

SNC2D PHYSICS

LIGHT & GEOMETRIC OPTICS

The Index of Refraction (P.437-438)

The Index of Refraction

In the vacuum of space, where there are very few particles, light travels at almost 300,000 km/s or 3.0×10^8 m/s. However, just like a student trying to move from class to class when the hallways are full, it is impossible for light to move at top speed when the particles in a medium get in the way.

Medium	Index of Refraction (n)
air/vacuum	1.00
ice	1.31
pure water	1.33
ethyl alcohol	1.36
Pyrex glass	1.47
Plexiglas	1.49
table salt	1.51
flint glass	1.61
sapphire	1.77
cubic zirconia	2.16
diamond	2.42
gallium phosphide	3.50

May 19, 2013 2DPHYS - The Index of Refraction 1

The Index of Refraction

*The amount by which a transparent medium decreases the speed of light is indicated by a number called the **index of refraction**, also called the refractive index. The larger the refractive index, the more the medium decreases the speed of light (Table 11.5/P.437).*

NOTE!
"n" is usually expressed with two decimal places.

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The Index of Refraction

Light travels fastest in a vacuum. The refractive index of the speed of light in a vacuum is assigned a value of 1.00. Air has a refractive index of 1.0003 but a value of 1.00 can also be used for air as well since the fourth decimal place does not affect the calculations. Since water, glass, diamond, and other media all slow down light, they have higher values than air.

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The Index of Refraction

The index of refraction for a medium (n) is defined as the ratio of the speed of light in a vacuum (c) to the speed of light in that medium (v). Mathematically, the index of refraction is written as:

$$\text{index of refraction of medium} = \frac{\text{speed of light in a vacuum}}{\text{speed of light in the medium}}$$

$$n = \frac{c}{v}$$

NOTE!
Since the units cancel, a refractive index value does not have any units!

May 19, 2013 2DPHYS - The Index of Refraction 4

The Index of Refraction

INDEX OF REFRACTION (n)

$$n = \frac{c}{v}$$

where n is the index of refraction of the medium (no units)
 c is the speed of light in a vacuum (3.00 x 10⁸ m/s)
 v is the speed of light in the medium (m/s)

NOTE!

- as n increases, v decreases and the light bends (refracts) more
- n and v usually have 2 decimal places

May 19, 2013 2DPHYS - The Index of Refraction 5



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1. The speed of light in a sample of glass is 1.91×10^8 m/s. The speed of light in a vacuum is 3.00×10^8 m/s. What is the refractive index of this glass? (Be sure to use GRESS when answering these questions.)

$$n_{\text{glass}} = 1.57$$

May 19, 2013

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6



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2. The speed of light through a material is 1.86×10^8 m/s.
 (a) What is the index of refraction of the material?
 (b) What is the material? (Hint: refer to Table 11.5/P.437)

- (a) $n = 1.61$
 (b) flint glass

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7



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3. What is the speed of light in water given that water has a refractive index of 1.33?

$$v_{\text{water}} = 2.26 \times 10^8 \text{ m/s}$$

May 19, 2013

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8



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TEXTBOOK

P.438 Q.1-3 (1st & 2nd set)

NOTE!

- You may need to refer to Table 11.5/P.437 to find "n" values.
- Answers (1st set) ⇒ 1.81, 1.43, 2.42 (diamond)
(2nd set) ⇒ 2.21×10^8 m/s, 8.57×10^7 m/s, 1.69×10^8 m/s
