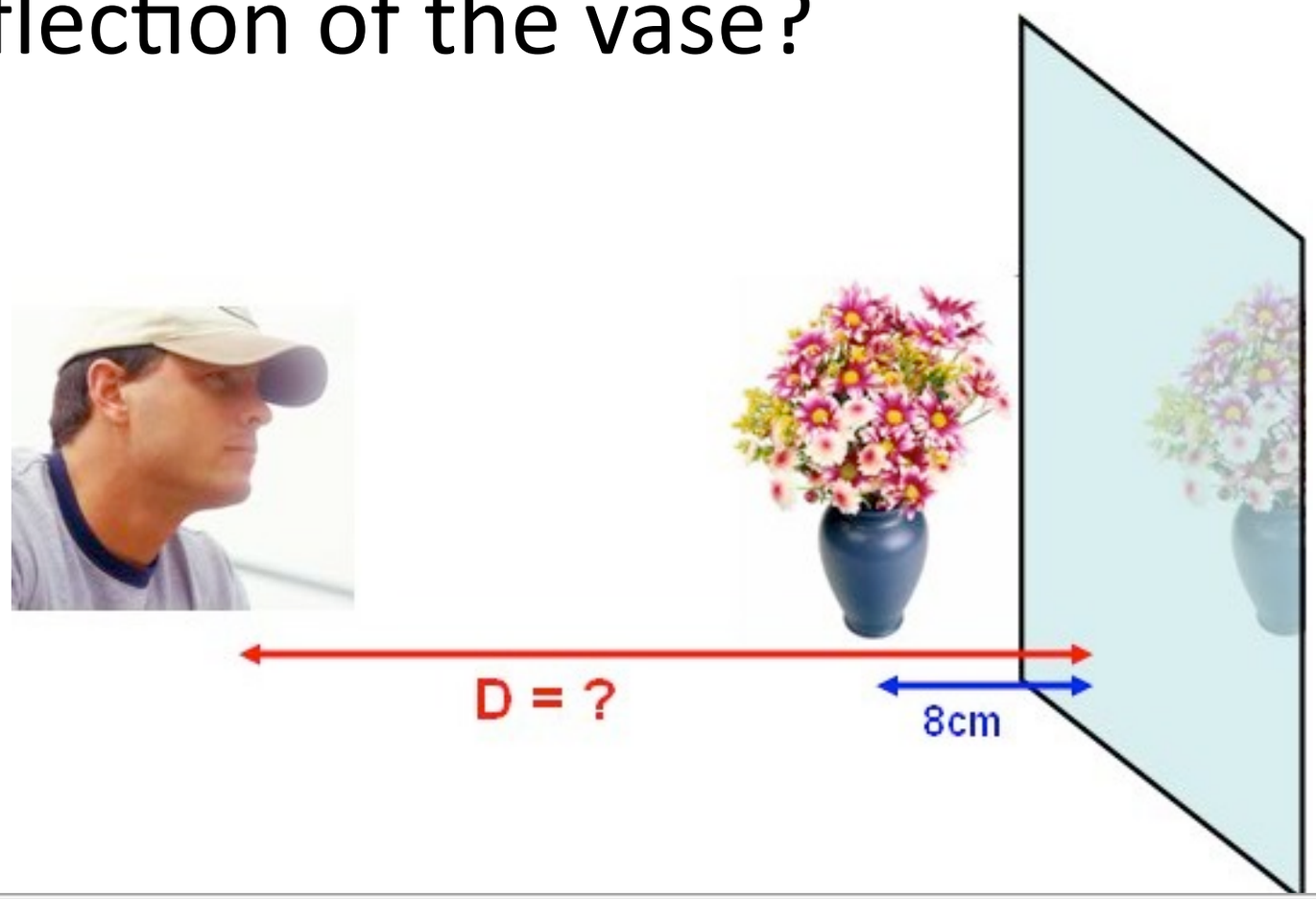
A vase is placed 8 cm in front of a flat mirror. A person with normal vision (near point 25 cm) looks at the reflection of the vase in the mirror. What is the closest distance D the person can stand from the mirror and clearly see the reflection of the vase?

A)D = 36 cm

B)D = 25 cm

C)D = 17 cm

D)D = 9 cm



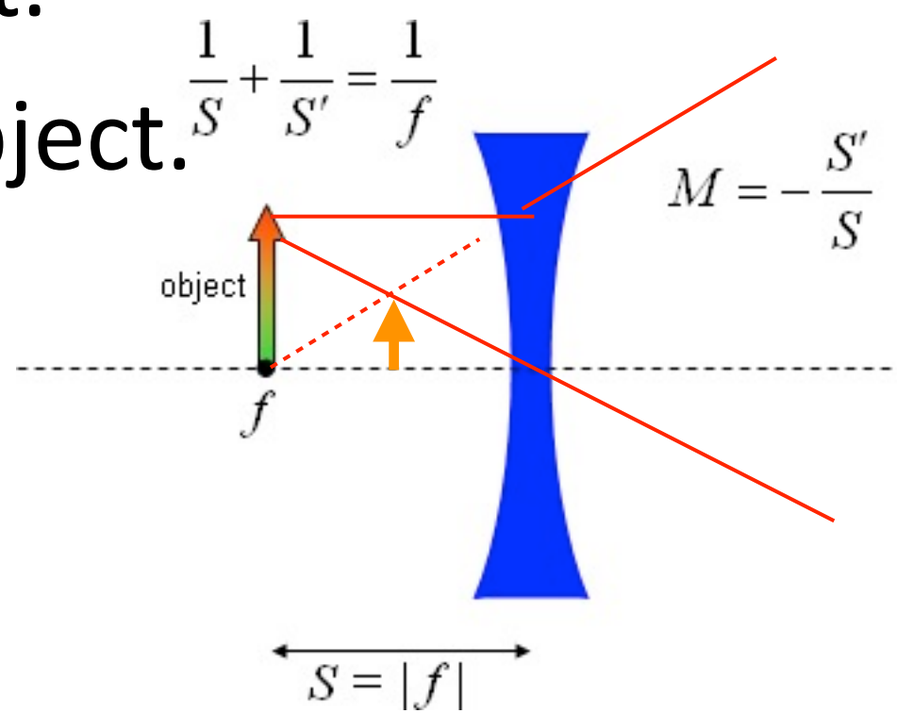
Using the lens equation and the magnification equation, what can you say about the image of an object located a distance $S = |f|$ to the left of a diverging lens?

A)The image is twice as big as the object.

B)The image is half as big as the object.

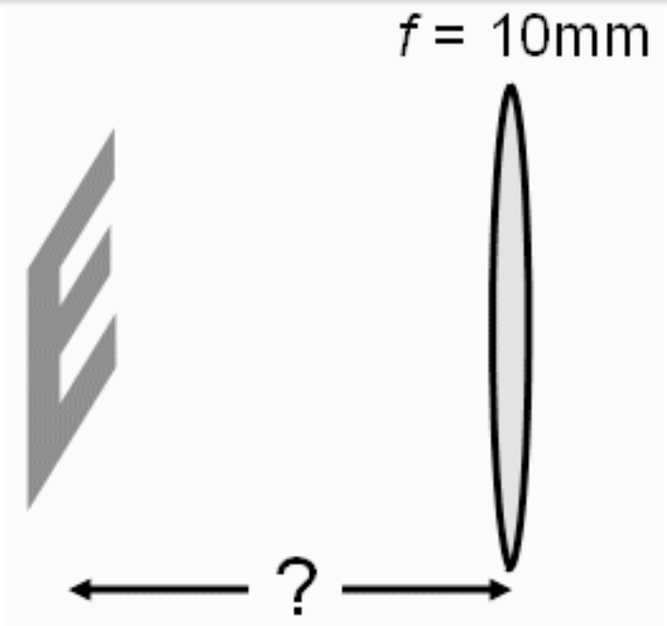
C)The image is the same size as the object.

D)There is no image in this case.



A magnifying glass is used to read the fine print on a document. The focal length of the lens is 10mm.

At what distance from the lens must the document be placed in order to obtain an image magnified by a factor of 5 that is not inverted?



How does the object distance compare to the focal length?

A) $|s| < |f|$ B) $|s| = |f|$ C) $|s| > |f|$

Lens equation → $\frac{1}{S'} = \frac{1}{f} - \frac{1}{S}$

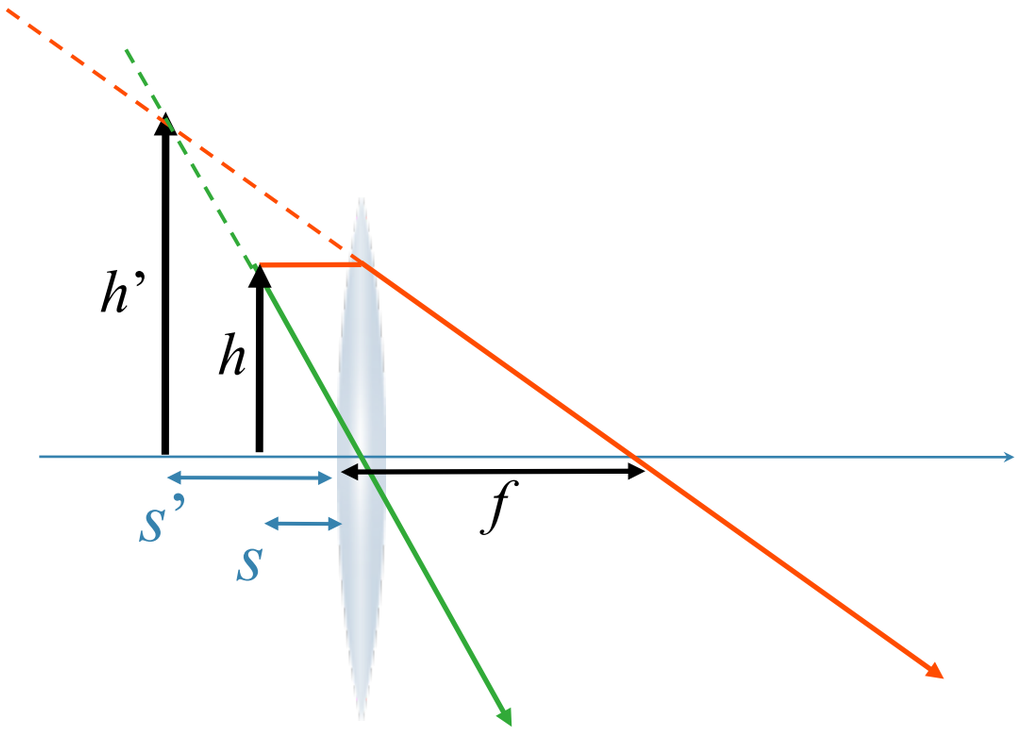
→ $S' = \frac{fS}{S - f}$

Virtual Image Þ $s' < 0$

Real object Þ $s > 0$

Converging lens Þ $f > 0$

$S - f < 0$



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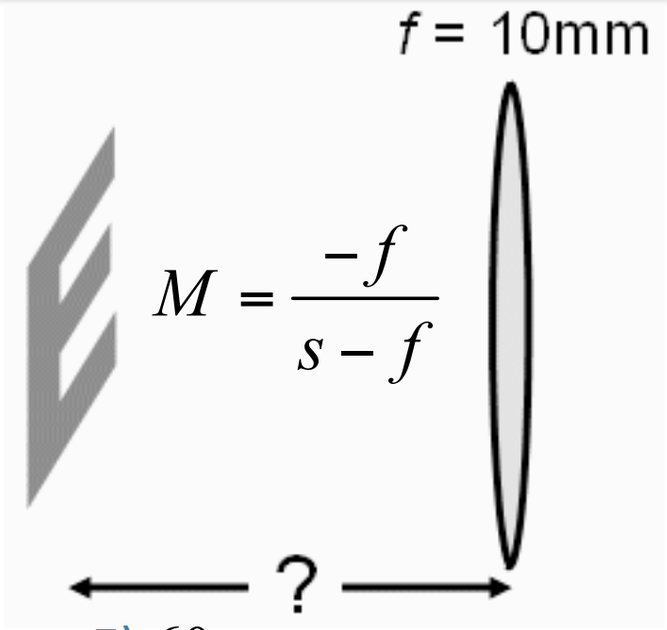


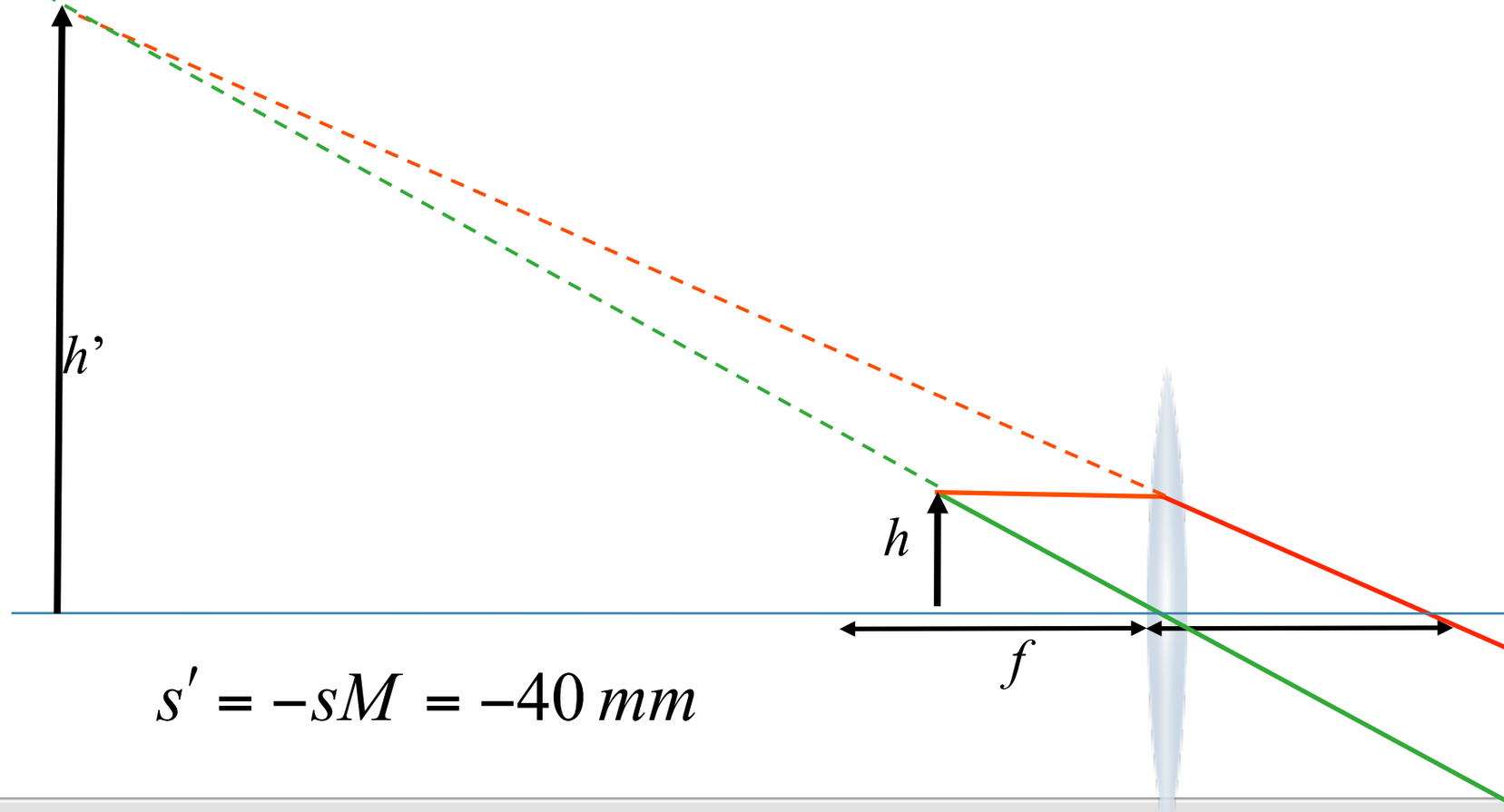
A) 1.7mm B) 6mm C) 8mm D) 40 mm E) 60 mm

$M = +5$

$f = +10\,mm$

$M = \frac{-f}{s-f} \rightarrow s = f\frac{(M-1)}{M}$

$\rightarrow s = \frac{4}{5}f = 8\,mm$



$s' = -sM = -40\,mm$

If you put your eye 25 cm from the object without the lens, the angle subtended will be h/25.

If you then put your eye up to the lens the angle subtended by the image will be 5h/40.

Therefore the angular magnification is

(5h/50 x 25/h) = 2.5

angular magnification is 2.5

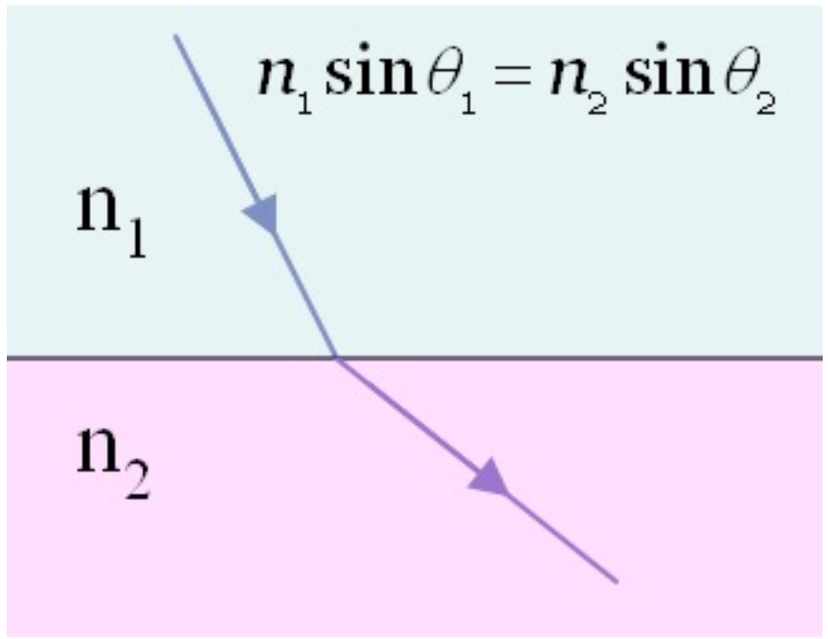
lateral magnification is 5.0

Light travelling through a medium with index of refraction n_1 is refracted as it enters a medium with index of refraction n_2 as shown in the figure to the right. Based on this figure what can you infer about the index of refraction of the two materials?

A) $n_1 < n_2$

B) $n_1 = n_2$

C) $n_1 > n_2$



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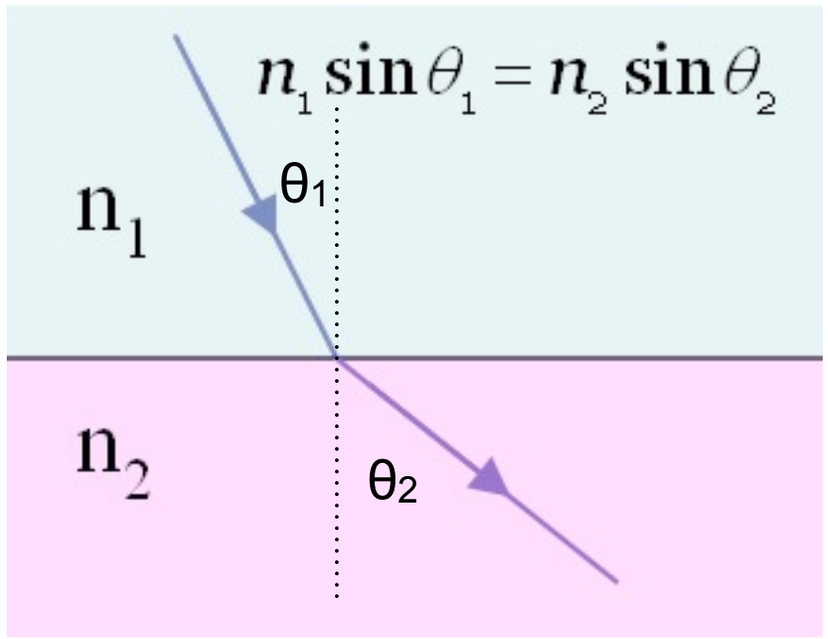


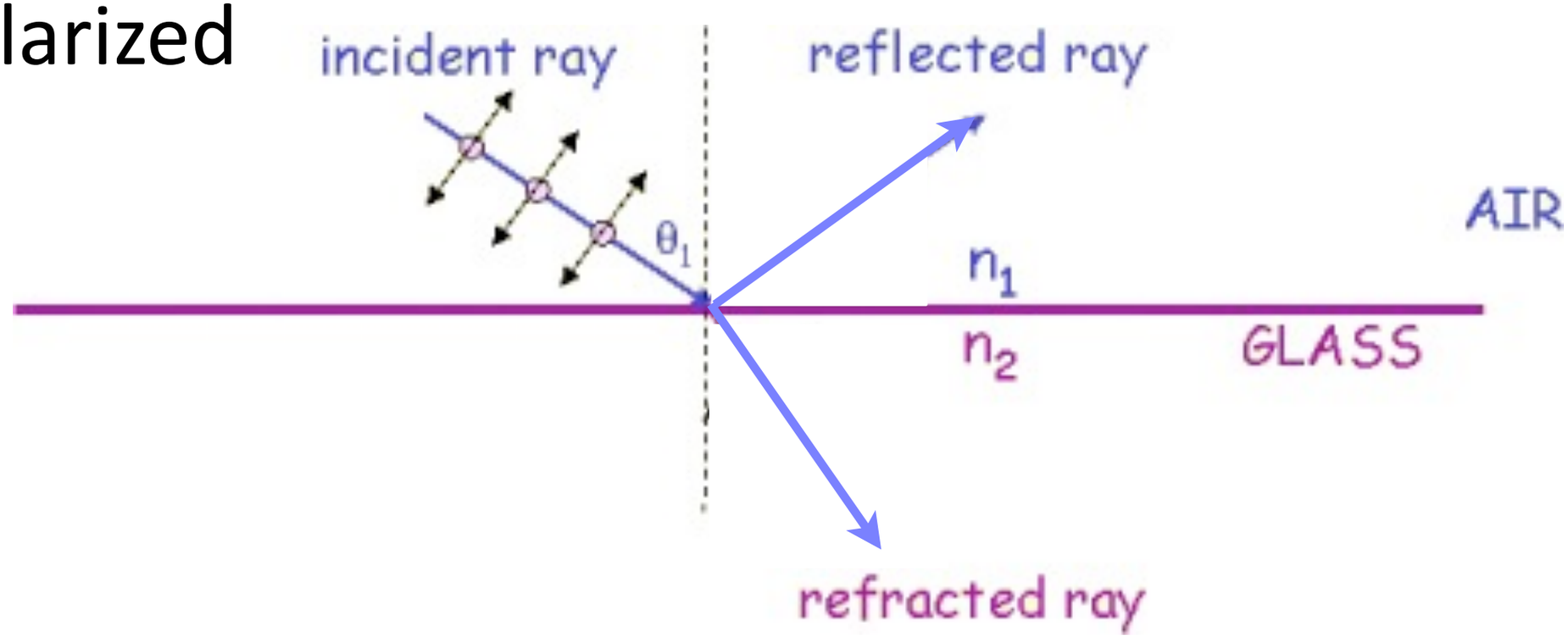
Unpolarized light traveling through the air is incident on glass at Brewster's angle. Which statement best describes the polarization of the reflected wave?

A)Vertically Polarized

B)Horizontally Polarized

C)Circularly Polarized

D)Unpolarized



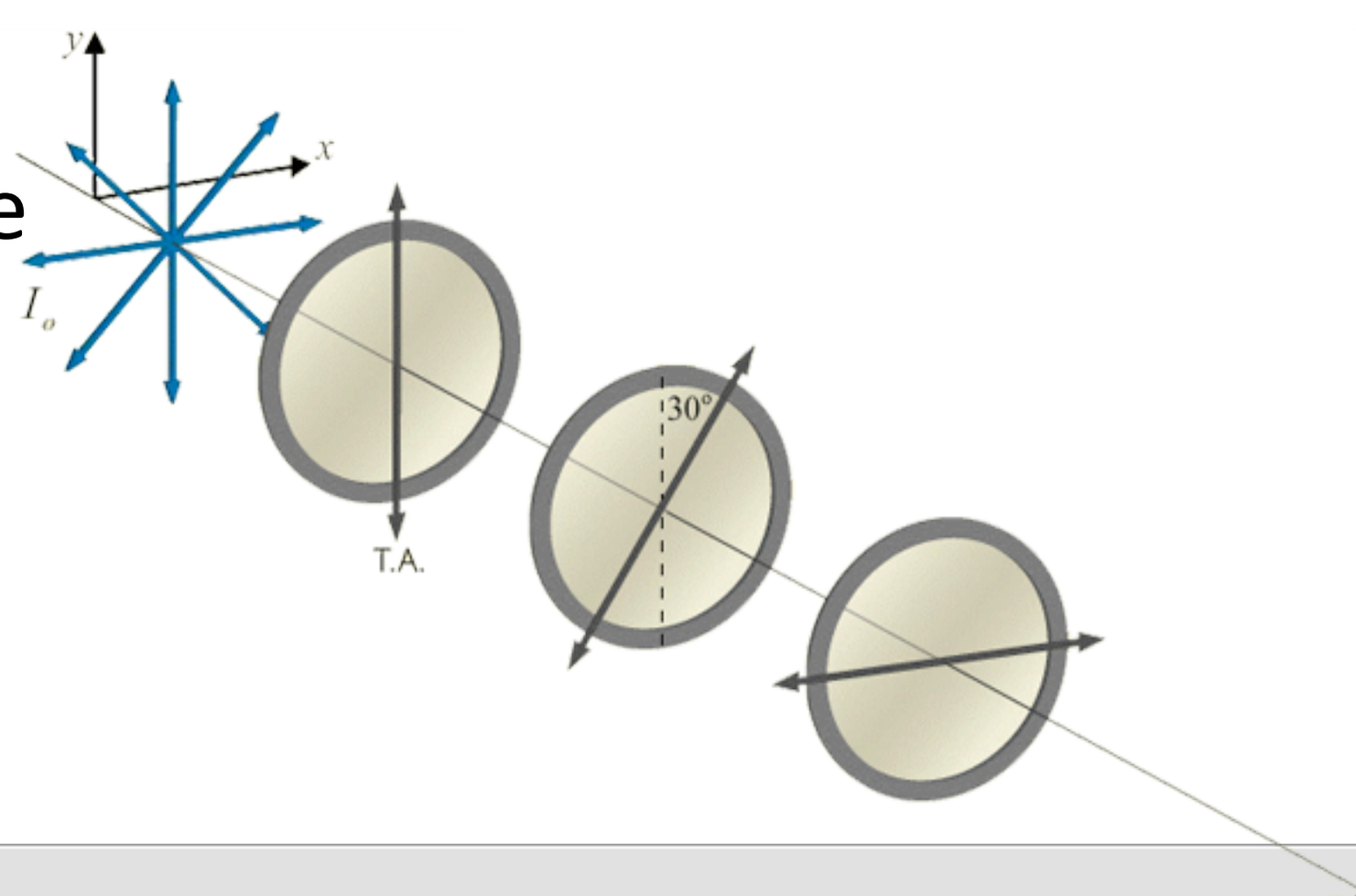
Unpolarized light of intensity I_0 is incident on a set of three linear polarizers oriented at 0°, 30° and 90° with respect to vertical as shown. The intensity of the light after passing through all three polarizers is I_{final}.

If the middle polarizer is removed, how does I_{final} change?

A) I_{final} remains the same

B) I_{final} increases

C) I_{final} decreases



Unpolarized light of intensity I_0 is incident on a set of three linear polarizers oriented at 0°, 30° and 90° with respect to vertical as shown. The intensity of the light after passing through all three polarizers is I_{final}.

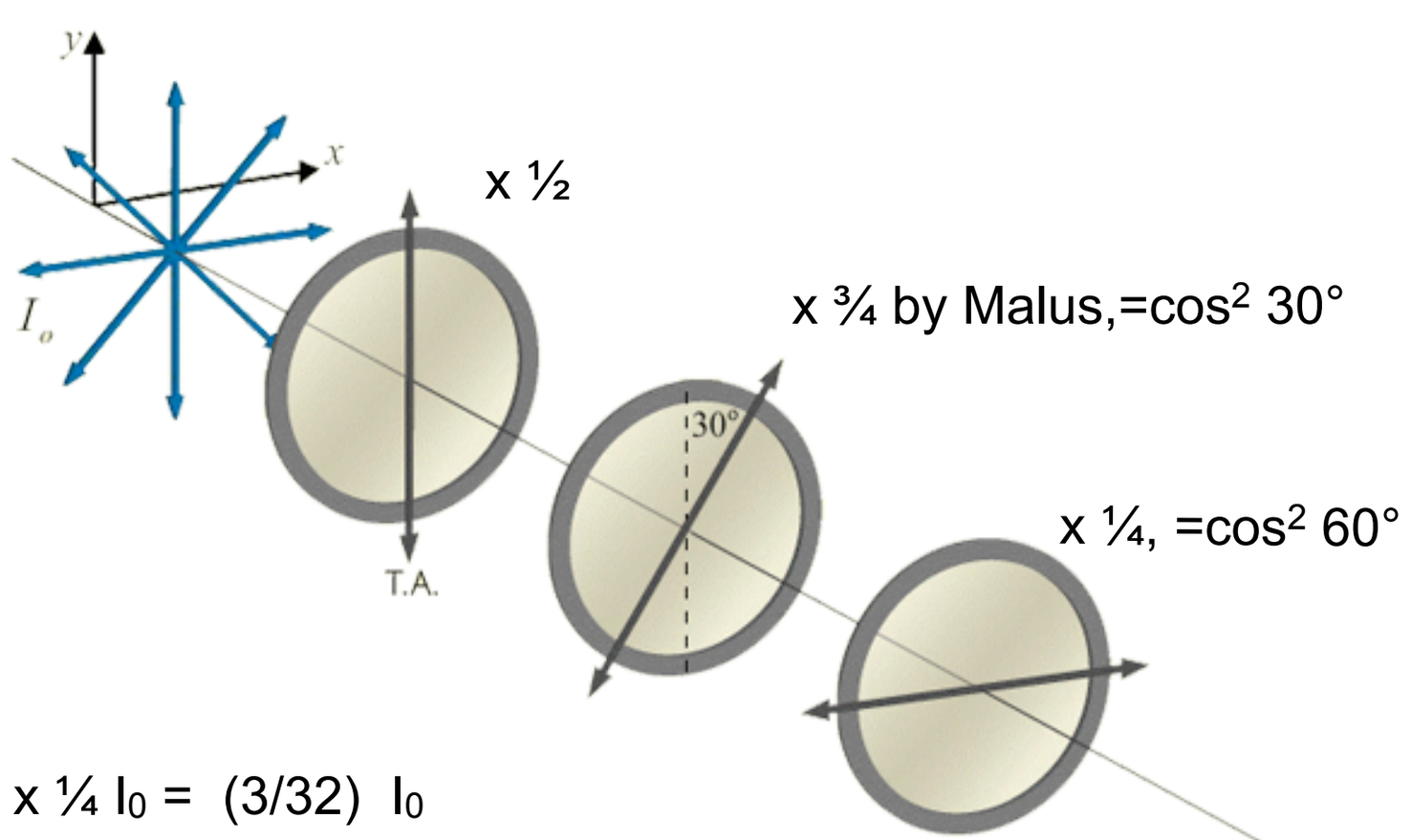
A) $I_{final} = ½\ I_0$

B) $I_{final} = 3/8\ I_0$

C) $I_{final} = ¼\ I_0$

D) $I_{final} = ⅛\ I_0$

E) $I_{final} = (3/32)\ I_0$



½ x ¾ x ¼ I_0 = (3/32) I_0

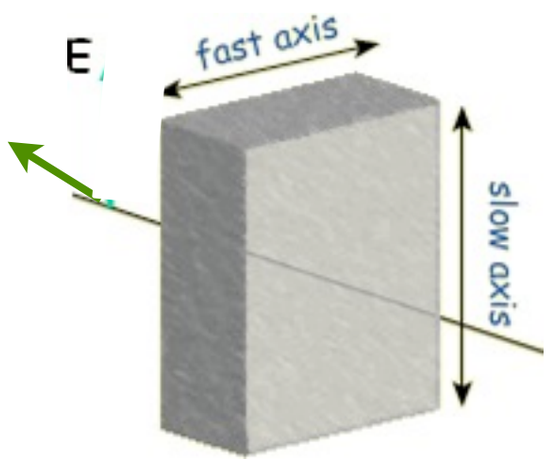
Linearly polarized light is incident on a half wave plate which is oriented so that its slow axis is in the vertical direction and its fast axis is in the horizontal direction.

What is the polarization of the light after it exits the half wave plate?

A)Linearly polarized

B) Unpolarized

C)Circularly polarized



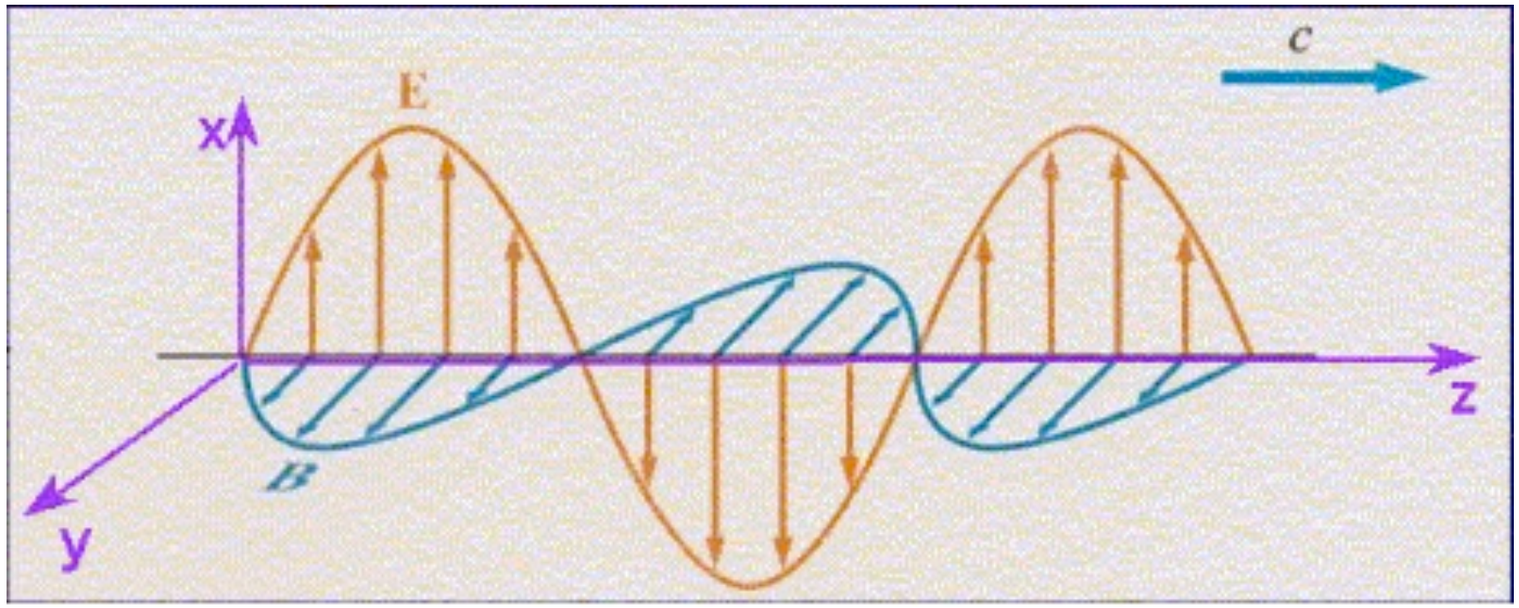
The color of the stars we observe in galaxies can be used to deduce the velocity of the galaxy relative to Earth.

Suppose the average color of the stars in a newly discovered galaxy is bluer than the average color of stars in our own galaxy. What would be a sensible conclusion about the motion of the new galaxy relative to our own?

A)It is moving towards us

B)It is moving away from us.

Which equation correctly describes the electromagnetic wave shown?



A) $E_x = E_o \sin(kz + \omega t)$

B) $E_y = E_o \sin(kz - \omega t)$

C) $B_y = B_o \sin(kz - \omega t)$

D) $E_x = E_o \sin(\omega t + kz)$

E) $B_x = B_o \sin(\omega t - kz)$

Which of the following is **not** a unit vector?

A) $\dfrac{\hat{i}+\hat{k}}{\sqrt{2}}$

B) $\dfrac{\hat{i}-\hat{j}}{\sqrt{2}}$

C) $\dfrac{3\hat{i}+4\hat{j}}{5}$

D) $\dfrac{3\hat{i}+4\hat{j}}{5}\times\hat{k} = \dfrac{-3\hat{j}+4\hat{i}}{5}$

E) $\dfrac{3\hat{i}+4\hat{j}}{5}\times\dfrac{3\hat{i}-4\hat{j}}{5} = \dfrac{0+12\hat{k}-12(-\hat{k})-0}{25} = \dfrac{24}{25}\hat{k}$

Which of the following statements does not correctly describe a harmonic plane wave traveling in some medium?

A)The time taken by any point of the wave to make one complete oscillation does not depend on the amplitude.

B)Doubling the wavelength of the wave will halve its frequency.

C)Doubling the amplitude has no effect on the wavelength.

D)Doubling the frequency of the wave will double its speed.

The equation for the x-component of the electric field of a plane electromagnetic wave is given by:

$E_x = E_o \sin(kz - \omega t)$

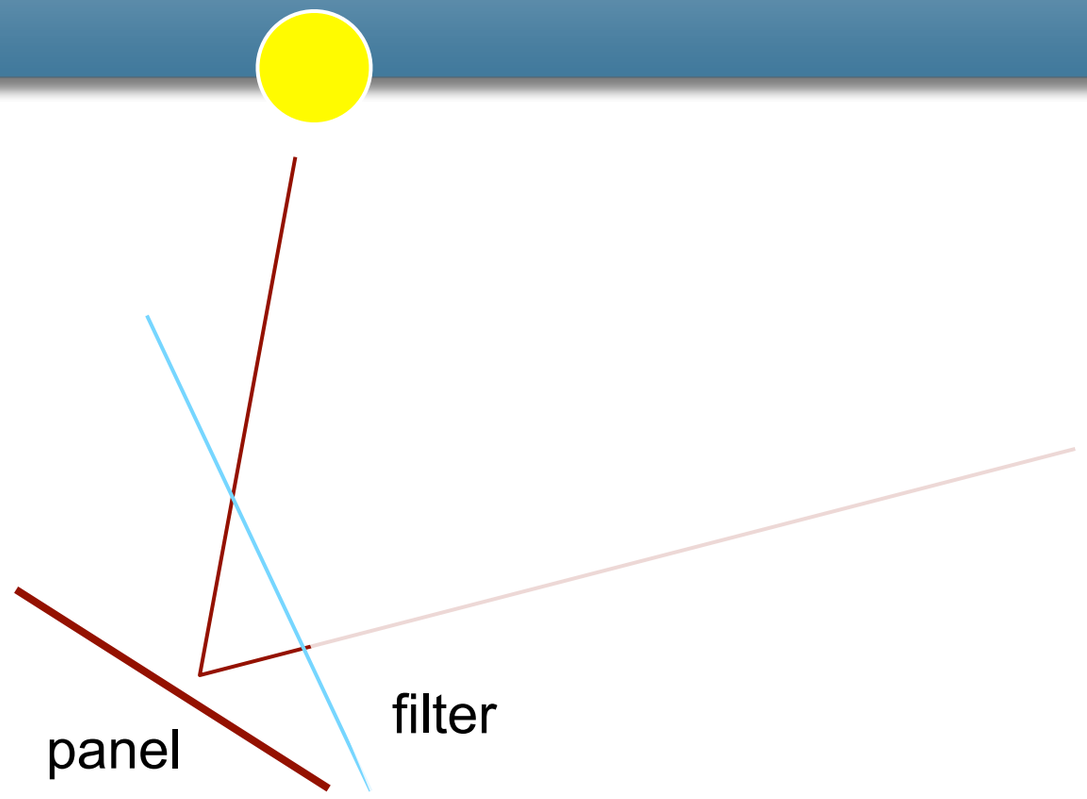
Which of the following equations describes the associated magnetic field?

A) $B_y = E_o c \sin(kz - \omega t)$

B) $B_y = (E_o/c) \sin(kz - \omega t)$

C) $B_y = E_o c \cos(kz - \omega t)$

D) $B_y = (E_o/c) \cos(kz - \omega t)$



A filter is put in front of an instrument panel to block reflected rays from the sun. It should be a

A) linear polarizer

B) circular polarizer

C) linear analyzer

D) circular analyzer