Physics

Leaving Certificate

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Week 1: Light - Reflection

1.0 Learning Intentions

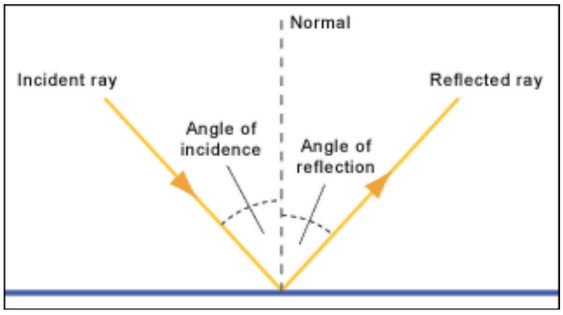
You will be able to explain;
- Light
- Reflection
- Different types of mirrors
- Draw ray diagrams
- Calculate the focal length of a mirror

1.1 Revision Notes

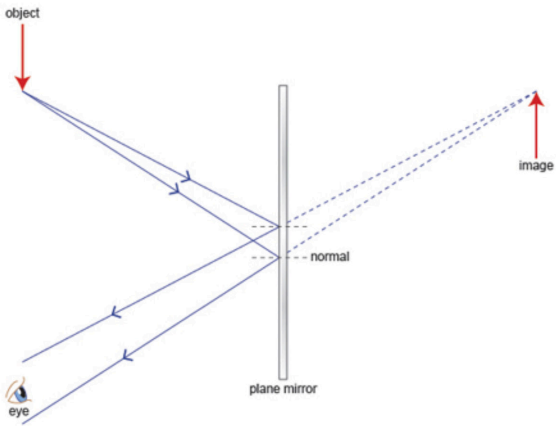
1.1.1 Mirrors

Everyday we see a reflection of ourselves and how beautiful we look but what is the physics behind the reflection.

Reflection is the bouncing of light off surfaces. We are mainly interested in the reflection of light off smooth surfaces like mirrors.



As we can see from the diagram the light ray reflects off the mirror at an angle equal to the angle it hits the mirror at.
When you look in the mirror at your ugly face, the image is behind the mirror. This is called a virtual image (see Definitions)



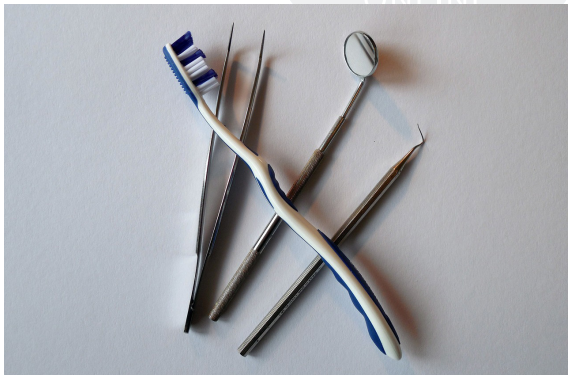
1.1.2 Spherical Mirrors

All mirrors are not flat, we use curved mirrors for many different things: Dentists, make-up, floodlights, supermarkets.



Week 1: Light - Reflection

Concave mirrors



The most common use of a concave mirror is a dentist's mirror. Why?
The image in the mirror is magnified.
This is not always the case, it depends on how far the object is from the mirror.

Ray Diagrams

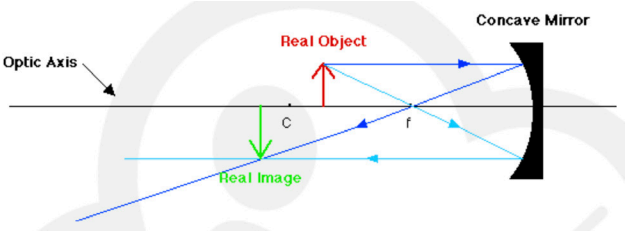
To show the formation of an image in a concave mirror we follow three rules

1. **Parallel and focal point:** From top of object to mirror (parallel to principle axis) and back through focal point.

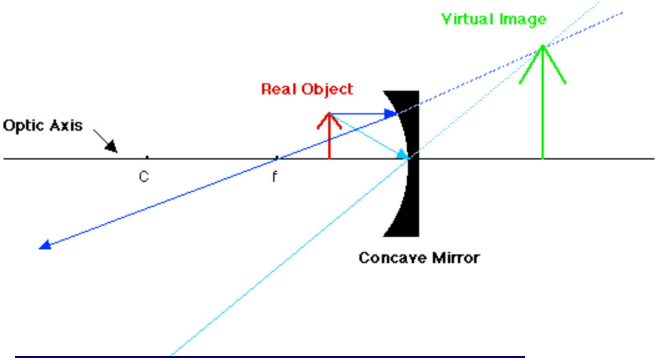
2. **Focal point and parallel:** From top of object through focal point and back parallel to the principle axis.

3. **Centre of Curvature:** From top of object to centre of curvature and back out at an equal angle

Object outside f



Object inside f



Convex Mirrors

What do we use convex mirrors for? Concealed entrances
Supermarkets
Car rear view mirrors

Why? Convex mirror give a diminished view of the object.

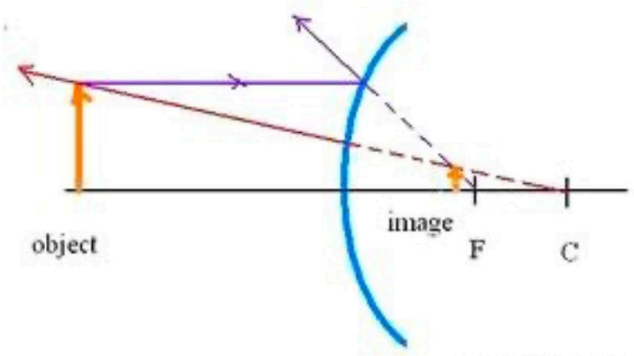


Week 1: Light - Reflection

Ray Diagrams

In a convex mirror the image is always:

- Behind the mirror
- Virtual
- Erect
- Diminished



1.1.3 Formula

The focal length of a spherical mirror can be found using the following formula:

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

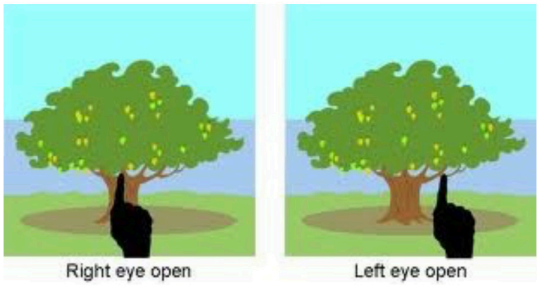
Concave Mirrors

- if the image is virtual then use – v

Convex Mirrors

- always use –f and –v

Magnification



Parallax: The apparent displacement or difference in the apparent position of an object viewed along two different lines of sight.

Week 1: Light - Reflection

Definitions

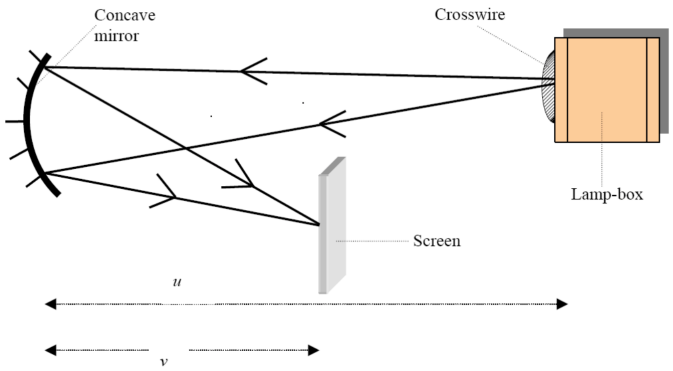
1. Light is a form of energy
2. Reflection is the way in which light bounces off surfaces
3. Diffuse reflection is the way in which light is reflected off a rough surface
4. Laws of Reflection
   - The incident ray, the normal and the reflected ray are in the same plane
   - The angle of incidence = the angle of reflection
5. Object distance (u) is the distance between the mirror and the object
6. Image distance (v) is the distance between the mirror and the image
7. Parallax the relative motion of two objects due to the motion of the observer
8. Real image is the actual intersection of light rays
9. Virtual image is the apparent intersection of light rays

1.1.4 Experiment

MEASUREMENT OF THE FOCAL LENGTH OF A CONCAVE MIRROR

APPARATUS:
Concave mirror, screen, lamp-box with cross wires, metre stick, retort stand.

DIAGRAM:



$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

METHOD:

1. First find an approximate value for the focal length
2. Focus the image of a distant object onto a screen.
3. Measure the distance between the mirror and the screen.
4. This corresponds to an approximate value for the focal length of the mirror.
5. Place the ray-box well outside the approximate focal length.
6. Move the screen until a clear inverted image of the cross wires is obtained.
7. Measure the distance u from the cross wires to the mirror,
8. Measure the distance v from the screen to the mirror.
9. Repeat this procedure for different values of u.
10. Calculate the focal length of the mirror using the formula and get an average.

Week 1: Light - Reflection

RESULTS

Object distance u						
Image distance v						
Focal Length f						

SOURCES OF ERROR / PRECAUTIONS

- Determining when the image was sharpest ; repeat to get an average.
- Parallax error associated with measuring u and v
- Take all measurements from the back of the mirror.

1.2 Syllabus

LIGHT			
Content	Depth of Treatment	Activities	STS
REFLECTION			
1. Laws of reflection		Demonstration using ray box or laser or other suitable method.	
2. Mirrors	Images formed by plane and spherical mirrors. Knowledge that $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ and $m=\frac{v}{u}$	Real-is-positive sign convention. Simple exercises on mirrors by ray tracing *or* use of formula.	Practical uses of spherical mirrors: Concave: • dentists • floodlights • projectors. Convex: • supermarkets • driving mirrors

1.3 Chief Examiner's Report

In this section I will give you some advice from the Chief Examiner's reports.

Candidates need to be able to express their understanding of physics concepts in language that is clear, concise and correct.

Where candidates did poorly, there were three major causes: not answering enough questions, not displaying a clear understanding of physics; and not calculating correctly.

Week 1: Light - Reflection

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1.5 Homework Task

Here are three exam questions to try;

1. Draw a ray diagram to show the formation of an image in a convex mirror.

2. An object O is placed 30 cm in front of a concave mirror of focal length 10 cm. How far from the mirror is the image formed?

3. Using the values given below calculate the focal length of the concave mirror.

u/cm	24.0	32.0	40.0	48.0
v/cm	72.5	40.3	33.0	27.9

Notes

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