

# Reflection and Refraction

**Spoken Tutorial Project**

**<https://spoken-tutorial.org>**

**National Mission on Education through ICT**

**<http://sakshat.ac.in>**

**Himanshi Karwanje**

**IIT Bombay**

**11 December 2019**



# Learning Objectives



# Learning Objectives

- **Simulate reflection and refraction of a light ray**



# Learning Objectives

- **Simulate reflection and refraction of a light ray**
- **Calculate the angles of reflection and refraction**



# Learning Objectives

- Simulate reflection and refraction of a light ray
- Calculate the angles of reflection and refraction
- Change the medium and angle of incidence to verify **Snell's law**



# Learning Objectives



# Learning Objectives

- Calculate the value of critical angle



# Learning Objectives

- Calculate the value of critical angle
- Verify **Huygens' principle**





# System Requirements



# System Requirements

- **Ubuntu Linux OS v 16.04**



# System Requirements

- **Ubuntu Linux OS v 16.04**
- **Firefox Web Browser v 62.0.3**



# Pre-requisites



# Pre-requisites

- Learner should be familiar with **Apps on Physics**



# Pre-requisites

- Learner should be familiar with **Apps on Physics**
- For pre-requisites tutorials please visit this site  
<https://spoken-tutorial.org>



# Link for Apps on Physics



# Link for Apps on Physics

<https://www.walter-fendt.de/html5/phen>





# Apps on Physics



# Apps on Physics

- **Refraction of Light**



# Apps on Physics

- **Refraction of Light**
- **Reflection and Refraction of Light Waves**



# Snell's Law of Refraction



# Snell's Law of Refraction

$$\frac{\sin i}{\sin r} = n_{21}$$



# Snell's Law of Refraction

$$\frac{\sin i}{\sin r} = n_{21}$$

$n_{21}$  is the **refractive index** of second medium w.r.t first medium



# Snell's Law of Refraction



# Snell's Law of Refraction

- Case 1: If  $n_{21} > 1$ , angle of refraction is less than angle of incidence





# Snell's Law of Refraction

- Case 1: If  $n_{21} > 1$ , angle of refraction is less than angle of incidence
- Case 2: If  $n_{21} < 1$ , angle of refraction is greater than angle of incidence



# Critical Angle



# Critical Angle

- $i_c = \sin^{-1}(n_2/n_1)$



# Critical Angle

- $i_c = \sin^{-1}(n_2/n_1)$
- $i_c$  = Critical angle



# Critical Angle

- $i_c = \sin^{-1}(n_2/n_1)$
- $i_c$  = Critical angle
- $n_1$  = Refractive index of first medium



# Critical Angle

- $i_c = \sin^{-1}(n_2/n_1)$
- $i_c$  = Critical angle
- $n_1$  = Refractive index of first medium
- $n_2$  = Refractive index of the second medium



# Tabular Column



# Tabular Column

Formula for critical angle :  $(i_c) = \sin^{-1}(n_2/n_1)$

Denser medium $n_1$	Rarer medium $n_2$	Refractive index		Critical angle (Measured)	Critical angle (Calculated)
		$n_1$	$n_2$		
Diamond	water				
Water	Air				
Crown glass N-K5	Air				
Flint glass LF5	water				
Rock salt	water				





# Tabular Column



# Tabular Column

Formula for critical angle :  $(i_c) = \sin^{-1}(n_2/n_1)$

Denser medium $n_1$	Rarer medium $n_2$	Refractive index		Critical angle (Measured)	Critical angle (Calculated)
		$n_1$	$n_2$		
Diamond	water	2.42	1.33	33.3	33.2
Water	Air				
Crown glass N-K5	Air				
Flint glass LF5	water				
Rock salt	water				



# Tabular Column



# Tabular Column

Formula for critical angle :  $(i_c) = \sin^{-1}(n_2/n_1)$

Denser medium $n_1$	Rarer medium $n_2$	Refractive index		Critical angle (Measured)	Critical angle (Calculated)
		$n_1$	$n_2$		
Diamond	water	2.42	1.33	33.3	33.2
Water	Air	1.33	1.0003		
Crown glass N-K5	Air				
Flint glass LF5	water				
Rock salt	water				



# Tabular Column



# Tabular Column

Formula for critical angle :  $(i_c) = \sin^{-1}(n_2/n_1)$

Denser medium $n_1$	Rarer medium $n_2$	Refractive index		Critical angle (Measured)	Critical angle (Calculated)
		$n_1$	$n_2$		
Diamond	water	2.42	1.33	33.3	33.2
Water	Air	1.33	1.0003	48.8	48.7
Crown glass N-K5	Air				
Flint glass LF5	water				
Rock salt	water				



# Assignment



# Assignment

Formula for critical angle :  $(i_c) = \sin^{-1}(n_2/n_1)$

Denser medium $n_1$	Rarer medium $n_2$	Refractive index		Critical angle (Measured)	Critical angle (Calculated)
		$n_1$	$n_2$		
Diamond	water	2.42	1.33	33.3	33.2
Water	Air	1.33	1.0003	48.8	48.7
Crown glass N-K5	Air				
Flint glass LF5	water				
Rock salt	water				





# Assignment



# Assignment

- **Change the refractive index values of both media as given in Refraction of Light App**



# Assignment

- Change the refractive index values of both media as given in Refraction of Light App
- Observe the formation of wavefront and give an explanation



# Summary



# Summary

- Simulated reflection and refraction of a light ray
- Calculated the angles of reflection and refraction
- Changed the medium and angle of incidence to verify **Snell's law**



# Summary

- Calculated the value of the critical angle
- Verified **Huygens' principle**



# Acknowledgement

- These Apps were created by **Walter-fendt** and his team



# About the Spoken Tutorial Project

- Watch the video available at [https://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](https://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- It summarises the Spoken Tutorial project





# About the Spoken Tutorial Project

- Watch the video available at [https://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](https://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- It summarises the Spoken Tutorial project
- If you do not have good bandwidth, you can download and watch it



# Spoken Tutorial Workshops

## The Spoken Tutorial Project Team

- Conducts workshops using spoken tutorials
- Gives certificates to those who pass an online test
- For more details, please write to [contact@spoken-tutorial.org](mailto:contact@spoken-tutorial.org)



# Forum for specific questions

- Questions in THIS Spoken Tutorial?
- Visit <https://forums.spoken-tutorial.org>
- Choose the minute and second where you have the question
- Explain your question briefly
- The Spoken Tutorial project will ensure an answer

**You will have to register to ask questions**



# Acknowledgement

**Spoken Tutorial project is supported by**

- **National Mission on Education through ICT (NMEICT)**
- **Pandit Madan Mohan Malaviya  
National Mission on Teachers and  
Teaching (PMMMNMTT)**

**MHRD, Government of India**

