**Experiments with light**

**Introduction**

This group of practical activities allows students to observe how properties of materials affect the propagation of light.

The range of activities detailed below cover both OCR Physics specifications, and you should identify those activities which your students should undertake.

Students should be aware of the principles of reflection and refraction, and from Physics B (Advancing Physics) calculations related to the power of lenses.

**Aims and skills covered**

* To use skills and techniques related to refraction

**Links to Specifications**

**Physics A**

* 4.4.1(f)(i) reflection, refraction, polarisation and diffraction of all waves
* 4.4.2(d)(i) refraction of light; refractive index; ; *n sin θ* = constant at a boundary where *θ* is the angle to the normal
* 4.4.2(d)(ii) techniques and procedures used to investigate refraction and total internal reflection of light using ray boxes, including transparent rectangular and semi-circular blocks
* 4.4.2(e) critical angle; sin *C* = ; total internal reflection for light

**Physics B**

* 3.1.1b(i) Make appropriate use of the terms the terms: focal length and power, polarisation
* 3.1.1c(ii) Power of a converging lens *P* = 1/*f*, as change of curvature of wave-fronts produced by the lens
* 3.1.1c(iii) use of (Cartesian convention)
* 3.1.1d((i) determination of power or focal length of a converging lenses
* 4.1a(iii) refraction of light at a plane boundary in terms of the changes in the speed of light and explanation in terms of the wave model of light
* 4.1c(ii) Snell's Law, ****
* 4.1d(ii) determining refractive index for a transparent block

**Practical Skills**

* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record observations/measurements
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification
* 1.2.2(a) use of appropriate analogue apparatus to record a range of measurements (to include length/distance, temperature, pressure, force, angles and volume) and to interpolate between scale markings
* 1.2.2(c) use of methods to increase accuracy of measurements, such as .… use of fiduciary marker or set square ….
* 1.2.2(j) use of a laser or light source to investigate characteristics of light

**CPAC**

* (1) Follows written procedures
* (2) Applies investigative approaches and methods when using instruments and equipment
* (3) Safely uses a range of practical equipment and materials
* (4) Makes and records observations

**Mathematical skills**

* M0.1 Recognise and make use of appropriate units in calculations
* M0.3 Use ratios, fractions and percentages
* M0.4 Estimate results
* M0.6 Use calculators to handle sin *x,* cos *x* andtan *x* when *x* is expressed in degrees or radians
* M1.1 Use an appropriate number of significant figures
* M2.3 Substitute numerical values into algebraic equations using appropriate units for physical quantities
* M3.1 Translate information between graphical, numerical and algebraic forms
* M4.5 Use sin, cos and tan in physical problems

**Equipment (per learner or group)**

A) Refraction using a semi-circular block

* ray box or similar light source
* semi-circular glass or plastic block
* optical pins
* drawing pins
* photocopied sheets with protractor scale
* fibre board mat
* ruler and protractor

B) Refraction using a rectangular block (additionally)

* rectangular block

D) Investigating the power of lenses (additionally)

* at least two lenses with differing focal length
* lens stands
* plain white screen

**Health and safety**

* Note that lamp bulbs will be very hot.

Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirements, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.

**Notes**

* These practical activities are not controlled assessments, should not be carried out in exam conditions and can be adapted by the centre. Students can collaborate during the activities which should take place as part of the normal teaching sequence. They are intended to be formative with students acquiring and practising skills throughout the course.
* To achieve a pass in the Practical Endorsement each student is required to demonstrate competence in all the skills, apparatus and techniques listed in section 1.2 of the specification and assessed against the Ofqual Common Practical Assessment Criteria (CPAC) at the end of the course.
* The skills, apparatus and techniques can be demonstrated during any practical work undertaken during the A Level course whether an OCR practical activity or not.
* Teachers should select the appropriate activities to match their specification and their intended learning outcomes.

**Recording**

* Learners should not need to re-draft their work but rather keep all their notes as a continuing record of Practical Activity.
* As evidence for the Practical Endorsement learners should have clear ray diagrams and recorded observations.
* In addition, to support the assessment of practical work in the written examinations learners should have made notes to clarify their conclusions.