

THE SHADOW ZONE

Purpose

To determine how the size of the core and its refractive index control the start and end of the shadow zone.

In this practical the surface of the earth is represented by the circle, the core by the beaker of water or resin. The seismic waves (P only) are represented by light.

Instructions

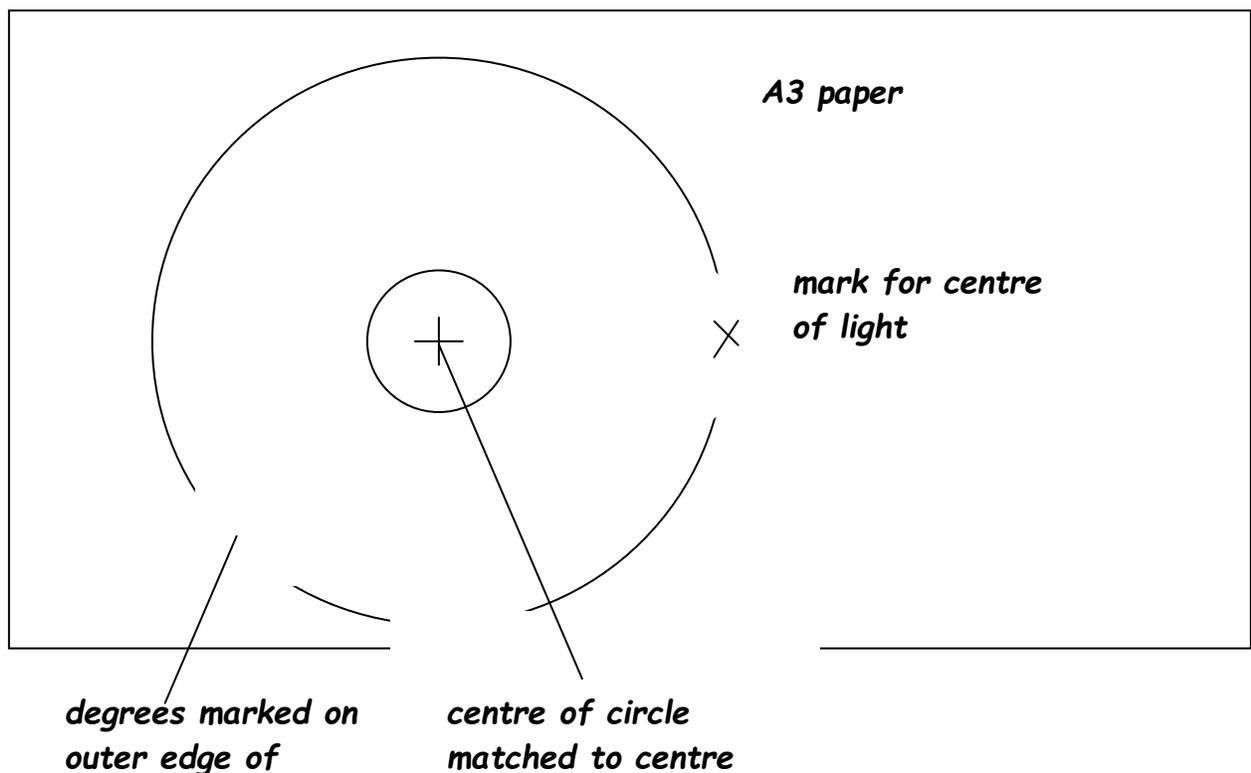
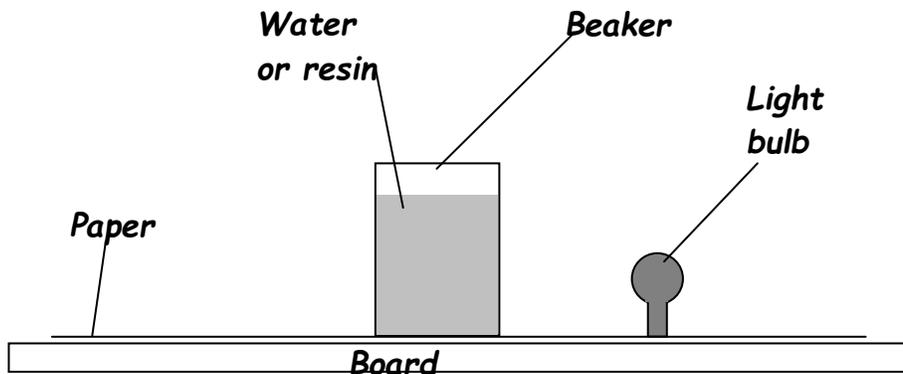
- 1. Place your sheet so that the cross on the edge of the circle is immediately below the filament of the bulb.*
- 2. Measure and record the diameter of a beaker and whether it is water or resin filled.*
- 3. Place the beaker in the centre of the circle. Make sure the shadow zone is symmetrical.*
- 4. Mark on the sheet the positions of the start and end of the shadow zone on both sides. Record on the line the diameter of the beaker and whether the line is the start or end of the shadow zone. Use a different colour for each beaker*
- 5 Repeat instructions 2 to 4 for each of the other beakers.*
- 6 Remove the paper and draw lines to represent the ray paths of the light/ seismic waves by joining the focus to the point marking the start of the shadow zone for each beaker.*
- 7 Draw lines from the start and end of the shadow zone to the centre of the circle. Use a protractor to measure and record the epicentral angles for the beginning and end of the shadow zone for each beaker. Calculate the beaker size divided by the diameter of the circle.*
- 8 Plot the epicentral angle against the beaker size divided by the diameter of the circle.*

9 The earth has a radius of 6371 km. Using your graph determine the radius of the core?

10 The accepted radius of the core is 3471km. Why does your result differ from this? Look at the ray paths for the seismic waves shown in the diagrams in textbooks.

11 How does the size and refractive index of the core affect the position of the shadow zone?

12 Draw the ray paths for the end of the shadow zone.



Teacher's Section

Requirements

Light bulb with vertical filament and low voltage source. The bulb needs to be positioned so that it is close to the paper.

For each student a sheet of A3 paper with a 25 cm diameter circle drawn on with a cross at the centre and a cross on the circle.

Beakers of different sizes e.g. 2 litre, 1 litre, 500ml, and 250ml filled with water. 1 litre beaker filled with at least 2cm depth of clear resin (obtainable from art and craft shops).

Notes

It is better if the degrees are already marked on the circle with 180° opposite the cross on the edge of the circle. You can enlarge a protractor by photocopying it so that it fits the 25cm diameter circle.

Checks

Check that the beaker and bulb are positioned correctly.

Check that the students are marking the lines clearly so that they know which line is which.

Results

As the core gets larger in proportion to the earth the epicentral angle decreases for the start and end of the shadow zone. The start of the shadow zone is not affected by the composition of the core, but the epicentral angle for the end increases with a higher refractive index.

Time

30 minutes

Cost

Resin £12