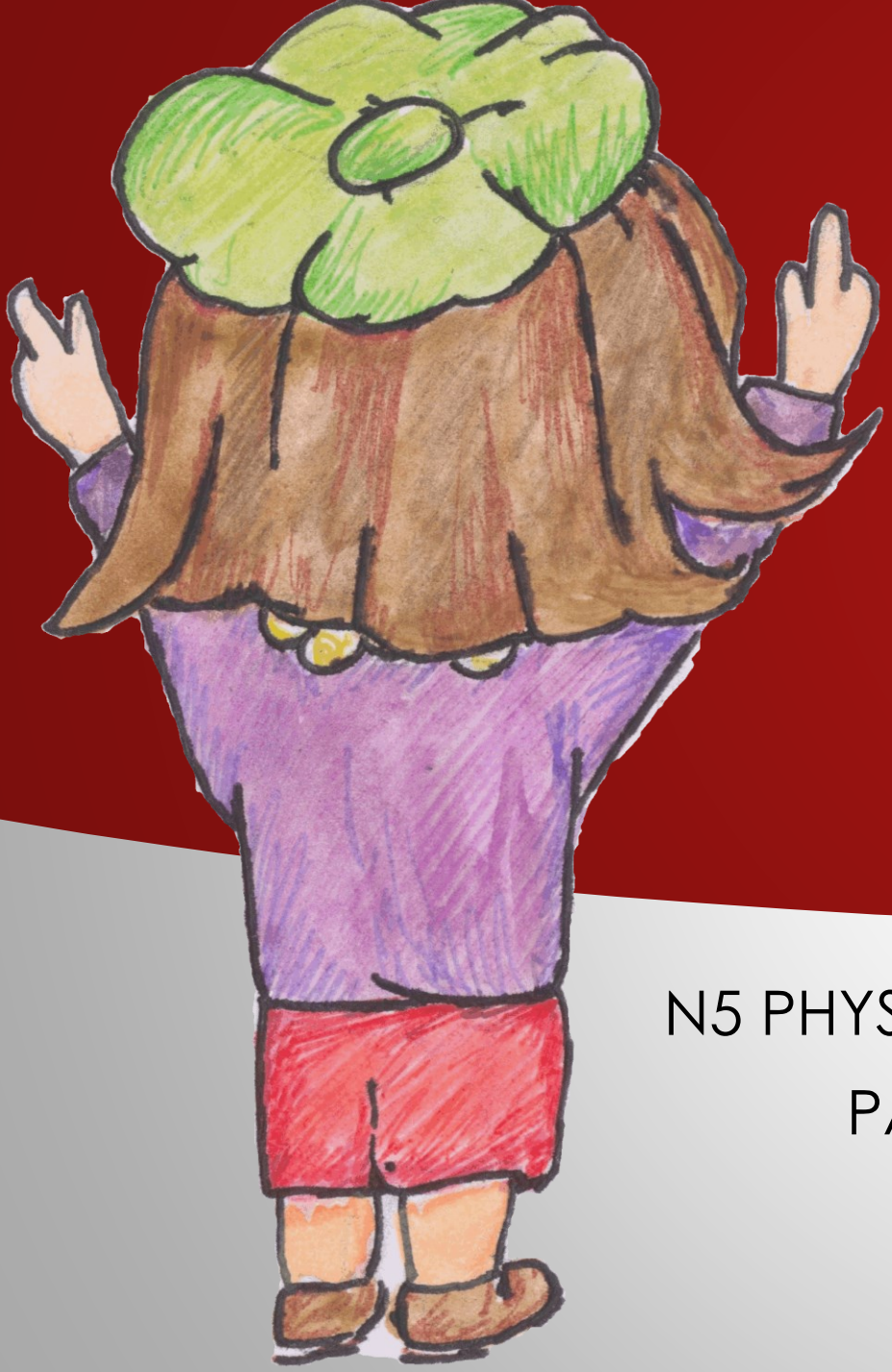
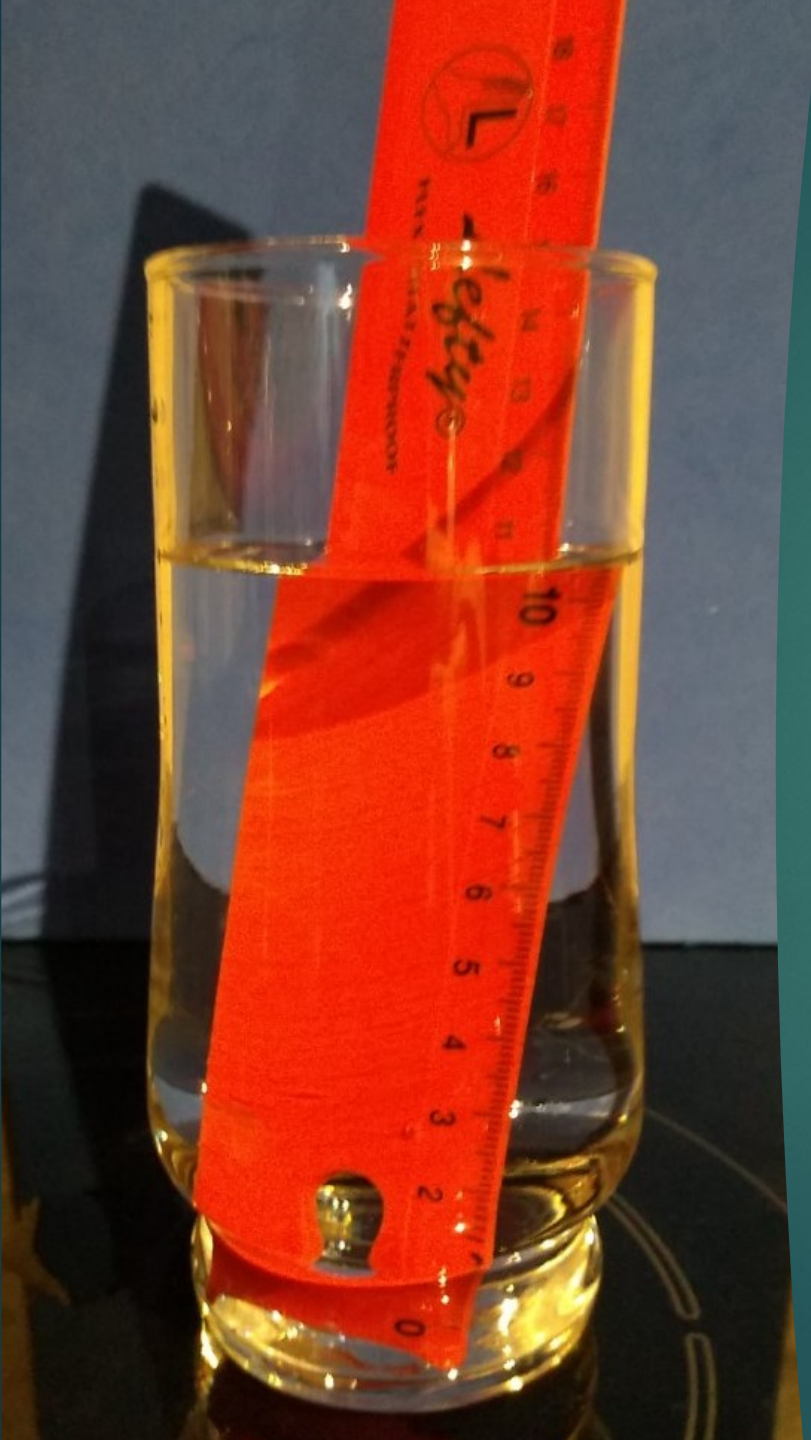


Refraction

N5 PHYSICS REVIEW & **HIGHER PHYSICS**

PARTICLES & **WAVES** TOPIC



Why?

Write down all you remember about this phenomenon

Outcomes

16.	**Refraction**
Eq	$n = \frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$ and $v = f\lambda$ and $\sin\theta_c = \frac{1}{n}$
a)	I can define absolute refractive index of a medium as the ratio of the speed of light in a vacuum to the speed of light in the medium.
b)	I can use $n = \frac{\sin\theta_1}{\sin\theta_2}$ to solve problems involving absolute refractive index, the angle of incidence and the angle of refraction.
c)	I can describe an experiment to determine the refractive index of a medium.
d)	I can use $\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$ and $v = f\lambda$ to solve problems involving the angles of incidence and refraction, the wavelength of light in each medium, the speed of light in each medium, and the frequency, including situations where light is travelling from a more dense to a less dense medium.
e)	I know that the refractive index of a medium increases as the frequency of incident radiation increases.
f)	I can define critical angle as the angle of incidence which produces an angle of refraction of 90°.
g)	I know that total internal reflection occurs when the angle of incidence is greater than the critical angle.
h)	I can use to solve problems involving critical angle and absolute refractive index.

Refraction- definition

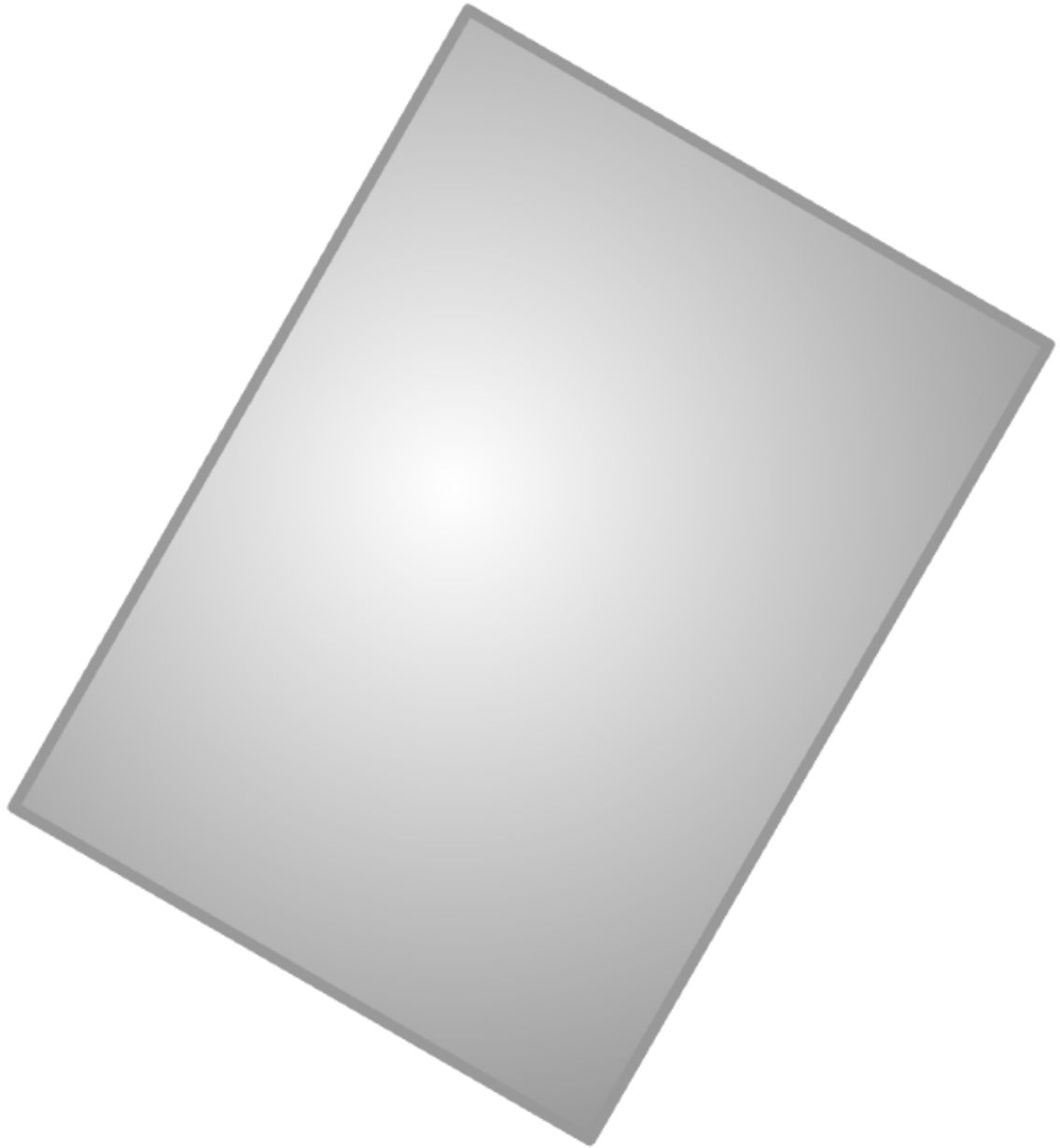
- **Refraction** is the **ratio of the speed of light in a vacuum to the speed of light in the medium.**

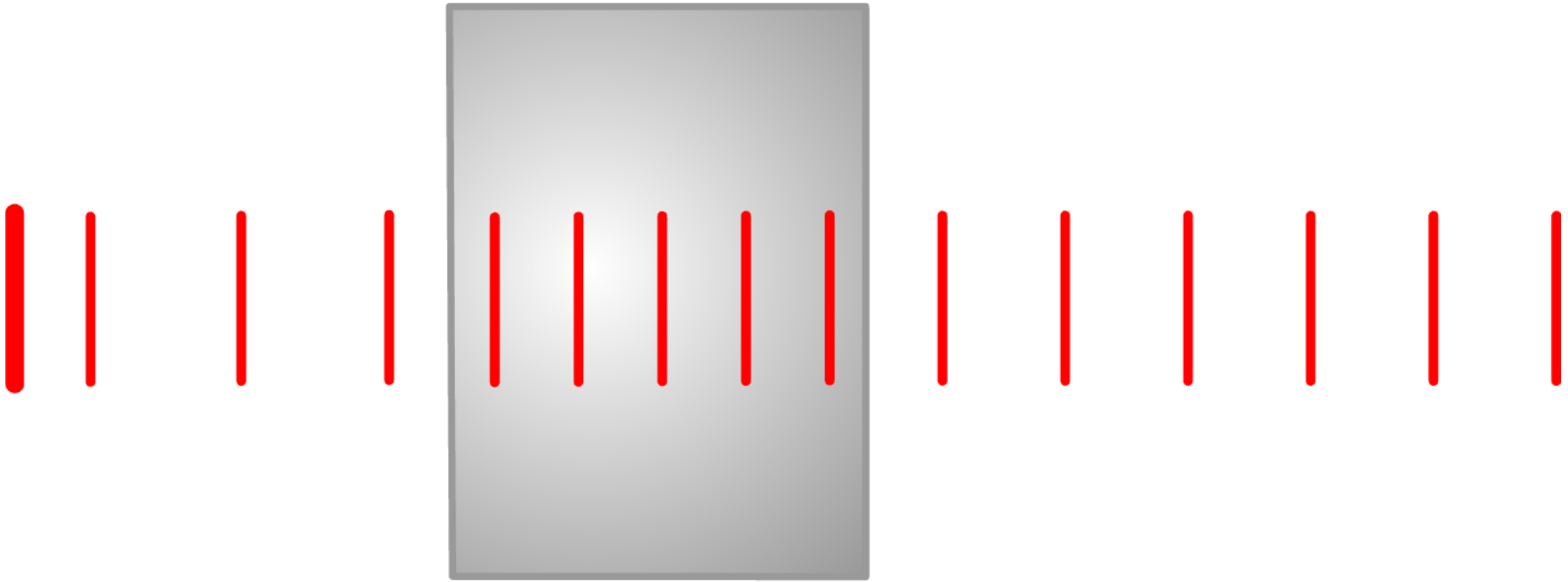
IMPORTANT NOTE

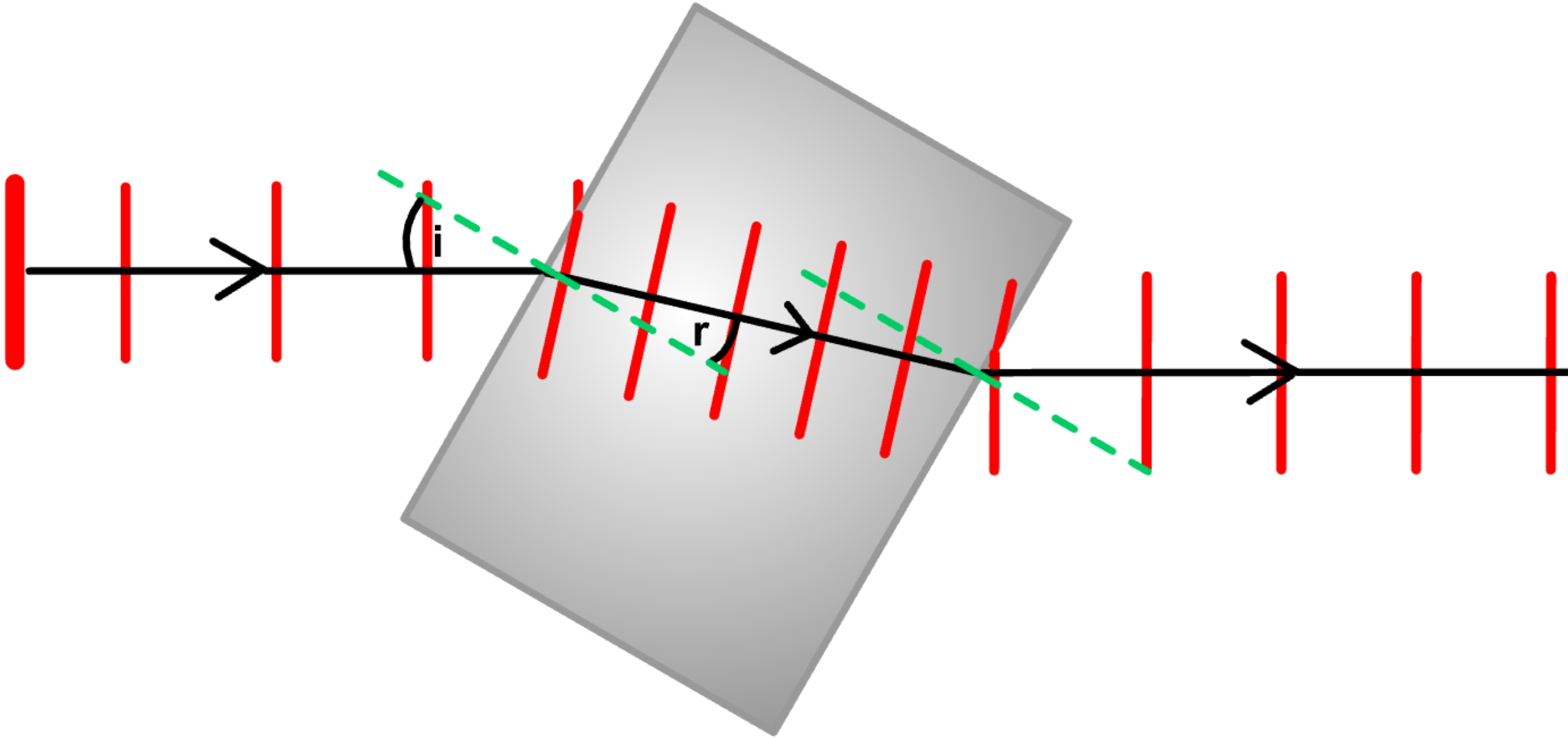
- **Never** use the term **bending** with the term **refraction**. ✗
- Please note bending does not occur with refraction, but there is often a change in direction of the wave

Bending

changing direction



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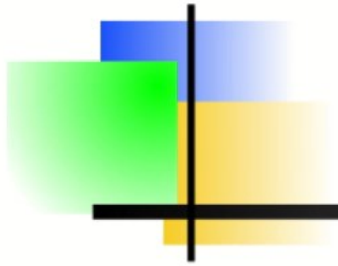


Interactive summary

Introduction

Refraction

Example problem

Refraction through blocks and prisms

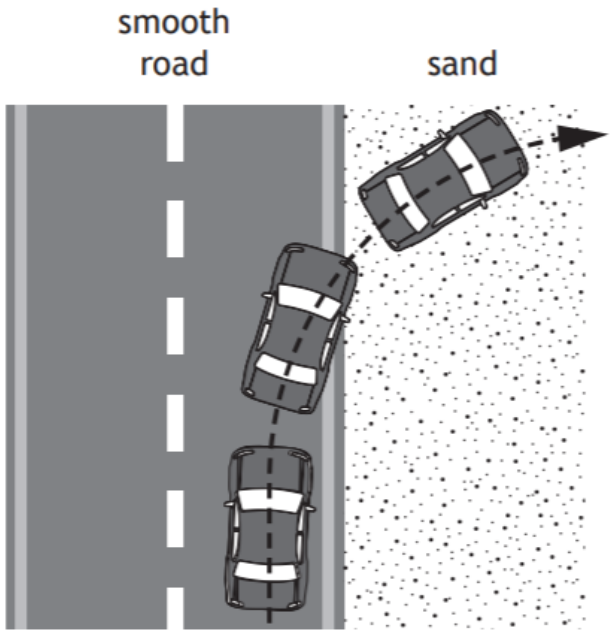
Optical fibre

Critical angle and total internal reflection

REMEMBER

- All angles are measured from the normal.
- The angle of incidence is the angle in the air.

11. The use of analogies from everyday life can help better understanding of physics concepts. A car moving from a smooth surface to a rough surface, eg from a road to sand, can be used as an analogy for the refraction of light.



Use your knowledge of physics to comment on this analogy.

Try this OEQ

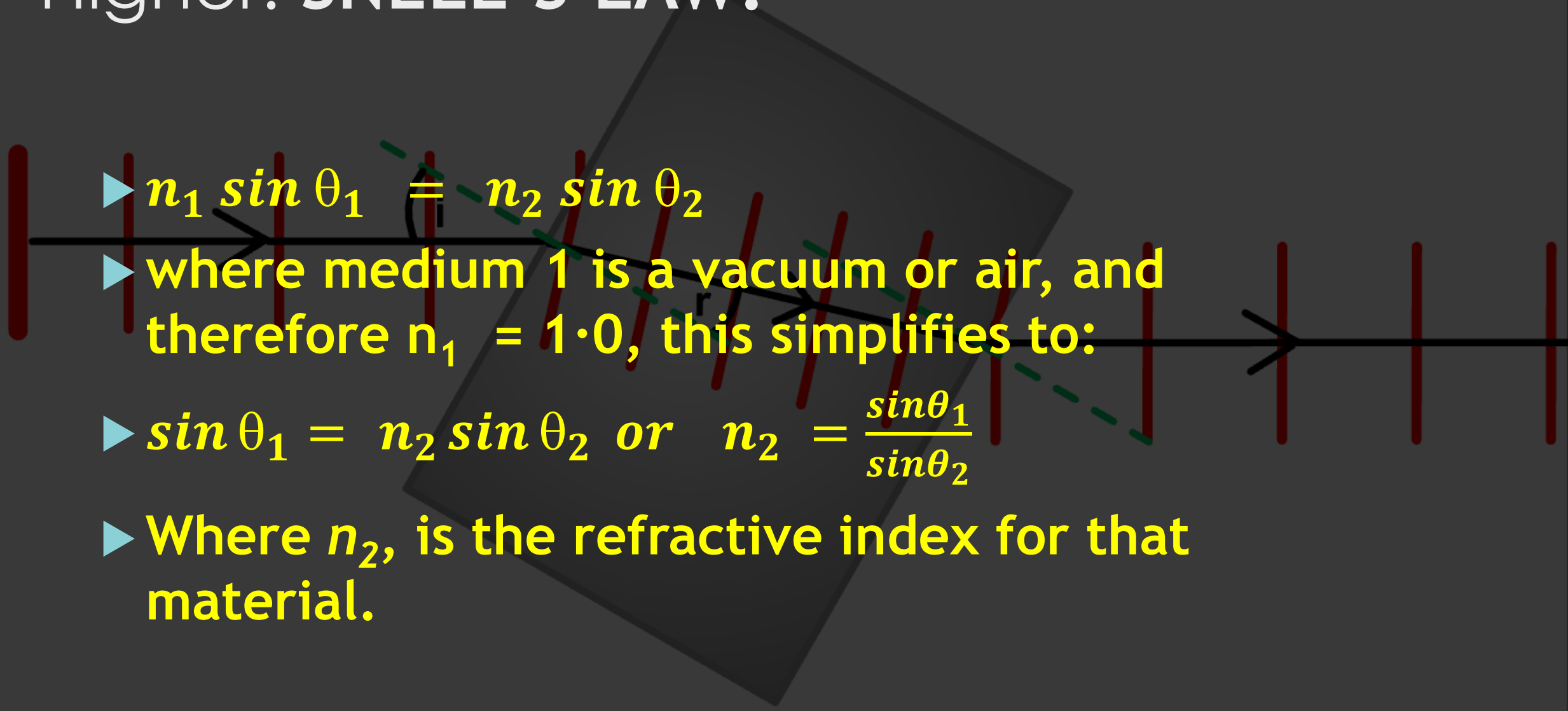
- Jot down a few bullet points before you start.

https://www.youtube.com/watch?v=zarxpu43-ls

- Quite a good video but he wrongly says refract and bend in the same sentence, instant trouble at N5!

https://www.youtube.com/watch?v=zarxpu43-ls

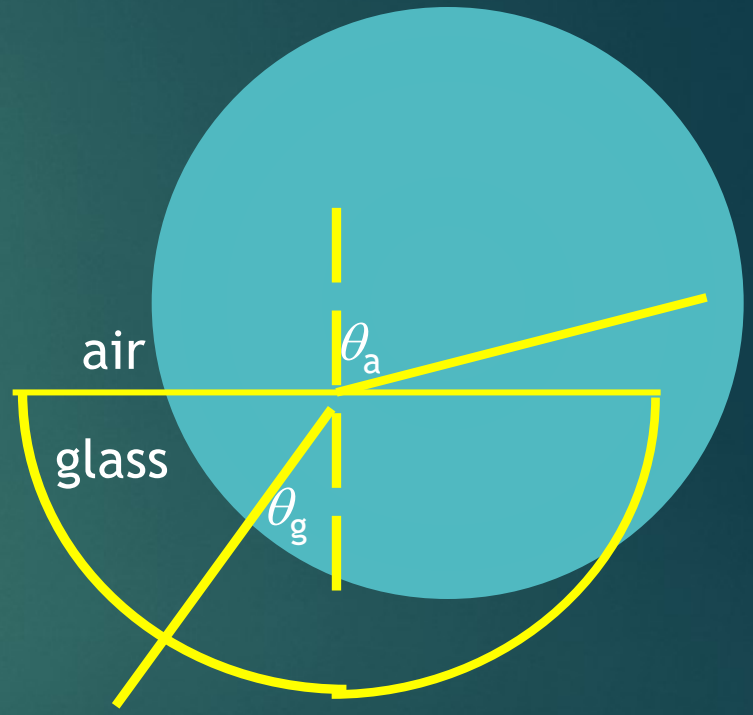
Higher: **SNELL'S LAW:**



- $n_1 \, sin\,\theta_1 \; = \; n_2 \, sin\,\theta_2$
- where medium 1 is a vacuum or air, and therefore n_1 = 1·0, this simplifies to:
- $sin\,\theta_1 = \; n_2 \, sin\,\theta_2 \;\; or \;\; n_2 \; = \frac{sin\theta_1}{sin\theta_2}$
- Where n_2, is the refractive index for that material.

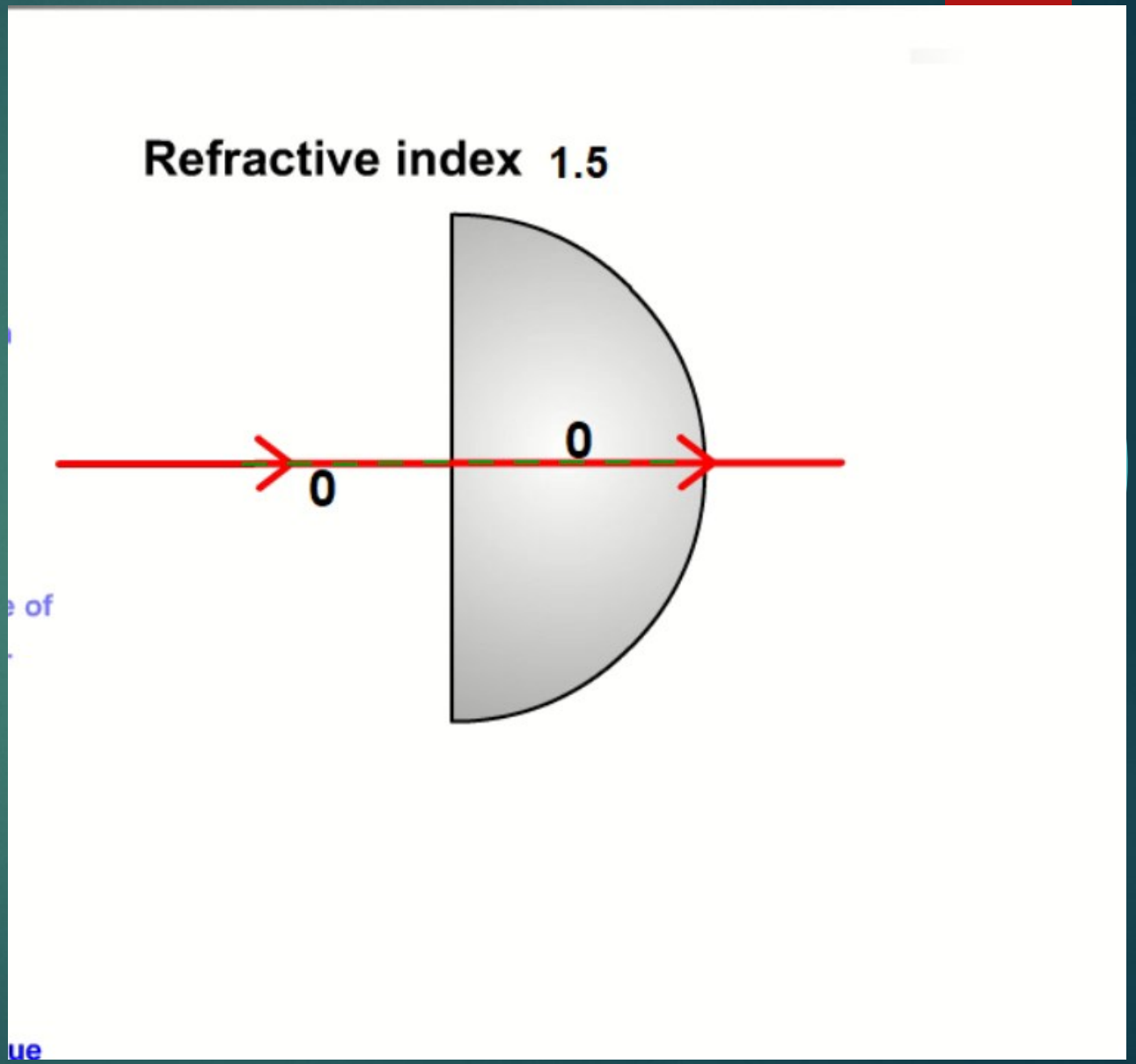
Proving Snell's Law

1. On plain paper draw round a Perspex block with a PENCIL.
2. Copy the table as shown below
3. Draw a normal to the block using a **protractor** and shine a ray of light into the block.
4. Measure the angle of incidence and the angle of refraction. NB. all angles are measured from the normal. Why do you think it is best to draw lines either side of the normal?
5. Repeat for other angles.
6. Find the angle at which total internal reflection occurs.



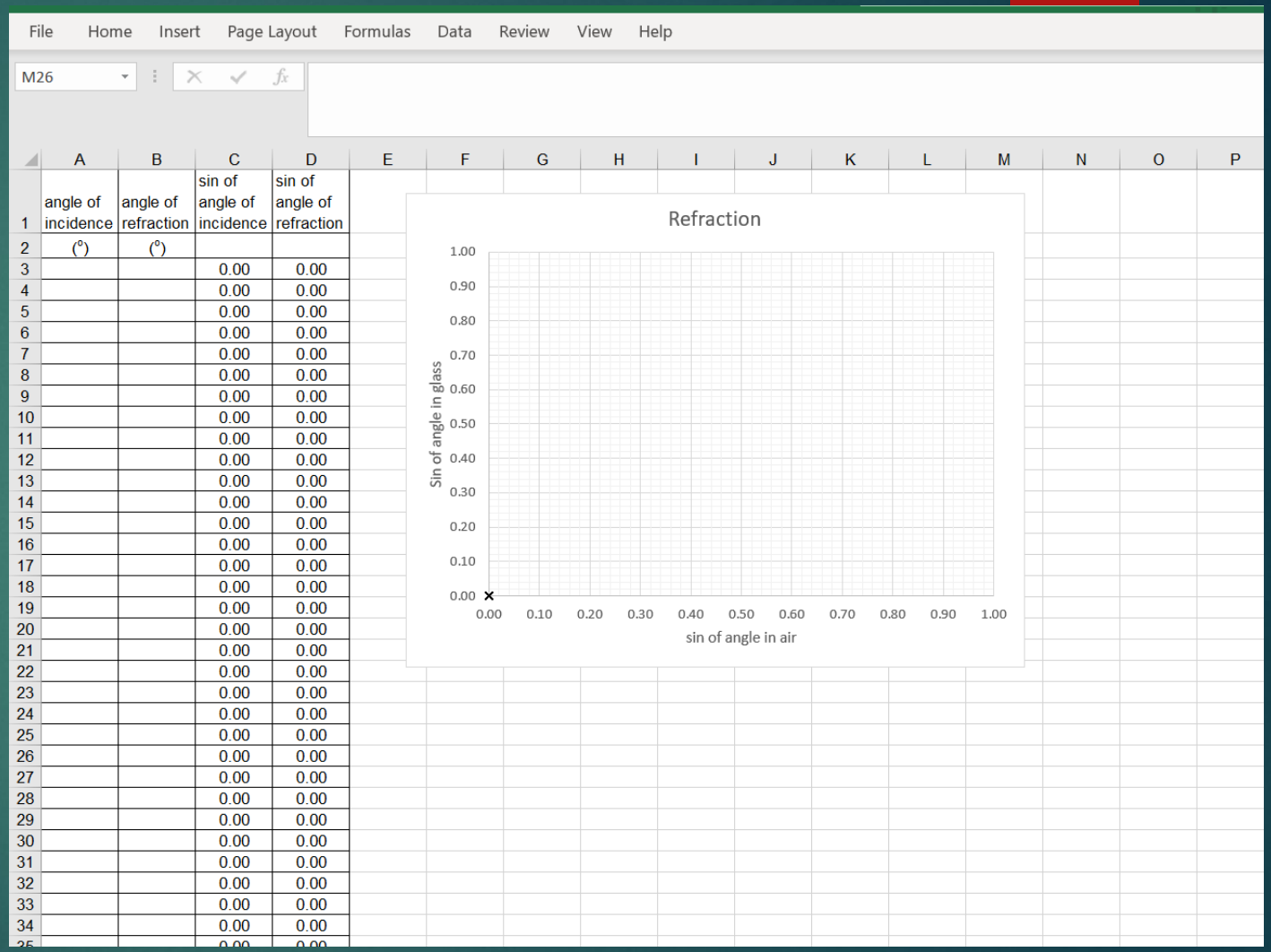
Refraction Practical

- Take readings of the angle of incidence (in air) and the corresponding angle of refraction (angle in the glass)
- Add these to the excel spreadsheet and it ought to generate a graph for you.
- Keep a copy of your final graph and table.



Generate the graph

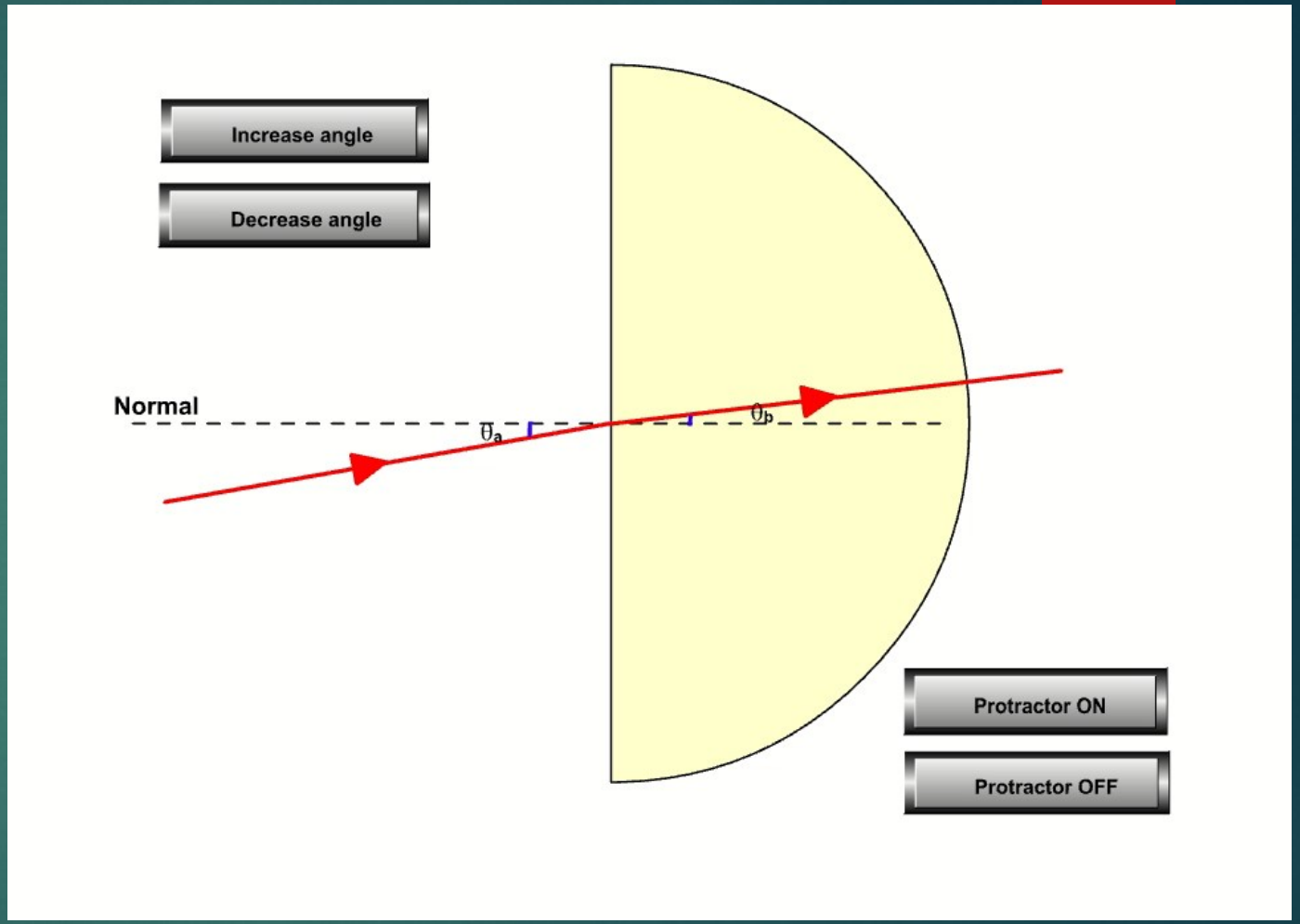
- Just add the results into columns A and B and the graph should automatically draw itself if you don't alter any other boxes
- FOR HIGHER THIS IS A TEMP MEASURE YOU'LL NEED A PROPER TABLE FOR YOUR FINAL RESULTS



	A	B	C	D
1	angle of incidence	angle of refraction	sin of angle of incidence	sin of angle of refraction
2	(°)	(°)		
3			0.00	0.00
4			0.00	0.00
5			0.00	0.00
6			0.00	0.00
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
11			0.00	0.00
12			0.00	0.00
13			0.00	0.00
14			0.00	0.00
15			0.00	0.00
16			0.00	0.00
17			0.00	0.00
18			0.00	0.00
19			0.00	0.00
20			0.00	0.00
21			0.00	0.00
22			0.00	0.00
23			0.00	0.00
24			0.00	0.00
25			0.00	0.00
26			0.00	0.00
27			0.00	0.00
28			0.00	0.00
29			0.00	0.00
30			0.00	0.00
31			0.00	0.00
32			0.00	0.00
33			0.00	0.00
34			0.00	0.00

Refraction Practical (Advanced)

- Wait until the protractor comes up (11:52s)
- Take readings of the angle of incidence (in air) and the corresponding angle of refraction (angle in the glass). You will need to read the angles from the protractor carefully. The angles in the air go up in 5°, the angles in the block are 1° intervals
- Add these to the excel spreadsheet and it ought to generate a graph for you.
- Keep a copy of your final graph and table.



Relationship to find the refractive index

The relative refractive index is the ratio of the speed of light in the two media:

$$ {}_1n_2 = \frac{v_1}{v_2} $$

In summary,

- the refractive index of medium 2 relative to medium 1 can be determined from:
  - the ratio of the speeds in the two media
  - the ratio of the wavelengths in the two media
  - the ratio of the sines of the angles in the two media.

$$n = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{sin\,\theta_1}{sin\,\theta_2}$$

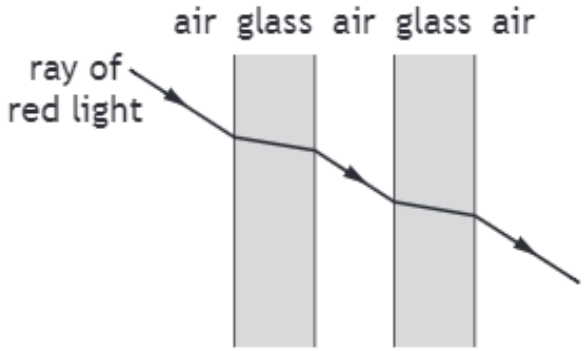
	2015		2016		2017		2018		SPQ		2019	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
refraction of light	15	9a	14	10	12,13		14	9	19	12	18	11

Past paper questions

11. A ray of red light passes through a double glazed window.

Which diagram shows the path of the ray as it passes through the window?

A



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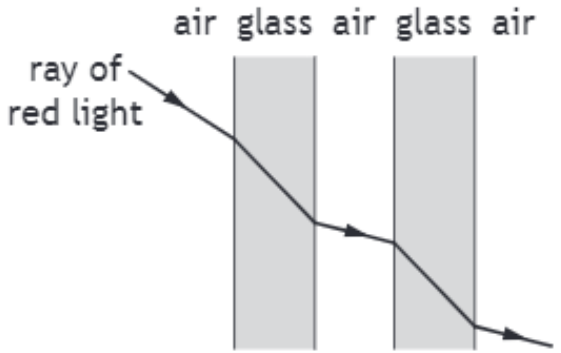
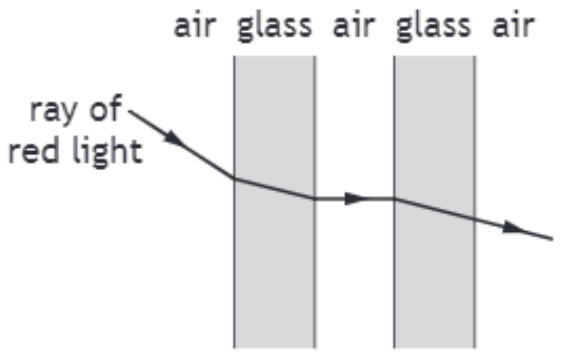
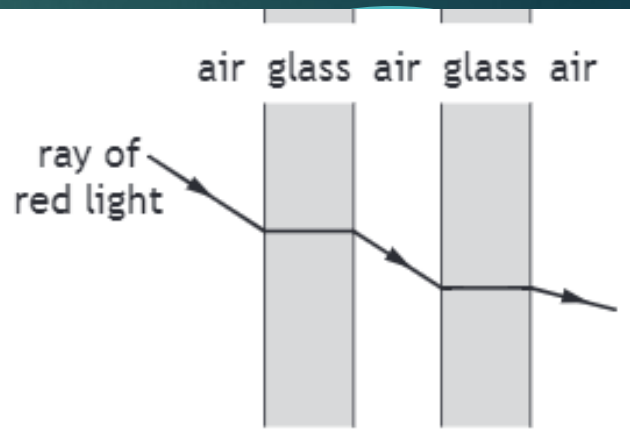


C



D



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