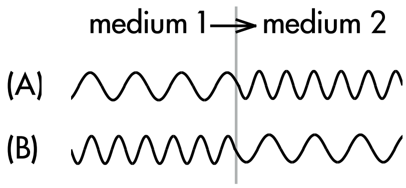
Light of wavelength 540 nm in medium 1, passes into medium 2, where it has a wavelength of 590 nm.

1. Which diagram best depicts how the relative wavelengths of light change?



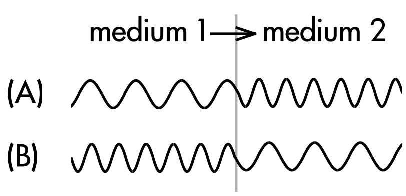
(C) (Unsure/lost/guessing help!)

2. The $\begin{bmatrix}\text{speed } v \\ \text{frequency } f\end{bmatrix}$ of this light __________ as it passes from medium 1 to medium 2:

(A) decreases.
(B) remains the same.
(C) increases.
(D) (Not enough information is given.)
(E) (Unsure/guessing/lost/help!)

Light of wavelength 550 nm in medium 1 ($n_1 = 1.00$) passes into medium 2 ($n_2 = 1.33$).

3. Which diagram best depicts how the relative wavelengths of light change?

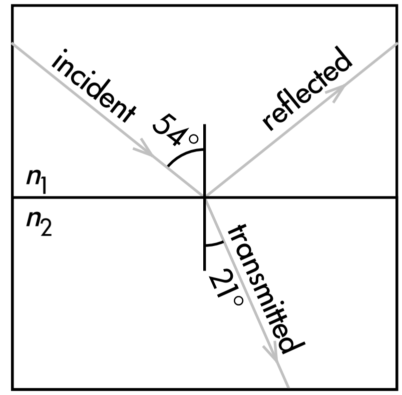


(C) (Unsure/lost/guessing help!)

4. The $\begin{bmatrix}\text{speed } v \\ \text{frequency } f \\ \text{wavelength } \lambda\end{bmatrix}$ of this light __________ as it passes from medium 1 to medium 2:

(A) decreases.
(B) remains the same.
(C) increases.
(D) (Not enough information is given.)
(E) (Unsure/guessing/lost/help!)

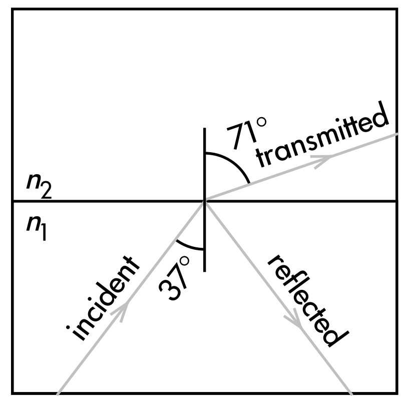
A beam of light strikes the interface between two transparent materials, with an incident angle of 54° in medium 1, and a transmitted angle of 21° in medium 2.



5. __________ has the [greater index of refraction / faster speed of light].

(A) Medium 1.
(B) Medium 2.
(C) (There is a tie.)
(D) (Not enough information is given.)
(E) (Unsure/guessing/lost/help!)

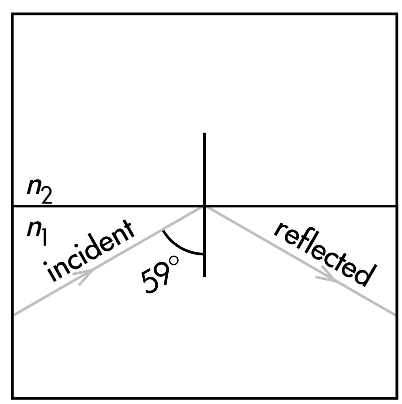
A beam of light strikes the interface between two transparent materials, with an incident angle of 37° in medium 1, and a transmitted angle of 71° in medium 2.



6. __________ has the [greater index of refraction / faster speed of light].

(A) Medium 1.
(B) Medium 2.
(C) (There is a tie.)
(D) (Not enough information is given.)
(E) (Unsure/guessing/lost/help!)

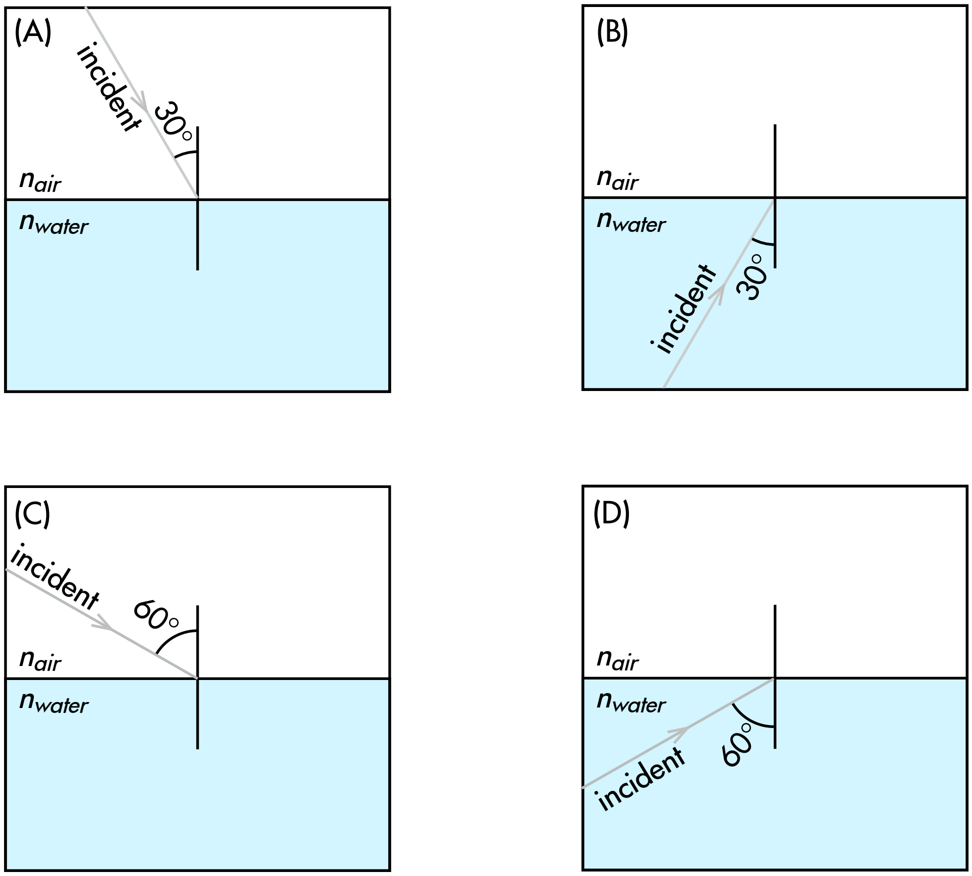
A beam of light strikes the interface between two transparent materials, with an incident angle of 59° in medium 1, but there is only a reflected ray in medium 1, and no transmitted ray in medium 2.



7. __________ has the [greater index of refraction / faster speed of light].

(A) Medium 1.
(B) Medium 2.
(C) (There is a tie.)
(D) (Not enough information is given.)
(E) (Unsure/guessing/lost/help!)

A beam of light has four different incident angles at an interface of air and water (index of refraction 1.33).



8. Calculate, draw in, and rank the reflected ray angles, from smallest to largest. Indicate ties, if any.

________	________	________	________
(smallest)			(largest)

9. Calculate, draw in, and rank the transmitted ray angles, from smallest to largest. Indicate ties, if any. (If there is no transmitted ray, then omit it from the ranking.)

________	________	________	________
(smallest)			(largest)

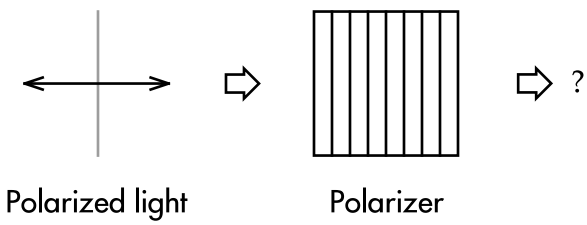
10. Identify the cases (if any) that will not have a transmitted ray. Briefly explain why there would be no transmitted ray.

Case(s) with no transmitted ray: ________.

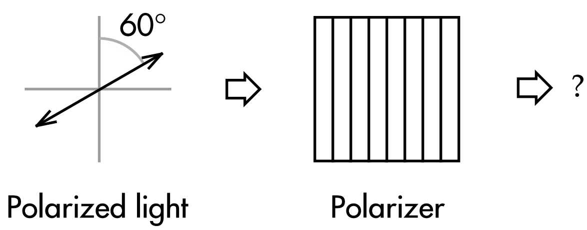
Explanation:

Polarized light is incident on ideal polarizers with four different transmission axes.

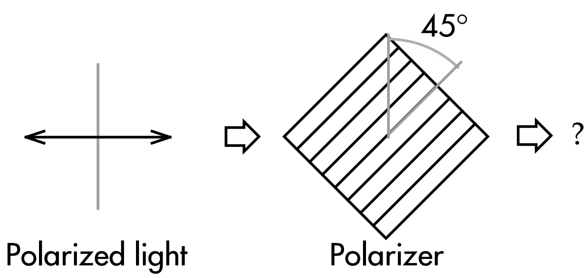
(A)



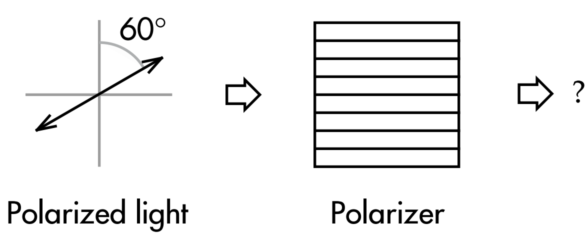
(B)



(C)



(D)



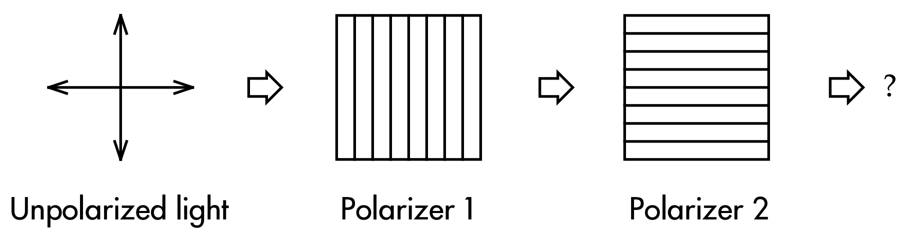
11. Rank the amount of transmitted light, from least to greatest. Indicate ties, if any.

________ ________ ________ ________
(least) (greatest)

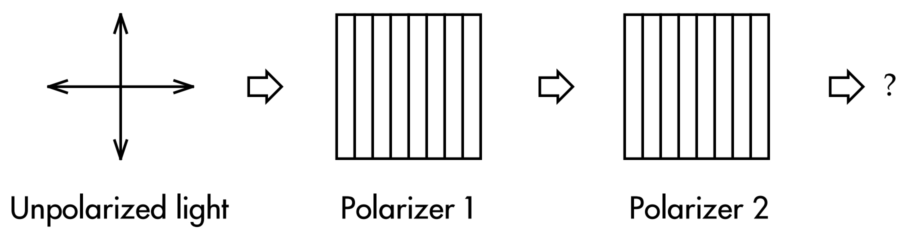
12. For each case above, draw in the orientation of the final transmitted light polarization (if any).

Unpolarized light is incident on sets of ideal polarizers with different transmission axes.

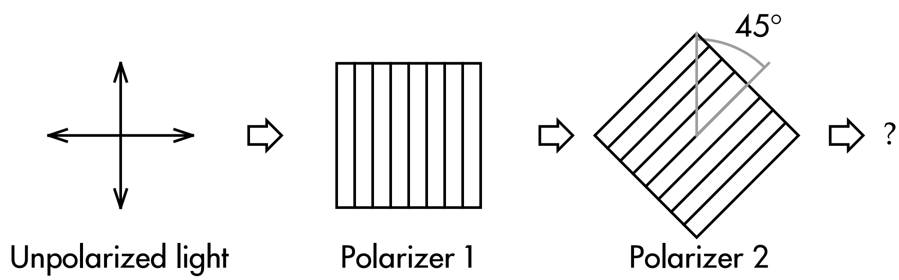
(A)



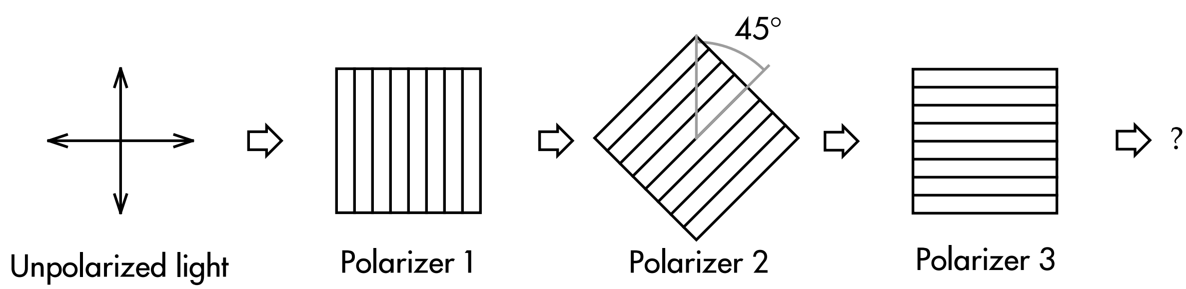
(B)



(C)



(D)



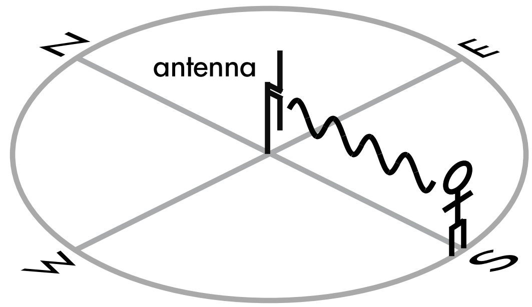
13. Rank the amount of transmitted light, from least to greatest. Indicate ties, if any.

________ (least) ________ ________ ________ (greatest)

14. For each case above, draw in the orientation of the final transmitted light polarization (if any).

15. A radio station broadcasts using a vertical electric dipole antenna. For each of the following locations, determine the polarization direction of the radio waves that can be received (if any).

North of the antenna: _____.
East of the antenna: _____.
South of the antenna: _____.
West of the antenna: _____.
Directly overhead: _____.

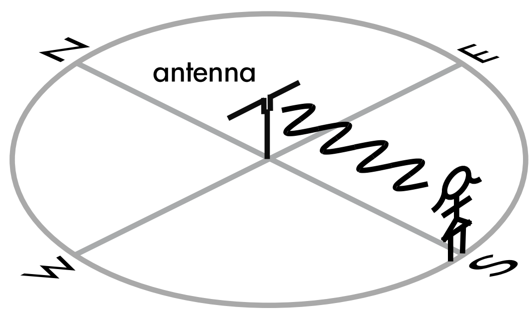


(A) vertically up-down.
(B) horizontally north-south.
(C) horizontally east-west.
(D) (No radio waves can be received.)
(E) (Unsure/guessing/lost/help!)

---

16. A radio station broadcasts using a horizontal electric dipole antenna mounted along the east-west direction. For each of the following locations, determine the polarization direction of the radio waves that can be received (if any).

North of the antenna: _____.
East of the antenna: _____.
South of the antenna: _____.
West of the antenna: _____.
Directly overhead: _____.



(A) vertically up-down.
(B) horizontally north-south.
(C) horizontally east-west.
(D) (No radio waves can be received.)
(E) (Unsure/guessing/lost/help!)

17. A radio station is located due north of your location.

It uses an electric dipole antenna oriented $\begin{bmatrix} \text{vertically} \\ \text{horizontally north - south} \\ \text{horizontally east - west} \end{bmatrix}$.

In order to maximize reception of this broadcast at your location, you would need to orient an electric dipole receiving antenna:

(A) vertically.
(B) horizontally north-south.
(C) horizontally east-west.
(D) (No reception is possible using an electric dipole antenna.)
(E) (Unsure/guessing/lost/help!)

---

18. If the sun is $\begin{bmatrix} \text{directly overhead} \\ \text{rising in the east} \\ \text{setting in the west} \end{bmatrix}$, and you are looking at the $\begin{bmatrix} \text{north} \\ \text{east} \\ \text{south} \\ \text{west} \end{bmatrix}$ horizon,

you would observe light that is:
(A) partially polarized horizontally, north-south.
(B) partially polarized horizontally, east-west.
(C) partially polarized vertically (up-down).
(D) randomly polarized (unpolarized).
(E) (Unsure/guessing/lost/help!)

---

19. If the sun is $\begin{bmatrix} \text{directly overhead} \\ \text{rising in the east} \\ \text{setting in the west} \end{bmatrix}$, and you are looking directly overhead,

you would observe light that is:
(A) partially polarized north-south.
(B) partially polarized east-west.
(C) randomly polarized (unpolarized).
(D) (Unsure/guessing/lost/help!)

Equations and constants:

$n_{air} = 1.000$; $c = 3.00 \times 10^8 \ \frac{\text{m}}{\text{s}}$; $n = \frac{c}{v}$; $\lambda = \frac{v}{f}$.

$\overline{S}_{through} = \frac{1}{2}\overline{S}_{unpolarized}$; $\overline{S}_{through} = \overline{S}_{polarized} \cos^2\theta$; $n_1 \sin\theta_1 = n_2 \sin\theta_2$; $\theta_c = \sin^{-1}\frac{n_2}{n_1}$.