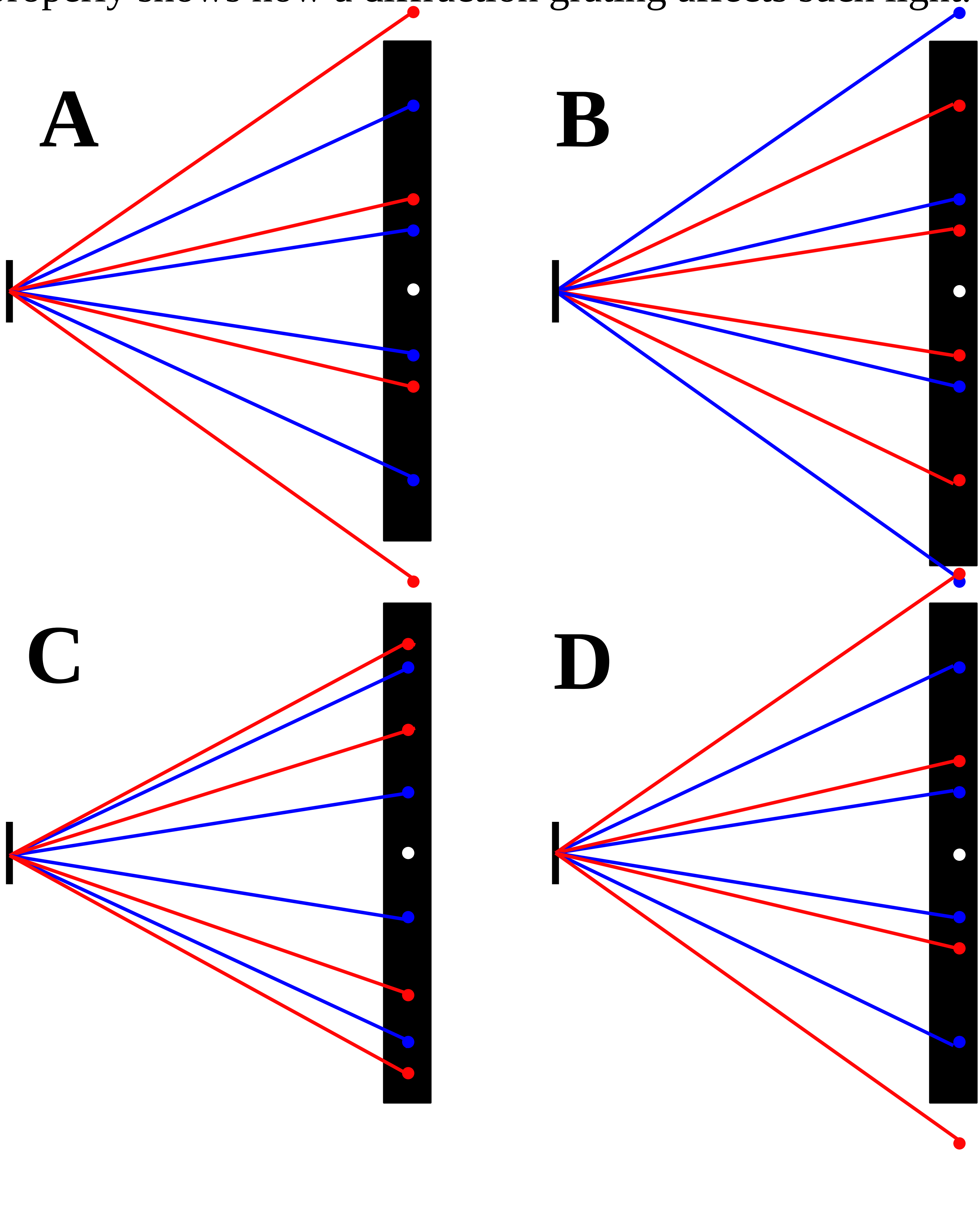
6. The entire experiment is conduced under water

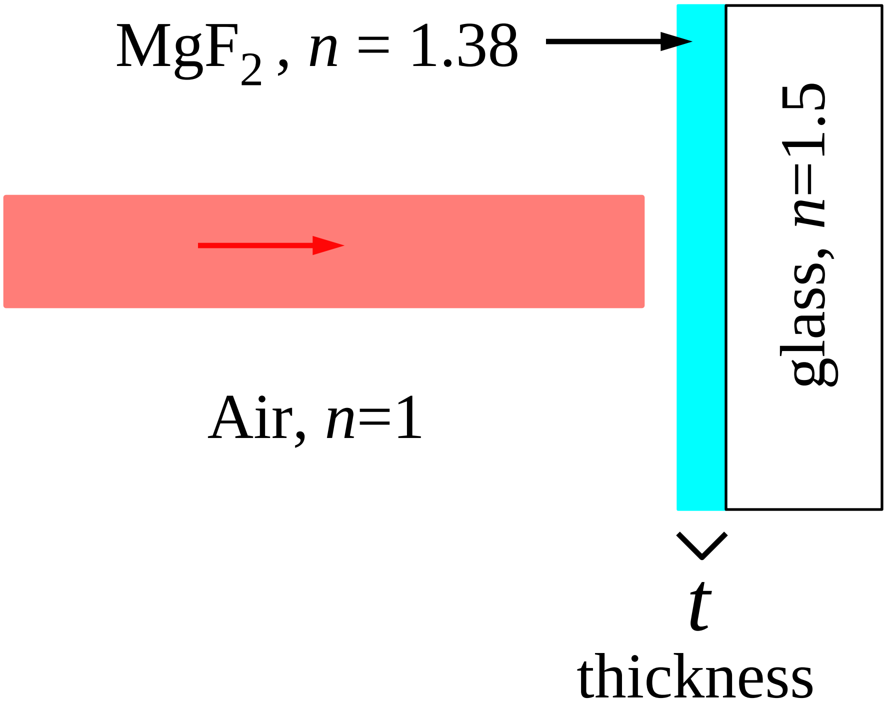
7. Use polarized light rather than unpolarized light

Which of the below diffraction patterns would be produced by a slit that had this shape/orientation?



A light source consists of blue and red light that looks white to human eyes. Which of the below diagrams properly shows how a diffraction grating affects such light.





A beam of red light shines on a glass sheet which has been coated with a MgF_2 film. Below we denote the situation in air with **1**, in MgF_2 with **2**, and in glass **3.**

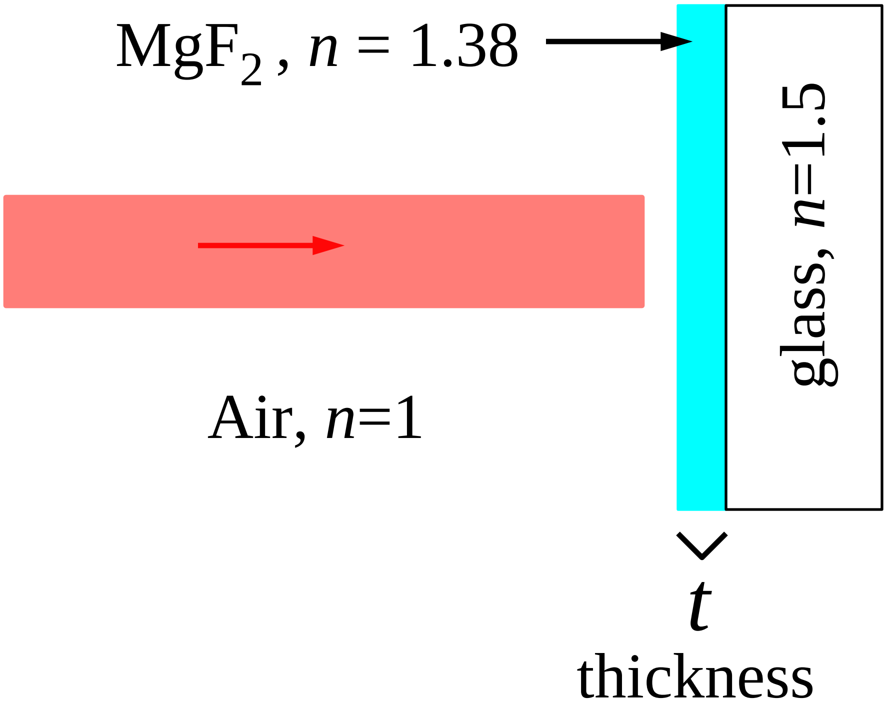
Rank the frequency of the light in each material:

A: $f_1 < f_2 < f_3$

B: $f_1 > f_2 > f_3$

C: $f_1 = f_2 = f_3$

D: none of the above



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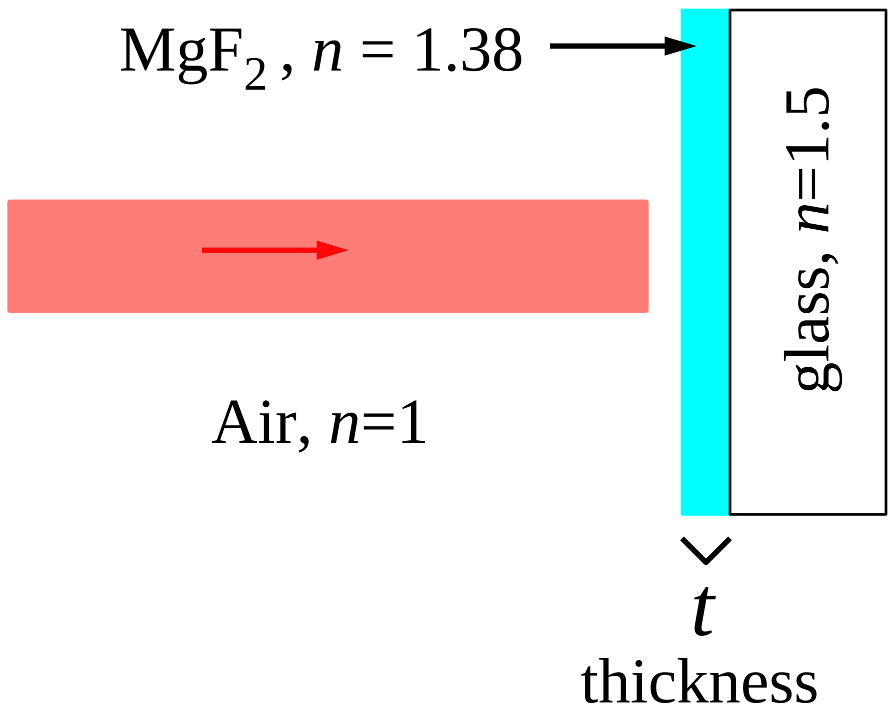
A: $\lambda_1 < \lambda_2 < \lambda_3$

B: $\lambda_1 > \lambda_2 > \lambda_3$

C: $\lambda_1 = \lambda_2 = \lambda_3$

D: none of the above



A beam of red light shines on a glass sheet which has been coated with a MgF_2 film. Below we denote the situation in air with **1**, in MgF_2 with **2**, and in glass **3.**

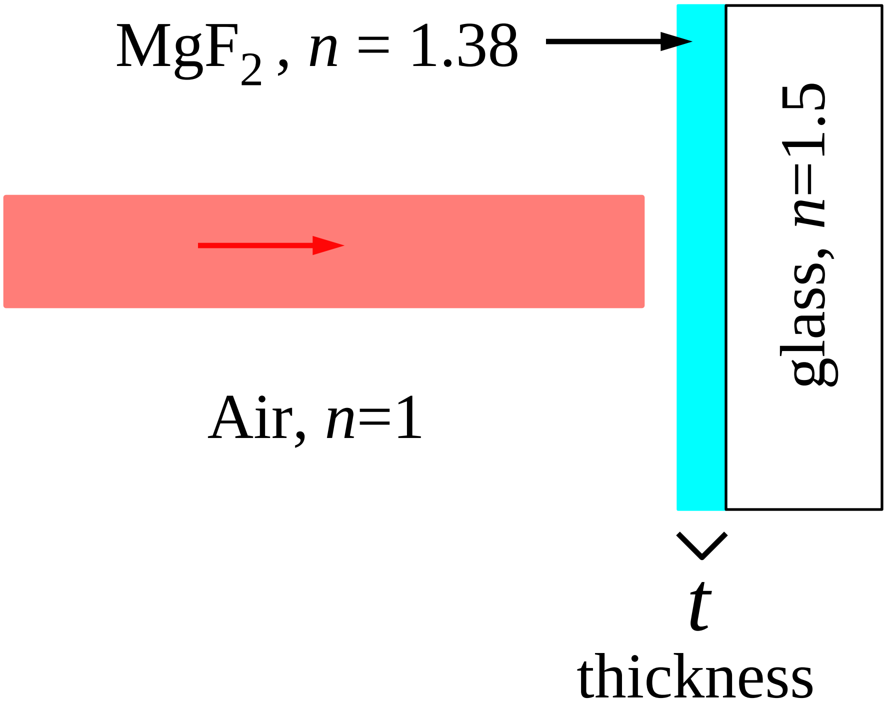
Rank the velocity of the light in each material:

A: $v_1 < v_2 < v_3$

B: $v_1 > v_2 > v_3$

C: $v_1 = v_2 = v_3$

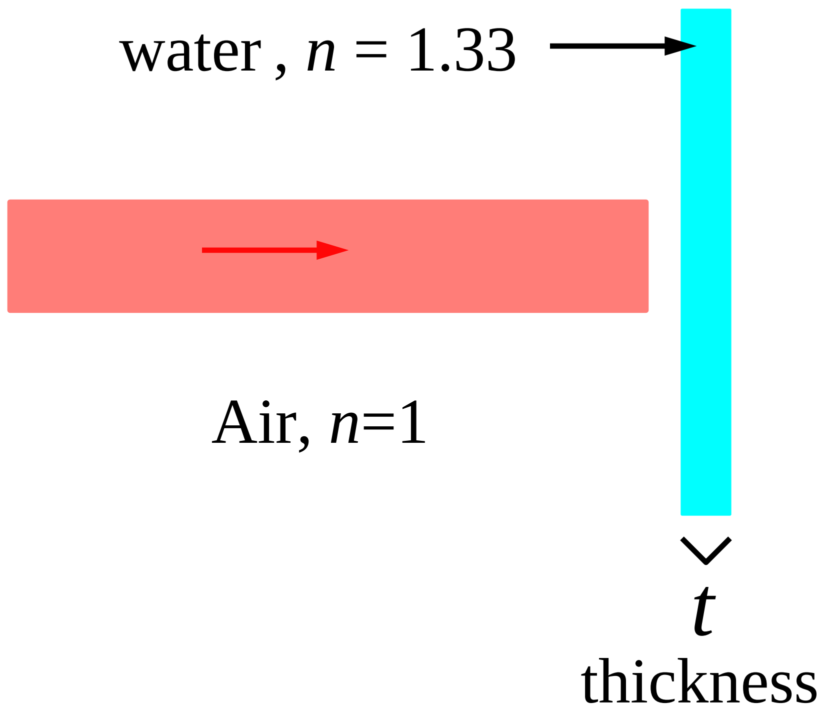
D: none of the above



In order to produce no reflected light, the thickness t should be:

A. $t=\lambda$
B. $t=\lambda/2$
C. $t=\lambda/4$
D. none of the above

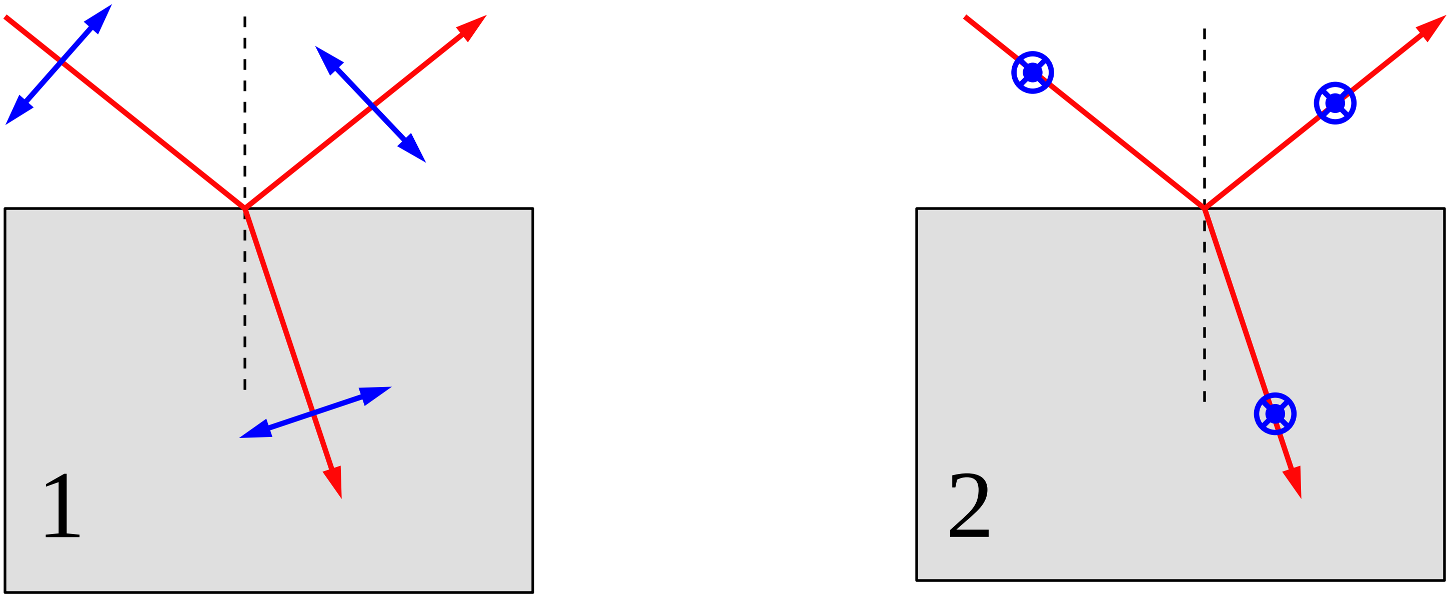
NOTE: λ denotes the wavelenth of the light in the MgF_2



Red light shines on a thin film of water. In order to produce lots of reflected light, the thickness t should be:

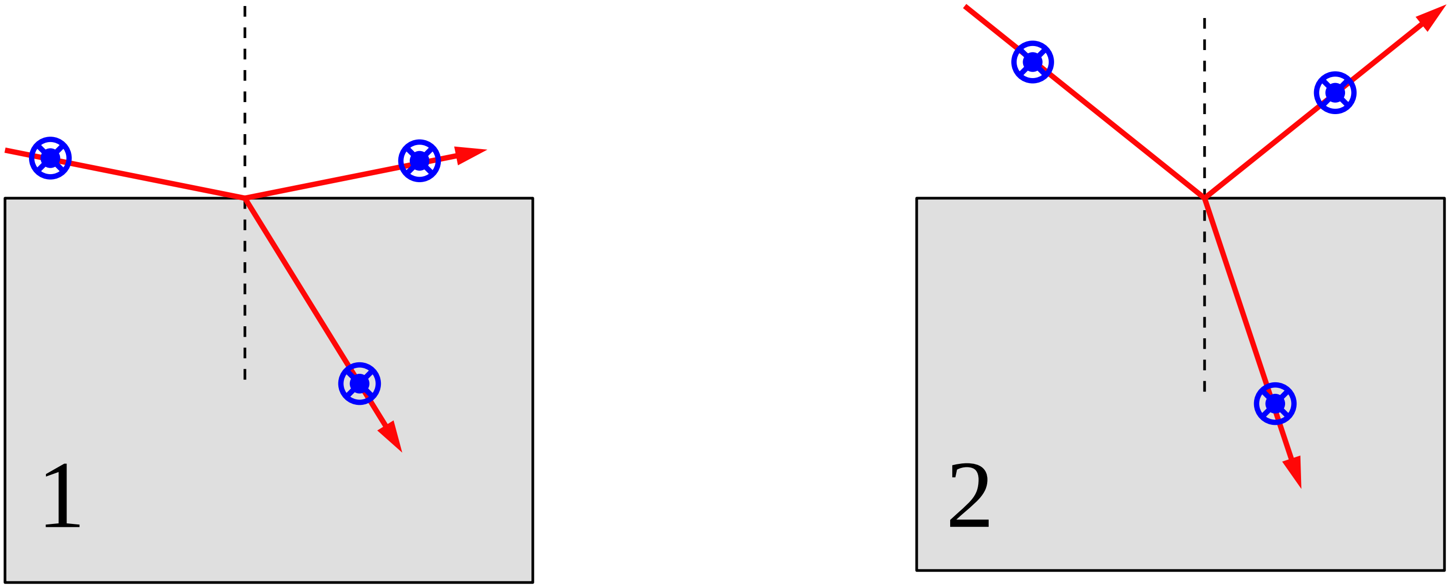
A. $t=\lambda$
B. $t=\lambda/2$
C. $t=\lambda/4$
D. none of the above

NOTE: λ denotes the wavelenth of the light in the water



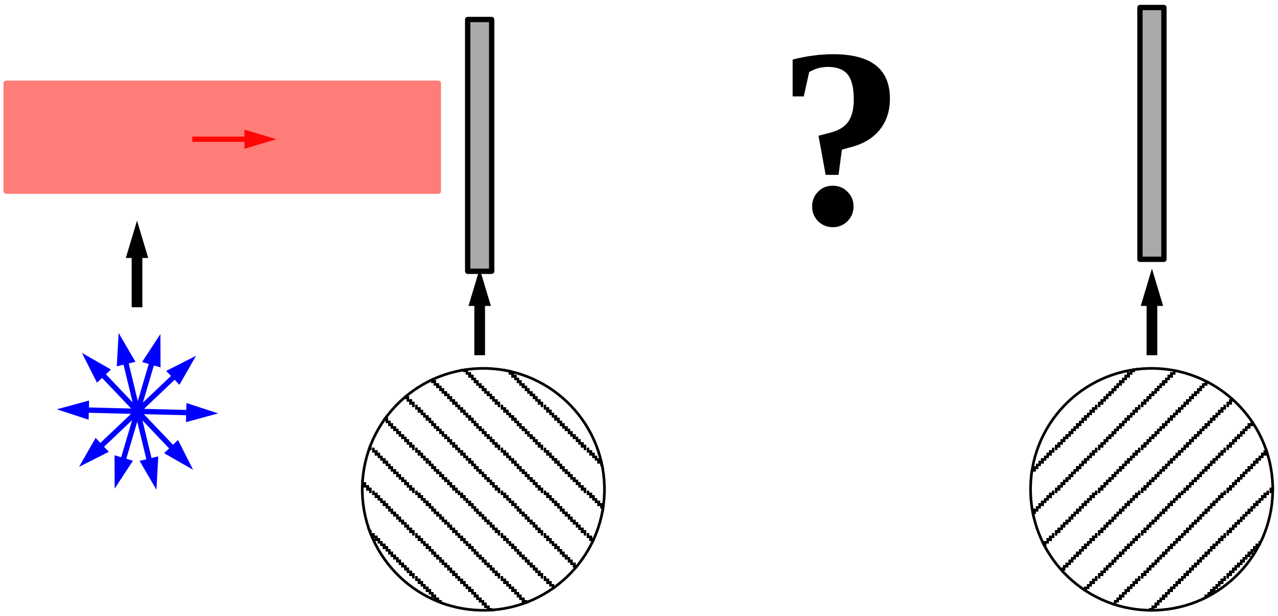
Equally intense beams of red light in air are reflecting/refracting off sheets of glass. In situation 1 the light's electric field (denoted by the blue arrows) is in the plane formed by the three rays. In situation 2 the light's electric field (denoted by the blue dot/cross) is parallel to the air/glass surface. Compare the intensity I of the reflected in these situations.

A. $I_1 > I_2$
B. $I_1 < I_2$
C. $I_1 = I_2$



Equally intense beams of red light in air are reflecting/refracting off sheets of glass. In both situations the light's electric field (denoted by the blue dot/cross) is parallel to the air/glass surface, but as shown the angle of the light is different in the two situations. Compare the intensity I of the reflected in these situations.

A. $I_1 > I_2$
B. $I_1 < I_2$
C. $I_1 = I_2$



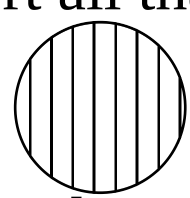
A beam of unpolarized red light with intensity I_0 is aimed at a pair of crossed polarizers. The intensity between the polarizers is:

A. 0, **B.** $(1/\sqrt{2})\,I_0$. **C.** $(1/2)\,I_0$. **D.** $(\sqrt{3/4})\,I_0$

The intensity after the rightmost polarizer is:

A. 0, **B.** $(1/\sqrt{2})\,I_0$. **C.** $(1/2)\,I_0$. **D.** $(\sqrt{3/4})\,I_0$

What could be placed between the polarizers to increase the final intensity? (report all that apply)

A. a polarizer like this: 
B. optically active material
C. dielectric material
D. paramagnetic material

You have the option of making a space telescope that is wide and short (soup can) or narrow and long (pencil).

1. Which would have the greater magnification?

2. Which would have the greater resolution?

3. Which would have the larger f number?

A. soup can

B. pencil

A telescope has magnification $m_T = -100$; a microscope has magnification $m_M = -200$. If you looked throught these devices backwards (using the objective as an eyepiece), what magnifications result?

A. $m_T = +100$; $m_M = +200$
B. $m_T = -1/100$; $m_M = -200$
C. $m_T = -1/100$; $m_M = -1/200$
D. $m_T = +1/100$; $m_M = +1/200$

In which of the following optical instruments is your eye seing a real image?

A. telescope
B. microscope
C. simple magnifier
D. none of the above

A. True
B. False

The Moon has a smaller angular size than my pinky fingernail.

The bigger the magnification the better the microscope.

The larger the f-number the brighter the image

"Long" lenses have more "magnification"

"Bringing it closer" in the aim of magnification.

A. True
B. False

A near sighted person has a far point of 2 m; prescription: −.5 diopters

The glasses of a near sighted person might be used to light a fire using sunlight

Given a choice between a telescope with a large aperture or one with a long objective focal length, astronomers select larger aperture.

Given a choice between a microscope objective with a large numerical aperture ("NA") and one with a small numerical aperture, microbiologists select the one with a large NA.

The larger the magnification the better the telescope.

A. True
B. False

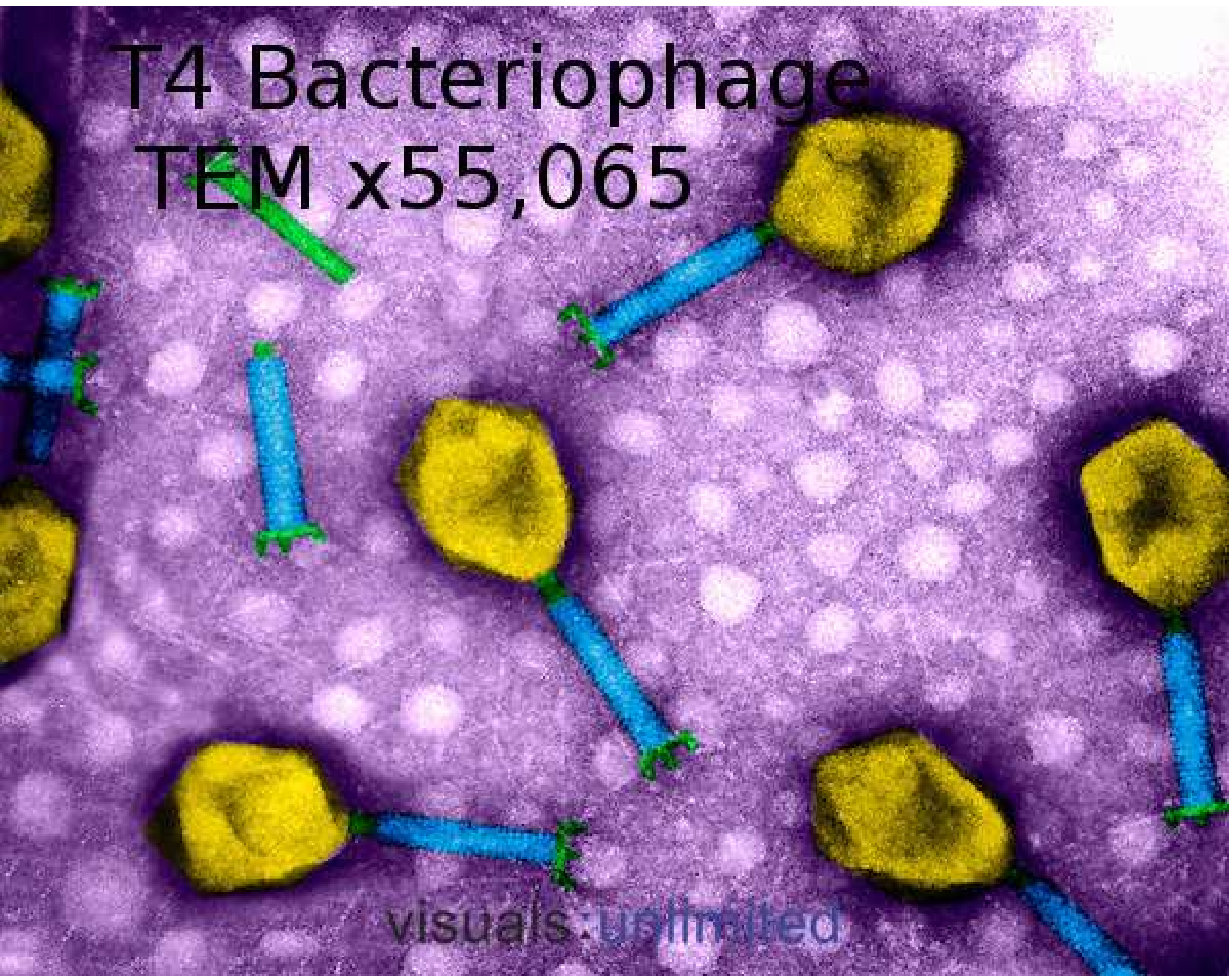
What is wrong with this photo of a virus?

A. Coloring objects that are smaller than a wavelength of light is nonsense.

B. Magnifications like x55,065 make no sense when the physical size of the photo depends on how reproduced/displayed

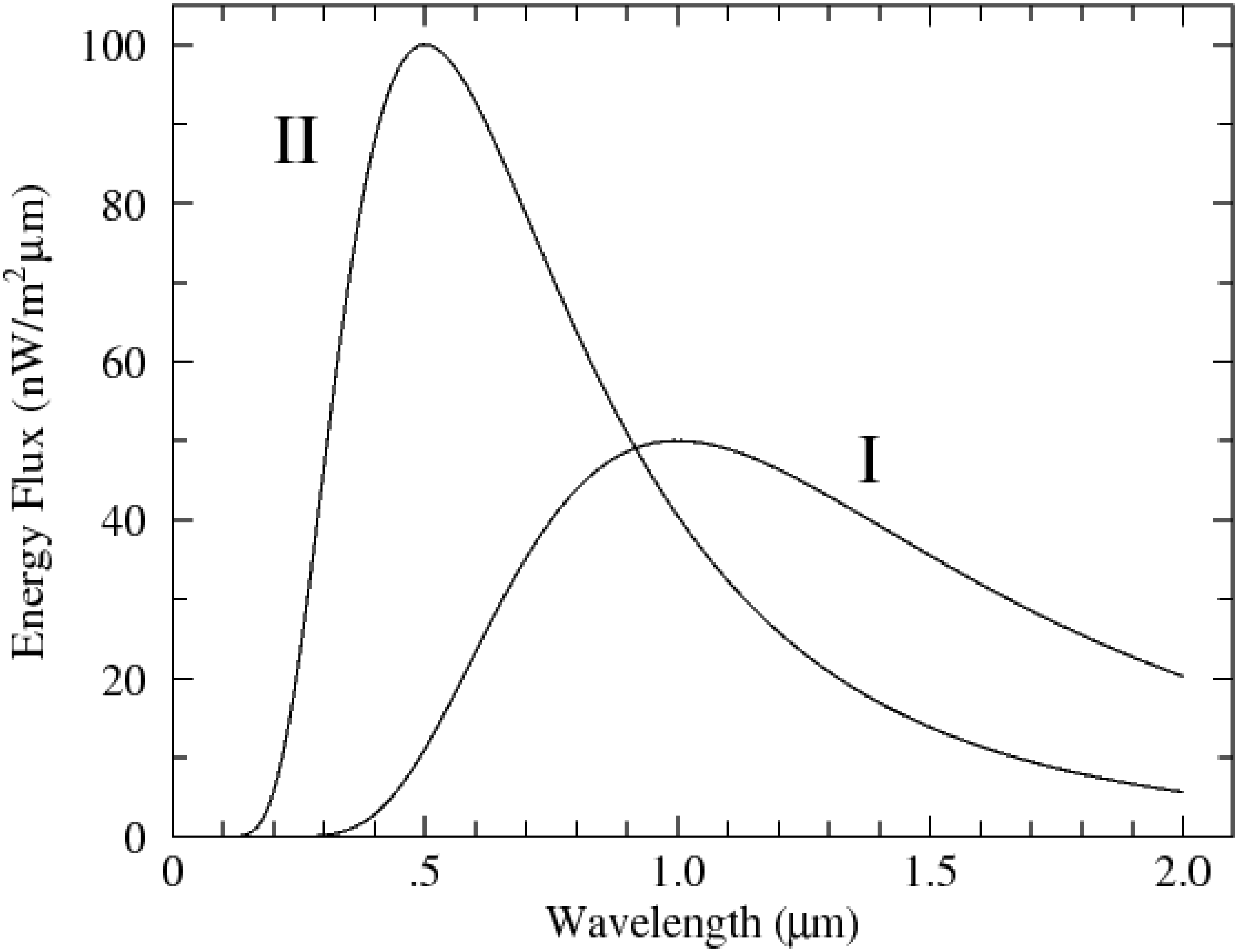
C. Its not as cool as a picture of a galaxy

D. More than one of the above



A. Planck
B. Einstein
C. Compton
D. de Broglie
AB. Davisson & Germer
AC. Bohr
AD. Moseley
BC. Bragg
BD. Schrodinger
CD. Heisenberg
∀. Pauli
ꓭ. Lorentz
Ɔ. Michelson & Morley
ᗡ. Wien

1. uncertainty
2. wave function
3. contraction
4. *c* constant expt
5. photoelectric
6. crystal plane-spacing
7. displacement
8. electron orbits
9. exclusion
10. characteristic X-ray
11. first photon use
12. electron waves expt
13. particle waves λ
14. photon collisions



Above find the spectra of two stars that are the same distance from Earth. Consider the temperature and radius of these stars.

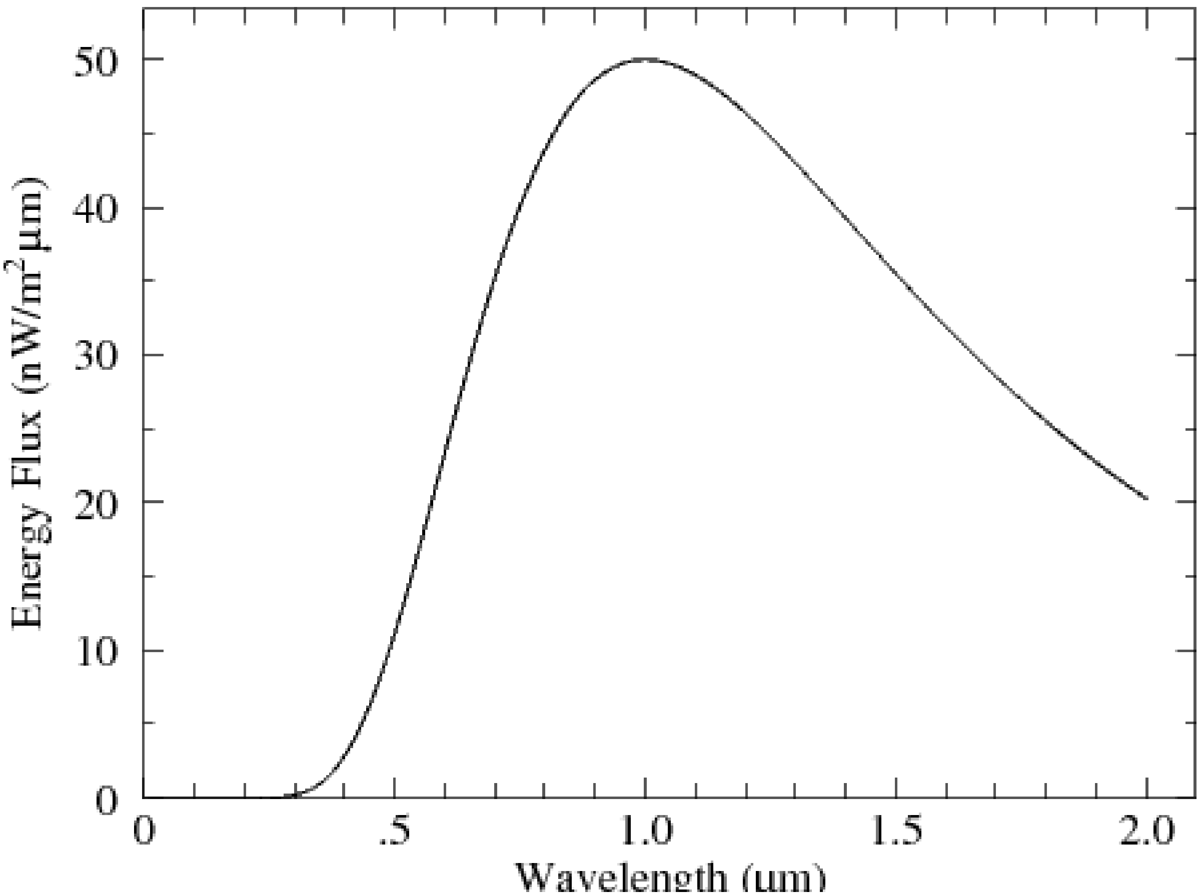
A. *II* is the hotter and larger star

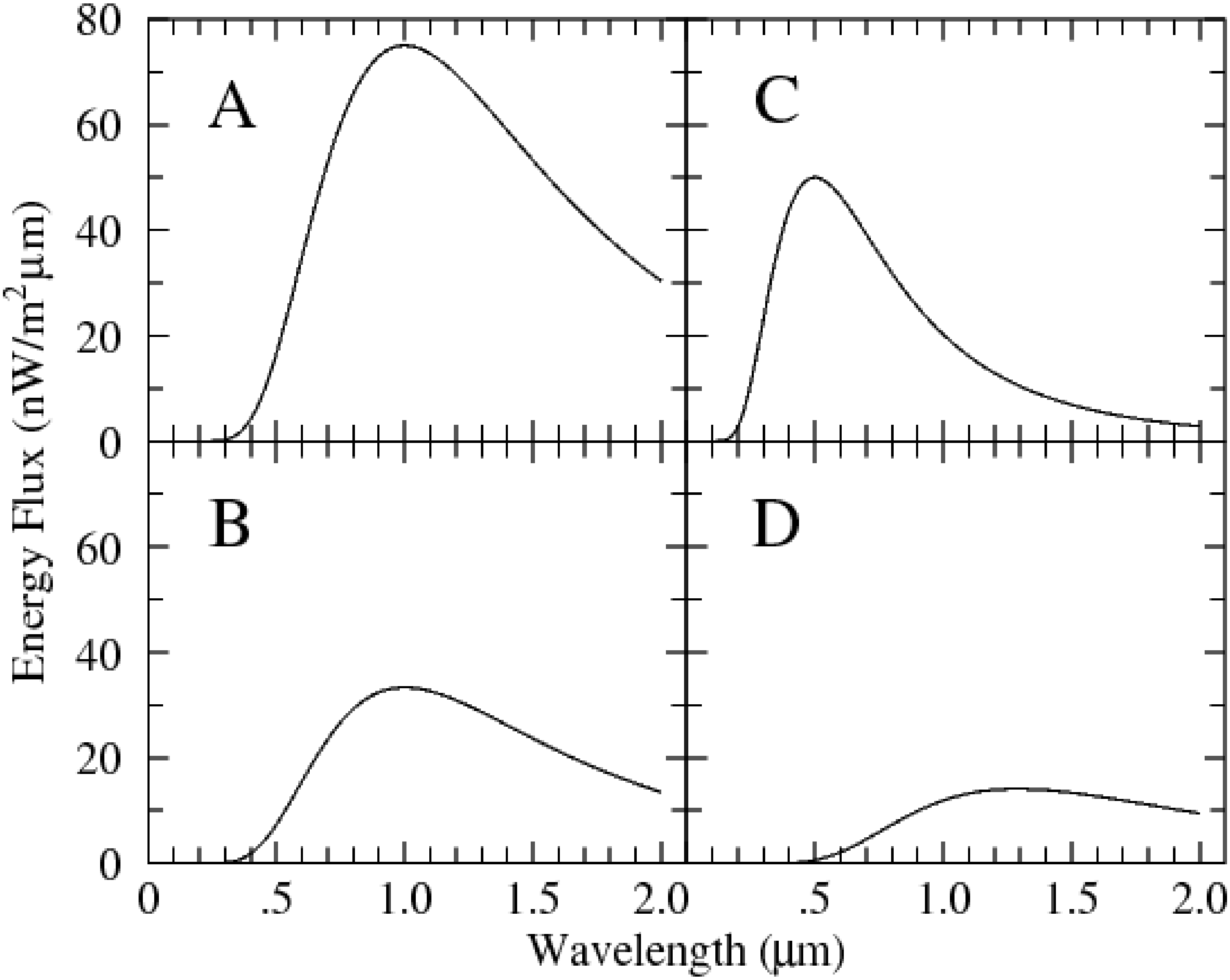
B. *I* is the hotter and larger star

C. *I* is hotter, *II* is larger

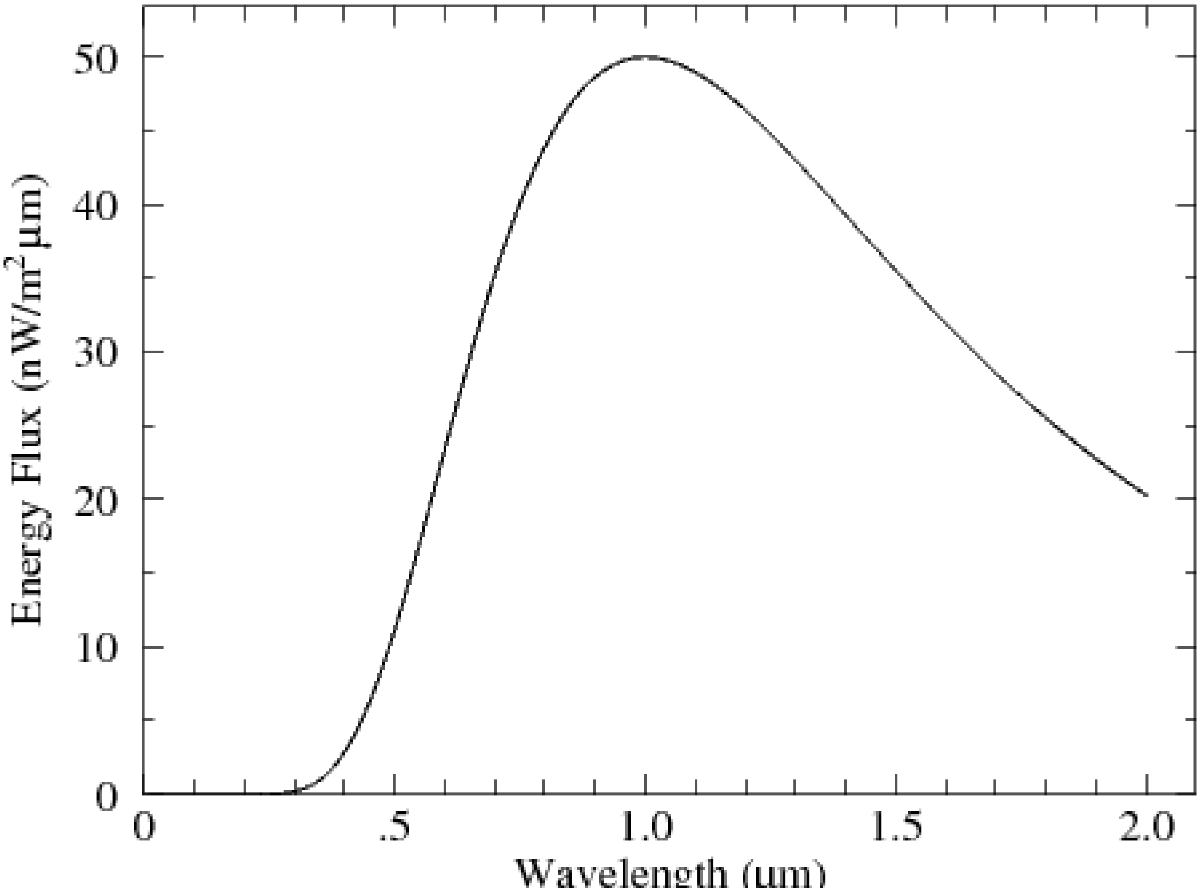
D. *II* is hoter, *I* is larger

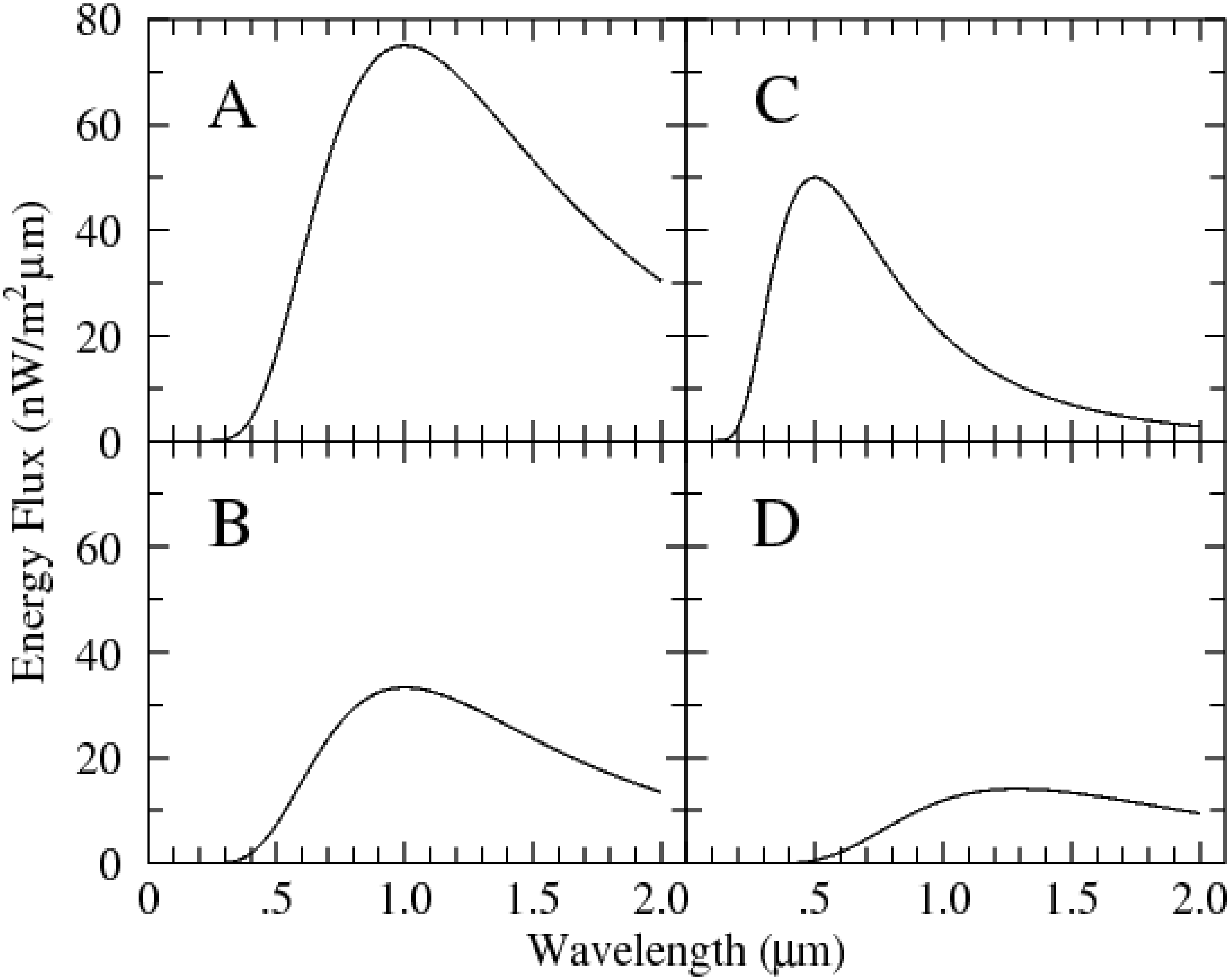
select same but cooler





select same but larger





Which of the below will **not** change the kinetic energy of the most energetic electrons emitted in the photoelectric effect?

A. changing the color of the light

B. changing the brightness of the light

C. changing the frequency of the light

D. changing the metal the light is hitting

How many of the below are true when light is scattered directly back (θ=180˚) from an electron (Compton).

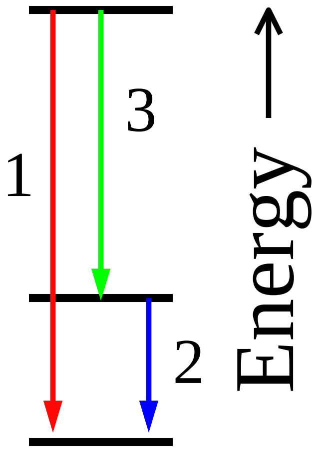
1. the scattered light has the largest possible wavelength

2. the scattered electron has the largest possible energy

3. the scattered electron has more momentum than the incoing photon.

4. the energy of the scattered photon may approach (but not exceed) half the rest energy of the electron.

A. 4 **B.** 3 **C.** 2 **D.** 1



The diagram shows 3 energy levels with electron jumps labeled 1, 2, 3. Rank the wavelengths that would result from these jumps.

A. $\lambda_2 < \lambda_3 < \lambda_1$

B. $\lambda_2 > \lambda_3 > \lambda_1$

C. $\lambda_1 < \lambda_2 < \lambda_3$

D. none of the above

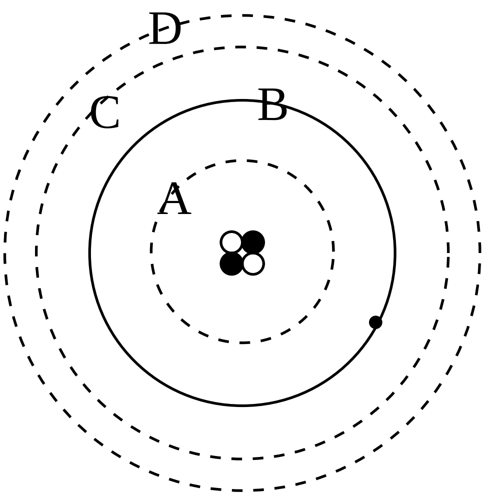
Frequencies?

A. $f_2 < f_3 < f_1$

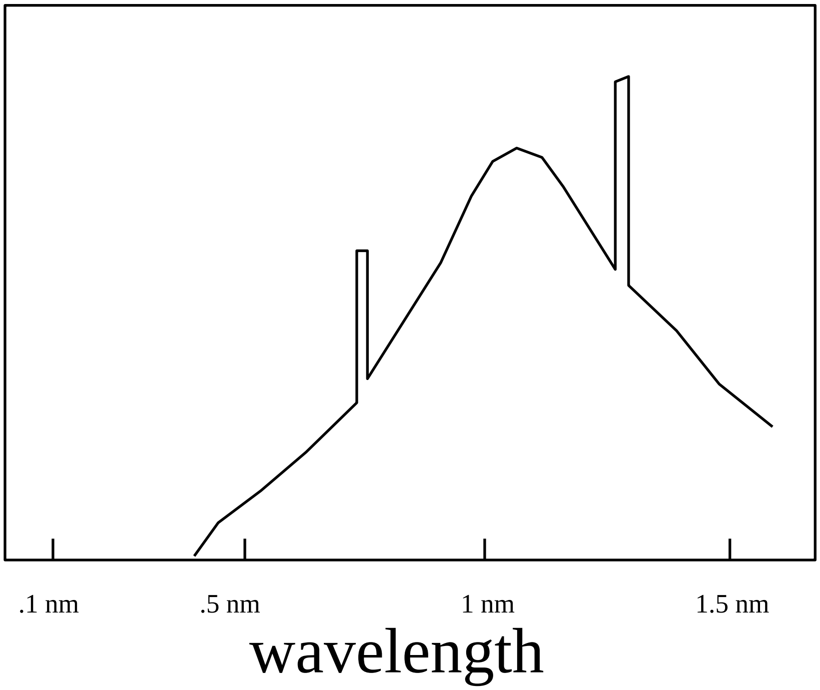
B. $f_2 > f_3 > f_1$

C. $f_1 < f_2 < f_3$

D. none of the above

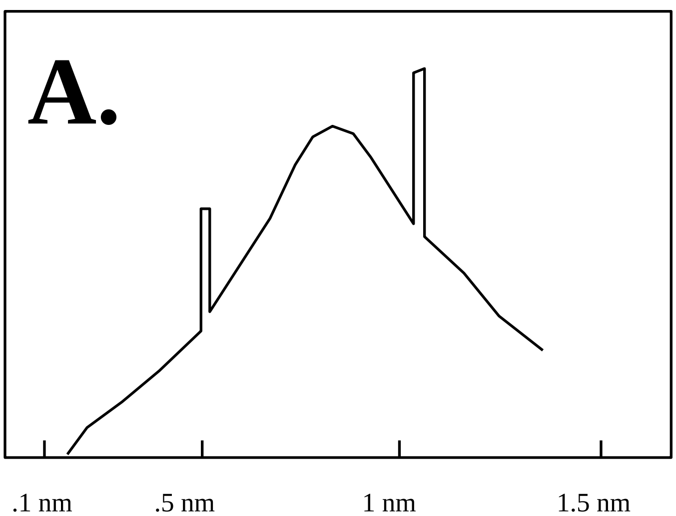


If this electron absorbed a photon to which level(s) may it move?

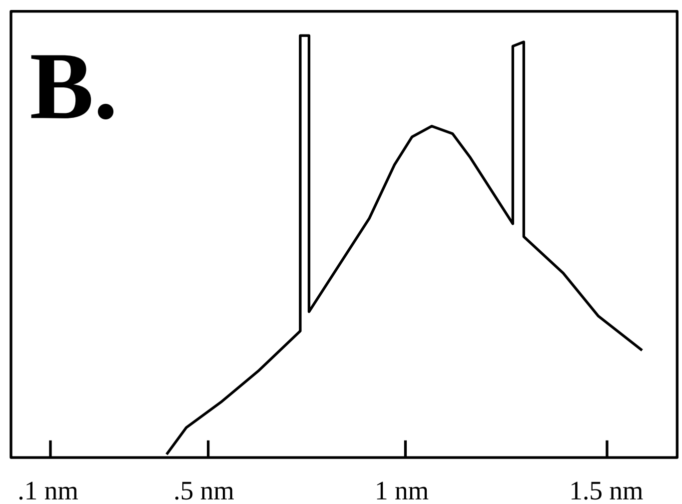


This graph shows the spectra of X−rays produced by a X−ray tube. If the accelerating voltage is increased how would this plot change?

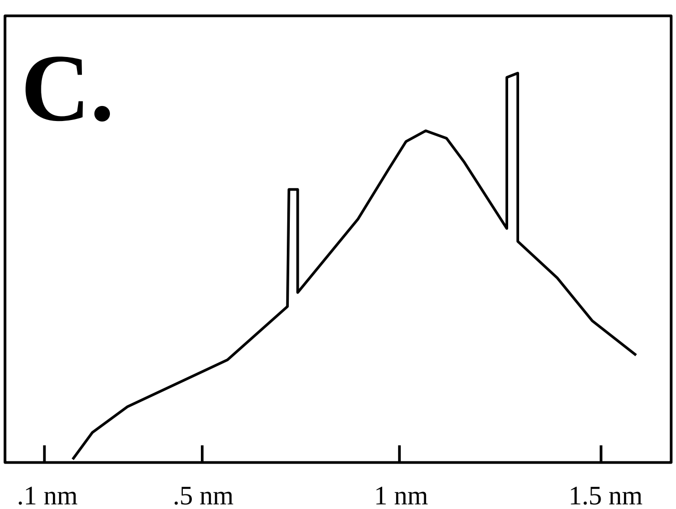
A.



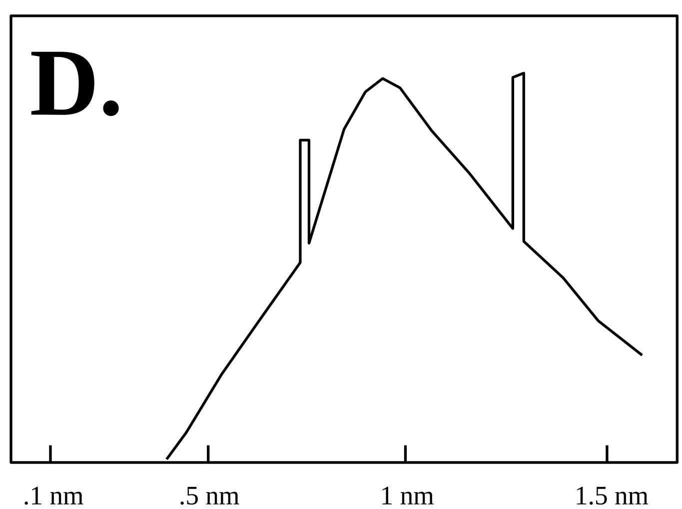
B.

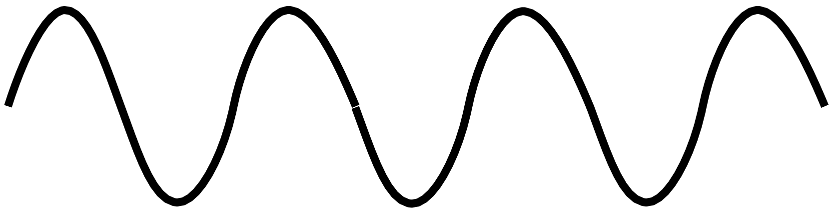


C.

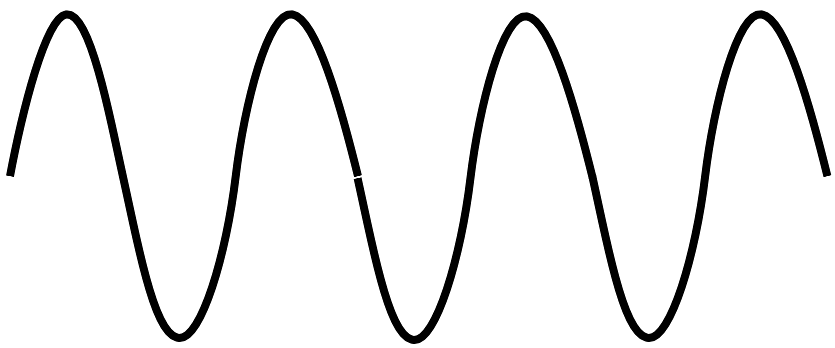


D.

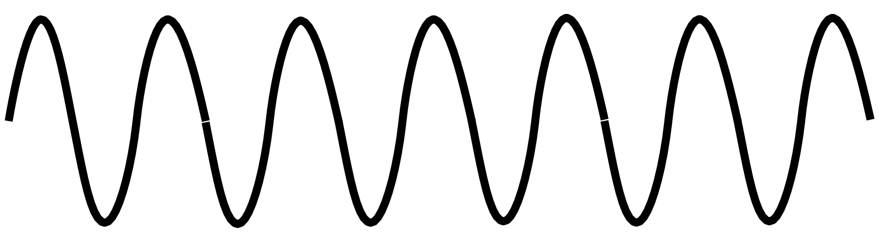




A



B



C

Which of the above particle waves has the largest momentum?

A proton, an electron, and a photon have the same kinetic energy. Which has the largest wavelength?

A. proton **B.** electron **C.** photon

In the quantum mechanical model of the hydrogen atom, if the principal quantum number n=4, what is the maximum value of the orbital angular momentum quantum number l and what letter goes with the number?

A. l=2, *p*

B. l=2, *d*

C. l=3, *f*

D. l=4, *g*

If the orbital angular momentum is *g* and what number goes with the letter and what is the smallest possible value for the magnetic quantum number?

A. l=3, −3

B. l=4, −3

C. l=4, −4

D. l=5, −4

The shell letter is *M*, the principal quantum number *n* is:

A. n=1

B. n=2

C. n=3

D. n=4

If the spin of electrons was 3/2, the first inert gas (like He) would have *Z*

A. Z=2

B. Z=4

C. Z=6

D. Z=8