حل مراجعة دروس وحدة Light of Fundamentals منهج انسباير

ID Resources: Topic 7– Fundamentals of Light

Subtopic 7.1: Illumination

KPI 7.1.1

1. What is light?

√ A. Electromagnetic radiation
B. Electric waves
C. Longitudinal waves
D. Electric conduction

KPI 7.1.1, 7.1.4

2. When does light no longer travel in a straight line?

A. When it loses power
B. When there is electrical interference
√ C. When it hits a boundary
D. When there is magnetic interference

KPI 7.1.3

3. Windows in a home usually give a clear view of what is outside. Which term describes this type of window?

A. Opaque
√ B. Transparent
C. Translucent
D. Reflector

KPI 7.1.6

4. Which is the correct formula for point-source illuminance?

A. $E = P/4\pi r$
B. $E = 4P\pi r$
C. $E = 4\pi r^2$
√ D. $E = P/4\pi r^2$

KPI 7.1.6

Which best describes the relationship between distance and illuminance?

A. $E \propto r$
√ B. $E \propto 1/r$
C. $E \propto r^2$
D. $E \propto 1/r^2$

Free Response:

KPI 7.1.3

1. Compare and contrast the behavior of light rays hitting opaque, translucent, and transparent materials by filling in the table below.

	Opaque Material	Translucent Material	Transparent Material
Absorb	Some light	Some light	Some light
Reflect	Some light	Some light	Some light
Transmit	No light	Some light, but scatters it	Most light

KPI 7.1.5

2. Define illuminance and state the units that are used for illuminance.

Illuminance is the luminous flux falling on a given surface area at any instant. It is measured in lux (lx), which is equivalent to lumens per square meter (lm/m^2).

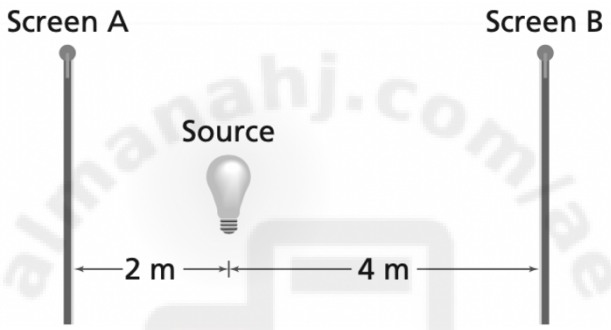
KPI 7.1.8, 7.19

3. Describe what luminous intensity is a measure of and what its relationship is to illuminance.

Luminous intensity is a measure of the luminous flux that falls on 1 m^2 of the inside of a 1 m radius sphere. The relationship of luminous intensity to illuminance is an inverse-square relationship

KPI 7.1.6, 7.1.7

4. The figure below shows an incandescent lamp that emits a luminous flux of 2200 lm and is placed between two screens.



a. Complete the table below by finding the illuminance at screens A and B (show your work).

Illuminance at screen A	$E_A = \frac{P}{4\pi r^2} = \frac{2200\ lm}{4\pi(2.0\ m)^2}$ $\rightarrow 1\ mark$ $E_A = 44\ lx$ $\rightarrow 1\ mark\ for\ answer$
Illuminance at screen B	$E_B = \frac{P}{4\pi r^2} = \frac{2200\ lm}{4\pi(4.0\ m)^2}$ $\rightarrow 1\ mark$ $E_B = 11\ lx$ $\rightarrow 1\ mark\ for\ answer$ (1 mark for unit seen on either A or B)

b. What is the ratio (E_B/E_A) of the illuminance at screen B to the illuminance at screen A?

$\frac{E_B}{E_A} = \frac{1}{4}$

OR (1: 4) OR illuminance at screen B will be one-fourth that at A. (do not accept 4:1)

Subtopic 7.2: The Nature of Light

KPI 7.2.1

1. What is the bending of light as it passes the edge of a barrier called?

A. Reflection
B. Refraction
√ C. Diffraction
D. Polarization

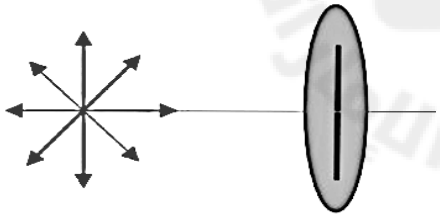
KPI 7.2.4

5. Polarized light consists of waves ___ with a specific pattern.

A. fixed
√ B. oscillating
C. combining
D. traveling

KPI 7.2.6

3. A polarizing filter is placed in front of an unpolarized light source as shown below.



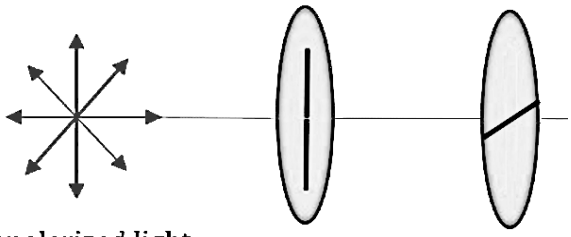
Unpolarized light of intensity I_o

How much of light is blocked by this single polarizing filter?

A. 0%
√ B. 50%
C. 75%
D. 100%

KPI 7.2.8, 7.2.9

4. Two polarizing filters are placed in front of a light source.



Unpolarized light of intensity I_o

If the axis of the two filters are perpendicular to each other, how much of the light is blocked by them?

A. 0%
B. 50%
C. 75%
√ D. 100%

KPI 7.2.11, 7.2.12

2. What do astronomers use to help determine how objects such as galaxies move relative to Earth?

√ A. Doppler shift
B. Light reflection
C. Light refraction
D. Light shift

Free Response:

1. Match the descriptions in the table to the terms below.

Polarization **Wavelength** **Malus's Law** **Diffraction**

Description	Term
The shortest distance between points of a wave where the wave pattern repeats itself, such as from crest to crest or trough to trough KPI 7.2.10, 6.2.4	Wavelength
the bending of light as it passes the edge of a barrier KPI 7.2.1	Diffraction
production of light with a specific pattern of oscillation KPI 7.2.4	Polarization
law that explains the reduction of light intensity as light passes through a second polarizing filter KPI 7.2.8	Malus's Law

2. Fill in the blacks by choosing the appropriate term from the brackets.

a. Diffraction demonstrates that light has _____(wave / particle) like properties. KPI 7.2.3

b. The waves that cannot pass through a polarizing filter are those whose electric fields are vibrating _____(parallel/perpendicular) to the polarizing axis. KPI 7.2.6

KPI 7.2.2

3. Explain how Huygens' principle explain the blurred edges of the shadow around the edges.

Huygens used a model of wavelets to explain how light moves around edges. The wave front moves in a line except near edges, where the wavelet propagates as a circular wave. This creates a blurry edge.

KPI 7.2.6

4. Explain why polarization by filtering decreases the intensity of light.

When light passes through a polarizing filter, only the waves with electric fields oscillating parallel to the polarizing axis pass through; the others are stopped, decreasing the intensity of light.

KPI 7.2.8, 7.2.9

5. Two polarizing filters are lined up. The light entering the first is 100 lm. Use Malus's law to complete the table below.

Angle between Filters	Intensity of Light after Passing through Second Filter
90°	0
0°	100 lm
60°	25 lm

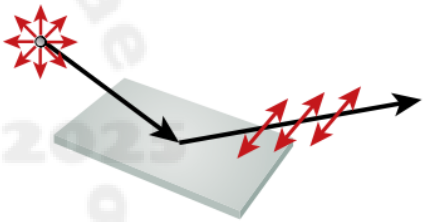
KPI 7.2.5, 7.2.6

6. Describe a simple experiment you could do to determine whether sunglasses in a store are polarizing.
See whether the glasses reduce glare from reflective surfaces, such as windows or roadways.

KPI 7.2.7

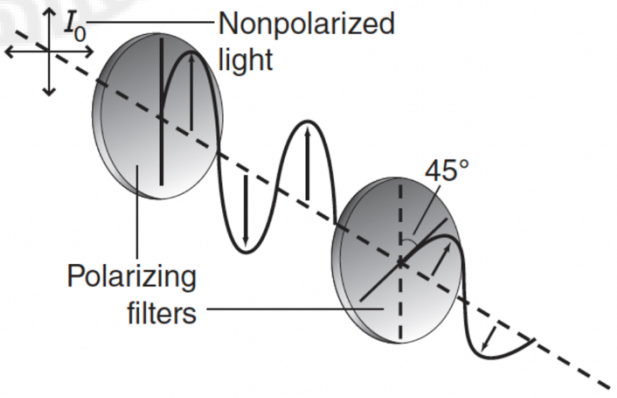
7. Use the figure below to determine the direction the polarizing axis of polarizing sunglasses should be oriented to reduce glare from the surface of a road: vertically or horizontally? Explain.

The polarizing axis should be oriented vertically, since the light reflecting off the road will be partially polarized in the horizontal direction. A vertical polarizing axis will filter horizontal waves.



KPI 7.2.6, 7.2.8, 7.2.9

8. Nonpolarized light of intensity I_0 is incident on a polarizing filter, and the emerging light strikes a second polarizing filter, as shown.



a. What is the light intensity emerging from the first polarizing filter?

$I_1 = \frac{I_0}{2}$

b. What is the light intensity emerging from the second polarizing filter?

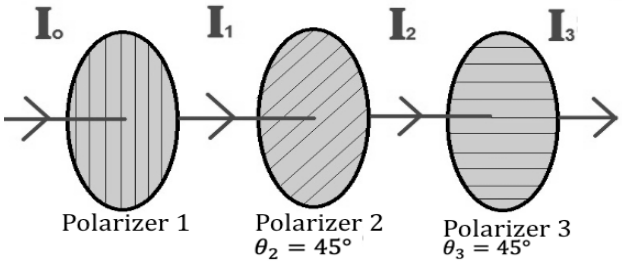
$I_2 = I_1 \cos^2\theta_2$

$I_2 = \frac{I_0}{2}(\cos 45°)^2 = \frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2$

$I_2 = \frac{I_0}{4}$

KPI 7.2.6, 7.2.8, 7.2.9

9. Unpolarized light is passed through polarizer 1. The light then goes though polarizer 2 with its plane of polarization at 45.0° to that of polarizer 1. Polarizer 3 is placed after polarizer 2. Polarizer 3 has its plane of polarization at 45° to the plane of polarization of polarizer 2 and at 90° to that of polarizer 1 as shown below.



What fraction of the intensity of the original light I_0 gets through:

a. The polarizer 2?

$I_2 = I_1 \cos^2\theta_2$

$I_2 = \frac{I_0}{2}(\cos 45°)^2 = \frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2$

$I_2 = \frac{1}{4}(I_0) = 0.25(I_0)$

b. The polarizer 3?

$I_3 = I_2 \cos^2\theta_2$

$I_3 = \left(\frac{I_0}{4}\right)(\cos 45°)^2 = \left(\frac{I_0}{4}\right)\left(\frac{1}{\sqrt{2}}\right)^2$

$I_3 = \frac{I_0}{8} = 0.125(I_0)$

c. Suppose the second polarizer is removed. What is the intensity of light transmitted by the two (i.e., first and third) polarizers now?

Zero. Light passed by the first polarizer is polarized along the vertical direction. Without the second polarizer to rotate the polarization direction, none of the vertically-polarized light gets through the third polarizer, which passes light polarized in the horizontal direction.

KPI 7.2.11, 7.2.12

10. What are the only factors involved in the Doppler effect for light between a source and an observer?

The only factors are the velocity components along the axis between the source and the observer.

KPI 7.2.12, 7.2.13

11. A hydrogen atom in a galaxy moving with a speed of $9 \times 10^6\ m/s$ toward Earth emits light with a wavelength of 555 nm. What wavelength would be observed on Earth from that hydrogen atom?

$$\lambda_{obs} - \lambda = \pm\left(\frac{v}{c}\right)\lambda$$

$$\lambda_{obs} = \lambda - \left(\frac{v}{c}\right)\lambda = 555\ nm\left[1 - \left(\frac{9 \times 10^6\ m/s}{3 \times 10^8\ m/s}\right)\right]$$

$$\lambda_{obs} = 538\ nm$$

KPI 7.2.12, 7.2.13

12. How fast is a galaxy moving relative to Earth if light from hydrogen's spectrum of 486 nm is redshifted to 491 nm?

$$\lambda_{obs} - \lambda = \pm\left(\frac{v}{c}\right)\lambda$$

$$v = c\left(\frac{\lambda_{obs} - \lambda}{\lambda}\right) = (3 \times 10^8\ m/s)\left(\frac{491\ nm - 486\ nm}{486\ nm}\right) = 3.09 \times 10^8\ m/s$$

KPI 7.2.12, 7.2.14

13. Describe the relative motions of objects when light is redshifted and when light is blueshifted. Answer using the term Doppler effect.

Redshifted light is shifted to longer wavelengths. When a light source and an observer are moving away from each other, the observed light is redshifted. Blueshifted light is shifted to shorter wavelengths. When a light source and an observer are moving toward each other, the observed light is blueshifted. This shift in the apparent wavelength is called the Doppler effect.