



SKJ Education

LC HL PHYSICS
FOUNDATION PHYSICS
PROGRAM: WEEK 7

**LIGHT &
REFLECTION**

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LC HL PHYSICS – FOUNDATION PROGRAM

Week 7: Light & Reflection

Learning Objectives

- **7.1:** To state the laws of reflection and refraction.
- **7.2:** To use Snell's Law to calculate refractive index and critical angle.
- **7.3:** To explain total internal reflection and its applications (e.g., fibre optics).
- **7.4:** To draw ray diagrams to show image formation in plane mirrors and converging lenses.

Key Terms - Week 7

- **Law of Reflection:** The angle of incidence is equal to the angle of reflection ($\theta_i = \theta_r$).
- **Law of Refraction (Snell's Law):** $n_1 \sin \theta_1 = n_2 \sin \theta_2$, relating the angles of incidence and refraction to the refractive indices of the media.
- **Refractive Index (n):** A measure of a medium's ability to bend light, defined as the ratio of the speed of light in vacuum to the speed of light in the medium.
- **Critical Angle (θ_c):** The angle of incidence above which total internal reflection occurs, given by $\sin \theta_c = \frac{n_2}{n_1}$.
- **Total Internal Reflection:** The phenomenon where light is completely reflected back into a denser medium when it hits a boundary with a rarer medium at an angle greater than the critical angle.
- **Ray Diagrams:** Graphical representations of the path of light rays as they interact with optical elements, such as mirrors and lenses.
- **Image Formation:** The process by which an image is created through the reflection or refraction of light, as seen in plane mirrors and converging lenses.

Weekly Challenge: Investigate the principles behind fibre optic communication, including total internal reflection. Design a simple experiment to demonstrate the phenomenon, or research and present on a real-world application of fibre optics. Share your findings on Google Classroom.



WEEK 7 STUDY PLAN

Day	Activities & Time Commitment	✓	Rating (1-10)
Monday	- Review Learning Objectives (5 min) - Rank your current ability (5 min) - Review Key Terms (10 min) - Complete Exercise A1 (15 min) <i>Focus: PREPARATION</i>		
Tuesday	- Complete Exercises A2 & A3 (60 min) - 1-hour online lesson (60 min) <i>Focus: QUESTIONING</i>		
Wednesday	- Reflect on content so far (what has been challenging?) (10 min) - Plan remaining study sessions (10 min) <i>Focus: PROCESSING</i>		
Thursday	- Complete Exercise B (50 min) <i>Focus: EXPERIMENTAL THINKING</i>		
Friday	- Complete Exercise C (40 min) <i>Focus: ERROR ANALYSIS</i>		
Saturday	- Complete Exam Question Assessment (D) (60 min) <i>Focus: EXECUTION</i>		
Sunday	- Correct assessment (30 min) - Complete self-reflection (15 min) - Plan next week (15 min) <i>Focus: REFLECTION & RECHARGING</i>		

Study Tips for Success

- **Active Recall:** After studying, close your notes and write down **everything** you remember. Force your brain to grow.
- **Spaced Repetition:** Review concepts **multiple times** over several days.
- **Physics in Action:** Look for **real-world examples** of the concepts you're learning.
- **Ask Questions:** Don't hesitate to ask for help when concepts are unclear. Reach out via *Google Classroom* or email; steven@skjeducation.com.
- **Celebrate Progress:** **Acknowledge your improvements**, no matter how small.

D. Weekend Assessment – Past Exam Questions

Learning Focus: Applying learning to exam questions under timed conditions.
Think deeply about these questions.

Assessment Instructions

Answer as many questions as you can in 60 minutes - try to solve them alone first before checking your notes!

Past Exam Questions

Question 1 (2014, Q7)

- What is meant by the terms (i) diffraction and (ii) interference?
- A laser produces a beam of red light with a wavelength of 709 nm. The beam is incident on a diffraction grating, as shown in the diagram. A diffraction pattern is formed on a screen. A second order image is detected at an angle of 34.6° from the central image.
- Derive, with the aid of a labelled diagram, the diffraction grating formula.
- Calculate the number of lines per millimetre on the grating used in the experiment.
- What would be observed on the screen if the laser was replaced by a ray of white light?

Question 2 (2017, Q9)

- Sodium emits visible light with a wavelength of 589 nm. This light is passed through a diffraction grating of 300 lines per mm.
- Calculate the angular separation between the first line to the left of the central image and the first line to the right of the central image.

Question 3 (2019, Q10)

- Explain the terms diffraction and interference.
- In 1801 Thomas Young performed an experiment to demonstrate that light is a wave. He passed monochromatic light through two narrow slits and observed a series of bright and dark fringes on a screen. Explain, with the aid of a labelled diagram, how a series of bright and dark fringes were produced.
- The experiment was repeated in the school laboratory. The slits were 0.5 mm apart and were placed at a distance of 1.25 m from the screen. The distance across 13 bright fringes on the screen was found to be 1.65 cm. Calculate the wavelength of the monochromatic light.
- List two adjustment to the apparatus that could be made to increase the distance between the bright fringes.



Question 4 (2021, Q8)

- (i) What is meant by diffraction?
- (ii) What is a diffraction grating?
- (iii) Derive the diffraction grating formula, $n\lambda = d \sin \theta$.
- (iv) Calculate the angular separation between the two 3rd order images formed when blue light of wavelength 442 nm is incident on a diffraction grating of 600 lines per mm.
- (v) Calculate the distance between these images on a screen placed 50 cm from the grating.
- (vi) What changes would be observed if the blue light was replaced with red light?
- (vii) What changes would be observed if the blue light was replaced with white light?

Question 5 (2013, Q12(b))

- (i) A narrow beam of light undergoes dispersion when it passes through either a prism or a diffraction grating. What is meant by dispersion?
- (ii) Give two differences between what is observed when a narrow beam of light undergoes dispersion as it passes through a prism, and what is observed when a narrow beam of light undergoes dispersion as it passes through a diffraction grating.
- (iii) Yellow light of wavelength 589 nm is produced in a low-pressure sodium vapour lamp. Calculate the highest order image that could be produced when a beam of light of this wavelength is incident perpendicularly on a diffraction grating that has 300 lines per mm.

Question 6 (2010, Q7)

- (i) What is the Doppler effect?
- (ii) What causes the red shift in the spectrum of a distant star?
- (iii) The yellow line emitted by a helium discharge tube in the laboratory has a wavelength of 587 nm. The same yellow line in the helium spectrum of a star has a measured wavelength of 590 nm. What can you deduce about the motion of the star?
- (iv) Calculate the speed of the moving star.



Self-Assessment

After completing the assessment:

- Grade your work honestly
- Identify areas needing improvement
- Scan and submit via Google Classroom
- Reflect on your performance in your weekly reflection

Another excellent week of work completed - ***well done!*** You are another step closer to *smashing your exams*, and another week closer to your summer holidays!

Weekly Reflection Zone

What worked well this week?

What challenges did I face?

What surprised me the most this week?

Key physics concepts I want to review:

Goals for next week: