ScE8.2.2 : Reflection and Mirrors - ANSWERS

Outline and Study Guide

1. Exploration activities : hand mirrors and ray boxes.
2. The law of reflexion (p.178)
3. Lab activity: reflection in a plane mirror (ray box)
4. Ray diagrams for plane mirrors. (p.189)
5. Real and virtual images
6. Activity : Images in hand-held plane and curved mirrors.
7. Lab activity : Reflected rays in curved mirrors (ray box)
8. Curved mirrors : focal point, principal axis, vertex. (p.198, 204)
9. Ray diagrams with curved mirrors

Principal axis	**Focal point**	**Plane**	**Reflection**
concave	**Angle of incidence**	**Real image**	**Vertex**
convexe	**Incident ray**	**Reflected ray**	**Virtual image**
Normal			

1. **Incident ray** : the light ray that hits the mirror
2. **Reflected ray** : the light ray that bounces off the mirror
3. **Normal** : an imaginary line perpendicular to the surface of the mirror
4. **Angle of incidence** : the angle between the incident ray and the normal
5. **Angle of reflection** : the angle between the reflected ray and the normal
6. **Plane** : a flat surface
7. **Concave** : a curved surface like the inside of a sphere
8. **Convex** : a curve surface like the outside of a sphere
9. **Focal point** : with a curved mirror, the point of intersection of all incident rays parallel to the principal axis.
10. **Principal Axis** : an imaginary like perpendicular to the centre of a curved mirror
11. **Vertex** : the point in the centre of the surface of a curved mirror where the principal axis meets the mirror.
12. **Real image** : an image formed when the reflected rays really intersect in front of the mirror.
13. **Virtual image** : an image formed behind the mirror where the reflected rays appear to come from.

Exploration A : Where to hang a mirror?

Where should you place the mirror when the two students are at the same distance from the wall?

The mirror has to be halfway between the two students, at about eye level.

Where should you place the mirror when one student is closer to the wall than the other?

The mirror has to be moved closer to the student who is closer to the wall.

Exploration B : Using a ray box

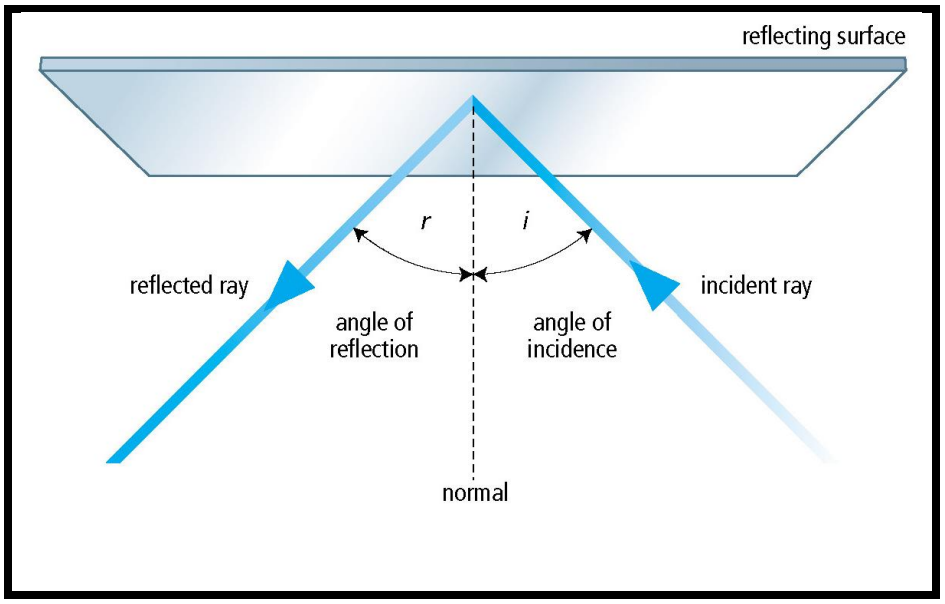
From the activity shown by your teacher, what do you notice about the angles of the light rays and the mirror?

The reflected ray makes the same angle with the mirror as the ray that hit it.

Rays and Angles in Reflection

Complete the diagram shown by your teacher and label

- The mirror
- The incident ray
- The reflected ray
- The normal
- The angle of incidence
- The angle of reflection

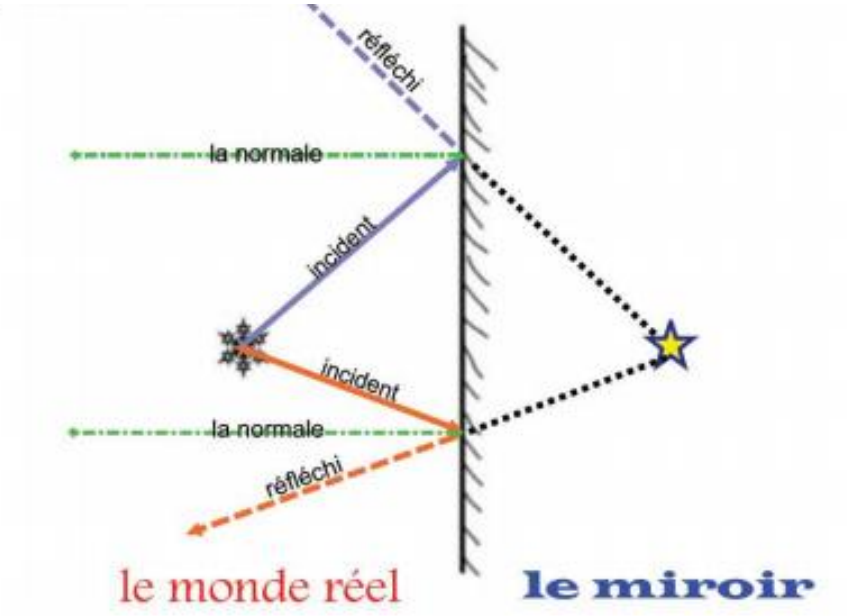


State the Law of Reflection :

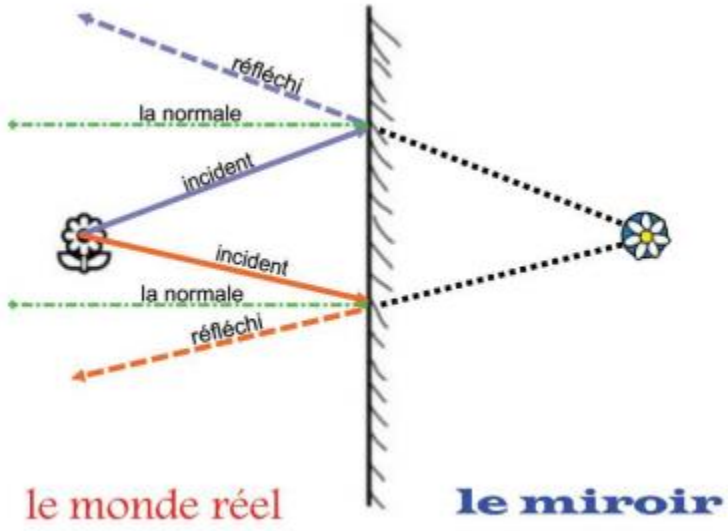
The angle of incidence = the angle of reflection

Ray Diagrams for Plane Mirrors

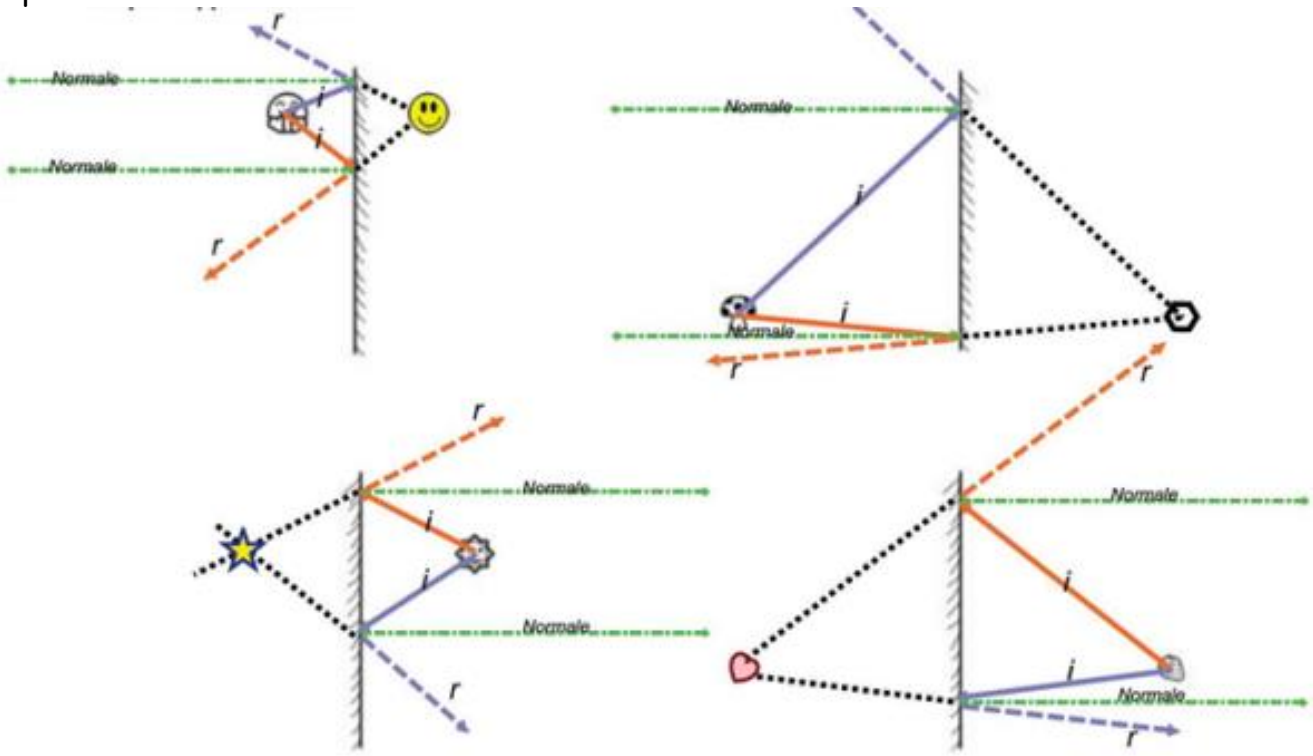
Copy along as your teacher shows on the board how to construct a ray diagram to find the image of the snow flake.



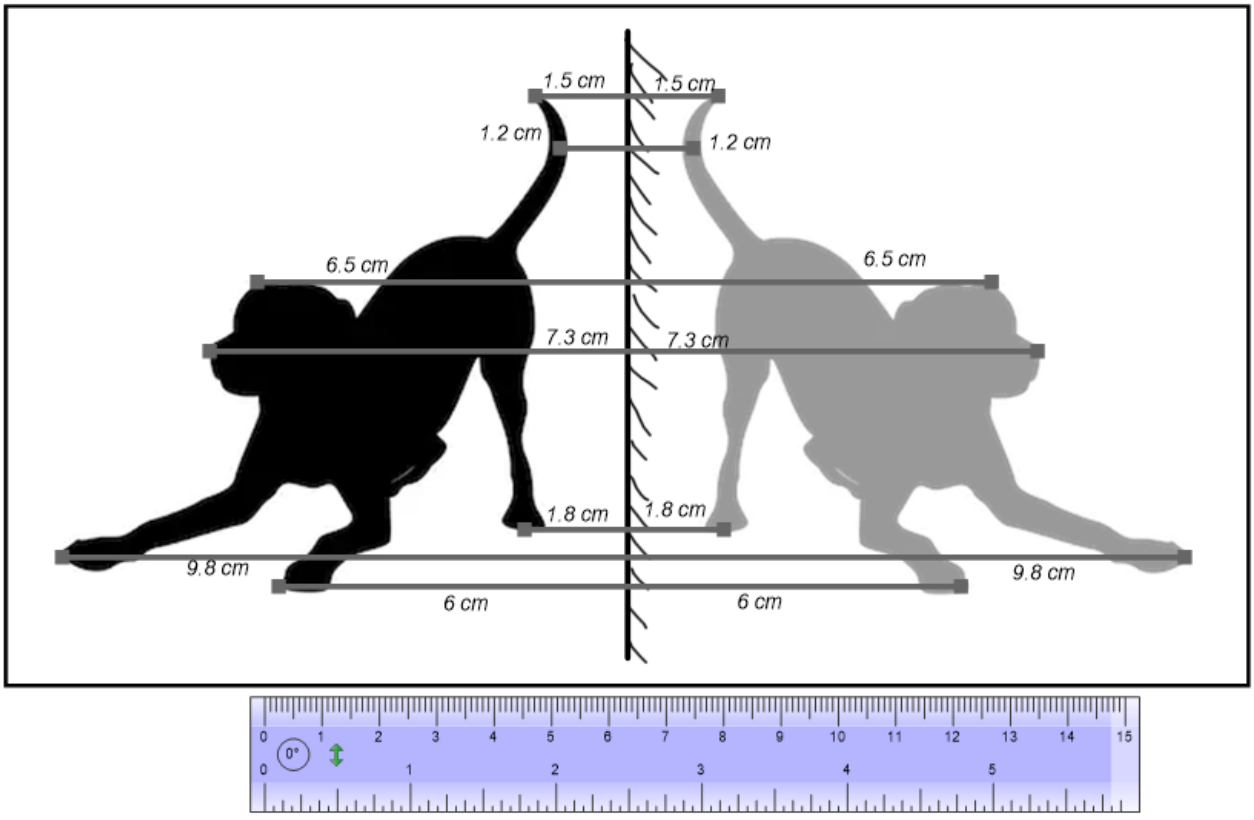
Second example.



Now practice!



For a bigger more complicated object use the « trick with the normal » to find the image of several points on the object, and then draw the rest of the image



Real vs Virtual Images

Observe your teacher's demonstration of a real image with a mirascope.
Explain the difference between a real and a virtual image.

A "virtual" image is what we usually see in a mirror. The image appears to be **behind the mirror**, where no light rays actually go. In order to find the image with a ray diagram, you have to extend the reflected rays behind the mirror to find where they would intersect.

A "real" image is formed **in front of the mirror** (same side as the object) where the reflected rays actually do meet in reality.

Curved Mirrors : Concave and Convex

What is the difference between concave and convex?

Concave is like the inside of a spoon (a cave) and convex is like the back of a spoon.

Exploration : Comparing Images in Plane and Curved Mirrors

Material : hand-held mirrors : one plane, one concave, and one convex. One small sticker.
Method : Put the sticker on the tip of your finger, and hold a mirror with the other hand. Observe the image of the sticker in the mirror. Move your finger close up and farther away and compare what happens. Repeat for each kind of mirror.

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Plane Mirror

Characteristic of the image in the mirror			Your observations
S	Size	Bigger or smaller than the object?	**Image is same size as object**
P	Position	Is the image in front or behind the mirror? Is it closer or further away from the mirror than the object?	**Behind the mirror, same distance as the object is in front**
O	Orientation	Right side up or upside down?	**Right side up**
T	Type	Real or virtual?	**Virtual**

Do your observations change if the object is closer or further away from the mirror? How?

No, all those answers are the same no matter how close or far the object is from the mirror.

Convex Mirror

Characteristic of the image in the mirror			Your observations
S	Size	Bigger or smaller than the object?	**Image is smaller than object**
P	Position	Is the image in front or behind the mirror? Is it closer or further away from the mirror than the object?	**Image is behind the mirror, appears closer than the object really is.**
O	Orientation	Right side up or upside down?	**Right side up.**
T	Type	Real or virtual?	**Virtual**

Do your observations change if the object is closer or further away from the mirror? How?

No, all those answers are the same no matter how close or far the object is from the mirror, but you might notice that objects closer to the mirror appear bigger than objects further away, so proportions are distorted.

Concave Mirror

Characteristic of the image in the mirror			**When object is close to mirror**	**When object is far from mirror**
S	Size	Bigger or smaller than the object?	**Image is bigger than object**	**Image is smaller than object**
P	Position	Is the image in front or behind the mirror? Is it closer or further away from the mirror than the object?	**In front of the mirror (though it's hard to tell)**	**Behind mirror**
O	Orientation	Right side up or upside down?	**Right side up**	**Upside down**
T	Type	Real or virtual?	**Real**	**Virtual**

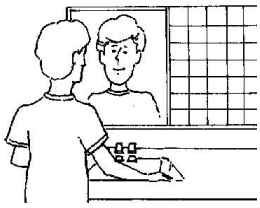
Do your observations change if the object is closer or further away from the mirror? How?

Yes, the reflection is very different depending on whether the object is close or far from mirror (see above)

Somewhere in between there is a point were all you see in the mirror is blurry colour, no clear image.

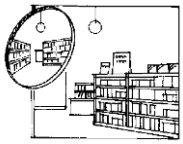
Identify the type of mirror (plane, concave, convex) used in each situation.

1.Bathroom mirror – PLANE



Use: so you can see yourself accurately
Type of mirror:

2.Surveillance mirror in a store – CONVEX

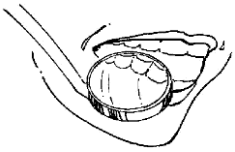


Use: so the staff can see the whole store
Type of mirror:

3.One way mirror – PLANE

Use: You can see through from one side but not from the other.
Type of mirror:

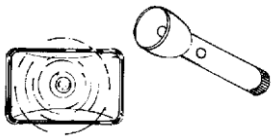
4.Dentist's mirror – CONCAVE



Use: to make your tooth seem bigger so the dentist gets a better look.

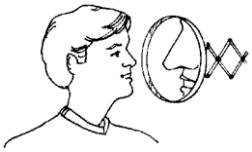
Type of mirror:

5.Reflecting mirrors in headlights and flashlights – CONCAVE



Use: to focus the light into a strong beam
Type of mirror:

6.Makeup mirror – CONCAVE



Use: to make your face seem bigger so you can see details better
Type of mirror:

7.Side view mirror – CONVEX

Use: so you can see a wider area behind you
Type of mirror:

8.A disco ball – BALL IS CONVEX, EACH MIRROR PIECE IS PLANE

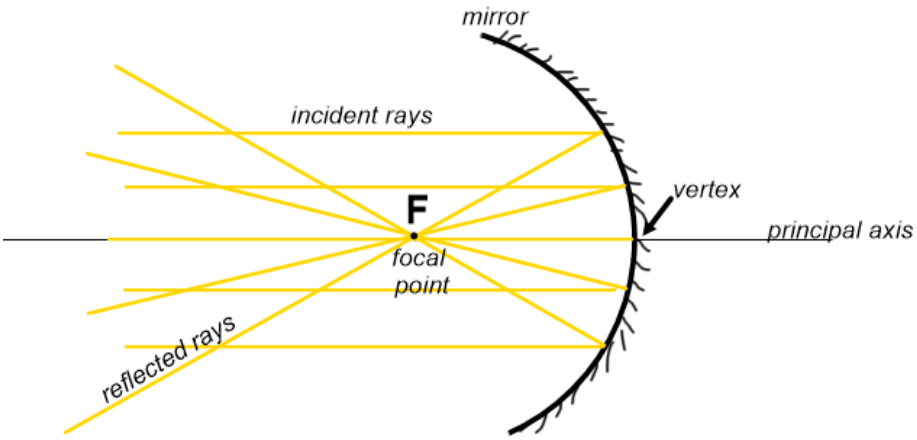
Use: to create small light rays that sweep across the room.
Type of mirror:

Characteristics of Curved Mirrors

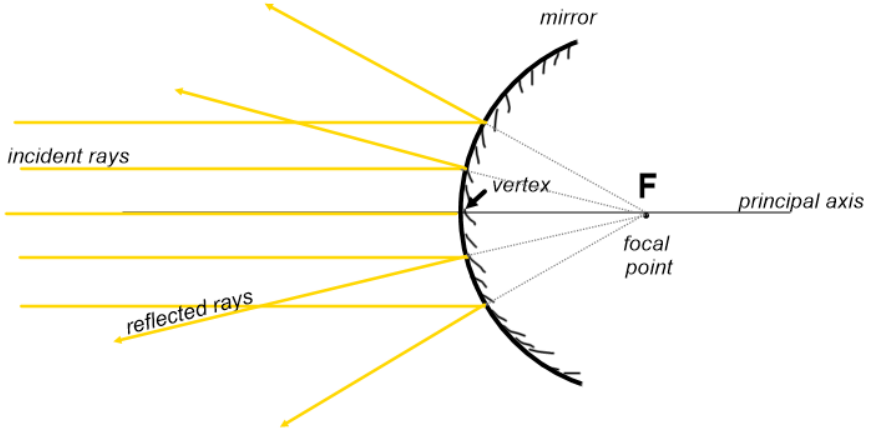
Sketch diagrams curved mirrors and their characteristics, labelling

- The mirror
- The principal axis
- The focal point
- The vertex
- Incident rays parallel to the principal axis
- Reflected rays

Concave mirror (p.198)



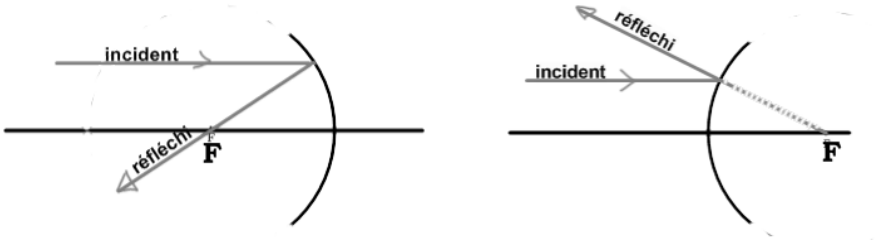
Convex mirror (p.204)



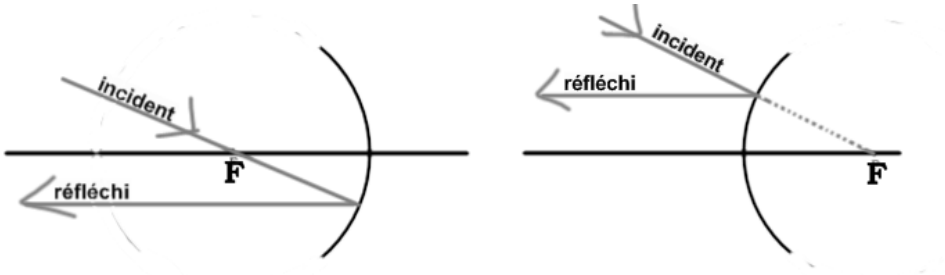
Ray Diagrams for Curved Mirrors

Important rays

Parallel incident rays ------> Reflect through the focal point.



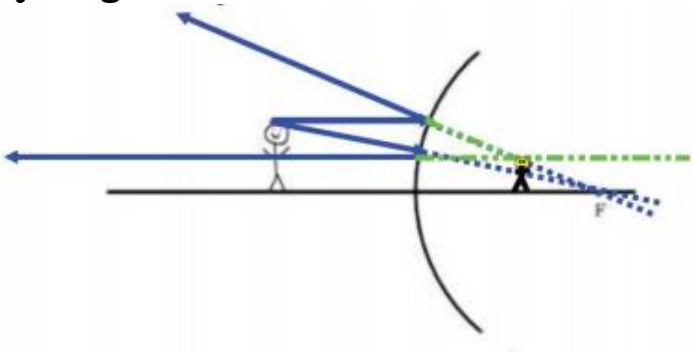
Incident rays through the focal point -------> Reflect parallel



Steps for finding the image in a curved mirror

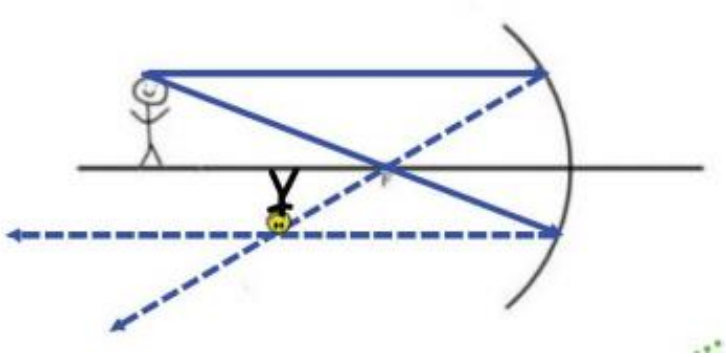
1. Incident ray parallel ------> Reflect through the focal point.
2. Incident ray through focal point -------> Reflect parallel
3. Where the REFLECTED rays meet -------> the top of the image.
4. The base of the image is on the principal axis
5. Sketch the rest of the image
6. SPOT characteristics

Ray Diagrams for a Convex Mirror :

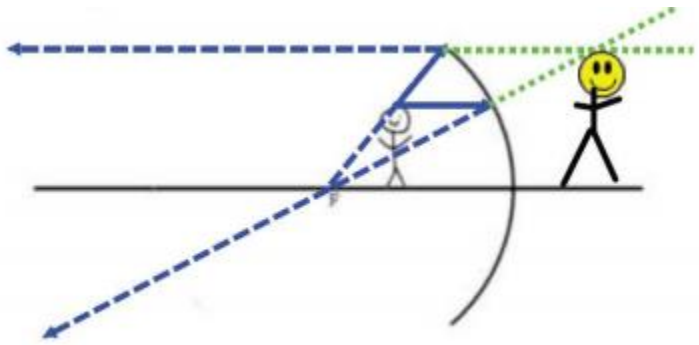


S	**Smaller than object**
P	**Behind the mirror – closer than object**
O	**Right side up**
T	**virtual**

Ray Diagrams with a Concave Mirror

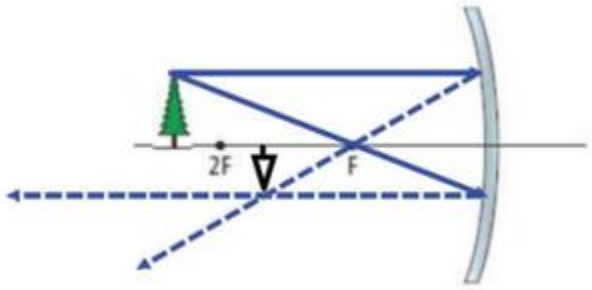


S	**Smaller than object**
P	**In front of mirror, closer than object**
O	**Upside down**
T	**Real**

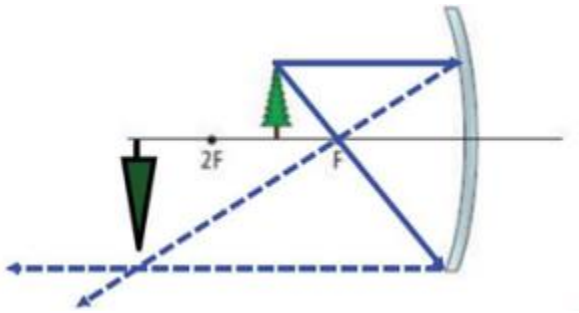


S	**Bigger than object**
P	**Behind mirror, closer than object**
O	**Right side up**
T	**Virtual**

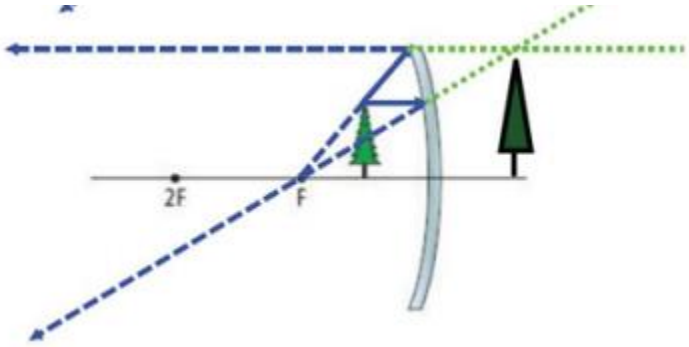
Practice



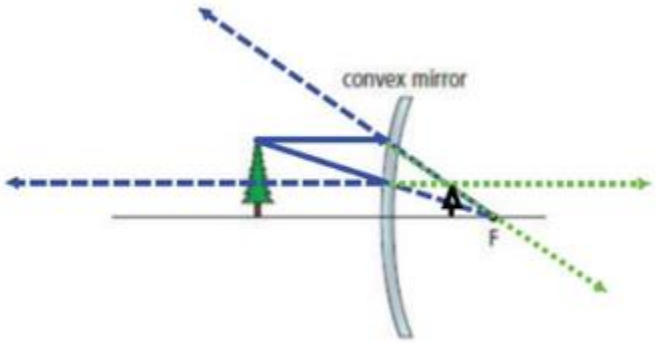
S	**Smaller than object**
P	**In front of mirror, closer than object**
O	**Upside down**
T	**Real**



S	**Bigger than object**
P	**In front of mirror, further than object**
O	**Upside down**
T	**Real**



S	**Bigger than object**
P	**Behind mirror, about same distance as object**
O	**Right side up**
T	**Virtual**



S	**Smaller than object**
P	**Behind mirror, closer than object**
O	**Right side up**
T	**Virtual**